



Review

Enhancing Capacity to Comply with Sustainability Standards in the Milk Value Chain in East Africa: Challenges, Prospects, and Policy Implications

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Abstract: This paper addresses the need to contextualize sustainability standards and supply chain management in dairy value chains in East Africa, where milk perishability and limited cold storage significantly impact the industry. The study highlights the importance of localizing these standards, given the greater dependence on local supply chains following the COVID-19 pandemic. Drawing on milk standards literature and various interventions aimed at promoting systemic change, this review analyses the capacity of marginalized stakeholders in East Africa's dairy value chains to meet sustainability standards, focusing particularly on the social dimensions of these standards. The findings indicate that compliance with sustainability and safety standards is predominantly restricted to formal dairy networks, which process less than 20 percent of milk produced in the region. Most milk sales occur through informal or unorganized markets, which face significant barriers to meeting international sustainability benchmarks. The review advocates for the alignment of international sustainability standards with the unique conditions of the informal markets dominating East Africa's dairy sector. It suggests enhancing stakeholder capabilities and addressing regulatory barriers as necessary steps for improving compliance with these standards. The co-operative model is highlighted as a promising approach to integrating farmers and marginalized value chain actors into the formal sector, thereby facilitating incremental adoption of sustainability standards. The paper identifies strategic entry points for organizing and upgrading the supply chain, including capacity building, certification, and catalyzing farmer groups to compliance and productivity.

Keywords: dairy value chains; governance; sustainability standards; East Africa



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1. Introduction

Africa's demand for animal source foods (ASFs), especially milk and dairy products, is surging due to a growing population, more people living in cities, and rising incomes [1]. In order to meet the rising demand for milk and dairy products, East Africa needs to streamline its complex and fragmented supply chains. There are several key players in these chains, including small-scale producers (less than five cows) in rural or suburban areas who often sell milk directly to neighbors; milk traders that operate independently or in collaboration depending on how they access markets; small and large dairy co-operatives that exist in areas with high milk production, and a few large processing companies which supply milk and dairy products mainly to major cities. While these groups operate independently, they are also interconnected, especially near big cities [2].

Although dairy regulators aim to improve value chains, protect consumers, and boost production, their reach in rural areas is limited. Farmers in these regions rely on private suppliers, neighbors, or themselves for resources and services. This creates a situation

where there are essentially “two sets of rules”: stricter standards in peri-urban and urban areas characterized by emerging formal marketing channels selling industrially pasteurized and packaged milk and looser ones in rural areas where informal (also commonly referred to as unorganized) marketing channels selling raw milk dominate. Often overlooked is the fact that the informality is perpetuated in a vicious cycle driven by consumer preference for lower-priced milk and increasing demand.

The gap between food safety standards in developed and developing countries is significant [3]. Developed countries have strong systems to ensure food quality while developing countries often lack clear standards and strict enforcement [4]. This is especially true in Sub-Saharan Africa, where most ASFs are sold through informal channels without regulations or certifications [5]. The major factors contributing to this problem are outdated food safety standards, weak enforcement by authorities, limited resources for food safety management, inconsistent application of existing rules, and overlapping responsibilities among different regulatory bodies [4]. Moreover, in these regions, affordability is often a bigger concern for consumers than food quality [6]. The combined effect of these issues is a “triple-lose situation”: small-scale market actors and businesses struggle to participate in the formal market, consumers are exposed to health risks, and increasing milk imports hinder the growth of domestic milk value chains and export potential.

Two main approaches have been used to tackle the identified challenges. The approaches entail the creation of regional trade blocs that establish consistent food standards and regulations, making inter-region trade easier [7] and setting minimum standards to ensure businesses comply with basic standards [8]. However, this one-size-fits-all approach is not ideal. These interventions often focus on strict application within limited market segments rather than encouraging broader changes in the entire food system. This means the interventions do not lead to lasting improvements across the whole community and offer limited opportunities for businesses to participate in markets with high standards.

The patchwork of food standards and inconsistent regulations across Africa makes it hard to know exactly how consumers can meet safety and quality requirements. This variation is especially large in the East African region. Enforcing sustainable practices is more challenging when most food is traded outside the formal channels. This is a common challenge in East Africa’s dairy industry, where over 80 percent of milk is traded informally [5,9].

This article significantly contributes to understanding and improving East Africa’s dairy industry by addressing its complex challenges, including fragmentation and governance. It identifies critical gaps in current standards and oversight practices. The paper provides new insights into how sustainability standards can be implemented inclusively, empowering various actors within the dairy sector. By advocating for a shift in enforcement practices, the article suggests innovative strategies to improve supply chain compliance, including small and medium-sized players who are often excluded. It underscores the urgent need for locally contextualized sustainability standards in the post-COVID-19 era to foster local supply chain growth and reduce dependency on global networks and imports. It offers actionable recommendations for immediate, targeted interventions to enhance compliance and ensure a stable milk supply and lasting benefits to key actors.

The paper is divided into six sections. Section 1 (the Introduction) has laid the groundwork for the topic under review. The following sections then: describe the conceptual and analytical framework that guides the review; describe key actors and compliance challenges that they face; present a review of sustainability within the dairy value chain; suggest ways to bridge the regulatory gap in milk markets to enhance inclusivity and compliance including suggestions on approaches, managing risk of exclusion, enabling environment, capacities to be built, co-operatives as a tool for sustainable and inclusive dairy development; and make conclusions and recommendations.

2. Conceptual and Analytical Framework

East Africa's dairy industry is perceived to be a dynamic system where people collaborate within a changing agricultural landscape. Sustainability is perceived to play a central role, with established rules guiding the interactions of actors to ensure environmental responsibility. Similarly, research and development (R&D) projects act as powerful engines for achieving sustainable growth. By focusing on economic and social well-being alongside environmental protection, these projects can strengthen the industry's resilience against biodiversity challenges like climate change and food safety risks [10]. In view of the proposed framework, sustainability standards integrate practices across the economic, social, and environmental aspects of agriculture. These practices target specific Sustainable Development Goals (SDGs) outlined by the United Nations. These goals are critical for alleviating poverty, guaranteeing food security, fostering inclusivity, and tackling climate change [11].

While we have defined sustainability standards with the three-pronged approach, we acknowledge that "sustainability" is a complex concept with many interpretations that can vary when circumstances change [12,13]. Despite this cognizance, our view is that a stronger focus on social factors is the most crucial for ensuring sustainable goals in the local context. A greater focus on the social dimension to balance the economic and environmental needs is also alluded to by [14] for better overall outcomes.

Partly inspired by [13] and various agricultural knowledge and innovation systems literatures across sub-Saharan Africa, we illustrate how interrelations around the small-holder dairy farming system affect behaviors by farmers and impact the sustainability pillars (Figure 1).

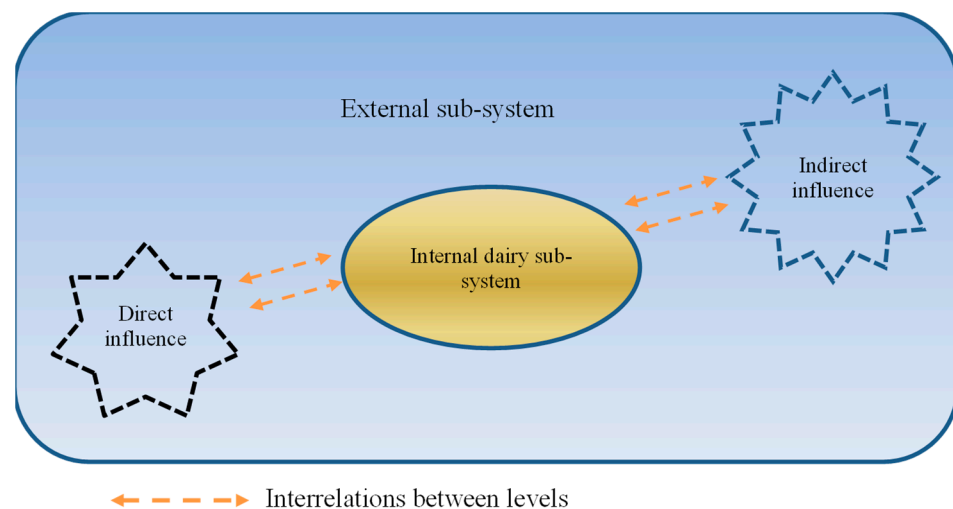


Figure 1. Illustration of interrelations relevant to sustainability pillars around the dairy farming system.

In this framework, dairy farmers interact with other actors and institutions based on their farming methods, location, and relationships in an external environment that influences their behavior and practices both directly and indirectly. Direct influences come from readily identifiable sources like community expectations, local regulations, and interactions with input suppliers and buyers predominantly in the informal sector that offer a higher price [5]. Decisions made within this network are driven by factors like potential profits, established rules, and the understanding of how helping others (reciprocity) can benefit everyone. Traditions and established ways of doing things, both formal rules and informal customs, have a deep and hidden (indirect) influence on how actors in the system interact and their motives to uphold recommended practices. This, in turn, directly affects the industry's ability to govern itself. For example, it can impact the capacity to set best

practices, establish clear standards, define objective sustainability measures, enforce those standards, and manage the health of the environment that sustains the system.

3. Key Actors and Compliance Challenges

Most East African milk comes from smallholder dairy farmers within low-input, low-output systems [15]. These systems with local and mixed breeds average less than 400 L of milk per cow per year, far below the potential of 4000 L for improved breeds [16–18]. The smallholder farmers who dominate the milk supply produce approximately 70 percent of the total milk in Tanzania, 80 percent in Kenya, and 85 percent in Uganda. Over 80 percent of the total supply across these countries is sold through informal actors. The milk marketing process usually starts with collecting and aggregating milk, managed by a range of actors in both informal and formal channels. Milk collection centers and individual traders play a crucial role in both channels. The other actors involved include transporters and agents or employees of processing companies and dairy co-operatives who oversee milk collection, cooling, and distribution. These formal milk market establishments usually offer additional services such as artificial insemination, veterinary care, credit, and extension services.

The low-input, low-output smallholder production and marketing systems underpin myriad compliance challenges [2,5,6,15,19,20]. The dominance of direct sales of small volumes of raw milk by smallholder producers has been listed among the top three challenges because it precludes economies of scale and, therefore, results in high costs in terms of production and marketing as well as milk safety concerns. The other related challenges are poor access to inputs and services, poor disease control, lack of knowledge and information, poor animal husbandry, and a lack of appropriate organizational structures and financial arrangements to increase farmers' access to the basic inputs and services.

The traditional production system is increasingly becoming unsustainable as it struggles to adapt to the growing population that puts pressure on forests and land for grazing, while the seasonality of rainfall and other shocks threaten feed availability [21,22]. Seasonal rainfall patterns significantly disrupt the stability of milk supply, due to higher output during the rainy season and lower output during the dry season. The informal milk market often struggles to absorb the surplus milk produced during peak periods. While the excess milk could be redirected to processors in the formal sector to extend its shelf-life and stabilize supply year-round, many farmers face challenges accessing the formal market. Key challenges include limited volumes per farm unit, difficulties in differentiating milk products, identifying market niches, and communicating product quality and safety to buyers. Furthermore, most farmers struggle to reduce production costs while maintaining high quality and production levels.

The dairy system also poses additional risks to its own sustainability because it contributes to emissions of greenhouse gasses (GHGs). In East Africa, carbon dioxide, methane, and nitrous oxide levels have been shown to be the highest GHG emissions [23,24]. Although emissions from the dairy sector represent only a small fraction of global totals, it is crucial to increase awareness and leverage various global initiatives that can effectively address the dairy sector's GHG emissions, support global climate goals, and improve overall sustainability.

The literature shows that local and foreign direct investment (FDI) in value-added activities, such as milk processing, can significantly enhance technology adoption, compliance with quality standards, and the livelihoods of dairy farmers [25,26]. This approach is especially beneficial in regions where farmers can consistently produce milk throughout the year, as is the case in much of East Africa, which leads the African continent in cow milk production and has a huge potential to produce more milk and improve rural livelihoods [27]. Unfortunately, many dairy farmers in the region face challenges in producing high-quality milk regularly. As a result, milk processors frequently operate below capacity, with idle rates estimated at 25 percent in Kenya, 36 percent in Uganda, 29 percent in Tanzania, and as high as 57 percent in Rwanda [28].

To address these capacity issues, milk processors outside major production areas often integrate backwards, producing their own milk or sourcing most of it from larger-scale producers. They also invest heavily in transportation, collection centers, and quality control. While investment in milk processing can bring benefits, it may also worsen the problem of excess milk processing capacity and potentially marginalize producers in the informal milk markets.

The most significant hurdles include the reduced quantity of low-quality feed, linked to droughts, which directly limits milk yield and the system's contribution to sustainable development. Other challenges are limited adoption of productivity-enhancing technologies and poor husbandry practices that compromise milk quality and safety, ultimately hindering the realization of potential benefits from adopting sustainable practices [21,22].

4. Sustainability within the Dairy Value Chain

A value chain becomes more sustainable when its practices enhance the well-being of all actors involved. This, in turn, creates feedback loops that encourage positive changes throughout the chain (Figure 2).

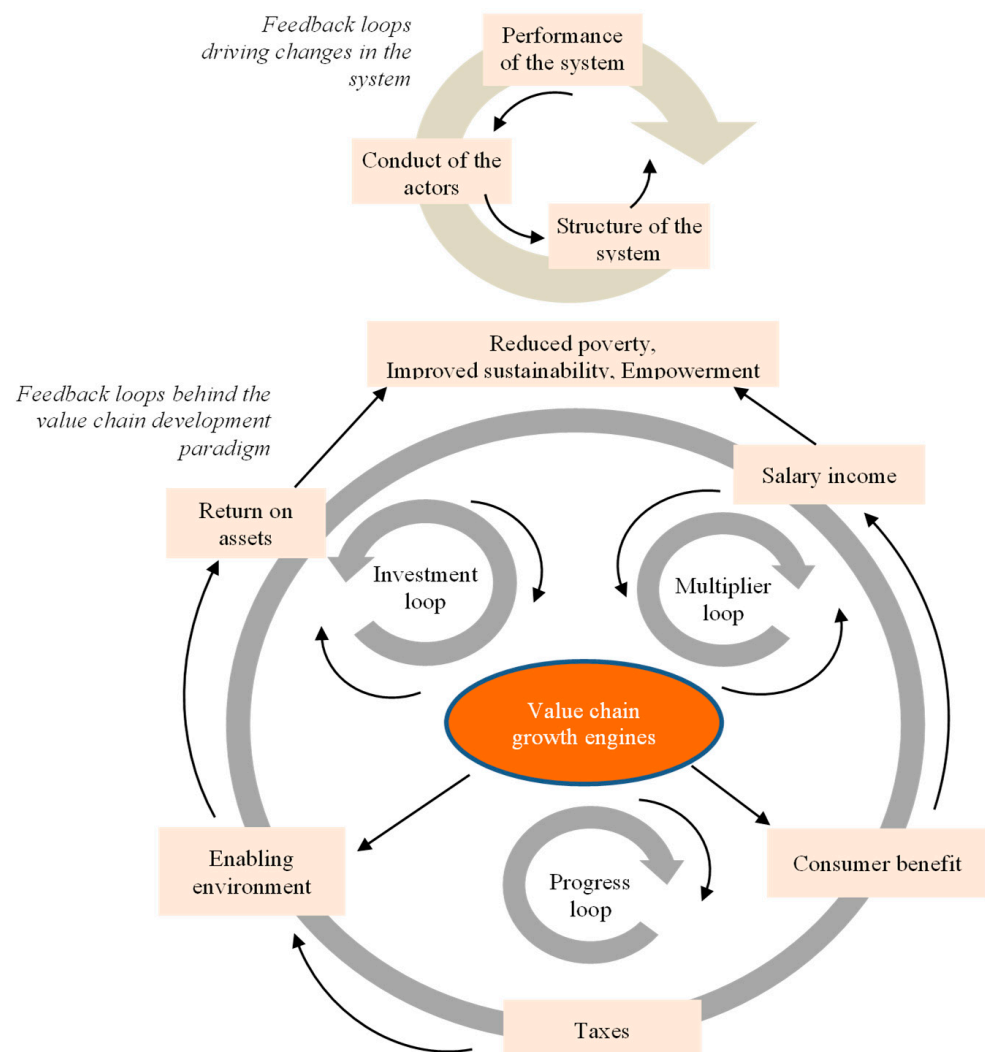


Figure 2. Sustainable dairy value chain development framework. Source: adapted from [29].

Although Figure 2 outlines a comprehensive plan for sustainable dairy production, most of the current interventions in East Africa have not embraced the framework. The initiatives face several limitations, especially in relation to the following:

- (i) Growing emphasis on exports beyond milk, particularly in horticultural products, with much of the current initiatives led by private companies, particularly those engaged in export activities [30];
- (ii) Limited demand for certified milk because most sales happen locally, where consumers are less sensitive to quality standards [31];
- (iii) Underdeveloped standards because sustainability standards specifically designed for East African dairy production are still being developed;
- (iv) Inefficient manure management as small farms have not been able to effectively use it to improve feed production and reduce emissions of GHGs [30];
- (v) Exclusion of local stakeholders where many initiatives fail to involve local governments as key partners in governing sustainability standards.

Examples of Sustainable Initiatives

While there are promising efforts to promote the sustainability of the dairy chain in East Africa, most of the initiatives have generally been fragmented and adopted varied approaches that are limited in geographical scope and policy uptake. A few recent and ongoing examples below illustrate these approaches.

One intervention popularized as the “Solidaridad’s approach” (the Solidaridad approach: www.solidaridadnetwork.org/publications/climate-smart-dairy-in-africa/, accessed on 2 September 2024) has been implemented in northern Tanzania. The intervention addresses productivity challenges by offering credit to farmers for crucial inputs and support services. The initiative seeks to foster climate-smart practices as it allows farmers to afford improved feeding and adopt appropriate manure management practices, which reduce the emission of GHGs leading to a more sustainable dairy chain outcome. The impact of such interventions is amplified through the establishment of commercially oriented hubs. These hubs support farmers with their technological needs and market access services.

Another intervention in northern and central Tanzania, *Maziwa Zaidi* (“More Milk” in Swahili), piloted pathways for more inclusive and sustainable development of smallholder dairy value chains guided by a theoretical framework [19]. The work has yielded policy-level actions for climate-smart dairy practices, supported by local research demonstrating benefits for the environment, economy, and livelihoods (e.g., [32,33]) that gained stakeholder endorsement and were associated with lasting sustainability impacts. The identified entry point for upgrading the smallholder dairy value chain enables agri-entrepreneurs to benefit from capacity building and linkages that deliver bundled inputs and services to farmers, which is being further piloted under the CGIAR Sustainable Animal Productivity for Livelihoods, Nutrition and Gender Inclusion (SAPLING) initiative in Tanzania [34]. The focus is on promoting linkages among inputs and service providers facilitated by a digital platform to catalyze greater access and use of bundled innovations by farmers to spur production towards volumes that make dairy co-operatives viable.

Many efforts to promote sustainable dairying in East Africa have faced challenges and have not always achieved their intended outcomes. Improving access and the use of feeds in adequate quantities and of adequate quality remains a major challenge. For instance, initiatives aimed at increasing hay production to solve unpredictable weather and feed shortages for livestock in Kenya have not yielded substantial benefits for small-scale dairy farmers. These farmers rely predominantly on rain-fed pasture production, which is affordable but unreliable during unforeseen droughts. Moreover, the costs associated with hay harvesting machinery and storage facilities are typically too high for small-scale operations [35].

The nature of farming systems is an important context for sustainability at the production node. Smallholder dairy farming and agriculture, in general, are characterized by integrated dairy–crop systems with permanent cultivation. The diversity of dairying practices encompassing the most intensive (zero-grazing), semi-intensive methods, and free-range systems involves varying levels of nutrient recycling. In Uganda, for instance, inadequate nutrient recycling has led to declining levels of essential plant nutrients in the

soil, falling below the critical thresholds necessary for successful crop production. Nutrients removed through crop harvests and milk production are not adequately replenished [20]. The varying levels of intensification cannot ensure profitability for those committed to sustainable practices. The trade-off between achieving immediate profitability and adopting sustainable methods often leads dairy farmers to prioritize short-term gains over long-term sustainable outcomes.

Evaluation of the efforts geared to facilitate the entry of small-scale dairy farmers into formal milk markets by upholding milk quality and safety indicates that most of the efforts have been ineffective [36,37]. Challenges such as unreliable power and a lack of cold chain infrastructure are significant hurdles to the wider adoption of improved milk storage and processing facilities [21]. While biogas-powered chillers and generators offer a promising solution to the observed adoption challenge [38], their adoption and effectiveness remain limited because fuel-powered generators are more expensive to run and maintain. In view of these challenges, rather than fully adhering to all best practices, most farmers are currently encouraged to implement selected practices such as maintaining herd health and adhering to hygienic milking procedures. This partial adoption often falls short of meeting the quality standards required by formal milk buyers, leading them to sell milk primarily in informal markets.

While some of these interventions seem to uphold sustainable practices, widespread adoption remains a challenge. Informal systems dominate the East African dairy sector, and it can be challenging to ensure the consistent implementation of best practices, higher productivity, resource efficiency, and sustainable outcomes. Given the dominance of informal systems and our view that the social dimension needs greater weighting, the following section explores opportunities to enhance inclusion and compliance among informal sector actors.

5. Bridging the Regulatory Gap in Milk Markets to Enhance Inclusivity and Compliance

Building capacity and crafting inclusive regulations that consider the social and economic realities of informal food chains can empower participants and improve sustainability. An understanding of informal markets is crucial for identifying opportunities to improve sustainability. The term “informal” is used ambiguously. While [39] defines it as operating outside the law, in the East African dairy sector, there is a significant overlap between lawful and unlawful informal activities. This has led some researchers (e.g., [40]) to propose using “traditional” or “indigenous” instead of “informal” for markets where practices align with established ways of handling local products that already contribute to risk management, even if they differ from official regulations.

In our subsequent discussion related to milk market channels, we use these terms interchangeably to assess how these informal chains (selling raw milk) and formal chains (selling pasteurized and packaged milk) measure up against sustainability standards. We will draw on evidence from East African initiatives that aim to improve small-scale dairy value chains, particularly their experiences navigating the role of informal actors and bridging regulatory gaps. We examine whether applying standards designed for economies with mostly pasteurized and packaged milk aligns with the three pillars of sustainability (economic, social, and environmental) in the East African context, given our emphasis on inclusivity.

International guidelines, like the Codex Alimentarius Commission’s Appropriate Level of Protection (ALOP), allow for science-based standards to be adapted to local contexts. This creates an opportunity to balance three key priorities: public demand for safe food, improving the affordability of milk for low-income consumers, and guaranteeing producers a fair profit. This presents a chance to improve the lives of those involved in the informal food chain while adhering to sustainability principles. However, the main hurdle is the absence of food safety risk assessments that reflect the realities of the East African context. Table 1 summarizes the advantages, disadvantages, and supporting evidence

needed to build a strong scientific case across the economic, social, and environmental aspects of sustainability.

Table 1. Pros and cons of informality/formality against sustainability pillars in the dairy value chain in East Africa.

Sustainability Pillar and Related Topics	Informal and Small-Scale	Formal and Medium- to Large-Scale
Economic <input type="radio"/> Jobs <input type="radio"/> Incentives <input type="radio"/> Supply and demand <input type="radio"/> Costs <input type="radio"/> Prices	Pros: Easy entry, lower cost to consumers/high demand, pays more to producers per unit of milk, profitable to sellers, employs many (family and non-family labor), can be a broad foundation for formalization, a flexible outlet for farmers Cons: Poorly organized, not easy to govern, no licensing and/or registration, lack of labor contracts, verbal agreements, pay little or no taxes, risky given no regulatory support, high transactions costs due to rent-seeking, milk spoilage Pros Serves majority producers and poor consumers (over 80% of market) with good nutrition, investment-free business, higher women participation, an opportunity for more inclusion, thrives where co-operatives or processors do not due to low milk supply.	Pros: Organized, legally enforceable contracts, easy to govern, well connected and powerful, licensed, pays taxes, receive policy support; less risky than informal; a reliable outlet for farmers Cons: Highly capitalized with high costs to entry, higher-priced products/low demand, pays less to producers per unit of milk, employs fewer people
Social <input type="radio"/> Inclusion <input type="radio"/> Human health <input type="radio"/> Food and nutrition security <input type="radio"/> Equity <input type="radio"/> Education	Cons: Variable milk quality (boiling by consumers mitigates microbial risks), limited access to finance	Pros: Good access to finance, perceived as healthier due to industrial pasteurization and packaging Cons: Serves minority (below 20 percent of the market), less inclusive, high capital requirements
Environmental <input type="radio"/> Animal welfare <input type="radio"/> Waste management <input type="radio"/> GHGs	Pros: Serves majority of small-scale producers, inclusive, less waste due to recycling of manure into smallholders' crop farms Cons: Actors have poor access to health services High GHGs due to low productivity	Pros: Actors have good access to health services Cons: Serves minority medium- to large-scale producers, less inclusive, generation of some waste because not all manure is recycled, Relatively low-intensity GHGs

Sources: Authors' compilation and [15,33,40–43].

5.1. Approaches to Improve the Informal Sector

The informal sector is a crucial survival strategy, particularly for those lacking access to land or formal employment. This limited opportunity likely drives the rise of “lawful informal” actors who operate with licenses to sell raw milk as a steppingstone towards a more formal future. Many participants in the informal sector may transition out once they find formal employment or accumulate resources. Low investment in the business, limited awareness of regulations and access to information, and restricted capital are common reasons why people end up in the informal sector.

Informality is often perceived as a sign of underdevelopment, yet it can be reconsidered in a different light. The informal milk sector generates substantial employment income, estimated to exceed three times the minimum wage [40] and operates with greater flexibility to capitalize on emerging opportunities. It provides affordable milk for low-

income consumers that aligns with traditional preferences while ensuring better prices for producers. Moreover, this sector has the potential to yield widespread and sustainable benefits, contributing to economic development on a broader scale. Enhancing these opportunities requires effective policy dialog supported by evidence to mitigate the economic risks associated with informality by offering the protective regulatory advantages typically associated with formalization. Policy changes in Kenya, which resulted in significant welfare benefits that amounted to a net present value of USD230 million for consumers, producers, and milk vendors have been demonstrated [42]. A crucial factor preceding these policy changes was a well-coordinated effort in policy dialog and advocacy to promote inclusivity [41].

5.2. Managing Risk of Exclusion Given the 'Formal' Regulation and Governance Standards

Managing food safety risks through standards is vexing when balancing the trade-off between improving poor people's welfare and mitigating safety concerns. This challenge is more pronounced in low- and middle-income countries due to large income disparities. Richer citizens want to live by 'one standard' that is often benchmarked internationally, but this often excludes the poor and voiceless from participating in local indigenous markets. The policy dialog should focus on bridging gaps among key players and stakeholders. Rather than attempting to implement 'double standards', which has proven challenging, the emphasis should be on promoting the concept that standards can be aspirational. This is particularly crucial when there is a risk of excluding the majority from participating in value chain activities unless concerted efforts are made to integrate them through capacity building. This approach has the potential to provide mutual benefits by closing regulatory gaps and addressing the imperative to safeguard informal channels through policy measures while simultaneously maintaining public health standards and requirements. The approach refrains from segmenting value chain actors but rather focuses on analyzing the trade-offs between the welfare of disadvantaged populations and the associated risks.

The second challenge involves encountering resistance from vested interests. Any attempt to improve commodity marketing in sectors dominated by strong vested interests should expect significant opposition. The conflict between a few large, specialized, highly organized producer-processors with substantial processing capacity and a multitude of often part-time, poorly organized, and voiceless small-scale producer-traders of unprocessed milk has been illustrated by [41]. The competition for market dominance between these two groups, which have different levels of investment, has revolved not around price (as it ideally should), but around perceived quality and safety concerns, even when these concerns were unfounded. Effective risk management requires balancing the power dynamics between these groups, thereby maximizing the social and economic aspects of sustainability standards.

5.3. The Right 'Enabling Environment'

Creating a supportive environment to accommodate new standard requirements is essential [37]. Experience from Kenya emphasizes the importance of dairy development authorities recognizing the potential benefits of establishing such an environment for small-scale traders. These traders urgently need comprehensive information to formulate locally relevant food safety regulations and standards. These standards should also delineate necessary institutional and technical adjustments and trade-offs. This approach can serve as a foundation for R&D collaborations aimed at addressing two critical gaps: first, the lack of accurate information on health risks associated with milk consumption, and second, the practical measures needed to enhance milk quality in informal milk markets. The central question is whether evidence-based policy actions and technology can effectively bridge the divide between regulated and unregulated markets [40–42] with a specific emphasis on ensuring quality assurance in the case of the dairy sector. The need to support the growth of the private sector to advance the uptake of productivity-enhancing innovations in East Africa has become more widely recognized in recent years [34,44,45].

5.4. Capacities to Be Built

The fundamental question revolves around how to effectively implement practical and inclusive measures to transition the informal sector into a sustainable formal sector on the outputs side. Insights from Kenya underscore the importance of prioritizing capacity building through training and certification offered by accredited business development service (BDS) providers (Appendix A). This approach has demonstrated its effectiveness in providing a viable pathway to acquiring knowledge and services aimed at improving milk hygiene and safety, thereby addressing policymakers' concerns and generating significant welfare benefits to chain actors [42].

Moreover, the certification scheme, which includes mandatory training, is a distinguishing factor for stakeholders within the informal small-scale milk markets. It establishes a framework upon which traders can develop strategies for value addition and innovate their marketing approaches. Regulatory bodies across East Africa have endorsed training manuals designed for all informal milk value chain participants under this scheme [46]. However, a recent evaluation has highlighted the potential for further enhancing this approach through increased investments in expanding BDS provision for training and finance, representing the informal sector in policymaking and strengthening the capabilities of certification bodies [47].

The interventions suggested here generally demand significant financial and human resources. While individual countries may have their own methods for financing such initiatives, the most effective approach is to leverage support from BDS and publicly funded services. Public investments that offer opportunities for attractive returns to the private sector are expected to act as incentives, encouraging increased private sector involvement. Although each Eastern African country may adopt its financing strategies, utilizing BDS and public extension services is crucial for fostering a supportive business environment and boosting private sector participation.

5.5. Co-Operatives as a Tool for Sustainable and Inclusive Dairy Development

Well-established and well-managed co-operatives can serve as effective mechanisms for building trust and fostering collaboration among actors, whether formal or informal [48]. These co-operatives play a crucial role in facilitating access to information, essential inputs, business support services, and innovations, thereby significantly contributing to the sustainability of value chains across three key dimensions. Firstly, co-operatives enhance economic stability by reducing transaction costs for individual dairy farmers through the collective procurement of inputs, services, and the marketing of milk. This collective approach strengthens economic gains and stability [49].

Secondly, co-operatives promote social sustainability by empowering marginalized actors within the chain through collective arrangements [50]. This includes improving market access and enhancing milk quality through effective knowledge sharing, governance, monitoring, enforcement measures, and access to quality-assured dairy inputs [51]. Lastly, co-operatives contribute to environmental sustainability by fostering strategic synergies and promoting environmentally friendly practices with support from relevant stakeholders [6]. In Kenya, for example, co-operatives have adopted a mixed approach that includes bundling inputs and services and collaborating with milk processors to uphold sustainable practices.

Successful models like Kenya Co-operative Creameries and Githunguri Dairy Farmers Co-operative Society in Kenya and Tanga Dairy Co-operative Union in Tanzania demonstrate how co-operatives can be upgraded and scaled to achieve sustainability outcomes. Similar achievements are observed in Uganda and Rwanda, where dairy co-operatives play a crucial role to efficiently manage production and marketing functions. Looking ahead, ensuring dedicated technical support and identifying appropriate business models and their entry points are crucial for enhancing co-operative development endeavors across dairy value chains. This integrated approach involves promoting linkages across small, medium, and large-scale dairy farmers, milk processors, and service providers, aiming to

strengthen sustainability efforts in existing key milk production areas and emerging dairy production zones.

5.6. Limitations of the Study

Although the analysis captures current data on the status of East Africa's dairy sector, it is complex and highly fragmented. It faces enormous and evolving governance challenges, some unique to the sub-sectors in individual countries. This is predicted because regulations and compliance depend on the stability of national economies, budgets, and political regimes, which can sometimes be complicated by the need to address immediate priorities such as food security and nutrition challenges. Traditional markets for milk and milk products in East Africa are deeply rooted in history, and approaches to improve it sustainably may differ by country and social context.

6. Conclusions and Recommendations

6.1. Conclusions

East Africa leads the African continent in cow milk production and has huge potential to produce more milk and improve rural livelihoods. The dairy chains in the region predominantly operate on a small scale within the informal sector, highlighting the need for unique governance systems to achieve sustainable development outcomes.

The dominance of informality in the dairy sector underscores the importance of the social dimension of sustainability standards. Related indicators and compliance systems need to consider the socio-economic conditions of key stakeholders while ensuring adherence to basic food safety and hygiene standards.

6.2. Recommendations

Gradually integrating and graduating informal actors into the formal dairy industry through training and certification is essential for optimizing welfare and sustainability. This opportunity should be seized through increased policy support and investments to support key actors involved in the dairy value chains.

To break the vicious cycle of informality, efforts to increase milk supply beyond the volumes handled by informal actors must precede the enforcement of stricter standards.

The co-operative model offers a promising avenue to promote the enhanced organization of the supply chain in the emerging formal sector and encourage the adoption of sustainability standards. This role can be enhanced by supporting the efficient management of core functions to enhance competitiveness and resilience against market risk factors and seasonal fluctuations of supply. In areas with low milk production where co-operatives are non-viable, interventions to simulate milk production through greater access to bundled inputs and advisory service provision by individual agri-entrepreneurs and/or public extension are the most appropriate.

The interventions suggested here demand dedicated financial and human resources. Public investments that the private sector can profitably leverage are recommended. It is crucial to ensure public technical support to identify suitable business models for more effective participation in existing co-operatives. Public investments play a vital role in establishing and nurturing small farmer groups that have the potential to evolve into larger farmer-owned co-operatives. Promoting linkages across existing and emerging start-up businesses and farmer groups is paramount for sustainability, especially in the post-COVID-19 era, which is marked by increased demand for locally sourced and sustainably produced products that align with traditional preferences.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Capacity Building through Training and Certification Piloted in Kenya

The key components of the quality assurance pilot scheme involving business development services (BDS):

- (i) Accreditation of BDS providers: The involvement of BDS providers in training and provision of other services was factored into the scheme to ensure the sustainability of the intervention. Selected providers were assisted to provide their services for a fee, following their accreditation by a committee established to work on behalf of the regulatory authority and induction on how to conduct the training of traders using approved training manuals and guidelines on milk quality control and entrepreneurship. Once inducted, a public promotion campaign to stimulate demand for the BDS services was mounted. The BDS providers were empowered to issue certificates of competence in milk handling to trained milk traders on behalf of the regulatory authority and to report their activities regularly to them.
- (ii) Training of milk traders: The training covered basic principles of hygienic milk production, milk handling, and simple milk quality tests such as organoleptic, clot-on-boiling, alcohol, and lactometer tests as elaborated in approved training guides.
- (iii) The role of the regulatory authority: In line with current legislation, the regulatory authority is empowered to register and license all traders in the dairy industry. An important criterion for issuing licenses is milk quality management, given the high perishability of milk and potential zoonoses that can be passed through milk. The regulator, therefore, has a central role to play in mainstreaming the informal sector because hygiene standards and milk-borne health risks are usually a concern. In Kenya, KDB revised its previous rigid licensing requirements to pave the way for the implementation of this new approach to service delivery.

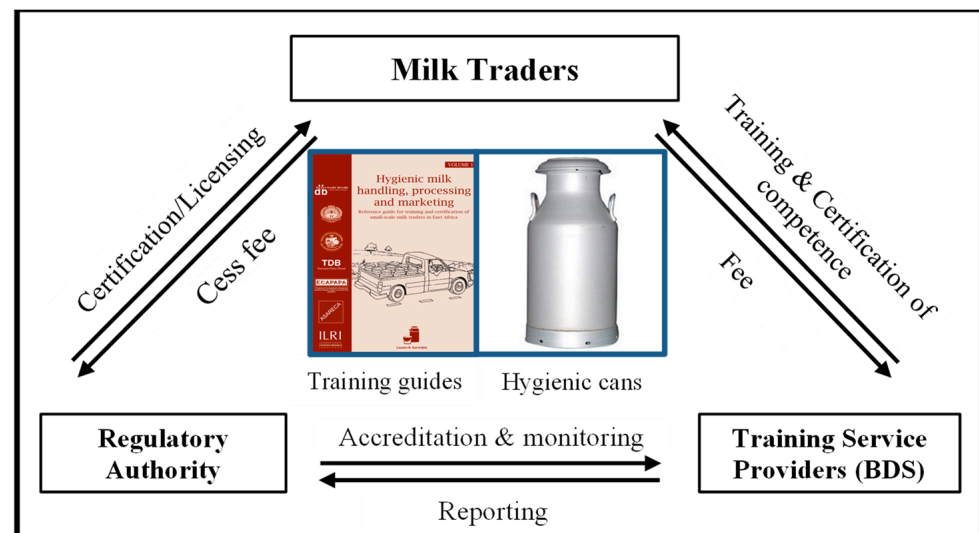


Figure A1. Schematic representation of the quality assurance scheme. Source: [40].

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