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Review on the Dynamics of Smallholder Cattle Business Systems in Ethiopia: Geographical Opportunities, Challenges and Sustainability Business Implications

Amanu Abate[1,*], Worku Masho[2]

[1]*Ministry of Labour and Skill, Agarfa College, Agarfa, Ethiopia*

[2]*Department of Animal Science, Mizan-Tepi University, Mizan-Aman, Ethiopia*

ABSTRACT

This review examines the dynamics of smallholder cattle business systems in Ethiopia, analysing the interplay between geographical opportunities, persistent challenges, and implications for sustainable development. Ethiopia possesses significant geographical advantages for cattle production, including diverse agro-ecological zones that support specialized systems from the crop-livestock mixed farming of the highlands, ideal for dairy and draft power, to the extensive pastoral beef production systems of the lowlands. Despite hosting one of the largest cattle populations in Africa, the sector's potential remains largely untapped due to a complex web of constraints. Key challenges include chronic feed shortages, high disease prevalence, limited access to finance and veterinary services, fragmented markets, and poor infrastructure. These limitations are compounded by the growing pressures of climate change and population growth, which threaten the natural resource base. Achieving a sustainable and commercially viable smallholder cattle business requires a transformative approach. This entails moving beyond subsistence-oriented practices towards market-led, climate-resilient strategies.

Critical interventions include promoting improved feed resources, enhancing animal health systems, developing inclusive value chains with robust linkages to formal markets, and fostering policies that support equitable access to resources and technology. By leveraging its geographical strengths to address these systemic challenges, Ethiopia can unlock the sector's potential to become a powerful engine for sustainable economic growth, livelihood improvement, and food security.

Keywords: Smallholder Cattle Business, Ethiopia, Geographical Opportunities, Sustainability, Value Chains, Climate Resilience.

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***Corresponding Author**

Amanu Abate,

Ministry of Labour and Skill, Agarfa College, Agarfa P.O.BOX-15/2011, Ethiopia, Phone: +88-01712563750, E-mail: amanuabate2006@gmail.com

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INTRODUCTION

Ethiopia is home to the largest livestock population in Africa, with an estimated cattle herd of over 70 million heads, forming the backbone of the nation's agricultural economy and the livelihood foundation for an estimated 80% of the rural population [1]. The cattle sector is a critical source of traction power for crop cultivation, milk, meat, manure, and household income, contributing significantly to food security and accounting for a substantial portion of agricultural GDP [2]. Despite this immense resource endowment, the sector's productivity and commercial potential remain disproportionately low, trapped in what is often termed a "low-input, low-output" cycle. Smallholder cattle businesses, which dominate the production system, are predominantly characterized by subsistence-oriented practices, limited market integration, and high vulnerability to shocks [3].

The performance of these systems is deeply intertwined with Ethiopia's diverse and distinct geographical landscapes, which present both unique opportunities and formidable challenges. The country's varied agro-ecology, ranging from the fertile highlands to the vast arid lowlands, dictates specialized but often fragmented production systems [4]. The highlands, with their cooler climates and integration with crop production, are well-suited for dairy and draft power, while the lowlands support extensive pastoral beef production systems reliant on mobility and adapted indigenous breeds [5]. However, this geographical diversity also creates disparate hurdles. Challenges such as chronic feed shortages, prevalent livestock diseases, inadequate infrastructure, and deeply inefficient markets are not uniformly distributed but are instead shaped by these regional contexts [6,7]. These persistent issues are now being compounded by emerging pressures, most notably climate change, which threatens the natural resource base through increased temperature and erratic rainfall, and population growth, which intensifies competition for land and water [8].

This review, therefore, seeks to comprehensively examine the dynamics of smallholder cattle business systems in Ethiopia. It specifically analyses the geographical opportunities inherent in different regions, the multifaceted challenges constraining productivity and commercialization, and the resulting implications for building sustainable and resilient business models. By synthesizing existing knowledge, this paper aims to provide a holistic perspective essential for informing policy, guiding investment, and designing targeted interventions that can unlock the transformative potential of the smallholder cattle sector for Ethiopia's sustainable development.

Geographical opportunities of cattle in Ethiopia

Ethiopia's diverse geography presents significant opportunities for its massive cattle population, primarily through its varied agro-ecological zones that enable specialized production systems. The cool, fertile highlands, which host the majority of the cattle, are ideally suited for dairy production and provide draft power for the predominant crop-livestock systems, benefiting from proximity to major urban markets [2,4]. In contrast, the vast arid and semi-arid lowlands offer extensive rangelands perfectly suited for beef production, where hardy, indigenous breeds like the Boran are naturally adapted to the harsh conditions, and traditional mobility practices allow for the efficient use of scattered resources [5,9]. This potential is further bolstered by Ethiopia's rich repository of indigenous cattle genetics, which provides a crucial foundation for breeding programs aimed at enhancing resilience and productivity [10], and its strategic location near the high-demand livestock markets of the Middle East, offering a lucrative export pathway [11]. Ultimately, the synergy between the highlands and lowlands, underpinned by genetic diversity and market access, creates a complementary national system with substantial potential for growth.

The distribution of cattle across different regions in Ethiopia

The distribution of cattle in Ethiopia is profoundly influenced by the country's diverse agro-ecology, which creates a distinct spatial pattern across its regions. The densely populated Ethiopian highlands, particularly in regions such as Oromia, Amhara, and the Southern Nations, Nationalities, and Peoples' Region (SNNPR), host the vast majority of the national herd, estimated to be over 90% [1]. This concentration is primarily driven by the integrated crop-livestock farming systems dominant in these areas, where cattle are essential for draft power, manure, and household food security [2]. In contrast, the vast arid and semi-arid lowland regions, including Afar, Somali, and parts of Gambella, support a more extensive, pastoral mode of production. Here, cattle distribution is sparser and more nomadic, with herds seasonally migrating in search of water

and pasture, making use of rangelands that are less suitable for cultivation [5,9]. This uneven distribution reflects not only ecological adaptations but also deep-seated socio-economic functions, with highland cattle central to arable farming and lowland cattle representing the primary asset and livelihood for pastoral communities [10].

Smallholder cattle distribution and composition across regions in Ethiopia

The distribution and composition of smallholder cattle in Ethiopia are a direct reflection of the country's agro-ecological and socio-economic gradients, creating a clear regional dichotomy. In the highland regions of Amhara, Oromia, and SNNPR, which host the overwhelming majority of the national herd, smallholder systems are characterized by mixed crop-livestock farming where a small number of cattle typically 2 to 5 animals per household are kept primarily for draft power, manure, and milk for home consumption [1,4]. The composition here is dominated by indigenous breeds like the Horro and local zebu, valued for their traction ability and adaptability to limited feed resources, with limited adoption of crossbred animals mainly found in peri-urban areas for market-oriented milk production [2]. Conversely, in the vast lowland regions of Afar, Somali, and parts of Oromia, smallholder or more accurately, pastoralist herds are larger in size, often comprising dozens of animals, and are composed almost exclusively of hardy indigenous breeds such as the Boran and Ogaden, which are specially adapted to heat and drought [9]. In these systems, the composition is geared towards survival and mobility, with cattle serving as walking banks and social capital, and their distribution is not tethered to farmland but is fluid, following seasonal availability of water and pasture [5]. Thus, the regional variation moves from a few, multi-purpose animals integrated with crops in the highlands to larger, mobile herds managed for meat, milk, and trade in the lowlands, a distinction fundamentally shaped by environmental pressures and livelihood strategies.

Table 1. Smallholder Cattle Distribution and Composition across Regions in Ethiopia

Region	Total Cattle Population (Millions)	Key Indigenous Breeds	Key Crossbred/Exotic Breeds	Primary Production System
Oromia	~20.5 (Largest)	Ogaden, Boran, Arsi, Horro	Jersey, Holstein-Friesian, crossbreds	Mixed crop-livestock (highlands), Pastoral (lowlands)
Amhara	~14.8 (2nd Largest)	Fogera, Begait, Arado	Jersey, Holstein-Friesian, crossbreds	Intensive Mixed crop-livestock (highlands)
SNNPR (Southern Nations)	~11.9 (3rd Largest)	Gurage, Sheko, Horro, Sidama	Jersey, crossbreds	Mixed crop-livestock (enset-based), Peri-urban dairy
Somali	~5.1	Ogaden, Gasara	Very limited	Pastoral / Agro-pastoral
Tigray	~4.5	Arado, Begait, Abergelle	Jersey, crossbreds	Mixed crop-livestock (highlands), Agro-pastoral (lowlands)
Afar	~2.8	Afar	Very limited	Nomadic Pastoral
Benishangul-Gumuz	~1.0	Arado, Gumuz	Limited	Agro-pastoral
Gambela	~0.8	Nilotic, Anuak	Limited	Pastoral / Agro-pastoral
Dire Dawa & Harari	~0.3	Ogaden, Harar	Crossbreds (peri-urban)	

Attributable factors to the cattle population distribution in Ethiopia

The distribution of Ethiopia's cattle population is not a random phenomenon but is attributable to a complex interplay of environmental, socio-economic, and biological factors. Primarily, the stark contrast between the densely stocked highlands and the sparsely populated lowlands is driven by agro-ecology, with rainfall patterns, altitude, and the resultant farming systems being the most significant determinants [4]. In the fertile highlands, the integration of crop and livestock production creates a high demand for draft animals and supports a larger herd density, as cattle

are essential for ploughing and benefit from crop residues as feed [2]. Conversely, in the lowlands, the distribution is dictated by the availability of water and seasonal pasture, with pastoralists practicing transhumance to navigate these scarce resources, leading to a more dispersed but mobile population [5]. Beyond ecology, the prevalence of diseases like trypanosomiasis, which is endemic in the lowlands, acts as a major biological constraint, limiting the distribution of susceptible breeds and shaping the genetic composition of the herds towards trypanotolerant types in affected regions [9]. Furthermore, market access and infrastructure play a role, as proximity to urban centres can intensify dairy production and increase cattle concentrations in peri-urban areas, while limited infrastructure in remote regions reinforces extensive, subsistence-oriented practices [11]. Therefore, the observed distribution is a cumulative outcome of where feed and water can be secured, where disease pressure is manageable, and how the socio-economic role of cattle as draft power, asset, or food source is prioritized within different livelihood systems.

District cattle distribution dynamics and business opportunities in Ethiopia

At the district level, the dynamics of cattle distribution in Ethiopia reveal nuanced patterns that create distinct, localized business opportunities. While national trends show a highland-lowland divide, district-specific dynamics such as the intensification of dairy around growing towns, the concentration of livestock along trade routes to export terminals, and the seasonal mobility of herds in pastoral areas define the real economic landscape [7]. These micro-distributions create fertile ground for entrepreneurial ventures. In districts experiencing agricultural intensification in highland regions, there is a critical opportunity for establishing private veterinary clinics, feed mills, and mechanized hire services to replace draft power, capitalizing on farmers' need to optimize a smaller number of more productive animals [4,12]. Conversely, in pastoral-dominated lowland districts, the business model shifts towards supporting mobility and trade; opportunities abound in the development of mobile banking and insurance services tailored to migratory herders, the establishment of regulated live animal markets, and investments in strategic boreholes and fodder banks that can stabilize production [5,9]. Furthermore, districts positioned along key livestock export corridors are prime locations for investing in modern abattoirs, cold chain logistics, and quarantine stations to meet international standards and capture value from the lucrative export market [11]. Therefore, understanding these fine-grained distribution dynamics is key to identifying viable, context-specific business opportunities across the Ethiopian cattle sector, moving from a generic value chain approach to one that is geographically intelligent and responsive to local production systems.

Challenges in smallholder cattle business systems in Ethiopia

Smallholder cattle business systems in Ethiopia face a constellation of interconnected challenges that severely limit their productivity and commercial potential. A fundamental constraint is the widespread scarcity and poor quality of feed, especially during the dry season, which leads to low milk yields, poor body condition, and high calf mortality, directly undermining the marketable surplus [6]. This is compounded by a high burden of diseases such as foot-and-mouth disease and internal parasites, alongside inadequate access to veterinary services, which result in direct economic losses and restrict market access by preventing movement and trade [13]. Beyond production hurdles, significant marketing challenges persist, including a lack of market information, which exacerbates the exploitation of farmers by informal traders, and poor physical infrastructure that limits access to profitable urban markets [7]. Furthermore, limited access to formal credit and financial services prevents smallholders from investing in improved technologies, such as crossbred animals or better feeding practices, trapping them in a cycle of subsistence production [3]. These challenges are often most acute for women, who, despite their crucial role in dairy management, frequently face restricted access to and control over livestock assets, further diminishing system efficiency and equity [14]. Consequently, the smallholder cattle system remains predominantly subsistence-oriented, with its vast potential for pro-poor economic growth largely untapped due to this complex web of biophysical, institutional, and socio-economic constraints.

Inadequate funding of cattle sector in Ethiopia

The cattle sector in Ethiopia, despite being the largest in Africa and critical to the national economy, is severely constrained by chronic and systemic underfunding, which stifles its potential for growth and commercialization. This

financial neglect is evident in the disproportionately low allocation of the national budget to agriculture, of which livestock a sub-component is, consistently falling short of the 10% target pledged under the Comprehensive Africa Agriculture Development Programme (CAADP) [15]. This inadequate public investment manifests in a crippling lack of essential infrastructure, including a sparse network of veterinary clinics, insufficient cold chain facilities, and underdeveloped market access roads, which directly impedes productivity and market integration [3]. Furthermore, smallholder farmers, who form the backbone of the sector, face extreme difficulty in accessing formal credit from financial institutions that perceive agricultural lending as high-risk, thereby preventing investments in improved breeds, feed, and technologies [16]. The limited funding that does exist is often fragmented and skewed towards short-term projects rather than sustained, strategic investments in research, extension services, and value-addition initiatives, such as meat and dairy processing plants [17]. Consequently, this cycle of underinvestment traps the sector in a low-input, low-output system, undermining its capacity to contribute significantly to poverty reduction, export earnings, and overall agricultural GDP, despite its enormous inherent potential.

Climate change and cattle business in Ethiopia

Climate change poses a profound and multi-faceted threat to the cattle business in Ethiopia, directly challenging its productivity and economic viability. The sector is highly vulnerable to increasing temperatures, altered rainfall patterns, and a higher frequency of extreme droughts, which collectively degrade the quantity and quality of natural pastures, the primary feed source for most herds, leading to reduced weight gain, lower milk yields, and increased cattle mortality [8]. These climatic stresses are exacerbating resource-based conflicts among pastoral communities and disrupting traditional migratory routes, thereby destabilizing the very foundation of the extensive beef production systems in the lowlands [18]. Furthermore, a warming climate is expanding the geographical range of livestock diseases and parasites, such as tick-borne diseases, increasing the incidence of illness and raising the cost of animal health management for both pastoralists and smallholder farmers [19]. The cumulative impact translates into significant economic losses, disrupted market supplies, and heightened livelihood insecurity for millions dependent on the cattle value chain. Consequently, building resilience through the promotion of climate-smart practices like forage cultivation, water harvesting, and the use of adapted indigenous breeds is no longer optional but a critical necessity for safeguarding the future of the cattle business in Ethiopia [20].

Cattle Market failures in Ethiopia

The cattle market system in Ethiopia is characterized by significant failures that stifle its efficiency and limit financial returns for the primary producers, smallholder farmers and pastoralists. A central failure is the pronounced information asymmetry, where producers in remote areas have little knowledge of prevailing prices in terminal markets, making them vulnerable to exploitation by a small number of powerful intermediaries who capture a disproportionate share of the value [7]. This is compounded by high transaction costs arising from poor road infrastructure, a lack of market standards for grading live animals, and the absence of formal contractual enforcement, which discourages investment in quality improvement [3]. Furthermore, missing or incomplete markets for key inputs and services, such as formal credit and livestock insurance, prevent producers from making productivity-enhancing investments and from managing risks, trapping them in a cycle of low-input, low-output production [16]. These collective failures asymmetric information, high transaction costs, and missing markets create a disincentive for quality production, undermine commercial competitiveness, and prevent the cattle sector from realizing its full potential for both domestic economic growth and export earnings, ultimately perpetuating poverty among rural livestock keepers.

Cattle production systems in Ethiopia

Cattle production systems in Ethiopia are predominantly defined by the country's agro-ecology, leading to a primary distinction between the mixed crop-livestock systems of the highlands and the pastoral/agro-pastoral systems of the lowlands. In the densely populated highlands, cattle are primarily integrated with crop farming, where they provide essential draft power for ploughing, manure for soil fertility, and a steady supply of milk for household consumption, with surpluses sold locally [2]. This system is characterized by small herd sizes, the use of indigenous breeds like the Horro, and a heavy reliance on crop residues for feed [4]. In stark contrast, the vast lowland regions support pastoral

and agro-pastoral systems where cattle are the main livelihood asset, managed in large, mobile herds that migrate seasonally in search of water and pasture [5]. Here, breeds such as the Boran are prized for their drought tolerance and mobility, with production focused on meat, milk, and lives animal sales for the market and export [9]. A third, emerging system is the urban and peri-urban dairy, which is market-oriented and often involves crossbred or exotic cattle kept under zero-grazing or semi-zero-grazing conditions to supply milk to major cities [12]. Despite their differences, these systems collectively face challenges of feed shortages, disease pressures, and market inefficiencies, yet they remain the backbone of rural livelihoods and a critical component of the national agricultural economy.

Sustainable cattle business implications in Ethiopia

Achieving a sustainable cattle business in Ethiopia necessitates a fundamental shift from viewing cattle merely as assets for subsistence to managing them as pillars of a resilient, market-oriented, and environmentally sound economic sector. This has profound implications, requiring integrated strategies that address environmental, economic, and social dimensions. Ecologically, sustainability implies the widespread adoption of climate-smart practices, such as improved forage cultivation, water harvesting, and sustainable grazing management, to mitigate land degradation and build resilience against climate change, thereby securing the natural resource base upon which the sector depends [6,8]. Economically, it demands enhancing value chain efficiency by addressing critical market failures such as information asymmetry and high transaction costs and investing in infrastructure for veterinary services, cold chains, and market information systems to ensure fair returns for producers and improve the sector's commercial viability [3,17]. Socially, a sustainable model must be inclusive, ensuring that the benefits accrue to smallholder farmers and pastoralists, with particular attention to empowering women who are central to dairy management but often lack access to resources and decision-making power [14]. Ultimately, the transition to a sustainable cattle business in Ethiopia is not merely an environmental imperative but a socio-economic one, vital for ensuring long-term food security, poverty reduction, and the preservation of the nation's vast livestock genetic diversity in the face of a changing climate.

Customer segmentation and value add in smallholder cattle farming business in Ethiopia

Implementing customer segmentation and value addition are critical strategies for transforming smallholder cattle farming in Ethiopia from a subsistence activity into a viable business. The diverse market can be segmented into distinct customer groups with specific needs, allowing producers to tailor their offerings. Key segments include the large, price-sensitive domestic live animal market for ceremonial and cultural purposes; the growing urban dairy market, which demands consistent, safe, and packaged milk; and the high-value export market, which requires animals meeting specific weight, health, and quality standards [11,12]. To effectively serve these segments and capture more value, smallholders must move beyond selling raw, ungraded commodities. Value addition can take multiple forms, from basic but crucial steps like fattening animals to improve grade and weight, and cooling/processing milk into yogurt or cheese to extend shelf life, to adhering to formal standards such as quarantine and vaccination protocols for export [3]. For the dairy segment, value is added through consistent quality, hygienic packaging, and reliable delivery, while for the beef export chain, value is created through traceability and certification [7]. By aligning production with the demands of specific customer segments and integrating these value-adding activities, often through cooperative models to achieve scale, smallholder farmers can significantly increase their income and build a more resilient and commercialized cattle enterprise.

Markets and Customers relationships of cattle business in Ethiopia

The customer markets and corresponding relationship dynamics within Ethiopia's cattle business are complex and largely defined by the informality of the value chain, creating a stark contrast between transactional and relational interactions. The primary customer market for the vast majority of smallholder farmers and pastoralists is the extensive network of informal, spot-market traders who operate at local auctions or purchase animals directly from homesteads; these relationships are typically transient and price-driven, with little loyalty or incentive for quality improvement from the producer's side [3,7]. In contrast, a more formal and relational market is emerging in the dairy sector, particularly in urban and peri-urban areas, where

processors and dairy cooperatives act as key customers for smallholders. Here, relationships are more stable, built on contracts or regular purchases that prioritize consistent milk quality, volume, and hygiene, creating mutual dependency and offering producers a more predictable income [12]. At the apex are the highly regulated export markets in the Middle East and North Africa, where the "customer" is often an importing company or government agency; relationships in this segment are strictly formal, requiring adherence to complex standards, and are managed by specialized export enterprises that act as intermediaries, often isolating primary producers from the end-customer [11]. This segmentation reveals a critical business imperative: transitioning from anonymous, low-trust transactions in the informal market to building long-term, value-based customer relationships in formal markets is essential for unlocking higher and more stable revenues within the Ethiopian cattle sector.

Key activities and Cost structure driving the smallholder farming business in Ethiopia

The smallholder farming business in Ethiopia is fundamentally driven by a set of labor-intensive key activities and a cost structure dominated by implicit family labor and critical cash inputs. The most crucial activities revolve around the annual crop cycle and integrated livestock management, including land preparation using oxen-drawn plows, planting, weeding, and harvesting for staple crops like teff and maize, alongside the daily husbandry of cattle grazing, watering, and managing animal health [3]. The cost structure of these enterprises is uniquely characterized by a high proportion of non-monetized, imputed costs, primarily the value of family labor, which constitutes the single largest input but rarely appears as a formal expense [21]. Beyond labor, the most significant direct cash costs are for purchasing essential inputs, specifically chemical fertilizers and improved seeds, which have become increasingly central to productivity yet represent a major financial burden for households [2]. For livestock-owning households, other substantial costs include veterinary services and medicines to combat prevalent diseases, and in drought-prone areas, the expense of purchasing supplemental feed or water for animals can become prohibitive [6]. This combination of high reliance on unpaid labor and vulnerability to fluctuating costs for a few critical inputs creates a fragile economic model with thin profit margins, making smallholder farms highly susceptible to shocks and limiting their capacity for reinvestment and growth.

Environmental, demographic, socio-economic and regulatory factors for sustainable cattle business systems in Ethiopia

Achieving sustainable cattle business systems in Ethiopia is contingent upon the complex and dynamic interplay of environmental, demographic, socio-economic, and regulatory factors, which can either reinforce or undermine one another. The environmental foundation, characterized by climate change-induced droughts and pastures degradation, directly constrains herd productivity and dictates mobility patterns, creating a baseline of biophysical stress [8]. This environmental reality is intensely mediated by demographic pressures, as a growing human population in the highlands leads to farmland expansion and rangeland fragmentation, escalating competition for resources and often forcing pastoral systems into increasingly marginal lands, thereby intensifying environmental pressure [5]. These environmental-demographic interactions are then channelled through socio-economic structures, where deep-rooted poverty and limited access to credit prevent smallholders from investing in climate-smart technologies like improved forages or health care, locking them into low-input/low-output cycles that exacerbate resource depletion [3]. Ultimately, the regulatory framework or often, the lack thereof either mitigates or amplifies these challenges. Ineffective land tenure policies can discourage long-term investment in sustainable land management, while inadequate enforcement of veterinary standards and market regulations perpetuates disease spread and unfair trade practices, stifling commercial incentives for quality production [7,17]. Therefore, sustainability cannot be pursued through a single lens; it requires integrated policies that recognize how population growth intensifies environmental stress, how poverty limits adaptive capacity, and how coherent regulation is essential to create an enabling environment for resilient and profitable cattle enterprises.

Business opportunities of the dairy industry in Ethiopia

The burgeoning dairy industry in Ethiopia, driven by rapid urbanization and rising incomes, is creating a fertile ground for a wide range of auxiliary business opportunities that extend beyond primary milk production. The growth in milk collection and the push for quality have spurred demand for

input supply enterprises, including the manufacturing of balanced animal feed concentrates, the cultivation and sale of improved forage seeds, and the distribution of affordable veterinary pharmaceuticals and artificial insemination services [12]. Furthermore, significant opportunities exist in post-harvest technologies and services, where there is a critical need for businesses specializing in milk cooling and transportation logistics, the production of packaging materials like plastic sachets and bottles, and the manufacture of small-scale processing equipment for yogurt, cheese, and pasteurized milk, which help reduce spoilage and add value [7]. A third tier of opportunity lies in specialized support services, including dairy-specific extension and consultancy, ICT platforms for market information that link farmers to buyers, and financial products tailored to the cash-flow cycles of dairy farmers and cooperatives [3]. These auxiliary ventures are not merely supplementary; they are essential for building a resilient and efficient dairy value chain, as they address critical bottlenecks in input access, reduce post-harvest losses, and enhance market integration, thereby unlocking the full commercial potential of the sector while creating non-farm employment.

Cattle business limitations in Ethiopia

A comprehensive acknowledgment of the limitations within Ethiopia's cattle business is crucial for designing effective interventions, as the sector is constrained by a multi-faceted set of challenges. A primary limitation lies in the structural and biological constraints at the production level, including the endemic prevalence of diseases like foot-and-mouth disease, chronic feed shortages, and the low genetic potential of the indigenous herd, which collectively suppress productivity and marketable surplus [6,13]. Compounding this are severe market and institutional failures, such as a lack of formal credit access, poor rural infrastructure, and deeply entrenched information asymmetries that disadvantage smallholder producers and prevent them from investing in quality improvements or capturing fair value [3,16]. Furthermore, external and policy-related limitations pose significant risks, with climate change exacerbating resource scarcity and volatility, while often uncoordinated or poorly enforced regulations on quality standards, land tenure, and cross-border trade create an unpredictable business environment [8,17]. It is also critical to acknowledge that many proposed solutions face a socio-cultural limitation, as the deep-seated cultural significance of cattle as a store of wealth, rather than a market commodity, can conflict with commercial objectives, and gender disparities often limit women's participation in and benefit from the business [9,14]. Therefore, effectively addressing the sector's potential requires a candid recognition that these interconnected limitations are not merely technical but is deeply rooted in economic, environmental, and social systems.

Cattle business Policy implications in Ethiopia

The multifaceted challenges within Ethiopia's cattle sector necessitate a coherent and multi-pronged policy framework that moves beyond isolated interventions to address systemic constraints. A primary policy implication is the need for increased public investment in foundational infrastructure, including expanding veterinary service networks, constructing all-weather roads to connect production areas to markets, and supporting the development of cold chains and processing facilities to reduce post-harvest losses and add value [3,17]. Furthermore, policy must prioritize creating an enabling environment for market efficiency by establishing and enforcing transparent live animal grading standards, supporting digital market information systems to break information asymmetry, and fostering financial inclusion through tailored credit and insurance products that de-risk investments for smallholders [7,16]. Given environmental pressures, integrating climate-smart agriculture (CSA) into national livestock programs is essential, promoting practices like improved forage cultivation, water harvesting, and sustainable rangeland management to build resilience against climate variability [6,8]. Finally, effective policy must be inclusive and gender-sensitive, recognizing and strengthening the role of pastoralists in the export value chain while enacting measures that secure women's access to resources, training, and decision-making power within the cattle economy, as their empowerment is directly linked to improved productivity and household welfare [5,14]. Ultimately, a successful policy regime will be one that strategically coordinates public investment, market regulation, environmental sustainability, and social equity to transition the sector from subsistence to a commercially viable and resilient engine of economic growth.

CONCLUSION

In summary, the smallholder cattle business system in Ethiopia stands at a critical juncture, defined by the tension between its immense geographical potential and the deep-rooted challenges that hinder its sustainable development. The nation's diverse landscapes offer a natural foundation for a robust and diversified livestock sector, with different regions suited for specialized dairy, beef, and pastoral production. However, this inherent advantage is offset by systemic obstacles, including feed scarcity, animal disease, market inefficiencies, and limited access to capital and technology, which keep productivity and profitability low for the average smallholder. Addressing these constraints requires a holistic and integrated strategy. The path forward must simultaneously focus on enhancing productivity through improved inputs and veterinary care, building resilient and market-oriented value chains that offer fair returns to farmers, and promoting climate-smart practices to safeguard the natural resource base. Ultimately, transforming the smallholder cattle business from a subsistence activity into a dynamic commercial sector is not merely an economic objective but a vital imperative for ensuring national food security, reducing rural poverty, and achieving sustainable and equitable growth for Ethiopia

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CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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