




Supply chain collaboration for sustainable dairy sector



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Purpose: This study examines collaboration among industry stakeholders and how it influences the sustainability of Zimbabwe's dairy supply chains (DSCs) through practitioners' perspectives.

Design/methodology/approach: Adopting an interpretive paradigm, the study employed purposive sampling to select 25 DSC professionals with extensive experience across different value chain segments. Data were collected through semi-structured interviews and analysed using ATLAS.ti (version 9.1) following a rigorous thematic analysis approach.

Findings/results: Six themes emerged from the analysis: recognition of value chain interdependence, industry knowledge exchange and resource sharing networks, structural and economic power dynamics, resource constraints and input challenges, infrastructure and technical capacity limitations and environmental sustainability and climate resilience. These themes collectively reveal how collaboration operates within Zimbabwe's dairy sector and the complex factors that influence its effectiveness.

Practical implications: The study developed a framework that provides a structured approach for practitioners and policymakers to enhance collaboration by addressing foundational determinants, developing appropriate collaborative mechanisms and measuring multi-dimensional impacts. Findings underscore the need for targeted interventions addressing power asymmetries, prioritising infrastructure development and integrating environmental sustainability initiatives into core business practices.

Originality/value: This research extends supply chain collaboration theory by explicating how contextual factors in developing economies shape collaborative capacity and sustainability outcomes. The proposed framework advances theoretical understanding by accounting for structural conditions that determine collaborative possibilities, offering insights applicable to agricultural supply chains in similar resource-constrained environments globally.

Keywords: dairy supply chains; collaboration; sustainability; stakeholder perception; resource constraints; knowledge exchange.

Introduction

The dairy industry forms a vital part of the global food supply chain, contributing significantly to food security, employment and economic growth. This is especially the case in developing countries where the dairy sector supports millions of livelihoods, thus playing a key role in poverty reduction and rural development (Chouinard et al., 2008; IbrāHiM et al., 2020). In developed economies such as the United States and the United Kingdom, dairy production accounts for 3.5% and 16.4% of agricultural output, respectively, considered to be substantial portions (DairyNewsToday, 2025; International Dairy Foods Association [IDFA], 2021). However, the industry's continued viability increasingly depends not only on productivity but also on its ability to integrate sustainable and collaborative practices across supply chain stages – from farm to consumer.

Globally, the dairy supply chain (DSC) faces growing pressures from climate change, volatile markets, resource scarcity and rising consumer expectations for sustainability (Argon & Co, 2025). Consequently, transitioning towards environmentally responsible and socially inclusive dairy production has become a strategic priority. Collaboration among stakeholders has emerged as a cornerstone for achieving sustainability under complex and resource-constrained conditions (Wang & Ran, 2018). Collaborative governance enables supply chain actors to share resources, coordinate actions and build resilience against systemic uncertainties (More et al., 2015). In the dairy sector context, collaboration can reduce food losses, enhance product quality

and foster innovation through the exchange of knowledge and technology (Romadlon et al., 2025).

Despite its importance, collaboration in the dairy sector remains constrained by structural, technological and managerial barriers. Factors such as limited digital infrastructure, financial constraints and regulatory inefficiencies particularly constrain collaboration in developing regions (Nalluri et al., 2025; Vuvor et al., 2025). Studies across agricultural supply chains reveal that while collaboration enhances sustainability and competitiveness (Gouiferda & Iddik, 2024; Sudusinghe & Seuring, 2022), its effectiveness depends on the enabling conditions within the institutional, technological and socio-economic environments. This is especially true under resource-constrained contexts where trust, communication and equitable benefit-sharing are critical but often lacking (Papaioannou et al., 2020). Mishra et al. (2024) observed that effective collaboration among stakeholders in agricultural sectors is essential for overcoming structural barriers and fostering sustainable development outcomes. In resource-constrained economies such as Zimbabwe, the view held by dairy industry partners that collaboration is a means to achieve sustainability remains under-explored (Al-Ramahi et al., 2024).

The Zimbabwe's dairy sector continues to encounter significant barriers, such as limited collaboration, insufficient resource sharing and inadequate infrastructural support, which threaten the industry's sustainability and long-term viability (Matangaidze et al., 2023). The significance of collaboration within the dairy sector is underscored by its potential to mitigate challenges such as resource scarcity, fragmented distribution channels and inefficient production processes (Tan et al., 2024). Recent empirical evidence underscores the value of integrating cross-functional coordination and government partnerships to improve sustainability outcomes (Bunchongpru & Maneerattanarungrot, 2025; Sánchez-Navarro et al., 2024). However, there remains a paucity of studies that have investigated collaboration among industry stakeholders and how it influences the sustainability of Zimbabwe's DSCs through practitioners' perspectives. Understanding how collaboration influences sustainability can inform policy and practice dairy sector operating under resource-constrained contexts, such as Zimbabwe.

Accordingly, this study investigates collaboration among industry stakeholders and how it influences the sustainability of Zimbabwe's DSCs through practitioners' perspectives. Specifically, it explores the factors that impede and facilitate collaborative practices. By doing so, the study contributes to the growing discourse on sustainable supply chain management by integrating collaboration theory with empirical insights from the dairy industry – a sector that lies at the intersection of food security, economic development and environmental stewardship. This study draws on two complementary theoretical perspectives to examine collaborative dynamics in DSCs. Resource dependence

theory (RDT) (Pfeffer & Salancik, 2015) explains how resource constraints shape inter-organisational relationships. Dynamic capabilities theory (DCT) (Teece, 2018) frames how firms develop collaborative competencies to adapt to changing environments. These theories collectively provide a lens for understanding how structural conditions influence collaborative capacity in resource-constrained contexts. Hence, the study examined collaboration among industry stakeholders and how it influences the sustainability of Zimbabwe's DSCs through practitioners' perspectives.

Theoretical foundation

The study draws on the RDT and DCT. According to the RDT, firms are dependent on resources provided by others in order to sustain growth (Pfeffer & Salancik, 1978). Resource dependence theory suggests that firms cannot be fully self-sufficient when it comes to critical resources for survival and sustainable development (Heide, 1994; Ulrich & Barney, 1984). In order to secure the much-needed resources, firms need to manage these dependencies well (Hillman et al., 2009). The RDT suggests that, in the supply chain, member firms should recognise the fact that in the long run, inter-dependencies and collaboration result in higher performance gains than the pursuit of short-term benefits at the expense of others (Sarkis et al., 2011). Hence, this study employs RDT to investigate collaboration among industry stakeholders and how it influences the sustainability of DSCs through practitioners' perspectives in a resource-constrained country such as Zimbabwe.

The DCT explains how firms build, integrate and reconfigure resources to address rapidly changing environments (Teece, 2018; Teece et al., 1990). Dynamic capabilities reflect the speed and degree to which the firm's resources or competences can be aligned and realigned with the opportunities and requirements of the market (Teece, 2010). According to Masteika and Cepinskis (2015), the combination of dynamic capabilities and supply chain management makes organisations more flexible and dynamic, enabling them to adapt to new market trends and navigate market turbulences. In line with the DCT, collaborative capabilities by supply chain partners are essential for the success of supply chains, especially for SMEs (Pooe & Munyanyi, 2019). Collaborative dynamic capabilities are 'capabilities of companies and industries to build enduring relationships of trust, to realise co-specialisation and capabilities synthesis through strategic collaborations with ecosystem partners' (Kodama, 2018). Collaborative capabilities represent higher-order dynamic capabilities enabling firms to sense opportunities, seize resources through partnerships and reconfigure collaborative arrangements as conditions change. This perspective is particularly relevant for understanding how dairy stakeholders adapt to climate change and market volatility through collaboration. These theories converge to suggest that collaboration in agricultural supply chains is simultaneously driven by resource dependencies (RDT) and

enabled by dynamic capabilities (DCT). This theoretical perspective provides a comprehensive framework for understanding collaboration among industry stakeholders and how it influences the sustainability of Zimbabwe's DSCs through practitioners' perspectives.

Literature review

Dairy supply chains

Supply chain management in the dairy industry entails coordinating a complex network of interdependent processes and stakeholders to ensure the sustainable and efficient delivery of quality dairy products (Huerta-Soto et al., 2025). These processes encompass milk production, collection, transportation, processing and distribution, each requiring effective collaboration among farmers, processors, logistics providers and policymakers (Piao et al., 2021). Once milk is produced, processing facilities convert it into value-added products – such as yoghurt, cheese, pasteurised milk and butter (Goyal et al., 2023) – which are subsequently distributed through logistics networks to retailers. Retailers, ranging from large supermarket chains to small rural outlets, ultimately make these products accessible to consumers.

The dairy industry constitutes a vital component of Zimbabwe's agricultural economy, contributing significantly to both economic growth and nutritional security (Jaja & Yanga, 2022). Historically dominated by large-scale commercial enterprises, the sector has in recent decades expanded to include a growing number of smallholder farmers, thereby diversifying production and introducing new complexities in supply chain coordination (Tuni et al., 2022). Despite these developments, Zimbabwe's DSCs continue to face persistent sustainability challenges, including resource scarcity, weak infrastructure, high production costs and fragmented stakeholder coordination (Chari & Ngcamu, 2017).

According to Chirinda et al. (2021), the number of large-scale commercial dairy farmers declined sharply from approximately 314 in 2000 to around 165 in 2018. Consequently, annual milk production fell from roughly 262 million litres in 1990 to about 50 million litres in recent years, against an estimated national demand of 120 million litres (Bórawski et al., 2020). While government policy frameworks have sought to promote collaboration and investment in the sector, there remain significant gaps in translating these policies into practice – particularly regarding how dairy practitioners experience and implement collaborative supply chain strategies (Jebaraj et al., 2023). Understanding these perceptions, along with implementation challenges and enabling conditions, is therefore critical to advancing sustainable supply chain management in Zimbabwe's dairy sector (Sinha & Mishra, 2023).

Collaboration in supply chains

Collaboration forms the cornerstone of efficient and sustainable supply chain management. In the dairy context, collaboration can take vertical, horizontal or lateral forms,

each contributing uniquely to supply chain performance and sustainability (Al-Dobashi & Wright, 2024). Vertical collaboration refers to partnerships among actors at different stages – such as farmers, processors and retailers – designed to streamline processes and improve information flow. Horizontal collaboration, by contrast, involves cooperation among entities at the same level, such as groups of farmers pooling resources or sharing infrastructure to achieve economies of scale (Monageng & Adetunji, 2020). Lateral collaboration integrates both forms and extends to include cross-sectoral engagement with policymakers, financial institutions and non-governmental organisations to advance broader sustainability objectives (Mrabti et al., 2023).

When effectively implemented, these collaborative arrangements enhance environmental sustainability, reduce operational costs and build resilience against systemic shocks such as resource shortages or market volatility (Malik et al., 2024). Thus, examining the perceptions of dairy practitioners regarding collaboration, as well as the institutional and operational enablers that support it, is essential for strengthening the sector's competitiveness and sustainability (Matangaidze et al., 2023). The success of collaboration, however, depends heavily on effective performance measurement and decision-making frameworks. Angerhofer and Angelides (2006) proposed a comprehensive model for evaluating collaborative performance, emphasising that success requires systematic assessment beyond traditional firm-centric metrics. Similarly, De Frutos et al. (2020) highlighted the fact that operational decisions in collaborative supply chains must balance individual firm objectives with collective goals, particularly in areas of resource allocation and information sharing.

Information quality is another critical determinant of collaboration effectiveness. Wiengarten et al. (2010) demonstrated empirically that information quality mediates the relationship between collaborative practices and performance outcomes, suggesting that collaboration without reliable and timely information exchange offers limited benefits. In agricultural contexts, Leat and Revoredo-Giha (2008) found that trust, transparent communication and a shared strategic vision are foundational to sustainable collaboration – especially in developing economies where institutional support is limited. Recent advances in collaborative supply chain research have also introduced innovative cost-sharing mechanisms. Guo et al. (2022) developed a combinatorial framework for lateral collaboration with cost-sharing in sustainable supply chains, showing that actors operating at the same level can achieve both environmental and economic gains through structured resource pooling. This framework is particularly relevant to the dairy sector, where small-scale producers face common resource constraints. Overall, collaboration among farmers, processors, distributors and policymakers has been widely recognised as a key driver of sustainability and competitive advantage in the dairy industry (Barbosa & Cansino, 2024; Fontana & Pisalyaput, 2023).

Sustainable dairy supply chains

Sustainability has become an overarching imperative for modern supply chains. A sustainable DSC integrates economic, social and environmental objectives to meet present needs while safeguarding future generations' capacity to meet theirs (Kumar & Choubey, 2024). Within the dairy sector, adopting sustainable practices contributes to reducing environmental impacts, improving economic resilience and enhancing social outcomes such as food security and rural livelihoods (Shamsuddoha et al., 2023). Yet, persistent issues such as inefficient resource use, pollution and inadequate waste management continue to hinder progress towards sustainability (Jiménez-Sánchez et al., 2024).

Addressing these challenges requires a holistic approach that combines stakeholder collaboration, supportive policy environments and effective sustainability-oriented management systems (Gupta et al., 2020). Sustainability challenges in DSCs often manifest across multiple stages – from production and processing to distribution and consumption – creating systemic vulnerabilities such as environmental degradation, resource depletion and economic inefficiencies (Herczeg et al., 2018; Petrov et al., 2023). Sustainability breakdowns typically occur when operational processes become misaligned with broader environmental, social and economic expectations, thereby threatening the competitiveness and long-term viability of the dairy industry (Bassotto et al., 2021). Therefore, achieving genuine sustainability requires managing environmental impacts systematically and promoting inclusive collaboration across all levels of the dairy value chain, from smallholder producers to large-scale processors and distributors (Tan et al., 2024). Meaningful progress will depend on coherent policies and targeted interventions designed to strengthen collaboration, reduce environmental impacts and address economic barriers within the sector (Sharma & Bhardwaj, 2024).

The literature underscores the fact that sustainability in DSCs cannot be achieved through isolated firm-level interventions. Instead, it depends on multi-level collaboration, effective governance structures and coherent policy frameworks that align stakeholder interests across the value chain. As such, investigating how practitioners perceive, experience and operationalise collaboration provides critical insights for designing strategies that enhance sustainability and resilience in the country's dairy sector.

TABLE 1: Sample profiles.

Code	Roles	No.	Minimum qualifications	Location
P1, P3	Regional heads	2	Diploma and Masters	Bulawayo
P2, P11, P14, P15, P19, P24, P25	Executives	7	Masters	Gweru, Bulawayo, Harare, Kwekwe
P4, P8, P21	Managers – production and marketing	3	Diploma and Masters	Mutare, Harare
P5, P6, P7, P9, P16, P20	Dairy cattle specialists and analysts	6	Bachelors, Hons and Masters	Harare, Zvishavane, Mutare, Sekel, Gweru, Harare
P10, P18	Cattle breeders	2	Diploma	Mutare, Marondera
P12, P13, P17, P22, P23	Dairy producers	5	Diploma and Bachelors	Harare, Bulawayo, Kwekwe

Methodology

This qualitative study employed semi-structured interviews with 25 DSC practitioners to examine collaboration among industry stakeholders and how it influences the sustainability of Zimbabwe's DSCs. Participants were purposively selected based on their extensive industry experience and representation across different stages of the supply chain, including milk producers, processors, logistics coordinators, distributors and regulatory officials. Data saturation was reached after the 23rd interview, with two additional interviews conducted to enhance robustness. All interviews were audio-recorded and transcribed verbatim following informed consent. Thematic analysis was conducted using ATLAS.ti (version 9.1), following Braun and Clarke's (2022) six-phase framework. Initial coding captured key concepts related to collaboration and sustainability challenges, which were subsequently refined into coherent themes aligned with the research questions. Trustworthiness was ensured through prolonged engagement with participants, detailed audit trails, rich contextual descriptions and reflexive practices (Nowell et al., 2017).

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of Johannesburg Department of Business Management Research Ethics Committee (No. 21SOM06).

Results

Table 1 presents the participants' profiles of the 25 supply chain practitioners interviewed for this study and includes participants' roles, years of experience, qualifications, gender, age and location.

Participants were drawn from key economic regions – Harare, Bulawayo, Mutare and Kwekwe – which serve as major hubs of Zimbabwe's dairy industry. Their professional experience ranged from 4 years to 21 years, and their educational qualifications spanned from diplomas to doctoral degrees. This diversity ensured that the insights obtained were grounded in substantial industry knowledge, practical expertise and contextual understanding of the DSC.

Emergent themes

Table 2 highlights themes that emerged from the primary data collected.

Theme 1: Recognition of value chain interdependence

Findings indicate that dairy industry stakeholders in Zimbabwe increasingly recognise their mutual interdependence as fundamental to achieving sustainable practices. One dairy processor highlighted this interconnectedness:

'We all need each other. We all exist because of each other. So when we have quarterly meetings with the Zimbabwe Association of Dairy Farmers, those stakeholders are invited to come through.' (P13)

Similarly, a consultant explained:

'Since last year, we started with a dairy multi-stakeholder platform where all the dairy value chain players meet every quarter.' (P21)

The data underscore strong interdependence between farmers and processors. A production manager explained:

'The processor ensures you always get milk because your cows will not get foot and mouth ... the farmer might not have a lump sum to vaccinate the cows.' (P15)

Participants described how this interdependence is operationalised through shared transport systems, coordinated quality control and joint disease management initiatives. However, this recognition manifests unevenly across the supply chain – being stronger between farmers and veterinarians than between processors and retailers. Hence, despite the challenges they may face, participants recognise the interdependence among the value partners as fundamental for achieving sustainability within the DSC in Zimbabwe.

Theme 2: Industry knowledge exchange and resource-sharing networks

Knowledge exchange and resource-sharing networks emerged as critical infrastructures for collaboration in Zimbabwe's dairy industry. These are facilitated through field days, industry associations and multi-stakeholder platforms that enable multidirectional learning and coordination.

As one dairy specialist stated:

'Dairy is a very highly technical field ... it is one industry where it is difficult to do it alone. You cannot do it alone.' (P2)

A female dairy farmer echoed this:

'We do have collaborative meetings every quarter ... even the policy guys, the dairy services, they come because they exist because of the farmer.' (P13)

These networks serve multiple purposes – technical training, policy advocacy, disease control and market intelligence:

TABLE 2: Emerged themes.

Theme	Description
1	Recognition of value chain interdependence
2	Industry knowledge exchange and resource-sharing networks
3	Structural and economic power dynamics
4	Resource constraints and input challenges
5	Infrastructure and technical capacity
6	Environmental sustainability and climate resilience

'There is a strong association called the Zimbabwe Association of Dairy Farmers. They organise field days for extension and information sharing.' (P2)

However, gaps persist, particularly in information access between commercial and small-scale farmers. One participant observed:

'We need a mindset change with our farmers and show them how lucrative the business is.' (P12)

Evidently, participants stressed the need for these networks to evolve from addressing short-term operational issues towards long-term strategic collaboration. As a processor puts it:

'We need to chat ... we are all interested in the value chain and seeing that things work.' (P13)

It is noteworthy that participants expressed appreciation for the value of building networks for the long-term benefit of the partners in the value chain. It is also evident that structural arrangements, such as quarterly meetings, are in place to deepen collaboration among supply chain partners. As the participants admit, a mindset change is also required among the partners to leverage on these structural arrangements and deepen collaboration for the sustainability of the industry.

Theme 3: Structural and economic power dynamics

Findings reveal persistent power asymmetries that shape collaboration outcomes across Zimbabwe's dairy value chain. These asymmetries are most evident in price determination, profit distribution and decision-making authority.

A technologist noted:

'The farmer is always a price taker ... you walk in, and they say the feed went up by 10%. You have no choice.' (P15)

Another participant remarked:

'Absolutely no collaboration because everybody is trying to undermine each other ... processors want to milk dry the farmers.' (P6)

Power imbalances are especially pronounced between input suppliers and farmers and between processors and retailers:

'The supermarkets want to charge 25–30%, and that causes a pushback ... we are not getting a viable price.' (P22)

These tensions foster mistrust, with one retailer admitting:

'There is no trust, that's why they are regulators.' (P25)

Nonetheless, some processors attempt to mitigate these imbalances through innovative financing arrangements:

'If you help the farmers purchase the feed, then you take your money from the milk that is delivered to you.' (P23)

Power asymmetry among the Zimbabwe dairy sector supply chain partners seems to be one of the main causes of concern for some supply chain partners. What is also evident from

the participants' sentiments is trust deficit among the partners, where some feel superior over others. This undermines the value that accrues from collaboration.

Theme 4: Resource constraints and input challenges

Resource constraints emerged as a central barrier to effective collaboration and sustainability. Participants cited high feed costs, limited financing and prohibitive compliance expenses as the main impediments. A farmer mentioned:

'Feed is a challenge ... they don't give enough water to produce their food.' (P24)

Another added:

'The cows are very expensive; for high-producing cows, you're looking at about \$1,800 per cow.' (P14)

Feed costs reportedly consumed 60% – 76% of total expenses. Compliance costs further strained viability:

'It costs \$84 per cow per year just on compliance costs.' (P21)

In response, some farmers adopted self-sufficiency strategies such as on-farm feed production and silage.

One farmer explained:

'I silage my crop and use that as part of my feed.' (P18)

These efforts illustrate attempts to reduce dependence – what Teece (2018) terms reconfiguring capabilities. Yet, as one participant noted, systemic constraints persist:

'Without access to farmland ... it doesn't make sense.' (P4)

Participants feel strongly about the problems associated with lack of access to resources by some partners within the DSC in Zimbabwe. From the participants' sentiments, the high cost of doing business and lack of access to the required inputs put a strain on the supply chain partners. This resource impediment gets even more acute as the supply chain partners look at the situation individually rather than collectively.

Theme 5: Infrastructure and technical capacity

Deficiencies in infrastructure and technical capacity were identified as major impediments to collaboration. Challenges included unreliable electricity, poor roads, weak cold chain systems and limited technical training.

A processor mentioned:

'Roads, I don't know. Roads – it's a non-starter.' (P25)

A logistics expert added:

'We're replacing our fleet sooner than expected because of bad roads to farms.' (P19)

Power outages also disrupted operations:

'If electricity goes now, I have to run the generator continuously ... if you're not financially strong, you collapse.' (P5)

Participants noted widespread gaps in technical expertise. A farmer remarked:

'You learn about a cow that's struggling to give birth, but you've never seen it.' (P13)

Integrating small-scale farmers into formal value chains was seen as a potential solution, exemplified by programmes linking large-scale farmers to mentor smallholders (P20). Participants point to the lack of infrastructure and technical capacity as a serious impediment for many supply chain partners to collaborate. Participants are frustrated by the lack of support from the authorities as they navigate the difficult terrains to make their businesses work.

Theme 6: Environmental sustainability and climate resilience

Environmental sustainability and climate resilience emerged as growing concerns and catalysts for collaboration. Participants reported tangible climate impacts such as erratic rainfall, water scarcity and pasture degradation:

'Climate change is an issue ... The rains, how dry it is, the impact on water and pastures.' (P16)

Another added:

'My father planted five times as much 15 years ago ... the rainy season has changed.' (P18)

Emerging responses include renewable energy initiatives and biogas use:

'Biogas is being used for solar-powered tricycles ... there are many interventions to create a just environment.' (P21)

Another added:

'We encourage farmers to use manure to produce biogas.' (P23)

Yet another participant put it this way:

'Plan ten years now, before we get to ten years later', advised one stakeholder (P25)

Clearly, participants viewed sustainability not only as environmental adaptation but as business continuity. Participants seem to have ideas on how to survive climate change and have some indigenous knowledge that has been passed on to them by previous generations to share with others. As long as there are no collaborative platforms to share this wisdom, their business may not survive the current climate change.

Discussion

This study revealed that collaboration within Zimbabwe's DSC is shaped by an interplay of interdependence, knowledge networks, power dynamics, resource constraints, infrastructure limitations and environmental pressures. Stakeholders increasingly recognise the interdependent nature of the value chain, particularly between farmers and processors, reflecting value-enhancing collaborative relationships where complementary resources generate

mutual benefits (Irfan, 2021). However, collaboration manifests unevenly, with stronger connections between farmers and veterinarians than between processors and retailers, illustrating asymmetrical integration across relational interfaces (Verghese et al., 2022). In terms of Theme 1, a strong interdependence between farmers and processors aligns with RDT, which posits that organisations acknowledge and manage dependencies as precursors to collaboration (Pfeffer & Salancik, 2015). The reciprocal reliance between farmers and processors exemplifies Casciaro and Piskorski's (2005) notion of mutual dependence, where bidirectional needs mitigate power asymmetries. Recognising the value of interdependence is thus a necessary precursor to value-creating collaboration, especially in sectors with perishable, time-sensitive products.

In line with Theme 2, knowledge exchange networks – through field days, multi-stakeholder platforms and industry associations – emerge as critical infrastructures for collaborative capability development. These networks facilitate technical skill development, policy coordination, disease management and market intelligence sharing (Dyer & Singh, 1998; Teece, 2018). Yet disparities in access between commercial and small-scale actors limit equitable collaborative benefits, reinforcing power asymmetries (Stoeva et al., 2024). Participants emphasised that knowledge networks must evolve beyond operational problem solving to long-term strategic visioning, reflecting Mehdikhani and Valmohammadi's (2019) observation that sustainable agricultural supply chains require both operational knowledge sharing and collaborative strategic planning. The knowledge exchange networks illustrate what Teece (2018) refers to as sensing capabilities – the ability to identify opportunities through collective learning. Regular interactions, such as field days and stakeholder forums, help build absorptive capacity (Cohen & Levinthal, 1990), strengthening system-wide adaptive potential.

Theme 3 revealed persistent power asymmetries that shape collaboration outcomes across Zimbabwe's dairy value chain. Persistent power asymmetries shape collaboration by influencing pricing, profit distribution and decision-making authority (Malik & Hingley, 2021; Wang et al., 2024). Vertical disparities are particularly pronounced between input suppliers and farmers and between processors and retailers, undermining trust and constraining knowledge flows. Processors' feed-financing arrangements exemplify hybrid governance mechanisms that partially internalise transactions while maintaining market relationships (Cao & Zhang, 2011; Ménard, 2004). The dual role of power – coercive versus legitimate – further explains why some collaborative relationships flourish despite similar structural conditions (Cai et al., 2013).

As emerged in Theme 4, resource constraints were seen as a central barrier to effective collaboration and sustainability. Resource constraints, particularly high feed costs, input access difficulties and regulatory compliance burdens, represent major barriers to collaboration (Adriant et al., 2021).

Feed constitutes 60% – 76% of production expenses, severely limiting financial flexibility. Self-sufficiency strategies, such as on-farm feed production and silage management, illustrate adaptive reconfiguration of resources to reduce dependence on external actors, consistent with Teece's (2018) dynamic capabilities framework and Tosi and Marty's (2024) coordination mechanisms. Nevertheless, these strategies remain limited in effectiveness without institutional support (Myeni et al., 2021). The resource constraints reinforce asymmetric dependence (Gulati & Sytch, 2007), where resource-poor actors remain vulnerable within the supply chain.

As per Theme 5, infrastructure and technical capacity limitations further constrain collaboration. Inadequate electricity, poor road networks, unreliable cold chains and limited technical expertise elevate transaction costs and reduce operational resilience (Hernández-Socha & Zuluaga-Jiménez, 2024; Williamson, 2014). Inclusive value chain approaches, where large-scale actors support small holders and exemplify hybrid governance structures addressing both capacity gaps and transaction costs (Parshotam & Revilla Diez, 2019). Stakeholders emphasised the need for technological advancement beyond incremental improvements, reflecting dual challenges of addressing deficiencies while attempting technological leapfrogging.

According to Theme 6, environmental sustainability and climate resilience emerged as both the challenges and catalysts for collaboration. Climate change impacts, including erratic rainfall and pasture degradation, affect all stakeholders, creating a shared urgency that can transcend traditional power and resource barriers (Safdar et al., 2024). Collaborative initiatives such as biogas production and renewable energy adoption illustrate dynamic capability development – sensing environmental threats, seizing collaborative opportunities and reconfiguring operations for sustainability (Rasul, 2021). These initiatives reflect circular supply chain principles and proactive ecological management, suggesting that environmental pressures may catalyse deeper collaboration than market incentives alone (Lavelli, 2021).

The six themes reveal systemic interconnections shaping collaborative dynamics. Recognition of interdependence underpins knowledge exchange networks, yet both are constrained by power asymmetries. Resource and infrastructure limitations compound these challenges, restricting participation in collaborative networks and reinforcing structural inequalities. Environmental pressures provide a unifying impetus for collective action, prompting adaptation and innovation despite pre-existing constraints. Collaborative mechanisms thus develop along paths of least resistance, flourishing where power is balanced and resources sufficient, while stagnating where structural constraints dominate.

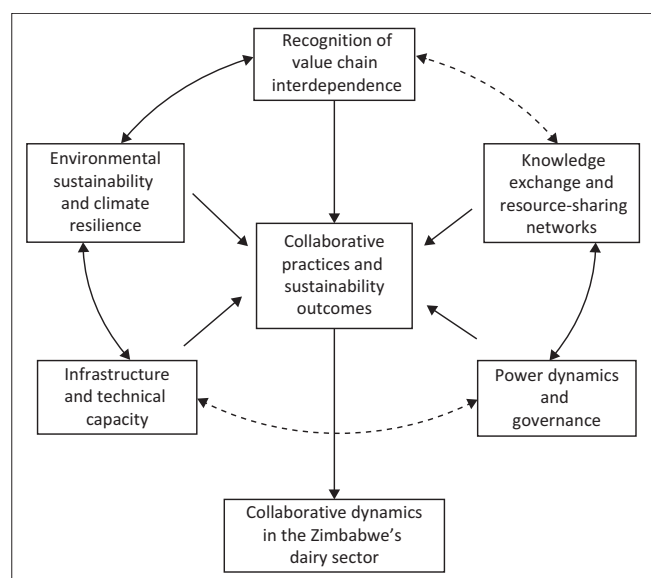
A critical insight is that environmental sustainability can override conventional barriers. Renewable energy adoption and biogas initiatives exemplify collaborative solutions

emerging from shared ecological challenges rather than economic optimisation. Such crisis-driven collaboration highlights that, in resource-constrained contexts, collaboration functions as a survival mechanism as much as a performance-enhancing strategy. Unlike in resource-abundant economies, where collaboration primarily addresses efficiency or competitive advantage, in Zimbabwe's dairy sector, it addresses scarcity, infrastructure deficiencies and climate vulnerabilities.

These findings extend the collaborative supply chain theory by showing that foundational determinants that include power, resources, infrastructure and environmental pressures act as boundary conditions rather than mere contextual factors. Effective collaboration arises where interdependence is acknowledged, knowledge networks are accessible, power asymmetries are managed, resources are adequate, infrastructure is sufficient and environmental pressures demand collective action. This underscores the need for context-sensitive frameworks that account for structural constraints and adaptive capacities, rather than assuming universal applicability of models developed in developed economies. In conclusion, Zimbabwe's DSC demonstrates that collaboration is selective, adaptive and shaped by systemic factors. Policy interventions, inclusive knowledge networks and adaptive infrastructure support are essential to enhance sustainability. Recognising the interplay of interdependence, power dynamics, resource limitations and environmental pressures offers critical guidance for scholars and practitioners aiming to foster sustainable DSCs in developing economies.

Framework for collaborative and sustainable supply chains in the Zimbabwe's dairy sector

Figure 1 illustrates a framework for collaborative and sustainable supply chains in the Zimbabwe's dairy sector.



Note: Solid arrows: direct influence or enabling effect; dashed arrows: conditional influence (e.g. collaboration possible if resources or trust exist); circular arrows: feedback loops showing iterative adaptation and learning.

FIGURE 1: Framework for collaborative and sustainable supply chains in the Zimbabwe's dairy sector.

As Figure 1 shows, collaboration and sustainability in DSCs are shaped by the interaction of interdependence, knowledge networks, power dynamics, resource constraints, infrastructure capacity and environmental pressures. Achieving the collaboration and sustainability outcomes in the Zimbabwean dairy sectors depends on the following factors:

- Recognition of value chain interdependence between the DSC partners such as farmers, processors and retailers drives collaboration.
- Knowledge exchange and sharing resource networks. This involves sharing the technical know-how, market intelligence, policy alignment and shared practices.
- Power dynamics and governance. Make a shift from the power dynamics and governance systems that support the vertical and horizontal power asymmetries among supply chain partners in favour of hybrid governance mechanisms to mitigate imbalances.
- Resource constraints and input challenges – Feed costs, financial limitations, compliance costs and self-sufficiency strategies.
- Infrastructure and technical capacity. Ensure there is electricity reliability, proper road networks, cold chain logistics and human resource capability.
- Environmental sustainability and climate resilience. Develop climate-smart practices, renewable energy, biogas adoption and adaptive responses.

Interconnections

- Interdependence → Knowledge networks: Acknowledgement of mutual reliance motivates information sharing and joint problem-solving.
- Power dynamics → Resource and infrastructure access: Power asymmetries shape who can access critical resources or participate in knowledge networks.
- Resource and infrastructure constraints → Collaboration effectiveness: Scarcity and capacity gaps limit collaboration intensity and coverage.
- Environmental pressures → Catalytic collaboration: Climate risks provide a unifying impetus for stakeholders to collaborate beyond conventional economic incentives.

Feedback loops

- Effective collaboration enhances resource utilisation, strengthens networks, reduces vulnerability to power imbalances and improves climate resilience.
- Conversely, poor infrastructure, severe resource constraints and extreme power asymmetries weaken collaborative outcomes.

Conclusion

This study intended to examine collaboration among industry stakeholders and how it influences the sustainability of Zimbabwe's DSCs through practitioners' perspectives. Six critical themes emerged: value chain interdependence, knowledge exchange networks, power dynamics, resource constraints, infrastructure and technical limitations and

environmental sustainability challenges. These findings reveal that while collaboration is widely recognised as essential for achieving sustainability, its realisation remains constrained by systemic inequities, resource shortages and institutional weaknesses.

The study makes a significant contribution to sustainable supply chain management by developing the Dairy Industry Collaboration and Integration Framework (DICIF), which conceptualises how foundational determinants shape collaborative mechanisms and outcomes in developing economies. The framework extends existing theories by contextualising collaboration within environments characterised by scarcity and institutional fragility.

Practically, the findings highlight the need for industry actors to adopt inclusive, strategically aligned collaborative models that address structural imbalances, enhance infrastructure capacity and embed environmental sustainability into operational strategies. For policymakers, the study underscores the importance of enabling policies and institutional coordination to strengthen resource access and equitable participation across the supply chain. Collectively, these insights provide a solid foundation for improving collaboration to enhance the resilience, competitiveness and sustainability of Zimbabwe's dairy sector.

Theoretically, the study advances three key perspectives. Firstly, it extends RDT by illustrating how scarcity drives collective interdependence beyond dyadic relationships. Secondly, it contributes to DCT by demonstrating how collaborative capabilities evolve incrementally under severe constraints. The DICIF framework thus offers a nuanced understanding of how collaboration operates as both a necessity and a strategy for sustainability in resource-constrained supply chains.

Limitations and directions for future research

While this study provides valuable insights, several limitations must be acknowledged. The research was geographically confined to Zimbabwe's main dairy-producing regions, potentially overlooking dynamics in more remote areas where infrastructural and logistical challenges may differ. Additionally, limited participation from informal producers and small-scale retailers may have constrained the diversity of perspectives. The cross-sectional design also restricted the ability to observe how collaborative relationships evolve over time.

Future research could address these limitations through longitudinal studies that track collaboration dynamics in response to policy or market changes. Comparative studies across similar developing economies could illuminate contextual factors shaping collaborative effectiveness. Quantitative analyses examining the economic, social and environmental impacts of specific collaborative mechanisms would also complement this study's qualitative findings. Furthermore, action research involving multiple stakeholders could test the DICIF framework in practice, identifying real-world barriers and enablers. Finally, future

work should explore how emerging technologies such as blockchain, IoT and digital traceability platforms can reduce power asymmetries, improve transparency and foster more equitable collaboration across DSCs in developing contexts.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

CRedit authorship contribution

John Chivero: Conceptualisation, Methodology, Writing – original draft. David Poee: Project administration, Supervision, Writing – review & editing. Blessing Takawira: Data curation, Software. All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Data availability

The data that support the findings of this study are available from the corresponding author, David Poee, upon reasonable request.

Disclaimer

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