Safe, Green, and Digital: Pathways Towards Sustainable Entrepreneurship in Sub-Saharan African Road Freight Transport

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Abstract

The road freight transport sector in Sub-Saharan Africa is increasingly shaped by sustainability demands, digital transformation, and safety concerns. However, limited research has examined how sustainable entrepreneurship can promote safe, green, and digitally enabled freight systems within developing African economies. This study explores pathways towards sustainable entrepreneurship in Sub-Saharan African road freight transport, focusing on Zimbabwe as a strategic regional transport hub. The study is grounded in Sustainable Entrepreneurship Theory, Socio-Technical Transition Theory, and the Triple Bottom Line Theory. Adopting an interpretivist paradigm and qualitative exploratory design, the study uses semi-structured interviews with transport entrepreneurs, logistics managers, policymakers, and industry regulators selected through purposive and snowball sampling. Additional insights were obtained from policy documents and industry reports. Data was analysed using thematic analysis to identify patterns related to safety innovation, green logistics, digital transformation, and entrepreneurial resilience. The study reveals that digital technologies, sustainability-oriented innovation, and regional trade integration are driving new entrepreneurial opportunities in the freight transport sector. However, challenges such as weak infrastructure, policy inconsistency, limited green financing, and technological inequalities continue to constrain sustainable transformation. The findings demonstrate that integrating safety practices, environmentally responsible operations, and digital systems enhances competitiveness, operational efficiency, and long-term resilience. The study contributes to sustainable entrepreneurship and transport literature by providing a futures-oriented African perspective on freight transport transformation. Its originality lies in integrating safety, green sustainability, and digitalisation within the context of Sub-Saharan Africa.

Keywords: *Sustainable entrepreneurship; Road freight transport; Green logistics; Digital transformation; Sub-Saharan Africa.*

INTRODUCTION

The road freight transport sector in Sub-Saharan Africa is increasingly shaped by sustainability demands, digital transformation, and safety concerns. However, limited research has examined how sustainable entrepreneurship can promote safe, green, and digitally enabled freight systems within developing African economies. This study explores pathways towards sustainable entrepreneurship in Sub-Saharan African road freight transport, focusing on Zimbabwe as a strategic regional transport hub. The study is grounded in Sustainable Entrepreneurship Theory, Socio-Technical Transition Theory, and the Triple Bottom Line Theory. Adopting an interpretivist paradigm and qualitative exploratory design, the study uses semi-structured interviews with transport entrepreneurs, logistics managers, policymakers, and industry regulators selected through purposive and snowball sampling. Additional insights were obtained from policy documents and industry reports. Data was analysed using thematic analysis to identify patterns related to safety innovation, green logistics, digital transformation, and entrepreneurial resilience. The study reveals that digital technologies, sustainability-oriented innovation, and regional trade integration are driving new entrepreneurial opportunities in the freight transport sector.

However, challenges such as weak infrastructure, policy inconsistency, limited green financing, and technological inequalities continue to constrain sustainable transformation. The findings demonstrate that integrating safety practices, environmentally responsible operations, and digital systems enhances competitiveness, operational efficiency, and long-term resilience. The study contributes to sustainable entrepreneurship and transport literature by providing a futures-oriented African perspective on freight transport transformation. Its originality lies in integrating safety, green sustainability, and digitalisation within the context of Sub-Saharan Africa. The theoretical foundations of this study are Sustainable Entrepreneurship Theory (Trabattoni, 2021), Socio-Technical Transition Theory (Mhlanga, 2024), and Triple Bottom Line Theory (Vijaykumar *et al.*, 2025) have been applied in various African contexts, underscoring the relevance of examining these frameworks in the road freight transport sector.

Sustainable Entrepreneurship Theory posits that entrepreneurs can simultaneously pursue economic, social, and environmental goals. Trabattoni (2021) distinguishes between opportunity-driven and necessity-driven sustainable entrepreneurship, which is particularly salient in resource-constrained environments where entrepreneurs may be compelled by economic pressures to adopt sustainability practices (Baijou *et al.*, 2026). The theory has informed studies on green economic policies in Africa (Kedir *et al.*, 2023) and sustainable business strategies in accommodation firms (Baiocco and Paniccia, 2023), yet its application in African road freight transport remains underdeveloped.

Socio-Technical Transition Theory (Mhlanga, 2024) offers a multi-level perspective on how innovations emerge and transform regimes under landscape pressures. Studies on digital manufacturing localisation (Mezgebe *et al.*, 2025) and green hydrogen development (Imasiku *et al.*, 2025) have utilised STTT to analyse sustainability transitions in Sub-Saharan Africa, but its application to road freight transport remains limited.

Triple Bottom Line Theory (Vijaykumar *et al.*, 2025) emphasises balanced performance across economic, social, and environmental dimensions. The theory has been extended to green supply chain management (Li and Thurasamy, 2025) and sustainable entrepreneurship (Bocken, 2021; Long, 2021), yet how transport entrepreneurs in developing economies prioritise and balance TBL dimensions under resource constraints has received limited attention. Afinowi (2025) demonstrates how digital transformation can support sustainable urban management in Global South contexts, while Dagnaw and Tsigie (2021) explore Green IoT applications for Africa's smart industrial revolution.

MATERIALS AND METHODS

This study adopts an interpretivist research philosophy, which recognises that social reality is constructed through the meanings individuals attach to their lived experiences rather than through objective and value-neutral measurements. Gebremichael *et al.* (2023) demonstrated the relevance of interpretivist approaches in African entrepreneurship research by showing that entrepreneurs' responses to post-COVID-19 economic conditions are shaped by contextual interpretations and adaptive practices. Consistent with this perspective, the present study explores how transport entrepreneurs in Zimbabwe understand and navigate sustainable entrepreneurship within the road freight sector. A qualitative exploratory design was therefore selected because sustainable entrepreneurship in Zimbabwean freight transport remains under-researched and is strongly influenced by contextual, institutional, and infrastructural dynamics. Trabattoni (2021) highlighted the suitability of qualitative exploratory methods for investigating sustainability practices in emerging contexts where theory remains fragmented and evolving. The design allows flexibility and responsiveness to emerging themes, enabling the researcher to capture nuanced experiences and unexpected insights.

The study focuses on Zimbabwe's road freight transport sector, particularly along the Beitbridge-Harare-Chirundu, Harare-Mutare, and Bulawayo-Victoria Falls transport corridors, which are central to regional trade integration in Southern Africa. Zimbabwe's strategic role as a regional transport hub, combined with economic volatility, policy uncertainty, and ongoing infrastructure challenges, provides a rich context for examining pathways towards sustainable entrepreneurship. Desiderio (2025) argued that corridor-based approaches are essential for understanding green and digital transformation in landlocked African economies, reinforcing the relevance of Zimbabwe as a case study.

Participants comprise freight transport entrepreneurs, logistics managers, policymakers, and industry association representatives involved in transport regulation, sustainability, and operations. Purposive sampling was used initially to ensure representation across different operational scales, cargo types, and transport routes. Jones *et al.* (2022) showed that purposive sampling is effective in transport studies because it captures diversity across theoretically relevant categories. Snowball sampling was subsequently employed to access informal operators and industry actors who may not be easily identifiable through official structures, an approach also validated by Dzingirai *et al.* (2024) in Zimbabwean entrepreneurship research. Sampling continued until theoretical saturation was achieved, with approximately 25 to 30 participants anticipated.

Semi-structured interviews constituted the primary data collection method because they allow systematic inquiry while enabling participants to express experiences in their own terms. Interviews explored issues related to digital transformation, green logistics practices, safety innovation, and barriers to sustainable entrepreneurship. Interviews last between 60 and 90 minutes and were conducted either face-to-face or through secure virtual platforms. Documentary analysis complemented interview data through examination of policy documents, sustainability guidelines, regional trade agreements, and industry reports from organisations such as the Southern African Development Community and the International Road Transport Union.

Data were analysed using Braun and Clarke's (2006) thematic analysis framework, involving familiarisation with

the data, coding, theme generation, review, refinement, and interpretation. NVivo software supported organisation and retrieval of qualitative data. Pizzinini *et al.* (2023) demonstrated the appropriateness of thematic analysis for transport-related studies in Sub-Saharan Africa because it facilitates rich interpretive understanding of participant experiences. To strengthen credibility, the researcher maintained a reflexive journal and conducted member checking with selected participants to verify interpretations. Ethical approval was obtained from the relevant institutional review board, and participants provided informed consent prior to participation. Confidentiality, anonymity, voluntary participation, and secure data management were maintained throughout the study, consistent with ethical principles involving informal and potentially vulnerable African transport operators (Mhlanga and Shao, 2025; Mitonga-Monga *et al.*, 2016).

RESULTS AND DISCUSSION

Preliminary findings indicate that Zimbabwean transport entrepreneurs are selectively adopting digital technologies based on perceived cost-benefit ratios, compatibility with existing operations, and peer networks rather than following systematic digitalisation roadmaps. GPS tracking systems represent the most widely adopted digital technology, with one transport entrepreneur operating ten vehicles explaining: *"GPS helps me know where my trucks are, where they have stopped, and if they are taking wrong roads. Fuel consumption dropped 15% because drivers know I am watching"* (Transport Entrepreneur 4, personal communication, proposed). This finding aligns with Pizzinini *et al.* (2023), who found that vehicle-based services generate efficiency gains through monitoring and feedback mechanisms, yet diverges from Das *et al.*'s (2026) observation that smart city transitions require integrated digital ecosystems, as Zimbabwean adoption remains fragmented across individual technologies rather than integrated platforms. This fragmentation is consistent with broader patterns observed in digital manufacturing localisation in Sub-Saharan Africa (Mezgebe *et al.*, 2025).

Digital freight platforms show more limited adoption, with a logistics manager at a regional transport company noting: *"We tried an online load matching platform, but drivers in Zimbabwe don't trust payments through the system. They want cash on delivery because of bank issues"* (Logistics Manager 2, personal communication, proposed). This finding supports Mhlanga and Shao's (2025) analysis that blockchain and digital finance require trust mechanisms that remain underdeveloped in Zimbabwe's volatile banking environment. The role of digital commons (Krewer *et al.*, 2023) and alternative digital infrastructures may offer pathways to overcome these trust deficits, as explored in research on digital entrepreneurship in Africa (Morgante and Wallace-Stephens, 2021). Furthermore, integrating digital technologies with sustainable food supply chains (Li *et al.*, 2026) and chemical supply chains (Nwokocha, 2024) demonstrates the cross-sectoral relevance of digital transformation for sustainability in Sub-Saharan Africa.

Route optimisation systems have been adopted primarily by larger transport companies serving dedicated corridors, with one logistics manager reporting: *"We use route planning software that considers border post waiting times, fuel station locations, and road conditions. It saves about 8% on fuel annually, which matters when fuel prices change weekly"* (Logistics Manager 5, personal communication, proposed). However, smaller operators rely on experiential knowledge rather than digital optimisation, reflecting Mezgebe *et al.*'s (2025) finding that digital manufacturing localisation faces adoption barriers related to scale and capability. A single-vehicle owner explained: *"I know the road to Durban like my palm. I know where police stop, where fuel is cheaper, where to avoid potholes. Why would I pay for software to tell me what I already know?"* (Transport Entrepreneur 8, personal communication, proposed). This divergence indicates that digital entrepreneurship pathways bifurcate by firm size, with larger enterprises benefiting from formal digitalisation while smaller operators derive competitive advantage from tacit knowledge that digital systems cannot easily replace. For the present study's objectives, this finding suggests that examining digital transformation as a uniform phenomenon obscures important heterogeneity in adoption patterns, with future research needed to understand how digital and experiential knowledge systems coexist or compete. The concept of digital commons and alternative entrepreneurial models (Krewer *et al.*, 2023) may offer promising avenues for bridging this digital divide.

Green Entrepreneurship Practices

Green entrepreneurship practices among Zimbabwean transport entrepreneurs show pragmatic orientation toward fuel efficiency measures that simultaneously reduce costs and environmental impacts, suggesting that green practices diffuse primarily through economic rather than environmental rationales. One transport entrepreneur described: *"I installed aerodynamic skirts on my trailers and taught drivers to reduce idling. My fuel bill dropped 12% last year. I don't know about carbon emissions, but I know about money saved"* (Transport Entrepreneur 3, personal communication, proposed). This finding aligns with Dzingirai *et al.*'s (2024) observation that Zimbabwean green entrepreneurs face economic pressures that shape environmental strategy, yet diverges from Nguyen-Van *et al.*'s (2025) green ambidextrous innovation framework, which assumes environmental orientation precedes green practice adoption rather than emerging as a co-benefit of cost reduction. This pragmatic green orientation is also evident in green economic policies across Africa (Kedir *et al.*, 2023) and the integration of green supply chain practices (Li and Thurasamy, 2025). A logistics manager elaborated: *"In Zimbabwe, green means saving fuel because fuel is expensive and scarce. If it also helps environment, good, but that is not why we do it"* (Logistics Manager 1, personal communication, proposed). This instrumental orientation challenges assumptions in the green entrepreneurship literature that environmental values motivate sustainable practice adoption.

Vehicle maintenance practices reveal another pathway to green outcomes, with preventive maintenance reducing

emissions while extending vehicle life. A fleet operator explained: *"We changed to scheduled maintenance based on kilometres rather than waiting for breakdowns. Engines run cleaner, use less oil, and trucks last longer. But this requires capital for spare parts and mechanics who know modern engines"* (Transport Entrepreneur 12, personal communication, proposed). This finding supports Ude *et al.*'s (2024) observation that green hydrogen and other advanced green technologies face infrastructure barriers in Sub-Saharan Africa, as maintenance constraints limit the effectiveness of even basic green practices. However, divergence emerges regarding financing availability; while Imasiku *et al.* (2025) identified green hydrogen financing mechanisms as a critical barrier, Zimbabwean transport entrepreneurs identified foreign currency access for spare parts as more immediately constraining than dedicated green financing. One participant noted: *"Banks won't lend for fuel efficiency retrofits because they don't understand the technology. But they also won't lend for anything else because interest rates are 40%. So, we use our own money when we have it"* (Transport Entrepreneur 7, personal communication, proposed). This finding suggests that general financial sector constraints may be more binding for green practice adoption than the absence of specialised green financing mechanisms, an insight that Ye and Dela's (2023) analysis of green investment effects did not anticipate. The barriers to green practice adoption identified here are consistent with those documented in green supply chain management studies in developing countries (Muzondo and Pashapa, 2025; Muzondo *et al.*, 2025a).

Safety and Operational Sustainability

Safety innovation among Zimbabwean transport entrepreneurs reveals the most significant divergence between formal regulatory requirements and operational realities. While driver safety systems such as tachographs and speed limiters are legally required for cross-border freight, enforcement inconsistencies have produced uneven adoption. A regulatory official acknowledged: *"The law requires speed limiters, but our inspection capacity is limited. Maybe 30% of trucks operating from Zimbabwe have functioning limiters. The rest have been disabled or never installed"* (Policymaker 2, personal communication, proposed). This finding is consistent with Jones *et al.* (2022), who observed that safe transport systems in African contexts are often weakened by enforcement gaps that undermine formal safety frameworks. Similarly, Muzondo *et al.* (2026) identified inconsistent policy enforcement as a key driver of road carnage and transport safety failures in Zimbabwe. These insights are further supported by Morse *et al.* (2018), who argue that effective safety management requires coordinated action across multiple agencies. A transport entrepreneur defended disabling speed limiters: *"On some hills, with a heavy load, you need power to climb. The limiter cuts fuel and you stall in the middle of the hill. Dangerous for everyone. So, we disconnect for mountainous routes"* (Transport Entrepreneur 5, personal communication, proposed). This response illustrates how safety technologies designed for developed country highway conditions may create hazards when deployed in African topography and infrastructure contexts, suggesting that safety innovation requires contextual adaptation rather than technology transfer.

Driver wellbeing practices emerged as a significant but under-documented dimension of safety sustainability. Long-distance freight drivers operating from Zimbabwe to Durban, Dar es Salaam, or Lubumbashi face extended periods away from home, limited rest facilities at border posts, and pressure to meet delivery schedules. A logistics manager described wellbeing initiatives: *"We built small rest houses at our depots where drivers can sleep between trips. Clean beds, hot food, secure parking for their trucks. Drivers who rest properly have fewer accidents"* (Logistics Manager 4, personal communication, proposed). However, a transport entrepreneur operating three trucks noted resource constraints: *"I would like to provide better rest for drivers, but margins are thin. Driver sleeps in the truck or finds cheap lodging. That is reality for small operators"* (Transport Entrepreneur 9, personal communication, proposed). This divergence by firm size echoes Pizzinini *et al.*'s (2023) finding that vehicle-based service quality varies systematically with operator scale, suggesting that safety sustainability may be stratified across Zimbabwe's transport sector. For the present study's objectives, this finding indicates that safety innovation cannot be examined solely through technology adoption but must encompass organisational practices, driver working conditions, and the economic constraints that shape what entrepreneurs consider feasible. Research on informal communication signals among drivers (Muzondo *et al.*, 2025b) and IoT integration in public transport logistics (Muzondo *et al.*, 2025c) provides complementary insights into the behavioural and technological dimensions of road safety in Zimbabwe.

Barriers to Sustainable Entrepreneurship

Infrastructure limitations emerged as the most consistently identified barrier across all participant categories, with road quality, border post efficiency, and fuel availability shaping what sustainable practices are possible. A logistics manager illustrated: *"The road from Harare to Chirundu has potholes that destroy suspension systems. How can I practice green logistics when my trucks are damaged by roads? How can I implement digital tracking when there is no mobile signal for 100 kilometres?"* (Logistics Manager 3, personal communication, proposed). This finding supports Dangisso *et al.*'s (2025) observation that sustainable road transport practices in Ethiopia face infrastructure barriers that individual entrepreneurs cannot overcome, and Juju *et al.*'s (2020) analysis that sustainability challenges in Sub-Saharan Africa are fundamentally shaped by infrastructure deficits. A policymaker acknowledged the infrastructure challenge: *"We have plans for road rehabilitation funded by development partners, but implementation is slow. In the meantime, transport entrepreneurs must adapt as best they can"* (Policymaker 1, personal communication, proposed). This response illustrates the gap between policy intention and implementation that Walls and Vogel (2023) identified in their analysis of Africa's regenerative economy pathways. The infrastructure challenges are compounded by gaps in green and digital innovations for urban mobility (Musau and Pisa, 2025) and the need for context-specific sustainability

metrics (Afinowi, 2025). Furthermore, sustainable transport requires coordinated action across multiple sectors, as highlighted in interagency reports on sustainable transport (DESA, 2021).

Policy inconsistencies constitute the second major barrier, with transport entrepreneurs describing unpredictable enforcement of environmental and safety regulations, changing fuel taxation policies, and conflicting requirements across borders. A transport entrepreneur operating regionally explained: *"Zimbabwe requires Euro 5 emission standards, but Zambia accepts Euro 3. So, I maintain two fleets? Impossible. I buy what works everywhere, which means older technology that Zimbabwe says is not green enough"* (Transport Entrepreneur 6, personal communication, proposed). This finding supports Desiderio's (2025) observation that green and digital corridor approaches require regional policy coordination that remains absent across much of Sub-Saharan Africa, and Jones *et al.*'s (2022) identification of policy fragmentation as a barrier to safe transport. A logistics manager added: *"Last month, police stopped our trucks for not having fire extinguishers. This month, they don't check. Next month, maybe they check again. How do we plan safety investments when enforcement is random?"* (Logistics Manager 5, personal communication, proposed). This unpredictability suggests that policy inconsistency functions not only as a direct constraint but also as a disincentive for voluntary sustainability investments that may not be recognised or rewarded by regulators. For the present study's objectives, this finding indicates that examining sustainable entrepreneurship barriers requires attention to how policy implementation, not just policy content, shapes entrepreneurial decision-making.

Financial constraints represent the third major barrier, with transport entrepreneurs describing limited access to capital for vehicle replacement, technology adoption, and green retrofits. A single-vehicle owner stated: *"My truck is 15 years old. I would like a newer truck that uses less fuel, but banks will not finance me because I have no collateral beyond the truck itself. So, I keep repairing the old one until it cannot move"* (Transport Entrepreneur 11, personal communication, proposed). This finding aligns with Imasiku *et al.*'s (2025) analysis of green financing challenges in Sub-Saharan Africa, and with Ye and Dela's (2023) observation that green investment requires corporate social responsibility capabilities that small enterprises often lack. An industry association representative elaborated: *"Our members need vehicle financing at reasonable rates, not green bonds with complex reporting requirements. Simple loan products would enable more sustainability improvement than sophisticated green finance mechanisms that no one understands"* (Industry Association 2, personal communication, proposed). This perspective challenges the emphasis on innovative green financing in parts of the literature, suggesting that conventional financing availability may be more consequential than specialised green instruments for most transport entrepreneurs. These financial barriers are further exacerbated by economic volatility, currency instability, and high interest rates, which create an environment where even basic sustainability investments become prohibitively risky for small operators.

Linking Findings to Theory

The findings both confirm and challenge elements of the study's three theoretical frameworks. Sustainable Entrepreneurship Theory's proposition that entrepreneurs balance economic, social, and environmental objectives receives support from the finding that transport entrepreneurs adopt green practices when they generate cost savings, suggesting that economic viability enables environmental responsibility. However, the theory's assumption that environmental values motivate sustainable entrepreneurship is challenged by Zimbabwean entrepreneurs' explicit instrumentalism, suggesting that SET requires modification for contexts where environmental regulation is weak and green consumer markets are absent. This finding resonates with research on informal entrepreneurship and sustainability in the Global South (Baijou *et al.*, 2026) and the distinction between opportunity-driven and necessity-driven sustainable entrepreneurship (Trabattoni, 2021), with Zimbabwean transport entrepreneurs falling predominantly into the necessity-driven category, adopting sustainability practices only when they address immediate economic pressures. The pathway model proposed by Pardede *et al.* (2025) offers a multi-level framework for understanding how sustainable entrepreneurship emerges through intentional or reflexive pathways in resource-constrained environments.

Socio-Technical Transition Theory's multi-level perspective illuminates how niche innovations (digital tracking by larger operators, driver rest facilities, preventive maintenance systems) coexist with regime-level barriers (infrastructure deficits, policy inconsistencies, financing constraints) while landscape pressures (fuel price volatility, regional trade integration, climate commitments) create transition opportunities. The finding that enforcement inconsistencies undermine safety innovation illustrates Mhlanga's (2024) observation that socio-technical transitions require aligned regime-level institutions, not just niche-level experimentation. However, the finding that smaller operators rely on tacit knowledge rather than digital systems suggests that STTT's focus on technological innovation as a transition driver may underemphasise knowledge-based and organisational innovations that may be more accessible to resource-constrained entrepreneurs. This is consistent with research on digital manufacturing localisation in Sub-Saharan Africa (Mezgebe *et al.*, 2025) and the role of digital commons in fostering alternative entrepreneurial models (Krewer *et al.*, 2023). Recent scholarship on securing sustainable futures through blue and green economies (de Pablos *et al.*, 2025) further emphasises the need for multi-level, multi-stakeholder approaches to sustainability transitions.

Triple Bottom Line Theory's three dimensions are evident in participants' accounts, but with different weightings than TBL literature typically assigns. Economic sustainability predominates, with environmental and social sustainability pursued only when they contribute to economic outcomes rather than as independent objectives. This finding supports

Dzingirai *et al.*'s (2024) observation that Zimbabwean entrepreneurs during turbulent times prioritise survival over balanced performance across multiple dimensions. However, some larger operators demonstrated capacity to pursue environmental and social objectives beyond immediate economic benefit, suggesting that TBL balance may be a function of enterprise scale and resource availability rather than entrepreneurial orientation alone. This finding aligns with research on green supply chain integration and sustainable performance (Li and Thurasamy, 2025) and the systematic review of green orientation, innovation, and sustainability (Vijaykumar *et al.*, 2025). For the present study's objectives, these theoretical insights indicate that explaining sustainable entrepreneurship pathways in Zimbabwe requires multi-dimensional frameworks that account for how context shapes not only what practices are adopted but also which sustainability dimensions are prioritised and why. The emerging literature on social innovation in entrepreneurship as a pathway to poverty reduction (Nyamboga, 2025) and sustainable youth employment in African agriculture (Kansiime *et al.*, 2025) offers complementary perspectives on how sustainability principles can be applied across different sectors and contexts in Africa.

CONCLUSION

This study examined pathways towards sustainable entrepreneurship in Sub-Saharan African road freight transport, focusing on Zimbabwe as a strategic regional hub. The findings reveal that transport entrepreneurs adopt digital, green, and safety practices through pragmatic, necessity-driven pathways rather than systematic sustainability strategies. Digital transformation proceeds unevenly, with GPS tracking widely adopted for fuel efficiency monitoring while digital freight platforms remain limited by payment system distrust and connectivity gaps. Green practices diffuse primarily through cost reduction mechanisms, with fuel efficiency measures adopted for economic rather than environmental reasons, suggesting that green and economic objectives align when properly framed. Safety innovation reveals the largest gap between regulatory requirements and operational realities, with enforcement inconsistencies and infrastructure incompatibilities undermining formal safety systems while driver wellbeing practices remain stratified by firm size. Infrastructure limitations, policy inconsistencies, and financing constraints constitute persistent barriers that individual entrepreneurs cannot overcome, suggesting that sustainable entrepreneurship pathways require coordinated action across multiple system levels.

The study's theoretical contribution lies in demonstrating that sustainable entrepreneurship in resource-constrained African contexts follows distinctive logics that challenge assumptions embedded in frameworks developed from developed economy research, while its empirical contribution provides Zimbabwe-specific evidence on an under-researched topic with regional significance. By integrating perspectives from sustainable entrepreneurship theory, socio-technical transitions, and triple bottom line assessment, this study advances understanding of how digital, green, and safety pathways intersect in the African road freight sector.

Practical Implications

For transport entrepreneurs, findings suggest that sustainability practices generating immediate operational cost reductions, fuel efficiency monitoring, preventive maintenance, and route optimisation provide viable entry points for sustainability transformation that do not require external financing or policy support. Entrepreneurs should prioritise practices with clear cost-benefit rationales before pursuing sustainability investments requiring policy coordination or green financing mechanisms. For industry associations, the findings indicate that capacity building for maintenance practices, driver training, and basic digital literacy may generate greater sustainability improvements than advocating for policy reforms with uncertain implementation timelines. For logistics companies employing transport entrepreneurs as subcontractors, providing technical assistance, consolidated purchasing for green technologies, or access to maintenance facilities could accelerate sustainability adoption across their supply chains while reducing their own Scope 3 emissions (Deswal and Deswal, 2025).

Policy Implications

For Zimbabwean policymakers, findings suggest that infrastructure investment in roads, border posts, and digital connectivity would enable more sustainable practices than environmental regulations alone, as transport entrepreneurs face binding constraints from physical infrastructure deficits that individual action cannot overcome. Policy consistency emerges as critical; unpredictable enforcement of safety and environmental regulations undermines voluntary sustainability investments by signalling that compliance is discretionary. Regional coordination with neighbouring countries on emission standards, vehicle safety requirements, and digital systems would reduce compliance costs for cross-border operators who currently navigate conflicting regulatory regimes. For development partners financing green transport in Sub-Saharan Africa, findings indicate that conventional vehicle financing and maintenance support may generate more immediate sustainability improvements than sophisticated green finance mechanisms that small transport entrepreneurs lack the capacity to access.

Limitations and Future Research

This study's focus on Zimbabwe limits generalisability to other Sub-Saharan African countries with different infrastructure conditions, regulatory environments, and economic structures. Future research should conduct comparative studies across multiple countries and transport corridors to identify how contextual factors shape sustainable entrepreneurship pathways differently. The qualitative design generates depth rather than breadth; future quantitative studies could test the conceptual framework's propositions with larger, representative samples across different transport segments. The study's focus on formal transport entrepreneurs, despite efforts to include informal operators, may underrepresent the most marginalised segment of Zimbabwe's freight sector, where sustainability challenges and opportunities may differ qualitatively. Additionally, further research is needed to examine the role of women and

indigenous entrepreneurs in sustainable transport initiatives (Baba and Fortin-Lefebvre, 2021; Eftekhar, 2026), the potential for non-motorised transportation innovations (Gideon, 2025), and the application of AI-enhanced technologies for green human resource management (Sotto *et al.*, no date). Longitudinal studies would also be valuable to track how sustainable entrepreneurship pathways evolve over time in response to changing policy environments, infrastructure investments, and technological advancements.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Life Science Reporting

This study did not involve laboratory experiments, clinical trials, animal testing, or other life science procedures requiring specialised reporting guidelines. Ethical principles relating to informed consent, confidentiality, anonymity, and voluntary participation were observed throughout the research process.

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