# Unpacking the Resilience-Performance Nexus in African MSMEs: A Systematic Literature Review

Felix Tete,<sup>1</sup> Laurine Chikoko<sup>2</sup> and Noah Ariel Mutongoreni<sup>3</sup>

<sup>1,2</sup>Midlands State University, Gweru, Zimbabwe

<sup>3</sup>Manicaland State University of Applied Sciences, Fernhill, Mutare, Zimbabwe



DOI: https://doi.org/10.52006/main.v7i4.1013

## Article history:

Submitted: October 15, 2024 Revised: December 5, 2024 Accepted: December 8, 2024

#### Keywords:

MSMEs Resilience Business performance Adaptive capacity Financial management Africa ABSTRACT. This systematic review examines the crucial link between resilience and performance in African Micro, Small, and Medium Enterprises (MSMEs). The study identifies key factors driving MSME resilience and their impact on business performance by analyzing existing literature. Findings highlight that adaptive capacity, sound financial management, market responsiveness, and strong networks enhance resilience and performance. These insights underscore the need for targeted support systems to bolster MSME sustainability and competitiveness, offering valuable guidance to policymakers, practitioners, and researchers working towards fostering sustainable economic development across Africa.

#### 1.0. Introduction

Micro, Small, and Medium Enterprises (MSMEs) constitute the cornerstone of African economies, responsible for approximately 80% of employment and substantial contributions to GDP growth (African Development Bank [AfDB] Group, 2020). These enterprises are vital in driving innovation, boosting competition, and nurturing the entrepreneurial spirit throughout the continent. Moreover, MSMEs are central development and environmental sustainable stewardship (World Bank, 2023). They have been acknowledged for their substantial contributions to the United Nations' Sustainable Development Goals (SDGs) (Endris & Kassegn, 2022). According to the World Bank (2023), these enterprises collectively form the bedrock of the private sector, comprising approximately 90% of businesses worldwide and fostering over 50% of global employment opportunities.

In addition, Micro, Small, and Medium Enterprises (MSMEs) globally serve as vital engines for employment creation and income generation, especially for disadvantaged and marginalized segments of societies, hitherto embodying the essence of the 'Leaving

\*Correspondence: fkmtete@gmail.com Felix Tete, Midlands State University, Gweru, Zimbabwe No One Behind' principle central to the 2030 Agenda (World Bank, 2023). Endris and Kassegn (2022) argued that a robust and resilient MSME sector not only propels economic advancement but also plays a pivotal role in social development by fostering a more equitable distribution of the benefits of economic growth and addressing challenges stemming from wealth inequality.

However, despite their significance, African MSMEs encounter a myriad of challenges that hinder their growth and sustainability. Key challenges include limited access to finance, inadequate infrastructure, and restricted market opportunities (World Bank, 2020b). Many MSMEs struggle to secure funding. Hence, they often rely on informal sources or personal savings. This, in turn, potentially limits their ability to invest in growth and innovation. In addition, inadequate infrastructure, unreliable transport, and insufficient energy supply limit operational efficiency and hinder market access for these enterprises. More so, some MSMEs face regulatory hurdles and lack market intelligence to penetrate local or international markets. Isichei et al. (2024) posit that the declining survival rate of many MSMEs has become a significant concern for stakeholders, highlighting the urgent need for effective support and intervention strategies.

©Tete et al. (2024). Open Access. This article published by Philippine Social Science Journal (PSSJ) is licensed under Creative Commons Attribution-Noncommercial 4.0 International (CC BY-NC 4.0). You are free to share (copy and redistribute the material in any medium or format) and adapt (remix, transform, and build upon) the material. Under the following terms, you must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way suggests the licensor endorses you or your use. You may not use the material for commercial purposes. To view the license, visit https://creativecommons.org/license/by-nc/4.0/

Resilience, which is the ability to endure and recover from challenges, is essential for the survival and success of MSMEs in dynamic environments. According to Alberti et al. (2018), resilience is the capacity of a system to withstand shocks. This quality has become increasingly important for MSMEs, significantly enhancing their overall performance and adaptability in adversity. Resilient MSMEs are better equipped to adapt to changing market conditions, recover from disruptions, and capitalize on emerging opportunities. This adaptability is especially vital in the face of external shocks, including economic downturns, political instability, and, more recently, the effects of global pandemics. Such challenges can disrupt operations and threaten the viability of MSMEs, making resilience a key factor in their ability to navigate and recover from these adverse conditions. MSMEs are entities globally recognized for their pivotal contributions to the economic and social fabric of nations. Hence, resilience stands as a linchpin intertwined with their performance.

Given the increasing volatility of the business environment in Africa, understanding the key factors that contribute to the resilience of MSMEs is essential. Shocks ranging from economic downturns to supply chain disruptions and regulatory changes serve as critical tests of the resilience of these businesses (Pellegrino & Abe, 2022). Without the pressures and adversities posed by these shocks, the true capacity of MSMEs to endure, adapt, and recover from challenges remains elusive (Miklian & Hoelscher, 2022). Research indicates that resilience is influenced by various factors, including organizational capabilities, leadership, access to resources, and social networks. An appreciation of these dimensions helps gain insights into how MSMEs can bolster their resilience and improve their overall performance.

Through a systematic literature review, this study investigates the critical relationship between resilience and performance in African Micro, Small, and Medium Enterprises (MSMEs). By analyzing existing research, this study aims to uncover the factors driving MSME resilience and how these factors contribute to business success. The findings will provide valuable insights for policymakers, practitioners, and researchers, enabling them to develop effective strategies that support MSME growth and sustainability, ultimately fostering broader economic stability and development in Africa.

### 2.0. Literature Review

Existing literature underscores the critical role of resilience in enhancing the performance of Micro, Small, and Medium Enterprises (MSMEs) across various global contexts. Resilience is increasingly recognized as an essential attribute that enables these enterprises to navigate uncertainties and adapt to changing market

conditions (Quingco & Leonoras, 2019; Casinillo & Salabao, 2023). Research identifies several resilience factors that contribute to improved business outcomes. For instance, adaptive capacity is crucial for MSMEs to respond effectively to challenges and leverage emerging opportunities (Arraya, 2024; Aragon-Sanchez & Sanchez-Martin, 2018). This capacity allows businesses to pivot their strategies, innovate, and implement changes that align with evolving consumer demands.

Financial management practices also play a pivotal role in fostering resilience (Dwyanti, 2024). Effective financial management equips MSMEs to allocate resources efficiently, manage cash flows, and make informed investment decisions, ultimately enhancing sustainability and growth potential (Hasyim & Bakri, 2025). Additionally, networking capabilities are vital; robust networks provide access to essential resources, information, and support systems, facilitating collaborations and knowledge exchange that help overcome obstacles (Sutrisno, 2023). These factors demonstrate that resilience is a proactive framework MSMEs can leverage to thrive in competitive and volatile environments.

Adopting digital tools is another crucial element in building resilience among MSMEs (Achieng & Malatji, 2022). By leveraging data analytics and digital marketing strategies, enterprises can gain valuable insights into consumer behavior, allowing for rapid adaptation to changing market demands (Hossain et al., 2021). In today's fast-paced environment, pivoting quickly is essential for survival and growth. Moreover, a culture of innovation enhances resilience, as businesses that continuously explore new ideas and processes remain competitive even in challenging economic climates (Zhang et al., 2019). Saad et al. (2021) argued that this innovative mindset encourages organizations to challenges as opportunities, significantly contributing to their agility in responding to market changes.

Recent studies in the U.S. highlight that resilience is intricately linked to innovation and agility (Kumar & Sharma, 2020). Resilient MSMEs leverage advanced technologies such as artificial intelligence and big data analytics to gain insights into consumer behavior, facilitating rapid business model adaptations (Hokmabadi et al., 2024). This proactive approach boosts performance during economic fluctuations, allowing MSMEs to mitigate risks associated with market volatility. For instance, firms employing agile methodologies can pivot their offerings during downturns, maintaining customer engagement and revenue.

In China, the resilience of MSMEs is mirrored by remarkable economic growth, particularly amid market volatility and regulatory changes (Shen & Wang, 2021).

Strong local networks, supported by government initiatives, enhance resilience, enabling firms to sustain performance during downturns (Zhang et al., 2019). Effective financial practices, especially cash flow management, empower businesses to navigate capital constraints and invest in growth opportunities during challenging times. Additionally, integrating technology, such as e-commerce platforms, enhances market reach and operational efficiency.

In India, MSME resilience is often tied to entrepreneurial spirit and adaptability in complex regulatory environments (Kumar & Sharma, 2019). Community support and informal networks are crucial for resource sharing and knowledge exchange (Singh, 2021). Financial literacy and robust management practices sustain performance amidst challenges, particularly for small enterprises. Government initiatives, such as the MSME Development Act, enhance competitiveness and facilitate access to credit and markets.

In the Middle East, resilience is vital for coping with geopolitical uncertainties (Kautsar et al., 2025). Strategic partnerships and government initiatives foster resilience, enabling MSMEs to navigate challenges and seize opportunities (Mehchy et al., 2023). Access to diverse funding sources, such as venture capital and government grants, is crucial for maintaining performance in volatile markets.

In Europe, resilience among MSMEs is closely linked to sustainability practices and innovation (Astuty et al., 2024). Firms adopting sustainable practices are better equipped to handle crises, as these often align with regulatory frameworks to enhance competitiveness. The European Union's Green Deal incentivizes MSMEs to innovate in sustainability, improving resilience against environmental and economic shocks. Integrating sustainability into business strategies enhances brand reputation, attracts investment, and fosters customer loyalty.

Despite the wealth of research on the resilience-performance nexus globally, the specific link between resilience and performance in the African context remains underexplored. Understanding these interactions in diverse settings can provide valuable insights for African MSMEs facing unique challenges and opportunities. Future research should aim to bridge this gap, drawing on successful strategies from different regions to enhance the resilience and performance of MSMEs in Africa.

## 3.0. Methodology

Research design. This study adopted a systematic literature review design to investigate the resilience-performance relationship in Africa's Micro, Small, and Medium Enterprises (MSMEs). This methodology is

essential for ensuring a thorough and transparent synthesis of existing research, thus enhancing the credibility and robustness of the findings (Moher et al., 2009). A systematic approach allows for identifying patterns, gaps, and trends in the literature, which facilitates a comprehensive understanding of how resilience factors influence MSME performance in diverse contexts. This is particularly relevant, given the unique challenges African MSMEs face, which necessitates a nuanced exploration of resilience strategies.

Study scope and limitations. This systematic literature review focuses on empirical studies exploring the resilience-performance nexus in African MSMEs, with a publication date from 2010 to 2024. The review is limited to articles published in English and excludes nonpeer-reviewed sources, book chapters, and conference proceedings to ensure a focus on high-quality, rigorously vetted research. While this study aims to provide a comprehensive overview of the existing literature, certain limitations should be acknowledged. The exclusion of non-English language studies may result in omitting significant insights. Furthermore, the potential for publication bias indicates that the findings may not fully capture the entire research on this topic. Nonetheless, this study aspires to make a meaningful contribution to understanding resilience in African MSMEs and its implications for performance.

Inclusion/exclusion criteria for studies. Including empirical studies is essential as it ensures that the review is anchored in evidence-based research, which is crucial for deriving meaningful and actionable insights (Mays et al., 2005; Petticrew & Roberts, 2008). By focusing on studies published between 2010 and 2024, the review captures the most recent developments and trends in the field, which reflects the current challenges and opportunities faced by African MSMEs. According to Kumar and Sharma (2019), this temporary focus allows for an accurate representation of the evolving landscape of resilience and performance, thereby providing a relevant context for understanding the dynamics at play.

Furthermore, restricting the geographic focus to African countries acknowledges the unique socio-economic factors influencing MSME performance in this region (Ekechi et al., 2024). Studies published in English enhance the comprehensiveness of the review, which allows a broader range of perspectives and findings to be considered. This approach, according to the World Bank (2020a), ensures that the review not only reflects diverse research methodologies but also encompasses a wide array of insights that can inform strategies aimed at enhancing the resilience and performance of MSMEs across Africa.

Table 1

Inclusion/Exclusion Criteria for Studies Inclusion/Exclusion Criteria Empirical studies (quantitative, Study Design qualitative, mixed methods) focusing on African MSMEs Studies published between 2010 and Publication Date 2024 Studies conducted in African Geographic Focus countries. Language Studies published in English. Micro, Small, and Medium Study Population Enterprises (MSMEs) operating in Africa.

Search Strategy. This targeted search strategy is vital for identifying a comprehensive body of literature relevant to the study's objectives. Employing multiple databases significantly increases the likelihood of capturing a diverse range of studies, which is essential for a thorough understanding of the resilience-performance nexus in African MSMEs (Chandler et al., 2019). Each database offers unique resources and perspectives, allowing for a more nuanced topic exploration.

Utilizing this multi-database approach broadens the scope of the literature included in the review and enhances the robustness of the findings by incorporating various methodological perspectives and contexts (Kumar & Sharmah, 2019). This is particularly important in MSME research, where local contexts and unique challenges can vary significantly across regions.

Moreover, a comprehensive search strategy helps mitigate publication bias by including studies that may not be widely known or cited, thus ensuring that the review reflects a more complete picture of the existing literature (Kolaski et al., 2023). Ultimately, such an inclusive approach strengthens the validity of the review's conclusions and provides a solid foundation for future research and policy recommendations.

Table 2

Search Strategy to Identify Pertinent Studies

Database Keywords Search Strings ("resilience" AND "performance" Resilience, performance, Scopus MSMEs, Africa AND "MSMEs" AND "Africa") ("African MSMEs" AND African MSMEs, Web of Science "resilience" AND resilience, sustainability "sustainability") MSME resilience Africa, ("MSME resilience Africa" OR Google Scholar small business "small business performance performance Africa Africa") Entrepreneurship, ("entrepreneurship" AND ScienceDirect resilience, Africa "resilience" AND "Africa") Small business resilience ("small business resilience **JSTOR** Africa, MSME Africa" OR "MSME performance

Africa")

*Study Selection Process*. The study selection process comprised several critical stages to ensure the rigor and relevance of the literature reviewed.

Initial Screening: The first stage consisted of screening titles and abstracts for relevance to the research questions. This preliminary assessment is crucial for filtering out unrelated studies and ensuring that only those addressing the resilience-performance nexus in African MSMEs are considered (Chandler et al., 2019). Through focusing on titles and abstracts, the process allows for a quick identification of pertinent literature, thereby optimizing the efficiency of the review.

Full-Text Review: Studies that met the initial screening criteria proceeded to a full-text review. This stage involved a detailed quality assessment, where each study was evaluated against predefined inclusion criteria to confirm its methodological rigor and relevance. Employing a structured assessment during this phase is essential for minimizing bias and ensuring that the review is based on high-quality, credible research (Moher et al., 2009). This step is crucial in a systematic review, as it helps to eliminate studies that may lack robustness or inadequately address the research questions.

Data Extraction: Following the full-text review, relevant information was systematically extracted using a standardized form. This form was designed to capture key details such as study design, sample size, resilience factors identified, and performance outcomes measured. Standardized data extraction facilitates comparison and synthesis of findings across different studies, allowing for a coherent analysis of the resilience-performance relationship (Gough et al., 2019). This structured approach ensures that the review produces comprehensive and meaningful insights, ultimately

contributing to a clearer understanding of the dynamics affecting MSMEs in Africa.

Quality Appraisal. The quality appraisal of selected studies is a fundamental component of the systematic literature review process. This stage involves critically evaluating each study's methodological rigor, relevance, and overall contribution to understanding the resilience-performance nexus in Africa's Micro, Small, and Medium Enterprises (MSMEs).

The Critical Appraisal Skills Programme (CASP, 2018) tool was

performance Africa

utilized to assess the quality of the studies. This tool provides a comprehensive framework for evaluating various aspects of qualitative and quantitative research, including clarity of research questions, appropriateness of study design, sampling methods, and the reliability of data analysis techniques. Petticrew and Roberts (2008) argue that employing a standardized appraisal tool is crucial to ensure consistency and objectivity in the evaluation process.

A robust quality appraisal process serves multiple purposes. Firstly, it helps to identify studies that meet high standards of research quality, thereby ensuring that the findings of the review are based on reliable evidence (Biondi et al., 2013). Secondly, it allows the identification of potential biases and limitations within individual studies, which can inform the interpretation of their findings (Chandler et al., 2019). For instance, studies with small sample sizes or those lacking control groups may provide valuable insights but should be interpreted cautiously regarding their generalizability.

Furthermore, quality appraisal enhances the credibility of the systematic review itself. By demonstrating a rigorous approach to evaluating the included studies, the review establishes a foundation of trustworthiness essential for influencing policy and practice (Mays et al., 2005; Cumpston et al., 2019). This is particularly important in research on African MSMEs, where evidence-based strategies are needed to address specific challenges these enterprises face.

#### 4.0. Results

**Study Characteristics.** A total of 35 studies met the inclusion criteria, comprising a diverse array of methodologies and contexts.

Table 3

Study Characteristics Characteristic f(n=35)Study Design Quantitative 21 (60%) 10 (29%) Qualitative 4 (11%) Mixed-Methods Publication Year 2010-2015 12 (34%) 2016-2020 15 (43%) 2021-2024 8 (23%) Country South Africa 10 (29%) Nigeria 8 (23%) 5 (14%) Kenya Other African countries 12 (34%) Sample Size 15 (43%) <100 100-500 12 (34%) 8 (23%)

Themes and Subthemes. Thematic analysis revealed three primary themes that encapsulate the resilience-performance dynamics of Africa's Micro, Small, and Medium Enterprises (MSMEs). The first theme, resilience, includes key components such as adaptive capacity, which refers to the ability of MSMEs to adjust their strategies in response to changing conditions. Additionally, financial management practices are crucial in enhancing sustainability and growth, while networking capabilities enable businesses to build relationships that provide access to vital resources and support.

The second theme is performance, which encompasses various indicators of success. This includes financial performance, which focuses on metrics such as profitability and revenue growth, as well as non-financial performance, which includes factors such as job creation and innovation. Furthermore, sustainability is highlighted as a critical aspect, thus emphasizing the long-term viability of MSMEs and their impact on the local economy and community.

Lastly, the theme of context plays an essential role in shaping the resilience and performance of MSMEs. This theme includes the economic environment, which encompasses market conditions and competition, the regulatory framework that governs MSME operations, and socio-cultural factors that reflect the influence of local culture, societal values, and community support. Together, these themes provide a comprehensive understanding of the factors that drive resilience and performance among African MSMEs.

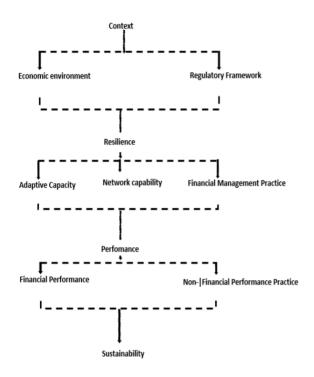
**Conceptual Framework.** The conceptual framework consists of three primary components: context, resilience, and performance. It illustrates the interrelationships between these themes as they pertain to Micro, Small, and Medium Enterprises (MSMEs) in Africa (cf. Figure 1).

Context plays a critical role in shaping the resilience and performance of MSMEs. Within this context, the economic environment includes factors such as market conditions, competition, and overall economic stability, which significantly influence operational success. For instance, favorable market conditions can provide growth opportunities, while economic instability may pose considerable challenges. The regulatory framework consists of policies and regulations that govern MSME operations; supportive regulations can foster growth, whereas restrictive policies may hinder progress. Additionally, socio-cultural factors encompass the influence of local culture, societal values, and community support, which can either facilitate or obstruct business endeavors. A strong sense of community and cultural support can enhance

entrepreneurial efforts, while negative societal perceptions may deter business activities.

Figure 1

Conceptual Framework



Resilience encompasses several critical elements that enable MSMEs to thrive in dynamic and often challenging environments. Key components of resilience include adaptive capacity and financial management practices. Adaptive capacity refers to the ability of MSMEs to adjust their strategies in response to evolving market conditions, enabling them to remain competitive and relevant. This flexibility is vital for survival and growth in a rapidly changing economic landscape. Effective financial management practices are equally essential, allowing MSMEs to implement sound financial strategies that enhance sustainability and promote growth. Through diligent cash flow management, budgeting, and investment planning, businesses can better navigate economic fluctuations. Furthermore, networking capabilities are crucial for building relationships that provide access to vital resources and support, fostering a collaborative ecosystem that strengthens resilience.

Performance is evaluated through a range of metrics. Financial performance encompasses profitability, revenue growth, and effective cost management, which quantitatively assesses operational success. In addition, non-financial performance indicators, such as job

creation, innovation, and customer satisfaction, offer a broader perspective on the impact of MSMEs within their communities. Moreover, sustainability emerges as a vital aspect, emphasizing the long-term viability of businesses and their contributions to the local economy and society. A sustainable approach ensures that MSMEs thrive financially and positively, impacting their communities and the environment.

The relationships within this framework are critical. A direct arrow from resilience strategies, specifically adaptive capacity, networking capabilities, and financial management practices to performance outcomes (financial, non-financial, and sustainability) illustrates that effective resilience strategies significantly enhance overall performance. Additionally, the arrows connect the contextual components (economic environment, regulatory framework, and socio-cultural factors) to both resilience and performance, highlighting how these external factors can enhance or inhibit the resilience and performance of MSMEs. Through this framework, it becomes evident that a holistic understanding of these interconnected elements is essential for fostering the success of MSMEs in dynamic African environments.

Summary of Findings. The findings suggest that African MSMEs employ various resilience strategies to navigate challenging environments. Key strategies include adaptive capacity, financial management practices, and networking capabilities, which are crucial for fostering resilience. Financial performance, non-financial performance, and sustainability are significant indicators of MSME success.

Narrative Summary. The studies revealed several key insights into the strategies employed by Micro, Small, and Medium Enterprises (MSMEs) across Africa to enhance their resilience in the face of economic challenges. MSMEs in South Africa and Nigeria have effectively utilized adaptive capacity strategies to navigate economic instability (Ibidunni et al., 2024; Atiase et al., 2023; Susilawati, 2024). These strategies enable businesses to adjust their operations and respond to market fluctuations, allowing them to maintain stability and continuity amid uncertainty (Shumba et al., 2024). In support of this view, Nosike et al. (2024) posit that enterprises often pivot their business models and innovate in response to changing consumer demands to demonstrate a strong ability to adapt to adverse conditions.

In Kenya, financial management practices have emerged as crucial in enhancing resilience. MSMEs that implement cost reduction and diversification strategies are better positioned to withstand economic shocks (Ahmed et al., 2021). Studies have shown that these practices improve financial stability and empower

businesses to explore new revenue streams, enhancing their overall sustainability.

Furthermore, networking capabilities significantly facilitate access to essential resources and markets for MSMEs in various African countries. Research highlights that partnerships and collaborations enable businesses to share knowledge, increase their market reach, and leverage external support, vital for growth and resilience (Hossain et al., 2021). MSMEs can enhance their operational capabilities and improve their competitive positioning in the market through fostering strong networks. These findings highlight the importance of adaptive capacity, sound financial management, and robust networking in fostering resilience among MSMEs across different African contexts (cf. Table 4).

This systematic overview of the literature underscores the multifaceted nature of resilience in Africa's MSMEs and its critical role in enhancing their overall performance amidst various contextual challenges.

Table 4

Systematic Summary

Theme	Subtheme	Findings
Resilience	Adaptive capacity	15 studies reported adaptive capacity as a key resilience strategy.
	Financial management	12 studies highlighted financial management practices as essential for resilience.
	Networking Capabilities	10 studies highlighted the significance of networking in providing resources and support for resilience.
Performance	Financial performance	20 studies found a positive relationship between resilience and financial performance.
	Non- financial performance	10 studies reported improvements in non-financial performance attributed to resilience strategies.

6Synthesis of Findings. The systematic review encompassed 35 studies focusing on the resilience-performance nexus within Africa's Micro, Small, and Medium Enterprises (MSMEs). The analysis revealed three overarching themes: resilience, performance, and context. These themes were further dissected into subthemes, illustrating the intricate relationship between resilience strategies and business outcomes, which is a critical consideration in the literature on MSMEs (Hossain et al., 2021).

Resilience emerged as a central theme, characterized by several subthemes, including adaptive capacity, resourcefulness, and strategic flexibility. Adaptive capacity refers to the ability of MSMEs to adjust their operations in response to external shocks, such as economic downturns or natural disasters (Casinillo & Salabao, 2023). Studies indicate that enterprises with robust adaptive strategies are better positioned to maintain continuity and mitigate risks (Kumar & Sharma, 2020). Resourcefulness, another subtheme, highlights the capacity of MSMEs to leverage limited resources creatively, often through community networks and informal partnerships, which has been demonstrated to enhance resilience.

In addition, performance, which has subthemes such as financial performance, operational efficiency, and market competitiveness, was identified as the second major theme. The review found that resilient MSMEs exhibit improved financial stability and growth, often attributed to effective financial management practices and strategic planning (Aragon-Sanchez & Sanchez-Martin, 2018). Operational efficiency is closely linked to resilience strategies, as businesses that swiftly adapt their operations tend to achieve better performance outcomes (Susilawati, 2024). Furthermore, market competitiveness is enhanced through innovation and customer engagement. This underscores the importance of resilience in fostering a proactive business environment.

Context is a critical theme in understanding the resilience of African MSMEs, reflecting the unique socio-economic and cultural environments in which they operate. The interplay of these contextual factors significantly influences the effectiveness of resilience strategies. Socio-cultural factors shape the behaviors, attitudes, and operational strategies of MSMEs. In many African communities, traditional values, social networks, and cultural norms can either facilitate or hinder entrepreneurial activities. For instance, in cultures prioritizing communal support, MSMEs benefit from networks that provide financial assistance, mentorship, and knowledge sharing, enhancing their adaptive capacity. Conversely, in more individualistic regions, MSMEs may struggle to secure the necessary support, limiting their resilience. External support systems, including NGOs and government initiatives, are essential for MSME resilience (World Bank, 2020a). Programs designed to meet local needs—such as skills training and market access—empower entrepreneurs to navigate challenges effectively. The success of these initiatives often depends on their alignment with local contexts, demonstrating that culturally informed support systems enhance resilience. Additionally, a favorable regulatory environment is crucial. Supportive government policies facilitate access to financial

resources and reduce bureaucratic hurdles, enabling MSMEs to implement effective resilience strategies (Vasani & Abdulkareem, 2024). In contrast, stringent regulations can stifle innovation. Finally, market dynamics, including competition and consumer preferences, complicate the resilience-performance nexus. MSMEs that adapt to local demands are better positioned for success, as this adaptability is influenced by socio-cultural factors.

Critical Analysis and Interpretation. The synthesis of findings underscores the intricate interplay between resilience-building initiatives and business performance within Africa's Micro, Small, and Medium Enterprises (MSMEs) landscape. The review reveals that while adaptive capacity, financial management practices, and networking capabilities are pivotal pillars of resilience, their influence extends beyond mere survival; they significantly impact financial and non-financial performance outcomes (Hossain et al., 2021). This holistic perspective on resilience is essential for understanding how MSMEs can thrive in dynamic and often challenging environments.

The ability of MSMEs to adjust their strategies and operations in response to external shocks is crucial (Casinillo & Salabao, 2023). Studies indicate that businesses with strong adaptive mechanisms are better equipped to withstand crises and capitalize on emerging opportunities (Kumar & Sharma, 2020). This adaptability fosters innovation, enhancing competitive advantage and market positioning, which aligns with findings from other regions that emphasize the importance of flexibility in business strategy (Boubakary, 2022).

Robust financial management is a cornerstone of resilience besides adaptive capacity (De Castro & De Castro, 2023). Effective financial practices—such as budgeting, cash flow management, and investment in growth—are linked to improved performance metrics (Aragon-Sanchez & Sanchez-Martin, 2018; World Bank, 2020b). Managing resources efficiently enables MSMEs to navigate economic uncertainties, thus reinforcing the argument that sound financial management is integral to long-term sustainability and success.

The role of networking (networking Capabilities) emerges as a critical factor in building resilience. Through strategic partnerships and collaborations, MSMEs can access vital resources, knowledge, and support systems that enhance their operational capabilities. This finding resonates with literature that highlights the significance of social capital in fostering resilience and performance (Kumar & Sharma, 2019), illustrating that the strength of relationships and networks can provide a buffer against external shocks.

The contextual nuances elucidated in the analysis further complicate the landscape of MSME resilience and performance. Factors such as regulatory environments, market dynamics, and socio-economic conditions significantly influence how resilience strategies are implemented and their effectiveness. This context-specific understanding urges the development of tailored strategies that reflect the unique challenges and opportunities within different African regions (Susilawati, 2024). For instance, policies that enhance access to finance and support entrepreneurship can enable MSMEs to thrive, ultimately contributing to broader economic development goals.

Identification of Patterns, Gaps, and Inconsistencies. The systematic review illuminated consistent patterns linking resilience strategies to improved performance outcomes in Africa's Micro. Small, and Medium Enterprises (MSMEs). Studies consistently identified adaptive capacity, financial management practices, and networking capabilities as pivotal factors contributing to enhanced performance. These findings underscore the importance of resilience as a proactive approach to navigating challenges and seizing opportunities, which concurs with broader literature that emphasizes the significance of resilience in entrepreneurship (Hossain et al., 2021).

However, notable gaps exist in understanding the nuanced effects of specific resilience factors across different African regions and industries. While the review highlights general trends, the variability in socioeconomic contexts means that resilience strategies may not have uniform impacts. For instance, factors influencing resilience in urban MSMEs may differ significantly from those affecting rural enterprises, yet this area remains underexplored (Kumar & Sharma, 2020). Additionally, the influence of industry-specific dynamics, such as technology adoption in manufacturing versus service delivery in tourism, warrants further investigation to fully comprehend how different sectors leverage resilience.

Inconsistencies in measuring and operationalizing resilience and performance indicators further complicate the landscape. The review revealed that various studies employ differing definitions and metrics, leading to challenges in drawing robust comparisons and conclusions. For instance, some studies define resilience primarily in terms of financial stability, while others emphasize operational adaptability or innovation capacity (Alberti et al., 2018). This lack of standardized frameworks for measuring resilience and performance, according to Sahu and Panda (2024), hinders the ability to conduct comparative analyses across studies and contexts, ultimately limiting the generalizability of findings.

To address these gaps and inconsistencies, there is a pressing need to develop standardized definitions and measurement frameworks to facilitate a more cohesive understanding of resilience and performance in African MSMEs. Such frameworks would enable researchers to generate more reliable data, fostering a deeper understanding of how various resilience strategies can be effectively implemented across different contexts and industries. This approach would enhance the academic discourse and provide valuable insights for policymakers and practitioners aiming to support the resilience and performance of MSMEs in Africa.

# 5.0. Discussion

This systematic review underscores the pivotal role of resilience in bolstering the performance of Africa's Micro, Small, and Medium Enterprises (MSMEs). The findings reveal that MSMEs that effectively leverage adaptive capacity, sound financial management practices, and robust networking capabilities are better positioned to navigate turbulent business landscapes. This insight concurs with existing literature (Hossain et al., 2021), highlighting resilience as a critical factor for organizational success in uncertain environments.

The ability of MSMEs to adapt to changing circumstances (adaptive capacity) is essential for survival and growth (Casinillo & Salabao, 2023). Businesses that cultivate an adaptive mindset are more likely to respond positively to disruptions from economic fluctuations, regulatory changes, or competitive pressures. This adaptability enhances operational continuity and fosters innovation, allowing MSMEs to seize new market opportunities (Kumar & Sharma, 2020). Consequently, fostering a culture of adaptability becomes a strategic priority for MSMEs aiming to thrive in dynamic contexts.

In addition, effective financial management is foundational to resilience. MSMEs implementing sound financial practices such as budgeting, cash flow monitoring, and prudent investment strategies are better equipped to withstand economic shocks and maintain performance (Aragon-Sanchez & Sanchez-Martin, 2018). The systematic review highlights the need for targeted financial literacy programs and resources tailored to the unique challenges faced by MSMEs in Africa. Supporting these enterprises in building robust financial management capabilities could significantly enhance their resilience and long-term viability.

The review also emphasizes the importance of networking (network capabilities) as a resilience-building strategy. Strong networks provide MSMEs access to vital resources, information, and support, enabling them to adapt more effectively to challenges. Collaborative relationships with other businesses, NGOs, and government entities can enhance knowledge

sharing and foster innovation (De Castro & De Castro, 2023). Therefore, promoting networking initiatives and platforms can play a crucial role in strengthening the resilience of MSMEs, particularly in regions where access to resources is limited.

Overall, the implications of this systematic review extend beyond individual enterprises. Policymakers and stakeholders in the MSME ecosystem should recognize the interconnectedness of resilience and performance. By fostering an environment that supports adaptive strategies, financial literacy, and networking opportunities, they can enhance the resilience of MSMEs, ultimately contributing to economic stability and growth in the region.

Comparison with Existing Literature. While this study concurs with prior research on MSME resilience, it contributes uniquely by focusing specifically on Africa's MSMEs. It amalgamates perspectives on resilience and performance, highlighting the importance of context-specific strategies. This focus on the African context is essential, as it addresses the unique socioeconomic challenges faced by MSMEs in the region, thereby enriching the existing literature on resilience in entrepreneurship.

The systematic review reveals several limitations that should be addressed in future research. First, there is a notable geographical bias, as the review primarily focused on specific regions within Africa. This narrow scope may limit the generalizability of the findings, suggesting a need for future studies to diversify their focus across a broader range of African countries. By capturing a wider spectrum of experiences and resilience strategies, researchers can better understand the resilience-performance nexus in varied contexts.

Additionally, limitations on methodology were identified, particularly the predominance of qualitative methods in the included studies. While qualitative research offers valuable insights, it can introduce biases that affect the validity of findings. Future research would benefit from incorporating mixed methods approaches, which can enhance the robustness of the analysis by combining qualitative depth with quantitative breadth.

Moreover, the temporary scope of the review was limited, focusing predominantly on recent studies. Expanding this scope to investigate the longitudinal effects of resilience on MSME performance could yield valuable insights into the sustainability of resilience strategies over time. Understanding how resilience evolves and impacts performance in the long term is essential for developing effective support mechanisms for MSMEs.

### 6.0. Conclusion

This systematic review examined the resilienceperformance nexus within Africa's Micro, Small, and Medium Enterprises (MSMEs), yielding several pivotal insights essential for understanding their operational dynamics. The analysis identified three cornerstone resilience strategies: adaptive capacity, financial acumen, and networking prowess. These elements enable MSMEs to effectively navigate challenges while enhancing overall performance. Moreover, the review highlighted that resilience positively influences financial and non-financial performance metrics, indicating that resilient MSMEs are better positioned for sustainable growth. Context factors, including diverse economic landscapes and regulatory frameworks, significantly shape MSME resilience, underscoring the need for localized strategies.

This review enriches the scholarly landscape by comprehensively understanding MSME resilience dynamics in Africa. It reveals context-sensitive resilience strategies that are crucial for the success of these enterprises and emphasizes the integration of resilience and performance perspectives for a holistic analysis. This study uniquely contributes to the existing literature by focusing specifically on the African context, addressing significant gaps, and offering a framework for understanding the complexities of resilience across diverse environments.

## 7.0. Limitations of the Findings

The study has several limitations that should be acknowledged. Firstly, it focuses exclusively on English-language articles, potentially omitting valuable insights from non-English studies relevant to the resilience-performance nexus in African MSMEs. The exclusion of non-peer-reviewed sources, book chapters, and conference proceedings may introduce publication bias, as studies with negative results are less likely to be published, leading to an incomplete understanding of MSMEs performance factors.

Additionally, the review's temporal scope (2010-2024) may overlook foundational research and recent developments beyond this period, affecting the findings' relevance. While the study focuses on African MSMEs, it may not fully capture the unique socio-economic factors present in different countries, which limits the generalizability of the findings. Lastly, the complexity of resilience may result in the omission of certain relevant factors, and the perspectives of key stakeholders—such as employees and customers—might not be sufficiently included. This lack of representation can influence both resilience and performance outcomes.

# 8.0. Practical Value of the Paper

This systematic review underscores the critical importance of integrating resilience strategies into the operations of Micro, Small, and Medium Enterprises (MSMEs) in Africa to ensure their sustainability and long-term viability. By embedding resilience into their core business practices, MSMEs can better navigate uncertainties, adapt to changing market dynamics, and contribute to broader economic stability and growth.

To foster MSME resilience, policymakers should prioritize creating enabling environments that provide access to resources, financial support, and networks. This can include targeted interventions such as subsidies for resilience-building initiatives, access to training programs, and establishing support networks connecting MSMEs with larger businesses and institutions. Furthermore, incorporating resilience training into entrepreneurship education programs is crucial to equip future entrepreneurs with the skills to withstand and overcome challenges.

This study highlights an urgent need for collaboration among policymakers, practitioners, and researchers to prioritize MSME resilience. By working together, these stakeholders can create a supportive environment that fosters sustainable MSME growth, contributing to economic development and prosperity in Africa. The findings provide valuable insights for developing and implementing effective strategies to enhance the resilience and performance of MSMEs, ultimately benefiting the overall economic stability of the region.

## 9.0. Directions for Future Research

Future research should include a broader range of languages and non-peer-reviewed sources to capture diverse insights overlooked in the current study. Longitudinal studies could also be undertaken to assess the long-term impacts of resilience strategies on MSME performance and their sustainability amid changing market conditions. Comparative studies across different African regions can highlight unique challenges and effective strategies tailored to specific socio-economic contexts. Additionally, research should examine the roles of stakeholders—such as employees, customers, and suppliers—in shaping resilience and performance outcomes. Finally, investigating the impact of emerging technologies on MSME resilience can offer valuable insights into modern adaptation strategies.

#### 10.0. Declaration of Conflict of Interest

The authors have no conflict of interest to declare.

•

## REFERENCES

- Achieng, M. S., & Malatji, M. (2022). Digital transformation of small and medium enterprises in sub-Saharan Africa: A scoping review. *Journal for Transdisciplinary Research in Southern Africa*, 18(1), 1-13. https://doi.org/10.4102/td.v18i1.1257
- African Development Bank (AfDB) Group. (2020). African economic outlook 2020. https://www.afdb.org/en/documents/african-economic-outlook-2020
- Ahmed, E., Kilika, J., & Gakenia, C. (2021). SME resilience to COVID-19: Insights from non-essential service providers in Nairobi. *International Journal of Finance & Banking Studies*, 10(4), 24-39. https://doi.org/10.20525/ijfbs.y10i4.1399
- Alberti, F. G., Ferrario, S., & Pizzurno, E. (2018). Resilience: Resources and strategies of SMEs in a new theoretical framework. *International Journal of Learning and Intellectual Capital*, 1(1). https://doi.org/10.1504/IJLIC.2018.091969
- Aragon-Sanchez, A., & Sanchez-Martin, J. (2018). The role of financial management practices in the performance of SMEs. *Journal of Business Research*, 88, 165-172.
- Arraya, M. (2024). Distinctive capabilities system in MSME's business model adaptation: Evidence of the moderating and mediating effect of adaptive capability. *Central European Management Journal*. https://doi.org/10.1108/CEMJ-11-2023-0438
- Astuty, E., Sudirman, I. D., & Aryanto, R. (2024). Sustainable resilience strategy: Unleash the micro-businesses' potential in the digitalization and sustainability era. *Cogent Business* & *Management*, 11(1). https://doi.org/10.1080/23311975.2024.2313672
- Atiase, V., Agbanyo, S., Ganza, P., Ameh, J., & Sambian, R. (2023). Understanding SME financial resilience and survivability in Africa. In Entrepreneurial Financial Resilience and Financial Innovation in a Turbulent Era (pp. 106-133). Edward Elgar Publishing. https://doi.org/10.4337/9781802203929.00014
- Biondi, L., Ivo, M., & Gallo, M. (2013). Quality assessment of systematic reviews: A comparison of two tools. *Journal of Evaluation in Clinical Practice*, 19(5), 865-870.
- Boubakary, B. (2022). Entrepreneurial resilience and performance in African SMEs: An exploratory analysis in Cameroon. *Management & Avenir*, 127(1), 131-154. https://doi.org/10.3917/mav.127.0131
- Casinillo, L. F., & Salabao, A. A. (2023). Characterizing the resilience of micro, small, and medium enterprises (MSMEs) and its causal determinants amid the health crisis. *Philippine Social Science Journal*, *6*(3), 46-53. https://doi.org/10.52006/main.v6i3.751
- Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. J. H. W. (2019). *Cochrane handbook for systematic reviews of interventions*. Hoboken: Wiley.
- Critical Appraisal Skills Programme (CASP). (2018). CASP checklist. https://casp-uk.net/casp-tools-checklists/
- Cumpston, M., Li, T., Page, M. J., Chandler, J., Welch, V. A., Higgins, J. P., & Thomas, J. (2019). Updated guidance for trusted systematic reviews: A new edition of the Cochrane

- Handbook for Systematic Reviews of Interventions. *The Cochrane Database of Systematic Reviews*, 10(10), ED000142. https://doi.org/10.1002/14651858.ED000142
- De Castro, E. G., & De Castro, C. A. (2023). Adaptive approach model as an effort to generate resilience in MSMEs. *Journal of Law, Social Science, and Humanities*, *1*(1), 8-20. https://myjournal.or.id/index.php/JLSSH/article/view/60
- Dwyanti, D. (2024). The importance of financial literacy in financial management in micro, small, and medium enterprises. *Journal of Applied Management and Business*, 5(1), 1–6. https://doi.org/10.37802/jamb.v5i1.661
- Endris, E., & Kassegn, A. (2022). The role of micro, small and medium enterprises (MSMEs) to the sustainable development of sub-Saharan Africa and its challenges: a systematic review of evidence from Ethiopia. *Journal of Innovation and Entrepreneurship*, 11(1), 20. https://doi.org/10.1186/s13731-022-00221-8
- Gough, D., Thomas, J., & Oliver, S. (2019). Clarifying differences between reviews within evidence ecosystems. *Systematic Reviews*, 8, 1–15. https://doi.org/10.1186/s13643-019-1089-2
- Ekechi, C. C., Chukwurah, E. G., Oyeniyi, L. D., & Okeke, C. D. (2024). A review of small business growth strategies in African economies. *International Journal of Advanced Economics*, 6(4). https://doi.org/10.51594/ijae.v6i4.1071
- Hasyim, H., & Bakri, M. (2025). Micro entrepreneur capacity building through financial management and marketing strategy training for MSME actors. *Celebes Journal of Community Services*, 4(1), 1-17. https://www.ojs.stieamkop.ac.id/index.php/celeb/article/view/1898
- Kolaski, K., Logan, L. R., & Ioannidis, J. P. A. (2023). Guidance to best tools and practices for systematic reviews. *Systematic Reviews*, 12, 96. https://doi.org/10.1186/s13643-023-02255-9
- Hokmabadi, H., Rezvani, S. M. H. S., & de Matos, C. A. (2024). Business resilience for small and medium enterprises and startups by digital transformation and the role of marketing capabilities—systematic review. *Systems*, 12(6), Article 220. https://doi.org/10.3390/systems12060220
- Hossain, M., Miah, M., & Rahman, M. (2021). Digital transformation and resilience in small businesses: Evidence from Bangladesh. *Journal of Small Business Management*.
  - https://doi.org/10.1080/00472778.2021.1930481
- Ibidunni, A. S., William, A. A. A. A., & Otokiti, B. (2024). Adaptiveness of MSMEs during times of environmental disruption: Exploratory study of capabilities-based insights from Nigeria. In Innovation, Entrepreneurship and the Informal Economy in Sub–Saharan Africa: A Sustainable Development Agenda (pp. 353-375). Springer Nature Switzerland.
- Isichei, E. E., Olabosinde, S. T., & Shaibu, B. (2024). Entrepreneurial resilience and business survival: The mediating role of self-compassion. *The Journal of Entrepreneurship*, 33(1), 7-33. https://doi.org/10.1177/09713557241233820
- Kautsar, N., Maulana, D., Mahfudz, M., & Raharjo, S. T. (2025). Revealing the vital role of MSMEs in community

- workforce empowerment. *Research Horizon*, *5*(1), 11-20. http://journal.lifescifi.com/index.php/RH/article/view/443
- Kumar, S., & Sharma, R. (2019). Understanding the challenges faced by MSMEs in India: A review. *Journal of Entrepreneurship, Management and Innovation*, 15(2), 5–22.
- Kumar, S., & Sharma, R. (2020). Enhancing the resilience of MSMEs: A study of the Indian context. *Journal of Entrepreneurship, Management and Innovation*, 16(1), 45–62.
- Mays, N., Roberts, E., & Popay, J. (2005). Systematic review of the qualitative literature on the public's views of the NHS. *Health Services Research*, 40(5), 1456–1473.
- Mehchy, Z., Turkmani, R., & Gharibah, M. (2023). The role of MSMEs in Syria in poverty reduction and peacebuilding: Challenges and opportunities. Peace and Conflict Resolution Evidence Platform, University of Edinburgh, Edinburgh.
  - https://era.ed.ac.uk/bitstream/handle/1842/42431/The-Role-of-MSMEs-in-Syria-in-Poverty-Reduction-and-Peacebuilding.pdf?sequence=1
- Miklian, J., & Hoelscher, K. (2022). SMEs and exogenous shocks: A conceptual literature review and forward research agenda. *International Small Business Journal: Researching Entrepreneurship*, 40(2), 178–204. https://doi.org/10.1177/02662426211050796
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group\*, T. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine*, 151(4), 264-269. https://www.acpjournals.org/doi/full/10.7326/0003-4819-151-4-200908180-00135
- Nosike, C. J., Ojobor, O. S. N., & Nosike, C. U. (2024). Enhancing business resilience: Innovation and adaptation during and after the global pandemic. *International Journal of Financial, Accounting, and Management*, 6(2), 217-229. https://doi.org/10.35912/ijfam.v6i2.1891
- Pellegrino, A., & Abe, M. (2022). Digital financing for SMEs' recovery in the post-COVID era: A bibliometric review. *Frontiers in Sustainable Cities*, 4, Article 978818. https://doi.org/10.3389/frsc.2022.978818
- Petticrew, M., & Roberts, H. (2008). Systematic reviews in the social sciences: A practical guide. John Wiley & Sons.
- Quingco, J. G., & Leonoras, C. S. (2019). The economic impact, contribution, and challenges of micro business enterprises to the local development. *Philippine Social Science Journal*, 2(2), 107-122. https://doi.org/10.52006/main.v2i2.84
- Saad, M. H., Hagelaar, G., van der Velde, G., & Omta, S. W. F. (2021). Conceptualization of SMEs' business resilience: A systematic literature review. *Cogent Business & Management*, 8(1). https://doi.org/10.1080/23311975.2021.1938347
- Sahu, C. K., & Panda, R. K. (2024). Evaluating the relationship between entrepreneurial ecosystem, resilience, and SME performance in the post-pandemic period. *Journal of Entrepreneurship and Public Policy*, 13(3), 491-506. https://doi.org/10.1108/JEPP-12-2023-0136
- Shen, J., & Wang, S. (2021). China's economy amidst the COVID-19 pandemic: Current situation, countermeasures, and implications for financial

- institutions. Countermeasures and Implications for Financial Institutions.
- https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=3779 079
- Shumba, K., Ebewo, P., & Ndlovu, E. N. (2024). MSMEs' resilience strategies during the COVID-19 crisis: A case of the tourism sector in South Africa. *International Journal of Business Ecosystem & Strategy*, 6(3), 83-92. https://doi.org/10.36096/ijbes.v6i3.511
- Singh, R. (2021). Information exchange at a distance: examining the influence of leadership on knowledge sharing in virtual teams. *Journal of the Australian Library and Information Association*, 70(2), 125-138. https://doi.org/10.1080/24750158.2020.1761090
- Susilawati, M. (2024). Entrepreneurial resilience: Strategies for MSMEs to navigate uncertainties and challenges in contemporary markets. *International Journal of Business, Law, and Education, 5*(2), 1687-1695. https://doi.org/10.56442/ijble.v5i2.661
- Sutrisno, S. (2023). The role of partnerships and business networks in the growth of MSMEs in the digital age. *Technology and Society Perspectives (TACIT), I*(3), 122–131. https://doi.org/10.61100/tacit.v1i3.61
- Vasani, S., & Abdulkareem, A. M. (2024). MSME market presence and competitiveness in a global economy. *Cogent Economics* & *Finance*, 12(1), 2416992. https://doi.org/10.1080/23322039.2024.2416992
- World Bank. (2020a). The World Bank annual report 2020. https://www.worldbank.org/en/about/annual-report
- World Bank. (2020b). World development report 2020: Global value chains and economic development. https://www.worldbank.org/en/publication/wdr2020
- World Bank. (2023). Small and medium enterprises (SMEs) finance: Improving SMEs' access to finance and finding innovative solutions to unlock sources of capital. World Bank. https://www.worldbank.org/en/topic/smefinance
- Zhang, Y., Li, X., & Zhang, Y. (2019). The impact of innovation on the performance of SMEs in China: The mediating role of resilience. *Technology Analysis & Strategic Management*, 31(9), 1066–1080.

# **Additional Author's Information:**

FELIX TETE fkmtete@gmail.com

LAURINE CHIKOKO chikokol@staff.msu.ac.zw. https://orcid.org/0000-0003-2244-7500

NOAH ARIEL MUTONGORENI namutongoreni@gmail.com https://orcid.org/0000-0002-6039-6241