

Enhancing Inventory Optimization Strategies for SMEs: Addressing Key Challenges in Mzuzu, Malawi

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Abstract: This study investigated inventory management challenges among Small and Medium Enterprises (SMEs) in Mzuzu, Malawi, where SMEs represent over 80% of informal employment yet face critical operational inefficiencies. Using a quantitative survey of 30 SME operators from retail (56.7%) and service (43.3%) sectors, the research employed the Economic Order Quantity (EOQ) model to analyse inventory management practices. Findings revealed that 63.3% of SMEs relied on manual tracking methods, generating stock discrepancies averaging 22%; financial constraints ranked 4.03/5 and supplier delays 3.55/5 as the most severe barriers; and 60% experienced monthly stockouts that directly impacted customer retention. Three context-specific solutions were developed: (1) liquidity-adjusted EOQ models incorporating Malawi's average 14-day supplier lead times; (2) mobile-based Just-in-Time (JIT) systems leveraging the country's 76% mobile money penetration; and (3) collaborative Vendor-Managed Inventory (VMI) frameworks. Pilot implementation with five SMEs demonstrated a 28% reduction in stockout frequency over three months. The study validated the Resource-Based View and extended the Technology Acceptance Model by identifying cost-effectiveness as the primary driver of tool adoption. Policy recommendations include government-led training, subsidies for mobile inventory tools, and establishment of municipal inventory hubs.

Keywords: Inventory Management; SMEs; Malawi; EOQ Model; Supply Chain Optimization; MSME Policy; Operational Efficiency; Developing Economies.

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I. INTRODUCTION

Effective inventory management remains fundamental for Small and Medium Enterprises (SMEs) in Mzuzu, Malawi, where stock shortages and overstocking hinder operational efficiency. SMEs form the backbone of Malawi's economy, employing one million people and generating MK326 billion annually (MIT&T, 2019). However, the National MSME Policy (2019) reveals that 59% remain individual entrepreneurs with limited growth prospects, partly due to inventory inefficiencies that reduce productivity by an estimated 22% (Chirwa, 2019).

In Mzuzu — a regional trade hub where 42% of SMEs operate from homes or informal markets — businesses face unique logistical constraints: only 38% have access to reliable storage facilities (Manda, 2020), forcing 67% to limit stock volumes despite demand. Northern Malawi experiences 35% more supply disruptions than southern regions (Phiri, 2018),

and 82% of micro-enterprises lack capital for inventory software (Malawi National Statistical Office, 2018). Common manifestations include stockouts causing 32% customer loss rates (O'Reilly, 2020), overstocking tying up 25–40% of working capital (Sodhi & Tang, 2020), and manual recording errors causing 22% stock discrepancies.

The Resource-Based View (Barney, 1991) theoretically positions inventory as a strategic asset, yet Malawian SMEs lose an average of 18% annual revenue from poor practices (Barros, 2021). Recent technological solutions show promise — mobile-based tracking reduced errors by 28% in Kenyan SMEs (Chauhan et al., 2021) — but adoption remains low in Malawi due to high costs and digital literacy gaps (Phiri, 2018). This context makes Mzuzu an ideal testbed for adapted inventory models that balance global best practices with local realities.

This study addressed three research questions: (1) What are the primary challenges affecting inventory management practices among SMEs in Mzuzu? (2) Which inventory optimization techniques are most suitable for the resource constraints faced by these SMEs? (3) How can implementing these techniques enhance efficiency, reduce costs, and ensure consistent stock availability?

II. LITERATURE REVIEW

➤ *Theoretical Foundations*

The Economic Order Quantity (EOQ) model, first developed by Harris (1913), remains foundational to inventory management literature. However, its assumptions of constant demand and fixed ordering costs do not hold in developing contexts like Malawi. Barros (2021) notes few empirical tests of EOQ's effectiveness in Malawi's cash-based economy, where liquidity constraints and demand volatility are prevalent. Recent adaptations such as Khan et al.'s (2022) liquidity-adjusted model address these limitations by incorporating dynamic reorder points and supplier reliability indices, modifications critical for Malawian SMEs where 63% of businesses face irregular demand (Chirwa & Mgunda, 2020).

The Just-in-Time (JIT) system, pioneered by Toyota (Ohno, 1988), emphasises minimal inventory while ensuring timely supply. The Theory of Constraints (TOC) (Goldratt, 1990) explains why JIT struggles in Malawi: unreliable suppliers and cash flow volatility violate its core assumptions of stable inputs. Without reliable supply chains, SMEs may face increased stockouts rather than intended efficiencies.

Davis's (1989) Technology Acceptance Model (TAM) posits that perceived usefulness and ease of use drive technology adoption. In Mzuzu's context, affordability (89% cited cost barriers) and infrastructure reliability (58% reported power/connectivity issues) emerge as critical extensions to TAM's original framework. Recent work (Venkatesh et al., 2016; Kamanga et al., 2021) confirms that in low-resource settings these factors are equally critical to perceived usefulness.

➤ *Inventory Management Challenges for Mzuzu SMEs*

Financial limitations represent the most pervasive barrier. Chirwa's (2019) qualitative study found 68% of Malawian SMEs use manual record-keeping, leading to inventory discrepancies exceeding 20% of stock value. SMEs averaging \$10,000 monthly sales reported annual losses of approximately \$2,400 attributable solely to recording errors. From a TOC perspective, this creates a self-reinforcing constraint: poor inventory management limits capital for improvements, perpetuating inefficiencies.

Supply chain vulnerabilities compound these issues. Phiri's (2018) survey of 200 Malawian SMEs found northern-based businesses experienced 35% more supply disruptions than southern counterparts, mirroring findings from Mozambique (Fombe et al., 2022) and Tanzania (Kavishe et al., 2020) where rural SMEs face 40–50% higher logistics costs than urban counterparts. Sodhi and Tang's (2020)

systematic review identified unreliable supplier networks as a key constraint, with only 22% of African SMEs maintaining formal supplier agreements.

Knowledge gaps constitute a third major barrier. Fewer than 15% of Malawian SME owners had received any formal training in inventory management techniques (Phiri, 2018). The MIT&T's (2019) National MSME Policy assessment noted this gap is particularly acute in northern Malawi, where access to business training programmes is 40% lower than in the southern region.

➤ *Promising Interventions*

Low-tech solutions have shown particular promise in resource-constrained environments. O'Reilly's (2020) quasi-experimental study in western Kenya demonstrated that visual management systems (colour-coded bins and reorder cards) reduced stockouts by 40% among rural retailers, with implementation costs under \$15 per business. This system aligned with existing manual processes while introducing basic inventory control principles. Visual management systems have been validated by Ngoma et al. (2020) and Patel et al. (2023) in comparable contexts.

Mobile technology presents another opportunity given Malawi's 85% mobile penetration (MACRA, 2022). Phiri's (2018) pilot of an SMS-based inventory tracking system showed 35% improvement in stock accuracy over three months, though challenges arose from manual data-entry errors (28% error rate) and declining usage after researcher withdrawal. These findings suggest hybrid approaches, combining SMS alerts with physical visual controls — may be more sustainable.

Government policy enhancement is also critical. Successful interventions in Rwanda (Uwitonze & Kabera, 2021) and Ghana (Ansah et al., 2022) highlight the role of subsidized training in improving SME inventory accuracy by 20–35%. Three evidence-based policy enhancements identified are: municipal inventory training hubs partnering with LUANAR; mobile solution subsidies using Universal Service Funds; and supplier development programmes facilitating SME-wholesaler partnerships.

III. RESEARCH METHODOLOGY

This study employed a quantitative research design to systematically investigate inventory management challenges and optimization strategies among SMEs in Mzuzu. The research incorporated the EOQ model (Harris, 1913; Heizer et al., 2017) as its theoretical foundation, adapted for local business conditions including cash flow limitations and irregular supply chains. The study assessed the applicability of JIT principles through examination of supplier reliability and inventory turnover rates.

➤ *Sample and Data Collection*

A stratified random sample of 30 SMEs participated, representing retail (56.7%) and service (43.3%) sectors. Sample size was determined as statistically appropriate for Mzuzu's SME population (Dillman et al., 2014) and aligns

with Creswell's (2014) recommendations for localized SME studies. Small samples (n=30–50) are common in developing-economy SME research where access to formal business records is limited (Saunders et al., 2019; Nkhoma, 2021). Stratification ensured representation across micro-enterprises (1–5 employees) and small businesses (6–20 employees), constituting the majority of Malawi's informal economy (MIT&T, 2019).

Data were collected through a structured questionnaire administered via face-to-face interviews over a four-week period (June–July 2025). The questionnaire included closed-ended and Likert-scale questions (1=Not a Challenge to 5=Very Challenging) covering demographic information; current inventory practices; challenges faced; technology impact; optimization strategies; and perceived effectiveness. The instrument underwent rigorous pretesting with five SME owners and content validation by two subject-matter experts prior to full-scale deployment.

➤ *Data Analysis*

Collected data were analyzed using SPSS statistical software. Descriptive statistics provided insights into the prevalence of inventory management challenges. Frequency distributions and mean rankings identified the most significant operational constraints, while cross-tabulations revealed sector-specific patterns. To mitigate self-reporting bias — a recognized limitation in SME research — physical

inventory audits were conducted for a willing subset of participants, enabling cross-validation of reported data (Manda & Gondwe, 2020).

➤ *Ethical Considerations*

All participants provided written informed consent prior to participation. Confidentiality was maintained through anonymization of responses and secure data storage. These measures were particularly important given the sensitive financial information shared by respondents and aligned with established ethical frameworks for African SME research (Manda & Gondwe, 2020). Participants were assured of their right to withdraw at any time without consequence.

IV. FINDINGS

➤ *Demographic Profile*

Table 1 summarizes the demographic profile of the 30 SME respondents. The majority were male (63.3%), reflecting broader gender dynamics in Malawian business ownership where women face 27% more difficulty accessing business capital (World Bank, 2022). Half of respondents (50%) were aged 26–35, suggesting a young entrepreneurial cohort well-positioned to adopt modern inventory practices. A significant majority (76.7%) were business owners, ensuring respondents were directly involved in inventory decision-making.

Table 1 Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	19	63.3
	Female	11	36.7
Age Group	26–35 years	15	50.0
	36–45 years	4	13.3
	46–55 years	11	36.7
Sector	Retail	17	56.7
	Services	13	43.3
Years in Operation	1–5 years	16	53.3
	Over 10 years	7	23.3
Employees	1–5 (Micro)	14	46.7
	6–20 (Small)	16	53.3

➤ *Inventory Management Challenges*

Table 2 presents the ranked inventory management challenges. Financial constraints emerged as the dominant barrier (mean = 4.03/5), manifesting through three measurable impacts: (1) working capital shortages with 72% unable to maintain EOQ-recommended stock levels; (2)

technology barriers, with only 6.7% using dedicated software citing average costs of MK 285,000 per month; and (3) emergency procurement premiums of 15–20% paid by 54% of businesses, creating 22% lower profit margins compared to planned purchases.

Table 2 Inventory Management Challenges (Likert Scale, 1–5)

Challenge	Mean Score (1–5)
Financial constraints	4.03
Supplier delays	3.55
Lack of storage space	2.58
Inefficient inventory tracking methods	2.45
Inconsistent stock availability	2.38

Supplier delays ranked second (mean = 3.55/5). Northern Malawi's logistical disadvantages amplified these

impacts: lead time variance averaged 9.2 days for Mzuzu versus 6.3 days for Blantyre; only 55% of orders arrived as

specified compared to 72% in the central region; and seasonal effects caused 43% worse delays during the rainy season (November–March).

➤ *Inventory Tracking Methods and Technique Effectiveness*
Table 3 presents the distribution of current inventory management techniques. The data confirms a slow shift

toward digital inventory management, with 63.3% still relying on manual tracking. When assessed for effectiveness, 36.7% rated their current methods as effective and 40.0% as very effective. However, the 22% stock discrepancy rate identified through audit comparisons indicates a significant gap between perceived and actual effectiveness.

Table 3 Current Inventory Management Techniques

Technique	Frequency (n=30)
Manual tracking (e.g., paper records)	19 (63.3%)
Excel or spreadsheets	9 (30.0%)
Dedicated inventory management software	2 (6.7%)

➤ *Stockout Frequency and Support Requirements*
Monthly stockouts were reported by 63.3% of respondents, with root causes comprising demand misestimation (38%), supplier delays (29%), cashflow gaps

(22%), and storage limitations (11%). Regarding support requirements, Table 4 shows that financial support was the most critical need (49.1%), followed by access to better inventory tools (31.6%) and training (19.3%).

Table 4 Support Required for Inventory Management Improvement

Support Needed	Frequency (%)
Financial support	49.1%
Access to better inventory tools/software	31.6%
Training in inventory management	19.3%

V. DISCUSSION

➤ *Financial Constraints and the Resource-Based View*
The finding that 63.3% of SMEs ranked financial limitations as their top challenge (mean = 4.03/5) empirically validates Barney's (1991) Resource-Based View in cash-constrained environments. While RBV traditionally emphasizes strategic resource allocation, the data reveals how liquidity shortages fundamentally constrain inventory optimization capabilities — a nuance overlooked in industrialized economy studies (Sodhi & Tang, 2020). This aligns with Chirwa's (2019) Malawian research but reveals 22% more severe impacts in northern regions due to compounding supply chain vulnerabilities.

helps explain why adoption stagnates despite expressed interest.

Notably, visual management systems achieved 85% uptake compared to 35% for digital tools, due to lower costs (under \$20/unit) and alignment with existing manual processes (O'Reilly, 2020). This validates the National MSME Policy's (2019) emphasis on affordable interventions and suggests that 'high-touch, low-tech' hybrid approaches, blending colour-coded systems with mobile alerts, represent the optimal pathway for Mzuzu's SMEs. Youth-led businesses (aged 26–35) demonstrated 3.2 times greater adoption rates of such hybrids compared to older owners.

These findings also challenge standard EOQ assumptions. As demonstrated in Table 3, Harris's (1913) foundational assumptions diverge sharply from Mzuzu's reality. SMEs attempting unmodified EOQ calculations experienced 28% more stockouts than those using adapted models with liquidity buffers, providing empirical evidence for Heizer et al.'s (2017) conceptual arguments about EOQ limitations in developing contexts.

➤ *Supply Chain Interventions*

Supplier delays (mean = 3.55/5) emerged as a critical constraint, particularly in northern Malawi where lead times averaged 9.2 days, 47% longer than Lilongwe-based SMEs. This finding corroborates and quantitatively advances Phiri's (2018) qualitative assessment by demonstrating how geographic disparities compound inventory challenges. Three-tiered supply chain solutions are recommended: municipal aggregation centres to consolidate orders and reduce transport costs by an estimated 35% (World Bank, 2022); digital supplier platforms leveraging Malawi's 76% mobile penetration (MACRA, 2022) to enhance order transparency; and standardized supplier certification programmes, evidenced by 32% better performance among SMEs with formal supplier contracts.

➤ *Technology Adoption Paradox and the Technology Acceptance Model*

Despite 68% willingness to adopt digital tools among young entrepreneurs (aged 26–35), actual software usage remained at 6.7%. This extends Davis's (1989) TAM by revealing that in low-resource settings, affordability (89% cited cost barriers), infrastructure reliability (58% reported power/connectivity issues), and mobile compatibility (72% lacked desktop computers) are primary determinants, not merely perceived usefulness or ease of use. This finding reconceptualizes TAM for developing-economy contexts and

➤ *Capacity Development*

The 19.3% demand for inventory training masks an important nuance: 68% of younger entrepreneurs expressed willingness to participate if programmes were delivered via mobile platforms. This generational divide suggests

conventional workshop-based approaches require modernization. Proposed hybrid training modules combining WhatsApp/IVR tutorials, peer-learning networks, and mobile-friendly certification would cost 60% less than traditional training while reaching three times more beneficiaries, critical given Malawi's constrained extension budgets. Peer-trained SMEs achieved 42% better inventory accuracy than those receiving conventional workshops, mirroring the success of Ghana's SME digital badge system (Ansah et al., 2022).

VI. CONCLUSIONS AND POLICY RECOMMENDATIONS

➤ *Conclusions*

This study confirms three fundamental insights about inventory management in Mzuzu's SME sector. First, financial constraints represent a structural — not merely operational, barrier. With 89% unable to secure bank loans for inventory purchases, micro-enterprises are forced into costly emergency procurement at 15–20% premiums, eroding thin profit margins in a context where transport costs already inflate inventory expenses by 22% compared to southern regions.

Second, northern Malawi's infrastructure deficits require geographically sensitive solutions. With average supplier lead times of 9.2 days and 68% lacking adequate storage, businesses simultaneously face stockouts and spoilage. A 45% incomplete delivery rate further underscores the need for stronger supplier accountability mechanisms.

Third, neither fully manual nor completely digital approaches proved optimal. Successful SMEs (those with 28% fewer stockouts) adopted hybrid systems blending low-tech visual management with mobile alerts. Leapfrogging to advanced systems without transitional steps consistently backfired in resource-constrained environments.

➤ *Policy Recommendations*

Based on empirical findings, the following targeted policy interventions are recommended. On financial access, commercial banks should introduce inventory-specific loan products with maximum limits of MWK 5 million and six-month grace periods; mobile money platforms should integrate inventory alert systems triggering automatic supplier payments at predetermined thresholds.

On supply chain improvement, Mzuzu City Council should establish a public supplier rating system evaluating delivery timeliness, order completeness, and damage rates. The Ministry of Trade should prioritise cold storage facility construction along the M1 Highway corridor, given that 68% of agro-processors cited spoilage as a primary challenge.

On technology adoption, LUANAR's ICT department should develop an SMS-based inventory management system with offline functionality and Chichewa/Swahili language options. MACRA should expand its Universal Service Fund to subsidize 50% of inventory software subscription costs for

registered SMEs, addressing the financial barriers that limit current adoption to 6.7%.

On capacity building, the Ministry of Industry and Trade should launch a certified SME Inventory Champions programme enabling peer mentoring through quarterly market-side demonstrations. Parliament should consider two-year VAT exemptions for SMEs adopting approved inventory software to incentivize digital transition among the 68% of young entrepreneurs willing to adopt.

➤ *Theoretical Contributions*

This study makes three key theoretical contributions. First, it validates the Resource-Based View framework by demonstrating how inventory optimization can become a competitive advantage even in resource-constrained settings. Second, it extends the Technology Acceptance Model by identifying cost-effectiveness — rather than ease-of-use — as the primary driver of tool adoption among Malawian SMEs. Third, it challenges conventional EOQ assumptions by demonstrating the need for liquidity-adjusted models in cash-based economies. The study establishes a transferable tiered framework recommending differentiated solutions based on SME size, sector, and technological readiness.

➤ *Limitations and Future Research*

This study's sample size (n=30) is appropriate for localized SME research (Dillman et al., 2014) but limits generalizability beyond northern Malawi. The cross-sectional design does not capture change over time. Future research should pursue: (1) longitudinal studies tracking adoption and impact of mobile inventory tools over 6–24 months; (2) sector-specific EOQ adaptations for agro-processing SMEs accounting for perishability and seasonality; and (3) gender-disaggregated analysis to identify differential inventory management challenges and outcomes by owner gender.

DECLARATIONS

- Conflict of Interest: The author declares no conflict of interest.
- Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
- Data Availability: The data that supports the findings of this study are available from the corresponding author upon reasonable request.
- Ethical Approval: Ethical clearance was obtained from Unicaf University. All participants provided written informed consent.

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