

Entrepreneurial Bricolage and Configurations of COVID-19 Resilience Among Women Food Vendors in Nairobi's Informal Settlements

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Abstract

Women food vendors are central to urban informal food systems in Nairobi's informal settlements. They connect low-income households to accessible and affordable food while sustaining their own livelihoods. However, they operate these enterprises under conditions of income precarity, limited capital, unstable demand, food perishability, and constrained urban informality. The COVID-19 pandemic intensified these vulnerabilities, turning everyday livelihood pressures into acute shocks to household survival and enterprise continuity. This paper examines COVID-19 resilience among women food vendors in four informal settlements in Nairobi. Drawing on entrepreneurial bricolage and a configurational perspective, it investigates how digitalisation, market sensing, resource mobilisation and operational adaptation combined to support recovery from pandemic-related business disruption. Using survey data from 260 women vendors and fuzzy-set Qualitative Comparative Analysis (fsQCA), the study finds that no single condition was necessary for resilience. Instead, the main pathway to resilience was resource mobilisation under conditions of low digital and operational adaptation. This suggests that some women vendors recovered not primarily through digital tools or extensive operational change, but through relational, collective and financial resources such as credit, customer trust, supplier relations, savings groups and peer support. The paper contributes to research on informal food systems, gendered livelihoods, and crisis recovery by showing that resilience is situated, relational, and produced through configurations of everyday practices rather than a single universal pathway.

Keywords

women food vendors, COVID-19 pandemic, coping and resilience, entrepreneurial bricolage, informal settlements, fuzzy-set Qualitative Comparative Analysis (fsQCA)

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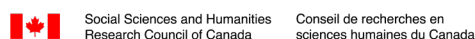
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Cover Image

Food vendor in Mukuru Kwa Reuben informal settlement, Nairobi. Photo credit: Sam Owuor

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Introduction

Informal food vending is a critical component of everyday urban food systems in African cities (Giroux et al., 2021). This role is especially important in contexts where formal food retail systems are spatially uneven, economically inaccessible, or insufficiently responsive to the purchasing patterns of low-income urban residents (Tawodzera, 2019, 2023; Tawodzera & Crush, 2019). In Nairobi's informal settlements, informal food vendors play a central role in livelihood generation and food provisioning by providing affordable, accessible food to low-income urban residents while generating income for their households (Ahmed et al., 2019; Githiri et al., 2016; Owuor et al., 2026). Moreover, low-income neighbourhoods rely heavily on informal vendors, because informal food outlets dominate food access in poorer urban areas (Adundo & Akingbemisilu, 2026; Adundo & Annys, 2025).

Women food vendors occupy a particularly significant position in this urban food economy because their enterprises support both income generation and household reproduction (Owuor, 2020). This role is critical because food insecurity in Nairobi's informal settlements is widespread and closely tied to poverty, household vulnerability, food-price shocks, dependence on purchased food, and limited access to stable income sources (Chege et al., 2022; Faye et al., 2011; Mwenjeri et al., 2026). These informal settlements are constrained yet economically dynamic livelihood spaces where residents navigate insecure tenure, limited infrastructure, income precarity, and uneven access to public services. Informal food vending should therefore be understood not simply as a marginal survival activity but as part of the everyday urban food system that jointly sustains livelihoods and food access in these spaces.

Research shows that women in Nairobi's informal settlements faced distinct economic and social vulnerabilities during COVID-19, including heightened exposure to income insecurity, care burdens, and food insecurity (Pinchoff et al., 2021). Pandemic containment measures disrupted income, food security, mobility, and household welfare, with disproportionate effects on women and low-income households, especially those engaged in informal economic activities (Pinchoff et al., 2021; Shupler et al., 2021). This aligns with broader evidence from the International Labour Organisation (ILO) that informal workers are especially vulnerable to shocks because many depend on daily earnings, lack adequate social protection, and have limited capacity to absorb livelihood disruptions (ILO, 2020).

Similarly, lockdown conditions in some Nairobi informal settlements led to near-universal income declines and severe food insecurity, demonstrating how pandemic shocks affected livelihoods and household systems simultaneously (Shupler et al., 2021; Vertigans et al., 2021). Although several studies offer insights into the multidimensional impacts of COVID-19 on informal workers and food vendors, as well as their resilience and coping strategies, they treat resilience-related factors as separate influences. Such a linear explanation may therefore overlook the possibility that

different women vendors become resilient through different pathways. What remains underexplored in the extant literature is not simply whether women food vendors coped with COVID-19, but which combinations of practices, resources, and conditions were associated with stronger recovery.

This study moves beyond single-factor or additive explanations of resilience to examine the configurations of COVID-19 resilience among women food vendors in Nairobi's informal settlements. Adopting a configurational perspective, the study recognises that resilience may emerge through multiple pathways rather than a single universal mechanism. This approach is especially appropriate in informal food economies, where business recovery depends on situated combinations of market sensing, resource mobilisation, operational adaptation, digital practices, household-enterprise linkages, and exposure to shock. The study therefore contributes by shifting the analytical focus from documenting COVID-19 impacts and coping strategies to explaining how different conditions combine to support or constrain resilience among women food vendors in Nairobi's informal settlements.

Conceptual Framework: Entrepreneurial Bricolage and Enterprise Resilience

Enterprise resilience is the capacity of organisations or livelihood units to absorb shocks, maintain or restore essential functions, adapt to changing conditions, and recover from adversity (Bhamra et al., 2011; Linnenluecke, 2017; Williams et al., 2017). Resilience, therefore, is not limited to "bouncing back" to a pre-shock state but also involves adjustment, learning, improvisation, and reconfiguration in response to uncertainty. For small and informal enterprises, this adaptive dimension is especially important because resilience often depends more on flexible routines, resourcefulness, social ties, and the ability to continue operating despite unstable markets and limited institutional protection than on formal contingency planning (Bullough et al., 2014; Korber & McNaughton, 2017). Enterprise resilience is conceptualised as a multidimensional process involving continuity, adaptation, and recovery under conditions of constraint, reflecting the ability of enterprises to absorb shocks, maintain essential functions, adjust practices, and regain viability after disruption (Duchek, 2020).

In this study, however, resilience is understood more specifically as COVID-19 enterprise resilience. This distinction is important because the COVID-19 pandemic was not an ordinary business disturbance but a compound shock that simultaneously affected mobility, customer demand, supply chains, operating hours, public health requirements, household income, food security, and access to support (Kuckertz et al., 2020; Swinnen & McDermott, 2020). In Nairobi, COVID-19 functioned as a multi-dimensional livelihood and food-system shock, disrupting food supplies to urban markets, increasing prices, reducing sales volumes, weakening household purchasing power, and threatening urban food security (Kunyanga et al., 2023).

Further studies on informal workers and small enterprises during COVID-19 show that the pandemic disrupted income flows, intensified vulnerability, and forced enterprises to adopt coping and adaptation practices to survive (ILO, 2020; Kuckertz et al., 2020). For women food vendors in informal settlements, COVID-19 resilience therefore refers not to a general capacity for long-term business success, but to the situated capacity to absorb pandemic-related disruptions, continue or adjust operations, and recover from the negative effects of containment measures.

Entrepreneurial bricolage provides a useful lens for explaining informal enterprise survival because it foregrounds how actors respond to constraint by “making do” with resources at hand rather than waiting for ideal resources, formal support, or stable institutional conditions. In their seminal formulation, Baker and Nelson (2005) define entrepreneurial bricolage as making do by applying combinations of available resources to new problems and opportunities. This perspective is especially relevant to informal enterprises, as survival often depends on improvisation, recombination, and practical adjustment under conditions of scarcity, uncertainty, and institutional exclusion. Rather than treating resource limitations solely as barriers, bricolage directs attention to how entrepreneurs creatively mobilise ordinary, imperfect, or undervalued resources to keep enterprises operating (Baker & Nelson, 2005; Di Domenico et al., 2010; Fisher, 2012).

For women food vendors in Nairobi’s informal settlements, bricolage is evident in everyday practices that sustain food enterprises despite unstable demand, limited capital, insecure operating environments, perishable goods, and household pressures. Their survival strategies may include adjusting stock to demand, adjusting prices, buying or selling on credit, relying on customer relationships, mobilising family or peer support, engaging with welfare groups, and modifying business routines during disruptive periods (Alfers, Bamu, et al., 2022; Odhiambo et al., 2026; Owuor et al., 2026; Wegerif, 2024). These practices reflect the broader insight that informal enterprises often operate through resourcefulness and adaptive improvisation rather than formalised strategic planning (Webb et al., 2009; Williams & Youssef, 2014). During the pandemic, these practices became even more critical as women vendors navigated disrupted supply chains, reduced customer bases, higher costs, movement restrictions, and household food insecurity (ILO, 2020; Orleans Reed & Skinner, 2023; Owuor et al., 2026). In this study, bricolage is used to interpret women vendors’ COVID-19 resilience as a configurational outcome emerging from the use of four practices: digitalisation, market sensing, resource mobilisation, and operational adaptation.

Digitalisation

Digitalisation in informal enterprises is often modest, relational, and practice-based, rather than infrastructurally advanced. In African informal economies, mobile phones have become important tools for communication, price discovery, customer contact, coordination with suppliers, and access to financial services (Aker & Mbiti, 2010; Donner &

Escobari, 2010; Larsson & Svensson, 2018; Tsarwe & Mare, 2021). In Kenya specifically, mobile money has reduced transaction costs and expanded financial inclusion, with evidence that it has supported risk sharing, consumption smoothing, and poverty reduction, particularly among women (Jack & Suri, 2014; Suri & Jack, 2016). For women food vendors, such digital practices may include receiving orders by phone, coordinating stock purchases, communicating with customers and suppliers, and using mobile payments or mobile-based credit. These practices are important because they allow vendors to maintain economic interactions even when mobility, face-to-face transactions, and physical market access are disrupted.

However, digitalisation should not be treated as an automatic driver of resilience. Studies of mobile phone use among micro and small enterprises show that digital tools can support business activity, but their effects depend on how they fit into existing social relations, market structures, resource constraints, and institutional environments (Aker & Mbiti, 2010; Donner & Escobari, 2010). For informal food vendors, a mobile phone may help maintain customer contact or coordinate stock, but it does not, by itself, resolve declining purchasing power, rising costs, food perishability, limited savings, or insecure operating conditions. This distinction is important because it prevents a technologically deterministic interpretation of COVID-19 resilience.

Market Sensing

Market sensing is the capacity of enterprises to detect, interpret, and respond to changes in their operating environment, including customer needs, demand fluctuations, price movements, competitor behaviour, supply conditions, and broader market dynamics. In the dynamic capabilities literature, sensing is treated as a foundational capability that enables firms to identify threats and opportunities before mobilising resources or reconfiguring practices (Teece, 2007, 2014). Related work on market orientation similarly emphasises the generation, dissemination, and use of market intelligence on customers, competitors, and environmental changes (Kohli & Jaworski, 1990; Narver & Slater, 1990). Although these ideas were developed largely in relation to formal firms, they are useful for understanding informal enterprises because survival in volatile markets depends heavily on the ability to detect subtle shifts in demand, prices, supply availability, and customer behaviour.

For women food vendors in Nairobi’s informal settlements, market sensing is likely to be practical, embodied, and relational – rather than formalised through market research systems. Vendors may sense the market by observing daily customer flows, negotiating prices, responding to regular customers’ preferences, adjusting stock variety, monitoring wholesale prices, tracking seasonality, and assessing whether certain food items are moving quickly or likely to spoil. These practices are especially important in food vending because products may be perishable, margins are thin, demand is unstable, and stock decisions must often be made with limited working capital. In this context, market sensing becomes a situated capability that enables women

vendors to continuously align prices, stock, sourcing, and customer relations with changing market conditions.

Resource Mobilisation

Resource mobilisation is central to informal enterprise survival because women food vendors often operate with limited savings, thin margins, insecure workspaces, and restricted access to formal credit, insurance, and social protection. While bricolage explains how actors “make do” by recombining resources at hand under conditions of scarcity and uncertainty (Baker & Nelson, 2005), in informal food economies these resources are not only material or financial; they are also relational and embedded in social networks. As Granovetter (2002) notes, economic action is socially embedded in networks of trust, obligation, and reciprocity. Additionally, extant literature emphasises that social capital can facilitate access to resources, cooperation, and collective action where formal institutions are weak or unevenly accessible (Woolcock & Narayan, 2000). For women vendors, resource mobilisation may therefore involve customer trust, supplier flexibility, buying or selling on credit, membership in an informal savings and investment group (*chama*), small loans, family support, peer collaboration, and shared transport or supply arrangements.

This study conceptualises resource mobilisation as relational bricolage because the resources that support resilience are assembled through everyday social and economic relations rather than through formal enterprise systems alone. Literature on informal work shows that informal workers frequently manage livelihood risks without adequate formal protection, making social networks, rotating savings groups, reciprocal credit, and workplace solidarities important survival mechanisms (Chen, 2012; ILO, 2020). Gendered analyses of informality further show that women’s enterprises are often constrained by unequal access to finance, markets, networks, and business support (World Bank, 2024). These constraints are compounded by unpaid care responsibilities, which limit women’s time, mobility, and participation in income-generating work (ILO, 2024). Among informal workers, enterprise survival is also closely tied to household livelihood pressures, including income and food insecurity (Alfers, Braham, et al., 2022).

In Nairobi’s informal settlements, women food vendors rely on resource mobilisation as both an enterprise strategy and a household survival strategy, drawing on loans, savings groups, customer relations, supplier arrangements, and social networks to sustain businesses and households during disruptions (Owuor et al., 2026). In urban food systems, vendors also depend on relationships with suppliers, customers, and other traders to manage perishability, price volatility, and unstable demand (Crush & Frayne, 2011; Githiri et al., 2016). During COVID-19, when income flows, mobility, and customer demand and supply channels were disrupted, these relational resources became especially important for sustaining operations and coping with uncertainty (Owuor et al., 2026).

Operational Adaptation

Operational adaptation refers to the practical adjustments enterprises make to routines, resource use, and market practices in response to disruption. Adaptation is more than survival; it involves absorbing disturbance, adjusting practices, and reorganising activities under changing conditions (Bhamra et al., 2011; Ducheck, 2020). With operational adaptation, routines are not always rigid, as actors can revise and recombine them when they confront uncertainty or shifting performance demands (Feldman & Pentland, 2003). This adaptation matters especially for small, resource-constrained enterprises, which often lack formal buffers and must respond with rapid, low-cost, improvised changes to operations, pricing, sourcing, and customer engagement (Eggers, 2020; Kuckertz et al., 2020). For informal food vendors, operational adaptation may therefore include altering prices, adjusting stock levels, changing procurement frequency, adjusting the product mix, improving hygiene practices, extending or reducing opening hours, or temporarily reorganising routines to align with shifting customer flows and public health requirements.

From a broader livelihoods’ perspective, these adaptations may represent both flexibility and distress. These two dimensions call for strategies that strengthen adaptive capacity, as well as coping responses that protect short-term survival without necessarily improving longer-term security (Ellis, 2000; Scoones, 1998). This distinction matters for women food vendors because reducing stock may protect against spoilage but may also signal reduced capital or declining demand; selling on credit may sustain customers but increase financial exposure; and raising prices may protect margins but reduce affordability for low-income consumers. COVID-19 disrupted supply chains, food prices, market access, and household food security, especially in low-income urban contexts where households and small vendors are highly exposed to daily market fluctuations (Kakaei et al., 2022; Laborde et al., 2020). In Nairobi, COVID-19 affected women food vendors’ sales, costs, stock access, and perishability, prompting vendors to adjust prices, stock levels, procurement routines, and hygiene practices as survival strategies (Owuor et al., 2026).

The paper uses fuzzy-set Qualitative Comparative Analysis (fsQCA) to examine how combinations of conditions relate to an outcome (Ragin, 2008). In management and organisational research, fuzzy-set approaches have been used to develop configurational explanations, especially when different combinations of conditions can produce the same outcome (Fiss, 2011). fsQCA’s analytical value lies in its treatment of causal complexity as conjunctural, equifinal, and asymmetric. This logic fits the present study because COVID-19 resilience among women food vendors may be *conjunctural*, as digitalisation, market sensing, resource mobilisation, and operational adaptation may work together; *equifinal*, because different combinations of these practices may produce resilience; and *asymmetric*, because the conditions associated with resilience may not simply be the reverse of those associated with non-resilience.

Through this analysis, the paper makes four contributions. First, it advances resilience research by situating COVID-19 resilience within the gendered, spatial, and informal livelihood realities of Nairobi's informal settlements. Second, it contributes to bricolage and informal entrepreneurship scholarship by showing how women food vendors configure digital, market, relational, and operational practices under constrained conditions. Third, it extends existing MiFOOD-related research on women food vendors in Nairobi by shifting from documenting COVID-19 struggles and coping strategies to explaining configurational pathways to COVID-19 resilience (Owuor et al., 2026). Fourth, it contributes methodologically by demonstrating the utility of fsQCA for studying informal enterprise resilience, where conventional linear models may obscure alternative pathways to the same outcome.

Methodology

The Study Area Context and Sampling

The study used survey data collected from women food vendors operating in four informal settlements in Nairobi, Kenya: Mukuru Kwa Njenga, Mukuru Kwa Reuben (in Embakasi sub-County), Viwandani (Makadara sub-County), and Mathare (Mathare sub-County). Mukuru Kwa Njenga, Mukuru Kwa Reuben, and Viwandani border one another and are part of the larger Mukuru informal settlement near Nairobi's industrial area, about 7 kilometres south-east of the city's Central Business District (CBD). Mathare is about 6 kilometres north-west of the CBD. As in other informal settlements in the Global South, the four settlements are characterised by insecure land tenure, poor housing, limited access to public infrastructure, socio-economic marginalisation, and overlapping health, environmental, and livelihood vulnerabilities (Balakrishnan et al., 2024; Foellmer et al., 2026; Republic of Kenya, 2016). These conditions are further shaped by dense, unregulated informal economic activity and reliance on insecure, low-income livelihoods (Balakrishnan et al., 2024).

To ensure broader spatial coverage, the study used a stratified random sampling procedure to target informal food vendors in the settlements. Stratification was based on villages within each settlement, and a random sample

of informal food vendors was selected according to their concentration on specific streets. The sampling process was coordinated with settlement leaders who had contextual knowledge and familiarity with the settlements. At the end of data collection, the quantitative survey interviewed 448 female vendors and a comparative sample of 130 male vendors (Table 1).

Data Collection and Analysis

Trained research assistants and community-based field supervisors collected data in May and June 2024 using the KoBo Toolkit/KoBo Collect platform on Android mobile phones. The research assistants were a mix of community-based and university-based co-researchers. The quantitative survey included single- and multiple-response items and gathered information on vendor characteristics, enterprise structure and practices, enterprise opportunities and challenges, vendors' migration profiles and urban-rural interactions, and the impact of COVID-19 containment measures on vendors' enterprises and households.

Several enterprise-based and COVID-19 adaptation practices were recorded as binary responses indicating whether a respondent engaged in a particular practice. Other items captured ordinal responses, particularly those measuring the extent of COVID-19 impacts and recovery. Vendors who started their businesses after the COVID-19 containment period were excluded from the COVID-19 resilience analysis because they were not exposed to the business shock under investigation. They were also skipped for the relevant COVID-period enterprise questions. Table 2 summarises information about the full sample and the COVID-19 surviving sample. The female vendors' COVID-19 surviving sample was used for the analysis in this paper.

The analytical sample was limited to 260 women food vendors whose businesses were operational during the COVID-19 containment period, enabling analysis of their recovery from pandemic-related business disruption. Composite indices were constructed for the four causal conditions: digitalisation, market sensing, resource mobilisation, and operational adaptation. Indicators were coded as binary practices, with 1 indicating presence and 0 absence. The binary indicators for each condition were then averaged

Table 1: Sampled Informal Food Vendors by Settlement and Gender

Settlement	Female vendors			Male vendors		
	No. of villages	(n=448)	(%)	No. of villages	(n=130)	(%)
Mukuru Kwa Njenga	6	65	14.5	3	20	15.4
Mukuru Kwa Reuben	12	172	38.4	10	49	37.7
Viwandani	14	129	28.8	12	34	26.2
Mathare	11	82	18.3	10	27	20.8

Table 2: Full and the COVID-19 Surviving Sample

Sample	Female vendors	Male vendors	Total
Full sample	448 (77.5%)	130 (22.5%)	578 (100%)
COVID-19 surviving sample	260 (78.1%)	73 (21.9%)	333 (100%)

to produce standardised indices ranging from 0 to 1. This approach was appropriate because the indicators captured distinct practices that jointly constitute each condition rather than interchangeable reflective-scale items.

Thereafter, the constructed indices were calibrated to fuzzy-set membership scores. Calibration is central to fsQCA because it transforms raw empirical measures into set-membership scores ranging from full non-membership to full membership (Ragin, 2008; Schneider & Wagemann, 2012). For the main analysis, we used direct fuzzy-set calibration with three anchors: 0.25 for full non-membership, 0.51 for the crossover point, and 0.75 for full membership. We set the crossover at 0.51 rather than 0.50 to avoid placing cases at the point of maximum ambiguity, where they are neither more-in nor more-out of the set. This aligns with set-theoretic logic: cases should be meaningfully assigned degrees of membership in analytically defined sets rather than treated merely as raw scores (Ragin, 2008; Schneider & Wagemann, 2012). We also calibrated the outcome, COVID-19 enterprise resilience, so that higher membership indicated stronger recovery from the negative effects of pandemic containment measures.

We conducted a fuzzy-set Qualitative Comparative Analysis using standard QCA procedures, beginning with a necessity analysis to determine whether any single condition was consistently present across resilient enterprises. We treated a condition as potentially necessary if its consistency approached the commonly used threshold of 0.90 (Ragin, 2008; Schneider & Wagemann, 2012). The analysis then proceeded to truth-table construction, in which all logically possible combinations of digitalisation, market sensing, resource mobilisation, and operational adaptation were examined in relation to the resilience outcome. Truth-table analysis is central to fsQCA because it enables researchers to identify configurations of conditions rather than estimate the isolated net effects of individual variables (Fiss, 2011; Ragin, 2008).

The next step was a sufficiency analysis to identify configurations consistently associated with high enterprise resilience to COVID-19. We assessed configurations using consistency and coverage, where consistency indicates the degree to which cases sharing a configuration also display the outcome, and coverage indicates the empirical relevance of a configuration in explaining the outcome (Ragin, 2008; Schneider & Wagemann, 2012). The truth table was then subjected to Boolean minimisation to derive simplified solution terms. The study emphasised the intermediate solution, which is widely recommended for substantive interpretation because it combines empirical evidence with theoretically informed directional expectations (Fiss, 2011; Schneider & Wagemann, 2012). In this study, the directional expectation was that the presence of digitalisation, market sensing, resource mobilisation, and operational adaptation could contribute to resilience, while also allowing for the possibility that resilience may emerge through different combinations of these conditions.

Finally, robustness checks were conducted to assess the stability of the results. These included testing alternative

calibration thresholds and, where appropriate, comparing the fuzzy-set results with stricter or crisp-set specifications. Robustness checks are important in QCA because configurational findings may be sensitive to calibration choices, consistency thresholds, and frequency cut-offs (Duşa, 2019; Schneider & Wagemann, 2012). Consequently, the analysis treated the final configurations not as universal causal laws, but as empirically grounded pathways through which women food vendors in Nairobi's informal settlements achieved COVID-19 enterprise resilience.

Measures and Construction of Conditions

The analysis included four causal conditions and one outcome (Table 3). The causal conditions were digitalisation, market sensing, resource mobilisation, and operational adaptation. The outcome was COVID-19 enterprise resilience. Digitalisation captured the use of mobile phones and related digital practices to maintain business continuity, including phone-based orders, payments, and stock coordination. Market sensing captured vendors' ability to detect and respond to customer demand, prices, seasonality, stock availability, and broader market dynamics. Resource mobilisation captured the use of credit, loans, informal savings, and investment groups (*chamas*), as well as supplier relations, customer trust, and vendor collaboration. Operational adaptation captured COVID-period adjustments to prices, stock levels, procurement routines, hygiene practices, and other operational routines.

We treated most indicators as binary practices and, for each condition, averaged the relevant indicators to create a 0–1 index. This approach captured distinct practices that jointly constituted the broader condition rather than interchangeable reflective measures. For example, resource mobilisation could occur through customer credit, supplier credit, loans, *chamas*, or collaboration with other vendors – distinct but complementary ways of mobilising resources. The resulting indices therefore captured the extent to which each vendor exhibited a given condition. COVID-19 enterprise resilience was measured as the extent to which the business had recovered from the negative effects of COVID-19 containment measures. When a composite resilience index was used, relevant indicators were rescaled so that higher values represented stronger resilience before being averaged into a 0–1 score.

Calibration of Conditions and Outcome

Calibration converted the study's empirical measures into fuzzy-set membership scores. These scores indicated the degree to which each female food vendor belonged to the sets of digitally adaptive vendors, strong market sensors, resource mobilisers, operational adapters, and COVID-19-resilient enterprises. This step is central to fsQCA because cases must be assigned membership in theoretically meaningful sets before assessing necessity and sufficiency (Ragin, 2008; Schneider & Wagemann, 2012). The study treated calibration as a theoretically informed measurement decision rather than a purely statistical transformation, and guided its decisions by both the conceptual meaning of the conditions and the empirical structure of the data (Duşa, 2019; Fiss, 2011; Greckhamer et al., 2018).

Table 3: Conditions and Measurements			
Condition 1: Digital Adaptation (DA)			
Questionnaire item	Code	Sub-indicator	Supporting literature
I use mobile phone for orders and payments	DA1	Digital Coordination	Mobile phones support communication, transactions, customer contact, supply coordination, and micro-enterprise activity in African and developing-country contexts (Aker & Mbiti, 2010; Donner & Escobari, 2010).
I relied on my mobile phone to get orders from customers	DA2		
I relied on my mobile phone to order for stock	DA3		
Loan from mobile phone apps, for example Tala, M-Shwari	DA4	Digital Finance	Mobile financial services can expand access to financial resources, reduce transaction costs, and support risk management among low-income users and women in Kenya (Jack & Suri, 2014; Suri & Jack, 2016).
Condition 2: Market Sensing (MS)			
Questionnaire item	Code	Sub-indicator	Supporting literature
Negotiate with customers	MS3	Customer Sensing	Market orientation and sensing involve generating and using customer intelligence to respond to customer needs, preferences, and behaviour (Kohli & Jaworski, 1990; Narver & Slater, 1990; Teece, 2007).
Give discount to regular customers	MS4		
Stock variety depends on specific demand of regular customers	MS7		
I respond to my regular customers' demands and preferences	MS9		
Price depends on wholesale price	MS2	Price sensing	Sensing capabilities involve detecting changes in markets, costs, opportunities, and threats; and that in informal food markets, price, and stock-cost signals are central to adaptive business decisions (Kunyanga et al., 2023; Teece, 2007).
Price depends on demand and supply	MS1		
Stock variety depends on price of stock	MS8		
Stock variety depends on general demand and supply	MS5	Market scanning	Dynamic capabilities emphasise sensing shifts in the external environment, including demand, supply, and market dynamics; and that market orientation literature similarly highlights monitoring environmental changes (Kohli & Jaworski, 1990; Teece, 2007, 2014).
Stock variety depends on seasonality of product	MS6		
I frequently assess the market dynamics	MS10		
Condition 3: Resource Mobilisation (RM)			
Questionnaire item	Code	Sub-indicator	Supporting literature
I offer credit facilities and fair prices to my regular customers	RM1	Relational credit	Informal enterprises often mobilise resources through trust-based exchange, credit relations and socially embedded economic ties rather than formal financial systems alone (Chen, 2012; Granovetter, 2002; Woolcock & Narayan, 2000).
I bought my stock on credit	RM5		
I sold my items on credit	RM6		
I am a member of a welfare group/ chama of fellow food sellers	RM2	Collective support	Social capital, networks, and collective arrangements support access to resources, cooperation, and risk-sharing in resource-constrained and informal settings (Chant & Pedwell, 2008; Githiri et al., 2016; Woolcock & Narayan, 2000).
I partner with other food sellers in supplies and transport	RM3		
I took a loan to help in my business	RM4	Financial access	Access to financial resources is central to small enterprise survival, while informal workers often rely on mixed formal and informal financing strategies under conditions of limited protection (Chen, 2012; ILO, 2020).
I applied for a bank loan to improve this business and was granted	RM7		

Condition 4: Operational Adaptation (OA)			
Questionnaire item	Code	Sub-indicator	Supporting literature
I increased my prices because of high cost of stock	OA1	Price adaptation	Crisis and resilience research shows that small enterprises adjust pricing and operating practices in response to demand shocks, cost pressures, and uncertainty (Eggers, 2020; Kuckertz et al., 2020; Owuor et al., 2026).
I increased my prices because of high demand of reduced stock	OA2		
I reduced my prices to clear stock and reduce loss	OA4		
I increased my stock because of high demand	OA3	Stock adaptation	Adaptive routines involve reconfiguring operational practices under changing conditions; and that for food vendors, stock adjustment is especially important because of perishability, demand uncertainty, and supply disruption (Feldman & Pentland, 2003; Laborde et al., 2020; Owuor et al., 2026).
I reduced my stock to avoid loss	OA5		
I reduced the number of times in a week of getting stock	OA6		
I placed a handwashing point for my customers	OA7	Hygiene adaptation	COVID-19 required enterprises and informal workers to adapt routines in response to public-health measures, customer safety concerns, and changing operating requirements (Chen, 2012; ILO, 2020; Owuor et al., 2026).
I increased the hygiene conditions at my business	OA8		
Outcome: Enterprise Resilience (ER)			
Questionnaire item	Code	Sub-indicator	Supporting literature
To what extent do you think that your business has recovered from the negative effects of COVID-19 containment measures?	ER1	Recovery	Resilience involves recovery after adversity and the restoration of viability following disruption (Bhamra et al., 2011; Duchek, 2020; Williams et al., 2017).
Overall impact of COVID-19 containment measures	ER2	Shock absorption	Resilience includes absorbing shocks and maintaining core functions under disruption; and that in food enterprises, reduced demand, business-hour disruption, and perishability losses are central threats to continuity (Bhamra et al., 2011; Laborde et al., 2020; Owuor et al., 2026; Swinnen & McDermott, 2020).
Reduced daily sales and profit	ER3		
Reduced number of customers	ER4		
Reduced daily business hours	ER5		
Loss/spoilage/wastage of perishable products	ER6		

We first constructed the causal conditions as composite practice-intensity indices. Indicators for digital adaptation, market sensing, resource mobilisation, and operational adaptation were coded as binary practices, with 1 indicating the presence of a practice and 0 its absence. Related items were averaged to form sub-indicators, which were then aggregated into higher-order condition scores ranging from 0 to 1. This approach was appropriate because the conditions were formative rather than reflective (Urbach & Ahlemann, 2010). For example, resource mobilisation could occur through relational credit, collective support, or financial access, while operational adaptation could involve price, stock, or hygiene adjustments. The outcome, COVID-19 enterprise resilience, was similarly constructed so that higher scores represented stronger recovery and shock absorption.

Because all indices were standardised between 0 and 1, the study used direct fuzzy-set calibration with three qualitative anchors. Scores at or below 0.25 were treated as full non-membership, scores around 0.51 as the crossover point, and scores at or above 0.75 as full membership. Values between these anchors were retained as partial mem-

bership scores, thereby preserving meaningful gradations in the extent to which vendors exhibited each condition. The crossover point was set at 0.51 rather than 0.50 to avoid assigning cases to the point of maximum ambiguity, where membership and non-membership would be exactly equal. This calibration approach was appropriate because the indices measured bounded practice intensity while still requiring theoretically meaningful thresholds for set membership. To assess the stability of the findings, we used alternative calibration specifications and crisp-set versions of the conditions as robustness checks, consistent with recommendations that QCA studies report and test the sensitivity of calibration decisions (Greckhamer et al., 2018; Nikou et al., 2024; Schneider & Wagemann, 2012).

fsQCA Procedure

The fsQCA analysis proceeded in five stages. First, a necessity analysis was conducted to assess whether any single condition was consistently present among cases with high COVID-19 resilience. A condition was considered potentially necessary when its consistency approached or exceeded the commonly used threshold of 0.90 (Ragin,

2008; Schneider & Wagemann, 2012). Second, a truth table was constructed. The truth table listed all logically possible combinations of the four conditions: digitalisation, market sensing, resource mobilisation, and operational adaptation. Each row represented a distinct configuration of conditions and showed whether that configuration was associated with the resilience outcome. Third, sufficiency analysis was conducted to identify configurations consistently associated with high COVID-19 resilience. Sufficiency analysis is central to fsQCA because it shows whether certain combinations of conditions are enough to produce the outcome, even when no single condition is necessary on its own. Fourth, the truth table was subjected to Boolean minimisation to simplify complex configurations into more parsimonious solution terms. The study focused on the intermediate solution, which balances empirical evidence with theoretically informed directional expectations and is commonly recommended for substantive interpretation in fsQCA studies (Ragin, 2008; Schneider & Wagemann, 2012). Finally, we conducted robustness checks by varying calibration thresholds and comparing the fuzzy-set results with alternative specifications, including crisp-set QCA where appropriate. This helped assess whether the identified configurations were stable across reasonable analytical choices.

Results

Descriptive Analysis

The descriptive analysis provides the empirical context for interpreting the fsQCA results. It first summarises vendors' reported recovery levels following COVID-19 containment measures. It then presents the main business disruptions

that shaped the enterprise resilience outcome. It also presents descriptive statistics for the calibrated conditions and the outcome used in the configurational analysis. Together, the descriptive results show both the severity of the COVID-19 shock and the distribution of the key practices through which vendors attempted to sustain and recover their enterprises.

Level of Recovery from COVID-19 Containment Measures

The recovery from COVID-19 containment measures was measured using the question "To what extent do you think that your business has recovered from the negative effects of COVID-19 containment measures?" Figure 1 presents the distribution of vendors' reported recovery from COVID-19 containment measures. This provides an initial overview of the resilience outcome before the fsQCA calibration and configurational analysis. The key pattern is that most responses cluster around moderate to large recovery, suggesting that the analytical sample includes substantial variation in post-COVID enterprise recovery while still showing a generally positive recovery profile.

COVID-19 Business Disruptions

The most outstanding pattern emerging from the COVID-19 business disruptions is that the indicators are concentrated in the moderate-to-large categories, particularly for reduced business hours, reduced customers, reduced sales and profit, and perishable product losses (Table 4 and Figure 2). This implies that the resilience outcome should be interpreted against a background of substantial business disruption during the COVID-19 containment period.

Figure 1: Level of Recovery from COVID-19 Containment Measures

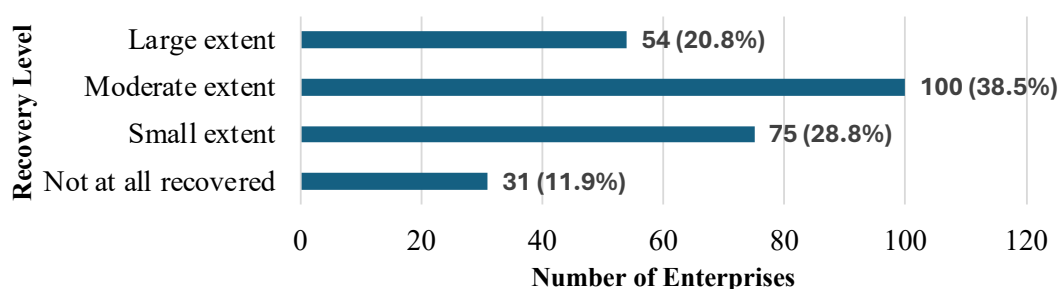
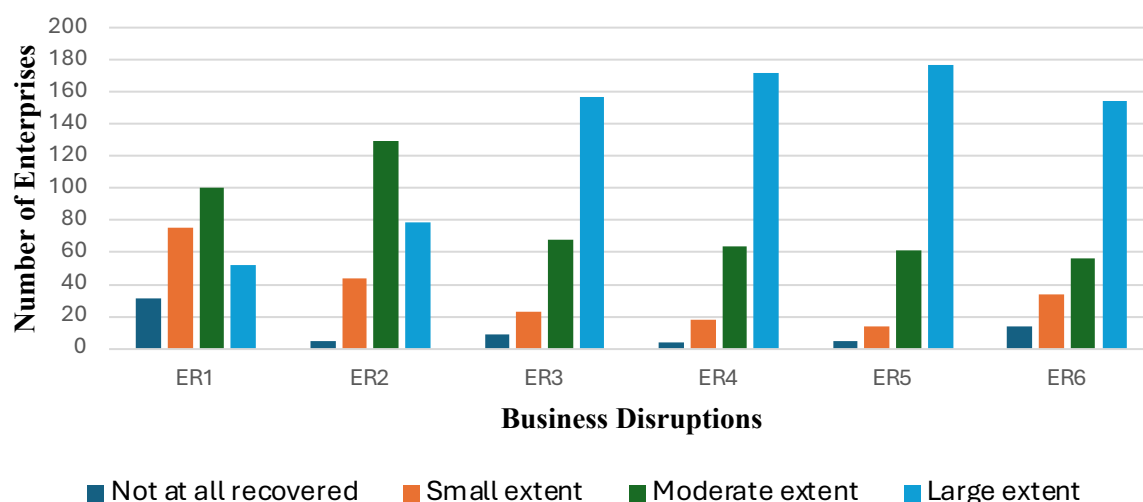


Table 4: COVID-19 and Business Disruptions

Code	Questionnaire Item	Not at all (1)	Small extent (2)	Moderate extent (3)	Large extent (4)	Total
ER1	To what extent do you think that your business has recovered from the negative effects of COVID-19 containment measures?	31	75	100	52	258
ER2	Overall impact of COVID-19 containment measures	5	44	129	79	257
ER3	Reduced daily sales and profit	9	23	68	157	257
ER4	Reduced number of customers	4	18	64	172	258
ER5	Reduced daily business hours	5	14	61	177	257
ER6	Loss/spoilage/wastage of perishable products	14	34	56	154	258

Figure 2: COVID-19 Business Disruptions Among Informal Food Vendors



Resource Mobilisation Practices

Table 5 and Figure 3 indicate that the most common resource-mobilisation practice was offering credit facilities and fair prices to regular customers, reported by 81% of vendors. Selling on credit was also common, reported by over half (64.2%), while nearly half (47.7%) bought stock on credit. These findings suggest that customer relations and credit-based exchange were important resource-mobilisation strategies. Participation in collective and formal financial arrangements was less common. Close to half (41.5%) reported membership in a welfare group (chama), while over one-fourth (28.5%) partnered with other food sellers for supplies and transport. A similar share (26.9%) reported taking a business loan, and nearly one-fifth (18.5%) had ap-

plied for and received a bank loan. Overall, the results show that relational and informal credit arrangements, rather than formal borrowing, drove resource mobilisation.

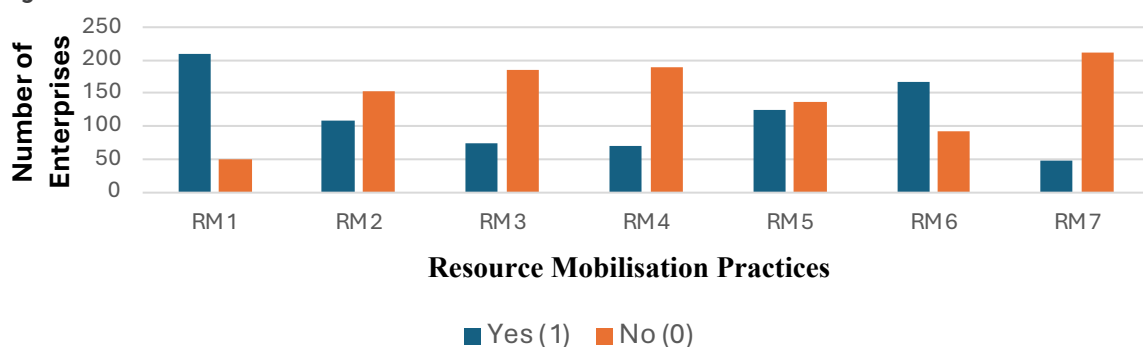
Digital Adaptation Practices

Digital adaptation was mainly centred on ordinary mobile phone use rather than mobile-based credit (Table 6 and Figure 4). Most vendors used mobile phones for orders and payments (68.1%), while slightly more than half used them to receive customer orders (55.8%) and to order stock (56.2%). In contrast, very few vendors used mobile phone app loans such as Tala or M-Shwari (8.8%), suggesting that digital tools supported communication and transactions more than digital borrowing.

Table 5: Resource Mobilisation Practices

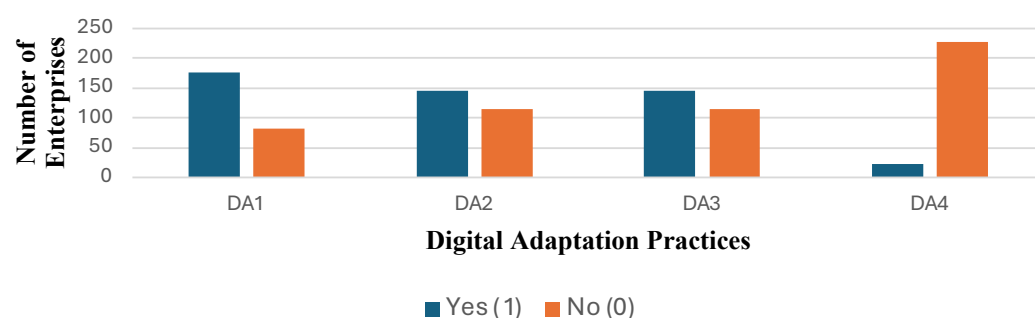
Code	Questionnaire Item	Yes (1) n, (%)	No (0) n, (%)	Total n, (%)
RM1	I offer credit facilities and fair prices to my regular customers	210 (80.8 %)	50 (19.2%)	260 (100%)
RM5	I bought my stock on credit	124 (47.7%)	136 (52.3%)	260 (100%)
RM6	I sold my items on credit	167 (64.2%)	93 (35.8%)	260 (100%)
RM2	I am a member of a welfare group/chama of fellow food seller	108 (41.5%)	152 (58.5%)	260 (100%)
RM3	I partner with other food sellers in supplies and transport	74 (28.5%)	186 (71.5%)	260 (100%)
RM4	I took a loan to help in my business	70 (26.9%)	190 (73.1%)	260 (100%)
RM7	I applied for a bank loan to improve this business and was granted	48 (18.5%)	212 (81.5%)	260 (100%)

Figure 3: Resource Mobilisation Practices



Code	Questionnaire Items	Yes (1) n, (%)	No (0) n, (%)	Total n, (%)
DA1	I use mobile phone for orders and payments	177 (68.1%)	83 (31.9%)	256 (100%)
DA2	I relied on my mobile phone to get orders from customers	145 (55.8%)	115 (44.2%)	260 (100%)
DA3	I relied on my mobile phone to order for stock	146 (56.2%)	114 (43.8%)	260 (100%)
DA4	Loan from mobile phone apps, for example Tala, M-Shwari	22 (8.8%)	227 (91.2%)	249 (100%)

Figure 4: Digital Adaptation Practices



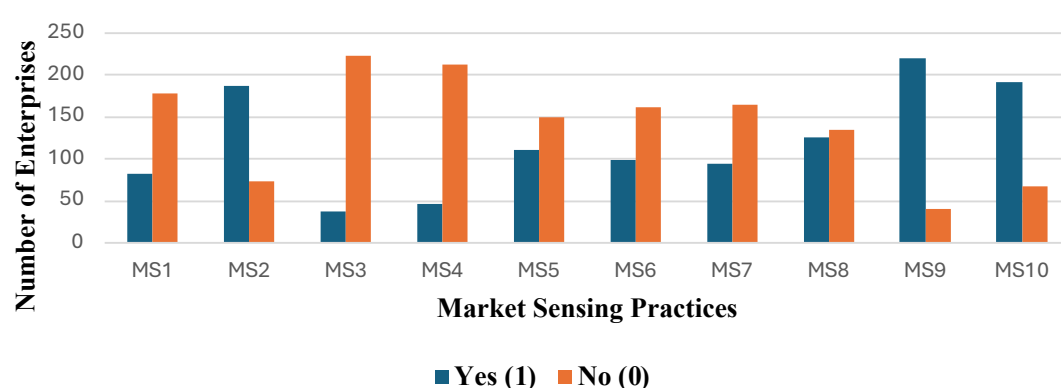
Market Sensing Practices

Table 7 and Figure 5 indicate that market sensing was strongest in vendors' frequent assessment of market dynamics (73.8%) and in reliance on wholesale prices when setting prices (71.9%). Nearly half of vendors also adjusted stock variety based on stock prices (48.5%) and responded

to regular customers' demands and preferences (48.5%). However, more direct customer-oriented practices, such as negotiating with customers (14.2%) and offering discounts to regular customers (18.1%), were less common. Overall, price and market monitoring drove market sensing more than direct negotiation or discounting.

Code	Questionnaire Item	Yes (1) n, %	No (0) n, %	Total n, %
MS3	Negotiate with customers	37 (14.2%)	223 (85.8%)	260 (100%)
MS4	Give discount to regular customers	47 (18.1%)	213 (81.9%)	260 (100%)
MS7	Stock variety depends on specific demand of regular customers	95 (36.5%)	165 (63.5%)	260 (100%)
MS9	I respond to my regular customers' demands and preferences	126 (48.5%)	134 (51.5%)	260 (100%)
MS2	Price depends on wholesale price	187 (71.9%)	73 (28.1%)	260 (100%)
MS1	Price depends on demand and supply	82 (31.5%)	178 (68.5%)	260 (100%)
MS8	Stock variety depends on price of stock	126 (48.5%)	134 (51.5%)	260 (100%)
MS5	Stock variety depends on general demand and supply	111 (42.7%)	149 (57.3%)	260 (100%)
MS6	Stock variety depends on seasonality of product	99 (38.1%)	161 (61.9%)	260 (100%)
MS10	I frequently assess the market dynamics	192 (73.8%)	68 (26.2%)	260 (100%)

Figure 5: Market Sensing Practices



Operational Adaptation Practices

Operational adaptation was most evident in hygiene and stock-management practices (Table 8 and Figure 6). Almost all vendors reported improving hygiene at their businesses (95.4%), installing handwashing stations for customers (91.5%), and reducing stock to avoid losses (91.9%). A large majority also reduced the frequency of weekly stock orders (77.3%). Price-related adjustments were more varied: 61.2% reduced prices to clear stock and minimise losses, while fewer increased prices due to high stock costs (42.7%) or reduced stock availability (32.3%). Overall, the results suggest that vendors responded primarily through hygiene measures and loss-reduction strategies.

Necessity Analysis

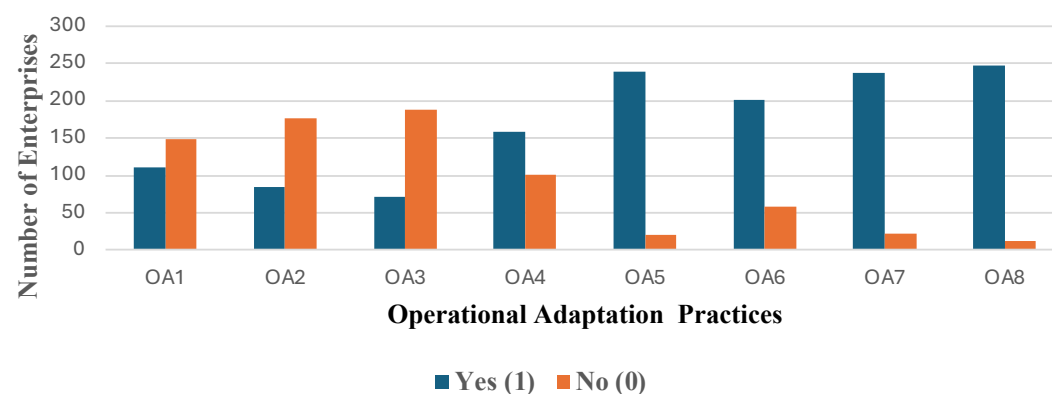
Before examining sufficient configurations, the study first conducted a necessity analysis to determine whether any single condition was required for high COVID-19 enterprise resilience. In fsQCA, a condition is considered necessary when the outcome is consistently a subset of that condition. That is, when cases displaying the outcome also display the condition. Following established QCA practice, a consistency score of approximately 0.90 or higher was used as the benchmark for identifying a necessary condition (Duşa, 2019; Ragin, 2008). Recent applied QCA studies similarly treat scores well below this threshold as insufficient to claim necessity, even when a condition appears substantively important (Brush et al., 2024; Khizar et al., 2024).

Table 9 presents the necessity analysis for high enterprise resilience during the COVID-19 pandemic. None of the four conditions, nor their absence, met the conventional 0.90 consistency threshold. Operational adaptation recorded the highest necessity consistency score among the present conditions (OAC: inclN = 0.765), followed by digital adaptation (DAC: inclN = 0.558), market sensing (MSC: inclN = 0.474), and resource mobilisation (RMC: inclN = 0.471). The absence of market sensing (~MSC: inclN = 0.654) and the absence of resource mobilisation (~RMC: inclN = 0.628) showed higher necessity consistency than their presence, but these values remained well below the threshold for necessity. The absence of operational adaptation recorded the lowest necessity consistency (~OAC: inclN = 0.339), indicating that low operational adaptation was clearly not a necessary condition for high resilience.

These findings suggest that COVID-19 enterprise resilience was not dependent on any single factor. This is important because studies of informal enterprise survival often highlight specific adaptive practices, such as digital communication, customer credit, pricing adjustments, collective support, or operational changes, as critical survival mechanisms during crises (Chen, 2012; ILO, 2020; Owuor et al., 2026). However, the necessity analysis indicates that none of these conditions was universally required for high resilience. In other words, some resilient vendors displayed high levels of operational adaptation, while others did not; some relied on digital practices, while others did not; and some mobilised resources in visible ways, while others achieved resilience through different combinations of practices.

Code	Questionnaire Item	Yes (1) n,%	No (0) n,%	Total
OA1	I increased my prices because of high cost of stock	111 (42.7%)	149 (57.3%)	260 (100%)
OA2	I increased my prices because of high demand of reduced stock	84 (32.3%)	176 (67.7%)	260 (100%)
OA4	I reduced my prices to clear stock and reduce loss	159 (61.2%)	101 (38.8%)	260 (100%)
OA3	I increased my stock because of high demand	72 (27.7%)	188 (72.3%)	260 (100%)
OA5	I reduced my stock to avoid loss	239 (91.9%)	21 (8.1%)	260 (100%)
OA6	I reduced the number of times in a week of getting stock	201 (77.3%)	59 (22.7%)	260 (100%)
OA7	I placed a hand-washing point for my customers	238 (91.5%)	22 (8.5%)	260 (100%)
OA8	I increased the hygiene conditions at my business	248 (95.4%)	12 (4.6%)	260 (100%)

Figure 6: Operational Adaptation Practices



Condition	inclN	RoN	covN
~DAC	0.507	0.721	0.593
DAC	0.558	0.714	0.620
~MSC	0.654	0.652	0.631
MSC	0.474	0.809	0.660
~RMC	0.628	0.635	0.605
RMC	0.471	0.809	0.658
~OAC	0.339	0.889	0.683
OAC	0.765	0.502	0.608

Rather than treating resilience as the outcome of an isolated resource, capability, or adaptive behaviour, the findings point to the need to examine how conditions combine. This interpretation aligns with the principle of conjunctural causation in QCA, in which outcomes arise from combinations of conditions rather than from the independent effect of any single factor (Fiss, 2011; Greckhamer et al., 2018; Misangyi et al., 2017). It also resonates with recent work on informal food systems and women's informal enterprises, which shows that COVID-19 coping and recovery were uneven, relational, and shaped by context-specific combinations of household pressures, customer relations, supply constraints, credit access, and everyday improvisation (Odhiambo et al., 2025; Owuor et al., 2026; Pinchoff et al., 2021; Shupler et al., 2021). The absence of any necessary condition therefore provides empirical justification for moving to the truth-table and sufficiency analyses, where the focus shifts from individual conditions to alternative pathways to resilience.

Truth Table Analysis

Following the necessity analysis, the study constructed a truth table to assess whether specific combinations of digital adaptation, market sensing, resource mobilisation, and operational adaptation were sufficient for high enterprise resilience during COVID-19. Truth table analysis is central to fsQCA because it shifts the focus from the isolated importance of individual conditions to the empirical assessment of configurations. Studies indicate that fsQCA identifies combinations of conditions that lead to an outcome, and that truth tables provide the analytical basis for evaluating sufficient configurations (Cangialosi, 2023; Mattke et al., 2022; Pappas & Woodside, 2021; Rasoolimanesh et al., 2023; Saridakis et al., 2020).

This configurational orientation is useful when outcomes are expected to arise from causal complexity, conjunctural causation, and equifinality, rather than from the independent net effects of single variables. With four causal conditions, the analysis produced 16 logically possible configurations. The truth table was generated using a frequency threshold of three cases and a sufficiency inclusion threshold of 0.80. The frequency threshold ensured that configurations retained for interpretation were not based on isolated cases, while the inclusion threshold provided a conservative criterion for assigning configurations to the outcome.

Table 10 presents the truth table for high enterprise resilience to COVID-19. The data included all 16 configurations, with case counts per configuration ranging from five to 48. However, only two configurations met the sufficiency inclusion threshold of 0.80 and were therefore assigned an outcome value of 1. The first configuration was ~DAC*~MSC*RMC*~OAC, with 11 cases, an inclusion score of 0.810, and a Proportional Reduction in Inconsistency (PRI) score of 0.658. The second configuration was ~DAC*M-SC*RMC*~OAC, with nine cases, an inclusion score of 0.806, and a PRI score of 0.648. These two configurations were therefore retained as empirically relevant pathways for further minimisation.

The two outcome-producing configurations share three conditions: the absence of digital adaptation, the presence of resource mobilisation, and the absence of operational adaptation. Market sensing varies across the two configurations, being absent in one and present in the other. This indicates that, at the truth-table stage, market sensing does not distinguish the two high-resilience configurations. In contrast, resource mobilisation appears consistently across both high-resilience configurations, while digital adaptation and operational adaptation are absent in both. This pattern suggests that the most empirically stable feature of the high-resilience truth-table rows is not digital intensity or operational restructuring, but the ability to mobilise relational, collective, or financial resources.

This finding is relevant to understanding resilience in informal food enterprises. It suggests that some vendors may have survived and recovered not primarily by intensifying digital practices or visibly changing operational routines, but by drawing on resource buffers embedded in everyday market relations. These may include customer and supplier credit, membership in a welfare group (chama), loans, collaboration with other vendors, and other forms of informal support. The pattern aligns with recent bricolage-oriented work showing that resilience among resource-constrained enterprises often emerges through the creative recombination of available resources rather than through formalised capabilities alone (Li et al., 2024; Park & Seo, 2024; Tehseen et al., 2024). It also resonates with recent informal-economy research showing that crisis survival is frequently anchored in social embeddedness, trust-based exchange, social capital, and collective coping arrangements, especially where formal institutional protection is weak or uneven (Aditya &

Row	DAC	MSC	RMC	OAC	OUT	n	inclx	PRI
3	0	0	1	0	1	11	0.810	0.658
7	0	1	1	0	1	9	0.806	0.648
13	1	1	0	0	0	5	0.790	0.641
8	0	1	1	1	0	6	0.787	0.659
9	1	0	0	0	0	13	0.787	0.670
15	1	1	1	0	0	5	0.783	0.617
4	0	0	1	1	0	21	0.775	0.661
5	0	1	0	0	0	9	0.771	0.605
11	1	0	1	0	0	7	0.761	0.590
14	1	1	0	1	0	10	0.748	0.646
1	0	0	0	0	0	30	0.743	0.623
12	1	0	1	1	0	32	0.737	0.643
16	1	1	1	1	0	15	0.722	0.614
10	1	0	0	1	0	26	0.680	0.576
6	0	1	0	1	0	13	0.674	0.517
2	0	0	0	1	0	48	0.657	0.547

Amri, 2023; Mpanje et al., 2022; Owuor et al., 2026; Salvi et al., 2023).

The absence of digital adaptation in the two high-resilience configurations does not indicate that digitalisation undermines resilience. Rather, it indicates that, in this sample and under the selected threshold, digital adaptation was not part of the configurations most consistently associated with high resilience. This distinction implies that digital tools may still have mattered for some vendors, but they did not constitute the dominant configurational pathway identified by the truth table. Similarly, the absence of operational adaptation should not be read as the absence of all adaptation. It may instead indicate that the operational adaptation indicators captured visible crisis-response adjustments, such as changes in stock, prices, procurement routines, or hygiene arrangements, which may have been more common among vendors experiencing disruption than among those whose resilience was supported by resource buffers.

Several configurations fell just below the 0.80 inclusion threshold. For example, DAC*MSC*~RMC*~OAC had an inclusion score of 0.790, ~DAC*MSC*RMC*OAC had an inclusion score of 0.787, and DAC*~MSC*~RMC*~OAC also had an inclusion score of 0.787. These near-threshold rows indicate that the truth table contains borderline configurations that may become relevant under less conservative threshold choices. However, they were not assigned to the outcome in the main analysis because they did not meet the predefined inclusion threshold. In such cases, it is important to conduct robustness checks using alternative thresholds while retaining the 0.80 inclusion threshold as the main analytical decision.

This approach is supported by QCA methodological literature, which emphasise that calibration choices, consistency thresholds, and frequency thresholds can affect solution

formulas and should therefore be tested through robustness or sensitivity checks (Brush et al., 2024; Oana & Schneider, 2024; Pappas & Woodside, 2021). Additionally, fsQCA guidelines commonly treat 0.80 as a defensible benchmark for sufficiency inclusion in the main truth-table analysis, especially when the researcher seeks to avoid over-interpreting weaker or borderline configurations (Cangialosi, 2023; Nikou et al., 2024; Pappas & Woodside, 2021).

Overall, the truth table analysis provides initial configurational evidence that high COVID-19 enterprise resilience was associated with a resource-centred pathway rather than with a single dominant digital, market, or operational condition. The two configurations retained for minimisation both point to the importance of resource mobilisation under conditions of low digital adaptation and low operational adaptation. The next step in the analysis therefore involved Boolean minimisation to determine whether these two empirical configurations could be simplified into a more parsimonious sufficient pathway to high resilience.

Sufficiency Analysis

The sufficiency analysis was conducted to identify configurations of conditions associated with high enterprise resilience to COVID-19. In fsQCA, sufficiency analysis assesses whether a condition or configuration of conditions forms a consistent subset of the outcome, meaning that cases displaying the configuration also tend to display the outcome (Cangialosi, 2023; Ragin, 2008). While the necessity analysis examined whether any single condition was required for resilience, the sufficiency analysis examines whether specific combinations of conditions are consistently linked to the outcome. This is relevant because resilience in informal enterprises is unlikely to result from a single isolated factor; rather, it may emerge through conjunctural combinations of practices, resources, and contextual responses (Fiss, 2011).

Boolean minimisation of the truth table produced one pathway associated with high COVID-19 enterprise resilience: That is $\sim\text{DAC}*\text{RMC}*\sim\text{OAC}\rightarrow\text{ER1C}$. This configuration indicates that high resilience was associated with the absence of digital adaptation (DAC), the presence of resource mobilisation (RMC), and the absence of operational adaptation (OAC). Market sensing (MSC) does not appear in the minimised solution because it varied across the two truth-table rows that met the inclusion threshold. In one row, market sensing was absent, while in the other it was present. Its absence from the minimised solution suggests that market sensing was not decisive in distinguishing this individual resilience pathway.

The pathway recorded a solution consistency of 0.771, a PRI score of 0.627, and a coverage score of 0.137. The consistency score indicates that the configuration is moderately associated with high resilience, though it falls slightly below the commonly used 0.80 benchmark. The PRI score suggests that the pathway has moderate ability to distinguish high resilience from the negation of resilience, while the coverage score indicates that the configuration explains only a small share of the outcome. Therefore, the pathway is considered a specific resilience configuration within a subgroup of vendors rather than a dominant or universal explanation of COVID-19 enterprise resilience.

Substantively, the solution points to a resource-mobilisation pathway to resilience. In this pathway, vendors appear to have been resilient not because they were strongly digitally adapted or because they undertook extensive operational adjustments, but because they were able to mobilise resources. In the context of informal food vending, such resources may include supplier and customer credit, loans, welfare-based support, collaboration with other vendors, and other relational or financial buffers. This interpretation aligns with bricolage-oriented accounts of enterprise survival, which emphasise that resource-constrained actors respond to uncertainty by creatively recombining resources already at hand rather than relying solely on formal capabilities or planned routines (Baker & Nelson, 2005; Di Domenico et al., 2010; Fisher, 2012). It also aligns with informal-economy scholarship showing that livelihoods are often sustained through social embeddedness, trust-based exchange, relational infrastructures, and collective coping arrangements, especially where formal institutional support is weak or uneven (Ghani & Jan, 2025; Mpanje et al., 2022; Salvi et al., 2023).

The absence of digital adaptation in this pathway should not be interpreted as evidence that digitalisation undermines resilience. Rather, it suggests that this resilience pathway was not digitally driven. Some vendors may have used mobile phones, digital payments, or mobile-based credit, but these practices did not define the main minimised configuration. Similarly, the absence of operational adaptation should not be understood as the absence of all adaptive behaviour. The operational adaptation indicators captured visible crisis-response adjustments, such as price changes, stock adjustments, procurement changes, and hygiene-related measures. Their absence in this configuration may indicate

that vendors with stronger resource buffers relied less on these visible operational changes, or that operational adaptation was more strongly associated with coping during disruption than with recovery itself.

Overall, the sufficiency analysis suggests that COVID-19 enterprise resilience among vendors was configured around resource mobilisation rather than digital intensity or operational adjustment alone. This finding strengthens the configurational argument that resilience in informal food enterprises is not simply a function of adopting digital tools or changing business operations, but may emerge from situated combinations of relational, collective and financial resources. However, because the solution consistency and coverage are modest, the result is interpreted cautiously and treated as evidence of a specific resource-based pathway rather than a comprehensive explanation of resilience across all vendors.

Robustness Analysis

To assess the stability of the fsQCA results, we conducted three robustness checks. First, we repeated the sufficiency analysis using a lower inclusion threshold of 0.75 to examine whether the main solution ($\sim\text{DAC}*\text{RMC}*\sim\text{OAC}\rightarrow\text{ER1C}$) was sensitive to how near-threshold truth-table rows were treated. Second, we varied the frequency threshold to test whether the solution depended on the minimum number of cases required to retain a configuration. Third, we repeated the analysis for the absence of the outcome to assess causal asymmetry, since QCA assumes that configurations associated with the presence of an outcome need not be the mirror opposite of those associated with its absence.

These checks follow methodological guidelines that recommend assessing the sensitivity of solutions to calibration, consistency, frequency, and case-classification decisions, rather than reporting a single solution as self-evident (Brush et al., 2024; Cangialosi, 2023; Oana & Schneider, 2024; Pappas & Woodside, 2021). Empirical studies using QCA have also tested the stability of configurational findings by varying consistency and frequency thresholds, rechecking calibration decisions, and analysing both the presence and absence of the outcome to account for causal asymmetry (Galioto et al., 2024; Haefner et al., 2023; Mion et al., 2024).

Lower Inclusion Threshold

The first robustness check repeated the sufficiency analysis using a lower inclusion threshold of 0.75, while retaining the frequency threshold of three cases. This test was conducted because several truth-table rows in the main analysis were close to, but below, the original 0.80 threshold. Lowering the inclusion threshold to 0.75 therefore allowed the study to examine whether the main solution was sensitive to the exclusion of borderline configurations. The lower-threshold analysis produced three pathways to high COVID-19 enterprise resilience: $\sim\text{DAC}*\text{RMC}$, $\text{DAC}*\sim\text{OAC}$, and $\text{MSC}*\sim\text{OAC}$ (Table 11).

The overall solution coverage increased to 0.391, indicating that the relaxed model captured a broader share of

the outcome than the main solution. However, the overall solution consistency declined to 0.694, suggesting that the additional pathways are less consistently associated with high resilience. The most substantively important result is that the resource-mobilisation pathway remained present through $\sim\text{DAC}^*\text{RMC}$, which recorded the highest unique coverage ($\text{covU} = 0.120$) among the three pathways.

Lower Frequency Threshold

The second robustness check varied the frequency threshold from three (3) cases to two (2) cases, while retaining the main sufficiency inclusion threshold of 0.80 (Table 12). This test examined whether the main solution depended on the minimum number of cases required for a truth-table row to be retained. The lower-frequency analysis reproduced the same solution as the main sufficiency analysis: $\sim\text{DAC}^*\text{RMC}^*\sim\text{OAC} \rightarrow \text{ER1C}$. The solution consistency remained 0.771, with a PRI score of 0.627 and coverage of 0.137. This implies that reducing the frequency threshold did not introduce additional sufficient pathways or alter the core configuration associated with high COVID-19 enterprise resilience. The result therefore strengthens confidence in the stability of the main solution. Substantively, it confirms that the most stable pathway remains a resource-mobilisation configuration in which high resilience is associated with the presence of resource mobilisation under conditions of low digital adaptation and low operational adaptation.

Absence of Resilience

As a further robustness check, the analysis was repeated using the negation of the outcome, $\sim\text{ER1C}$, to assess whether the absence of high COVID-19 enterprise resilience was produced by configurations that mirror those associated with high resilience. This check is grounded in fsQCA's causal asymmetry, which holds that conditions associated with the presence of an outcome should not be assumed to be the simple opposite of those associated with its absence (Brush et al., 2024). Across the alternative specifications tested, the truth-table output values for the negated outcome were all zero. This indicates that no configuration met the criteria for being treated as sufficient for the absence of

resilience. The four conditions (DAC, MSC, RMC, and OAC) used in this study explain the presence of high resilience more clearly than its absence.

This result suggests that other vulnerabilities not captured in this study may shape non-resilience among informal food vendors. These vulnerabilities may include household dependency and care burdens (Ibrahim et al., 2025; Shupler et al., 2021), health shocks and weak social protection (Alfers, Bamu, et al., 2022; ILO, 2020; OECD, 2024), debt exposure and cost-of-living pressures (Orleans Reed & Skinner, 2023), insecurity, harassment, and loss of trading space (Martínez & Young, 2022; Orleans Reed & Skinner, 2023), and uneven access to public relief or external recovery support (Owuor et al., 2026; Resnick et al., 2020). This reinforces the study's configurational argument that high resilience is not merely the opposite of low resilience, and that the absence of a low-resilience solution should be interpreted as evidence of causal asymmetry rather than as a failure of the analysis.

Discussion

This study examined COVID-19 enterprise resilience among women food vendors in Nairobi's informal settlements using a configurational approach. The results show that resilience was situated rather than generic. The vendors did not recover through a single universal pathway, nor did any individual condition emerge as necessary for high resilience. Digital adaptation, market sensing, resource mobilisation, and operational adaptation all mattered in different ways, but none operated as a stand-alone explanation. This supports the use of fsQCA because the findings point to conjunctural causation, where resilience emerges from combinations of conditions rather than the isolated effect of one dominant variable (Cangialosi, 2023; Pappas & Woodside, 2021). In the context of informal food vending, crisis survival is shaped not only by firm-level practices but also by household pressures, customer relations, credit arrangements, supplier ties, urban informality, and uneven institutional support.

The main sufficiency result ($\sim\text{DAC}^*\text{RMC}^*\sim\text{OAC} \rightarrow \text{ER1C}$) identified a resource-mobilisation (RMC) pathway to re-

Table 11: Robustness Check Using Lower Inclusion Threshold of 0.75

Pathway	Configuration	inclS	PRI	covS	covU	Interpretation
1	$\sim\text{DAC}^*\text{RMC} \rightarrow \text{ER1C}$	0.735	0.643	0.244	0.120	Resource mobilisation under low digital adaptation
2	$\text{DAC}^*\sim\text{OAC} \rightarrow \text{ER1C}$	0.716	0.608	0.197	0.046	Digital adaptation with low operational adaptation
3	$\text{MSC}^*\sim\text{OAC} \rightarrow \text{ER1C}$	0.730	0.597	0.216	0.034	Market sensing with low operational adaptation
Overall solution	M1	0.694	0.609	0.391	—	Broader but weaker robustness solution

Table 12: Robustness Check Using Lower Frequency Threshold of Two (2) Cases

Pathway	Configuration	inclS	PRI	covS	covU	Interpretation
1	$\sim\text{DAC}^*\text{RMC}^*\sim\text{OAC} \rightarrow \text{ER1C}$	0.771	0.627	0.137	—	Resource mobilisation under low digital and operational adaptation
Overall solution	M1	0.771	0.627	0.137	—	Same as main sufficiency solution

silience. This indicates that some vendors achieved high resilience despite low digital and operational adaptation when resource mobilisation was present. This outcome suggests that resilience among women food vendors may be anchored less in formalised managerial capabilities and more in the capacity to mobilise relational, collective, and financial resources under constraints. This finding aligns with bricolage-oriented accounts of resilience, in which resource-constrained enterprises survive crises by recombining what is already available rather than relying solely on formal planning, institutional support, or standardised capabilities (Baker & Nelson, 2005; Di Domenico et al., 2010; Park & Seo, 2024). It also resonates with informal-economy research showing that social capital, trust, customer relationships, and local support networks can shape recovery among businesses after a crisis (Ghani & Jan, 2025).

The findings indicate how digitalisation should be understood in relation to informal enterprise resilience. Digitalisation is often presented as a general solution for small-enterprise survival, but the results suggest a more nuanced interpretation. In the main solution, digital adaptation was absent, indicating that the most stable resilience pathway was not digitally driven. However, the lower-threshold robustness analysis identified an additional pathway in which digital adaptation, combined with low operational adaptation, was associated with resilience. This suggests that digitalisation may matter for some vendors, but not all. For some, mobile phones, digital payments, or mobile-based credit may have supported communication, ordering, payment, and liquidity. But for others, resilience may have depended more on resource mobilisation and market relationships than on digital practices. This supports a situated view of digitalisation in informal economies. A situated view posits that digital tools matter when they are embedded in existing social, market, and financial practices, rather than when they are treated as independent drivers of resilience.

Resource mobilisation and market sensing appear to play compensatory roles. The robustness solution showed that ~DAC*~RMC and MSC*~OAC were associated with high resilience when the inclusion threshold was relaxed to 0.75. Although these pathways were weaker than the main solution, they suggest that vendors with limited digital adaptation may still recover if they can mobilise resources or read the market effectively. Market sensing may help vendors detect shifts in customer demand, price fluctuations, seasonality, and stock availability, while resource mobilisation may provide the credit, collaboration, and liquidity needed to act on that knowledge. This aligns with research on crisis responses in resource-constrained enterprises and food systems, where resilience is often supported by flexibility, local knowledge, non-financial capital, and relational support rather than financial capital alone (Kopczykńska & Migalska, 2024; Suresh et al., 2025).

In both the main solution and the two robustness pathways, low operational adaptation appeared within configurations associated with resilience. This does not imply that operational adaptation is unimportant or undesirable. Rather, the indicators of operational adaptation in this study captured

visible crisis-response practices, such as price changes, stock adjustments, procurement changes, and hygiene-related measures. These practices may reflect reactive coping among vendors who experienced more intense disruption, rather than proactive resilience among vendors who were already buffered by resources, relationships, or market knowledge. In this sense, operational adaptation may indicate flexibility, but it can also signal exposure to disruption. Extant literature treats resilience as a process involving distinct but related phases of coping, adaptation, and recovery, and therefore cautions against interpreting all visible adjustment as evidence of stronger resilience (Duchek, 2020; Paeffgen, 2023; Shaya et al., 2023). It also aligns with informal-economy research showing that crisis-coping strategies may signal vulnerability and exposure as much as adaptive capacity, especially where informal workers face livelihood insecurity, weak social protection, and uneven recovery support (Aditya & Amri, 2023).

Finally, the absence-of-resilience analysis strengthens the study's configurational argument. The analysis of absence-of-resilience (~ER1C) yielded no sufficient configurations under the tested specifications. This confirms that low resilience is not simply the mirror opposite of high resilience. This is theoretically important because QCA assumes causal asymmetry, the idea that the presence and absence of an outcome may be produced by different causal structures. In this study, the conditions explain a particular resource-based pathway to high resilience more clearly than they explain the absence of resilience. Non-resilience may therefore be shaped by other vulnerabilities not captured in the model. These vulnerabilities may include household dependency and care burdens (Ibrahim et al., 2025; Shupler et al., 2021), health shocks and weak social protection (Alfers, Bamu, et al., 2022; ILO, 2020; OECD, 2024), debt exposure and cost-of-living pressures (Orleans Reed & Skinner, 2023), insecurity, harassment, and loss of trading space (Martínez & Young, 2022; Orleans Reed & Skinner, 2023), and uneven access to public relief or external recovery support (Owuor et al., 2026; Resnick et al., 2020). Overall, the findings support a view of COVID-19 resilience among women food vendors as situated bricolage: an emergent capacity to combine available tools, relationships, market knowledge, and everyday practices under conditions of uncertainty.

Contribution and Implications

This study makes a theoretical contribution by extending resilience theory, bricolage theory, and dynamic capabilities theory to women-led informal food enterprises in urban informal settlements. While resilience theory explains how enterprises withstand, adapt to, and recover from shocks, much of this literature has focused on formal organisations with identifiable resources, routines, and institutional support. This study shows that among women food vendors, resilience is more situated, relational, and improvised. The findings also extend bricolage theory by showing that COVID-19 resilience was not necessarily driven by formalised capabilities or planned innovation, but by the creative recombination of resources already available through customer relations, supplier credit, welfare groups

(*chamas*), peer collaboration, and informal finance. At the same time, the findings refine dynamic capabilities theory by showing that sensing, mobilising, and adapting do not operate as isolated capabilities in informal enterprises. Rather, their value depends on how they are configured under conditions of informality, resource constraints, and crisis. In this sense, the study shows that resilience among women food vendors is not simply a generic capability, but a situated configuration of bricolage practices and micro-level dynamic capabilities.

On the methodological front, the study demonstrates the usefulness of fsQCA for informal enterprise resilience research. Informal enterprises are heterogeneous, embedded in social relations, and exposed to multiple overlapping vulnerabilities, making them difficult to explain with methods that assume uniform net effects. Using fsQCA, the study examined whether resilience emerged from combinations of digital adaptation, market sensing, resource mobilisation, and operational adaptation. The necessity analysis showed that no single condition was necessary for high resilience, while the sufficiency analysis identified a specific resource-mobilisation pathway. The absence-of-resilience analysis further showed that low resilience was not simply the mirror opposite of high resilience. This demonstrates the value of configurational analysis for capturing conjunctural causation, equifinality, and asymmetry in informal enterprise resilience.

Finally, the study's findings caution against relying solely on digitalisation interventions for informal enterprise resilience. This has important policy and practical implications. Digital tools may support communication, payments, ordering, and mobile credit, but the results show that digital adaptation was not a universal pathway to resilience. Programmes supporting women food vendors should therefore combine digital interventions with broader support for credit access, supplier networks, savings groups, market information, and secure trading environments. Since resource mobilisation emerged as the most stable feature in the results, policy should strengthen both formal and informal resource channels, including affordable microcredit, informal savings and investment groups (*chamas*), emergency liquidity, supplier credit arrangements, and peer-based business support. More broadly, resilience strategies in informal settlements should be context-sensitive, recognising women food vendors not as passive beneficiaries of support but as adaptive economic actors whose survival depends on situated combinations of social, financial, digital, market, and operational resources.

Conclusion

This study examined COVID-19 enterprise resilience among women food vendors in Nairobi's informal settlements using a configurational approach. The findings show that no single condition or universal pathway explained resilience. Rather, resilience emerged from situated combinations of digital adaptation, market sensing, resource mobilisation, and operational adaptation. The necessity analysis showed that no individual condition was required for high resilience,

while the sufficiency analysis identified a resource-mobilisation pathway in which women vendors achieved resilience through relational, collective, and financial resources under conditions of low digital and operational adaptation. The robustness checks further showed that this resource-mobilisation pathway remained visible even when the analytical threshold was relaxed, although additional weaker pathways also emerged.

The study therefore advances a situated, bricolage-based understanding of informal enterprise resilience. For women food vendors, resilience lies not simply in adopting digital tools, adjusting operations, or accessing finance in isolation, but in how available tools, market knowledge, relationships, credit arrangements, supplier ties, informal savings and investment groups (*chamas*), and everyday adaptive practices are combined under constraints. This suggests that informal food-system resilience should not be approached through digitalisation-only or formalisation-only interventions. Instead, policy and practice should strengthen the social, financial, market, and infrastructural conditions that enable women vendors to sustain and recover their enterprises. Future research should extend this work through longitudinal studies, qualitative case follow-ups, gendered comparisons, and broader analysis of post-COVID-19 informal food-system resilience amid inflation, climate disruption, food price volatility, and evolving digital-financial ecosystems.

Declaration

We used Generative AI (specifically ChatGPT 5.5) sporadically to brainstorm ideas and assist with the literature search. The authors independently reviewed and verified the generative AI outputs.

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