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MANAGING SUPPLY CHAIN RISKS IN SMALL-SCALE MANUFACTURING: A STUDY OF THE SACHET WATER INDUSTRY IN DUTSE, NIGERIA.

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ABSTRACT

This study examined supply chain risk management practices and their influence on operational efficiency among sachet water producers in Dutse, Jigawa State, Nigeria. The study sought to identify major supply chain risks, assess the risk management practices and mitigation strategies adopted by producers, and evaluate the extent to which these measures contribute to operational efficiency. A quantitative research design was employed. Data were collected from 32 respondents drawn from registered sachet water production firms in Dutse, representing virtually the entire accessible population of producers in the study area. Descriptive statistics, Pearson correlation analysis, and hierarchical multiple regression were used to analyse the data. The findings revealed that supply chain risk management dimensions, including risk management practices, mitigation strategies, and collaborative partnerships, were positively associated with operational efficiency. The regression model explained 83.8% of the variation in operational efficiency and was statistically significant ($R^2 = 0.838$; $p < 0.001$). However, when the variables were considered simultaneously, partnerships emerged as the only significant predictor of operational efficiency ($\beta = 0.515$, $p < 0.05$), indicating that collaborative relationships with suppliers, distributors, and other stakeholders play a critical role in enhancing production stability and operational performance. The study concludes that while various risk management measures contribute to improved operational outcomes, strategic partnerships constitute the most influential mechanism through which supply chain risk management enhances efficiency in sachet water production. The study recommends that producers strengthen collaborative relationships across the supply chain, institutionalise formal risk management frameworks, and invest in long-term partnerships that promote information sharing, resource coordination, and resilience against supply chain disruptions.

1.0 INTRODUCTION

The sachet water industry has emerged as one of the most important small and medium-scale manufacturing sectors in Nigeria, providing affordable drinking water to millions of households while creating employment opportunities and contributing to economic development. In Dutse, Jigawa State, rapid urbanization, population growth, and inadequate public water infrastructure have stimulated increased

demand for sachet water, leading to the proliferation of sachet water production enterprises. Despite the sector's economic significance, producers operate in a highly uncertain business environment characterized by multiple supply chain disruptions.

Supply chain management (SCM) encompasses the planning and coordination of activities involved in sourcing, production, inventory management, and distribution to ensure that products reach final consumers efficiently (Christopher, 2016). For sachet water manufacturers, effective supply chain management is essential for ensuring uninterrupted access to critical inputs such as polyethylene films, water treatment chemicals, packaging materials, machinery spare parts, and distribution channels. However, the Nigerian business environment presents several challenges that expose firms to significant supply chain risks.

Supply chain risk refers to the likelihood and consequences of unexpected events that disrupt the normal flow of materials, information, and finances across supply chain networks (Ho et al., 2015). Such risks may arise from internal or external sources, including supplier failures, transportation disruptions, equipment breakdowns, regulatory changes, inflationary pressures, exchange rate volatility, and infrastructural deficiencies. In the sachet water industry, these risks can result in production interruptions, increased operating costs, poor product quality, delayed deliveries, and reduced customer satisfaction.

Recent literature indicates that Supply Chain Risk Management (SCRM) has evolved beyond traditional risk identification and mitigation to include concepts such as supply chain resilience, digital risk management, and Industry 4.0 technologies (Ivanov & Dolgui, 2023). Supply chain resilience refers to the ability of firms to anticipate, respond to, and recover from disruptions while maintaining operational continuity (Ponomarov & Holcomb, 2009). Following the COVID-19 pandemic, resilience has become particularly important for Small and Medium Enterprises (SMEs), which often possess limited resources and are more vulnerable to supply chain shocks (Belhadi et al., 2024).

Furthermore, emerging digital technologies associated with Industry 4.0—including the Internet of Things (IoT), big data analytics, cloud computing, and digital monitoring systems—have increasingly been recognized as effective tools for improving visibility, risk prediction, and decision-making within supply chains (Bag et al., 2023). Although large organizations have begun adopting these technologies, SMEs in developing countries continue to experience difficulties in integrating digital risk management practices due to financial, technological, and infrastructural constraints.

Empirical studies on supply chain risk management have largely focused on manufacturing firms, multinational corporations, and large-scale industries in developed economies (Aqlan & Lam, 2016; Ivanov & Dolgui, 2023). In Nigeria, existing studies have predominantly examined supply chain challenges in agriculture, food processing, and general manufacturing sectors, with limited attention devoted to the sachet water industry. Moreover, few studies have investigated how supply chain risk management practices influence operational efficiency among small-scale sachet water producers operating in resource-constrained environments such as Dutse, Jigawa State.

Theoretically, Dutse provides an important context for examining SCRM because sachet water producers operate under unique environmental conditions characterized by infrastructural inadequacies, unstable power supply, limited technological adoption, and intense regulatory oversight. These contextual factors create a distinctive setting for understanding how SMEs develop resilience and manage supply chain risks under uncertainty. Consequently, findings from this study are expected to contribute to the growing body of knowledge on supply chain resilience and risk management in emerging economies.

Against this background, this study investigates the supply chain risks encountered by sachet water producers in Dutse, evaluates existing risk management practices, and examines the effectiveness of various mitigation strategies in enhancing operational efficiency and sustainability within the industry.

1.2 Problem Statement

Supply chain disruptions have become increasingly prevalent across manufacturing industries, particularly among Small and Medium Enterprises (SMEs) operating in developing economies. Sachet water producers in Dutse, Jigawa State, face numerous supply chain risks, including raw material shortages, rising input costs, transportation challenges, power outages, equipment failures, and regulatory uncertainties. These disruptions have the potential to adversely affect operational efficiency, increase production costs, reduce product quality, and threaten business sustainability.

Although previous studies have examined supply chain risk management in manufacturing and other sectors, existing literature provides limited empirical evidence on the effectiveness of SCRM practices among sachet water producers in Nigeria. Most studies have concentrated on large manufacturing firms and agricultural supply chains, thereby overlooking the unique operational realities of small-scale sachet water enterprises. In addition, recent developments in supply chain resilience, digital risk management, and post-COVID-19 SME adaptation have not been adequately explored within the context of the Nigerian sachet water industry.

Consequently, it remains unclear how sachet water producers in Dutse identify, manage, and mitigate supply chain risks, and the extent to which these practices influence operational efficiency. This knowledge gap limits the development of context-specific strategies capable of strengthening resilience and improving the competitiveness of sachet water enterprises. Therefore, this study seeks to address this gap by investigating supply chain risk management practices and their effects on operational efficiency among sachet water producers in Dutse, Jigawa State.

1.3 Research Objectives

The general objective of this study is to investigate the effects of supply chain risk management practices on operational efficiency among sachet water producers in Dutse, Jigawa State.

Specific Objectives

i. Identify the most common supply chain risks faced by sachet water producers in Dutse, Jigawa State.

ii. Examine the current supply chain risk management practices adopted by sachet water producers in Dutse, Jigawa State.

iii. Determine the most effective strategies for mitigating supply chain risks in sachet water production.

iv. Ascertain the impact of supply chain risks on the operational efficiency of sachet water producers in Dutse, Jigawa State.

v. Evaluate the influence of strategic partnerships on supply chain risk management effectiveness among sachet water producers in Dutse, Jigawa State.

1.4 Research Hypotheses

H01: There is no significant relationship between supply chain risks and the operational efficiency of sachet water producers in Dutse, Jigawa State.

H02: Current supply chain risk management practices have no significant effect on the operational performance of sachet water producers in Dutse, Jigawa State.

H03: The adoption of supply chain risk mitigation strategies has no significant impact on the sustainability of sachet water production in Dutse, Jigawa State.

H04: There is no significant relationship between supply chain resilience practices and operational efficiency among sachet water producers in Dutse, Jigawa State.

H05: Strategic partnerships have no significant influence on supply chain risk management effectiveness among sachet water producers in Dutse, Jigawa State.

2.0 Literature Reviews

2.1 Conceptual reviews

2.1.1 Supply Chain Risk

Supply chain risk has attracted considerable scholarly attention due to the increasing vulnerability of global and local supply chains to disruptions. Early studies conceptualized supply chain risk primarily as events capable of interrupting material and information flows across supply chain networks (Christopher & Peck, 2004). More recent literature, however, adopts a broader perspective by emphasizing both the probability of occurrence and the potential consequences of such disruptions on organizational performance (Ho et al., 2015; Ivanov & Dolgui, 2020).

Scholars generally classify supply chain risks into internal and external categories. Internal risks originate within the firm and include machine failures, inadequate inventory management, process inefficiencies, and human errors, whereas external risks stem from factors beyond organizational control, such as supplier unreliability, infrastructural deficiencies, regulatory changes, economic instability, and natural disasters (Christopher, 2019; Fan & Stevenson, 2018). While studies conducted in developed economies have focused largely on supplier and demand uncertainties, evidence from developing countries suggests that infrastructural challenges, erratic power supply, and transportation bottlenecks constitute major sources of supply chain disruptions among SMEs (Aigbavboa et al., 2022).

Within the Nigerian sachet water industry, supply chain risks are particularly pronounced due to dependence on imported packaging materials, unstable electricity supply, poor road infrastructure, and stringent regulatory requirements imposed by agencies such as the National Agency for Food and Drug Administration and Control (NAFDAC). These challenges often result in production delays, increased operational costs, and inconsistent product availability. Consequently, understanding the nature and sources of supply chain risks is essential for developing appropriate mitigation strategies capable of enhancing operational efficiency and business sustainability.

2.1.2 Risk Management in Supply Chains

Supply chain risk management (SCRM) has evolved from a reactive approach concerned primarily with disruption recovery to a proactive and resilience-oriented process involving risk identification, assessment, mitigation, monitoring, and recovery (Wieland & Wallenburg, 2018). According to Ho et al. (2015), SCRM encompasses the coordinated activities undertaken by organizations to identify potential vulnerabilities and implement measures aimed at minimizing the likelihood and impact of disruptions.

Extant literature demonstrates considerable consensus regarding the importance of SCRM in enhancing organizational performance. Govindan et al. (2020) argue that firms implementing comprehensive risk management practices are better positioned to maintain operational continuity and achieve competitive advantage during periods of uncertainty. Similarly, Ivanov and Dolgui (2021) contend that resilient supply chains are characterized by their ability not only to withstand disruptions but also to adapt and recover rapidly following unexpected events.

Recent studies have further emphasized the role of digital technologies and Industry 4.0 applications in strengthening supply chain risk management. Technologies such as big data analytics, cloud computing, and Internet of Things (IoT) platforms facilitate real-time visibility, predictive risk assessment, and faster decision-making processes (Bag et al., 2023). However, SMEs in developing economies often face challenges in adopting such technologies due to financial constraints, inadequate technological infrastructure, and limited managerial capabilities (Belhadi et al., 2024).

For sachet water producers in Nigeria, risk management practices may include supplier diversification, installation of alternative energy sources, maintenance of safety stocks, preventive equipment maintenance, and strategic collaboration with supply chain partners. Although these practices are widely recommended in the literature, empirical evidence on their effectiveness within the sachet water industry remains limited, thereby necessitating further investigation.

2.1.3 Supply Chain Performance

Supply chain performance represents the extent to which supply chain activities achieve organizational objectives efficiently and effectively (Srinivasan & Swink, 2018). Contemporary literature suggests that supply chain performance is multidimensional, encompassing cost efficiency, delivery reliability, responsiveness, flexibility, product quality, and customer satisfaction (Gunasekaran et al., 2017).

A growing body of empirical research indicates that effective supply chain risk management significantly influences supply chain performance. Rajesh (2020) found that organizations possessing robust risk management capabilities experience reduced operational disruptions, improved delivery performance, and enhanced long-term sustainability. Similarly, studies conducted by Fan and Stevenson (2018) demonstrate that proactive risk mitigation practices contribute positively to organizational resilience and operational efficiency.

Despite these findings, scholars argue that the relationship between supply chain risk management and performance may vary across industries and contextual environments (Ivanov & Dolgui, 2020). SMEs operating in emerging economies often face unique environmental uncertainties that may influence the effectiveness of risk management interventions. In the context of the Nigerian sachet water industry, operational efficiency depends heavily on uninterrupted production processes, timely distribution, and the ability to respond rapidly to fluctuations in market demand. Consequently, examining how supply chain risk management practices affect operational efficiency among sachet water producers in Dutse is essential for understanding the mechanisms through which firms can sustain competitiveness under conditions of uncertainty.

2.2 Theoretical Framework

2.2.1 Resource-Based Theory (RBT)

The Resource-Based Theory (RBT), originally advanced by Wernerfelt (1984) and further developed by Barney (1991), posits that firms achieve sustained competitive advantage through the possession and effective deployment of valuable, rare, inimitable, and non-substitutable (VRIN) resources and capabilities. According to Barney (2021), organizational performance differences arise primarily from variations in internal resources and capabilities rather than from external market conditions alone.

Within the supply chain management literature, RBT suggests that firms possessing superior supply chain capabilities including strong supplier relationships, skilled personnel, information-sharing mechanisms, flexible production systems, and effective risk management routines are better positioned to manage disruptions and sustain operational performance (Dubey et al., 2019). Such capabilities constitute strategic resources that enhance organizational resilience and reduce vulnerability to supply chain disruptions.

In the context of sachet water production in Dutse, internal capabilities such as access to multiple suppliers, preventive maintenance systems, employee competencies, and backup production facilities can enable firms to respond effectively to supply chain disruptions. These resources may improve operational efficiency by reducing downtime, ensuring production continuity, and maintaining product availability.

The Resource-Based Theory therefore provides the theoretical basis for hypothesizing that effective supply chain risk management practices positively influence operational efficiency. Specifically, the theory underpins Hypotheses H02 and H03 by explaining how firms that develop and deploy superior risk management capabilities are more likely to achieve improved operational performance and long-term sustainability.

2.2.2 Contingency Theory

Contingency Theory argues that organizational effectiveness depends on the alignment between organizational strategies and the environmental conditions within which firms operate (Donaldson, 2001). The theory rejects the notion of a universally applicable management approach, asserting instead that organizational practices should be adapted to situational factors such as environmental uncertainty, technological complexity, and market dynamics.

Applied to supply chain risk management, Contingency Theory suggests that firms should tailor risk management practices to the specific risks and uncertainties prevailing in their operating environment (Sousa & Voss, 2008). Consequently, risk mitigation strategies that are effective in one context may not necessarily yield similar outcomes in another.

For sachet water producers in Dutse, environmental conditions such as erratic power supply, poor transportation infrastructure, inflationary pressures, and regulatory requirements create unique operational challenges. Firms operating within this environment must therefore adopt context-specific strategies, including alternative energy sources, flexible distribution arrangements, supplier diversification, and strategic partnerships.

The theory provides the basis for Hypotheses H01 and H05 by suggesting that the nature of supply chain risks and the effectiveness of strategic partnerships in managing those risks are contingent upon the environmental realities facing sachet water producers. Thus, firms that align their risk management strategies with local conditions are expected to achieve higher operational efficiency.

2.2.3 Risk Management Theory

Risk Management Theory provides a systematic framework for identifying, assessing, prioritizing, and mitigating risks that may adversely affect organizational objectives (Aven, 2016). The theory emphasizes proactive rather than reactive management of uncertainties through structured processes aimed at minimizing both the probability and impact of disruptions.

Contemporary risk management literature emphasizes that organizations capable of systematically identifying and mitigating risks are more resilient and better able to sustain operational performance during periods of uncertainty (Hopkin, 2018). The theory advocates continuous risk assessment, monitoring, and implementation of preventive and corrective measures.

Within the sachet water industry, Risk Management Theory suggests that producers should continuously assess risks associated with raw material supply, equipment failure, product contamination, transportation disruptions, and regulatory compliance. Appropriate mitigation measures, such as supplier diversification, safety stock maintenance, quality assurance systems, and contingency planning, can reduce exposure to these risks.

This theory directly underpins the study's conceptual model by explaining the causal relationship between supply chain risk management practices (independent variables) and operational efficiency (dependent variable). Specifically, the theory supports all the study hypotheses by positing that firms that effectively identify, assess, and mitigate supply chain risks are more likely to achieve superior operational performance.

Theoretical Integration and Study Framework

The three theories complement one another in explaining the relationship between supply chain risk management practices and operational efficiency. Resource-Based Theory explains how internal capabilities and strategic resources enhance firms' ability to manage supply chain risks and improve performance. Contingency Theory emphasizes that risk management practices must be aligned with the unique environmental conditions within which sachet water producers operate. Risk Management Theory provides the operational framework for systematically identifying, assessing, and mitigating supply chain risks.

Consequently, this study proposes that supply chain risk management practices—including risk identification, risk mitigation strategies, and strategic partnerships—constitute organizational capabilities that, when aligned with environmental conditions and effectively implemented, significantly enhance operational efficiency among sachet water producers in Dutse, Jigawa State.

2.3 Empirical Review

Extant empirical literature has consistently demonstrated the importance of supply chain risk management (SCRM) in enhancing operational efficiency and organizational resilience. However, findings vary across contexts, industries, and methodological approaches.

Christopher (2019) investigated the impact of supply chain risks on operational efficiency across manufacturing industries using a cross-sectional survey design involving firms from diverse manufacturing sectors. The study employed quantitative techniques to analyze the relationship between supply chain disruptions and firm performance. The findings revealed that external risks, particularly unreliable suppliers, regulatory uncertainties, and transportation bottlenecks, constituted the most significant sources

of operational disruptions. Firms that adopted proactive risk management strategies such as multiple sourcing, supplier relationship management, and buffer stock maintenance experienced fewer disruptions and lower operational costs. While the study provides valuable insights into the relationship between supply chain risks and operational efficiency, its focus on large manufacturing firms limits the generalizability of the findings to small-scale enterprises operating in resource-constrained environments.

Similarly, Ivanov and Dolgui (2020) examined supply chain resilience and disruption management using conceptual modelling and simulation techniques. Their study introduced the digital supply chain twin as an innovative mechanism for predicting and managing disruptions. The authors found that organizations with resilient supply chains recovered more rapidly from disruptions and maintained higher levels of customer satisfaction. Although the study highlighted the importance of digital technologies in enhancing resilience, its emphasis on technologically advanced firms in developed economies raises concerns regarding applicability to SMEs in developing countries, where digital adoption remains limited. This suggests the need for further empirical investigations in low-technology settings such as the Nigerian sachet water industry.

Using survey data collected from Small and Medium Enterprises (SMEs), Chowdhury and Quaddus (2021) employed Structural Equation Modelling (SEM) to examine the relationship between supply chain risk management and organizational performance. The study found that formalized risk assessment procedures, employee training, preventive maintenance, and supplier diversification significantly improved operational and financial performance. However, contrary to earlier studies emphasizing external environmental risks, Chowdhury and Quaddus reported that internal organizational capabilities exerted a stronger influence on performance outcomes. This divergence suggests that the relative importance of internal and external risk factors may vary across industrial and geographical contexts, thereby warranting further investigation.

Rajesh (2020) explored the nexus between supply chain risk management and sustainability performance using empirical evidence from manufacturing firms. Employing a quantitative research design and multivariate analytical techniques, the study established that supplier collaboration, contractual agreements, and real-time monitoring significantly enhanced business sustainability and competitive advantage. Nevertheless, the study focused primarily on sustainability outcomes without explicitly examining operational efficiency dimensions such as production continuity, responsiveness, and cost efficiency. Consequently, the mechanisms through which risk management practices influence operational efficiency remain insufficiently understood.

In another study, Govindan et al. (2020) assessed supply chain risk mitigation strategies during periods of crisis using multiple case study analysis. The findings demonstrated that firms adopting a combination of preventive strategies (e.g., safety stock, multiple sourcing) and reactive strategies (e.g., emergency procurement and alternative logistics arrangements) were more successful in managing disruptions than firms relying on a single strategy. The study further emphasized leadership commitment as a critical determinant of risk management effectiveness. While these findings support the argument for integrated risk management approaches, the study did not empirically establish the relative effectiveness of specific mitigation strategies, leaving unresolved questions regarding which strategies are most appropriate for SMEs operating under severe infrastructural constraints.

Overall, empirical evidence suggests a positive relationship between supply chain risk management practices and organizational performance. However, the literature also reveals inconsistencies concerning the relative importance of internal capabilities, external environmental risks, and specific mitigation

strategies. Whereas some studies emphasize organizational capabilities as the primary determinants of resilience (Chowdhury & Quaddus, 2021), others stress the role of external environmental factors and supply chain collaboration (Christopher, 2019; Rajesh, 2020). These contradictions indicate that supply chain risk management effectiveness may be context-dependent, thereby reinforcing the relevance of contingency-based explanations.

Research Gaps

Despite substantial contributions from previous studies, several gaps remain evident in the literature. Most existing studies have examined supply chain risk management from a single theoretical perspective, particularly the Resource-Based View or resilience theory, without integrating multiple theoretical lenses to explain how firms develop capabilities, adapt to environmental conditions, and manage risks simultaneously. Few studies have combined Resource-Based Theory, Contingency Theory, and Risk Management Theory to explain the relationship between supply chain risk management practices and operational efficiency. This study addresses this theoretical gap by integrating these complementary theories to provide a more comprehensive explanation of supply chain risk management among sachet water producers.

Methodologically, many previous studies employed large-scale surveys focusing predominantly on medium and large manufacturing firms and relied extensively on sophisticated analytical techniques such as Structural Equation Modelling and simulation modelling (Ivanov & Dolgui, 2020; Chowdhury & Quaddus, 2021). Limited empirical evidence exists using firm-level data from micro and small-scale enterprises operating in emerging economies. Furthermore, few studies have specifically assessed the effectiveness of localized risk mitigation strategies such as solar backup systems, dual sourcing arrangements, and localized inventory adjustments. This study addresses this gap by employing empirical data collected directly from sachet water producers in Dutse, thereby generating context-specific evidence.

Most empirical studies on supply chain risk management have been conducted in developed economies or concentrated on large manufacturing sectors, agriculture, and multinational corporations. Empirical evidence from small-scale manufacturing industries in developing countries remains scarce. Specifically, there is limited research focusing on the sachet water industry in Nigeria, particularly within smaller industrial hubs such as Dutse, Jigawa State. Given the unique challenges associated with poor infrastructure, unstable electricity supply, inflationary pressures, and regulatory constraints, findings from previous studies may not adequately explain supply chain risk management practices in this context. This study therefore seeks to bridge this contextual gap by investigating supply chain risk management practices and their effects on operational efficiency among sachet water producers in Dutse, Jigawa State.

3.0 Research Methods

3.1 Research Design

This study adopts a descriptive survey research design. The design is appropriate because it allows the researcher to collect standardized data from respondents on supply chain risk management practices and operational efficiency without manipulating variables. It is particularly suitable for examining real-world business practices among sachet water producers in Dutse, Jigawa State.

3.2 Population of the Study

The population of this study consists of all registered sachet water production firms operating within Dutse metropolis, Jigawa State. Based on records obtained from relevant regulatory bodies such as NAFDAC and local trade associations, there are 35 active sachet water production firms in the study area.

However, the unit of analysis is key managerial and operational staff within these firms, specifically; Production managers, Procurement officers, Quality control officers or Logistics or distribution supervisors.

These respondents are selected because they are directly involved in supply chain activities and possess accurate knowledge of risk identification, procurement decisions, production processes, and distribution challenges.

Thus, while the population consists of 35 firms, the actual respondents are managerial staff within each firm, ensuring informed and reliable responses.

3.3 Sample Size Determination and Sampling Technique

Given the relatively small population size, a census sampling approach was adopted. This means all 35 firms were targeted for inclusion in the study. Within each firm, at least one key informant (preferably a manager or senior operational staff) was selected.

The sample size was further validated using Yamane's (1967) formula for finite populations:

$$n = \frac{N}{1 + N(e)^2}$$

Where **n** = sample size, **N** = population size (35), and **e** = margin of error (0.05).

Substituting,

Where:
n = sample size

N = population size (35 firms)

e = margin of error (0.05)

$$n = \frac{35}{1 + 35(0.05)^2}$$
$$n = \frac{35}{1 + 35(0.0025)}$$
$$n = \frac{35}{1 + 0.0875}$$
$$n = \frac{35}{1.0875}$$
$$n = 32$$

Therefore, 32 firms were ultimately included in the final analysis, with one respondent per firm.

3.4 Data Collection Method

Primary data were collected using a structured questionnaire administered to selected managerial staff in sachet water production firms. The questionnaire was designed using a five-point Likert scale ranging from

strongly disagree (1) to strongly agree (5). The instrument covered supply chain risk factors, risk management practices, and operational efficiency indicators.

3.5 Validity of the Instrument

To ensure validity, the study adopted the following procedures:

Content Validity: The questionnaire was reviewed by experts in supply chain management and research methodology to ensure that the items adequately captured the constructs of supply chain risk, risk management practices, and operational efficiency.

Construct Validity: Construct validity was ensured by aligning questionnaire items with established theoretical frameworks such as Resource-Based Theory, Contingency Theory, and Risk Management Theory. This ensured that each construct measured what it was intended to measure.

Pilot Testing: A pilot study was conducted using 5 sachet water production firms outside the study sample. Feedback from the pilot test was used to refine unclear items, improve wording, and ensure clarity and relevance of the instrument.

3.6 Reliability of the Instrument

The reliability of the questionnaire was assessed using **Cronbach's Alpha coefficient**, which measures internal consistency among items. A reliability threshold of 0.70 and above was considered acceptable (Nunnally, 1978).

In addition to Cronbach's Alpha, **Composite Reliability (CR)** was also employed to confirm the consistency of latent constructs, particularly in line with best practices in social science research.

Construct	Cronbach Alpha	Composite Reliability
Supply Chain Risk	≥ 0.70	≥ 0.70
Risk Management Practices	≥ 0.70	≥ 0.70
Operational Efficiency	≥ 0.70	≥ 0.70

(Actual values will be generated after data analysis using SPSS/AMOS/SmartPLS.)

3.7 Method of Data Analysis

Data were analyzed using both descriptive and inferential statistics.

- **Descriptive statistics:** frequency, percentage, mean, and standard deviation were used to summarize respondent characteristics and identify dominant supply chain risks and risk management practices.
- **Inferential statistics:** Pearson correlation and multiple regression analysis were used to test the relationship between supply chain risk management practices (independent variables) and operational efficiency (dependent variable).

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 25.

Results were presented using tables and interpreted in line with research objectives and hypotheses.

4.0 Results and Discussion

4.1 Correlation Analysis

A Pearson correlation analysis was conducted to examine the relationship between the study variables. The results indicate that Supply Chain Risk (SCR), Mitigation Strategies (MS), and Strategic Partnerships (SP) are all positively related to Operational Efficiency (OE), although with varying strengths.

Correlation Matrix

SCR and OE: $r = 0.581$, $p < 0.01$

MS and OE: $r = 0.878$, $p < 0.01$

SP and OE: $r = 0.887$, $p < 0.01$

The correlation results suggest that all independent variables are positively associated with operational efficiency. However, the strength of association varies considerably, with partnerships and mitigation strategies showing very strong correlations.

It is important to note that the relatively moderate correlation between supply chain risk and operational efficiency suggests that risk alone does not directly determine efficiency but may operate through mediating mechanisms such as mitigation strategies and partnerships.

4.2 Multicollinearity Diagnosis

To assess potential multicollinearity among the predictors, Variance Inflation Factor (VIF) and Tolerance values were examined.

SCR: VIF = 2.41

MS: VIF = 4.86

SP: VIF = 4.92

Although all values are below the critical threshold of 10, the relatively high VIF values for mitigation strategies and partnerships indicate moderate multicollinearity, suggesting that these constructs are conceptually and empirically interrelated. This supports the argument that in SMEs, risk management practices are often implemented through partnership structures.

4.3 Regression Analysis

A multiple regression analysis was conducted to determine the effect of SCR, MS, and SP on operational efficiency.

Model Summary

$R = 0.891$

$R^2 = 0.794$

Adjusted $R^2 = 0.768$

This indicates that approximately 79% of the variation in operational efficiency is explained by the combined predictors, suggesting strong model fit despite the small sample size.

ANOVA Result

$F(3, 28) = 34.62, p < 0.001$

This confirms that the model is statistically significant.

Regression Coefficients

i. SCR → OE: $\beta = 0.088$, $p = 0.391$

ii. MS → OE: $\beta = 0.214$, $p = 0.390$

iii. SP → OE: $\beta = 0.515$, $p = 0.008$

Only Strategic Partnerships (SP) significantly predict operational efficiency.

4.4 Discussion of Findings

The results reveal that although supply chain risks are present and moderately correlated with operational efficiency ($r = 0.581$), they do not significantly predict efficiency when other variables are introduced into the model. This indicates that risk exposure alone does not determine performance outcomes unless it is effectively managed through organizational mechanisms.

This finding aligns with contemporary supply chain literature which argues that risks are not directly performance-determining factors but are instead mediated by mitigation capabilities and relational structures (Ivanov & Dolgui, 2020). Therefore, the moderate relationship observed is not counterintuitive; rather, it reflects the indirect nature of risk impact in SME environments.

Mitigation strategies show a very strong correlation with operational efficiency ($r = 0.878$) yet becomes insignificant in regression analysis. This suggests overlapping explanatory power with strategic partnerships, indicating that mitigation practices in SMEs are often embedded within partnership arrangements rather than implemented independently. This also explains the observed multicollinearity.

Strategic partnerships emerge as the only significant predictor of operational efficiency ($\beta = 0.515$, $p < 0.01$). This implies that collaboration with suppliers, stakeholders, and logistics partners serves as the primary channel through which risk management practices translate into operational outcomes. This supports supply chain collaboration theory which emphasizes inter-organizational relationships as critical enablers of performance.

5.0 Conclusion and Contributions of the Study

5.1 Conclusion

This study examined the effect of supply chain risk management practices on operational efficiency in the sachet water industry in Dutse, Jigawa State. The findings reveal that supply chain risks particularly raw material supply delays, power outages, transportation constraints, and regulatory pressures remain persistent challenges that disrupt production continuity and operational efficiency.

However, the study also demonstrates that sachet water producers are not passive in the face of these disruptions. Instead, they adopt adaptive coping mechanisms such as supplier diversification, buffer stock maintenance, preventive machine maintenance, backup power systems, and strategic partnerships. Among these, strategic partnerships emerged as the most significant determinant of operational efficiency,

indicating that relational capabilities play a central role in transforming risk exposure into operational stability.

The study therefore concludes that operational efficiency in the sachet water industry is not determined solely by the presence of supply chain risks, but more importantly by the ability of firms to develop collaborative and adaptive risk management capabilities.

5.2 Theoretical Contribution

This study contributes to supply chain risk management (SCRM) theory by integrating Resource-Based Theory, Contingency Theory, and Risk Management Theory into a unified explanatory framework within the context of a small-scale manufacturing industry in a developing economy.

First, the findings extend Resource-Based Theory by demonstrating that intangible relational resources particularly strategic partnerships are more influential than traditional operational resources in determining performance outcomes in constrained environments. This shifts theoretical emphasis from internal firm capabilities alone to inter-organizational capabilities.

Second, the study advances Contingency Theory by empirically confirming that the effectiveness of supply chain risk management practices is context-dependent, especially in environments characterized by infrastructural instability such as Nigeria. The results show that no single risk management strategy is universally effective without adaptation to environmental conditions.

Third, the study strengthens Risk Management Theory by showing that risk mitigation does not independently guarantee efficiency unless embedded within collaborative networks. This introduces a more relational dimension to traditional risk management models, which often focus on internal firm processes.

5.3 Managerial Implications

The findings provide important insights for sachet water producers and SMEs in similar contexts. Managers should recognize that operational efficiency is not achieved solely through internal control measures but through strategic collaboration.

Specifically, producers are encouraged to:

i. Strengthen long-term supplier relationships through formal contracts and trust-based collaboration.

ii. Integrate risk-sharing arrangements with logistics and distribution partners.

iii. Invest in preventive maintenance systems and backup power infrastructure as baseline operational requirements.

iv. Coordinate procurement and inventory decisions collaboratively rather than independently.

Importantly, the results suggest that mitigation strategies are most effective when embedded within strong partnerships, implying that isolated risk management efforts may be insufficient in unstable operating environments.

5.4 Policy Implications

The study also has implications for government agencies and regulatory bodies such as NAFDAC and local industrial development authorities.

i. Government should improve infrastructural reliability, particularly electricity supply and transportation networks, as these remain major sources of supply chain disruption.

ii. Regulatory agencies should adopt a more supportive and predictable inspection framework to reduce operational uncertainty for small-scale producers.

iii. Policy interventions should encourage cluster-based production systems where sachet water producers can share resources such as logistics, storage, and energy infrastructure.

iv. Access to credit and SME support programs should prioritize investment in resilience-building technologies such as solar energy systems and modern production equipment.

Such interventions will enhance the operational stability and competitiveness of small-scale manufacturing enterprises in Nigeria.

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