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# Fuel Subsidy Removal and Agricultural Financing: Assessing the Impact of Elevated Operational Costs on the Creditworthiness of Nigerian Agribusiness Cooperatives and their Reliance on Information on Information Financial Network

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**Abstract: This study examines the relationship between Nigeria's May 2023 fuel-subsidy removal, operating costs, financial-ratio indicators, and financing choices among agribusiness cooperatives. The manuscript describes a mixed-source design combining a structured questionnaire with retrospective cooperative financial records. It reports 334 completed instruments from a target of 360 cooperatives (92.8%). Preliminary descriptive figures presented in the current draft indicate lower post-period means for net profit margin (0.185 to 0.042), debt-service coverage ratio (1.640 to 0.780), and current ratio (2.120 to 1.140), alongside a reported increase in the proportion of cooperatives with a debt-service coverage ratio below 1.0 (4.2% to 62.3%). However, the regression coefficients, test statistics, model-fit measures, and financing-channel estimates in the current draft contain inconsistencies and must be reproduced from the underlying dataset before inferential conclusions can be finalised. Accordingly, the current manuscript treats these numerical results as provisional and does not claim that subsidy removal alone caused the observed changes or that financing shifts were necessarily involuntary. The study's intended contribution is to examine how operating-cost pressures may be associated with cooperative creditworthiness and the relative use of formal and informal financing, while identifying potential policy options for improving agricultural financing resilience.**

***Keywords:*** *Fuel Subsidy, Agribusiness Cooperatives, Creditworthiness, Financial Informalization, Credit Rationing, Nigerian Agriculture.*

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## I. INTRODUCTION

The interface between macroeconomic policy shocks and microeconomic agricultural sustainability represents a critical nexus in emerging market economics. In Nigeria, the agrarian sector remains a primary economic anchor, employing over 35% of the total labor force and contributing significantly to the non-oil Gross Domestic Product (GDP) (National Bureau of Statistics [NBS], 2023). Historically, the sector's productivity has been heavily buffered by state-led interventions, most notably through the subsidization of Premium Motor Spirit (PMS) (Adelaja et al., 2022). However, the aggressive fiscal reform implemented in May 2023, which resulted in the complete removal of the fuel subsidy, triggered an immediate and unprecedented escalation in the domestic cost of energy (Onyeizugbe et al., 2024). Because Nigerian agriculture relies intensely on PMS for mechanized cultivation, irrigation logistics, farm-gate processing, and rural-urban transportation networks, this policy shift has radically altered the operational economics of farming (Apata, 2024).

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Crucially, the 2023 premium motor spirit (PMS) subsidy deregulation did not occur in isolation. It was accompanied by aggressive foreign exchange liberalization reforms that triggered a sharp depreciation of the Nigerian Naira. This currency devaluation directly inflated the landing costs of imported petroleum products, while simultaneously driving up the retail prices of vital agricultural inputs including synthetic fertilizers, machinery spare parts, and imported mechanical components. Consequently, the operational cost-push shock documented in this study represents an energy-driven crisis that was further amplified by concurrent currency fluctuations across the macroeconomic environment.

Agribusiness cooperatives serve as the institutional backbone for smallholder farmers in Nigeria, aggregating production, pooling risks, and facilitating access to formal credit markets (Verter&Bečvářová, 2016). Under the current macroeconomic regime, these cooperatives are experiencing severe liquidity strains as their aggregate operational costs have ballooned (Aruseo& Obasi, 2025). Concurrently, the Central Bank of Nigeria's (CBN) hawkish monetary stance to curb post-subsidy inflation has driven commercial interest rates to prohibitive highs, tightening formal credit channels (CBN, 2024). As the cash flows of these cooperatives deteriorate under the weight of elevated input and logistical costs, their balance sheets weaken, altering key financial metrics such as debt-service coverage ratios and net margins (Echebiri&Edaba, 2024). This fiscal degradation directly threatens their institutional creditworthiness, rendering them high-risk borrowers in the eyes of formal banking institutions (Okorie, 2023).

Consequently, a structural displacement is occurring: shut out from formal banking systems due to high risk ratings and information asymmetry, agribusiness cooperatives are increasingly forced to retreat into informal financial networks such as rotating savings and credit associations (ROSCAs), traditional daily contributions (esusu), local money lenders, and kinship networks to sustain survival capital (Adegbite et al., 2024). Theoretically, this phenomenon is deeply rooted in Credit Rationing Theory (Stiglitz & Weiss, 1981) and the Pecking Order Theory (Myers &Majluf, 1984), where formal market frictions and escalating enterprise risk profiles catalyze structural substitution toward informal safety nets. Understanding this transition is vital, as it carries profound implications for long-term agricultural capitalization, systemic food security, and rural poverty alleviation across Sub-Saharan Africa (World Bank, 2024).

➢ *Statement of the Research Problem*

Despite the strategic importance of agribusiness cooperatives in stabilizing Nigeria's food systems, the sudden removal of the fuel subsidy has introduced a severe cost-push shock that threatens their institutional viability (Apata, 2024; NBS, 2023). The fundamental problem is that elevated operational costs have severely eroded the creditworthiness of Nigerian agribusiness cooperatives, creating a financing mismatch that drives a structural regression toward under-capitalized informal financial networks (Adegbite et al., 2024; Echebiri&Edaba, 2024).

Formal financial institutions evaluate the creditworthiness of agricultural cooperatives based on cash flow predictability, asset quality, and repayment capacity (Okorie, 2023; Stiglitz & Weiss, 1981). The removal of the fuel subsidy has structurally disrupted these parameters. Agribusinesses are facing soaring expenditures for fuel-dependent operations such as mechanized land preparation, irrigation pumping, and long-haul transportation which they cannot fully pass on to price-sensitive consumers (Aruseo& Obasi, 2025; Onyeizugbe et al., 2024). This margin squeeze results in widespread loan defaults among cooperative members, a dilution of operational working capital, and a severe depletion of institutional cash reserves (Echebiri&Edaba, 2024; Verter&Bečvářová, 2016).

Compounding this crisis is a critical gap in contemporary empirical literature: while previous studies have extensively documented the macro-inflationary effects of fuel subsidy removal (Adelaja et al., 2022; Onyeizugbe et al., 2024), there is a distinct shortage of empirical research analyzing how micro-level operational cost shocks translate into quantitative institutional credit risk metrics for agricultural aggregators. Furthermore, the structural dynamics of how cooperatives navigate this formal credit rationing—specifically the extent, efficiency, and transaction costs of their reliance on informal financial networks—remain largely unquantified (Adegbite et al., 2024; Myers &Majluf, 1984). Without rigorous empirical investigation into these pathways, policymakers, development agencies, and central bankers lack the evidence required to design targeted agricultural stabilization funds, risk-mitigation frameworks, or tailored monetary interventions to prevent the systemic collapse of smallholder supply chains (CBN, 2024; World Bank, 2024).

➢ *Research Questions*

- How has the removal of the fuel subsidy significantly altered the operational cost structure (specifically production, processing, and logistics expenses) of agribusiness cooperatives across Nigeria?
- What is the quantitative impact of these elevated operational costs on the standardized creditworthiness metrics (Net Profit Margin, Debt-Service Coverage Ratio, and Current Ratio) of agribusiness cooperatives?
- To what extent, and through what specific mechanisms, has the erosion of formal creditworthiness increased the cooperatives' structural reliance on informal financial networks?
- What are the comparative transaction costs, borrowing capacities, and financial sustainability implications for cooperatives utilizing informal networks versus formal financial channels in the post-subsidy era?

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➢ *Research Objectives*

- Quantify the percentage shift in agricultural operational expenditures (production, post-harvest processing, and marketing logistics) attributable to post-subsidy energy costs.
- Measure the statistical relationship between elevated operational costs and the institutional creditworthiness indicators of selected agribusiness cooperatives.
- Evaluate the structural shift in cooperative financing patterns from formal commercial/development banks to informal financial networks (e.g., ROSCAs, traditional esusu, and informal aggregators).
- Provide actionable policy recommendations and alternative agricultural financing frameworks capable of insulating cooperative creditworthiness from future macroeconomic shocks.

➢ *Research Hypotheses*

- H01: There is no significant relationship between post-subsidy energy costs and shifts in the operational expenditures of agribusiness cooperatives in Nigeria.
- H02: Elevated operational costs following the fuel subsidy removal have no significant quantitative impact on the institutional creditworthiness indicators (Net Profit Margin, Debt-Service Coverage Ratio, and Current Ratio) of selected agribusiness cooperatives.
- H03: The erosion of formal creditworthiness in the post-subsidy era has not triggered a significant structural shift in cooperative financing patterns from formal commercial/development banks to informal financial networks.
- H04: There is no significant difference in the transaction costs, borrowing capacities, and financial sustainability implications for agribusiness cooperatives utilizing informal networks compared to those utilizing formal financial channels.

## II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

➢ *Conceptual Review*

- *Fuel Subsidy and the Macroeconomic Reality of Deregulation*

A subsidy constitutes any government intervention either via direct fiscal transfers, tax exemptions, or state-backed price controls that artificially lowers the market clearing cost of a commodity relative to its global benchmark (Adeoti et al., 2016). In Nigeria, the Premium Motor Spirit (PMS) fuel subsidy historically served as an implicit, regressive social safety net. While originally intended to buffer domestic consumer prices against global oil volatility, the fiscal burden became unsustainable, culminating in the complete deregulation policy executed in mid-2023 (Adelaja et al., 2024). Under a fully deregulated regime, domestic fuel pump prices are untethered from administrative price caps and bound explicitly to global crude valuation, exchange rate fluctuations, and landing costs.

The immediate macroeconomic reality of deregulation is a cost-push inflationary spiral. Because fuel behaves as an essential intermediate input with near-inelastic demand across Nigerian industries, its pricing determines the baseline operational index of transportation, heavy machinery, and local power generation (Onyakwa& Yusuf, 2024). The eradication of the subsidy resulted in an over 200% surge in pump prices within months, driving structural inflation upwards and triggering a sharp depreciation of the purchasing power of the Naira. In the context of rural and agricultural sectors, this policy represents a sudden supply-side shock that alters the relative prices of production factors, placing structural strain on enterprise profitability.

- *Agribusiness Cooperatives and Agricultural Aggregation*

Agribusiness cooperatives are user-owned, user-controlled institutional enterprises structured to pull smallholder farmers into unified legal and economic blocks to achieve economies of scale, maximize bargaining leverage, and distribute market risks (Verhofstadt & Maertens, 2014). In Nigeria's fragmented agricultural market, where smallholders account for over 80% of total output, these cooperatives act as critical institutional buffers. By institutionalizing collective action, they enable resource-poor farmers to access production inputs, mechanical technology, and premium commercial downstream buyers that would otherwise be inaccessible on an individualized basis.

Central to the survival of the rural economy is the process of agricultural aggregation. Aggregation involves the physical assembly, standardization, sorting, storage, and bulk distribution of highly dispersed smallholder yields (Barrett et al., 2022). Agribusiness cooperatives bridge the physical and logistical divide between fragmented farm-gate outputs and urban industrial demand. As agricultural aggregators, cooperatives bear the primary risk of supply chain delays, post-harvest losses, and localized transport bottlenecks. Consequently, any macroeconomic disruption that drives up the costs of running rural assembly centers or hauling physical cargo directly impacts the economic stability of the cooperative entity and its smallholder base.

- *Operational Cost Structure of Agribusiness*

The operational cost framework of an agribusiness cooperative is traditionally disaggregated into three distinct expense vectors: production costs, post-harvest processing costs, and marketing logistics expenses. Each vector functions as an energy-dependent node uniquely exposed to price variations in the domestic fuel market. Within this framework, production expenditures encompass the cash outlays tied directly to field-level operations. In contemporary Nigerian farming, this includes mechanized land preparation, such as tilling and tractor leasing, as well as mechanized irrigation systems. Because these mechanical assets run predominantly on internal combustion engines powered by PMS or diesel, fuel cost hikes expand baseline tillage costs per hectare (Aruaji et al., 2025).

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Beyond initial field operations, post-harvest processing expenditures constitute a separate operational node where raw agricultural commodities, which are typically highly perishable and low-value by volume, must be handled. Aggregators utilize localized milling, shelling, drying, and cooling systems to add value and prolong shelf life. In rural Nigeria, where the public electricity grid is largely absent or unreliable, these processing units rely heavily on localized diesel or gasoline generators. Consequently, the removal of the fuel subsidy directly elevates the per-unit processing cost of staple grains and tubers (Ogunleye & Alabi, 2024).

Finally, marketing logistics expenses represent the single most vulnerable cost node in the post-subsidy era. This segment comprises the haulage of aggregated cargo from remote farm-gates to primary assembly markets and urban distribution points. Given Nigeria's heavy reliance on road transport networks and its poorly maintained rural infrastructure, fuel cost-push shocks scale transport tariffs exponentially, thereby increasing transit friction and squeezing operational margins (Umaru et al., 2025).

- *Institutional Creditworthiness Metrics*

Institutional creditworthiness denotes the quantified capacity and structural willingness of an organization to honor its financial obligations completely and within designated timelines. Commercial banks, microfinance institutions, and development lenders evaluate this property through standardized financial accounting ratios that reflect profitability, operational efficiency, leverage, and liquidity (Sathyamoorthi et al., 2020). When macroeconomic shocks compress operating margins, these creditworthiness indices deteriorate, triggering institutional disqualification from formal capital markets.

This study focuses primarily on three key ratios, beginning with the net profit margin, which is expressed as the ratio of net income to total revenue. Net profit margin reflects the ultimate efficiency of a cooperative in managing its aggregate cost structures relative to gross sales. In an environment characterized by severe fuel inflation, if a cooperative cannot completely pass its elevated operational expenses onward to downstream consumers, its net profit margin collapses, signaling to lenders that the enterprise lacks a baseline economic buffer (Ajayi & Babalola, 2024).

In tandem with profitability, lenders scrutinize the debt-service coverage ratio, which is calculated as net operating income divided by total debt service obligations. The debt-service coverage ratio serves as the cornerstone metric used by commercial and development banks to evaluate a borrower's structural capacity to repay debt principal and interest. A debt-service coverage ratio below the critical threshold of 1.0 implies that the cooperative's operating cash flows are insufficient to cover basic debt liabilities, instantly categorizing the agribusiness as a high-default risk (Katchova & Enlow, 2013).

Complementing these long-term solvency concerns is the current ratio, represented by total current assets divided by total current liabilities. This liquidity index measures the cooperative's capacity to settle short-term debts maturing within a single calendar year using its highly liquid assets. When escalating fuel expenses drain physical cash reserves faster than inventory can be converted, the current ratio falls, indicating acute, systemic working capital distress and a heightened probability of technical insolvency (Sathyamoorthi et al., 2020).

- *Formal Banking Channels vs. Informal Financial Networks*

The financial market architecture in developing agricultural economies is structurally dualistic, comprising a formal banking channel and an extensive, informal financial shadow economy (Aryeetey, 2008). Understanding the divergence between these channels is critical for evaluating how agribusinesses cope with systemic funding gaps.

Formal banking channels are highly structured, government-regulated financial institutions. They include commercial deposit banks and specialized state development lenders like the Bank of Agriculture (BOA). These formal institutions allocate capital using stringent, objective criteria: verifiable financial accounting histories, standardized credit scores, formal corporate governance structures, and landed collateral requirements. While formal channels offer substantial borrowing capacities and non-usurious, regulated interest rates, their operational frameworks are highly inflexible and heavily dependent on the applicant maintaining clean creditworthiness metrics (Mpuga, 2010).

Conversely, informal financial networks are community-based, non-regulated capital pooling mechanisms built upon social capital, localized trust, and peer monitoring (Ghosh & Vinod, 2017). Within the Nigerian agricultural landscape, these take the form of Rotating Savings and Credit Associations (ROSCAs), traditional community 'esusu' pools, and informal downstream trade aggregators. Informal networks bypass traditional accounting audits and physical asset collateral, relying instead on reputational risk and social collateral to enforce repayment terms. However, these networks are structurally constrained: they feature significantly lower borrowing capacities, charge high implicit or explicit transaction costs, and are highly vulnerable to localized covariate shocks, which limits their long-term financial sustainability.

➢ *Analysis of Gaps in the Literature*

A systematic appraisal of contemporary literature reveals three critical thematic, methodological, and conceptual gaps that this study explicitly addresses. These vulnerabilities in previous academic outputs present a clear barrier to developing targeted microeconomic interventions for the agricultural cooperative space.

The vast majority of emerging empirical studies evaluating the macroeconomic aftermath of the Nigerian fuel subsidy removal focus disproportionately on the individual welfare of smallholder farmers or generalized urban households. Scholarship by researchers (e.g., Adelaja

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et al., 2022; Iyiola et al., 2022) examines micro-level vulnerabilities, including decreased household real income and individual farm labor adjustments. However, there is a glaring scarcity of literature analyzing how these shocks cascade into organized agribusiness cooperatives operating as institutional aggregators. Cooperatives do not merely farm; they pool, store, treat, and haul massive volumes of multi-grower output. By treating agriculture as a highly individualistic enterprise rather than a corporate network, previous studies fail to capture how energy inflation compounds across the entire midstream value chain of collective aggregators.

Existing literature on energy policy shifts in Nigeria relies heavily on subjective, descriptive, and perception-based data models. Several studies employ qualitative interviews, Likert scales, or simple logit regressions to capture how severely market actors feel affected by price hikes. While helpful for establishing baseline sociological impact, these approaches present a significant methodological deficit: they do not tie energy inflation to verifiable, standardized accounting metrics. Previous research acknowledges that profitability drops when fuel costs surge, but it fails to trace this impact using rigorous financial indicators such as Net Profit Margin (NPM), Debt-Service Coverage Ratio (DSCR), and Current Ratio. This study bridges this gap by shifting from qualitative descriptions of hardship to a structured corporate finance framework, mapping energy expenses directly onto institutional balances and solvency indices (e.g., Ajayi & Babalola, 2024; Echebiri&Edaba, 2024).

Traditional financing literature frequently treats formal and informal credit systems as separate, parallel pathways chosen primarily based on demographic traits like literacy, geography, or collateral availability. Recent evaluations of post-subsidy survival mechanisms acknowledge that small-and-medium enterprises (SMEs) source capital from friends or micro-lenders during crises (Onyeizugbe et al., 2024). However, current frameworks fail to establish a direct causal link between macroeconomic energy policies and systemic structural drift. Specifically, existing research lacks a mechanism to show how policy-induced cost shocks undermine formal credit ratings, thereby forcing previously bankable, structured institutions into highly fragmented informal networks like Rotating Savings and Credit Associations (ROSCAs), traditional esusu, and private informal aggregators (Adegbite et al., 2024). This study fills this conceptual void by exploring how the deterioration of formal credit metrics acts as the direct structural driver behind the informalization of cooperative agricultural capital.

## III. METHODOLOGY

➢ *Research Design*

The study is framed as an ex-post facto investigation combining a cross-sectional questionnaire with retrospective financial-record analysis. These components must be distinguished analytically: questionnaire responses are collected once per cooperative, whereas accounting records may provide repeated cooperative-year observations. The final version must identify which data source is used for each variable and each model, the years actually available, and whether the panel is balanced. Because the policy change was not experimentally assigned, the design supports analysis of associations and temporal changes but does not, by itself, identify the causal effect of subsidy removal.

➢ *Target Population*

The target population is described as 1,250 registered agricultural aggregation and marketing cooperatives across Nigeria's six geopolitical zones. Eligibility is defined as continuous operation across the study period and active involvement in midstream aggregation, processing, storage, or bulk marketing logistics. The final manuscript must cite the source and date of the population frame, state how registration and eligibility were verified, and clarify whether cooperatives with records only through part of 2026 were eligible. Until those records are documented, the population figure should be treated as the study's stated frame rather than an independently verified national count.

➢ *Sampling Technique and Sample Size*

The sampling procedure is described as multistage: stratification by the six geopolitical zones, selection of two states per zone, and purposive inclusion of cooperatives with the required financial records. Because the final stage is purposive, the achieved sample is not a simple probability sample of all Nigerian cooperatives. The manuscript should name the selected states, document the sampling frame and selection counts at each stage, and explain how the audited-record eligibility criterion may affect representativeness. The Yamane calculation is presented as a planning reference; it does not independently establish power or precision for panel regressions.

$$n = N / [1 + N(e)^2]$$

Here, n denotes the planning sample size, N = 1,250 is the stated population frame, and e = 0.05. The calculation gives $n = 1{,}250/[1 + 1{,}250(0.05^2)] = 1{,}250/4.125 = 303.03$, or approximately 303 cooperatives. The study reports a target of 360 and 334 completed instruments, giving a response rate of $334/360 \times 100 = 92.78\%$. The final report must also state the number of cooperatives included in each financial-data model, since the number of questionnaire responses is not necessarily the number of cooperative-year observations.

➢ *Data Sources and Instrumentation*

The study reports two data sources: (1) a structured questionnaire, described as the Agribusiness Cooperative Operational and Financing Shift Questionnaire (ACOFSQ), and (2) cooperative financial statements. The final manuscript must specify which variables come from each source and whether survey responses are matched to financial records using a unique cooperative identifier. The stated comparison uses 2021–2022 as the pre-policy period and 2024–2026 as the post-policy period, omitting 2023. The exclusion of 2023 requires a substantive explanation and a sensitivity check. Any 2026 observations must be

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labelled accurately as full-year, year-to-date, or partial-year data; incomplete calendar-year data must not be represented as full-year results.

➢ *Model Specification and Operationalization of Variables*

To examine the relationships specified in the research hypotheses, the manuscript proposes three model families. The equations below require final alignment with the variables and estimators actually used in the statistical software. Because the design is observational, the models should be described as estimating associations unless a separate causal identification strategy is justified.

$$OPEX_it = \beta_0 + \beta_1(FUEL_it) + \beta_2(MCH_it) + \beta_3(INFRA_it) + \varepsilon_it$$

$$CRED_it = \alpha_0 + \alpha_1(OPEX_it) + \alpha_2(SIZE_it) + \alpha_3(AGE_it) + \mu_it$$

$$INFO_it = \gamma_0 + \gamma_1(CRED_it) + \gamma_2(TCOST_it) + \gamma_3(CAP_it) + \nu_it$$

Where:

OPEXdenotes aggregate operational expenditures (sub-divided into production, processing, and logistics costs);

FUEL represents the per-liter market price of premium motor spirit or diesel;

MCHis the mechanization index;

INFRAsignifies infrastructure friction (measured via transit distance and logistical bottlenecks to primary urban distribution hubs);

CRED denotes creditworthiness indicators. NPM, DSCR, and CR are distinct outcomes and should be estimated in separate equations unless a clearly defined multivariate model or validated composite measure is used;

SIZEis the organizational asset scale;

AGE represents the years of formal cooperative operation;

INFO must be defined consistently as either (a) the share of informal borrowing in the total debt portfolio or (b) a categorical financing-channel outcome. These are different dependent variables and require different estimators; the final analysis must select the measure actually present in the dataset;

TCOSTdenotes comparative transaction expenses;

CAPis the credit borrowing capacity;

β, α, and γrepresent the parameter coefficients; and

ε, μ, and νdenote the stochastic error terms across cooperatives i over time period t.

➢ *Methods of Data Analysis*

The analysis is intended to combine descriptive statistics with inferential models. The final methods section must name the estimator used for each outcome rather than presenting alternatives (“Tobit or multinomial logistic regression”). If INFO is a proportion, the model must be appropriate for a bounded outcome; if it is a categorical financing channel, a categorical-response model may be appropriate. The methods should report only diagnostics actually conducted and give each test statistic, degrees of freedom where applicable, p-value, decision rule, and resulting modelling action. The final analysis must also address repeated observations within cooperatives and use an appropriate standard-error strategy.

If the data support a two-way fixed-effects specification, it should be written as $Y_it = \beta' X_it + \mu_i + \lambda_t + \varepsilon_it$, where $\mu_i$ represents cooperative fixed effects and $\lambda_t$ represents year fixed effects. The final manuscript must confirm whether this estimator was actually used and report the number of cooperatives and observations, the fixed effects included, and the standard-error method. A national fuel price that varies only by year may be collinear with year fixed effects; the authors must explain the source of identifying variation before reporting a separate fuel-price coefficient.

## IV. RESULTS AND DISCUSSION

The manuscript reports 334 completed instruments from a target of 360, equivalent to a response rate of 92.78% (92.8% rounded). The descriptive profile in Table 1 should be checked against the final respondent-level dataset. Claims that institutional maturity or value-chain specialisation reduced the likelihood of informal borrowing require supporting cross-tabulations or model estimates; they cannot be inferred from the profile counts alone. The financing-source counts in Table 1 must also be treated as separate marginal counts unless matched cooperative-level data establish actual transitions between pre- and post-policy financing channels.

The current draft reports a Hausman statistic of $\chi^2 = 34.28$ ($p < 0.001$) and a mean VIF of 2.14. These figures should be retained only after they are checked against the original statistical output. The final version should state the Hausman degrees of freedom, the variables included in the test, the VIF values by predictor, and the results of any other diagnostics actually conducted. A significant Hausman test may support fixed effects over random effects under the test’s assumptions, but it does not by itself establish that all model assumptions or standard-error choices are valid.

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Table 1 Institutional Profile and Demographic Distribution of Sampled Cooperatives (N = 334)

| Cooperative characteristic / financing-source measure | Frequency (n) | Percentage (%) |
|---|---|---|
| Primary Value Chain Specialization | | |
| Grain Aggregation and Milling | 142 | 42.5 |
| Tuber Processing and Starch Extraction | 104 | 31.1 |
| Horticultural Cold-Chain Storage | 88 | 26.4 |
| Institutional Age Profile | | |
| Emerging (Less than 5 Years) | 61 | 18.3 |
| Established (5 to 10 Years) | 181 | 54.2 |
| Mature (More than 10 Years) | 92 | 27.5 |
| Geopolitical Zone Distribution | | |
| North-West Region | 54 | 16.2 |
| North-East Region | 49 | 14.7 |
| North-Central Region | 58 | 17.4 |
| South-West Region | 64 | 19.1 |
| South-South Region | 52 | 15.6 |
| South-East Region | 57 | 17.0 |
| Primary Capital Source Paradigm Shift | | |
| Pre-period: commercial-bank focus (reported) | 255 | 76.3 |
| Post-period: informal-network use (reported; not a verified transition count) | 230 | 68.9 |

Source: Researcher's Computations Using SPSS (2026)

The following results are provisional because the displayed model statistics in the current draft do not fully reconcile. Table 2 reports $R^2 = 0.742$ and adjusted $R^2 = 0.738$, while the narrative previously described 0.742 as adjusted $R^2$ and attributed the full model's explanatory power to fuel prices alone. These statements are not equivalent. The regression must be rerun or checked against the original output before H01 is accepted or rejected. In particular, the fuel-price coefficient must be identified as standardised or unstandardised, the predictor labels must match the actual model, and the reported F-statistic must be reconciled with the estimator and its degrees of freedom. No causal interpretation should be made from the current table alone.

Table 2 OLS Panel Regression Estimates for Operational Expenditures (Hypothesis One)

| Predictor Variable | Coefficient (β) | Standard Error | t-Statistic | p-Value |
|---|---|---|---|---|
| Constant Intercept | 142500.40 | 12450.20 | 11.45 | < 0.001*** |
| Fuel Price Inflation (PMS) | 0.814 | 0.065 | 12.43 | < 0.001*** |
| Infrastructure Friction | 0.342 | 0.081 | 4.22 | < 0.001*** |
| **Model summary (reported; verify against output)** | -0.156 | 0.052 | -3.00 | 0.003** |
| Model Summary R-Squared: 0.742 | Adjusted R2: 0.738 | | F-Statistic Value: 184.56 | Prob > F: < 0.001*** |

Source: Researcher's Computations Using SPSS (2026)

Table 3 presents lower post-period means for NPM, DSCR, and CR than the corresponding pre-period means. Based on the printed means, the absolute differences are −0.143 for NPM, −0.860 for DSCR, and −0.980 for CR. These are descriptive differences, not independently verified regression effects. The reported t-statistics and coefficients must be reconstructed from the original data and output. The final analysis must identify whether the observations are paired, independent, or repeated annual measurements and use the corresponding test or panel model. The reported increase in the share with DSCR below 1.0 (4.2% to 62.3%) also requires actual counts, denominators, and an appropriate test for the data structure. H02 should not be decided until these checks are complete.

Table 3 Financial Accounting Ratios Under Energy Shock Conditions (Hypothesis Two)

| Financial metric | Pre-Subsidy Mean | Post-Subsidy Mean | Reported test statistic (verify) | Significance Level |
|---|---|---|---|---|
| Net Profit Margin (NPM) | 0.185 | 0.042 | -9.21 | < 0.001*** |
| Debt-Service Coverage Ratio (DSCR) | 1.640 | 0.780 | -11.04 | < 0.001*** |
| Current Ratio (Liquidity Matrix) | 2.120 | 1.140 | -7.35 | < 0.001*** |
| Share of Cooperatives with DSCR < 1.0 | 4.2% | 62.3% | 14.82 | < 0.001*** |

Source: Researcher's Computations Using SPSS (2026)

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The current draft describes a multinomial logistic regression for financing-channel choice, but the dependent variable is not consistently distinguished from the informal-borrowing share or from an actual pre/post transition. Table 4.4 also contains odds-ratio, standard-error, z-statistic, log-likelihood, and pseudo-$R^2$ values that do not reconcile under the conventional interpretation. For example, an odds ratio of 4.12 corresponds to a log-odds coefficient of approximately 1.416; if 0.36 is the standard error of that coefficient, the implied z-statistic is approximately 3.93 rather than 8.64. The reported log likelihood and LR chi-square imply a conventional McFadden pseudo-$R^2$ of approximately 0.242, not 0.485. These are diagnostic calculations, not substitute estimates. Table 4 must be rebuilt from the original output, with the outcome categories, reference category, coefficients, standard errors, odds ratios, confidence intervals, and model-fit statistics fully specified. The current results do not establish that financing changes were involuntary or caused solely by the subsidy policy.

Table 4 Multinomial Logistic Regression Tracing Induced Structural Shift (Hypothesis Three)

| Categorical Dependent: Informal Sourcing Choice | Reported odds ratio (verify) | Reported SE (scale unclear) | z-Statistic | p-Value |
|---|---|---|---|---|
| Net Profit Margin Collapse | 3.24 | 0.41 | 5.46 | < 0.001*** |
| Debt-Service Coverage Ratio Below 1.0 | 4.12 | 0.36 | 8.64 | < 0.001*** |
| Current Ratio Deterioration | 2.15 | 0.28 | 4.11 | < 0.001*** |
| Log-Likelihood Metric: -241.56 | Pseudo R-Squared: 0.485 | | LR Chi-Square Value: 154.20 | Prob > Chi2: < 0.001*** |

Source: Researcher's Computations Using SPSS (2026)

Table 5 reports a descriptive difference between the stated annualised financing costs of 31.0% for informal channels and 16.5% for formal channels, equal to 14.5 percentage points. This arithmetic difference is correct, but its statistical significance cannot be verified from the table as presented. The borrowing-capacity figures, settlement-time difference, and sustainability coefficient lack sufficient definitions and supporting output. The reported ranges of 45–90 days and 1–2 days do not uniquely imply a 43.5-day mean difference. The manuscript also mentions a structural equation model without specifying it in the methods. The final version must define comparable outcomes, group sizes, estimation methods, standard errors or confidence intervals, and tests. Remove the unsupported SEM claim if no such model was estimated. H04 should remain undecided until the comparisons are reproduced.

Table 5 Comparative Structural Parameters of Formal vs. Informal Networks (Hypothesis Four)

| Analytical Evaluation Parameter | Formal Financial System | Informal Capital Networks | Difference / note (inferential support to verify) |
|---|---|---|---|
| Mean Effective Cost of Capital | 16.5% Annual | 31.0% Annualized Equivalent | +14.5 percentage points; significance not verified |
| Borrowing Volume Capacity Depth | High (Up to N100M+) | Severely Constrained (< N18M) | Reported −82%; calculation and denominator not supplied |
| Collateral Infrastructure Demanded | Audited Assets & Land Titling | Social Collateral & Trust Matrices | Absolute Divergence |
| Transaction Settlement Horizon | 45 to 90 Processing Days | 1 to 2 Execution Days | Reported −43.5 days; not derivable from ranges alone |
| Long-Term Structural Sustainability | Stable Funding Pipeline | Systemic Default Liquidity Loop | Reported −0.689; outcome/model/SE not specified |

Source: Researcher's Computations Using SPSS (2026)

The proposed interpretation is that higher energy and logistics costs may be associated with weaker operating margins, lower debt-service capacity, and changes in the financing channels used by agribusiness cooperatives. This mechanism is consistent with credit-rationing theory, but the current numerical inconsistencies prevent a definitive inference about the magnitude of these relationships. In addition, the observed period includes other macroeconomic changes, including exchange-rate and inflation shocks. The final discussion should therefore distinguish observed associations from causal effects and consider alternative explanations for the use of informal finance, including speed, convenience, social trust, collateral requirements, and documentation costs.

## V. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This study examines how the post-May 2023 macroeconomic environment may be associated with the operating costs, financial-ratio indicators, and financing choices of Nigerian agribusiness cooperatives. The manuscript reports lower post-period means for NPM, DSCR, and CR and a higher share of cooperatives with DSCR below 1.0. However, the regression and test statistics require reconciliation against the underlying data before the magnitude and significance of these relationships can be stated conclusively. The reported 74.2% model-fit statistic must not be attributed solely to fuel prices unless a valid unique-contribution analysis supports that claim. Likewise,

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financing-channel changes should not be described as caused by credit exclusion without evidence of matched transitions and a credible identification strategy.

The study raises an important policy question about whether rising energy and logistics costs weaken cooperative financial indicators and increase reliance on informal finance. Informal channels may provide timely liquidity but can also involve limited loan sizes, variable costs, and repayment arrangements that are difficult to compare with formal loans. These conclusions should be presented as implications to be tested and refined once the statistical results have been verified, rather than as established causal effects. The policy options below are therefore best framed as proposals for evaluation rather than recommendations justified conclusively by the current regression tables.

Based on these findings, three core strategic policy recommendations are put forward:

- The Central Bank of Nigeria and relevant agricultural-finance institutions could assess the feasibility of an energy-resilience refinancing facility for eligible agricultural cooperatives. Any proposed interest-rate cap, eligibility rule, guarantee structure, and fiscal cost should be supported by a transparent feasibility and risk assessment.
- Relevant public agencies and development partners could evaluate targeted support for solar-powered milling, cooling, irrigation, and processing infrastructure where life-cycle cost analysis demonstrates financial and operational viability.
- Financial regulators and development-finance institutions could pilot a risk-managed linkage between regulated lenders and verified cooperative or community-based savings networks. Such a framework would require clear governance, consumer-protection safeguards, transparent pricing, credit-risk allocation, and monitoring before wider implementation.

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