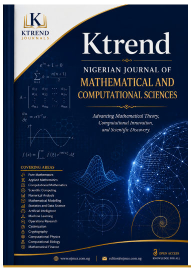

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A Mathematical Modeling Framework for Protest Dynamics, State Coercion, and Public Trust: Evidence from the 2024 #EndBadGovernance Protests in Nigeria

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Abstract. *The 2024 #EndBadGovernance protests in Nigeria emerged amid severe economic hardship, rising food prices, currency depreciation, unemployment, and declining confidence in public institutions. This paper develops a nonlinear mathematical framework that links economic hardship, digital mobilization, protest intensity, state coercion, public trust, and political efficacy. A five-dimensional autonomous system of ordinary differential equations is formulated and calibrated using quantitative relationships reported in a cross-sectional survey of 2,540 respondents, state-level digital engagement indicators, a Difference-in-Differences analysis, and a Structural Equation Model. The model is shown to be mathematically well posed: solutions remain nonnegative and enter a bounded positively invariant region. A protest activation threshold, denoted by* $\mathcal{R}_p$*, is derived. The protest-free equilibrium is locally asymptotically stable when* $\mathcal{R}_p < 1$ *and unstable when* $\mathcal{R}_p > 1$*, whereas a unique persistent-protest equilibrium exists for* $\mathcal{R}_p > 1$ *and is locally asymptotically stable under the stated parameter conditions. Sensitivity indices show that economic hardship, digital amplification, and recruitment responsiveness increase protest persistence, while grievance resolution and effective non-coercive de-escalation reduce it. Model-based numerical scenarios reproduce the observed pattern in which digital engagement increases protest intensity, coercion accelerates the erosion of public trust, and excessive coercion weakens citizens' institutional political efficacy without removing the underlying economic grievance.*

Keywords: nonlinear dynamical system; protest threshold; state coercion; public trust; political efficacy; digital mobilization; stability analysis; Nigeria; #EndBadGovernance

Mathematics Subject Classification (2020): 34D20; 34C60; 37N40; 91D10; 93A30

1. Introduction

Nigeria has a long history of civic resistance, from anti-colonial movements and labour actions to recent digitally coordinated demonstrations. The 2024 #EndBadGovernance protests were driven primarily by the rising cost of living, food insecurity, unemployment, currency depreciation, and dissatisfaction with public institutions. The protests also demonstrated the growing capacity of decentralized digital communication to transform dispersed grievances into coordinated physical action [14, 18, 19].

Most existing studies of Nigerian protest movements are historical, descriptive, sociological, or

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Vol. 1, Issue 2(2026)

econometric. Such approaches are essential, but they do not fully explain the time-dependent feedback among hardship, mobilization, coercive response, institutional trust, and political efficacy. In particular, a rise in hardship can increase mobilization; mobilization may induce coercive response; coercion can temporarily suppress street participation while simultaneously reducing public trust; and low trust can preserve the grievance environment that generates future mobilization. These feedback loops naturally motivate a dynamical-systems formulation.

The original quantitative study underlying this paper reported that digital engagement was strongly associated with protest intensity ($\beta = 0.68$), economic hardship was the strongest antecedent of mobilization in the Structural Equation Model ($\beta = 0.75$), mobilization increased coercive response ($\beta = 0.48$), and coercion reduced political efficacy ($\beta = -0.58$) and public trust ($\beta = -0.42$). A Difference-in-Differences estimate further indicated a larger post-protest decline in public trust in states with high-intensity repression (-0.45, $p = 0.001$). The present paper transforms these empirical relations into a coherent mathematical model.

The main contributions are as follows. First, a five-state nonlinear model is developed for hardship, protest mobilization, state coercion, public trust, and political efficacy. Second, positivity and boundedness of solutions are established. Third, a protest activation threshold $\mathcal{R}_p$ is derived and used to characterize the stability of the protest-free state. Fourth, the existence and local stability of a persistent-protest equilibrium are examined. Fifth, normalized sensitivity indices identify the parameters with the greatest influence on protest persistence. Finally, the mathematical model is connected to the reported regression, Difference-in-Differences, Structural Equation Model, and Public Trust Index results.

2. Empirical Motivation and Data Structure

The empirical component combines four sources of quantitative evidence:

(i) state-level digital engagement with the #EndBadGovernance hashtag and related terms;
(ii) event-based measures of arrests, curfews, security deployment, and other coercive actions;
(iii) a cross-sectional Public Trust Index survey of $N = 2{,}540$ Nigerian respondents; and
(iv) state-level economic and demographic controls.

The reported regression model explained 52% of the variation in protest intensity, with digital engagement as the dominant predictor. The Difference-in-Differences model compared states with high-intensity repression to states with low or no repression. The interaction coefficient was negative and statistically significant, indicating that coercion was associated with an additional decline in public trust. The SEM provided a directional empirical structure for the dynamic model.

The survey means reinforce this structure. Trust was very low for the Nigeria Police Force (1.78) and the Presidency/Federal Government (1.92), while belief that peaceful protests can produce change was comparatively high (3.64). This contrast suggests that citizens may distrust formal institutions while retaining confidence in collective action.

3. Model Formulation

3.1. State variables

Let $t \geq 0$ denote time. The model variables are normalized or scaled nonnegative quantities:

- $H(t)$: intensity of economic hardship;
- $M(t)$: intensity of active protest mobilization;
- $C(t)$: intensity of state coercion or restrictive response;

Table 1: Empirical relationships used to guide model construction

Relationship	Estimate	p-value	Model implication
Digital engagement → protest intensity	0.68	< 0.001	Digital amplification increases protest recruitment
Economic hardship → mobilization	0.75	< 0.001	Hardship is the principal grievance driver
Mobilization → coercion	0.48	0.005	Security response rises with protest intensity
Coercion → political efficacy	-0.58	< 0.001	Coercion weakens institutional efficacy
Coercion → public trust	-0.42	< 0.001	Coercion accelerates trust erosion
DiD: post-period × high repression	-0.45	0.001	High-repression states experience additional trust loss

- $T(t)$: public trust in governance institutions, with $0 \leq T(t) \leq 1$;
- $E(t)$: institutional political efficacy, with $0 \leq E(t) \leq 1$.

Digital communication is represented by the nonnegative index D. Over a short protest episode, D is treated as an external amplification parameter. For longer studies, it may be replaced by a time-dependent function or an additional differential equation.

3.2. Assumptions

The model is based on the following assumptions:

A1. Economic hardship is generated at an average rate Λ and is reduced by policy relief, adaptation, income recovery, or inflation moderation at rate μ_H.

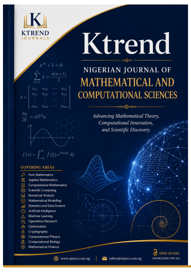
A2. Protest recruitment is proportional to current mobilization, hardship, and digital amplification. Recruitment saturates as mobilization approaches the carrying level K.

A3. Mobilization declines through fatigue, grievance resolution, negotiation, or withdrawal at rate δ, and is additionally suppressed by coercion at rate ηC.

A4. Coercive response increases with protest intensity at rate ρ and decays at rate ω when restrictions, deployments, or emergency measures are relaxed.

A5. Public trust recovers toward its upper bound through institutional responsiveness at rate λ_T, but is eroded by hardship and coercion.

A6. Institutional political efficacy increases when collective action appears meaningful, but decreases under coercion and ordinary political disengagement.



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Vol. 1, Issue 2(2026)

3.3. Governing equations

Under these assumptions, the dynamics are represented by

$$\frac{dH}{dt} = \Lambda - \mu_H H, \tag{1}$$

$$\frac{dM}{dt} = \left[\beta H(1+\alpha D)\left(1-\frac{M}{K}\right) - \delta - \eta C\right] M, \tag{2}$$

$$\frac{dC}{dt} = \rho M - \omega C, \tag{3}$$

$$\frac{dT}{dt} = \lambda_T(1-T) - \gamma_H HT - \gamma_C CT, \tag{4}$$

$$\frac{dE}{dt} = \sigma M(1-E) - \kappa CE - \nu E. \tag{5}$$

All parameters are nonnegative, and the parameters governing natural removal or decay are strictly positive.

Table 2: Model parameters and interpretations

Parameter	Unit	Interpretation
Λ	hardship/time	inflow or accumulation of economic hardship
μ_H	time^{-1}	rate of hardship reduction
β	hardship^{-1}time^{-1}	protest recruitment responsiveness
α	index^{-1}	digital amplification coefficient
D	index	digital mobilization intensity
K	mobilization	effective mobilization carrying capacity
δ	time^{-1}	protest fatigue, withdrawal, negotiation, and grievance-resolution rate
η	coercion^{-1}time^{-1}	immediate suppression effect of coercion
ρ	time^{-1}	coercive-response activation per unit mobilization
ω	time^{-1}	relaxation rate of coercive measures
λ_T	time^{-1}	institutional trust-recovery rate
γ_H	hardship^{-1}time^{-1}	erosion of trust due to hardship
γ_C	coercion^{-1}time^{-1}	erosion of trust due to coercion
σ	mobilization^{-1}time^{-1}	efficacy gain associated with meaningful collective action
κ	coercion^{-1}time^{-1}	coercion-induced loss of efficacy
ν	time^{-1}	ordinary decay of political efficacy

4. Qualitative Analysis

4.1. Existence, uniqueness, and positivity

Let $X = (H, M, C, T, E)^\top$. The right-hand side of equations (1)–(5) is continuously differentiable on $\mathbb{R}^5_+$ and is therefore locally Lipschitz.

Theorem 4.1 (Well-posedness and positivity)**.** *For every initial condition*

$$H(0) \geq 0, \quad M(0) \geq 0, \quad C(0) \geq 0, \quad 0 \leq T(0) \leq 1, \quad 0 \leq E(0) \leq 1,$$

the model admits a unique solution. Moreover, the solution remains nonnegative for all $t \geq 0$*, and* $T(t), E(t) \in [0, 1]$.

Ktrend - Nigerian Journal of Mathematical and Computational Sciences
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Vol. 1, Issue 2(2026)

Proof. Local existence and uniqueness follow from local Lipschitz continuity. On the coordinate boundaries,

$$\left.\frac{dH}{dt}\right|_{H=0} = \Lambda \geq 0, \quad \left.\frac{dM}{dt}\right|_{M=0} = 0, \quad \left.\frac{dC}{dt}\right|_{C=0} = \rho M \geq 0.$$

Also,

$$\left.\frac{dT}{dt}\right|_{T=0} = \lambda_T \geq 0, \qquad \left.\frac{dT}{dt}\right|_{T=1} = -(\gamma_H H + \gamma_C C) \leq 0,$$

and

$$\left.\frac{dE}{dt}\right|_{E=0} = \sigma M \geq 0, \qquad \left.\frac{dE}{dt}\right|_{E=1} = -(\kappa C + \nu) \leq 0.$$

Hence no trajectory crosses out of the feasible region. Continuation of the local solution follows from the boundedness result below. □

4.2. Boundedness

Theorem 4.2 (Positive invariant region)**.** *Every solution with feasible initial data eventually enters and remains in*

$$\Omega = \left\{(H, M, C, T, E) \in \mathbb{R}^5_+ : H \leq H_{\max},\ 0 \leq M \leq K_M,\ C \leq C_{\max},\ 0 \leq T, E \leq 1\right\},$$

where $H_{\max} = \max\{H(0), \Lambda/\mu_H\}$*,* $K_M = \max\{M(0), K\}$*, and* $C_{\max} = \max\{C(0), \rho K_M/\omega\}$*.*

Proof. Equation (1) has the explicit solution

$$H(t) = \frac{\Lambda}{\mu_H} + \left(H(0) - \frac{\Lambda}{\mu_H}\right) e^{-\mu_H t},$$

so $H(t) \leq H_{\max}$. If $M \geq K$, the recruitment term in (2) is nonpositive and $dM/dt \leq -(\delta + \eta C)M < 0$; hence M cannot remain above K_M. Since $M \leq K_M$ eventually,

$$\frac{dC}{dt} \leq \rho K_M - \omega C,$$

which yields $C(t) \leq C_{\max}$ by comparison. The bounds for T and E follow from the positivity theorem. □

5. Equilibria and the Protest Activation Threshold

At equilibrium, equation (1) gives

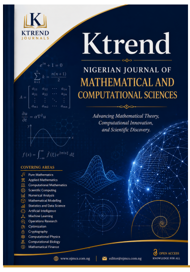
$$H^* = H_0 = \frac{\Lambda}{\mu_H}.$$

The effective per-capita mobilization growth rate near $M = 0$ and $C = 0$ is $\beta H_0(1 + \alpha D) - \delta$. This motivates the following threshold.

Definition 5.1 (Protest activation threshold)**.** The protest activation threshold is

$$\mathcal{R}_p = \frac{\beta H_0(1 + \alpha D)}{\delta} = \frac{\beta \Lambda(1 + \alpha D)}{\mu_H \delta}. \tag{6}$$

It measures the average strength of grievance-driven and digitally amplified protest recruitment relative to the rate at which mobilization dissipates.



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Vol. 1, Issue 2(2026)

5.1. Protest-free equilibrium

Setting $M = C = E = 0$ gives the protest-free equilibrium

$$\mathcal{P}_0 = (H_0, 0, 0, T_0, 0), \qquad T_0 = \frac{\lambda_T}{\lambda_T + \gamma_H H_0}. \tag{7}$$

Even in the absence of active protest, persistent hardship can keep institutional trust below its maximum value.

Theorem 5.2 (Local stability of the protest-free equilibrium)**.** *The protest-free equilibrium $\mathcal{P}_0$ is locally asymptotically stable if $\mathcal{R}_p < 1$ and unstable if $\mathcal{R}_p > 1$.*

Proof. The Jacobian matrix evaluated at $\mathcal{P}_0$ is block triangular after a suitable ordering of variables. Its eigenvalues include

$$-\mu_H, \quad -\omega, \quad -(\lambda_T + \gamma_H H_0), \quad -\nu,$$

and the mobilization eigenvalue

$$\lambda_M = \beta H_0(1 + \alpha D) - \delta = \delta(\mathcal{R}_p - 1).$$

All eigenvalues have negative real parts when $\mathcal{R}_p < 1$. If $\mathcal{R}_p > 1$, then $\lambda_M > 0$, so $\mathcal{P}_0$ is unstable. □

5.2. Persistent-protest equilibrium

For $M^* > 0$, equations (2) and (3) give

$$C^* = \frac{\rho}{\omega} M^*$$

and

$$\beta H_0(1 + \alpha D)\left(1 - \frac{M^*}{K}\right) - \delta - \eta \frac{\rho}{\omega} M^* = 0.$$

Therefore,

$$M^* = \frac{\delta(\mathcal{R}_p - 1)}{\dfrac{\delta \mathcal{R}_p}{K} + \dfrac{\eta\rho}{\omega}}, \qquad C^* = \frac{\rho}{\omega} M^*. \tag{8}$$

The remaining equilibrium components are

$$T^* = \frac{\lambda_T}{\lambda_T + \gamma_H H_0 + \gamma_C C^*}, \tag{9}$$

$$E^* = \frac{\sigma M^*}{\sigma M^* + \kappa C^* + \nu}. \tag{10}$$

Proposition 5.3 (Existence and uniqueness)**.** *A unique biologically and socially feasible persistent-protest equilibrium $\mathcal{P}_1 = (H_0, M^*, C^*, T^*, E^*)$ exists if and only if $\mathcal{R}_p > 1$.*

Proof. The denominator in (8) is positive. Thus $M^* > 0$ exactly when $\mathcal{R}_p > 1$. Once M^* is fixed, the values C^*, T^*, and E^* are uniquely determined and lie in their feasible ranges. □

Theorem 5.4 (Local stability of the persistent-protest equilibrium)**.** *Whenever $\mathcal{R}_p > 1$, the persistent-protest equilibrium $\mathcal{P}_1$ is locally asymptotically stable.*

ISSN: 3141-643X
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Vol. 1, Issue 2(2026)

Proof. The hardship direction contributes the negative eigenvalue $-\mu_H$. At $\mathcal{P}_1$, the (M, C) subsystem has Jacobian

$$J_{MC} = \begin{pmatrix} -aM^* & -\eta M^* \\ \rho & -\omega \end{pmatrix}, \qquad a = \frac{\beta H_0(1+\alpha D)}{K} > 0.$$

Its trace is $-(aM^* + \omega) < 0$ and its determinant is $M^*(a\omega + \eta\rho) > 0$. Hence both eigenvalues have negative real parts. The trust and efficacy diagonal terms are

$$-(\lambda_T + \gamma_H H_0 + \gamma_C C^*) < 0$$

and

$$-(\sigma M^* + \kappa C^* + \nu) < 0,$$

respectively. Since the full Jacobian can be arranged in block lower-triangular form with these stable diagonal blocks, all eigenvalues have negative real parts. □

6. Sensitivity Analysis

For a parameter p, the normalized forward sensitivity index of $\mathcal{R}_p$ is

$$\Upsilon_p^{\mathcal{R}_p} = \frac{\partial \mathcal{R}_p}{\partial p} \frac{p}{\mathcal{R}_p}.$$

Using (6),

$$\Upsilon_\beta^{\mathcal{R}_p} = 1, \qquad \Upsilon_\Lambda^{\mathcal{R}_p} = 1, \qquad \Upsilon_{\mu_H}^{\mathcal{R}_p} = -1, \qquad \Upsilon_\delta^{\mathcal{R}_p} = -1,$$
$$\Upsilon_D^{\mathcal{R}_p} = \frac{\alpha D}{1+\alpha D}, \qquad \Upsilon_\alpha^{\mathcal{R}_p} = \frac{\alpha D}{1+\alpha D}.$$

Thus, a 1% increase in recruitment responsiveness β or hardship inflow Λ produces a 1% increase in $\mathcal{R}_p$. A 1% increase in hardship reduction μ_H or mobilization dissipation δ produces a 1% decrease in $\mathcal{R}_p$. The sensitivity to digital mobilization is positive but bounded above by one.

This result has an important interpretation. Coercion parameters η, ρ, and ω do not appear in the invasion threshold because coercion is activated after mobilization begins. They do, however, influence the magnitude of the persistent-protest equilibrium and the long-run levels of trust and efficacy. Consequently, coercion may reduce visible mobilization without removing the economic and digital conditions that make renewed protest possible.

Ktrend - Nigerian Journal of Mathematical and Computational Sciences

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Vol. 1, Issue 2(2026)

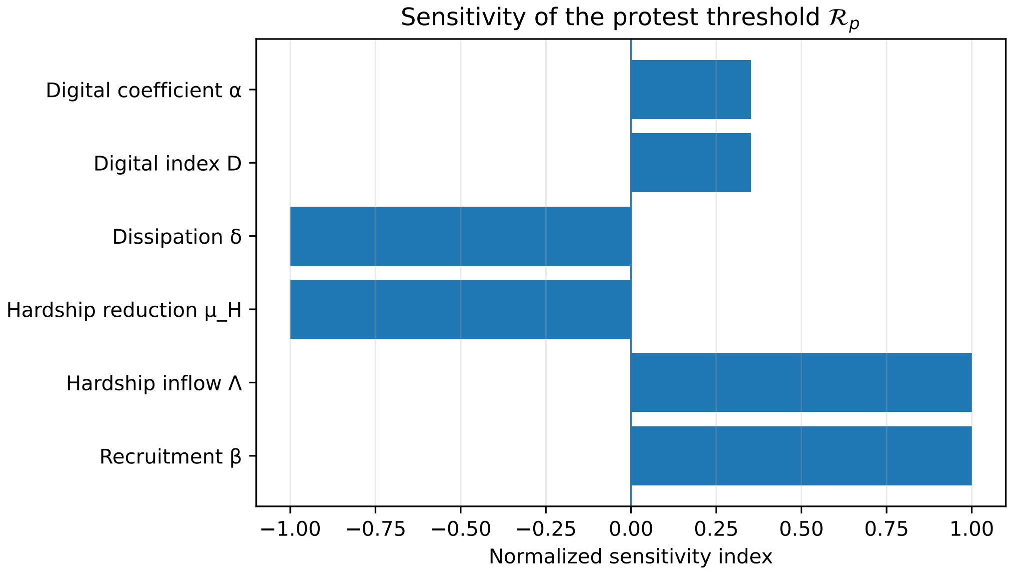

Figure 1: Normalized forward sensitivity indices of the protest activation threshold $\mathcal{R}_p$. Positive bars identify parameters that increase the threshold, whereas negative bars identify parameters that reduce it.

Figure 1 shows that the largest threshold-reducing interventions operate through μ_H and δ. In practical terms, policies that reduce the persistence of hardship and increase voluntary grievance resolution have a direct one-for-one proportional effect on $\mathcal{R}_p$. Digital sensitivity is smaller at the baseline because its elasticity is $\alpha D/(1 + \alpha D) = 0.352$; however, this elasticity approaches one as digital penetration and amplification increase.

7. Numerical Analysis and Graphical Results

7.1. Numerical method and reproducibility

The nonlinear initial-value problem was solved on $0 \le t \le 80$ weeks using the adaptive Dormand–Prince explicit Runge–Kutta method of orders four and five (RK45). Relative and absolute tolerances were fixed at 10^{-9} and 10^{-11}, respectively. The initial condition was

$$(H(0), M(0), C(0), T(0), E(0)) = (0.55, 0.025, 0.01, 0.62, 0.32).$$

The solution was evaluated at intervals of 0.1 week. Numerical non-negativity was verified at every output point, and the terminal values were compared with the analytical equilibria in equations (7)–(10). The small differences between the terminal numerical values and the exact equilibria are due to the finite integration horizon rather than instability or numerical error.

The original study did not provide a complete longitudinal record for all state variables. Therefore, the exercise is a calibrated scenario analysis rather than an assertion that the parameters are uniquely estimated causal quantities. The reported regression, DiD, and SEM coefficients determine signs and relative scales, while the ODE simulations reveal the dynamic implications of those relationships.

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Vol. 1, Issue 2(2026)

Table 3: Baseline parameter values used for numerical analysis

Λ	μ_H	β	α	D	K	δ	η
0.080	0.100	0.140	0.680	0.800	1.000	0.110	0.250
ρ	ω	λ_T	γ_H	γ_C	σ	κ	ν
0.480	0.350	0.100	0.120	0.420	0.200	0.580	0.080

At baseline, $H_0 = 0.8$ and

$$\mathcal{R}_p = \frac{(0.14)(0.8)[1 + (0.68)(0.8)]}{0.11} = 1.5721 > 1.$$

Consequently, the protest-free equilibrium is unstable. The analytical persistent-protest equilibrium is

$$\mathcal{P}_1 = (0.8000, 0.1220, 0.1673, 0.3756, 0.1211).$$

The numerical terminal state at week 80 is

$$(0.7999, 0.1179, 0.1604, 0.3812, 0.1193),$$

which is already close to $\mathcal{P}_1$ and continues toward it as the integration horizon increases.

7.2. Baseline trajectory analysis

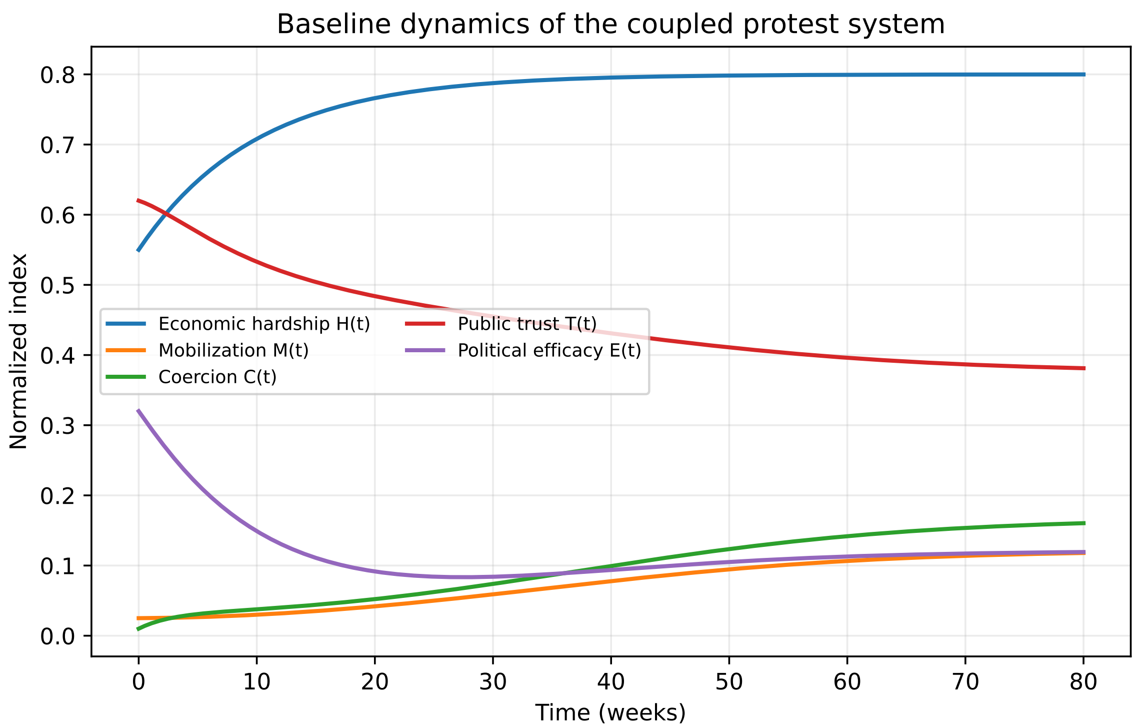

Figure 2: Numerical solution of the baseline five-dimensional system. Hardship converges independently to $H_0 = 0.8$. Mobilization and coercion approach positive equilibrium levels, while public trust and institutional political efficacy settle at comparatively low values.

ISSN: 3141-643X
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Vol. 1, Issue 2(2026)

Figure 2 displays the complete coupled dynamics. Economic hardship rises from 0.55 to its equilibrium value 0.8. Since $\mathcal{R}_p > 1$, the initially small mobilization does not disappear; instead, it grows gradually and activates the coercive-response equation. Coercion follows mobilization with a delay because $C'(t) = \rho M - \omega C$. Trust declines from 0.62 toward approximately 0.376, reflecting the combined effects of sustained hardship and coercion. Political efficacy initially responds to collective mobilization through $\sigma M(1 - E)$, but the negative terms κCE and νE dominate in the long run.

The baseline trajectory also confirms the local-stability result. No persistent oscillation or divergence is observed; all components approach the analytically derived equilibrium. The monotone hardship component and the damped adjustment of the remaining variables are consistent with the negative real parts of the equilibrium eigenvalues.

7.3. Comparative policy scenarios

Four scenarios were examined:

S1. baseline hardship and digital amplification;
S2. economic relief and dialogue, with $\mu_H = 0.16$ and $\delta = 0.16$;
S3. intensified coercion, with $\eta = 0.50$ and $\rho = 0.75$;
S4. stronger digital amplification, with $D = 1.20$ and $\alpha = 0.80$.

Table 4: Numerical comparison of the four dynamic scenarios at week 80

Scenario	$\mathcal{R}_p$	$\max M$	$\max C$	$M(80)$	$T(80)$	$E(80)$
Baseline	1.572	0.118	0.160	0.118	0.381	0.119
Relief and dialogue	0.676	0.025	0.026	0.0003	0.624	0.002
Intensified coercion	1.572	0.050	0.107	0.050	0.416	0.066
High digital amplification	1.996	0.195	0.267	0.195	0.325	0.142

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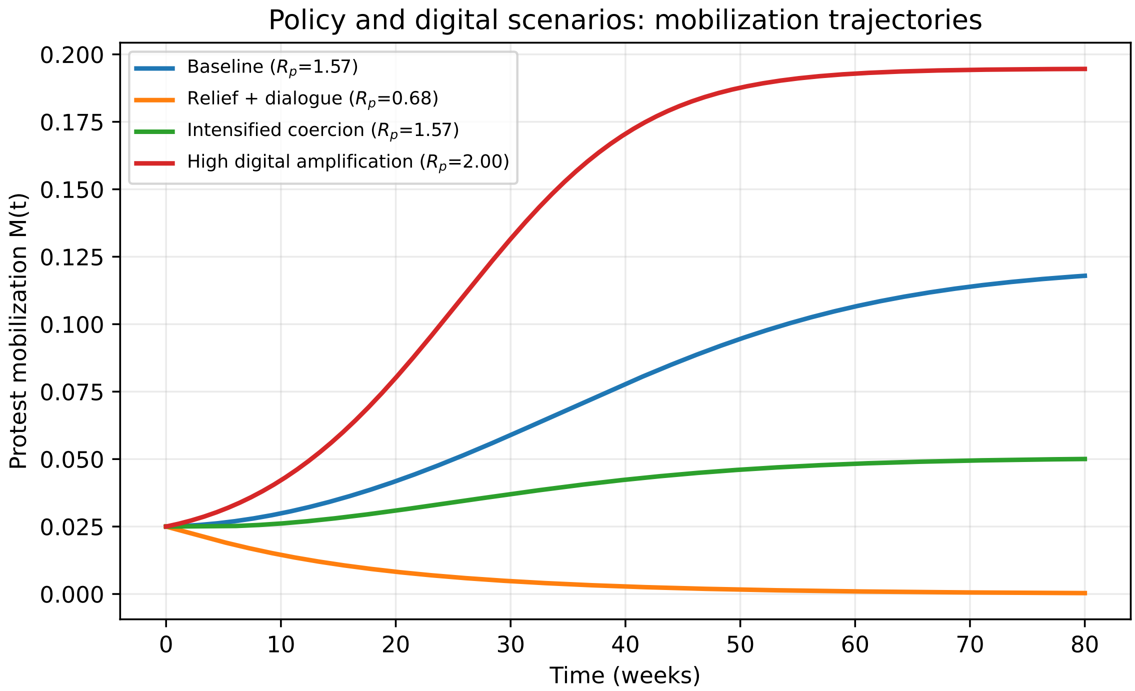

Figure 3: Protest mobilization trajectories under the four scenarios. Relief and dialogue drive $\mathcal{R}_p$ below unity and eliminate persistent mobilization. Intensified coercion reduces visible protest but leaves the activation threshold unchanged.

Figure 3 separates threshold-changing policies from level-changing policies. Economic relief and dialogue reduce $\mathcal{R}_p$ to 0.6755, making the protest-free equilibrium stable. Mobilization consequently decays from 0.025 to approximately 3.4×10^{-4}. By contrast, intensified coercion leaves $\mathcal{R}_p = 1.5721$ because the threshold is determined before reactive coercion becomes active. It lowers the persistent visible mobilization from approximately 0.122 to 0.051, but it does not remove the instability of the protest-free state. Stronger digital amplification increases $\mathcal{R}_p$ to 1.9956 and raises the persistent mobilization equilibrium to approximately 0.195.

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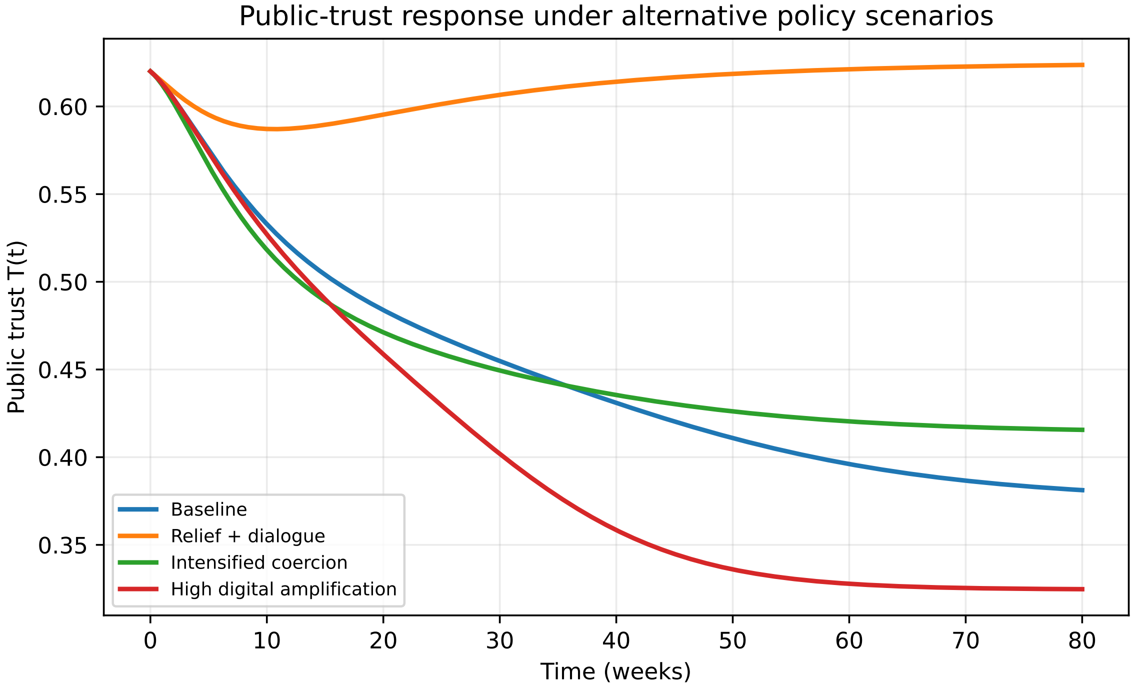

Figure 4: Public-trust trajectories under alternative scenarios. Relief and dialogue produce the highest long-run trust. High digital amplification produces the lowest trust because greater mobilization induces a stronger coercive response.

Figure 4 demonstrates that the best trust outcome is obtained by reducing hardship and resolving grievances. The relief-and-dialogue trajectory approaches $T_0 = 0.625$. High digital amplification produces the lowest terminal trust, $T(80) = 0.325$, because the resulting mobilization generates the highest coercion. Intensified coercion produces a terminal trust of 0.416, higher than the baseline in this particular calibration because its stronger suppression term sharply lowers mobilization and hence lowers the equilibrium coercion stock relative to the high-digital case. This result should not be interpreted as a general benefit of repression: increasing the trust-damage coefficient γ_C or slowing coercion relaxation ω reverses that comparison. The robust conclusion is that coercion does not reduce $\mathcal{R}_p$ and therefore cannot remove the underlying activation mechanism.

ISSN: 3141-643X
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Vol. 1, Issue 2(2026)

7.4. Threshold geometry

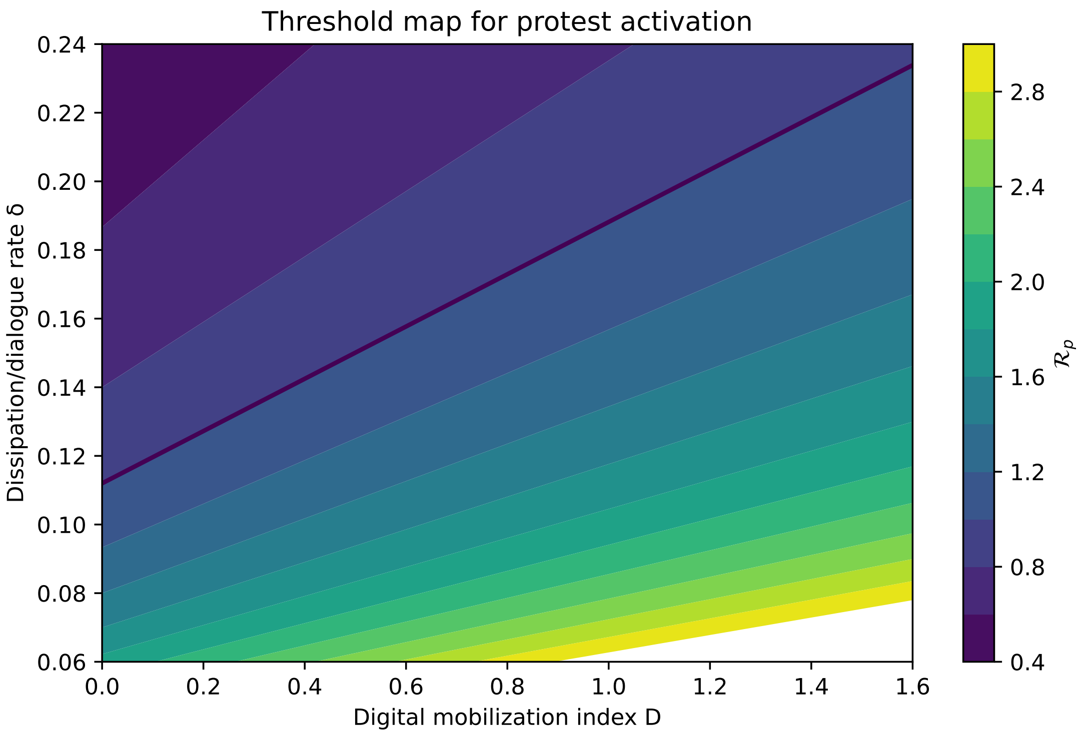

Figure 5: Contour map of $\mathcal{R}_p$ as a function of digital mobilization D and the dissipation/dialogue rate δ. The bold contour is the critical boundary $\mathcal{R}_p = 1$; points below that boundary correspond to persistent protest, while sufficiently large δ moves the system into the protest-free stability region.

The threshold map in Figure 5 provides a two-parameter bifurcation interpretation. For fixed hardship, increased digital mobilization requires a proportionately stronger dialogue, fatigue, or grievance-resolution rate to maintain $\mathcal{R}_p < 1$. Solving $\mathcal{R}_p = 1$ for δ gives the critical curve

$$\delta_c(D) = \frac{\beta\Lambda}{\mu_H}(1 + \alpha D). \tag{11}$$

Thus, the protest-free state is stable precisely when $\delta > \delta_c(D)$. At the baseline digital level $D = 0.8$, the critical value is $\delta_c = 0.1729$, which exceeds the baseline $\delta = 0.11$. This analytically explains why the baseline trajectory converges to a persistent-protest state.

7.5. Additional equilibrium response analysis

From equation (8), the equilibrium protest intensity satisfies

$$\frac{\partial M^*}{\partial \eta} < 0, \qquad \frac{\partial M^*}{\partial \rho} < 0, \qquad \frac{\partial M^*}{\partial \omega} > 0,$$

for $\mathcal{R}_p > 1$. Hence stronger suppression and faster coercive activation reduce visible equilibrium mobilization, whereas rapid withdrawal of coercive measures permits a larger visible protest equilibrium. However,

$$\frac{\partial T^*}{\partial C^*} = -\frac{\lambda_T \gamma_C}{(\lambda_T + \gamma_H H_0 + \gamma_C C^*)^2} < 0,$$

Ktrend - Nigerian Journal of Mathematical and Computational Sciences

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Vol. 1, Issue 2(2026)

and

$$\frac{\partial E^*}{\partial C^*} = -\frac{\sigma M^* \kappa}{(\sigma M^* + \kappa C^* + \nu)^2} < 0$$

when M^* is held fixed. These derivatives expose the central policy trade-off: coercion can reduce the observed protest level while directly depressing trust and efficacy. A complete policy comparison must therefore consider both M^* and the legitimacy variables T^* and E^* rather than minimizing mobilization alone.

8. Connection with the Statistical Results

8.1. Digital engagement and protest intensity

The regression coefficient 0.68 supports the positive sign assigned to α and the multiplicative term $1+\alpha D$ in equation (2). The model predicts that the marginal effect of digital engagement is strongest when hardship and existing mobilization are already substantial. This interaction is not visible in an additive linear regression but follows naturally from the nonlinear formulation.

8.2. Coercion and public trust

Equation (4) specifies the instantaneous coercion-related decline in trust as $-\gamma_C CT$. The DiD interaction estimate of -0.45 and the SEM path of -0.42 justify a relatively large positive value of γ_C. The multiplicative form also reflects the fact that the same coercive shock may have a smaller absolute effect when trust is already near zero.

8.3. Coercion and political efficacy

The term $-\kappa CE$ represents the observed negative path from coercion to political efficacy. The model distinguishes institutional efficacy from belief in collective protest. The survey result that respondents still believed peaceful protest could produce change, despite weak trust in officials, suggests that collective efficacy may remain high even while $E(t)$, interpreted as confidence in formal political responsiveness, is low.

8.4. Economic hardship as the principal driver

The SEM coefficient 0.75 motivates the direct role of H in the protest recruitment term. Since $H_0 = \Lambda/\mu_H$, fiscal relief, employment recovery, food-price stabilization, and other measures that increase μ_H reduce $\mathcal{R}_p$ directly. This is the primary policy pathway for moving the system below the activation threshold.

9. Discussion

The threshold $\mathcal{R}_p$ provides a concise mathematical summary of the conditions under which small-scale mobilization either dissipates or expands. When the product of economic hardship, recruitment responsiveness, and digital amplification exceeds the rate of voluntary mobilization loss, the protest-free state becomes unstable. The result formalizes the idea that protest is not generated by a single cause but by the interaction of grievance, communication, and collective responsiveness.

A central insight is the distinction between suppressing the current protest level and eliminating the conditions for future protest. Coercion reduces $M(t)$ through the term $-\eta CM$, but it does not enter $\mathcal{R}_p$ because the coercive apparatus is activated in response to mobilization. If hardship and digital recruitment remain high, the protest-free state remains unstable. Moreover, coercion reduces

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Vol. 1, Issue 2(2026)

$T(t)$ and $E(t)$, potentially making future institutional engagement less credible.

The model also explains why a government may observe temporary street-level calm while facing a worsening legitimacy problem. A high η can lower M^*, but a high ρ raises C^* and thereby lowers T^* and E^*. This trade-off is consistent with the empirical result that repression was associated with a larger post-protest decline in public trust.

The framework supports a combined policy strategy. Economic relief reduces H_0; credible dialogue and grievance resolution increase δ; transparent institutional reform increases λ_T; and restraint in the use of force reduces the trust and efficacy penalties governed by γ_C and κ. Policies that operate only through coercion may reduce visible participation but cannot guarantee $\mathcal{R}_p < 1$.

10. Limitations and Future Extensions

The model is deliberately parsimonious. First, digital mobilization is treated as an external index. A future model could include a separate equation for online attention, misinformation, counter-messaging, and network saturation. Second, Nigeria is spatially heterogeneous. A metapopulation or network model could represent state-to-state diffusion and regional differences in political identity. Third, the present framework does not distinguish peaceful participants, violent actors, security agents, and non-participating citizens. Fourth, the numerical scenarios are calibrated from reported coefficients rather than estimated from a complete longitudinal dataset. Future work should estimate parameters using daily protest-event data, social-media time series, inflation indicators, and repeated trust surveys.

Stochastic extensions may represent sudden triggering events, internet restrictions, unanticipated policy announcements, or external shocks. Optimal-control analysis could compare the cost and effectiveness of economic relief, dialogue, communication, and security deployment. Fractional-order formulations may also be useful when grievance and trust exhibit long memory.

11. Conclusion

This paper developed a nonlinear mathematical model for the interaction of economic hardship, digital mobilization, protest intensity, state coercion, public trust, and political efficacy during the 2024 #EndBadGovernance protests in Nigeria. The model is positively invariant and bounded, admits a protest-free equilibrium, and yields a threshold quantity $\mathcal{R}_p$ that determines whether small mobilizations decline or expand. A unique persistent-protest equilibrium exists when $\mathcal{R}_p > 1$.

The analysis shows that hardship reduction, grievance resolution, and non-coercive de-escalation directly lower the protest threshold. Coercion can reduce current mobilization but may simultaneously deepen distrust and weaken institutional political efficacy. The reported regression, DiD, SEM, and survey findings are consistent with these mechanisms. The model therefore provides an applied-mathematical basis for understanding why coercion alone may produce short-term control without long-term political stability.

Conflict of Interest

The authors declare no conflict of interest.

References

[1] O. Abayomi, "Consequences of fuel subsidy removal on Nigeria's balance of trade," *Vanguard*, June 18, 2023.

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DOI: 10.5281/zenodo.21683148
Vol. 1, Issue 2(2026)

[2] O. A. Aluko, "Leadership and governance crisis in Nigeria: The case of the #EndSARS protest," *Journal of Public Administration and Governance*, vol. 11, no. 2, pp. 246–257, 2021. doi:10.5296/jpag.v11i2.18733.

[3] Amnesty International, "Nigeria: Repression of peaceful protest must end," 2024.

[4] B. Archibong, T. Merenhout, and E. Osabuohien, "Protest matters: The effects of protests on economic redistribution," ICTD Working Paper 155, 2023. doi:10.19088/ICTD.2023.003.

[5] M. S. Bakari and J. S. Mai-lafiya, "Fiscal federalism and resource governance in Nigeria: Rethinking equity and efficiency," *International Journal of African Sustainable Development Research*, vol. 12, no. 2, 2026. doi:10.70382/tijasdr.v12i2.092.

[6] Chatham House, *Taking Action against Corruption in Nigeria: A Crisis of Trust*, 2025. doi:10.55317/9781784136390.

[7] O. Chidiebere and I. D. Chichem, "Aba Women's Riot of 1929: A revolution that reshaped colonial governance in Nigeria," *Interdisciplinary Journal of African and Asian Studies*, vol. 12, no. 1, pp. 29–34, 2026.

[8] E. Chukwu and Okoro, "Policy reforms and public reaction in Nigeria: A study of the Tinubu administration's early tenure," *West African Journal of Political Science*, vol. 42, no. 3, pp. 88–109, 2023.

[9] E. Emma, O. F. Jacob, E. D. Joseph, Q. I. Busayo, and J. C. Emmanuel, "Digital activism and collective resistance to police brutality: Systematic review of the quieter and less visible narratives of #EndSARS protest," *Social Sciences and Humanities Open*, vol. 12, 2025. doi:10.1016/j.ssaho.2025.101722.

[10] T. Falola and A. Genova, Eds., *The History of Nigeria*. Greenwood Press, 2009.

[11] B. Howard, "Let the poor breathe! Poverty and anti-government protests in Nigeria," Afrobarometer, 2025.

[12] J. A. Kelechi and O. O. Angela, "EndSARS protest and resource security in Nigeria: Reflections on the 2020 COVID era," *Journal of Conflict and Social Transformation*, vol. 14, no. 1, 2025.

[13] N. A. Kenechukwu and C. N. Ngozi, "Women, war and trauma: Perspectives from South-Eastern Nigeria," *International Journal of Research Publication and Reviews*, vol. 5, no. 3, pp. 4857–4865, 2024.

[14] Kimpact Development Initiative, *Beyond the Protests: Addressing Systemic Challenges*, 2025.

[15] E. Mmesoma, "Nigeria's #EndBadGovernance protest and the demand for systemic reforms," African Liberty, 2025.

[16] O. O. Moka, O. O. Chris-Obadigie, and I. E. Ogbebor, "Protests commercialisation and protests franchising: An analytics of EndSARS and End Bad Governance crises in Nigeria," *Journal of Social Theory and Research*, vol. 4, no. 2, pp. 1–18, 2025.

[17] A. Nasser, C. Neil, S. Shrabani, and K. Safdar, "The role of youth bulge on political instability: Cross-country evidence," *Economic Analysis and Policy*, vol. 76, pp. 1053–1074, 2022. doi:10.1016/j.eap.2022.09.013.

[18] U. Ndubuisi and J. Nneji, "Protests and the challenge of addressing unresolved socioeconomic and political issues in Nigeria's 2024 End Bad Government movement," *Gusau Journal of Sociology*, vol. 4, pp. 118–129, 2025. doi:10.57233/gujos.v4i4.08.

[19] P. Obi-Ani, E. Aniche, K. Udegbunam, N. Umeokafor, and V. Ekwelem, "Social media and the #EndSARS protest in Nigeria: A critical discourse analysis," *Media, Culture and Society*, vol. 44, no. 2, pp. 304–319, 2022. doi:10.1177/01634437211011489.

[20] E. Obinna, "EndBadGovernance protests: One year on, still no justice for victims of police brutality," Amnesty International, 2025.

[21] G. K. Sanusi and Y. T. Baba, "Political trust and legitimacy crisis in the age of COVID-19: An assessment of the EndSARS protest in Nigeria," *Frontiers in Political Science*, vol. 6, 1334843, 2024. doi:10.3389/fpos.2024.1334843.

[22] SBM Intelligence, *Assessing the Early Days of the #EndBadGovernance Protests in Nigeria*, 2024.

[23] M. Selepe, "The evaluation of public policy implementation failures and possible solutions," *EUREKA: Social and Humanities*, no. 1, pp. 43–53, 2023. doi:10.21303/2504-5571.2023.002736.

[24] S. A. Tope and P. A. Philip-Chika, "Diaspora and transnational activism: The role of the Nigerian diaspora in amplifying the #EndSARS protests," *International Studies Journal*, vol. 9, no. 6, 2025. doi:10.64633/wissj.v9i6.25.

A. Public Trust Index Questionnaire

This appendix reproduces the questionnaire used in the underlying Public Trust Index survey reported in the empirical component of the study. The instrument was administered for academic research purposes, and respondents were informed that their responses would be treated confidentially.

A.1. Introduction to respondents

This questionnaire is designed to assess public trust in key Nigerian governance institutions. All responses are confidential and will be used solely for academic research purposes. Please answer each question as honestly as possible and select only one response for each item.

A.2. Section A: Demographic and contextual information

Please select the appropriate option or fill in the blank where necessary.

A1. State of residence: ________________________________

A2. Age group (years):

☐ 18–25
☐ 26–35
☐ 36–45
☐ 46–55

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Vol. 1, Issue 2(2026)

☐ 56 and above

A3. Highest level of education attained:

☐ No formal education
☐ Primary School Leaving Certificate
☐ Secondary School Certificate (SSCE/GCE)
☐ National Diploma (ND)/Higher National Diploma (HND)
☐ University degree (B.Sc./B.A. or equivalent)
☐ Postgraduate degree (M.Sc./Ph.D. or equivalent)

A4. Employment status:

☐ Employed (formal sector)
☐ Employed (informal sector)
☐ Self-employed/business owner
☐ Student
☐ Unemployed/job seeker

A.3. Section B: Public Trust Index instrument

Please indicate your current level of trust in each governance institution by ticking one response. The response scale is:

1 = Very low trust; 2 = Low trust; 3 = Moderate trust; 4 = High trust; 5 = Very high trust.

Table 5: Public Trust Index items and response options

Institution	1	2	3	4	5
The Presidency/Federal Government	☐	☐	☐	☐	☐
Your State Governor/State Government	☐	☐	☐	☐	☐
The Nigeria Police Force (NPF)	☐	☐	☐	☐	☐
The Nigerian Military (Army, Navy, and Air Force)	☐	☐	☐	☐	☐
The National Assembly (Senate and House of Representatives)	☐	☐	☐	☐	☐
The Judiciary/Courts of Law	☐	☐	☐	☐	☐
The Independent National Electoral Commission (INEC)	☐	☐	☐	☐	☐
Anti-Corruption Agencies (e.g., EFCC and ICPC)	☐	☐	☐	☐	☐

A.4. Section C: Perceived political efficacy

These items measure the extent to which respondents believe that their actions, or the collective actions of citizens, can influence the political system. Please indicate your level of agreement with each statement using the following scale:

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Vol. 1, Issue 2(2026)

1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree.

Table 6: Political efficacy items and response options

Statement	**1**	**2**	**3**	**4**	**5**
Citizens like me have a say in the way the Federal Government is run.	☐	☐	☐	☐	☐
Peaceful protests can lead to real, positive policy changes in Nigeria.	☐	☐	☐	☐	☐
Public officials care about what ordinary people think.	☐	☐	☐	☐	☐
I believe the government will take steps to address hardship and inflation in the next year.	☐	☐	☐	☐	☐

A.5. Scoring and coding procedure

For Section B, responses are coded from 1 (very low trust) to 5 (very high trust). An institutional trust score may be computed as the mean of the eight completed trust items. For Section C, responses are coded from 1 (strongly disagree) to 5 (strongly agree). Item-level means are reported separately because the items distinguish internal, external, and collective political efficacy. Higher values indicate greater trust or stronger agreement with the stated efficacy belief. Missing responses should be recorded as missing values rather than replaced automatically.