

Regulus: AI-Assisted Policy Simulation for African Governance



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Simulate Before You Decide.

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1. Motivation

Public policy decisions across Sub-Saharan Africa are routinely implemented **without structured simulation or scenario testing**, directly impacting millions without prior verification.

The scale of the problem:

- Sub-Saharan Africa accounts for $\approx 60\%$ of global extreme poverty ($\approx 389\text{M}$ people) [1]
- A 1% growth in per-capita GDP reduces poverty by only 1% in Africa vs. 2.2% globally [1]
- Subsidy removal simulation without mitigation tracks a 1.2% poverty increase [2]

OECD (2025) [4] calls for AI-assisted ex ante policy evaluation — Regulus operationalises this for African governance contexts where dense, internet-dependent modelling pipelines are unavailable.

2. Related Work & Research Gap

- PolicySpace2** [6]: endogenous agent model using 66 calibration parameters. Requires dense spatial arrays and extensive expert calibration.
- XAI Frameworks** [5]: governance systems must remain strictly “glass-box” and auditable for public transparency.

Tool	Expert Sparse Africa		
PolicySpace2	Yes	No	No
Vensim / iThink	Yes	No	No
Regulus	No	Yes	Yes

Table 1. Comparison of policy simulation tools.

Research gap: No lightweight, explainable, locally adaptable policy simulation pipeline exists for data-sparse, low-connectivity decision environments.

3. Simulation Model

Impact score formula

$$S_d(p, m) = \sum_{i=1}^N \left[w_i(d) \cdot f_i(p, m) \cdot C_i \right] \quad (1)$$

p = policy, m = magnitude, $w_i(d)$ = data-calibrated causal weight [3, 1], f_i = factor response, C_i = confidence coefficient.

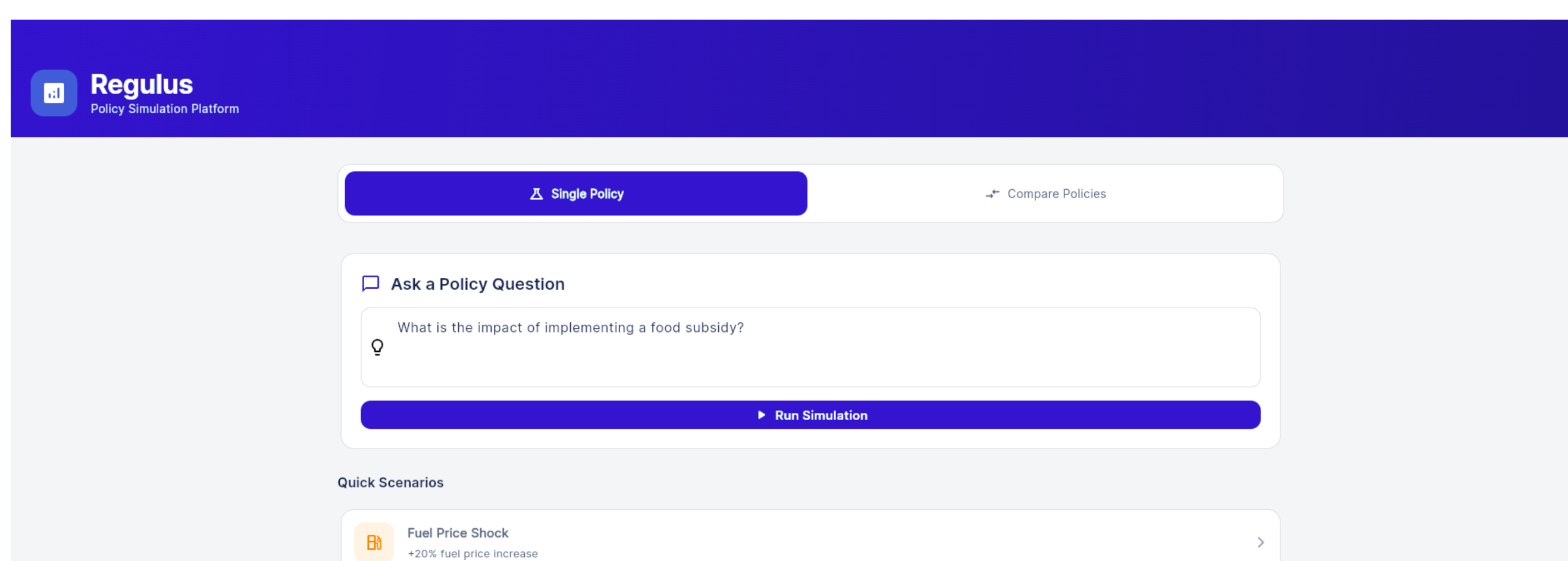
Composite risk index

$$R(p) = \alpha \cdot S_{\text{inf}}(p) + \beta \cdot S_{\text{soc}}(p) + \gamma \cdot S_{\text{fis}}(p), \quad \alpha + \beta + \gamma = 1 \quad (2)$$

Novel contribution — confidence-weighted scoring: C_i explicitly embeds sparse-data uncertainty directly into every output score. No existing African policy simulation tool does this.

● High (1.0) ● Medium (0.6) ● Low (0.3)

Live Prototype



4. Regulus Architecture

A three-layer hybrid architecture: deterministic calibration engines evaluate numerical operations while an accompanying language model structures queries and explains results.

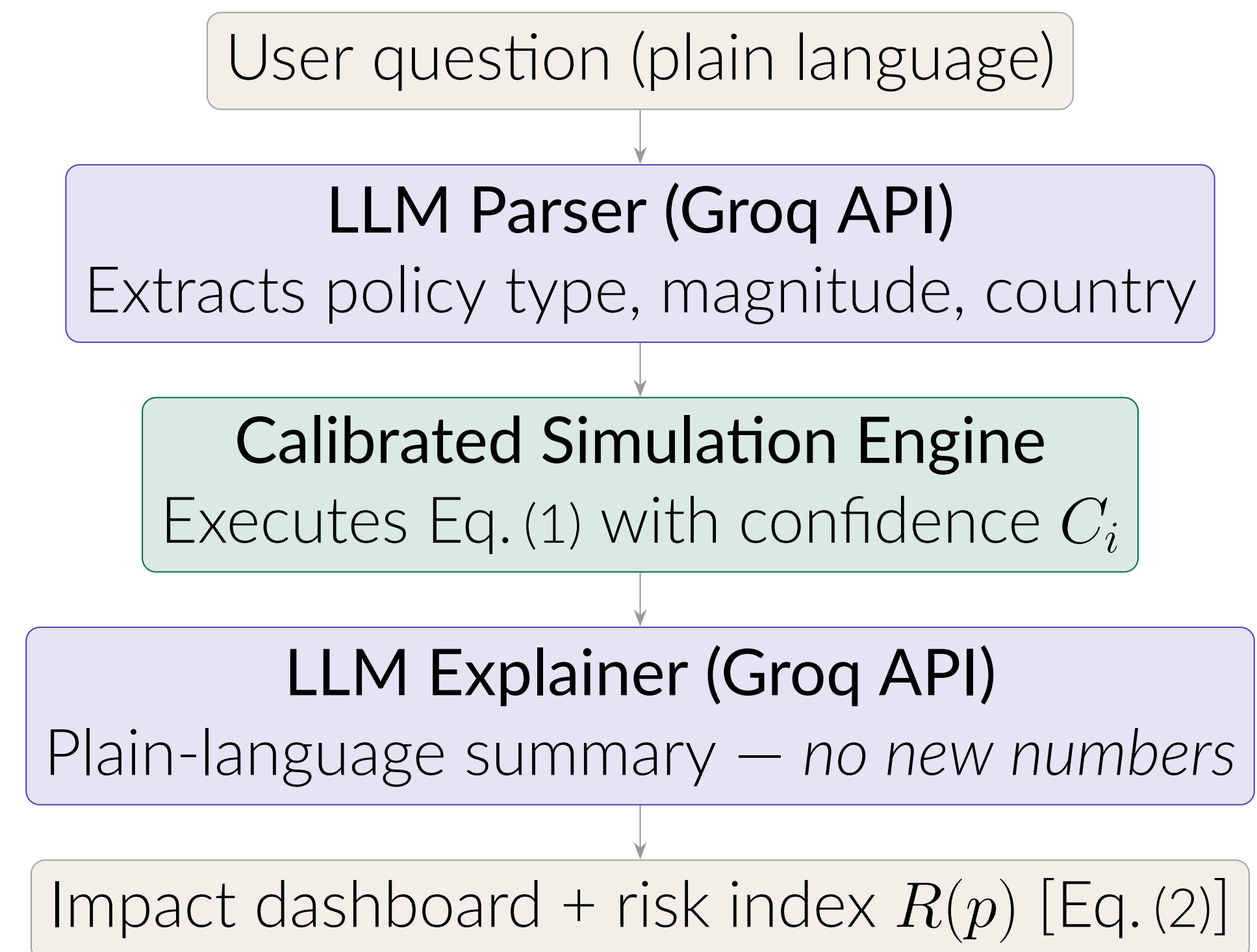


Figure 1. Hybrid architecture: LLM for language, calibrated engine for scores.

5. Case Study — Nigeria 2023 Fuel Subsidy Removal

Scenario: 20% fuel price increase ($\alpha=0.35$, $\beta=0.45$, $\gamma=0.20$). Pump prices roughly doubled (NGN 189 → NGN 346/litre); inflation rose $\approx 20\% \rightarrow 27\%$; subsidy cost $\approx 4\text{--}5\%$ of GDP [2].

Core Dimension	Score S_d	Dir.	Confidence
Inflation pressure (S_{inf})	0.50	↑	● Medium
Social risk (S_{soc})	0.70	↑	● Medium
Government revenue (S_{fis})	0.70	↑	● High
Supplementary indicators			
Household pressure	0.65	↑	● Medium
Short-term growth	0.30	↓	● Low
Risk Index $R(p)$	0.63		

Table 2. Regulus output anchored to IMF Nigeria 2023 data [2].

S_{inf} from IMF pass-through estimates; S_{soc} from IMF food-security data; S_{fis} from GDP subsidy accounting.

AI-generated explanation (constrained output)

“A 20% fuel price increase raises transport costs, pushing inflationary pressure through food supply chains. Household purchasing power declines for low-income urban groups. Social risk is elevated without compensating transfers — consistent with IMF distributional analysis [2].”

6. Limitations & Open Research Problems

- Weights derived from regional aggregates; country-specific validation pending
- Confidence coefficients C_i currently expert-assigned; formal elicitation protocol needed
- Open challenge: calibration without stable historical data streams; no closed-form uncertainty intervals yet

Try the Live Demo & References



Scan to try Regulus live

- [1] World Bank. *Poverty and Shared Prosperity*. 2022.
- [2] IMF. *Nigeria: Article IV Consultation*. 2023.
- [3] IMF. *Fossil Fuel Subsidies Policy Paper*. 2025.
- [4] OECD. *AI in Government Action Framework*. 2025.
- [5] Carullo, R. *Eur. J. Law & Technology*, 2023.
- [6] Furtado et al. *JASSS*, 25(1), 2022.