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Systemic Collapse and Conditional Resilience

Understating Sudan's Agri-food System Under Conflict

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Abstract: A Systemic Crisis

- Conceptualizes the crisis as a 'structural collapse' rather than a temporary sectoral shock.
- Uses a systems-based analysis to link production, markets, institutions, and livelihoods.
- Key Findings: 46% decline in 2023 cereal production (4.1 million tonnes).
- Introduces 'Conditional Resilience': A fragile, rainfall-driven rebound in 2024 that lacks the institutional support for long-term recovery.
- Identifies significant farm-gate losses (USD 675–945M) and export exposure (USD 362–652M).

Introduction: The Agricultural Backbone under Threat

- Agriculture contributes 35–40% of GDP and employs over 60% of the workforce.
- Conflict erupted April 15, 2023—a critical period between irrigated harvest and rainfed planting.
- The disruption affects 19 distinct livelihood zones across Sudan's diverse agro-ecology.
- Primary drivers of collapse: Insecurity, displacement of labor, collapse of financial services, and breakdown of input supply chains.
- Shift in focus: Moving beyond simple availability to understanding systemic failure.

Conceptual Framework: The Systems Approach

- Analyzing the Agri-food System as four interconnected domains:
 - Supply Systems: Availability of land, certified seeds, fertilizers, and skilled labor.
 - Market Systems: Trade connectivity, logistics (fuel/transport), and domestic/export price signals.
 - Institutional Systems: Banking and finance, irrigation governance (e.g., Gezira Scheme), and data systems.
 - Household Livelihoods: Purchasing power, asset depletion, and coping mechanisms.
- Key Concept: Reinforcing negative feedback loops (e.g., lower production leading to lower future input investment).

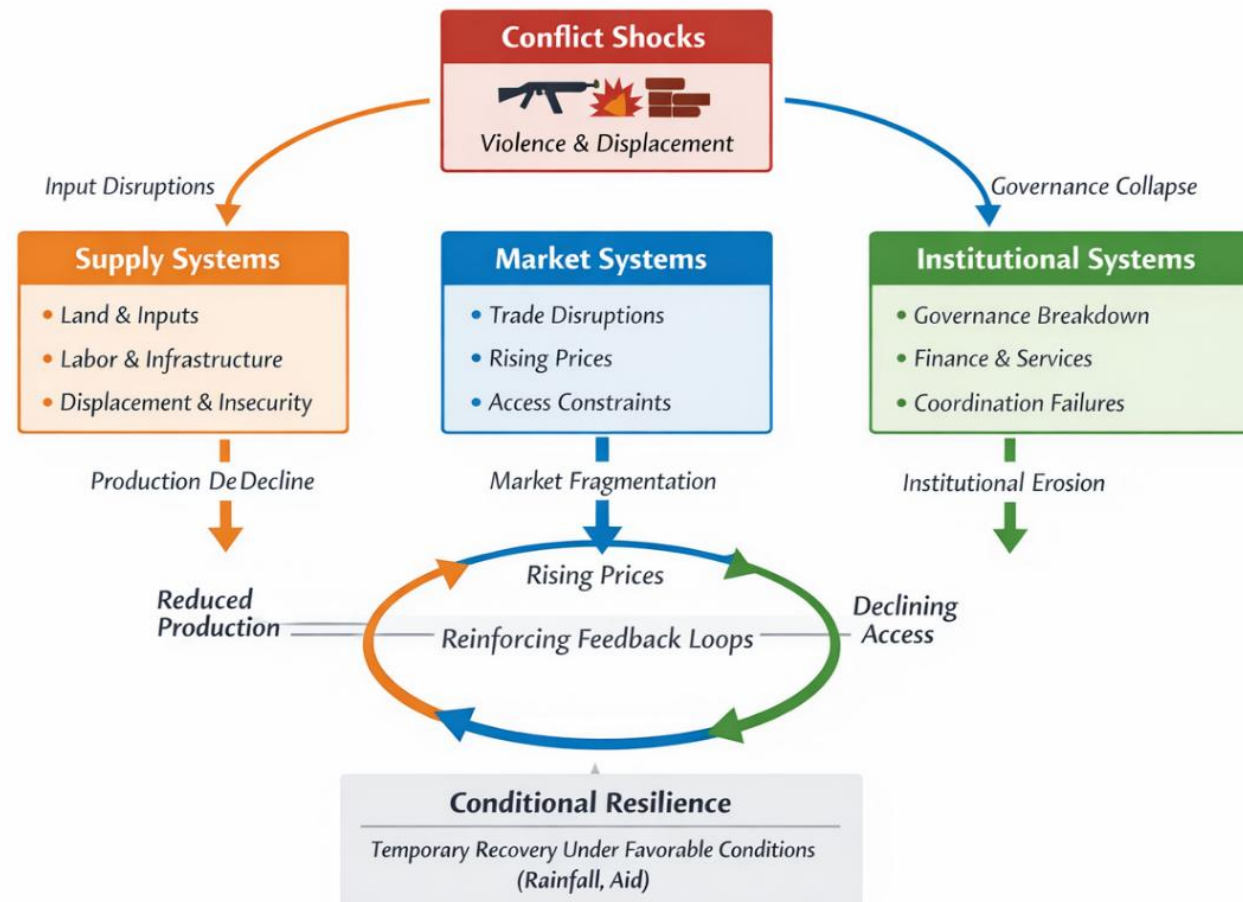


Figure 1: Conceptual framework of agri-food system collapse in conflict context

Methodology: Data-Driven Systems Analysis

- Mixed-methods framework combining quantitative modeling with qualitative systems theory.
- Analysis Phases:
 - Phase I (2023): Immediate shock and initial system contraction.
 - Phase II (2024–2025): Partial recovery assessment and resilience mapping.
- Data: Integrated datasets from FAO/GIEWS, IPC, World Bank, WFP, and IOM DTM.
- Scenario-based assessment: Estimating counterfactual losses vs. conflict-affected actuals.
- Analytical component:
 - Production losses estimate
 - Export Revenue Risk Modelling
 - Market and Food Security Analysis

The 2023 Production Shock: A Deep Contraction

- Cereal production dropped to 4.1 million tonnes—a 46% decline vs. previous years.
- Production gap identified at ~2.7 million tonnes, triggering extreme food insecurity.
- Estimated farm-gate losses: USD 675 million (Low) to USD 945 million (High).
- Impacts on Irrigated Sectors: Collapse of centralized management and maintenance in the Gezira and other state-run schemes.
- Impacts on Rainfed Sectors: Limited access to mechanical services and high-quality seeds.

Table 1: Estimated Cereal Production Loss under Alternative Price Scenarios

Scenario	Production Gap (million tonnes)	Price (USD/tonne)	Estimated Loss (USD million)
Low	2.7	250	675
Central	2.7	300	810
High	2.7	350	945

2024 Partial Recovery: Rainfall vs. System Restoration

- Production rebound to 6.6–6.7 million tonnes in 2024 (per FAO/GIEWS).
- Rebound Drivers: Exceptionally favorable rainfall and traditional farm resilience.
- The 'Conditional' Nature: Recovery is fragile because structural constraints (inputs, finance, security) remain unresolved.
- Asymmetric Recovery: Eastern and Northern states show resilience, while Darfur and Kordofan remain in deep collapse.
- High production does not equate to recovery if markets cannot absorb the surplus.

Export Exposure and Macroeconomic Instability

- Estimated export revenue loss: USD 362–652 million.
- High Concentration Risk: Sesame and Livestock represent over 60% of Sudan’s agricultural export value.
- Impacts: Massive reduction in foreign exchange earnings, fueling currency depreciation.
- Macro-Micro Link: Export failure limits the government and private sector capacity to finance food and fuel imports.

Table2: Export Revenue Exposure by Commodity

Commodity	Share (%)	Baseline Value (USD Million)	Shock Range (%)	Loss Range (USD Million)
Sesame	36	773	20–35	155–271
Livestock	30	644	20–35	129–225
Groundnuts	10	215	15–30	32–64
Cotton	7	150	20–40	30–60
Gum Arabic	5	107	15–30	16–32

Regional Shock Index: Spatial Heterogeneity

- Developed a Regional Shock Index (1–100) to map the severity of disruption:
 - Darfur (40–45): Severe systemic collapse due to conflict intensity and mass displacement.
 - Kordofan (45–50): High disruption from insecurity and supply chain breaks.
 - Gezira/Central (55–70): Failure of irrigation governance and infrastructure damage.
 - Eastern States (75–85): Relative resilience due to proximity to trade corridors and ports.

Table3: Regional Agriculture Shock Index

Region	Index	Interpretation
Darfur	40–45	Severe collapse
Kordofan	45–50	High disruption
Gezira	55–70	Irrigation shock
Eastern	75–85	Relative resilience

Market Fragmentation and Price Volatility

- Physical barriers: Transport costs rose by 200–300% due to fuel shortages and insecurity.
- Price Trends:
 - Staple foods (sorghum/millet): +100–125% increase year-on-year.
 - Livestock: +210% increase (Pastoralists face high transaction costs despite price gains).
 - Overall food basket (year-on-year): +101%
- Financial Failure: Breakdown of the formal banking system preventing market integration and trader liquidity.

Food Security Outcomes: The Humanitarian Toll

- Approximately 24.6 million people (IPC Phase 3+) facing acute food insecurity.
- Localized Famine Conditions: IPC Phase 5 identified in conflict hotspots (e.g., Darfur).
- Transition from availability crisis to access crisis: Markets have food, but people lack the income to purchase it.
- Cumulative Stress: Displacement of ~9.04 million people (IDPs) further strains host community resources.

Feedback Mechanisms: Why the Crisis Persists

- The 'Low-Input-Low-Output' Loop: High costs prevent investment -> Lower yields -> Lower household income -> Less capital for the next season.
- Institutional Erosion: Loss of technical personnel (extension) and damage to research facilities hinders productivity.
- Asset Depletion: Rural households selling productive assets (livestock, tools) to buy food, permanently lowering their productive capacity.

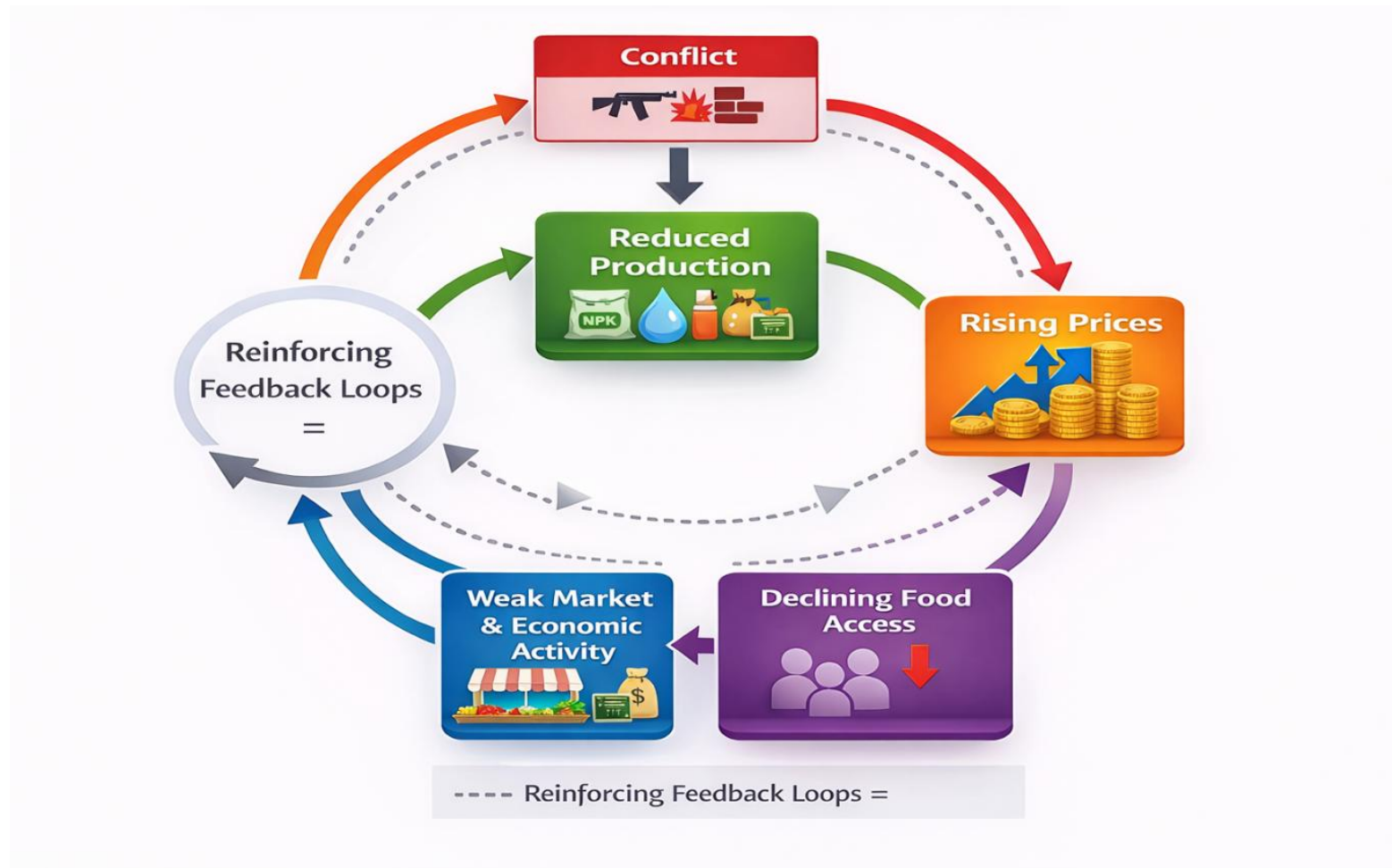


Figure 2: Reinforcing Feedback Loops in Conflict-Affected Agri-Food Systems

Policy Implications: A Multi-Sectoral Recovery Path

- Immediate Phase: Direct market stabilization and livelihood protection through scaled-up cash transfers and emergency input kits (seeds/tools).
- Medium-Term Phase: Restoration of core infrastructure, specifically the Gezira Scheme's irrigation governance and transport logistics to reduce trade costs.
- Long-Term Phase: Structural transformation through digital financial inclusion to bypass physical bank failures and building climate-resilient agricultural data systems.
- Resource Mobilization: Total systemic recovery requires an estimated investment exceeding USD 20 billion, necessitating a coordinated international and domestic funding strategy.
- Institutional Rebuilding: Prioritizing the return of technical expertise (extension services) and the rehabilitation of agricultural research centers damaged by conflict.

Conclusion: The Path Beyond Collapse

- Sudan's crisis is not a transient production shock but a systemic collapse of interconnected pillars (Finance, Markets, Institutions).
- The 2024 recovery is 'Conditional'—it proves that the ecological potential remains, but the economic ceiling is currently capped by institutional failure.
- Fragmented markets and high transaction costs mean that even good harvests do not translate into improved food security or rural wealth.
- Breaking the cycle: Success depends on an integrated approach that restores the value chain from farm-gate to global markets simultaneously.
- The path forward requires moving from a humanitarian-only lens to a system-wide restoration framework to prevent permanent asset depletion.

Key Recommendations for Stakeholders

- Decentralize Input Supply: Support local seed systems and traditional resilient varieties to reduce dependence on broken central corridors.
- Digital Liquidity: Accelerate mobile money and digital banking adoption to re-integrate fragmented markets and facilitate trade.
- Export Diversification: Move beyond sesame and livestock concentration to build resilience against localized shocks and global price volatility.
- Regional Recovery Corridors: Focus on stabilizing 'relative resilience' zones in the East to act as economic anchors for national recovery.
- Data-Driven Response: Establish real-time monitoring of Terms of Trade (ToT) between livestock and staples to target interventions accurately.

The Future of Sudan's Agri-food System: Discussion

- **Questions to Consider:**
- How can we transition from emergency food aid to 'system-saving' investments while active conflict persists?
- If 2024's recovery is rainfall-dependent, what happens to the system if a drought hits in 2025 or 2026?
- What specific roles can the private sector play in bridging the gap created by institutional collapse?
- Can digital finance truly bypass the current banking crisis, or does it require a baseline of physical security first?