Innovative data solutions for fragile and conflict-affected settings (FCAS)

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Drawing on a framing paper by the State Fragility Initiative, this brief summarises how innovative data solutions can help close information gaps in fragile and conflict-affected settings (FCAS).

- In FCAS, insecurity, displacement, weak institutional capacity, and political sensitivities often disrupt traditional surveys, censuses, and administrative systems – leaving major evidence gaps for decision makers.
- Three practical data innovations can partially close these gaps: (i) mobile phone data (for example, Call Detail Records or CDRs) for targeting and mobility tracking; (ii) rapid-response phone surveys (RRPS) for high-frequency welfare monitoring; and (iii) satellite imagery, especially nighttime lights, for near-real-time measurement of economic activities.
- Mobile-based targeting and RRPS scale quickly for urgent, low-cost programme delivery, while satellite indicators provide macro- and spatial diagnostics during conflict-related data blackouts.
- These tools are complements and not substitutes for official statistics as they face coverage gaps, model drift, privacy risks, and representativity constraints. Thus, hybrid approaches that integrate innovations with representative surveys and administrative data perform best and can significantly strengthen evidence-based decision making in FCAS.
- Successful deployment depends on strong governance, privacy protections, transparent consent, ethical safeguards, and local capacity to manage bias.

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Why this matters in FCAS

Fragility now shapes development outcomes for a large share of the world. As of 2025, 61 countries face high or extreme fragility, encompassing one-quarter of the world's population and nearly three-quarters of people living in extreme poverty (OECD, 2025). Yet, in FCAS, the very conditions that demand evidence also impede its production. Insecurity, weak infrastructure, displacement, and institutional erosion make it extremely difficult to collect reliable, timely, and disaggregated data through traditional methods such as censuses, household surveys, and administrative systems. Even when surveys are feasible, attrition, coverage errors, mistrust of institutions and survivorship bias can render estimates unrepresentative. Barriers include:

- **Security and inaccessibility**: Conflict, disease, and criminality limit enumerator access, making in-person surveys dangerous or unfeasible, especially in areas controlled by non-state actors.
- **Weak infrastructure and capacity:** Poor roads, unreliable electricity and connectivity, and hollowed-out statistical systems undermine survey operations and data management and capacity.
- **Poor data quality and bias:** Outdated sampling frames, attrition, selection and survivorship bias, and the politicisation of data all compromise representativeness and trust.
- **Displacement and mobility:** Large-scale, rapid movements render population figures obsolete and make it difficult to follow households over time.
- **Politics and mistrust:** Sensitive topics, contested sovereignty, and weak privacy protections reduce willingness to share information and create incentives to manipulate statistics.

What works: Pragmatic data innovations

Mobile-based approaches

- **Targeting social protection with mobile metadata (Call Detail Records, or CDRs)**: This approach builds on evidence that phone-use behaviour differs systematically across income groups (Blumenstock et al., 2015), allowing these patterns to serve as indirect indicators of living standards. These can then be used to deliver cash transfers to the poorest households. More specifically, survey data on consumption or income are collected from a subset of the population of interest and then matched to mobile phone metadata (for example, airtime purchases, call frequency, etc.). Machine-learning (ML) models trained on matched survey-CDR samples can then be applied to screen millions of subscribers at near-zero marginal cost, enabling rapid scale-up during crises. Thus, mobile metadata can deliver fast, low-cost, scalable, and hard-to-reach coverage, helping governments respond more quickly and inclusively in fragile contexts. However, accuracy remains constrained by low phone ownership among the poorest households, the need to regularly retrain models to prevent rapid performance decline, and the requirement for strict privacy and ethical safeguards given the sensitivity of CDRs.

- **Tracking displacement and mobility in fragile settings**: Anonymised CDRs record movements between cell-tower areas in near real-time, allowing researchers to infer where people live, travel, and resettle. These can then be applied to study various aspects of population movements, including conflict-induced mobility, response to conflict alerts, and post-disaster displacement. More importantly, these insights can support humanitarian logistics when field surveys are unsafe or too slow, allowing near–real-time tracking of displacement with fine-grained spatial and temporal detail. The insights can also be scaled to millions of users to produce national maps, strengthening official statistics by helping validate and update survey-based estimates. However, coverage and operator access remain binding constraints: uneven phone ownership risks excluding the poorest. Also, accessing operator data is often expensive and beset by trust barriers, while conflict frequently disrupts network infrastructure. Lastly, the sensitivity of CDR data demands robust privacy protections.
- **Generating evidence during emergencies**: During health, political, or security crises, rapid response phone surveys (RRPS) have proven indispensable for delivering real-time information at moments when insecurity, displacement, and travel restrictions prevent direct engagement with affected communities. RRPS typically use three modalities: (i) Computer-Assisted Telephone Interviewing (CATI), (ii) Interactive Voice Response (IVR), and (iii) SMS polls. CATI relies on trained enumerators using survey software that enables complex skips, clarifications, and real-time quality checks. IVR automates data collection through recorded prompts and keypad responses, allowing large-scale standardised surveys. SMS polls send brief text questions for rapid pulse checks, but are limited by their simplicity and literacy requirements. CATI remains the most widely used and generally the most suitable in FCAS, offering higher data quality and avoiding literacy barriers in contexts with low education levels or highly localised languages (GSMA, 2023). Bias diagnostics and post-stratification are essential to address coverage bias, as mobile phone surveys systematically miss poorer, rural, and less literate groups, face high nonresponse and attrition, and offer less scope for complex questioning than face-to-face methods.

Evidence snapshots:

- Togo's Novissi Cash Transfer used satellites and CDRs to target emergency cash during COVID-19, outperforming most feasible alternatives under tight timelines.
- In Afghanistan and other crises, mobile mobility data provided near-real-time visibility on displacement, welfare, and firm dynamics when ground data were unavailable.
- Ebola and COVID-19 response showed that well-designed CATI with bias adjustments can yield informative national trackers during health emergencies.

Satellite-based economic measurement

Measuring economic activity in data-scarce settings: Satellite-derived indicators, especially nighttime lights (NTLs), have become a practical tool for estimating economic activity where traditional statistics are weak. These signals capture patterns linked to infrastructure, production, and broader economic dynamics. They can be complemented by vegetation indices, land use, atmospheric pollutants, and maritime activity to assess GDP components and sectoral trends. In FCAS, they allow near real-time monitoring of shocks, disasters, and recovery, revealing changes that conventional indicators often miss. Advances in satellite technology have improved resolution and stability, while integrating NTL with daytime imagery, machine learning and auxiliary datasets enables finer-scale analysis of welfare and localised shocks. However, coverage and operator access remain binding constraints in a different form: measurement quality varies across settings, auxiliary data needed for calibration are often outdated, and assumptions about consistency across rural, urban, and informal areas do not always hold. It is thus important to publish uncertainty bands and avoid over-interpreting satellite brightness changes as capturing economic activity without validation. Lastly, while satellite-based tools offer timely insights, they require careful interpretation to avoid mismeasurement in fragile contexts.

Evidence snapshots:

- IMF analysis in Somalia used nighttime lights, vegetation and land-cover imagery to monitor economic activity when conventional statistics were unavailable.
- World Bank work in Afghanistan used NTLs to track the scale of the post-takeover economic shock and the uneven nature of recovery.
- VIIRS nighttime lights provided near-real-time signals of disruption after the Turkey–Syria earthquake and in crises such as Nepal, Haiti and Sudan when ground data were inaccessible.

- In Yemen, nighttime lights and gas-flaring data were used to estimate oil and non-oil GDP during the conflict, capturing sharp declines in activity despite a data blackout.

IGC research: Using satellite imagery to inform urban policy in Ethiopia[1]

Nearly two decades have passed since Ethiopia's last census in 2007, leaving critical gaps in understanding the country's urban transformation. Policymakers lack reliable data on Ethiopia's current degree of urbanisation, how many urban centres exist, where growth is concentrated, and crucially, what factors explain why urbanisation is advancing rapidly in some locations but slowly in others. In the absence of census data, policymakers have had to rely on model-based projections and regional administrative classifications. However, these sources produce markedly different estimates: roughly 900 versus 2,600 urban centres. Neither provides the spatial granularity required for infrastructure planning, service delivery, or fiscal allocation. At the request of Ethiopia's policymakers, the research team set out to establish how urbanised the country is, where urban growth is occurring, and why expansion appears concentrated in some locations but not others.

To address the data gap, the study uses satellite-based, globally available geospatial datasets to directly measure the location and expansion of built-up areas over the past two decades. The approach identifies urbanisation through observable changes in land cover and settlement patterns. This enables a spatially consistent definition of "urban" that can be compared across regions and over time. Importantly, the method is designed for contexts where urban growth is fragmented, partly informal, and not always captured in official statistics. There are characteristics common in many developing countries, and particularly in fragile and conflict-affected settings.

This research can directly inform policy, helping governments capture fast-growing secondary towns that may otherwise be overlooked. This then helps governments better allocate transfers and prioritise infrastructure development. Since the data is globally accessible, it is replicable in other countries that face outdated census data. In this sense, the Ethiopia application serves as a proof of concept for how remote sensing can strengthen state capacity in data-scarce environments.

[1] The study is currently being finalised and has not yet been published; readers interested in forthcoming findings are encouraged to keep an eye on the Ethiopia country team page on the IGC website, where updates will be shared once the report is released.

Policy recommendations

Cross-cutting lessons

- **Complement, don't substitute:** treat innovations as complements to official statistics. This means using innovative data sources to enhance accuracy, coverage and timeliness of official statistics by, for instance, using satellite imagery to fill gaps in official statistics to get an accurate picture or pairing mobile phone mobility data with household surveys for displacement and migration figures during conflict outbreaks.
- **Use hybrid designs:** the greatest value comes from combining CDRs/RRPS/satellite data with representative surveys and administrative sources to cross-validate findings and cover different populations and outcomes.
- **Context-sensitive deployment:** method choice should reflect coverage realities (phone and electricity access), institutional capacity, and political risks and legal frameworks.
- **Model lifecycle:** plan for model lifecycle management (drift checks, periodic retraining, and performance audits) when using ML on CDRs or satellite imagery.

Governance, ethics, and capacity

- **Legal and regulatory frameworks:** establish data governance and enforcement of data protection laws and sectoral regulations aligned with international standards. Ensure clear consent, purpose limitation, independent oversight, and safe-harbour data-sharing with Mobile Network Operators.
- **Privacy-enhancing technologies (PET) and secure infrastructure:** Use PETs, strong anonymisation, and controlled access environments and trusted intermediaries to mitigate risks around CDRs and sensitive data.
- **Build local capacity** for bias adjustment (e.g., post-stratification, calibration) and for geospatial analysis. Invest and co-produce methods with National Statistics Offices, line ministries, universities, and local intermediaries.

Future directions

Analytical advances – especially in machine learning, forecasting, and adaptive sampling – will expand what is possible, including finer-grained monitoring, nowcasting and policy simulation. But their value will depend on pairing technical innovation with strong ethics, political economy awareness, and long-term investments in national data systems.

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