

REBUILDING AGRICULTURAL STATISTICS IN POST-WAR SUDAN: A STRATEGIC FRAMEWORK FOR RECOVERY AND RESILIENCE

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Abstract

Since the conflict began in Sudan in April 2023, obtaining the agricultural information needed for planning and recovery has become far more difficult. This matters because decisions on food assistance, production support, livestock services, and reconstruction depend on credible information about farms, crops, markets, and affected communities. This paper sets out a practical framework for restarting and strengthening agricultural statistics after the conflict. It draws on international guidance, post-crisis lessons, and the author's professional experience in Sudanese agricultural and official statistics. The framework has five parts: restoring institutions and coordination; retaining skills and institutional memory; rebuilding digital and geospatial systems; improving methods and combining data sources; and securing partnerships and sustainable funding. It proposes an initial recovery period of up to one year, followed by system strengthening over one to three years and longer-term transformation over three to five years. The central argument is straightforward: Sudan should not simply return to the methods used before the war. It should build a system that can continue to produce useful, well-documented statistics when access, staffing, or communications are disrupted. This is a practice-based planning paper, not a damage assessment. Its recommendations should be tested, costed, and refined through a nationally led assessment when conditions allow.

Keywords: Agricultural statistics; Sudan; post-conflict recovery; official statistics; food security

1. Introduction

Agriculture is central to livelihoods, food security, and economic recovery in Sudan. Decisions about seed and input support, irrigation, livestock services, markets, humanitarian response, and reconstruction need information that is timely, disaggregated, and credible. Agricultural statistics provide that evidence through censuses, probability surveys, administrative records, market monitoring, and geospatial observation. They also provide the basis for national accounts and for monitoring commitments under the Sustainable Development Goals (SDGs) [1].

The conflict that began in April 2023 created an acute information problem. Insecurity, displacement, damage to infrastructure, disrupted communications, and interrupted public administration can affect every stage of statistical production: frame maintenance, fieldwork, supervision, processing, quality assurance, dissemination, and archiving. These constraints coexist with urgent needs to understand cultivated area, production, livestock conditions, displacement-related changes in farming, and local food availability. FAO's emergency planning for Sudan underscores the scale and urgency of agricultural recovery needs [2].

The question is therefore not only how to restart surveys. It is how to rebuild a statistical system that can operate credibly under uneven access, changing populations, fiscal pressure, and future shocks. The United Nations Fundamental Principles of Official Statistics provide the normative baseline: relevance, professional standards, transparency, confidentiality, and impartial dissemination [3]. These principles are particularly important where data may shape the allocation of scarce recovery resources.

This paper offers a practical framework for rebuilding agricultural statistics in post-war Sudan. It asks four questions: What has made statistical work difficult during the conflict? Which international standards and operational lessons remain useful? What should a rebuilt system contain? And what can realistically be done first? The paper does not estimate losses or present a complete damage assessment. That work requires current administrative, survey, and geospatial evidence collected under safe and representative conditions.

2. Background and literature review

2.1 Agricultural statistical systems and resilience

An agricultural statistical system connects institutions, people, methods, technology, data, and users. The World Programme for the Census of Agriculture frames the census as a foundation for structural information, frames, and intercensal survey programmes [4, 5]. Regular integrated surveys then support a continuing flow of indicators on production, inputs, labour, farm income, assets, practices, and selected SDGs [6, 7].

The literature on data governance emphasizes that statistical value depends on both reuse and safeguards. Data must be discoverable and usable for public purposes while institutions protect confidentiality, prevent misuse, and maintain public trust [8]. Resilience consequently involves more than backup servers. It includes distributed skills, documented procedures, secure records, interoperable systems, alternative collection modes, and transparent quality communication.

2.2 Post-crisis constraints

Conflict can fragment records, displace skilled staff, restrict access to farms and markets, and invalidate sampling frames. Population movement can also change the meaning of a “usual” farm, household, locality, or season. In such contexts, repeating a pre-conflict operation without redesign risks producing estimates that appear precise but are not representative. Broader evidence on conflict and development highlights the need for institutions that can restore confidence and deliver services during recovery [9].

The pandemic further demonstrated the usefulness—and limits—of remote modes, telephone interviews, administrative data, and geospatial sources when face-to-face collection is constrained [10]. These sources can increase timeliness, but they do not automatically remove coverage, measurement, or model error. They should be integrated through transparent statistical methods and accompanied by metadata, quality indicators, and independent review.

2.3 Implications for Sudan

For Sudan, the priority is a nationally owned system that starts with essential recovery information yet is designed to mature into a routine programme. The Global Strategy and the 50x2030 Initiative illustrate complementary approaches: strengthening institutions and skills while building sustainable, nationally representative survey programmes [7, 11]. Their relevance lies not in transplanting a template, but in adapting principles of country leadership, modular design, capacity transfer, and data use to Sudan’s operating environment.

The design of a recovery programme should also distinguish three information functions. First, *situational information* provides rapid signals for operational choices, such as whether planting was possible in a locality or whether markets are functioning. Second, *official estimates* provide comparable indicators intended for policy, national accounts, and international reporting; these require explicit target populations, defensible sampling or modelling, and documented uncertainty. Third, *administrative intelligence* supports programme management, but its completeness and incentives must be assessed before it is used as an official statistical source. Conflating these functions is a common source of misinterpretation in emergencies.

In practice, the system must serve users at several levels. Local authorities and humanitarian actors may require short-interval, small-area signals; national planners need comparable seasonal and annual aggregates; researchers and development partners require documented microdata or tabulations; and farmers need accessible information on markets and services. A well-designed dissemination

programme should therefore include a public release calendar, concise statistical bulletins, machine-readable aggregates, metadata, and controlled access to confidential microdata. The objective is not maximal data release, but useful and trustworthy information for clearly defined users.

3. Methodology

3.1 Design and evidence base

This is a qualitative, practice-based paper. I reviewed international guidance on official statistics, agricultural censuses and surveys, agricultural data systems, and data collection in crisis settings. I also draw on my professional experience in Sudanese agricultural and official statistics. That experience helps identify operational constraints and judge whether proposed actions are realistic; it is not presented as independently verified empirical evidence.

3.2 Analytical procedure

I developed the framework in three steps. First, I considered how conflict can affect governance, sampling frames, collection, processing, quality checks, dissemination, and preservation. Second, I identified practical responses that remain consistent with the Fundamental Principles of Official Statistics. Third, I grouped the responses into five areas and arranged them according to urgency and the conditions needed to implement them.

3.3 Scope and limitations

The paper is intentionally a strategic design rather than a nationally representative assessment. It does not quantify damage, crop output, staff losses, or costs; current evidence is incomplete and access conditions vary. The recommendations should therefore be validated through a post-conflict diagnostic involving the national statistical authority, sector ministries, state institutions, universities, farmer representatives, and development partners. A detailed investment case should follow the diagnostic.

4. Results: diagnostic of recovery needs

Five needs stand out. First, the institutions that produce and use agricultural statistics need clear roles and working arrangements. Second, staff knowledge must be protected: directories, questionnaires, codebooks, procedures, and archived datasets should be located and documented before they are lost. Third, fieldwork and data management need systems that can work with weak connectivity and can be recovered after disruption. Fourth, methods need to reflect displacement, access constraints, and changes in where farming takes place. Finally, recovery cannot depend only on short emergency projects; it needs stable funding and partnerships that strengthen national capacity.

These needs are sequential in some respects but cannot be addressed one at a time. A frame update requires geospatial skills and access protocols; digital collection requires instruments, enumerator training, and supervision; dissemination requires a governance decision on confidentiality and a process for explaining revisions. The minimum viable system should therefore be defined as a connected production cycle: a documented indicator need, an approved method, safe collection or acquisition, quality checks, a release product, and a preserved dataset with metadata. Starting with a smaller number of indicators is preferable to collecting a broad range of measures that cannot be validated or maintained.

5. Strategic framework for rebuilding agricultural statistics

5.1 Pillar 1: institutional recovery and governance

The first pillar restores an effective mandate, roles, and coordination arrangements. A national agricultural statistics steering committee should convene the national statistical authority, agricultural and livestock institutions, subnational statistical offices, and key data users. It should approve a minimum indicator set, data standards, a release calendar, and protocols for quality assurance and secure data sharing. Its role is coordination, not political control of results; professional independence and impartial release must be protected [3].

Table 1 – Illustrative post-conflict risks and statistical responses

Risk	Statistical consequence	Priority response
Insecurity and uneven physical access	Interrupted fieldwork; geographic coverage bias	Access protocols; mixed-mode collection; publish coverage and nonresponse indicators
Displacement and changing settlement patterns	Obsolete frames and weak comparability	Rapid frame update; area-based sampling; explicit population and seasonal definitions
Loss of records and equipment	Broken time series; loss of institutional memory	Inventory and recovery plan; encrypted backups; metadata and codebook reconstruction
Loss or dispersal of skilled staff	Weaker supervision and quality assurance	Staff mapping; remote mentoring; targeted recruitment and training
Fragmented data initiatives	Duplication and inconsistent estimates	National coordination mechanism; shared standards; release calendar and data catalogue

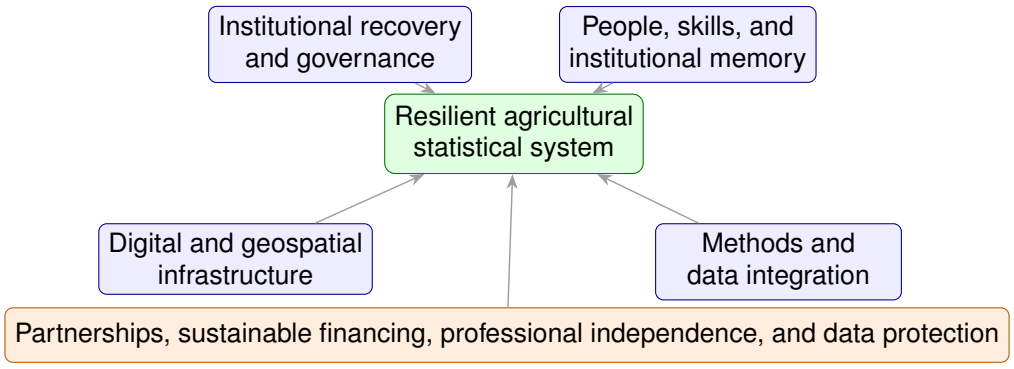


Figure 1 – Five-pillar framework for rebuilding agricultural statistics in Sudan.

5.2 Pillar 2: people, skills, and institutional memory

Recovery depends on people as much as equipment. An initial workforce and knowledge inventory should identify available staff, critical competencies, existing questionnaires, sampling materials, historical datasets, and technical documentation. A tiered development programme can combine refresher training for experienced staff with entry pathways for younger statisticians. Priorities include survey design, field supervision, sampling, data management, GIS, remote sensing, reproducible analysis, confidentiality, and communication of uncertainty.

5.3 Pillar 3: resilient digital and geospatial infrastructure

The system should use an offline-capable computer-assisted personal interviewing platform for fieldwork, with version-controlled instruments and audit trails. A layered data architecture can separate identifiable collection data, analytical files, and public-use outputs. It should include role-based access, encrypted backup, a metadata catalogue, secure file transfer, and a recovery plan. Geospatial infrastructure should support frame updating, area measurement, field monitoring, and integration with weather and Earth-observation products. Technology choices should be proportionate to connectivity, maintenance capacity, and data-protection requirements.

The proposed architecture is deliberately vendor-neutral. At the operational layer, enumerators use secure devices capable of working offline, with controlled synchronization once a safe connection is available. At the management layer, authorized staff monitor progress, resolve edits, and preserve paradata. At the analytical layer, reproducible scripts transform raw data into documented estimates. At the dissemination layer, approved aggregates, methodology notes, and anonymized files are published through a catalogue. Separating these layers reduces accidental disclosure, permits recovery from a damaged device or server, and makes it easier to audit revisions.

5.4 Pillar 4: methodological modernization and data integration

No single source can meet all recovery information needs. The proposed system combines a future agricultural census, recurring probability surveys, administrative records, market monitoring, climate and hydrological data, and Earth observation. Each source has a defined statistical purpose and documented limitations. Remote sensing can improve area frames and provide timely crop-condition signals, but model-assisted estimates require ground observations, uncertainty assessment, and transparent validation. Administrative data should be assessed for coverage, definitions, timeliness, and incentives before use in official estimates.

Methodological modernization should begin with clear statistical concepts: agricultural holding, operator, plot, crop season, livestock unit, and geographic reference. These concepts need to be consistently applied even when the population has moved or access is constrained. Survey designs can employ area frames, household frames, or dual-frame approaches depending on the target population and available maps. Where some areas are inaccessible, the release must state whether they are excluded, modelled, or included through a remote protocol. Such transparency is more valuable than a superficially complete national total.

Data integration should follow a documented hierarchy. Probability samples remain central for population inference. Administrative and private-sector records can improve timeliness or support frame maintenance after their quality has been assessed. Earth observation and weather data are best treated as auxiliary information for stratification, calibration, nowcasting, and model-assisted estimates. Any model should report its training data, validation approach, update frequency, geographic coverage, and uncertainty. This approach keeps innovation compatible with the professional standards required of official statistics.

5.5 Cross-cutting requirement: ethics, protection, and communication

Agricultural data may contain personally identifiable information, land locations, household assets, production levels, or commercial relationships. In a post-conflict setting, the consequences of disclosure can be especially serious. The recovery programme should include a data-protection impact assessment, minimum necessary data collection, role-based access, secure retention rules, anonymization procedures, and a process for reviewing requests for microdata. Enumerators should be trained not

only in interviewing but also in informed consent, secure device handling, and referral protocols if respondents disclose urgent needs.

Communication is similarly a quality function. Releases should state the reference period, geographic coverage, collection mode, response rate where applicable, main limitations, and whether estimates are preliminary or revised. Maps must be generalized where detailed locations could create risk. Publishing uncertainty is not a weakness; it helps decision makers judge whether a difference is meaningful and protects the credibility of the institution when estimates are later updated.

5.6 Pillar 5: partnerships and sustainable financing

Partnerships should be organized around national priorities and a multi-year costed plan. Potential partners include FAO, United Nations agencies, the World Bank, the African Development Bank, universities, civil society, farmer organizations, and regional statistical networks. Early support should transfer skills and systems to national institutions rather than create parallel reporting structures. A financing strategy should combine recovery funding with a protected recurrent budget for core surveys, data infrastructure, and staff development.

Table 2 – Strategic pillars, actions, and indicative outputs

Pillar	Priority actions	Indicative outputs
Governance	Mandate review, coordination forum, standards, release calendar	Agreed work programme and quality governance
People	Skills inventory, training, mentoring, documentation recovery	Retained institutional memory and capable workforce
Digital and geospatial	CAPI, secure backups, metadata, GIS and data catalogue	Recoverable, interoperable, documented data assets
Methods and integration	Frame update, mixed modes, integrated sources, validation	Relevant estimates with published quality information
Partnerships and finance	Costed plan, partner alignment, recurrent budget strategy	Nationally led and sustainable implementation

6. Implementation roadmap

The sequence below distinguishes urgent minimum operations from investments that require a more stable operating environment. Exact timing should be reviewed regularly as security and access change.

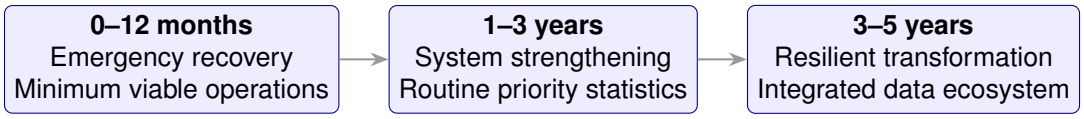


Figure 2 – Phased implementation roadmap; timing should be adapted to security, access, and institutional conditions.

6.1 Measurement and accountability

Progress should be monitored using a concise dashboard: proportion of priority indicators released on schedule; geographic coverage; survey response rates; completeness of metadata; number of trained staff applying skills in production; system uptime and successful recovery tests; number of datasets documented and securely archived; and use of statistics in approved recovery plans. Indicators should measure quality and trust, not merely the volume of data collected.

Table 3 – Three-phase implementation roadmap

Phase	Core actions	Decision-ready outputs
0–12 months: emergency recovery	Rapid institutional and data-asset assessment; secure archive recovery; minimum food and agricultural monitoring; access and quality protocols; workforce mapping	Published situation indicators with coverage notes; recovery work plan; data-security baseline
1–3 years: system strengthening	Frame updating; regular integrated survey design; CAPI scale-up; GIS and metadata services; training programme; formal coordination and data-sharing arrangements	Routine priority statistics; documented methods; strengthened state and national capacity
3–5 years: resilient transformation	Agricultural census preparation or implementation; mature data platform; model-assisted estimates; open-data dissemination; recurrent financing and independent quality review	Integrated agricultural information system and resilient production cycle

7. Discussion

Agricultural statistics should be treated as part of recovery work, not as an activity to be resumed only after other priorities are complete. A rapid survey can be useful, but it will not rebuild a system if the dataset is not secured, the frame is not updated, and the limitations are not explained to users. The same is true of technology: tablets, satellites, and cloud systems can help, but they cannot solve unclear responsibilities or weak public trust. The practical task is to make the institutions, people, methods, and systems work together.

There are also trade-offs. Fast, non-probability reporting can be useful for situational awareness but must not be represented as nationally representative official statistics. Open-data objectives must be balanced against protection of respondents, sensitive locations, and commercial information. Satellite-derived products can be timely but should not displace ground validation. These trade-offs require a transparent quality policy and communication practice.

The contribution of this paper is a Sudan-focused, phased framework that connects immediate operational choices to long-term statistical resilience. Its limitations are equally important: the framework requires field validation, institutional consultation, detailed costing, and governance review. Further work should develop a baseline diagnostic, a data inventory, a minimum indicator reference list, and tested pilot protocols in accessible locations.

8. Conclusion and recommendations

Sudan needs reliable agricultural statistics for both the immediate food-security response and the longer work of economic recovery. The conflict has made normal operations difficult, but it also makes clear which parts of the old system were too fragile. The five areas proposed in this paper—governance, people, digital and geospatial systems, methods and data integration, and sustainable partnerships—offer a practical starting point rather than a fixed blueprint.

The following actions merit early national attention:

1. Establish a nationally led agricultural statistics recovery mechanism that protects professional independence and coordinates producers and users.
2. Complete a rapid inventory of staff, data assets, frames, systems, and legal or operational constraints; secure and document recoverable archives.
3. Define a minimum, decision-oriented indicator set and publish estimates with clear metadata, coverage, and uncertainty statements.

4. Invest in offline-capable digital collection, secure data management, GIS, and capacity for reproducible analysis before pursuing complex technologies.
5. Update frames and pilot mixed-mode, probability-based collection in accessible areas, using remote sensing as a complement subject to validation.
6. Develop a costed multi-year programme with a path from external recovery support to recurrent national financing.

The first practical deliverable should be a jointly endorsed recovery diagnostic and work programme, rather than an immediate attempt to reproduce every historical series. It should identify the minimum set of statistics needed for the next agricultural season, the available evidence base, the areas that can be safely covered, and the risks that must be disclosed. From that baseline, the phased framework offers a feasible route to a complete, modern, and trusted national agricultural statistical system.
With national ownership, sustained investment, and transparent standards, Sudan can rebuild an agricultural statistical system that supports recovery now and remains useful through future climatic, economic, and institutional shocks.

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