Data for Policy: How AI and Advanced Technologies Can Strengthen Food Security in Sub-Saharan Africa

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In July 2023, seasonal forecasts warned of severe drought across Southern Africa. The predictions were clear: El Niño conditions would devastate crops and push millions towards hunger. Yet by August 2024, as widespread crop losses materialised, the Zimbabwe Drought Flash Appeal was only 11.3% funded and Malawi's appeal had received nothing[1]. This sequence of early warning followed by delayed response captures a fundamental weakness in how Sub-Saharan Africa addresses food security, and the human cost of this weakness is staggering

More than 1 billion people across Africa could not afford a healthy diet in 2024[2], and projections suggest that nearly 60% of the world's chronically undernourished population may live in Africa by 2030[2]. In Sub-Saharan Africa alone, around 282 million people were chronically undernourished in 2022, representing roughly one-fifth of the region's population[3]. Meanwhile, the region's population continues to grow rapidly and is expected to surpass 2 billion by the late 2040s[4]. Climate variability and long-standing weaknesses in agricultural systems intensify these pressures further.

For policymakers, development partners, and agricultural institutions working on these challenges, the path forward requires a fundamental and sustained shift in approach. This shift must treat data and technology not as supplementary tools but as core infrastructure for anticipating and preventing food crises before they occur.

The Reactive Pattern

One major weakness of the regional food system is that food security challenges are often addressed as short-term emergencies rather than as predictable and preventable risks[5]. The 2023-24 El Niño drought illustrates this clearly. Despite early warnings, funding and response efforts lagged significantly. By the time resources were mobilised, large areas of Zimbabwe, Malawi, Mozambique, and Angola were experiencing sustained Crisis-level food insecurity, with some households at risk of Emergency conditions[1]. This delayed mobilisation illustrates a reactive approach in which assistance scales up only after livelihoods have been damaged, reducing overall effectiveness and increasing long-term vulnerability.

A more effective pathway is to treat data and technology as core policy infrastructure that enables early action, timely investment, and risk reduction before shocks translate into humanitarian crises. The example above shows that some tools needed for this shift already exist. Satellite imagery, internet-connected environmental sensors, predictive analytics, and artificial intelligence can provide timely information on soil conditions, weather patterns, crop performance, and emerging threats. When well integrated, these tools allow policymakers and agricultural service providers to make decisions based on current conditions in specific locations rather than relying on outdated reports or broad assumptions. The value lies not only in better information but also in better timing and clearer priorities.

The Data Foundation Problem

While stronger policy responses are clearly needed, from a technical perspective, there are still critical gaps that technology can bridge. The fundamental barrier remains data quality and availability. In many countries across the region, soil maps date back decades, environmental monitoring networks are sparse, and crop yield records are incomplete or inconsistent. Data systems remain fragmented across different institutions that rarely share information. This creates a cascade problem: when underlying data are weak, even advanced analytical tools cannot produce reliable insights. Early warning systems can predict climate variability effectively, but optimised responses require granular data to maximise resource allocation and outcomes. Without this foundation, policymakers make critical decisions about crop priorities, investment targets, and climate adaptation strategies with limited evidence, navigating through fog on questions that will shape food security for decades.

Closing these data gaps requires sustained investment in agricultural data infrastructure. Recent advances in IoT sensors, satellite technology, mobile communications, and artificial intelligence have created the enabling conditions for such investment. While individual technologies can remain expensive, strategic combinations of complementary technologies (what I call "tech-synergies ") can significantly improve data coverage and accuracy at manageable cost.

These synergies work across multiple dimensions. Ground-based sensors combined with satellite observations and AI-driven modelling can deliver high-resolution insights across large geographic areas without dense physical infrastructure6. Mobile networks paired with digital payment systems can connect smallholder farmers to markets and financial services while generating real-time data on commodity flows and prices. Weather forecasting combined with soil mapping and crop advisories can provide farmers with tailored guidance on optimal planting times and varieties. In each case, the combination delivers more value than any single technology could achieve alone, whilst reducing per-unit costs through shared infrastructure and integrated data flows.

Equally important are recent advances in generative AI, which now make it easier to translate raw data into formats that different users can readily apply. Policymakers require clear indicators and decision-support tools, extension workers need practical guidance they can share with farmers, and businesses need timely market intelligence. Data systems that produce only technical reports risk being underused. The infrastructure developed must be designed to meet the needs of these different users if it is to drive meaningful and lasting change on the ground.

Building Governance for Data-Driven Agriculture

Governance plays an equally important role, yet it remains underdeveloped in many contexts. Agricultural policy affects many groups (farmers, researchers, government agencies, and private companies), and progress depends on these groups working from shared information and clear rules. Without proper governance structures, even excellent data infrastructure can fail to deliver impact.

National agricultural data platforms offer a practical model. These platforms serve as central hubs where different institutions can contribute and access data under agreed protocols. Kenya's National Agricultural Information System and Rwanda's National Agricultural Information Management System provide working examples of such approaches, though at different scales and levels of maturity. These systems provide standards for data collection, quality control, and access permissions whilst maintaining interoperability across government departments, research institutions, and private sector users.

Transparent decision-making processes are equally essential. When policy changes are made, stakeholders need to understand what evidence informed those decisions and how trade-offs were weighed. This transparency builds trust and encourages broader participation in data-sharing arrangements. It also creates accountability mechanisms that help ensure evidence is used appropriately rather than selectively to justify predetermined conclusions.

Formal governance frameworks should address several key questions: Who owns agricultural data collected from smallholder farms? Under what conditions can it be shared with researchers or private companies? How are farmers compensated or credited for their contributions? What safeguards prevent misuse? Clear answers to these questions, codified in policy and backed by enforcement mechanisms, can reduce fragmentation and build trust . But trust must extend beyond institutions to the farmers whose participation determines whether data ecosystems function in practice.

Ensuring Inclusive Implementation

Smallholder farmers are central to this effort. They produce most of the food consumed across Sub-Saharan Africa, and any forward-looking agricultural policy must start with their needs.

Data-driven systems should be affordable, accessible, and practical for small farms, not only for large commercial producers. When farmers can access relevant data, they are better able to plan planting, manage risk, and connect to markets. Cooperative and aggregation models provide practical ways to extend these benefits more widely.

Trust is also essential. Although agricultural data are less sensitive than health or financial data, farmers still need clarity on who can access information about their land and production, and how that information is used. Clear rules on data ownership, consent, and use help build confidence and encourage participation.

Youth engagement deserves particular attention. Agriculture is often perceived as low-status work in many African contexts, contributing to rural-urban migration and labour shortages. Data-driven agriculture offers an opportunity to reframe the sector as modern, technology-enabled, and economically viable. Training programmes in digital agriculture, agritech entrepreneurship, and data analytics can create pathways for young people to engage with farming as knowledge workers rather than manual labourers. This shift could help address both the sector's ageing workforce and youth unemployment simultaneously.

Implementation Challenges and Realities

None of this will happen easily. Several significant obstacles stand in the way. Infrastructure gaps remain substantial; many rural areas lack reliable electricity and internet connectivity, limiting the deployment of digital tools. Initial investment costs are high, and many governments face competing budget priorities with more immediate political payoffs. Technical capacity is limited. Even when data systems exist, many institutions lack staff trained to use them effectively. Coordination across government ministries and between public and private sectors is chronically difficult in contexts where institutional rivalries and bureaucratic silos are entrenched.

Political economy factors also matter. Existing agricultural policies often reflect powerful interests (input suppliers, large-scale producers, political patronage networks) that may resist data-driven reforms if they threaten established arrangements. Change requires not only technical solutions but also political champions willing to push for transparency and evidence-based decision-making even when it creates short-term friction.

These challenges are real but not insurmountable. Successful models exist across the continent. Ethiopia's Agricultural Transformation Agency has demonstrated how a semi-autonomous institution can drive data-driven policy reform whilst navigating political constraints. Ghana's digitalisation of cocoa supply chains shows how public-private partnerships can mobilise investment and build infrastructure. Rwanda's performance contracts (imihigo) illustrate how political incentives can be aligned with evidence-based targets. Learning from these examples and adapting them to local contexts offers practical pathways forward.

A Vision for 2030 and Beyond

Looking ahead to 2030 and 2040, a more resilient food system is achievable. Such a system would be grounded in local knowledge and strengthened by modern technology. Policies would draw on real-time data from farms and landscapes rather than distant projections. Farmers would be recognised as contributors of valuable knowledge. Agriculture would be seen as a sector of opportunity that can attract young people and support inclusive economic growth.

Data and technology are powerful tools, but they are not solutions on their own. Their impact depends on governance, access, and long-term policy commitment. With inclusive design, strong institutions, and sustained use of evidence in decision-making, they can support a food system that is more resilient, more equitable, and better prepared for future shocks.

The time to act is now. For governments, this means treating agricultural data infrastructure as a strategic priority deserving sustained budget allocation and high-level political backing. For development partners, it means shifting funding from reactive humanitarian response towards proactive data systems and early warning mechanisms. For research institutions, it means ensuring that data collection serves policy needs and that findings are translated into actionable guidance. For private sector actors, it means investing in inclusive business models that bring smallholders into digital agricultural value chains rather than bypassing them.

The technical foundations are in place. What remains is the political will to build on them.

Policy Recommendations: Key Takeaways

1. Invest in agricultural data as national infrastructure

Soil, climate, yield, and market data should be treated as strategic national assets, with sustained investment in collection, updating, and interoperability.

2. Address core data gaps before expanding advanced analytics

Updating soil maps, expanding environmental monitoring, and strengthening yield records should take priority so that advanced tools are built on reliable data.

3. Create integrated and usable data platforms

Agricultural data systems should combine ground sensing, satellite data, and predictive models into tools that directly support policy, extension services, and investment decisions.

4. Formalise inclusive data governance frameworks

Clear rules should align farmers, researchers, government institutions, and the private sector around shared standards, transparent processes, and accountability.

5. Ensure accessibility for smallholders and youth

Data-driven systems must be affordable and practical for smallholder farmers whilst creating opportunities for youth involvement through digital skills and agritech innovation.

References

1. FEWS NET. (2024, August). Historic high needs anticipated across Southern Africa through early 2025. https://fews.net/southern-africa/alert/august-2024/print

2. Muhumuza, R. (2025). UN report reveals alarming rise in Africa's food insecurity despite global improvements. Associated Press World News. https://apnews.com/article/0d366a-4042d4524a79cb5b47a94bc0cd

3. Lee, D., Anderson, W., Chen, X., Davenport, F., Shukla, S., Sahajpal, R., Budde, M., Rowland, J., Verdin, J., You, L., & Ahouangbenon, M. (2025). HarvestStat Africa—Harmonized subnational crop statistics for sub-Saharan Africa. Scientific Data, 12(1), Article 690. https://doi.org/10.1038/s41597-025-05001-z

4. United Nations. (2022). Population and vital statistics report (Statistical Papers, Series A). United Nations. https://doi.org/10.18356/9789210014380

5. Baro, M., & Deubel, T. F. (2006). Persistent hunger: Perspectives on vulnerability, famine, and food security in sub-Saharan Africa. Annual Review of Anthropology, 35(1), 521–538. https://doi.org/10.1146/annurev.anthro.35.081705.123224

6. Odedeyi, T., Kolawole, O., Ugoji, C., Ayankanmi, T., Okhuoya, O., Rabbit, I., Asante, K.O.H. and Darwazeh, I., 2025, June. Multi-Source Data Integration and IoT-Based Sensing for Crop Yield Modelling and Optimisation. In 2025 IEEE International Conference on Smart Computing (SMARTCOMP) (pp. 294-299). IEEE. https://discovery.ucl.ac.uk/id/eprint/10209270/

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Dr. Temitope Odedeyi is a Senior Research Fellow at University College London (UCL) and a leading voice in the intersection of engineering, digital technology, and sustainable development. He holds a BSc in Electrical and Electronic Engineering from Olabisi Onabanjo University, Nigeria, and earned both his MSc and PhD from UCL. He is a recipient of the prestigious Nigerian Presidential Special Scholarship for Innovation and Development (PRESSID).

His research interest focuses on the analysis and design of high-speed telecommunication devices and electronic instrumentation, with applied interests in food quality prediction and precision agriculture. In 2023, he was awarded the Royal Academy of Engineering Research Fellowship, where he leads a groundbreaking 5-year Engineering for Development project. This initiative is developing IoT-enabled technologies that support data-driven farming and improve cassava yields in sub-Saharan Africa — advancing food security and climate-smart agriculture.

Dr. Odedeyi's work blends cutting-edge innovation with real-world impact, particularly in the Global South, where he is helping to reshape the future of agricultural productivity through digital transformation and smart systems.

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