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Putting research knowledge into action

Advancing digital agriculture for climate resilience and economic transformation in Malawi

Key messages

- Digital agriculture is key to resilient, inclusive growth in Malawi, boosting productivity, market access, and climate risk management, particularly for rainfed smallholders.
- Access barriers remain high, including limited ICT and energy infrastructure, high device/data costs, low digital literacy, gender disparities, and language mismatches.
- Policy support exists but lacks implementation. Malawi Vision 2063 and other frameworks are undercut by weak coordination, limited financing, and regulatory gaps.
- Digital adoption offers major gains: A 1% uptake could grow agricultural GDP by 0.4% (USD 20–30 million/year), with gender inclusion adding another USD 14 million.
- High-potential technologies are underused due to affordability, infrastructure, and capacity constraints, despite proven impact (e.g., mobile advisories, sensors, drones).

Malawi, a landlocked country in Southeastern Africa, is vulnerable to the impacts of climate change. Agriculture is the backbone of its economy, supporting more than 80% of the population, contributing 30% to the national Gross Domestic Product (GDP), and generating 80% of export earnings (UNCDF 2023). The World Bank projects that, under a business-as-usual scenario, climate change could reduce Malawi's GDP by 3–9% by 2030, 6–20% by 2040 and 8–16% by 2050 (World Bank Group 2022). These losses are primarily attributed to infrastructure damages, including roads and bridges, and decreased labor productivity due to heat stress. Additionally, climate shocks could push an estimated two million people into poverty by 2030 and increase to four million by 2040 (World Bank Group 2022). However, this critical sector is largely dominated by smallholder farmers who rely on rainfed systems and face persistent structural, technological, and climate-related challenges. As climate variability intensifies—bringing more frequent droughts, floods, and erratic rainfall—the urgency to adapt and innovate to ensure the resilience of the country's agrifood system becomes paramount. In this context, digital agriculture offers a transformative pathway to improve productivity, resilience, and inclusivity in the face of climate and economic uncertainty.

A group of women gather at a clean water pump in Malawi, Africa (*Photo:* Oxford Media Library/Shutterstock.com).

- Women and rural farmers are digitally excluded, with broadband coverage under 50% and electricity access under 10% in farming areas; women are 30–40% less likely to access digital tools.
- Locally tailored innovation is vital. Solutions must be voice-based, USSD-enabled, and offered in local languages, with hubs supporting youth- and women-led enterprises.
- Strategic public investment is urgent: Remove VAT/ import duties, expand rural broadband and solar energy, digitize extension services, and establish a Digital Agriculture Innovation Fund.
- Five catalytic actions: Expand mobile coverage, close the gender digital gap, study digital yield gaps, subsidize tools for 50,000 smallholders, and digitally train 600 extension officers.
- A phased, evidence-based approach should guide Malawi's digital transformation—prioritizing scalable wins over the next 3–5 years toward full system change by 2030.

This brief synthesizes findings from a study conducted by the International Water Management Institute (IWMI) and the Global Center on Adaptation (GCA) (Matchaya et al. forthcoming). Drawing on literature reviews, field consultations, and surveys from districts including Lilongwe, Dowa, Zomba and Mchinji, the report evaluates the role of digital agriculture in climate adaptation, identifies barriers to adoption, and proposes strategic investments for inclusive agricultural transformation.

Agricultural and climate challenges

Malawi's agricultural system faces multifaceted challenges. Low levels of irrigation development mean only 20% of irrigable land is utilized, limiting resilience during dry seasons (FAO and ITU 2022). Productivity is further constrained by the inadequate use of modern inputs, limited mechanization, and a weak extension system, which has a ratio of one officer per 1,388 farming households. Land fragmentation, with the average farm size being only 0.7 hectares (ha), results in poor economies of scale and accelerates land degradation. Compounding these challenges are high post-harvest losses, pest and disease outbreaks, and poor access to finance, markets, and infrastructure.

Climate change amplifies these structural vulnerabilities. Between 1960 and 2006, Malawi experienced a 0.9°C rise in temperature, with projections suggesting further increases of up to 1.5°C by the 2040s (McSweeney et al. 2010; Matchaya et al. forthcoming). Rainfall patterns are becoming increasingly unpredictable, with some models forecasting a 13% decrease in rainfall while others predict up to a 32% increase. Events such as Cyclone Ana in 2022 and Cyclone Freddy in 2023 have devastated communities and agricultural lands, displacing hundreds of thousands and destroying over 200,000 ha of crops (Government of Malawi 2023). Critical value chains such as maize, tobacco, and cotton are at risk, with maize yields projected to decline by 14% by mid-century (Msowoya et al. 2016). Cassava, although more drought tolerant, suffers from limited market integration and policy neglect, while fish stocks are threatened by warming waters and habitat degradation.

The digital agriculture landscape

Digital agriculture provides a critical toolset for navigating these complex challenges by giving smallholders faster and more affordable access to digital climate information and agricultural advisory services, compared to traditional face-to-face extension methods. They also increase the efficiency of resource utilization such as water (by detecting over-irrigation, for example) and time. Technologies including mobile applications, digital advisory platforms, remote sensing, drones, and data analytics have the potential to revolutionize how farmers access information, make decisions, and interact with markets. Malawi has made some progress in digital agriculture, particularly in expanding mobile services and experimenting with both weather alerts and mobile-based extension services. However, access to digital technology remains uneven and insufficient, particularly among women and rural populations. Surveys reveal that over 55% of farmers' needs for digital services are unmet (Matchaya et al. forthcoming). Women, in particular, face barriers related to device ownership, digital literacy, and sociocultural norms. Only 37% of rural Malawians own mobile phones, compared to 72% in urban areas, and women are 30% less likely than men to use mobile phones for agricultural purposes (FAO and ITU 2022).

Barriers to digital inclusion

The digital divide in Malawi is influenced by several interrelated factors. First, infrastructure deficits are substantial. Electricity access stands at just 11.2% nationally, with only 4.1% of rural households connected to the grid. Mobile network coverage is limited in many rural farming zones. High and volatile costs for devices and mobile data remain a critical barrier. However, regulatory reforms by the Malawi Communications Regulatory Authority (MACRA) and public advocacy campaigns like "Data Must Fall" have significantly lowered costs,

reducing the price of 1 GB of mobile data from over USD 27 in 2020 (FAO and ITU 2022) to under USD 1 following pressure on telecom providers (Nation Online 2023). Second, digital literacy is low—60% of the population lack basic digital literacy (Ernst & Young Private Limited 2021), particularly among older populations and those with a limited formal education. Though basic literacy rates are relatively high, skills required for effective digital engagement—such as navigating apps or interpreting data—remain limited. Third, content and services are often not localized. Many tools are not available in local languages or adapted for low-literacy users, reducing their usability and relevance.

Policy and institutional context

Despite these constraints, Malawi's policy framework generally supports digital transformation. Malawi Vision 2063 places a strong emphasis on digitalization, agricultural commercialization, and resilience. The National Agriculture Policy (NAP), the Irrigation Masterplan and Investment Framework (IMPIF), and the Digital Economy Strategy (2021–2026) promote smart farming, data-driven extension services and inclusive innovation. The country has also aligned its strategies with continental initiatives such as the African Union's Digital Transformation Strategy for Africa (2020–2030). However, implementation has lagged. Coordination between ministries remains weak, public funding for digital agriculture is minimal, and regulatory frameworks for emerging technologies—such as drones and digital farmer IDs—are underdeveloped (Wood and Morinière 2013).

Current digital applications and gaps

Malawi's digital agriculture landscape presents significant potential but is currently constrained by a range of entry and system barriers that restrict scale, inclusivity, and effectiveness across the agricultural value chain.

Fragmented and time-bound initiatives

While mobile phone-based services—such as SMS alerts, Unstructured Supplementary Service Data (USSD) codes, and voice messages—have emerged as the most accessible platforms for smallholder farmers, their reach remains uneven and fragmented. Though donor-funded programs like USAID's Feed the Future, the World Bank's Digital Malawi Project, and the EU's KULIMA Program have introduced promising digital tools, many remain pilot-level, localized, or temporary, with limited integration into national extension services and long-term sustainability frameworks (Matchaya et al. forthcoming).

Widespread service gaps across the value chain

Over 55% of farmers' digital service needs remain unmet, with even the best-supported tools indicating over 40% unmet demand (Matchaya et al. forthcoming). Key gaps are especially evident in input price data, market and output pricing, technical support, and tools for soil and water management. Moreover, a dominant focus on the production node—covering planting, pest control, and weather forecasting—has left post-harvest management, processing, aggregation, and marketing largely neglected. Fewer than 20% of farmers use digital tools for value addition, and digital solutions for fisheries and livestock remain virtually absent, despite their importance for rural nutrition and income diversification.

Persistent digital divide

Digital access in Malawi is highly unequal and often fails to reach those most in need, such as women, small and marginal farmers, older farmers, and those in remote rural areas. For example, 54% of female farmers reported an unmet demand for soil maps compared to 51% of their male counterparts (Matchaya et al. forthcoming). Additionally, women are 30–40% less likely to use digital agriculture services, largely due to lower mobile phone ownership and digital literacy (FAO and ITU 2022). As a result, fewer than 20% of female farmers use digital advisory services compared to 35% of their male counterparts (ITU 2022).

Technology affordability and infrastructure constraints

Adoption of advanced digital tools is hampered by affordability and access issues. Soil moisture sensors (approximately USD 100) and smartphones remain out of reach for most smallholders (Shanahan and Bahia 2023). Additionally, rural electricity coverage in key farming zones is below 10%, which undermines the use of digital technologies. Mobile broadband penetration in rural areas is below 50%, with many farmers experiencing intermittent network signals and frequent power outages (World Bank Group 2022; Shanahan and Bahia 2023).

Weak human and institutional capacity

Digital literacy remains a key constraint. Over 60% of farmers report a lack of confidence in using digital platforms (FAO and ITU 2022). Meanwhile, extension officers are often under-equipped and inadequately trained in digital service delivery, limiting their ability to support farmers effectively.

Policy and regulatory gaps

The enabling environment for digital agriculture is underdeveloped. Malawi lacks a comprehensive national digital agriculture policy. Key regulatory frameworks—covering data privacy, drone usage, IoT applications, and rural ICT investments—are either missing or poorly coordinated. Inter-ministerial collaboration across the Agriculture, ICT, Finance and Gender ministries remains weak and ad hoc, further constraining the integration of digital transformation efforts (FAO and ITU 2022).

An evidence-backed investment case for digital technologies in Malawi

Digital technologies offer an integrated pathway to transform agriculture through improved productivity, resilience, and inclusiveness. This section outlines key innovations, their quantified benefits, and enabling conditions to accelerate digital transformation in the sector.

Key digital technologies and innovations

The following digital innovations have been prioritized based on findings from the Digital Agriculture and Adaptation Profile for Malawi (Matchaya et al. forthcoming), stakeholder consultations, and global evidence on returns to digital technology adoption:

Smartphones, radios, and mobile apps

These tools facilitate access to agricultural advisories, real-time weather forecasts, and market price information. Farmers equipped with digital advisory tools can achieve 25–30% higher yields compared to those without (World Bank Group 2019). Despite this, rural smartphone ownership in Malawi remains under 40% (Shanahan and Bahia 2023). Scaling access through subsidies or bulk cooperative procurement could rapidly expand uptake.

Soil moisture sensors and weather stations

Devices like Chameleon Soil Moisture Sensors and Automatic Weather Stations (AWS) provide critical data for optimizing irrigation and planting times. In Malawi, pilot deployments have shown that these tools can boost productivity by up to 40% and reduce water wastage by 30% (Chikankheni et al. 2024). However, wider deployment is hampered by upfront costs and gaps in technical capacity.

Digital financial services

Mobile money and digital credit scoring systems increase smallholder access to finance. McKinsey Global Institute (2016) estimates that digital finance could add 3% to Sub-Saharan Africa's GDP. In Malawi, only 19% of rural households use mobile money services (ITU 2022). Expanding agent networks and bundling services with mobile agri-platforms could close this gap.

Drone technologies and remote sensing

Drones can support crop health monitoring, input application and land mapping. Use cases in East Africa show 10–25% yield improvements and a 30% reduction in pesticide use (Guebsi et al. 2024). Regulatory reforms are needed to strengthen Malawi's enabling environment to support commercial drone use in agriculture.

Early warning systems

Digital early warning system tools such as Modernized Climate Information and Early Warning Systems (M-CLIMES) and Participatory Integrated Climate Services for Agriculture (PICSA) provide climate forecasts and pest outbreak alerts. Evaluations of PICSA in Southern Malawi found reductions in climate-induced yield losses (Independent Evaluation Unit 2022). National rollout is constrained by a lack of integration with existing extension systems. Further, Malawi utilizes a smartphone app (Weather Chasers Malawi via WhatsApp) established in January 2016 (GIZ 2019), for weather alerts and reports. This WhatsApp group improves early warning communication and uses member observations to verify and enhance forecast reliability.

Digital agriculture platforms

Agricultural information management platforms like Esoko and Airtel M'chikumbe disseminate market and agronomic information via SMS and USSD. In Ghana, Esoko users received 10–20% higher farmgate prices (Goyal 2010). In Malawi, uptake remains low due to affordability and language barriers.

Internet of Things (IoT) tools

IoT solutions such as remote-controlled irrigation systems and automated weather sensors are emerging globally. While few pilots exist in Malawi, future benefits include water and input efficiency, especially in horticultural zones. These tools require high internet penetration and stable power—currently lacking in many rural areas (ITU 2022).

Economic justification

Return-on-investment (ROI) modeling from similar Sub-Saharan African contexts, applied to Malawi's situation, yields the following outcomes:

- Chameleon Soil Moisture Sensors: USD 100/ha cost; USD 150–200/ha productivity gain per season (ROI: 1.5–2x).
- Drones: USD 15/ha service cost; 10–25% yield gain and reduced input waste.
- Mobile advisory: USD 5/farmer/year; benefit of USD 30–50/year (ROI: 6–10x).
- Digital finance: 20–30% inclusion gain linked to productivity through access to credit and insurance.

At a macroeconomic level, a 1% increase in digital technology adoption could raise Malawi's agricultural GDP by 0.4% annually, equivalent to USD 20–30 million per year (Matchaya et al. forthcoming). Closing the gender digital divide could generate an additional USD 14 million annually through improved women's productivity (ITU 2022; Shanahan and Bahia 2023).

An African woman using a solar panel with radio to recharge phones and light, donated by a charity NGO, to improve life in rural areas (*Photo:* Lucian Coman/Shutterstock.com).

Policy and financing enablers

To unlock the value of digital technologies in Malawi's agriculture, enabling policies and sustainable financing are needed:

- Remove Value-Added Tax (VAT) and import duties on digital agri-equipment (e.g., sensors, drones, tablets, and other digital devices).
- Expand rural mobile broadband coverage to 65% by 2027 (currently 48%).
- Integrate digital agriculture into the national curriculum and extension systems.
- Establish a Digital Agriculture Innovation Fund with donor co-financing (e.g., African Development Bank Group (AfDB), Global Center on Adaptation (GCA), World Bank) to promote digital agriculture.
- Mandate USSD, voice-based, and local language interfaces in all publicly funded digital platforms.

Digital agriculture in Malawi offers a high-yield investment opportunity to address structural challenges in agriculture while improving resilience and inclusiveness. Prioritized investments in proven technologies such as mobile advisory tools, soil moisture sensors, drones, and digital finance can generate rapid productivity and income gains. With targeted financing, enabling policies, and inclusive design, Malawi can achieve substantial transformation in food systems and rural livelihoods.

Conclusion and recommendations

To unlock the potential of digital agriculture in Malawi, targeted, phased investments must focus on realistic gains over the next 3-5 years, guided by available evidence and achievable policy shifts.

1. Incrementally expand rural mobile coverage to priority districts

Malawi's rural mobile broadband coverage remains below 50% (Shanahan and Bahia 2023). Rather than aiming for full nationwide coverage immediately:

- Target a **stepwise increase** from the current ~48% to **60% by 2030**, focusing on high-potential agricultural districts with large service gaps and vulnerability to climate shocks (e.g., Nsanje, Chikwawa, Dowa, Mchinji).
- Track coverage using **geo-referenced telecom data** and prioritize expansion where the agricultural population density is highest.

2. Close the gender and rural digital divide through inclusive tool design

Current evidence suggests that women in Malawi face **30–40% lower access** to digital services than men (FAO and ITU 2022). To address this:

- Mandate that all public- and donor-supported digital agriculture platforms integrate **USSD and voice-based interfaces** in **local languages** (Chichewa, Tumbuka, Yao).

- Aim for **50% of users of new agri-digital services to be women** by 2030, supported by outreach via women's farmer cooperatives and Village Savings and Loan Associations (VSLAs).

- Design tools that accommodate local realities, including **low literacy and shared phone environments**, and monitor usage with **sex-disaggregated data.**

3. Establish a national study to quantify the digital yield divide

To strengthen the business case for digital agriculture, Malawi should:

- Commission a national comparative study by 2026 to assess **yield, income, and resilience differences** between digitally connected and disconnected farmers.

- Use the findings to support cost-benefit projections and determine where digital services should be prioritized for scale-up.

4. Subsidize high-impact digital tools for 50,000 smallholders

Instead of pushing a nationwide rollout, begin with a **phased deployment** of proven technologies in climate-vulnerable areas:

- Offer **targeted smart subsidies** for tools such as:
  - Soil moisture sensors (e.g., Chameleon)
  - Weather-based crop advisory apps
  - Mobile-based extension and financial literacy tools
- Focus the first rollout (2026–2028) on **50,000 farmers across ten districts**, prioritizing women, youth, and those in irrigation schemes.

5. Catalyze local innovation through regional hubs

To promote localized innovation and service relevance:

- Establish **three regional Agri-Digital Innovation Hubs** (Lilongwe, Blantyre and Mzuzu) by 2027 to incubate:
  - Youth- and women-led agri-tech enterprises.
  - Tools that respond to specific value chain needs (e.g., groundnut sorting, horticulture tracking).
- Provide up to **USD 10,000 in competitive grants** per innovation and ensure that supported ventures are monitored for user reach, adoption, and impact.

6. Digitally empower agricultural extension services

The extension system can be the bridge between digital services and last mile users:

- Train **600 extension officers** (three from each Extension Planning Area (EPA)) by 2027 to use tablets and mobile advisory platforms in farmer training and recordkeeping.

- Pilot the integration of **digital tools in extension training programs** at the Lilongwe University of Agriculture and Natural Resources (LUANAR) including the Natural Resources College (NRC) starting from the 2026 academic year.

- Monitor the effect of digital extension support on **input timing, adoption of recommendations, and yields** through regular farmer feedback.

7. Strengthen coordination and regulation

A coherent policy environment is necessary to prevent fragmented digital investments:

- Establish a **Digital Agriculture Coordination Taskforce** by 2026 with representation from the ministries of Agriculture, ICT, Finance, and Gender for unified actions.

- Revise the **National Agriculture Policy** and **ICT Policy** to explicitly:
  - Define digital agriculture tools and services.
  - Outline tax incentives for essential digital tools (e.g., smartphones, agri-sensors, solar kits).

For Malawi's digital agriculture agenda to succeed in the current policy window (2026–2030), a phased, evidence-informed, and inclusion-focused approach is essential. Rather than aiming for total transformation in one sweep, these recommendations offer achievable first steps with measurable results, especially for women, youth, and underserved farming communities.

By focusing on coverage expansion in priority districts, pilot subsidies for high-impact tools, and better coordination and monitoring, Malawi can build a foundation for scalable and sustainable digital agriculture transformation.

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