United Nations University
Institute for Water, Environment and Health

POLICY BRIEF
March 2026

Digital Agriculture and AI for Climate-Resilient Smallholder Farming in Zimbabwe

Executive Summary

- Digital technologies offer opportunities to strengthen smallholder farmers' access to markets, climate information services, and agricultural advisory support, contributing to more resilient and productive agrifood systems under climate change.
- In Zimbabwe, structural barriers – low digital literacy, inadequate rural connectivity, and persistent gender inequalities – continue to restrict equitable and inclusive digital adoption.
- The rapid growth in the use of smartphones offers a strong foundation for scaling digital agriculture, provided that constraints on costs, infrastructure, and digital skills are addressed.
- Strategic public investment in rural digital infrastructure, complemented by inclusive public–private partnerships, is crucial for expanding access in remote and underserved areas.
- Targeted, inclusive, and gender-responsive digital literacy and capacity building programmes are critical to ensure that women, youth, and older farmers participate effectively and benefit equitably from digital agricultural transformation.

Context

Smallholder farmers play a central role in Zimbabwe's food systems and rural livelihoods. Yet their productivity, resilience, and income generation remain constrained by persistent structural barriers. These include limited and unreliable access to markets[1], inadequate availability of accessible and timely climate information services, under-resourced agricultural extension systems, inadequate and restricted access to financial services, and heightened exposure to climate-related risks[2].

Digitalisation in agriculture presents a strategic opportunity to address several of these systemic constraints simultaneously[3,4]. Mobile-based platforms, digital financial services, and data-enabled advisory tools can improve information flows, reduce transaction costs, improve risk management and enhance farmers' better-informed decision-making[5,6]. During recent shocks, including the COVID-19 pandemic, digital tools demonstrated their potential to support continuity in agricultural production, service delivery and market access[7]. However, without targeted policy action, digitalisation risks reinforcing existing inequalities rather than delivering inclusive transformation.

However, digitalisation is not inherently inclusive. Without deliberate policy design, targeted investment,

and safeguards to address structural inequalities—particularly those related to gender, income, geography, and digital literacy—digital transformation may reinforce existing disparities rather than deliver equitable and climate-resilient outcomes.

This policy brief is intended for national policymakers, regulators, development partners, and implementing agencies in Zimbabwe and the broader region. Drawing on evidence from across sub-Saharan Africa, it provides policy-relevant guidance to support Zimbabwe's agricultural transformation, digital innovation, and rural development priorities over the period 2026 - 2030.

Digital policy and agricultural transformation in Zimbabwe: The National Context

Zimbabwe's digital transformation agenda is rooted within broader national planning and development frameworks. The National Development Strategy 1 (2021–2025)[8] identifies digitalisation as a cross-cutting enabler of economic transformation. The National ICT Policy (2022 - 2027)[9] further emphasises universal access, broadband expansion, and digital skills development, including equitable quality education. In parallel, agricultural transformation strategies recognise the importance of climate information systems, digital data platforms, and modernised extension services to enhance productivity and climate resilience.

Historically, agricultural extension in Zimbabwe has relied primarily on face-to-face advisory systems[10]. Financial constraints, such as limited access to finance and credit and high farmer-to-extension officer ratios, which limit extension support for farmers, have reduced coverage and responsiveness. Within this context, digital tools could complement and strengthen extension systems, thereby improving farmers' access to timely, relevant, and reliable climate and market information.

Evidence from previous ICT-for-development initiatives across Africa demonstrates that digital initiatives/interventions are unlikely to achieve scale or sustainability where institutional coordination is fragmented, affordability safeguards are inadequate or non-existent and regulatory frameworks lack clarity and enforcement[11]. Digitalisation must therefore be embedded within coherent governance frameworks and institutional arrangements, sustainable financing structures, and clear regulatory oversight to ensure inclusive, equitable, and resilient outcomes.

Key constraints to digital adoption

Despite growing interest and innovation, the uptake of digital agriculture among smallholder farmers in Zimbabwe remains uneven and structurally constrained. Key constraints include:

- **Limited connectivity** - Many rural areas continue to lack reliable, affordable internet access, limiting the use of digital platforms and services.
- **Low levels of digital literacy**: A significant proportion of smallholder farmers lack the skills to use mobile applications, digital advisory tools, and online services effectively.
- **Infrastructure gaps** - Unreliable electricity supply and limited mobile network coverage further restrict digital access and service continuity.
- **Affordability barriers** - The cost of smartphones, data bundles, and digital services remain prohibitive for many farming households.
- **Gender disparities** - Women farmers face compounded constraints related to access, device ownership, time burdens, mobility limitations, digital skills gaps, and decision-making power over financial and technological resources, risking further exclusion from digital transformation processes.

Addressing these challenges requires integrated policy responses and coordinated action across infrastructure investment, affordability measures, targeted digital skills development, and good governance through gender-responsive programming and strengthened institutions.

Why digital agriculture is a strategic policy option

Digital agriculture builds on an increasingly widespread and rapidly evolving mobile ecosystem across sub-Saharan Africa. By 2022, smartphones accounted for approximately half of all mobile connections in the region[7], and this share continued to rise, reaching an estimated 64% of total mobile connections by 2025.This trend reflects expanding digital readiness and provides a scalable foundation for agricultural digitalisation. Importantly, even basic technologies such as SMS, voice-based services, and mobile money have demonstrated positive impacts on access to information, finance, and markets when embedded within supportive institutional and regulatory frameworks[12].

- For Zimbabwe, digital agriculture presents a strategic and catalytic pathway to advance national development priorities through: Strengthened delivery of climate information and agricultural extension services;
- Expanded access and participation in markets by smallholder farmers;
- Enhanced financial inclusion and insurance through mobile-based services; and;

- Improved resilience to climate variability and economic shocks through better risk management and inclusive decision-making.

Realising these benefits, however, depends on enabling coherent policy planning, cohesive institutional arrangements and sound investment choices.

Evidence from across sub-Saharan Africa indicates that digital agriculture delivers measurable benefits when embedded within supportive institutional ecosystems. A recent meta-analysis of digital advisory tools found improvements in input use efficiency, yield outcomes, and market participation, particularly where digital tools were combined with extension and financial services[13]. Similarly, climate information services delivered via mobile platforms have been associated with improved risk management and adaptive decision-making among smallholder farmers[2].

However, impact heterogeneity remains significant. Studies show that digital adoption tends to disproportionately benefit better-connected, male, and relatively wealthier farmers unless deliberate inclusion mechanisms are put in place[14,15]. Without targeted gender-responsive and inclusivity safeguards, digital transformation risks reinforcing existing socio-economic inequalities rather than narrowing them.

Policy priorities for Zimbabwe (2026 - 2030)

1. **Expand rural digital infrastructure**: Public investment should prioritise the expansion of mobile broadband and affordable data coverage in underserved rural and farming areas. Off-grid, solar-powered energy solutions can support digital infrastructure and device use in areas with unreliable electricity supply. In remote locations where terrestrial networks are not viable, low-Earth-orbit satellite internet solutions can be piloted to extend connectivity. Financing mechanisms may include blended finance instruments, concessional loans from development partners, and performance-based subsidies tied to rural coverage expansion. The Universal Service Fund[16], administered under national ICT regulation, provides a practical vehicle for subsidising connectivity in commercially unattractive areas. This instrument could be used to provide free and low-cost internet connectivity in rural and underserved markets. To ensure equitable and inclusive outcomes, transparent allocation criteria, strong oversight mechanisms and regular public reporting are essential.

2. **Strengthen digital literacy and skills**: Digital literacy programmes should be context-specific and demand-driven, reflecting the practical needs of smallholder farmers and local agricultural systems. Training should focus on the use of mobile advisory tools, climate information services, digital financial platforms, and market information systems that directly facilitate market access, enhance risk assessment and support enhanced farm-level decision-making. Gender-responsive and youth-inclusive approaches are essential, alongside the use of multimedia channels such as radio and voice-based services to reach farmers with low literacy levels and limited digital access. Community-based digital champions, including trained youth agripreneurs, can play an important role in providing peer-level support and facilitating capacity building at the local level. Embedding digital skills training within existing agricultural extension platforms, such as farmer field schools, can reduce duplication of efforts and enhance uptake. Monitoring and evaluation frameworks should include pre- and post-training assessments to evaluate behavioural change rather than relying solely on device ownership and/or connectivity levels.

3. **Promote inclusive and affordable digital solutions**: Policies should incentivise the development of low-cost, user-friendly digital tools tailored to the needs and capacities of smallholder farmers. This includes applications that operate offline or via SMS, use local languages, and address priority issues such as information on pest management, access to market prices, and location or crop-specific agronomic advice. Zero-rated data agreements for vetted agricultural applications and information services can further improve affordability and support uptake among smallholder farmers.

4. **Leverage public–private partnerships responsibly:** Inclusive partnerships can catalyse the scaling of digital agriculture solutions. Governments can help de-risk private investment through instruments such as matching grants, innovation funds, and regulatory sandboxes that enable the testing of digital tools in real-world farming contexts. Partnerships should prioritise locally adapted technologies and ensure alignment with national development objectives and priorities.

5. **Expand access to digital financial services:** Digital financial services, including mobile-based credit, savings, and insurance products, should be aligned with agricultural production cycles to support farmers. Integrating these services with extension support and market access can enhance adoption and impact, particularly for women and resource-constrained farmers.

The policy options outlined above are rooted in empirical evidence on what works in digital agriculture

Box 1. What Works in Digital Agriculture? Lessons from Sub-Saharan Africa

Evidence suggests that digital agricultural tools are most effective when they:

- Complement rather than replace extension systems
- Operate across multiple channels (SMS, voice, app-based)
- Address clear farmer needs and priorities such as weather risks, pest management, and market access
- Integrate financial, advisory and market services
- Include gender-responsive outreach and training mechanisms

Isolated technology deployments without supportive institutional ecosystems and corresponding capacity-building initiatives have shown limited impact [13,18].

in sub-Saharan Africa. They are consistent with commitments under the Sustainable Development Goals of the 2030 Agenda for Sustainable Development, the Comprehensive Africa Agriculture Development Programme and relevant national policy frameworks.

Final Remarks

For digital agriculture to deliver meaningful and inclusive outcomes, coordinated policy action is required across infrastructure, affordability, skills, and governance frameworks[17]. The following priority actions are recommended for effective implementation of digital transformation between 2026 and 2030 in Zimbabwe and other comparable contexts:

1. **Establish a rural digital infrastructure acceleration plan**: Leverage the Universal Services Fund to prioritise broadband expansion in high agricultural potential but digitally underserved districts. Incentivise telecom operators through tax credits or co-investment models tied to rural coverage targets. In remote areas where fibre deployment is not economically viable, pilot satellite connectivity to support digital services in farming communities and advise on adaptation measures such as irrigation schemes and crop choices.

2. **Implement a national digital agriculture capacity building programme:** Ensure that investments in digital infrastructure are used optimally, and coordinate efforts to build and strengthen capacity. This could be achieved through integrating digital literacy modules into AGRITEX training curricula and farmer field schools. Additionally, partnering with universities, agricultural colleges, and youth innovation hubs to deliver short, accredited courses in digital agriculture. Developing local-language audio and voice-based advisory tools can further improve accessibility for farmers with low literacy levels.

3. **Introduce targeted affordability mechanisms:** Affordability remains a key barrier to digital adoption. Negotiate zero-rated data access for approved agricultural information services and applications with the aim of significantly reducing costs for smallholder farmers. Support micro-financing schemes for smartphone acquisition tied to productive use (e.g., climate advisory subscription) to help expand access. Encourage handset manufacturers and network providers to introduce low-cost rural-optimised devices that can enhance smallholder farmers with connectivity and market access.

4. **Institutionalise gender-responsive digital inclusion targets:** Ensuring equitable participation requires explicit gender-responsive policy measures across frameworks and institutions. Mandate sex-disaggregated reporting for all publicly funded digital agriculture programmes to support more inclusive planning and investment. Set measurable targets for women's participation in digital literacy programmes and innovation funds to contribute to equal participation while partnering with women's farmer organisations to co-design tools and services.

5. **Create a national digital agriculture coordination platform**: Effective digital transformation requires strong inter-institutional coordination. Establish an inter-ministerial national task force linking Agriculture, ICT, Finance, and Energy portfolios to align regulatory frameworks, data governance standards, and investment pipelines for more integrated approaches. Such a platform can also facilitate structured engagement with private sector actors, research institutions, and development partners.

Without these concrete policy measures, digital transformation in agriculture risks reinforcing existing

structural inequities rather than enabling sustainable management. With coordinated investment, inclusive governance, and sustained capacity-building, Zimbabwe can position digitalisation as a strategic enabler of agricultural productivity, climate resilience, and rural inclusion.

Box 2. Alignment with global, continental and national policy frameworks

This policy brief aligns with relevant global, continental, and national policy frameworks that support inclusive, resilient, and sustainable agrifood systems. The policy orientations presented are intended to inform evidence-based decision-making and do not imply endorsement of specific policies, programmes or instruments.

Sustainable Development Goals (SDGs)

The policy options outlined in this brief contribute to the implementation of the 2030 Agenda for Sustainable Development, in particular:

- SDG 1 – No Poverty through improved access to markets, information and financial services for smallholder farmers.
- SDG 2 – Zero Hunger through enhanced agricultural productivity, food availability and resilience through digital advisory and climate information services.
- SDG 5 – Gender Equality through gender-responsive digital literacy and inclusive access to digital services.
- SDG 9 – Industry, Innovation and Infrastructure through investment in rural digital infrastructure and innovation systems.
- SDG 13 – Climate Action through strengthened climate adaptation and risk management in agriculture.

Comprehensive Africa Agriculture Development Programme (CAADP)

The proposed policy directions are consistent with CAADP commitments, including:

- Pillar II – Rural infrastructure and market access through expansion of rural connectivity and supporting infrastructure.
- Pillar IV – Agricultural research, technology dissemination and adoption through digital platforms and capacity development for technology uptake.
- Kampala Declaration (2025) – Inclusive digital transformation, with emphasis on youth engagement and gender responsiveness.

National policy frameworks in Zimbabwe

The policy options support the implementation of key national strategies, including:

- National Development Strategy 1 (NDS1, 2021–2025) through Agricultural productivity, innovation and digital transformation.
- Agriculture and food systems strategies through strengthened extension, climate resilience and market integration.
- National ICT and digital economy policies through digital inclusion, increased rural connectivity and Universal Service Funds.
- Climate change and adaptation frameworks using digital climate information and early warning systems.

REFERENCES

1. Aker JC, Fafchamps M. Mobile phone coverage and producer markets: Evidence from West Africa. World Bank Economic Review. 2015 Jan 1;29(2):262–92. doi:10.1093/WBER/LHU006

2. Mabhaudhi T, Dirwai TL, Taguta C, Senzanje A, Abera W, Govid A, et al. Linking weather and climate information services (WCIS) to Climate-Smart Agriculture (CSA) practices. Clim Serv. 2025 Jan 1;37:100529. doi:10.1016/J.CLISER.2024.100529

3. CTA. The Digitalisation of African Agriculture Report [Internet].

Netherlands; 2019 [cited 2023 May 29]. Report. Available from: https://cgspace.cgiar.org/bitstream/handle/10568/103198/Executive%20Summary%20V4.5%20ONLINE.pdf

4. Choruma DJ, Dirwai TL, Mutenje MJ, Mustafa M, Chimonyo VGP, Jacobs-Mata I, et al. Digitalisation in agriculture: A scoping review of technologies in practice, challenges, and opportunities for smallholder farmers in sub-Saharan Africa. Journal of Agriculture and Food Research. Elsevier B.V.; 2024. doi:10.1016/j.jafr.2024.101286

5. Krell NT, Giroux SA, Guido Z, Hannah C, Lopus SE, Caylor KK, et al. Smallholder farmers' use of mobile phone services in central Kenya. Clim Dev. 2021;13(3):215–27. doi:10.1080/17565529.2020.1748847

6. Parlasca MC, Johnen C, Qaim M. Use of mobile financial services among farmers in Africa: Insights from Kenya. Glob Food Sec. 2022 Mar 1;32:100590. doi:10.1016/J.GFS.2021.100590

7. GSMA. The State of Mobile Internet Connectivity Report 2021 - Mobile for Development [Internet]. 2021 [cited 2022 Oct 4]. Report. Available from: https://www.gsma.com/r/somic/

8. Government of Zimbabwe. National Development Strategy 1 (2021–2025). Harare; 2020. Report.

9. Government of Zimbabwe. National ICT Policy. Harare; 2022. Report.

10. Muvhuringi P, Terrence Kudzai N, Ngavaite C. The impact of COVID-19 on agricultural extension and food supply in Zimbabwe. http://www.editorialmanager.com/cogentagri. 2021;7(1). doi:10.1080/23311932.2021.1918428

11. Damalie ED, Karanfiller T. The Impact of Information and Communication Technology and Institutional Quality on Social Sustainability: Evidence From West African Countries. Sustainable Development. 2025. doi:10.1002/sd.70580

12. Silvestri S, Richard M, Edward B, Dharmesh G, Dannie R. Going digital in agriculture: how radio and SMS can scale-up smallholder participation in legume-based sustainable agricultural intensification practices and technologies in Tanzania. https://doi.org/101080/1473590320201750796. 2020;19(5–6):583–94. doi:10.1080/14735903.2020.1750796

13. Fabregas R, Kremer M, Schilbach F. Realising the potential of digital development: The case of agricultural advice. Science (1979). 2019 Dec 13;366(6471). doi:10.1126/science.aay3038 PubMed PMID: 31831641.

14. CTA. THE DIGITALISATION OF AFRICAN AGRICULTURE REPORT. 2018. Report.

15. GSMA. The Mobile Economy Sub-Saharan Africa 2023 [Internet]. 2023 [cited 2026 Feb 20]. Report. Available from: www.gsmaintelligence.com

16. Postal and Telecommunications Regulatory Authority of Zimbabwe. UNIVERSAL SERVICE FUND PROJECTS. Harare; 2013. Report.

17. Kabbiri R, Dora M, Kumar V, Elepu G, Gellynck X. Mobile phone adoption in agrifood sector: Are farmers in Sub-Saharan Africa connected? Technol Forecast Soc Change. 2018 Jun 1;131:253–61. doi:10.1016/J.TECHFORE.2017.12.010

18. World Bank. World Development Report: Data for Better Lives [Internet]. Washington D.C; 2021 [cited 2026 Feb 20]. Report. Available from: https://openknowledge.worldbank.org/server/api/core/bitstreams/f5dc3b54-6b4f-5d65-a173-b59e9a508843/content

Dr Dennis Choruma is a Regional Researcher – Land and Water Systems at the International Water Management Institute (IWMI) in Zimbabwe. His expertise is in agricultural water management, participatory action research and the application of digital technologies in smallholder farming systems.

Dr Tinashe Lindel Dirwai is a Regional Researcher at IWMI in Zimbabwe. He is an expert in systems thinking and agricultural water management across multiple scales.

Dr Hillary Mugiyo is an early warning and action specialist and data scientist for the Government of Zimbabwe's Ministry of Lands, Agriculture, Fisheries, Water and Rural Development.

Dr Bezzel Chitsungo is the Director of Irrigation Development at the Ministry of Lands, Agriculture, Fisheries, Water, and Rural Development in Zimbabwe. Bezzel is a specialist in irrigation development and agricultural water management across scales.

Sogol Jafarzadeh is the UN and Government Relations Coordinator and Gender and Capacity Building Focal Point for Africa at UNU-INWEH, working on policymaking, climate and water diplomacy, with a strong focus on gender and inclusivity

Professor Kaveh Madani is the Director of UNU-INWEH. He is an expert in the mathematical modelling of complex human-nature systems to advise policy.

Professor Obert Jiri is the Permanent Secretary for the Ministry of Lands, Agriculture, Fisheries, Water, and Rural Development in Zimbabwe. He is a seasoned agronomist and academic with expertise in developing agronomic solutions for optimising productivity in smallholder farming systems.

Hon. Dr. Engr. Anxious Jongwe Masuka is the Minister of Lands, Agriculture, Fisheries, Water, and Rural Development in Zimbabwe. He is an experienced agricultural scientist, academic, and public servant. Prior to his ministerial appointment he had a long career in agricultural research, lecturing, and management, including roles at the University of Zimbabwe, the Zimbabwe College of Forestry.

Professor Tafadzwa Mabhaudhi is a Professor of Climate Change, Food Systems and Health at the London School of Hygiene and Tropical Medicine, Director of the Lancet Countdown Africa Centre and the Executive Director for the United Nations University Hub on Resilient Environment, Agriculture, Climate and Health for Africa (REACH-AFRICA) at the University of Pretoria. He is an expert in mathematical and crop-climate modeling of complex human-nature systems to inform policy and practice.

doi: https://doi.org/10.53328/INR26PTM002
ISBN: 978-92-808-6139-6

Recommended Citation: Choruma, D., Dirwai, T. L., Mugiyo, H., Chitsungo. B., Jafarzadeh, S., Madani, K., Jiri, O., Masuka, A. J., Mabhaudhi T., Digital Agriculture and AI for Climate-Resilient Smallholder Farming in Zimbabwe. United Nations University Institute for Water, Environment and Health (UNU-INWEH), Richmond Hill, Ontario, Canada, doi: 10.53328/INR26PTM002