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Harmonizing Zambia's Digital Agriculture Ecosystem: Pathways for Coordination, Uptake, and Sustainability of CGIAR-Supported Innovations

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Key messages

- Zambia hosts a rapidly expanding suite of 16 digital agriculture and climate-information innovations developed by CGIAR centres and partners. These tools support decision-making across crops, livestock, and fisheries, reflecting the growing digitalization of the country's agri-food systems.
- Many innovations share similar user groups, geographic coverage, or informational functions, creating opportunities for strong complementarity—but also revealing areas of overlap and fragmentation that risk undermining efficiency and sustainability.
- Harmonization across the ecosystem will be critical for long-term government uptake. In particular, Smart Zambia Institute (SZI), as the mandated national digital coordinator, along with the Ministry of Agriculture (MoA), Zambia Meteorological Department (ZMD), Water Resources Management Authority (WARMA), and the Disaster Management and Mitigation Unit (DMMU), have central roles to play in integrating, hosting, and sustaining these tools.

Digital transformation in agriculture is rapidly accelerating in Zambia (Nalwimba, 2024; Malambo et al., 2023). A growing number of tools now support climate-informed decision-making, agricultural advisories, drought monitoring, livestock and fisheries management, and integrated data sharing (Amaranth et al., 2022; Jalango et al., 2025). CGIAR centres, namely the Alliance of Bioversity International and CIAT, the International Water Management Institute (IWMI), the International Livestock Research Institute (ILRI), International Institute of Tropical Agriculture (IITA), and World Fish have been key contributors to this transformation, supporting national institutions through tools, approaches, and frameworks that improve climate resilience and agricultural productivity.

However, this proliferation of digital systems has also generated fragmentation. Innovations developed at different times and for different projects often operate in parallel rather than in coordination, leading to multiple platforms targeting the same users or decision pathways.



Moreover, sector-specific mandates and objectives often fail to recognize interdependencies across sectors.

Without harmonization and institutional anchoring, these tools risk limited adoption or duplication of effort.

In response to these challenges, this InfoNote analyses overlap, complementarity, and synergies across Zambia's digital agriculture innovations and presents practical recommendations to strengthen coordination, accelerate government uptake, and build a harmonized digital ecosystem for climate-smart agriculture. In particular, it:

- maps and categorizes 16 current CGIAR-supported digital innovations in Zambia;
- analyses their complementarity and overlap;
- identifies opportunities for harmonization;
- assesses alignment with national and regional policy frameworks; and
- outlines pathways for sustainable government uptake.

Methods

This InfoNote draws upon a rapid landscaping exercise of digital innovations targeting Zambia's agricultural sector, defined broadly to include crops, livestock, and fisheries. Key informants from CGIAR centers with active engagement in Zambia—the Alliance of Bioversity International and CIAT, IWMI, ILRI, IITA, and World Fish were consulted to identify recent or ongoing digital tools they lead or co-develop with national partners. Teams provided standardized information for each innovation, including: technology type, lead organization, partners, supporting projects, implementation status, target users, geographic coverage, core functionality, maturity level, and current or likely government institution(s) for hosting or mainstreaming of the innovation.

In total, 16 innovations were identified and consolidated into a dataset ([See Table 1](#)). The

analysis contained herein examines overlaps, complementarities, and synergies across the tools, and a desk review of policy documents—including the Climate-Smart Agriculture Investment Plan (World Bank, 2019), the National Agricultural Policy (Ministry of Agriculture, 2011), the National Framework for Weather, Water, and Climate Services (Ministry of Green Economy and Environment, 2025), the National Water Policy (Ministry of Water Development and Sanitation, 2024), and the Zambia Digital Transformation Strategy (Ministry of Technology and Science, 2023)—was conducted to assess policy alignment and uptake pathways.

Zambia's Digital Agriculture and Climate-Information Landscape

Zambia's agricultural system is increasingly shaped by digitalization. Tools, approaches, and frameworks now support a spectrum of functions, including climate monitoring, hydrological analysis, agro-advisories, livestock management, fisheries operations, national-level data integration, drought monitoring, and early warning. This growth is consistent with regional trends emphasizing data-driven agriculture and digital extension (SADC Secretariat, 2021; AUC, 2020).

The mapped innovations highlight three important dynamics:

1. Rapid growth in digital systems

With 16 diverse tools from CGIAR alone, and additional systems from government and donors, Zambia's digital landscape is becoming increasingly dense.

2. Fragmented architectures

Many tools rely on separate servers, datasets, or dissemination channels. This increases maintenance costs and complicates data governance.

3. Strong foundation for integration

The various actors that comprise Zambia's digital ecosystem including the Zambia Meteorological Department (ZMD), Ministry of Agriculture (MoA),

Water Resources Management Authority (WARMA), the Disaster Risk Management and Mitigation Unit (DMMU), and Smart Zambia Institute (SZI) all have mandates that can anchor and sustain a unified digital agricultural ecosystem.

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Table 1: CGIAR-Supported Innovations in Zambia

No.	Innovation Name	Type of Technology	Lead CGIAR Organization	CGIAR/Partner Involvement	Project(s) Supporting the Innovation	Project Status	Target Users	Region(s) Covered	Purpose / Functionality	Status	Hosting Government Institution(s)
1	Crop Decision Tree (CDT)	Decision-support tool integrating climate data and farming activities	Alliance of Bioversity International and CIAT	CGIAR-led via AICCRA	AICCRA	Ongoing	Smallholder farmers, extension officers, district-level planners	National	Provides structured, climate-smart advisories by integrating seasonal forecasts with key farming activities	Pilot	Ministry of Agriculture (Department of ICT)
2	Zambia Drought Management System (ZADMS)	Satellite-based online drought monitoring and early warning system	International Water Management Institute (IWMI)	CGIAR-led via AICCRA	CGIAR Initiative on Climate Resilience (ClimBeR), AICCRA	Ongoing (AICCRA) Closed (ClimBeR)	Ministry of Agriculture, ZMD, WARMA, DMMU	National	Provides real-time weather forecasts, drought indices, and agricultural contingency plans	Ongoing	Ministry of Agriculture, Zambia Meteorological Department, WARMA, DMMU
3	Zambia Ag-Data Hub	Centralized digital platform integrating agricultural and climate data	International Water Management Institute (IWMI)	CGIAR-led via AICCRA	AICCRA	Ongoing	Government agencies, researchers, extension services, agribusinesses, universities, agricultural training institutes	National	Digitizes and integrates agricultural data from key institutions to improve agro-advisory services and support decision-making in agriculture	Pilot	SMART Zambia Institute
4	AWARE Platform	Early Warning, Early Action, Early Finance, an anticipatory action tool for disaster risk governance platform	International Water Management Institute (IWMI)	CGIAR-led via Climate Action	CGIAR Initiative on Climate Resilience (ClimBeR)	Ongoing (AICCRA) Closed (ClimBeR) Ongoing (Climate Action)	Government departments, humanitarian organizations, funders	National	Connects early warning systems, proactive measures, and timely financial interventions to mitigate the impact of disasters before they occur	Ongoing	Disaster Management and Mitigation Unit (DMMU)
5	Digital Climate Information Services (CIS) for Aquaculture	Web-based climate advisory platform	WorldFish	CGIAR-led via PROFISHBLUE	Program for Improving Fisheries Governance and Blue Economy Trade Corridors (PROFISHBLUE)	Ongoing	Smallholder fish farmers, aquaculture value chain actors	National	Provides tailored climate information services to help aquaculture stakeholders make informed decisions and build resilience against climate variability	Pilot	Ministry of Fisheries and Livestock, Ministry of Green Economy and Environment
6	Tilapia-Based Aquaculture E-Learning Platform	Online training platform	WorldFish, Blue Planet, NRDC Zambia	CGIAR-led via FISH	Aquaculture Technical Vocational and Entrepreneurship Training (AQ TEVET) Project	Ongoing	NRDC students, smallholder fish farmers	National	Enhances aquaculture training through digital modules focusing on tilapia production, covering biology, nutrition, health, and management practices	Ongoing	Natural Resources Development College (NRDC)

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7	Blue Resilience (Ulimi Wansomba) Early Warning System for Extreme Temperatures in Aquaculture	Algorithm-based forecasting tool	WorldFish	CGIAR led via AICCRA	AICCRA (Accelerating Impacts of CGIAR Climate Research for Africa)	Ongoing	Smallholder fish farmers	National	Forecasts water temperatures based on air temperature trends to alert farmers of extreme conditions that could affect tilapia farming	Pilot	Ministry of Fisheries and Livestock
8	Maprooms	Online analytical and visualization tools for climate data	International Research Institute for Climate and Society (IRI)	CGIAR-led via AICCRA	AICCRA (Accelerating Impacts of CGIAR Climate Research for Africa)	Ongoing	Meteorological services, ministries, extension agents, universities, research institutions, NGOs, private insurers	National	Provides location-specific climate analysis to support informed decision-making in agriculture and climate adaptation	Ongoing	Zambia Meteorological Department (ZMD)
9	Automatic Weather Station Data Tool (ADT)	Web-based application for accessing, processing, quality control, and visualization of AWS data	International Research Institute for Climate and Society (IRI), Columbia University	CGIAR-led via AICCRA	AICCRA (Accelerating Impacts of CGIAR Climate Research for Africa)	Ongoing	National Meteorological Services, climate researchers, agricultural planners	National	Enables access, quality control, and visualization of AWS data from various networks to support real-time monitoring and planning	Ongoing	Zambia Meteorological Department (ZMD)
10	Climate Data Tool (CDT)	Open-source R-based software for climate data management and analysis	International Research Institute for Climate and Society (IRI), Columbia University	CGIAR-led via AICCRA	AICCRA (Accelerating Impacts of CGIAR Climate Research for Africa)	Ongoing	National Meteorological Services, universities, climate researchers	National	Organizes and processes climate data, performs quality control, merges station data with satellite and reanalysis data, and facilitates analysis and visualization of climate information	Ongoing	Zambia Meteorological Department (ZMD)
11	E-PICSA (Enhanced Participatory Integrated Climate Services for Agriculture)	Digital climate advisory and decision-support tool	University of Reading	GIZ-led via Fund for the Promotion of Innovation in Agriculture (i4Ag); CGIAR-supported via AICCRA	Digital Climate Services for Smallholder Farmers in Zambia and Malawi	Ongoing	Smallholder farmers, agricultural extension officers, agricultural training institutes (Zambia Colleges of Agriculture), universities	Eastern Province (Zambia), Central Region (Malawi)	Provides tailored historical and forecast climate data to support participatory decision-making for crop planning and resource use	Pilot	Zambia Meteorological Department (ZMD), Ministry of Agriculture (Zambia)
12	DMMU Mobile app and dashboard	A mobile based app to enable DMMU to collect data about key events like droughts, floods etc	International Water Management Institute (IWMI)	CGIAR-led via AICCRA	AICCRA (Accelerating Impacts of CGIAR Climate Research for Africa)	Ongoing (AICCRA)	DMMU	National	Provides real-time data about incidence of events like droughts, flash floods, etc	Ongoing	Ministry of Agriculture, Zambia Meteorological Department, DMMU

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No.	Innovation Name	Type of Technology	Lead CGIAR Organization	CGIAR/ Partner Involvement	Project(s) Supporting the Innovation	Project Status	Target Users	Region(s) Covered	Purpose / Functionality	Status	Hosting Government Institution(s)
13	BUNA	Online platform	WorldFish and Rhodes University	WorldFish-led	Bilateral (WorldFish & Rhodes University)	Ongoing	Department of Fisheries	National	WorldFish has partnered with Rhodes University of South Africa to pilot a digital app, BUNA to collect data from aquaculture farmers and deploy advisory services, including market information, to farmers in real-time.	Pilot	Department of Fisheries
14	e-Learning - Resilient Rivers: Watershed-Based Management of Forests, Freshwater, and Inland fisheries	E-learning	FAO	WorldFish and CIFOR-ICRAF		Ongoing	Resilient rivers: Watershed-based management of forests, freshwater, and inland fisheries		Focusing on freshwater systems, this course inspires managers, scientists, and community members to work across disciplines and watersheds. The course coaches learners to understand, monitor, and manage watersheds as integrated systems.	Ongoing	Not yet identified
15	MlimiWanzeru Advisor	A site-specific soybean agronomy advisory tool (MlimiWanzeru Advisor)	IITA	CGIAR-led via AICCRA	AICCRA (Accelerating Impacts of CGIAR Climate Research for Africa)	Ongoing	Smallholder farmers, extension officers, agronomists, soil scientists, crop production change agents	National	A site-specific soybean agronomy tool for Eastern Zambia that provides customized advice on planting, and nutrient/fertilizer management. It uses a combination of weather forecasts, soil data, and market prices to give tailored recommendations via SMS or WhatsApp. The tool calculates specific fertilizer needs per hectare, suggests products and bag counts, and includes advice on soil amendments like lime and inoculants.	Ongoing	Not yet identified
16	Water Pricing Tool for Irrigation-as-a-Service (IaaS)	Digital decision-support tool for water tariff setting and service pricing for solar irrigation	International Water Management Institute (IWMI)	CGIAR-led via AICCRA (IWMI, partners in Zambia)	AICCRA Zambia (Solar Irrigation and IaaS Business Models)	Ongoing	Lead and follower smallholder farmers, IaaS service providers, farmer organisations, mobile network operators, financial institutions, government agencies (water, energy, agriculture)	Sub-national (Central Province : Chisamba, Mumbwa; scalable nationally)	Provides transparent, cost-reflective water service tariffs; integrates pump efficiency, labour, capital cost recovery, and financing terms; supports pay-per-irrigation and service-package models; enables economic viability checks for IaaS businesses; provides potential evidence for structuring USF-linked irrigation financing	Pilot	Potential: Ministry of Agriculture, Ministry of Green Economy and Environment; potential collaboration with Zambia Information and Communications Technology Authority (ZICTA) for USF

Innovations Grouped by Target Users

The 16 digital innovations mapped in Zambia's agricultural digital ecosystem serve a wide range of users operating at different decision-making levels. Grouping these innovations by their primary user groups helps illustrate how they collectively support climate-smart agriculture, where they overlap, and how they can be harmonized. These categories—national agencies, extension officers, farmers, researchers, and multi-sectoral planners—form a functional chain from data generation to advisory delivery and long-term capacity strengthening.

National Agencies and Actors

Zambia's digital agriculture and climate-information ecosystem is anchored in a set of national agencies that hold statutory mandates for climate services, agricultural extension, disaster risk management, water intelligence, and national digital governance. At the highest level, national technical agencies such as the Zambia Meteorological Department (ZMD), the Disaster Management and Mitigation Unit (DMMU), the Ministry of Agriculture (MoA), the Water Resources Management Authority (WARMA), and the Smart Zambia Institute (SZI) rely on digital tools that provide upstream climate, drought, and hydrological analytics. Innovations in this category include:

- the Zambia Drought Management System (ZADMS), which supports multi-hazard early warning and drought monitoring;
- the suite of climate Maprooms, offering historical and real-time climate visualizations for planning and analysis;
- NextGen seasonal forecast products, which provide improved seasonal predictions for agriculture and disaster preparedness;
- the Automatic Weather Station Data Tool (ADT) and the Climate Data Tool (CDT), which support ZMD in processing, managing, and disseminating climate datasets

- the Early Warning, Early Action, and Early Finance (AWARE) platform, which integrates risk indicators to guide anticipatory action; and
- the Zambia Ag-Data Hub, which consolidates agricultural datasets for cross-ministerial decision-making and digital service integration.

The Zambia Drought Management System (ZADMS) provides high-resolution drought monitoring and early warning capabilities, integrating satellite data and hydrological analytics to support DMMU and sectoral ministries during periods of heightened climate risk.

Complementing this is the suite of climate Maprooms, developed with Columbia University's International Research Institute for Climate and Society (IRI), which offers interactive visualizations past, present, and future climate tailored for ZMD, the Zambia Agricultural Research Institute (ZARI), and agricultural planners. ZMD also benefits from NextGen seasonal forecast products, which improve the skill, spatial resolution, and usability of seasonal climate predictions for agriculture, water management, and disaster preparedness.

ADT enables the processing, quality control, and visualization of real-time data from Zambia's network of automatic weather stations, improving the reliability and accessibility of climate observations for national analysis and forecasting (Faniriantsoa & Dinku, 2022; Grossi & Fiondella, 2023). Meanwhile, CDT enables ZMD and partners to clean, merge, analyze, and generate gridded climate datasets (including rainfall and temperature), supporting the production of high-quality climate information and tailored climate products for agricultural and early warning applications (Dinku et al., 2022; Grossi & Dinku, 2024).



For multi-hazard preparedness, the AWARE platform integrates rainfall anomalies, vegetation indices, and socio-economic indicators to support anticipatory action by DMMU and humanitarian actors.

Finally, the Zambia Ag-Data Hub, hosted at SZI, serves as a centralized platform for agricultural data integration and sharing, supporting evidence-based planning, monitoring, and policy formulation across government departments.

Taken together, these digital innovations strengthen Zambia's ability to anticipate climate shocks, guide resource allocation, inform extension and advisory systems, and support national resilience-building strategies. They also underscore an emerging need for stronger data governance, interoperability, and institutional coordination—areas where SZI is strategically positioned to play a central harmonizing role.

These systems support national mandates for climate monitoring, food security planning, water resource management, and early warning. Because these users depend on consistent and authoritative data pipelines, innovations serving them must be harmonized to avoid fragmented or contradictory information streams.

Provincial and District Extension Officers

A second major group consists of provincial and district extension officers, including Camp Extension Officers (CEOs), Block Officers, District Advisory Staff, and planners within the Ministry of Agriculture. These officers serve as the critical intermediaries between national climate and risk analytics and the farmers who make day-to-day production decisions. Their role is to interpret, contextualize, and communicate climate, agronomic, and risk information in ways that match local farming realities. Several of the CGIAR-supported digital innovations in Zambia are specifically designed to strengthen this frontline decision-support function.

Tools supporting this user group include:

- Crop Decision Tree (CDT), a tool that helps extension officers translate seasonal forecasts, rainfall patterns, and agronomic conditions into tailored crop and variety recommendations.
- The Zambia Ag-Data Hub, which aggregates localized climate information (e.g., seasonal forecasts, advisories, tailored messages) and help extension staff access geographically- and sectorally-tailored advisories for farmers.
- E-PICSA, which enables extension officers to facilitate Participatory Integrated Climate Services for Agriculture (PICSA), supporting farmers to interpret climate information and integrate it into household-level decision-making.
- MlimiWanzeru Adviser, a digital advisory tool that provides localized agronomic guidance and supports extension officers in preparing climate-smart messages for soybean farmers.
- Digital extension dashboards and channels, including integrated dashboards used by district-level staff and mobile-based dissemination tools (e.g., WhatsApp groups, SMS channels) for delivering advisories produced through CDT, CIS, E-PICSA, or AWARE outputs.
- Sector-specific tools for aquaculture and fisheries, such as the Blue Resilience (Ulimi Wansomba) tool and the Digital Climate Information Services (CIS) for Aquaculture platform.

These innovations equip extension officers with location-specific agronomic guidance, seasonal recommendations, and climate-risk interpretation skills. They also align closely with Zambia's roll-out of Climate Risk Management in Agricultural Extension (CRMAE) curriculum, which bundles innovations like the Maprooms, the Ag-Data Hub, and PICSA into its training package, helping extension systems evolve toward more climate-smart advisory functions (Hansen et al., 2025; Grossi et al., 2023). Unlike national technical tools, which emphasize analytics and monitoring, these tools focus on translation and field-level decision support.

Farmers and Producer Organizations

A third major user group—smallholder farmers, fishers, and producer organizations—interacts with innovations designed to provide direct, actionable advisory information that supports day-to-day livelihood decisions. Several of the CGIAR-supported tools in Zambia are built specifically for farmer-facing use, improving access to climate, agronomic, and fisheries information.

Tools for this group include:

- MlimiWanzeru Adviser, a digital advisory tool providing customized advice via SMS or WhatsApp on planting, and nutrient/fertilizer management using a combination of weather forecasts, soil data, and market prices;
- E-PICSA (Participatory Integrated Climate Services for Agriculture), which is delivered by extension staff but designed for direct farmer use, enabling households to interpret seasonal forecasts, historical climate data, and crop suitability information for planning.
- Fisheries and aquaculture advisory tools like Blue Resilience (Ulimi Wansomba), which provide small-scale fishers with climate-informed early warnings, safe fishing guidelines, and environmental status updates affecting fish stocks.
- Localized seasonal guidance products via CDT outputs. While CDT is a data organization and analysis tool, the resulting season-specific advisories (crop choices, planting windows, variety selection) are consumed directly by farming households.

Many tools in the ecosystem—including MlimiWanzeru, E-PICSA, and fisheries advisories—use SMS, WhatsApp, and community radio groups to deliver farmer-ready information.

These tools depend heavily on upstream climate information systems like ZMD's forecasts and Maprooms. When properly aligned, they can strengthen climate-smart decision-making at scale,

supporting Zambia's Climate-Smart Agriculture Investment Plan objectives. Their success, however, relies on coordinated messaging to avoid conflicting recommendations from different platforms.

Researchers, Universities and Training Institutions

A fourth user group includes universities, the Zambia Colleges of Agriculture (ZCA), Agricultural Training Institutes (ATIs), and national research entities such as ZARI, all of which play a central role in developing Zambia's future agricultural workforce. These institutions are increasingly adopting CGIAR-supported digital innovations for teaching, applied research, curriculum development, and digital skills strengthening. Several tools in the Zambia portfolio are already being used—or have significant potential—to support hands-on training in climate analytics, digital extension, and climate-smart agriculture.

Tools relevant to this group include:

- Climate Maprooms, which are interactive platforms for accessing historical climate data, visualizing trends, and conducting climate analysis exercises used in academic teaching, research, and CRMAE modules.
- Crop Decision Tree (CDT), a decision-support tool that can help students and extension trainees learn how to translate climate information (e.g., seasonal forecasts) into crop and variety recommendations.
- Fisheries and aquaculture decision-support tools such as Blue Resilience (Ulimi Wansomba), which can be used to teach climate-aquaculture interactions, environmental monitoring, and climate-informed fisheries management.
- Zambia Ag-Data Hub, which is a shared digital platform offering access to agricultural datasets suitable for student projects, research methods training, and data analysis coursework.
- Climate Data Tool (CDT), which is a backend climate-data processing tool used internationally in meteorology and climate services education; it enables students to

work with gridded datasets and climate diagnostics.

- Tilapia-Based Aquaculture E-Learning Platform, a digital training platform that provides structured modules on aquaculture production, feeding, water quality management, and climate-related challenges, supporting student learning and capacity building in fisheries programs.
- The Resilient Rivers Watershed-Management e-learning course, which provides students, extension trainees, and natural resource managers with practical skills in integrated watershed management, linking forests, freshwater systems, and inland fisheries to climate-resilient landscape planning.

Integrating these digital systems into formal pre-service curricula—as demonstrated through the Climate Risk Management for Agricultural Extension (CRMAE) mainstreaming process (Hansen et al., 2025)—creates a pathway for long-term institutionalization of digital agriculture competencies. Embedding tools such as Maprooms, the Climate Data Tool, the Ag-Data Hub and more into ATI and university syllabi ensures that the next generation of extension officers, planners, and agricultural professionals graduate with strong digital and climate literacy skills, supporting sustained national uptake of CGIAR innovations.

Multisectoral Planners and Humanitarian and Development Partners

A fifth user group—multi-sectoral planners, humanitarian agencies, development partners, NGOs, and private-sector agricultural service providers—relies on digital innovations that aggregate, integrate, or synthesize data from multiple ministries and sectors. These actors use digital platforms to guide coordination, anticipate risks, plan programming, target interventions, and support cross-sector climate and disaster preparedness efforts.

Relevant CGIAR-supported innovations for this user group include:

- The AWARE platform, which integrates climate, vegetation, and socioeconomic indicators to support coordinated anticipatory action, humanitarian targeting, and multi-sector response planning.
- Zambia Drought Management System (ZADMS), which provides drought monitoring, hazard alerts, and drought-risk dashboards used by planners across agriculture, disaster management, and food-security sectors.
- Climate Information Services (CIS) tools, including Crop Decision Tree-generated advisories, E-PICSA outputs, and Blue Resilience fisheries advisories, which are used by NGOs, UN agencies, and extension partners to design climate-smart programming.
- The Zambia Ag-Data Hub, which enables multi-ministerial data sharing, supports program design and monitoring, and serves as a central repository for agricultural datasets used by donors, implementers, and private-sector actors.
- The DMMU Mobile App and Dashboard, which is used by humanitarian agencies and responders to track multi-hazard alerts, report impacts, and support coordination during droughts, floods, and other emergencies.

These users require cross-cutting analytics for program design, investment planning, targeting, and resilience-building. Because their work spans climate, agriculture, water, and disaster risk management, tools serving this group must follow interoperability and data-sharing standards that enable cross-sectoral analysis.

Together, these user groups illustrate how Zambia's digital agriculture ecosystem functions as an integrated (but currently fragmented) supply chain—from upstream climate analytics to downstream advisory dissemination, and from data integration to long-term capacity building.

Understanding these user clusters is essential for identifying opportunities to harmonize tools, streamline data pipelines, and strengthen institutional uptake.

The Digital Agriculture Landscape

Zambia's digital agriculture landscape is evolving rapidly as national institutions, development partners, and CGIAR centers increasingly invest in data-driven approaches to support agricultural transformation, climate resilience, and food security. The 16 innovations mapped illustrate a vibrant yet fragmented ecosystem characterized by both expanding capabilities and structural challenges that impact long-term adoption and scalability.

Over the last several years, the demand for accurate, timely, and localized climate and agricultural information has accelerated, driven by recurrent droughts, increasing climate variability, and pressure to strengthen early warning and response systems across sectors (Ministry of Agriculture, 2018). Innovations such as climate Maprooms, NextGen seasonal forecast tools, ZADMS, and the AWARE platform demonstrate the growing sophistication of Zambia's climate service capabilities.

These tools collectively advance the country's National Framework for Weather, Water, and Climate Services (NFWWCS) by generating high-resolution climate analytics and enabling multi-hazard early warning capabilities (Ministry of Green Economy and Environment, 2025). This aligns with Zambia's national priorities under the 8th National Development Plan (Republic of Zambia, 2022) and the SADC Climate Change Strategy and Action Plan, both of which emphasize stronger climate service delivery and digital transformation (Republic of Zambia, 2022; SADC Secretariat, 2023).

At the same time, several innovations extend beyond climate services to support agricultural production systems, including crop, livestock, and fisheries sub-sectors. Tools such as the Crop Decision Tree (CDT), livestock health advisory systems, fisheries and aquaculture decision-support platforms, digital extension dashboards, and CIS advisory services illustrate how digital innovations are increasingly relevant for day-to-day decision-making at farm level. These tools support

Zambia's Climate-Smart Agriculture Investment Plan by helping farmers and extension officers adopt climate-smart practices, interpret seasonal forecasts, and implement suitable crop, livestock, and aquaculture management strategies (MoA, 2018).

Yet the digital ecosystem remains highly fragmented, largely due to the projectized nature of digital innovation in the development sector. Many tools have emerged through time-bound donor-funded initiatives without built-in strategies for long-term integration or interoperability. As a result:

- Multiple platforms provide similar functions, such as delivering seasonal forecasts or generating agronomic advisories, but use different data pipelines or dissemination channels;
- Several tools operate on separate servers, often hosted externally or within CGIAR infrastructure, rather than on national systems;
- Innovations rely on parallel data ingestion pathways, with limited alignment around ZMD as the authoritative climate-data source;
- Tools targeting extension officers or farmers often work independently of national agricultural information systems, such as ZIAMIS, limiting integration with MoA workflows;
- Cross-ministerial data sharing remains inconsistent, despite mandates under the Digital Transformation Strategy for integrated e-government systems (Ministry of Technology and Science, 2023).

This fragmentation poses operational challenges for national institutions. It complicates data governance, undermines consistent advisory messaging, creates redundancies in capacity building, and increases the burden on government agencies to maintain multiple platforms after project closure.

The Zambia Ag-Data Hub (Smart Zambia Institute,, 2025) and other emerging interoperability

initiatives aim to address this challenge by providing a unified digital backbone through which datasets, APIs, decision-support tools, and dashboards can be integrated and shared across ministries. However, further consolidation is needed to ensure scalability and sustainability.

Despite these challenges, the ecosystem's diversity presents significant opportunities for strengthening complementarities and building a more coherent digital agriculture architecture. Climate analytics tools can serve as upstream data sources for crop, livestock, and fisheries advisories. Hydrological and water-resource models can inform drought early warning, irrigation planning, and natural resource management. Advisory platforms can draw on harmonized national datasets from the Ag-Data Hub, while Maprooms and Crop Decision Trees can become integrated into training and extension curricula through the Zambia Colleges of Agriculture and universities.

Taken together, the innovations suggest a digital ecosystem that is rich in potential but in need of deliberate harmonization. With strong leadership from Smart Zambia Institute, ZMD, MoA, WARMA, and DMMU, Zambia can move toward a more integrated national digital agriculture system—one in which climate information, advisory services, early warning systems, and data integration platforms operate as components of a coherent whole rather than isolated pilots.

Complementarity Across Innovations

Despite initial appearances of overlap, the 16 innovations demonstrate strong complementarity when viewed across the full decision-making spectrum.

Upstream innovations—such as ZADMS, climate Maprooms, and NextGen seasonal forecasts—generate core analytics serving national early warning, risk monitoring, and agricultural planning. These tools form the foundation of Zambia's climate information ecosystem.

Intermediate-level innovations, including Crop Decision Trees, CIS platforms, and WorldFish fisheries tools, translate analytical outputs into actionable recommendations tailored to specific sub-sectors. They bridge the gap between national analytics and local extension needs, improving the usability of climate information for operational decision-making (Chileya, 2024).

Downstream advisory tools, such as SMS platforms and digital extension dashboards, push this information to farmers and communities. Their effectiveness relies on harmonized upstream data to avoid inconsistent or contradictory advisories.

Finally, cross-cutting integrators like the Zambia Ag-Data Hub enable interoperability by consolidating datasets across ministries and providing shared APIs for digital ecosystems (Smart Zambia Institute, 2025).

Together, the innovations form a mutually reinforcing ecosystem—provided their data pipelines, hosting arrangements, and dissemination channels are harmonized.

Mainstreaming and Scaling Pathways

Ensuring the long-term sustainability, coherence, and government integration of digital agriculture innovations requires deliberate institutional anchoring across Zambia's public sector. While Smart Zambia Institute (SZI), the Ministry of Agriculture (MoA), the Zambia Meteorological Department (ZMD), the Water Resources Management Authority (WARMA), and the Disaster Management and Mitigation Unit (DMMU) have clear statutory roles in hosting and operationalizing different components of the ecosystem, the education system—particularly the Zambia Colleges of Agriculture (formerly ATI colleges) and universities—also plays a critical, yet often overlooked, role in national uptake pathways.

Smart Zambia Institute

At the centre of Zambia's digital governance architecture, Smart Zambia Institute (SZI) remains

the mandated hub for e-government services and interoperable platforms. SZI is best positioned to host integrated national systems, ensure data standards and cybersecurity, manage the Government Service Bus, and provide the cloud infrastructure required for national-scale digital agriculture services. Zambia's Government Service Bus (GSB) is a national interoperability platform managed by the Smart Zambia Institute that enables secure, API-based data exchange between ministries, departments, and agencies to support integrated digital government services (Smart Zambia Institute, 2024). For innovations such as the Zambia Ag-Data Hub, this central role is indispensable for creating sustainable back-end infrastructure and ensuring that all digital agriculture systems comply with national interoperability frameworks.

The Ministry of Agriculture

The Ministry of Agriculture (MoA) is the natural host for sector-specific digital tools—including the Crop Decision Tree (CDT), CIS advisory platforms, and e-extension systems. These tools are more sustainable when integrated into MoA's existing systems (e.g., the Zambia Integrated Agriculture Management Information System, also known as ZIAMIS) and aligned to its extension strategy. Importantly, MoA also plays a bridging role with the Zambia Colleges of Agriculture in ensuring that training curricula reflect the needs of a modern, digital extension service.

Zambia Meteorological Department

The Zambia Meteorological Department (ZMD) remains the authoritative source of climate information under the National Framework for Weather, Water, and Climate Services. As such, all climate data pipelines—including Maprooms, forecast dashboards, and integrated drought monitoring tools—should link to ZMD to ensure consistency and reliability. ZMD's hosting and stewardship role is also essential for ensuring continuity after project closure.

Water Resources Management Authority

Zambia's Water Resources Management Authority (WARMA) is well positioned to operationalize IWMI-supported hydrological tools, water productivity platforms, and irrigation decision-support systems, aligning them with national water resource management practices, catchment-level planning, and early warning protocols.

Disaster Management and Mitigation Unit

Zambia's Disaster Management and Mitigation Unit (DMMU) should continue to host drought monitoring and early warning systems such as ZADMS and the AWARE platform. Its leadership role in disaster preparedness, multi-hazard early warning, and anticipatory action ensures that analytics from these tools feed directly into national decision-making and response protocols.

The Critical Role of Zambia's Education System

A sustainable digital agriculture ecosystem in Zambia depends not only on government ministries and technical agencies but also on the education and training system, especially the seven Agricultural Training Institutes (ATIs) and Zambia's universities. Evidence from the national CRMAE mainstreaming process shows that higher education institutions are indispensable for long-term institutionalization, retention of knowledge, and continuous capacity development (Hansen et al., 2025). Moreover, a nationwide needs assessment for integration of climate-smart agriculture and climate information services into the curricula of Zambian higher education institutions reveal a strong demand for skills-based training, including on digital agriculture innovations (Chinene et al., 2024).

Zambia's Agricultural Training Institutes and universities collectively train future Camp Extension Officers (CEOs), agricultural technicians, degree-level professionals, and planners. However, existing agricultural curricula contain significant gaps in climate information services (CIS) skills, foundational climate knowledge, and practical decision-making competencies that are necessary



“Education is very important in addressing issues of climate-smart agriculture....The agricultural training institutions (ATIs) must be involved with training extension officers on these topics. If these extension officers are trained and equipped with this information about climate-smart agriculture, they’ll be able to help the farmers who are most affected by these climate issues to make informed decisions.”

Isabel Sakala
Senior Horticultural Officer
Zambia Ministry of Agriculture

Figure 1: National Agricultural Research and Extension Services (NARES) actors involved in co-developing the Climate Risk Management in Agricultural Extension (CRMAE) training curriculum emphasize the importance of capacitating Zambia’s training institutions to provide locally-relevant information and services to farmers.

for modern climate-smart agricultural extension (Chinene et al., 2023; Hansen et al., 2024). These gaps are a major limiting factor for farmers’ ability to use the digital tools and climate advisories emerging from initiatives such as Crop Decision Trees, CIS platforms, fisheries tools, and ZADMS.

Alignment with National Policies and Strategies

Zambia’s CGIAR-supported digital agriculture innovations strongly align with the country’s overarching national development priorities, particularly those emphasizing climate resilience, digital transformation, agricultural productivity, and integrated natural resource management. At the national level, the National Agricultural Policy 2012–2030 (Ministry of Agriculture, 2012) underscores the need to modernize extension and advisory services through improved access to timely agricultural information, digital tools, and climate-smart technologies. Several CGIAR-supported digital innovations—such as the Ag-Data Hub, CIS advisory platforms, Maprooms, and livestock and fisheries tools—directly operationalize these policy goals by improving the delivery, quality, and consistency of

extension advice across Zambia’s agricultural sector.

In parallel, Zambia’s Climate-Smart Agriculture Investment Plan (CSAIP) calls for strengthening climate information services, integrating climate risk analytics into agricultural planning, and scaling farmer-responsive advisory systems (Ministry of Agriculture 2018). Many of the innovations mapped—including climate Maprooms, NextGen seasonal forecast products, ZADMS, and AWARE—contribute to these investment areas by enhancing farmers’ and extension officers’ ability to anticipate and adapt to climate variability. Moreover, the integration of several of tools that enable access to location-specific climate information tailored to the agricultural sector, including the Ag-Data Hub and Maprooms, alongside a module on climate basics into the CRMAE training curricula further strengthens the CSAIP’s objective of building climate literacy within the agricultural workforce.

The National Framework for Weather, Water, and Climate Services (NFCS) provides a structured approach for generating, translating, and disseminating climate information nationwide, designating the Zambia Meteorological Department

(ZMD) as the authoritative source of climate data (Ministry of Green Economy and Environment, 2025). Climate Maprooms, CIS platforms, and advisory tools are directly aligned with NFWWCS priorities, particularly in producing localized, actionable information for agriculture, disaster risk management, and water resource planning. Similarly, the National Climate Change Response Strategy (NCCRS) emphasizes the integration of climate information into agricultural planning, early warning systems, and community-level adaptation measures (MLNREP, 2016), roles well supported by ZADMS, AWARE, and the Ag-Data Hub.

Water management innovations are equally aligned with national frameworks. The National Water Policy (Ministry of Water Development and Sanitation, 2024) and WARMA's strategic mandates emphasize integrated water resource management, efficient irrigation planning, and cross-sector data sharing. Tools developed with IWMI—such as hydrological models and water-productivity analytics—support these goals and provide WARMA with digital capabilities for catchment monitoring and irrigation scheme optimization.

Beyond sector-specific policies, Zambia's macro-level development frameworks also endorse digital transformation. The 8th National Development Plan (8NDP) highlights digitalization as a cross-cutting enabler of economic transformation, agricultural resilience, and public service modernization (Republic of Zambia, 2022). The wide range of CGIAR-supported innovations—particularly the Zambia Ag-Data Hub, digital extension platforms, and climate advisory systems—advance these objectives by strengthening government information systems and supporting cross-ministerial data flows. The Digital Transformation Strategy for Zambia, led by Smart Zambia Institute, reinforces this by mandating interoperable digital platforms and integrated service delivery across ministries (Ministry of Technology and Science, 2023). Innovations such as the Ag-Data Hub and climate analytics APIs are directly aligned with the Strategy's requirements for secure hosting, interoperability, and standardized data governance. Moreover, the 16 digital innovations strengthen Zambia's National Disaster Risk Management Framework (2017–2030) by enhancing drought monitoring, climate and weather analysis, early

warning dissemination, multi-hazard data integration, and evidence-based decision-making—core pillars of the Framework's efforts to operationalize the Sendai priorities for risk assessment, preparedness, and resilience (Disaster Management and Mitigation Unit, 2017).

The innovations also align with regional and continental priorities. The SADC Climate Change Strategy and Action Plan (SADC Secretariat, 2023) calls for enhanced climate data generation, multi-hazard early warning, and strengthened national climate service capabilities—all of which are supported by Maprooms, ZADMS, and NextGen forecast tools. At the continental level, the African Union's Digital Transformation Strategy (AUC, 2020) emphasizes data interoperability, digital literacy, and regional technology platforms (AU, 2020). Zambia's work to institutionalize digital tools through CRMAE, integrate datasets into the Ag-Data Hub, and harmonize climate information systems aligns with these frameworks and positions the country to contribute to regional digital agriculture ecosystems.

Overall, the 16 innovations mapped in this InfoNote demonstrate a high degree of alignment with Zambia's policy environment, offering direct, practical contributions to national objectives across climate resilience, agricultural productivity, digital governance, and early warning systems. This alignment provides a strong foundation for government uptake, harmonization, and long-term sustainability.

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