CLIMATE INDUSTRY SPOTLIGHT

Digital Transformation in Climate Smart Agriculture in Africa: Strengthening Digital Climate Advisory Services (DCAS)

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HIGHLIGHTS

• Because they offer crucial data for farming, Digital Climate Advisory Services (DCAS) are of paramount relevance in sub-Saharan Africa and other low and middle-income nations. Because of their reliance on rain-fed agriculture, small-scale farmers stand to gain from DCAS. Climate change can disrupt rainfall distribution and increase severe weather occurrences, making the demand for such services among farmers even more pressing in the future.

• African institutions in charge of collecting and processing agricultural data are not communicating with one another. This restricts cooperation options for them to use agro-climate data in an integrated manner to assist end users such as small-scale farmers, in adapting to climate change.

• A common issue in many countries is a lack of coordination among stakeholders in the DCAS sector including agencies, the private sector, farmers, and ministries. This can lead to issues such as duplication of initiatives, policy gaps, redundant data collection and provision, dissemination of low-quality information and other well-intended services that fail to understand and meet farmers' needs in an efficient manner (Born et al., 2021)

• Those who need it the most frequently do not have access to relevant climatic information, as well as agricultural advisory and market information (Nhemachena and Hassan, 2014). Even when this information is available, it is usually not in a structure or delivery style that is contextual enough and/or encourages and maintains engagement, hence has little effect (Tall, Coulibaly, and Diop, 2018).

• Various donors, agencies, and private-sector players have invested in climate services, expanding knowledge about what works and the essential enabling variables in various situations (Born et al, 2021; Boogard et al, 2021; Vaughan et al., 2019) . As a result, Digital Climate-informed Advisory Services (DCAS) are being recognised as an important tool for small-scale producers in responding to climate variability and change.

INTRODUCTION

In this brief, we aim to provide insights into some of the bottlenecks and opportunities around the use of climate data for effective decision making, regarding climate change adaptation in Africa's agric sector. We focus on vulnerable small-scale farmers in Africa and how digital technologies could enable them to collect, process and receive data for climate smart decisions in farming. We bring attention to the landscape of successes and gaps in digitally enabled climate services.

Digitalisation in agriculture, particularly climate-smart digital technologies and solutions, has the potential to accelerate the transformation of African agriculture and food security by accelerating the mainstreaming and adoption of digital climate solutions at scale. Digital technologies and solutions can help address declining or inadequate productivity and unsustainable production practices, as well as mitigate the challenge of diminishing resilience to climate-induced shocks across Africa (CTA, 2019).

Globally, over 300 million small-scale agricultural producers have limited or no access to Digital Climate-informed Services (DCAS) due to fragmented and unsustainable service provision (Global Commission on Adaptation, 2021). To improve DCAS, six core principles of data quality, equity, co-creation, accountability, sustainability, and scalability should guide investment and service provision. The investment required by public and private actors to build the resilience of an additional 300 million small-scale producers via DCAS by 2030 is estimated to be US$7 billion (Global Commission on Adaptation, 2021).

Digital Climate-informed Advisory Services (DCAS) have the potential to bridge information gaps and support the transformational adaptation of large-scale food systems. However, insufficient data infrastructure and ineffective data governance at the national level are often obstacles to effective DCAS. Most small-scale producers, such as crop farmers, pastoralists, dairy producers, fishers, and foresters, are increasingly impacted by climate variability and change, particularly rising temperatures, shifting rainfall patterns, and shifting pest and disease dynamics (Born et al., 2021; Morton, 2007).

Relevant climate information, along with agricultural advisory and market data, is frequently inaccessible to those who require it the most (Nhemachena and Hassan, 2014). Even when this information is available, it is typically not in a format or delivery method that promotes and sustains engagement, resulting in minimal impact (Tall, Coulibaly, & Diop, 2018). A growing number of initiatives seek to provide farmers with climate information and advisory services that facilitate the adoption of climate-smart practices for enhancing risk management, resilience, lives and livelihoods (Born et al., 2021). Diverse donors, agencies, and private sector actors have invested in climate services, advancing knowledge of what is effective, as well as the important enabling factors in a variety of contexts. DCAS are acquiring recognition as a vital adaptation aid for small-scale producers facing climate variability and change (Born et al., 2021).

In a nutshell, digital climate services have the potential to support efficient, contextual, and relevant climate adaptation measures for small-holder farmers in Africa. By addressing the challenges and opportunities associated with the availability and use of digital climate services, these technologies can help address the pressing challenges posed by climate change and improve food security in Africa.

In this brief, we highlight the challenges and opportunities associated with the availability and use of digital climate services to support efficient, contextual, and relevant climate adaptation measures for small holder farmers in Africa.

WHAT ARE CLIMATE SERVICES?

Climate services are the decision support instruments that transform climate information into advisory services applicable to individuals and organisations to aid in more sustainable decision-making (Tall et al., 2018). The provision of climate information to farmers has long been acknowledged as a crucial utility with the potential to enhance decision-making in a sector that is inherently dependent on the climate. Digital technologies have played an increasing role in the translation, transmission, and use of climate services. Numerous initiatives contribute to the wider dissemination of digitally enabled climate services to enhance climate-informed decision-making (Born et al., 2021).

Enhancing National Climate Services (ENACTS), a programme active in several African nations, is one of several illustrative examples (Dinku et al., 2017). Using Rwanda as an example, ENACTS has facilitated the training of extension employees and farm promoters in the Participatory Integrated Climate Services Approach (PICSA) to increase capacity and assist farmers in integrating climate information into their decision-making (Born et al., 2021). Extension personnel use the interactive online "Maprooms" that are central to the ENACTS programme, where users can analyse, visualise, interpret, and download location-specific climate information products, and then communicate them to farmers along with decision-making tools (Born et al., 2021).

Also, the Africa Development Bank (ADB) is spending about 36 million euros via its ClimDev Fund to increase access to digitally enabled climate services in Africa. A network of regional climate centres (RCCs) positioned to guide Africa's efforts to manage severe weather hazards is at the centre of the Fund's initiatives. A €20 million investment in the RCCs by the ClimDev Fund aims to solve Africa's severe lack of access to meteorological and climate data, which has consequences for sustainable development and green growth. The IGAD Climate Prediction & Applications Centre (ICPAC) is located in Nairobi, Kenya, and it serves 11 nations in the Greater Horn of Africa, a region vulnerable to severe weather events including droughts and floods. Investment in ICPAC's high-performance super computers is assisting in the battle against the Greater Horn of Africa's worst desert locust epidemic in 25 years.

The Regional Agrometeorology and Hydrology Centre (AGHRYMET) is collaborating with 13 of the 17 ECOWAS countries in West Africa to establish partnerships with national meteorological and disaster risk management agencies. Both organisations are based in Niamey, Niger. The African Centre of Meteorological Application for Development (ACMAD) works to improve the capacity for forecasting extreme weather.

The Economic Community of Central African States (ECCAS) members are assisted by the Climate Application and Prediction Centre of Central Africa (CAPC-AC) in Douala, Cameroon, in developing their capacity to address disaster-related vulnerabilities and to improve the ability of regional and national institutions to use data from weather prediction models for early warning products.

The Southern African Development Community Climate Service Centre (SADC-CSC), located in Gaborone, Botswana, is in charge of helping Southern African nations lessen the effects of floods, droughts, cyclones, and increasing sea levels.

STATE OF DIGITAL CLIMATE-INFORMED ADVISORY SERVICES IN DEVELOPING COUNTRIES

Digitalisation

According to Born et al., (2021), the accelerated growth and spread of digital technologies over the past few decades presents a significant opportunity for ICT solutions to support agricultural advisory services at scale. In recent years, digitization in developing nations and agricultural sectors has increased (UNCTAD, 2019). Currently, more than three-quarters of individuals in low and middle-income countries own a phone, while only one-third have internet access (Fabregas, 2019). This proportion is expected to rise. Tsan et al. (2019) observes that the so-called digital divide is being bridged, with estimates that the majority of African farmers will have access to mobile phones, with many more having access to smartphones by 2030. The basis for incorporating digital solutions into agriculture is solid and expanding.

Digital Agricultural Advisory Services

Born et al., (2021) explain further that Digital Climate Advisory Services (DCAS) have existed in some form since at least the late 1980s, despite the fact that investment and interest have increased dramatically in recent years. Pioneering efforts to support farmers' management of climate risk in eastern Australia, for instance, integrated analyses of local daily data to quantify risks, using systems of modelling and decision support tools to translate climate information into management alternatives (Born et al., 2021; Hochman et al., 2009). It is anticipated that the lessons from Australia and other pioneering DCAS will apply to small-scale producers in Africa: DCAS improve livelihoods when they strengthen social learning, contribute to farmers' own decision-making processes, and enhance their already substantial capacity to manage their farms and livelihoods in the face of risk(Born et al, 2021).

A variety of digital agricultural services are offered to farmers and other participants in the food chain in Africa. For instance, numerous services are already in operation in Ghana, including weather information providers like Ignitia, aWhere, TAHMO (in association with IBM Weather Company), and the Ghana Met Office (for instance, in collaboration with Esoko).

Institutional and policy landscape

There is a growing consensus that DCAS are most effective when they augment human interaction and institutional services rather than replacing them (Fabregas et al., 2019). Smallholder farmers in developing countries can derive substantial benefits from well-designed and targeted climate information and climate-informed digital advisories, according to a growing body of evidence (Vaughan et al., 2019; Fabregas et al., 2019).

DCAS should support the decision-making processes of small-scale producers and develop their capacity to make improved decisions. Tools should go beyond "decision support" to "discussion support," that is, they should support producers' decision-making processes and facilitate dialogue and co-learning, thereby enhancing producers' collective capacity to make better decisions in a variable and changing climate. DCAS should be co-created with and "owned" by producers, and feedback should be perpetually captured, processed, and applied to enhance their quality (Born et al, 2021).

Due to the cross-sectoral and multidisciplinary nature of DCAS, numerous ministries, agencies, corporations, institutions, and organisations are involved in its production, transmission, and dissemination. These actors can be essentially classified as the public sector and its agencies, the private sector, development organisations and donors, international and local NGOs, research institutions, and agrarian and civil society organisations. As diverse as the institutional and policy origins of DCAS are, so too have a number of distinct factors contributed to its rapid proliferation (Born et al, 2021).

The public sector's participation in DCAS typically falls under the jurisdiction of the Ministries of Agriculture, Environment, Rural Development, and Technology, among others. The National Meteorological and Hydrological Services (NMHS) and the National Agricultural Research Service (NARS), which are typically supported by the government, are also essential to DCAS. In the majority of nations, public agricultural extension agencies are situated within the Ministry of Agriculture (Born et al., 2021). The government, donors, and farmer organisations can contract with private extension providers. The private sector is predominantly involved in DCAS via inputs companies, telecommunications companies, and farmer organisations.

ROLE OF PRIVATE SECTOR IN PROVIDING DIGITAL CLIMATE TECHNOLOGIES AND SERVICES

Driving of innovation, investments, and partnerships

The preponderance of technological innovation in agriculture is driven by the private sector, with an emphasis on application development using Information and Communication Technologies (ICTs). In general, the low entry barrier associated with ICT-related development activities facilitates prolific innovation within the private sector. Innovation has occurred through the translation and transfer of technologies developed and used by commercial farmers in high-income countries (Tsan et al., 2019), as well as through low to middle-income country-based technology companies developing locally specific technologies for use by local and regional customers. With increased penetration of mobile communications infrastructure and corresponding decreases in cost to access mobile technology and associated information and internet connectivity (GSMA, 2020), entry barriers continue to vanish and the technology itself is becoming more and more accessible to smaller scale farmers.

A significant hindrance to the scale of private sector provision of climate information services is the weak partnership between hydrological services and national meteorological services. These and several other inter-agency partnerships add very little value at a very slow rate (Usher et. al, 2018). The lack of expertise in data pricing in sub-Saharan Africa with no appropriate structure in place for data length, quality and pricing affects the dissemination of climate information services. According to the broadband pricing league table compiled by Cable.co.uk and referenced in (Kazeem, 2019), broadband Internet is expensive in many African countries. As of 2017, Egypt had the lowest monthly cost for Internet at $12.33, and Angola the highest at $139.29, with most potential clients unwilling to pay such prices for data. The existence of appropriate legal and regulatory frameworks is important in facilitating efficient partnerships amongst public and private institutions, and development partners. According to the Africa Climate Policy Center and the World Bank there is currently no such framework that guides public institutions to enter agreements with and/or serve private partners. Due to the diversity in Africa's private sector and presence of development partners who all respond to difference incentives, potential public-private projects will struggle to pinpoint ways to officially partner and collaborate on identified opportunities.

ROLE OF UNIVERSITIES AND OTHER RESEARCH INSTITUTIONS IN DCAS

Driving of research and partnerships

Universities and research institutes play a crucial role in innovation and scaling of climate and extension advisory services, frequently in collaboration with the National Weather Service (weather information services) and the private sector. Research organisations facilitate the formation of partnerships, the development of networks, and the collaboration of a vast array of stakeholders. Regional agricultural research organisations, such as ASARECA and CORAF in Africa, and the CGIAR in Latin America and the Caribbean, Africa, and Asia, contribute to the advancement of development-oriented research. Regional climate institutes in Africa, such as AGRHYMET and WASCAL, are also essential to the NMHS's capacity. Universities, non-profit organisations, and agricultural research councils play a crucial role in testing and scaling up new technologies and approaches pertinent to DCAS (Born et al., 2021).

Universities and research institutes can leverage their expertise to improve climate advisory services on the continent. The University Climate Change Coalition, a Western coalition of North American research universities, connects 23 leading institutions committed to accelerating climate action on campus, communities, and globally. The coalition has introduced a fellowship program and research for policy platform, supporting local communities in achieving climate goals and transitioning to a low-carbon future. A research paper by Ssekamatte (2023) studied two African universities, Makerere University in Uganda and University of Dar es Salaam in Tanzania, highlighting the strategic role of universities in combating climate change issues through the establishment of climate change centers and structures.

ROLE OF DEVELOPMENT AGENCIES IN DCAS

Tsan et al. (2019) report that in recent years, development organisations and donors have recognised the potential utility of digital advisory services and have played a crucial role in accelerating efforts to introduce DCAS to more marginalised communities. Governments and contributors collaborate to develop agricultural data infrastructure in the form of agronomic data, soil data maps, weather and climate observation systems, earth observations, pest and disease surveillance systems, socioeconomic data, and farmer registries (Tsan et al., 2019). The Grameen Foundation has developed a substantial advocacy model integrating mobile money tools with digital climate advisory services as a central component of their mission, among many other fascinating examples. This exemplifies both the potential impact of systematic investment in DCAS (and complementary digital technology) as well as the significance of the public sector and regulatory environment in ensuring the integrity of both the information being provided and the quality of the services themselves.

A properly structured policy and regulatory environment is essential for DCAS, which democratises technology to help establish an environment with relatively low entry barriers for the private sector. This serves to cultivate and promote innovation, but there is a risk that the content and quality of DCAS developed may vary considerably. While policies concerning the incorporation of DCAS in the government agenda tend to serve national interests, there is an increasing need for policies that protect individual interests. These policies range from agriculture-specific examples involving the preservation and use of farmer registration data to more general data governance such as consumer privacy and consent (Tsan et al., 2019). In the sphere of digital agriculture, governments face the challenge of balancing regulation to encourage innovation while protecting individual interests.

CHALLENGES AND PROSPECTS FOR STRENGTHENING DIGITAL CLIMATE ADVISORY SERVICES IN AFRICA

Born et al., (2021) identify the following set of gaps and challenges with DCAS in Africa:

Weakness or lack of institutional capacity: The lack of institutional capacity and policy incentives for national climate institutions (NMHS), agricultural institutions (Ministries of Agriculture and Rural Development), and ICT provider institutions to work together to support effective digital climate-informed advisory services (DCAS) is a significant challenge. The Global Commission on Adaptation DCAS initiative aims for co-leadership among relevant national agencies in target countries, but these institutions often fall under separate line ministries and policy frameworks. Inadequate multi-agency governance arrangements, differing institutional and disciplinary cultures, and competition for resources and influence can hinder the level of collaboration and co-leadership required for DCAS. Successful implementation will depend on new inter-agency institutional arrangements, enabling policies, and shared resources (Born et al., 2021).

Low capacity in data governance: Weaknesses in national data collection systems and governance threaten the quality and usability of data for DCAS. High-quality, open, interoperable, reusable data is essential for quality DCAS, and gaps in underlying climate, agricultural, environmental, or economic data can negatively affect the service's quality and impact on farmers' livelihoods.

Low quality of climate data: The availability and quality of climate data at the local scale of farmer decision-making is a significant concern, with long-term historical meteorological observations being the main source of knowledge about local climate behavior. National observation networks across the developing world are inadequate, particularly in rural and mountainous areas. Most DCAS use gridded interpolated data, which is difficult to use over data sparse areas. Additionally, donor-driven structural reform policies in the late 1980s and 1990s have prompted the use of globally available gridded proxy data from remote sensing or interpolation of public domain station observations for DCAS.

Inconsistency with climate services provision: Farmers face multiple providers of inconsistent information and advice, with inadequate guidance and accountability from providers. They participate in various roles, including managing farming operations, customers, buyers, and risk managers. Farmers must choose which DCAS to use, which is often inundated with uncoordinated sources of information. Without adequate benchmarking and transparency, farmers may not have the time and skills to make informed choices. Providers may not be adequately accountable for the advisories they supply, compromising the legitimacy of DCAS and eroding trust. Farmers require approaches to DCAS provision that consider their circumstances to deliver appropriate services through appropriate channels.

Gaps in digital skills of farmers: vulnerable small-scale producers often have limited capacity to select, understand, and act on climate-informed advisories, engage providers in coproduction, and access digital delivery channels, risking exacerbating inequity. Digital tools and delivery channels can exacerbate existing inequities, especially for poorer farmers. Digital technologies should complement existing sources of information and communication channels.

Weak agency of farmers to negotiate: Investment in the provision of information and advisories is essential for improving information and advisory services. However, dialogue alone is not sufficient, and users must have the capacity to articulate demand for products and services that might not yet be familiar or available. Institutional culture views farmers as passive recipients of expert information, which hinders farmers' ability to negotiate demands effectively with service providers. Sustaining adequate investment through public funding and viable business models after a donor-funded project is crucial for the long-term success of DCAS initiatives.

Opportunities for DCAS investment in Africa

Digital Agri Hub's report (2021) highlights the limitations of digital agriculture (DCAS) in African nations due to chronic governmental underinvestment and lack of favorable conditions for partnerships. Investment stability is lacking due to the rapidly developing industry, which spans various disciplines and dimensions. Public-private partnerships could be a solution for long-term DCAS development. To build DCAS, it is essential to map out players, evaluate contexts, and explore partnerships, scaling potential, and business strategies.

Opportunity for stakeholders to co-produce and collaborate to ensure relevance, legitimacy, and salience of services.

Climate services, such as DCAS, have historically had a supply bias due to the evolution of forecast skills. The current information age allows for more readily available advisory information, but it can also impact the relevance, legitimacy, and salience of services. Research collaborations between universities, farmer organizations, and government agencies can help identify and match small-scale farmers' needs to climate services. However, lack of coordination among stakeholders, such as agencies, private sector, farmers, and ministries, can lead to duplication of initiatives, policy gaps, redundant data collection, and low-quality information (Born et al., 2021).

WAY FORWARD: POLICY CONSIDERATIONS ON DIGITAL CLIMATE ADVISORY SERVICES (DCAS)

DCAS requires a national policy framework that incorporates climate change information into climate and weather information institutions' mandates. In some cases, public and private agricultural organizations independently administer their own weather station infrastructure, despite the responsibility of agriculture ministries and associated agencies. The introduction of new technologies and channels often falls under the purview of ICT ministries and can be influenced by rapidly evolving data and consumer protection laws. In many countries, local non-governmental organizations, private businesses, and farmers accumulate vast amounts of data that could be useful for developing DCAS that are tailored to local requirements and contexts (Born et al., 2021).

Lack of coordination among agencies, the private sector, farmers, and ministries is a common issue in many nations, resulting in issues such as duplication of initiatives, policy gaps, redundant data collection and provision, well-intentioned services that fail to understand and meet farmers' needs, and the dissemination of questionable quality information. Additionally, the business models and data regulations of various agencies may pose a barrier, particularly when cost recovery is central to the operational model of a government ministry or agency.

A research report by the Digital Agri Hub (2021) highlights that when establishing a Public-Private-Partnerships, a strategic focus should be on partnering with the "right" actors in the DCAS value chain: providers of weather and climate products, knowledge organizations in the agricultural domain, ICT platform providers, mobile operators, scaling partners (such as extension services, non-governmental organizations), and various potential business carriers (value chain aggregators and agribusiness, financial institutions and insurance companies, investors).

To effectively build the resilience of 300 million small-scale agricultural producers worldwide by 2030 through DCAS, the Global Commission on Adaptation (GCA) estimates that about $7 billion in donor, private sector, and government investment between 2021 and 2030 is needed (GCA, 2021). This investment would cover up-front costs and the annual recurrent costs of specific services but does not cover investments in infrastructure and enabling environments. Challenges make it difficult to determine the overall investment needed to build the resilience of 300 million producers with DCAS by 2030, including highly limited data on project costs, vast differences between projects in terms of service provision, necessary training, and infrastructure costs, regional variances in up-front costs for infrastructure, knowledge, and enabling environments, and large differences in farmers reached per project, with generally lower costs per farmer for bigger projects(GCA, 2021).

Universities and research institutes can leverage their expertise to improve climate advisory services on the continent. The University Climate Change Coalition, a Western coalition of North American research universities, connects 23 leading institutions committed to accelerating climate action on campus, communities, and globally. The coalition has introduced a fellowship program and research for policy platform, supporting local communities in achieving climate goals and transitioning to a low-carbon future. A research paper by Ssekamatte (2023) studied two African universities, Makerere University in Uganda and University of Dar es Salaam in Tanzania, highlighting the strategic role of universities in combating climate change issues through the establishment of climate change centers and structures.

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