Improving the reach and relevance of Climate Information Services through a Digital Public Infrastructure approach

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AICCRA INFO NOTE

Key Messages

- **Climate Information Services** (CIS) can significantly help vulnerable smallholder farmers to cope with climate risks – especially if they are data-driven and dynamically adjusted based on weather forecasts, and are location- and context-specific.
- To fulfil this potential, **better integration** between meteorological and agricultural sectors is needed.
- The Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) programme has **created national-scale digital platforms known as AgDataHubs** as a means to improve access and integration in agriculture and climate data, and develop weather- and climate-informed agro-advisory services.
- To unleash the full power of AgDataHubs, it will be necessary to **pivot towards a Digital Public Infrastructure (DPI) approach**, which shores up a suite of digital solutions – including initiatives like the Hubs – that enable the basic functions essential for public and private service delivery, and ensures they receive comprehensive and systemic investment.
- These hubs can also **serve as the basis for further innovation**, such as the development of application programming interfaces (APIs) that private innovators can adopt and use to create additional digital services.

CGIAR | AICCRA Accelerating Impacts of CGIAR Climate Research for Africa

Introduction

Climate variability is a major source of risk in food production in the semi-arid tropics (SAT). These regions are home to about 2.5 billion people, including some 644 million of the world's poorest (Gitz et al., 2016; Woldearegay et al., 2018). Alongside other biophysical, socio-economic, and political factors, climate risk contributes enormously to food insecurity, economic losses, and poverty.

In this critical context, Climate Information Services (CIS) can significantly help smallholder farmers to cope with climate risks (Carr et al., 2018; Guido et al., 2020; Simelton & Le, 2018) – pilot studies have clearly established their usefulness for smallholder decision-making (Rao et al. 2019). It's clear that location- and context-specific climate-informed advisory services that are data-driven and dynamically adjusted based on weather forecasts (seasonal, medium, and short-range) significantly enhance the ability of smallholder farmer to manage the vagaries of climate.

The Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) programme works to scale climate-smart agriculture and CIS to reach millions of smallholder farmers in Africa. Recently, scientists within the programme have developed AgDataHubs in six African countries as a means to improve access and integration of agriculture and climate data, and develop weather- and climate-informed agro-advisory services. Now, they're advocating to scale up its successes through a Digital Public Infrastructure (DPI) approach, whereby digital climate projects like the Hubs are viewed as foundational elements of a country's DPI, and accordingly receive comprehensive and systemic investment.

This InfoNote shares insights, early successes, generalizable lessons, and next steps in this important body of work, which offers major potential to address some of the most pressing challenges for many of the world's poorest farmers.

The challenge

Translating meteorological information and insights into actionable and localized advisories for farmers calls for a multi-disciplinary approach (Ahmad et al., 2017; Weiss et al., 1999). This requires greater integration between meteorological and agricultural sectors (Kim et al., 2022) than what currently exists in most places. The majority of existing climate information services for farmers currently deliver only fragmented and generic information, such as rainfall forecasts that are not specific to their locations, and crop management recommendations that are generalized for all soils and seasons.

If such services could instead deliver real-time, location-specific, crop-based dynamic agro-advisories before the start of, and during, the main crop season, the productivity and profitability of smallholder farmers could substantially improve via tactical management of crop and livestock production. Yet there are several operational challenges inherent in the task of coupling meteorological information with agriculture knowledge (represented as crop calendars, crop simulations models, and other knowledge products based on science) to generate context-specific advisories for dissemination to farmers. As the weather is a highly dynamic phenomenon, there is also a need to continuously keep track of data and generate and update such advisories.

A step in the right direction: AICCRA's AgDataHubs

Information and communication technologies (ICTs) and digital platforms can significantly improve institutional coordination and lead to better integration of climate and weather data in agro-advisories (Kim et al., 2022) and more effective knowledge transfer to farmers (WMO 2010). One of AICCRA's flagship initiatives aims to embrace this potential through the establishment of national-scale digital platforms called AgDataHubs. These are designed to overcome the operational challenges in accessing and integrating agriculture and climate data for the purposes of developing weather and climate informed agro-advisory services.

These hubs were commissioned in all six of AICCRA's country clusters, which are based in Senegal, Mali, Ghana, Ethiopia, Kenya, and Zambia. Users access the hubs through dashboards containing visualizations that convey climate and weather data – such as historic climate data (Figure 1), weather data for the current season, and forecasts from a diverse set of global and national sources (Figures 2 & 3).

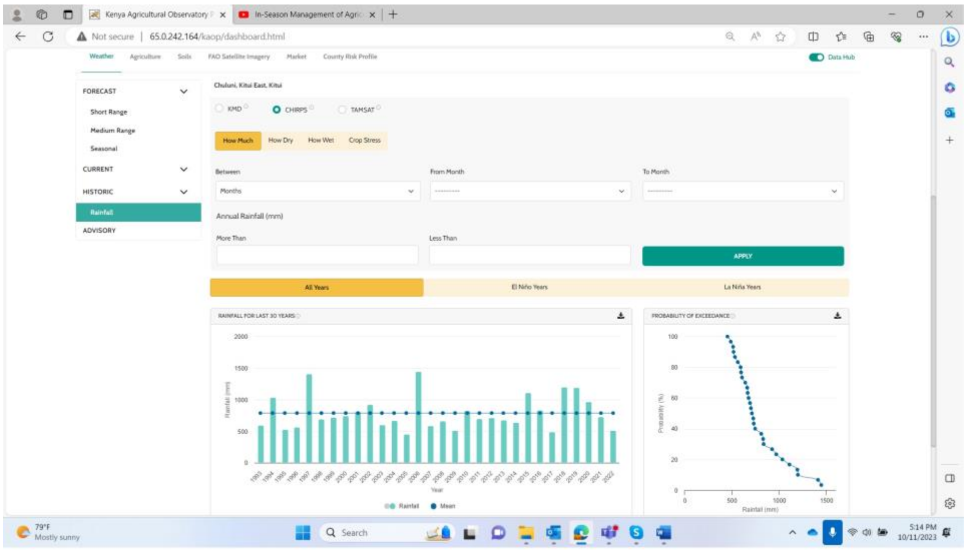

Figure 1: *Historic annual rainfall data from the Kenyan Meteorology Department (KMD) and global sources on the Kenya Agricultural and Livestock Research Organization (KALRO)'s Kenya Agricultural Observatory Platform (KAOP)/AgDataHub portal.*

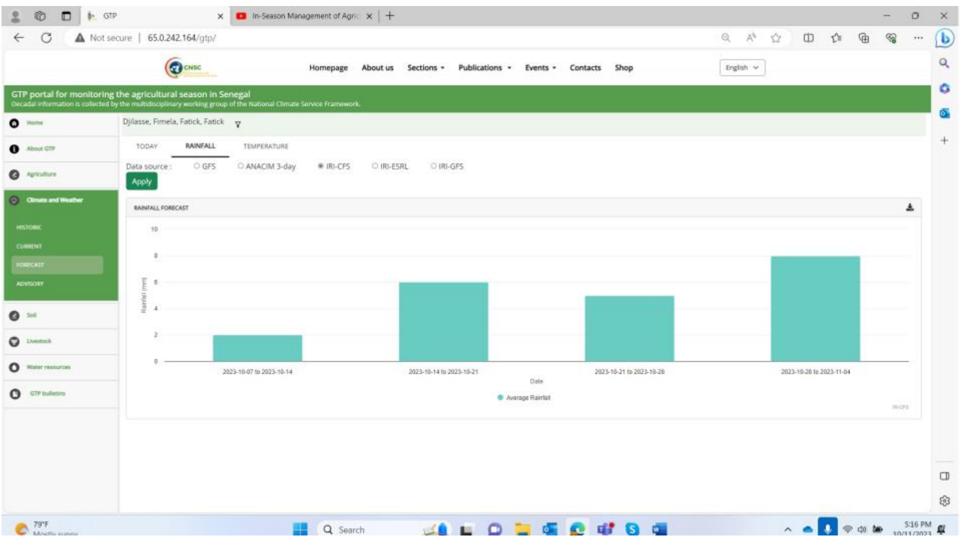

Figure 2: *Forecasts from Senegal's National Civil Aviation Agency (ANACIM) and global sources on the ANACIM's Multidisciplinary Working Group (GTP)/AgDataHub portal*

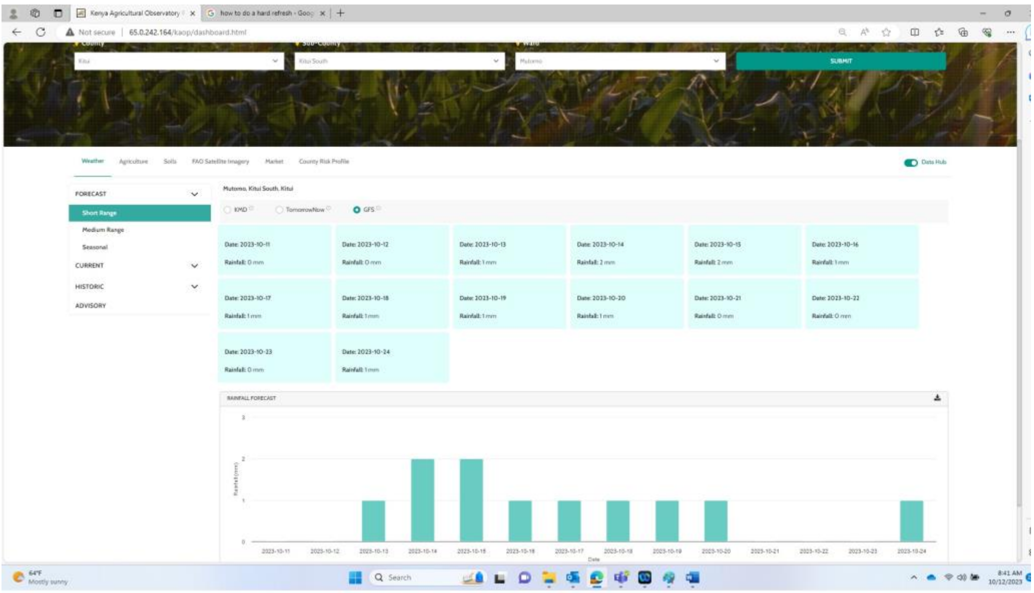

Figure 3: *Forecasts from KMD and global sources on the KALRO's KAOP/AgDataHub portal*

Agriculture data is ingested from global sources such as the FAO's Global Information and Early Warning System on Food and Agriculture (GIEWS), FAOSTAT, and data from national and regional agencies.

By aggregating this diverse data on climate, weather, forecasts, soils, and agriculture – as well as enabling insightful analysis through dashboards and visualizations – AgDataHubs offer powerful tools for users such as agronomists, agro-meteorologists, agriculture advisors and extensionists, and others in the public and private sector who develop weather- and climate-informed agro-advisory services, to perform contextual querying. With appropriate capacity-building, these users can then readily interpret these data to inform agro-advisories on pre-season planning and in-season tactical management. Such information can then be disseminated as text messages, voice messages, radio broadcasts, or agro-advisory bulletins (AAB) (comprehensive documents that are easily adaptable for a wide range for farmers and dissemination channels.)

A broader solution: the Digital Public Infrastructure approach

Whilst the AgDataHubs dashboards represent a significant step forward in the integration of climate and weather data into agro-advisory services, their potential for unlocking the creativity and enterprising spirit of AgTechs can best be unleashed by pivoting to a Digital Public Infrastructure (DPI) approach, which shores up a suite of digital solutions that enable the basic functions essential for public and private service delivery. Within such an approach, digital climate projects like the Hubs could be viewed as foundational elements of a country's DPI – and accordingly receive comprehensive and systemic investment.

In a DPI approach, the AgDataHub's underlying data, models, and analytical capabilties could be unbundled into building blocks that are atomic, independent, and reusable at scale, enabling others to use, configure and extend on top of them. All of these datasets and capabilities, when packaged as DPIs and made accessible to startups and innovators as Open APIs (application programming interfaces that are publicly available to software developers), could result in the development and deployment of several climate-smart digital innovations and services, including advisories.

According to the Center for Digital Public Infrastruture (CDPI), there are five main categories of DPIs: identifiers and registries; data sharing and models; signatures and consent; discovery and fulfillment; and payments (CDPI, n.d.). The proposed DPI for climate-informed advisory services falls under the 'data sharing and models' category. Figure 4 shows the data stack of AgDataHubs that could now be packaged as DPI for digital agro-advisory services. In some locations, a system called the Intelligent Systems Advisory Tool (iSAT), which generates crop specific advisories, is also integrated into the Hubs.

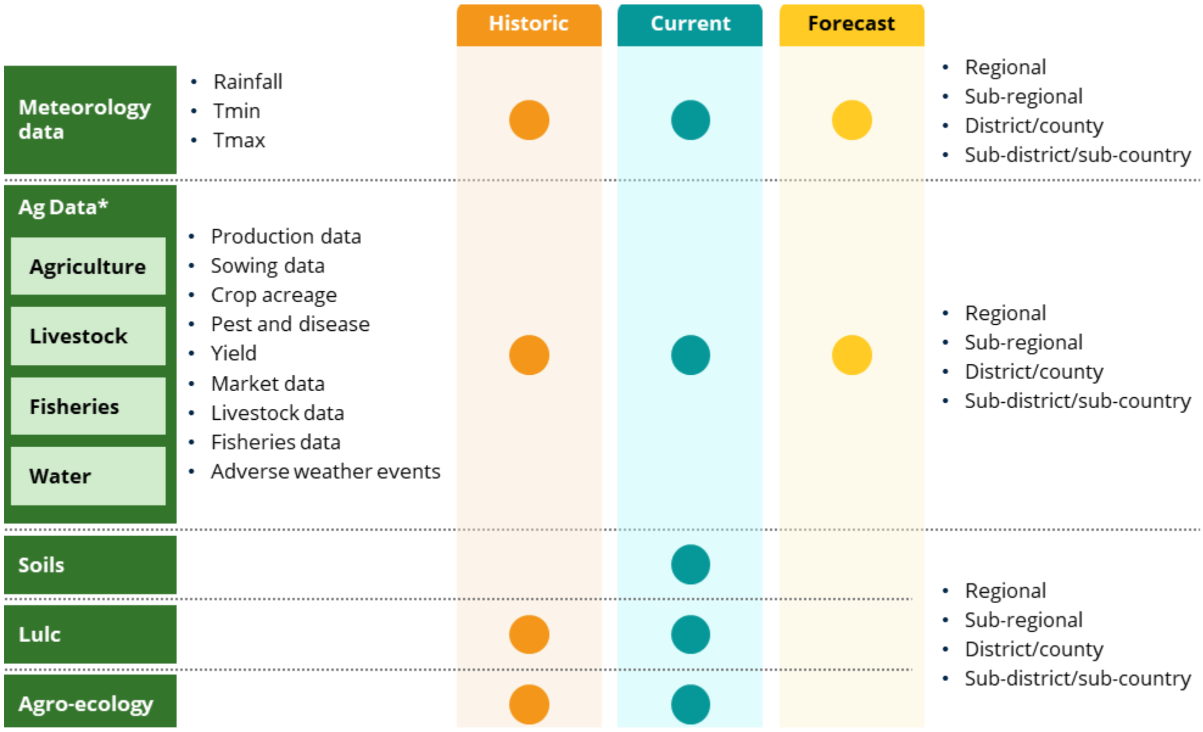

***Figure 4**: Fore Data stack of DPI for digital climate-informed agro-advisory services*

UPI–India's DPI to transform financial inclusion.

DPI can enable economic activities in the digital age and has the potential to transform economies and support inclusive growth. It can be harnessed to foster innovation and competition, expand markets, close gaps in financial inclusion, and help make financial transfers to the vulnerable. An example is the Unified Payments Interface (UPI) in India. India is generally called out for poor physical infrastructure but has experienced a radical transformation in the digital space. Most notably, UPI has reshaped the universe of informal transactions that make up 85% of its economy. In January 2023 alone, eight billion such transactions, worth nearly USD200 billion, were carried out involving 300 million people and 50 million merchants — remarkable for a country that used cash for 90% of transactions a few years ago.

Future applications

Climate adaptation requires concerted action by all actors in agri-food systems (AFS), and embedding climate and weather data into their decision-making is critical. Looking forward, the AgDataHubs could significantly be enhanced to provide such advisory services as well decision support analytics for other value chains. Several datasets proposed as part of the above stack (Figure 4) are digital public goods (DPGs) that – when stacked as a DPI and opened to public and private innovators – have the potential to usher in a digital agriculture revolution with climate and weather data at its core.

AgDataHubs are also an ideal platform to deploy Large Language Models (LLMs), Open AI, and AI/ML models, which could significantly enhance the generation and development of agro-meteorological advisories by making use of the rich and granular data that's available, without the need for human intervention.

Additional data streams – such as spatial soils information, and district data on crops, animals, productivity, disease, pests, infrastructure, and crop and pasture extent, could all support new applications and the development of new business models. Nurturing such innovation could also enhance the quality and availability of agro-meteorological advisories in return.

Such a shift, however, also requires investment into other enabling conditions like capacity building and innovation support arrangements such as incubation and acceleration, as well as innovation grants. Coupled with innovation support programs and acceleration programs, AgDataHubs combined with Open APIs could prove an interesting way to test market-driven models for bundling climate and weather data.

How to: set up a new AgDataHub using a DPI approach

To set up AgDataHubs in other countries, and transform these into DPIs to foster an ecosystem of innovators and create a suite of climate-smart products and services for farmers in an equitable and inclusive way, the following steps are recommended.

- Map the country's existing CIS data value chain to identify key national players and agricultural research and extension system (NARES) partners that are critical in translating climate and weather data from national meteorological and hydrological services (NMHS) and disseminating this as agro-advisories to farmers (Dhulipala et al. 2022; Kim et al. 2022).
- Based on this mapping, identify the organization upstream of these boundary organizations that can maintain and manage the AgDataHub in the future.
- Identify the sources of data to build the AgDataHub stack. In most cases, climate and weather data sit with the NMHS, while agricultural and allied sectors data is generated and maintained either by national statistical units, or by agricultural statistical units within agriculture ministries. NARES institutions also operate elaborate field activities which can be sources of rich data.
- In the absence of data from national and local institutional actors, global datasets based on satellite-derived data can be accessed and integrated into the AgDataHub.

How to: set up a new AgDataHub using a DPI approach (continued)

- Boundary organizations like agricultural extension agencies, farmer-facing organizations (FFOs), and AgTechs are the first users of the AgDataHubs, and it will be important to create a reference application or dashboard to help them develop advisories from the hub, and then build visualizations and analytics to demonstrate how to do so.
- Engage with key crop value chains in the country and start developing value chain-specific analytics, dashboards, and tools. Tools like iSAT, which work with the data from AgDataHub as an input and generate crop and location-specific advisories, can also be developed. Outputs from iSAT and any AABs can then be distributed to farmers through text, Interactive Voice Response (IVR), radio, and other channels owned by partner organizations (Ramaraj et al. 2023).

Conclusion

As climate change impacts on smallholder farmers' lives and livelihoods ever more deeply across the globe, this body of work has growing global relevance, and contributes importantly to a number of debates and challenges. Firstly, the conceptualization of AgDataHub as a boundary tool, which helps in translating complex climate science as well as amalgamating this with agro-advisory, is a pioneering effort in the domain of CIS. Secondly, the AgDataHub work, data stack design, and solution architecture make up an effective DPI for supporting agricultural adaptation in the face of climate change. Finally, the AgDataHub and data stack can also be viewed as a framework that guides public sector and philanthropic investments, which could fund institutions, efforts, and programmes to create data as DPGs and make this accessible to innovators as a DPI.

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