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Policy Innovation for Transforming Africa's Food System with Digital Technologies

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The use of digital technologies in Rwanda's agriculture sector is advancing rapidly. Yet, despite visible developments in the ICT sector, Rwanda scored just 3.8 out of 9 in the 2017 World Bank's EBA ICT Index.[i] While this indicates some progress, there is still room for improvement with respect to regulation and policies that enable a digital environment for the agriculture sector.[1] According to the GSMA 2017 Mobile Connectivity Index (MCI)[ii], Rwanda's overall performance regarding key characteristics for mobile internet adoption increased by 27 percent since 2014, with a score of 41.7 in 2017. However, Rwanda still ranks below the African average, mainly due to low network performance and accessibility of mobile apps in the local language. Yet, the country performs particularly well in providing network coverage—with a striking 93 percent of the population having access to 3G networks—affordable handset prices and gender equality in terms of the labor market and gender

literacy ratio.[2] While investments in African tech start-ups are primarily concentrated in South Africa, Kenya and Nigeria[iii], Rwanda has witnessed a growing interest by investors in recent years, with US$36.7 million raised by start-ups in 2017, making it the fourth most popular country for tech investors in Africa south of the Sahara.[3]

Institutional innovation

Through the development and coordination of national ICT and innovation policies, programs and citizen's empowerment, the Ministry of ICT and Innovation seeks to address national priorities for economic growth and poverty reduction. The ministry operates four units dedicated to innovation and business development, digital transformation, postal services, and regulatory services. Furthermore, the development of laws governing the use of ICTs and the prosecution of cybercrimes fall under the responsibility

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i   The EBA ICT indicator measures laws, regulations and policies that promote an enabling environment for the provision and use of ICT services, particularly in rural areas. The index ranges from 0-9 (9 indicating high performance). An index equal or higher than 4.5 is identified as 'developing' and 'prospering' in the regulatory framework performance and therefore considered as high performers in our cluster.

ii   The GSMA Mobile Connectivity Index measures the performance of 163 countries (44 African countries), against the four key enablers of mobile internet adoption – infrastructure, affordability, consumer readiness and content and services. The index ranges from 0-100 with 100 indicating high national capacity to support the adoption of mobile internet. Rwanda's MCI score was 31.6 in 2014 and 40.0 in 2017.

iii   Investments in South Africa, Kenya and Nigeria accounted for 76 percent of all total funds raised by start-ups in SSA in 2017.

of the ministry. With respect to ICT and innovation, the ministry coordinates efforts with the national Cyber Security Authority, the Rwandan Information Society Authority, and the Rwanda Utilities Regulatory Authority (RURA).[4]

RURA was created in 2001 through law 39/2001 as one of four partner agencies working under the ministry. In 2013, law 09/2013 gave RURA the mandate to regulate tele-communications, broadcasting, information technology and any other audio-visual ICTs. RURA also adopted the International Telecommunications Union ICT Standards and Quality of Service regulation, ICT Scarce Resources Management and Monitoring, Media Regulation, Innovation and Cybersecurity. Under RURA, there are four different subsectors and services.[5] The Innovation and Cybersecurity department was established to ensure the provision of faster, more secure and better online services in all sectors, including the agriculture sector.[6] The department, strength-ened by the 2016 ICT law, operates six different schemes, namely big data, information application, emerging communication technologies, cybersecurity, internet governance and an innovation fund. Overall, the department is responsible for implementing the requirements of the different sectors such as emerging technologies, big data, fintech, IoT, e-agriculture, e-commerce and internet governance.[7]

Within the Ministry of Agriculture and Animal Resources (MINAGRI) the General Directorate of Corporate Services coordinates, manages and assesses the status and usage of ICTs in the agriculture sector.[8] MINAGRI also cooperates with the Ministry of ICT and Innovations and their implementing agency, the Rwanda Information Society on some of their ICT projects, including the e-Soko service for farmers.[9]

Policy and programmatic innovation

Rwanda has been embracing an ICT transformation since 2000, with an ambitious National Information Communications Infrastructure (NICI) policy, which outlines a long-term plan to achieve full digitization in four stages of five years each. The NICI plan was also integrated into Vision 2020, the government's comprehensive program to transform Rwanda into a middle-income country by 2020. The first stage of the NICI (2000–2005) laid the basis for a thriving ICT sector, including the design of institutional, legal and regulatory frameworks, as well as liberalizing the telecommunication market by reducing entry barriers to encourage domestic and foreign direct investment and competition in the sector. During the NICI's second stage (2005–2010)[10], the focus was on enhancing ICT infrastruc-ture by establishing a national data center that provides information storage, management and protection, using cloud computing opportunities. In addition, a national fiber-optic backbone network connecting Rwanda to international sea cables was deployed, increasing internet

accessibility and affordability. In the third NICI plan (2010–2015), the focus was on the development and improvement of ICT services. The current and fourth stage, the Smart Rwanda Master Plan (2015–2020), seeks to propel Rwanda's economic development and to meet the goals under Vision 2020, in particular through increased ICT capability and capacity, secure and shared infrastructure across the public sector, and an institutional governance structure for integrated and centralized management of ICT strategy.[11,12]

With respect to the agriculture sector, Rwanda is currently implementing the third cycle of its National Agriculture Investment Plan (NAIP), the Strategic Plan for the Transformation of Agriculture in Rwanda (2018–2024). The country's first NAIP (2008–2013) focused on increasing agricultural outputs and incomes for all farmers and indicated the need for ICTs to strengthen institutional structures. The plan further aimed at strengthening the collection and analysis of statistical information on crop production, the creation of a sectorwide ICT system including the development of real-time market information and a network of local meteorological stations, and setting up community innovation and farmer training centers. To establish a sectorwide ICT system, US$3.3 million were allocated between 2008 and 2012.[13] During that time, extreme rural poverty fell from 39.5 percent to 26.4 percent due to interventions that aimed to move the agriculture sector from subsistence to a market economy. Rwanda's second NAIP (2014–2018) was designed in the spirit of transforming Rwanda's agriculture from a subsistence to a market-oriented, value-creating sector. The use of ICTs was encouraged at several stages, including the establishment of soil information systems using GIS, strengthening the quality and communication of weather forecasts, collection of cow production data for crossbreeding, and provision of digital platforms to improve information provision and mainstreaming related to regional and international trade through the digital service e-Soko. The third NAIP (2018–2024) aims to further increase wealth and prosperity of those living in rural areas.[14]

In 2016, MINAGRI launched the National ICT Rwanda Agriculture (ICT4RAg) Strategic Plan (2016–2020) with the objective of transforming agricultural practices. Its focus is on providing information to enhance productivity and ICT-based agricultural commercialization and to establish industrialization within the entire value chain.[15]

Prior to this, in 2007, MINAGRI and the Rwanda Information Society in collaboration with the Mobile Telecommunication Company (MTN) had launched e-Soko, Rwanda's Agricultural Market Pricing Information System, providing farmers in rural areas with market and price information on different crops, including beans, maize, rice, wheat, potato, and cassava. e-Soko allows farmers to access daily price quotes

of different commodities through text messages received in their local language. Farmers without mobile phones can access e-Soko via village phones—smartphones owned by extension agents and provided to farmers to access services. Data on commodities are also used by officials to forecast market trends. By 2015, the e-Soko platform provided information on 78 commodities in 61 markets across Rwanda.[iv] Earlier in 2011, the platform won the Technology in Government in Africa (TIGA) Award.[16] e-Soko is still being used widely across Rwanda and plans for an updated version, e-Soko+, have been released in the ICT4RAg indicating an additional investment of about US$4.2 million in the project until 2020. E-Soko+ aims to combine market price information, currently provided through e-Soko, with an online trading platform.[17]

In order to increase access to agricultural information, knowledge and markets, the government has opened 92 ICT centers countrywide. The centers aim to provide farmers with relevant information on agriculture-related topics by providing computer and internet access, and other services, including scanners, printers and photocopiers at low prices. While 30 of the centers are privatized, 62 remain under district management.[18]

Furthermore, the private sector plays an active role in the agricultural digitalization process, offering various online services across the value chain. Access to Finance Rwanda and TransUnion Rwanda launched Menyesha (meaning "inform me") as a pilot project in 2017. By determining farmers' creditworthiness through the use of credit-scoring tools offered by financial service providers, the project aimed to reduce risks for rural communities, including smallholder farmers. Menyesha is a digital tool that allows users to check their credit status by simply sending a SMS or USSD. The credit status is then sent to the potential lender via SMS specifying a "good" or "default" status, indicating the ability to pay back a loan on time and the associated risk to a borrower. On request, the user can also get the report, listing credit history payment behavior in terms of on time payments and personal details including name, ID number, address, and employer. The credit report fulfills two objectives. For the user, seeing the amounts of debt and outstanding payments at any particular time helps to resolve credit problems as Menyesha further supports transactions to various lenders and financial institutions directly via mobile money. Once debts are settled, users can decide to give permission for credit grantors to view the credit report if they apply for a loan. Since access to finance is a persistent problem for smallholder farmers in Rwanda, this tool can help farmers to build their digital identity and create trust. The initial pilot was targeted to serve 8,000 users within two

years. However, the target was surpassed within just nine months, reaching over 9,700 people.[19,20]

Based on the ambitious plans under the NAIP and the ICT4RAg, MINAGRI has implemented different projects related to the use of ICT in the agriculture sector, including an online exchange platform for all stakeholders of the agricultural and livestock sector (AMIS) and an online trade management information portal, the Rwanda Agricultural Livestock Inspection and Certification services (RALIS), facilitating international business and trade.[21] Given the country's topography with many hills and steep slopes, arable land is scarce in Rwanda and solutions to optimize land use are urgently needed. Based on the completed national land registry in 2012 and the mapping of 10.3 million parcels, 24,000 ha belonging to MINAGRI were found suitable for agricultural purposes. The Agriculture Land Information System (ALIS), implemented with support from USAID, is an open-source platform accessible through computers, tablets or smart phones that visually maps public land available for investment. The real-time online tool, which aims to attract private sector investments into agriculture, further provides information on plot size, general soil type, current use, proximity to infrastructure and agro-climatic conditions.[22] In collaboration with FAO, MINAGRI is currently developing a digital portfolio with five mobile services (weather and crop calendar; e-Nutrifood; cure and feed your livestock; agri-market place; and fall army worm monitoring system) with the objective of providing rural farmers with a better and more equitable access to agricultural information and knowledge, productive resources, services and markets using ICT.

In addition to existing projects, MINAGRI identified three different flagship projects that aim to further strengthen the agriculture sector through the use of ICT solutions. One of the projects is the Farm Management and Information System (FMIS), which serves as the backbone system for all other services. Through data collection, FMIS aims to enable communication and information exchange with external actors, such as providers, value chain actors and government authorities. A second project is the updated version of the already existing e-Soko platform, e-Soko+. The new version aims to improve the existing agriculture marketing services and lead to improved food security. As a third flagship, the ministry is developing several Mobile-Telephone Enabled Agriculture Technology Apps, including e-Growers information Management System, e-Inputs, e-Agri-Wallet, e-Trace Dairy, and e-Information. Overall, the ministry has allocated about US$15 million to the flagship projects until 2020 and aims for the private sector to finance additional ICT projects with estimated costs of US$22.7 million.[23]

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iv   Information provided by MINAGRI.

With support of US$10 million from the AfDB, the Rwanda Development Board (RAB) finished the construction of a new campus for the Carnegie Mellon University (CMU) Africa in 2019. The new CMU campus aims to provide better teaching and learning experiences to students and addresses the issue of limited capacity in hardware and software engineering, network design, and large-scale ICT project management in Africa.[24] Currently the university offers two master's programs, one in electrical computer engineering and one in information technology.[25] The 15-hectare CMU campus is one of the first facilities being completed on the land of the government's Kigali Innovation City (KIC), a public-private partnership between the government and Africa50 aiming to attract universities, technology companies, and biotech firms, as well as commercial and retail real estate. The KIC project aims to become a leading African tech hub, valuing about US$2 billion, and expected to create over 50,000 jobs and generating US$150 million annually through the export of ICTs.[26]

Rwanda has a rapidly developing environment for digitalization in agriculture. The government's dedication to increasing the uptake of digitalization in agriculture is evident as it puts in place clear and well-financed policies and mandates for ministries. As the sector develops, there will be more room for the private sector to play an active role.

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