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

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Digitalization in Nigeria's agriculture sector is advancing rapidly. The government's drive to shift away from oil revenues and toward less-developed sectors is providing a strong stimulus to modernize the agriculture sector. Nigeria's score of 4.5 of 9[i] on the World Bank's EBA ICT Index indicates a prospering enabling digitalization environment.[1] With a score of 45.9 in GSMA Mobile Connectivity Index (MCI)[ii], Nigeria is performing particularly well in providing affordable handsets, reducing mobile-specific taxation, and creating gender equality in the labor market.[2]

Institutional innovation

Nigeria's economic transformation plan covering the period 2009 to 2020 has been integrated in Vision 20:2020. Vision 20:2020 calls for a structural transformation of the Nigerian economy away from its reliance on oil production and a revitalization of other sectors, including agriculture. To deliver double-digit growth, the Vision aims to transform agriculture in several ways, including through the use of ICTs, to encourage more young people and recent graduates to enter the sector. At the same time, Vision 20:2020 endorses ICT as a key strategic objective to drive Nigeria's transition to an industry-based economy, not only to meet domestic needs, but also to exploit international market opportunities. In particular, the Vision promotes the development of local manufacturing, capacity and content to meet the needs of the ICT sector, as well as relevant R&D.[3]

These overarching objectives for economic direction guide Nigeria's Federal Ministry of Communications Technology (FMCT), and Federal Ministry of Agriculture and Rural Development (FMARD), with the former leading on infrastructure and regulatory aspects, while the latter focuses on its application in the agriculture sector. FMCT was established in 2011 to foster a knowledge-based economy and facilitate ICT as a key tool in job creation,

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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.

economic growth and transparency of governance. The ICT department within this Ministry is responsible for the formulation and supervision of the implementation of the National ICT Policy, facilitating public-private partnership involvement through, for example, the development of ICT parks and national databases to increase access to data and information that supports research and policy development. In addition, the Telecommunication and Postal Services (TPS) Department leads on the implementation of integrated national rural telecommunication programs, including promoting the development of universal broadband as well as satellite broadband access. The Universal Access Division within TPS is responsible for delivering rural telephone and satellite broadband services. Finally, the e-Government Department within the Ministry is responsible for the successful implementation of various e-Government projects, including e-agriculture.

Beyond the Ministry of Communications, the Nigerian Communications Commission (NCC), established under the Nigerian Communications Act 2003[4], is an independent regulatory authority to facilitate competition among operators in the industry as well as provide quality and efficient telecommunications services throughout the country. The Technical Services departments within the NCC oversee emerging technologies and information security while the Stakeholder Management Department manages legal, regulatory, licensing and compliance issues.[5]

Two additional agencies working in partnership with the Ministry of Communications are Nigerian Communications Satellite Ltd (NIGCOMSAT) and the National Information Technology Development Agency (NITDA). NIGCOMSAT owns and operates the Nigerian Communications Satellite systems. Although its first geostationary satellite, NigComSat-1 failed in 2008, the company successfully launched a replacement satellite in December 2011. NIGCOMSAT also provides an anti-counterfeiting system, Olubuster, which uses RFID technology to detect counterfeit products, including in the food industry.[6] NITDA is in charge of fostering the development and growth of IT in Nigeria by regulating, monitoring, evaluating and verifying progress on the goals of the National IT Policy, including fostering competitive local production and manufacture of IT components and improvements in food production and security.

In order to increase the uptake of ICT within FMARD and in relation to agricultural transformation in Nigeria, the Ministry works in close collaboration with the Agricultural and Rural Management Training Institute (ARMTI), a parastatal providing training and development to employees to manage agricultural and rural development projects.[7] Within ARMTI, this responsibility lies with the Agricultural Development Management Department

(ADEM) and the Computer Training and Information Management Division (CTIM), which provide training on ICT applications for agriculture and rural development programs as well as effective networking of ICT in rural management.[8] The National e-Agriculture portal was also recently handed over to FMARD by the Director General of the National Information Technology Development Agency (NITDA) to enable swift growth in the agriculture sector.[9] The e-Agriculture Portal is a strategic and collaborative initiative between NITDA and FMARD to provide an overview of the food and agriculture industry in Nigeria for potential investors and stakeholders.

Policy and programmatic innovation

Over the years, the Nigerian government has initiated and adopted several policies to guide the development of the ICT sector and to harness its potential for national development and capacity building. Digitalization in Nigeria's agriculture sector is emphasized in two key policy interventions: the National ICT Policy and the Agriculture Promotion Policy (APP) 2016–2020, nicknamed "The Green Alternative." The National ICT Policy outlines key objectives to create a conducive environment for a rapid uptake of digital solutions in the agriculture sector with appropriate fiscal and financing support, including government budget allocations, deregulation and liberalization, foreign direct investment, and public-private partnerships. The policy promotes universal access to high-quality and advanced ICT and services to reach the last-mile users in rural areas through a program of accelerated deployment of fiber optic networks; by ensuring appropriate security for ICT infrastructure nationwide; and by facilitating access to rights of way (ROW) over public land. The policy also advocates the strengthening of local capacity in ICT technologies and software development.[10] Specifically, the Guidelines for Nigerian Content Development in Information and Communications Technology require equipment manufacturers to maintain at least half local content by value either directly or through outsourcing to local manufacturers.[11] As per Vision 20:2020, the implementation of this strategy is driven mainly by the private sector, promoting entrepreneurship, innovation and local capacity development, while the government acts as facilitator and catalyst. By promoting the uptake of ICT within the government itself, both the National ICT policy and the guidelines ensure that the development of Nigeria's ICT industry is a bottom-up process.[12]

In addition, the APP acknowledges the importance of access to information and knowledge in enhancing agricultural productivity and improving agribusinesses. The policy focuses on the development of a knowledge system and data center with a focus on weather, input costs and crop prices, as well as improving the reach, effectiveness

and efficiency of extension services through the use of electronic means including SMS. APP also promotes the use of economic models, spatial data, GIS, satellite and other data for planning and monitoring of the sector. Finally, APP raises the role of digital mechanisms for supporting land registration processes and invites the research community to leverage digital innovations to lower costs of field work.[13]

To reform Nigeria's input subsidy systems, the government introduced a new digital delivery mechanism, the eWallet program, to manage the delivery of fertilizer and seeds farmers are entitled to; location of the agro-dealers supplying the input; and the amount of out-of-pocket contribution. A transaction confirmation is sent once inputs have been successfully purchased. Not only did this introduce transparency and traceability of transactions, the eWallet program also offered an avenue to contact farmers and was eventually used to deliver additional benefits to farmers, including vouchers for nutritional supplements. By 2017 the eWallet system was benefiting 17 million farmers (many of whom were women), 2,500 agribusinesses, 800 e-extension workers, and over 2,500 service points in Nigeria.[14] Cellulant Nigeria Limited—the company that implemented the eWallet system in Nigeria—now also operates in 12 other African countries—Kenya, Nigeria, Ghana, Uganda, Zambia, Mozambique, Tanzania, South Africa, Zimbabwe, Botswana and Malawi.[15]

Nigeria's drive to engage the private sector in digitalization for agriculture has led to several young entrepreneurs and start-ups investing in hardware and software solutions for the sector, and for various segments of the value chain. One of the first ventures into digital agriculture solutions in Nigeria was Farmcrowdy, a crowdfunding platform connecting potential investors to farmers.[16] The solution matches landowners and famers with capital "sponsors."[17] Farmers enrolled on the platform are also provided with extension services and access to improved inputs. After harvest, the platform also markets the produce to ensure higher prices, and hence higher returns for the investors.[18] As a result, Farmcrowdy has enabled over 11,000 farmers to receive sponsorships from 27,500 investors. Farmcrowdy was launched in 2016 by Onyeka Akumah, a young entrepreneur who has received several national and international accolades for his venture.[19]

Hello Tractor is another successful venture by a young entrepreneur. Hello Tractor is an IoT solution to increase and optimize tractor activity in Africa. Founded in 2014, the digital solution seeks to connect farmers to tractor owners through a digital application. Hello Tractor's technology is an off-the-shelf monitoring device that, when fitted onto a tractor, allows equipment owners to manage their machines using an app. Each monitoring device is equipped with an international SIM card, providing GPRS and SMS capabilities

for data transmission. Hello Tractor gives smallholder farmers access to machinery which would otherwise be out of reach because of their high cost. Tractors allow farmers to plant forty times faster at one-third the cost and carry produce to market quickly and with less damage, thus reducing postharvest losses. At the same time, tractor owners—who buy them as a source of income too—benefit from improved and coordinated access to farmers and a clear overview on the performance of each machine.[20] The company embarked on a new partnership with John Deere, FMARD and Nigerian Agricultural Mechanization & Equipment Leasing Company (NAMEL), in May 2018 to supply 10,000 tractors over five years. The government leases the tractors to new owners on a pay-as-you-go model (eventually reselling them to the owners at a discounted price), while Hello Tractor provides the telematics solution for monitoring, security and valuation of the tractors, as well as allowing the tractor owners to maintain connectivity and provide a connection for farmers to schedule services for tractors. It is expected that these tractors will bring 9 million ha. of land into production, producing 37 million metric tons of additional food and more than 2 million direct and indirect jobs.[21,22]

To receive financial services, Nigerian farmers are required to register for a Bank Verification Number (BVN), for which it is essential to have a mobile phone. However, in remote parts of Nigeria few smallholder farmers own a mobile phone. To bridge the gap to these last-mile farmers, AFEX Commodities Exchange Limited (AFEX) has developed a platform which, in partnership with the Nigeria Inter-bank Settlement System, creates offline profiles of farmers to generate BVN numbers for them. By May 2019, the company had already reached 20,000 farmers.[23] AFEX was established in Nigeria in 2014 through a public-private partnership with FMARD to establish a warehouse receipt system and commodities exchange for Nigeria. In fact, the electronic warehouse receipt can be used as collateral by the farmers to access financing and is also tradable on the AFEX.[24] By 2016, the company had traded 48,000 million tons of grain, of which 85 percent was maize, reflecting approximately 0.5 percent of Nigerian production, and the rest was sorghum, millet, soybean, peanut, cowpea, ginger and chili.[25]

In 2016, Zenvus, initially funded with grants from USAID and Western Union Foundation, started selling digital solutions and services to Nigerian farmers. Zenvus's products include a solar-powered soil sensor to measure humidity, moisture, nutritional content, temperature, and sunlight. The sensor is equipped with GPS, micro-SD and WiFi, so farmers can monitor changes on their farm remotely. The data is transmitted over cellular and WiFi networks and aggregated on a web-based application.[26]

Zenvus has also developed a hyperspectral imaging camera to track crop nutrition, droughts and outbreaks of pests and diseases. The camera is available in two different versions: one is optimized to work with drones on large farms, and the other is designed to be mounted on a stick allowing the farmer to walk around the farm with it.[27] In addition to the possible improvements in farm practices through the Zenvus products, the collected data also allows farmers to access financing and insurance through the company's different services schemes, zCapital, zInsure, and zCrowdfound. The aggregated, anonymous farmer data is also a key source of income for Zenvus, which it provides to subscribers for an annual fee allowing them to examine potential investments and track performance.[28,29]

It is clear that Nigeria has a prospering enabling environment for digitalization in agriculture. A concerted effort from the most senior levels to transform the economy is driving change at all levels, mapped by Vision 20:2020. The FMCT and FMARD have a clear mandate on infrastructure and regulation and have led on innovative program implementation such as the e-Wallet scheme. The Nigerian government has also developed clear guidelines on private sector engagement in the industry in order to drive innovation and entrepreneurship. Nevertheless, further coordination is required between the government and private sector to ensure that the budding industry delivers maximum benefits and impact to agriculture value chain actors, in particular smallholder farmers.

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