PARI Country Brief No. 9

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NIGERIA

Agrifood System Change and PARI Research on Innovations

INTRODUCTION

Government expenditure on agriculture in Nigeria has for the past two decades been low, yet stable. On average, Nigeria has been allocating only 3% of its total annual budget to agriculture. Consequently, the agriculture value added growth rate has remained at only 2% for the same period (see Figure 1 for details). This is despite the country's commitment to allocate a minimum of 10% of its annual budget to agriculture which was made under the Malabo Declaration in 2014 to enhance sustainable agricultural growth and development in the country. Complementing this agenda, Nigeria developed various innovative pathways to sustainable food systems transformation ranging from technological advancements, institutional frameworks to policy reforms (see Table 1). These initiatives require resources to materialise. It is also important to revisit these and other current innovative initiatives to draw lessons, as provided in this brief based on studies done under PARI, to guide future strategies.

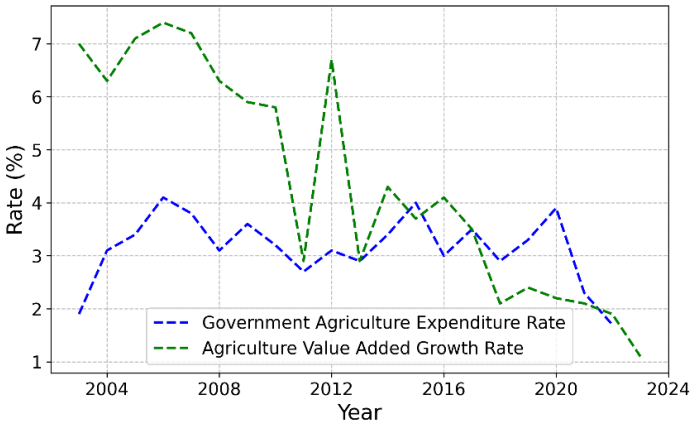

Figure 1: Trend of government agriculture expenditure and value added growth rate in Nigeria[1]

Table 1. Summary of innovative pathways to sustainable food systems transformation for Nigeria[2]

Category	Key Innovations	Implementation objectives/Strategies
Institution and policy frameworks	▪ Ecosystem preservation policy reforms	▪ Promote policy reforms and enabling acts to preserve forests, greenbelts, wetlands, and watersheds to support food production during adverse weather conditions.
	▪ Public-private partnerships for infrastructure and climate monitoring	▪ Promote PPPs to address infrastructure deficits and monitor climatic stresses through early warning systems.
Technological innovations	▪ Digital nutrition education tools	▪ Digitize nutrition education through games, apps, infographics and social media to foster behavioral change and promote healthy diets
	▪ Smart agriculture initiatives	▪ Scale up agriculture practices (e.g. biofortification crops, hydroponics, aeroponics) that require fewer natural resources and produce more food.

[1] Source: Authors' illustration using data from https://www.resakss.org/node/3, accessed on 26 May 2025

[2] Source: https://www.unfoodsystemshub.org/docs/unfoodsystemslibraries/national-pathways/nigeria/2021-09-13-en-national-pathways-to-food-systems-transformation-06-09-2021-final.docx?sfvrsn=2042e90e_1, accessed on 11 March 2025

	▪ Automated food value chains	▪ Automate food value chains to enhance product traceability, improve efficiency and reduce post-harvest losses.
	▪ Biofortification of staple crops	▪ Improve the nutrient value of staple crops through biofortification and promote their use as industrial raw materials.
	▪ Resilient crops, livestock and aquaculture varieties	▪ Develop and promote resilient seed, livestock, fish and aquaculture varieties to enhance food security and adaptability to climate challenges.
	▪ Rainwater harvesting systems	▪ Scale up rainwater harvesting systems to reduce farm flooding and conserve water for dry-season farming.
	▪ Climate-smart agricultural practices	▪ Adopt climate-smart agricultural practices and eco-friendly land development systems using biotechnology to enhance sustainability.

PARI CONTRIBUTIONS

The PARI research in Nigeria relates to priorities as indicated by PARI Partners, and took note of initiatives of the Green Innovation Centers.

Innovations in value chains

Limited access to finance, inputs, labour, transportation and markets hinder agricultural productivity growth in Nigeria, particularly in the cassava and rice sectors (Philip et al., 2018; Phillip et al., 2018). Additional factors contributing to low productivity include inadequate irrigation and market infrastructure, underinvestment in research and extension services, fluctuating exchange rates and restricted access to credit for essential inputs and services, such as processing, storage and transportation.

Innovation platforms are effective tools for scaling agricultural innovations in Nigeria by improving access to seeds, pest control, training and markets (Philip et al., 2018, 2016). A notable example focuses on cassava production, engaging stakeholders such as local governments, NGOs, private sector actors and research institutions such as the International Institute of Tropical Agriculture, the National Root Crops Research Institute, ARCN and the Agricultural Research Council of Nigeria. Through these platforms, farmers gain access to disease-resistant cassava varieties that combat Cassava Mosaic Disease, a major cause of post-harvest losses. Farmers also receive training on post-harvest practices and are connected to private agro-processors and markets. In Abia State, the number of beneficiary cassava farmers rose from 100 to 450,000 in just one year (2009–2010). Women, who make up the majority of cassava cultivators in the state, have particularly benefited. Similarly, innovation platforms have facilitated the distribution of improved rice varieties like FARO 44, FARO 52 and FARO 54 by linking farmers to private agro-processors.

Social capital innovations, such as farmers' groups, have empowered rural Nigerian households to invest in their farms and improve their livelihoods (Phillip, Jayeoba, and Ndirpaya, 2018). Under the National Fadama Development Project, these groups help farmers access credit and productive assets by pooling resources. This collaborative approach enables members to purchase equipment and save 10% of their net sales for asset maintenance, leading to higher incomes and reduced poverty. For cassava production, farmers have acquired tools like sprayers, wheelbarrows, cassava lifters and first aid kits. In rice production, groups have purchased water pumps, generators, milling machines and threshers (Philip et al., 2018). Implemented in partnership with the World Bank and local governments, this program has been scaled up to all 36 states in Nigeria.

Livestock

Grazing, supplemented with crop residues, forages and fodder shrubs, is the most profitable feeding regime for Nigerian pastoralists (Obayelu, 2023). Exclusive grazing for dairy animals also results in

higher average milk productivity compared to other feeding methods.

To unlock the full potential of Nigeria's livestock sector, significant improvements are needed in feed mills and the development of the livestock feed value chain. Additionally, establishing feed safety standards is essential. These infrastructure upgrades should be paired with policies aimed at reducing feeding costs to ensure sustainable growth in the sector.

Aquaculture

Nigeria has one of the largest aquaculture sectors in Africa, yet production volumes fall short of meeting domestic demand. Investments in feed, fingerlings and infrastructure, guided by development plans, are crucial to help producers seize market opportunities (Hinrichsen et al., 2022; Walakira et al., 2023). As Africa's second-largest aquaculture producer, Nigeria has a high production rate in aquaculture and capture fisheries, but local consumer demand still exceeds supply, making it one of the world's largest fish importers. Coastal areas have significant potential for mariculture, but industrial pressures, particularly from oil and gas, have hindered growth. Inland production leads in aquaculture output, yet scaling remains difficult due to limited land and insufficient incentives. Key challenges include limited access to affordable, quality feed ingredients and poorly developed infrastructure, which hampers feed distribution. The domestic supply of fingerlings also struggles to meet rising demand. Federal investment in aquaculture-specific legislation and a national strategy could boost production, reduce imports and enhance food security.

Mechanization

The private sector is key to mechanizing agriculture in Nigeria, but manufacturers and tractor owners need support through investments in transport, fuel, maintenance infrastructure and skill development programs (Daudu et al., 2022, 2020). Most tractors are sourced from private companies, though state-imported tractors still play a role. Private owners often provide hiring services, while those acquiring tractors through state programs are typically government employees with higher education levels. Challenges include limited capital, inadequate training, poor infrastructure, limited fuel access and a lack of maintenance services. Concerns about mechanization's potential negative impacts—such as soil erosion, youth unemployment and land-use conflicts—add to the barriers (Daum et al., 2020). Supportive policies, including training programs to address knowledge gaps, are essential to enhance private sector participation in mechanization.

Renting tractors via digital technologies could accelerate mechanization in Nigeria, but challenges like seasonal demand, poor road and mobile infrastructure and low digital literacy must be addressed (Daum et al., 2021). Digital platforms lower transaction costs for both providers and users, but issues such as mismatched supply and demand during peak seasons and delays caused by poor road networks persist. Tractors in Nigeria are mainly used for land preparation and transportation, with farmers typically accessing them through neighbors, relatives, or private companies. To improve access, the government has established Agricultural Equipment Hiring Enterprises and subsidized tractors for private entrepreneurs. New digital solutions like the Hello Tractor app are also emerging, enabling farmers to request tractor services remotely via smartphone or through agents. However, barriers such as limited internet connectivity, low smartphone usage, digital illiteracy and distrust in agents hinder their effectiveness.

Mechanization and automation technologies are widely used in Nigeria's food and beverage manufacturing sector. Training programmes are needed to close technical skill gaps and help employees adapt to changing technologies (Baumüller et al., 2023b). A survey among manufacturers shows all firms use machinery for processing and packaging and 55% also employ computer-controlled automation. Almost all of these machines are imported, primarily from Asia and Europe. Key benefits reported by the firms include improved product quality, greater efficiency, reduced costs and lower food waste. Most firms (79%) believe staff are qualified to operate these systems, though skill gaps in technical and computer skills are noted. Mechanization and automation have led to both job gains and losses (reported by about 34% of firms respectively). Job losses more frequently affected lowerskill workers. Around a third of workers — especially in automated firms— were reassigned to new tasks if needed. To support workers in adjusting to evolving technologies, targeted training to build technical skills is essential. Additionally, social safety nets should be in place to address potential job losses.

Nigeria's agricultural machinery sector is underdeveloped despite its market potential. Scaling it requires improved access to capital and raw materials, reliable electricity and road infrastructure and skilled labour will be essential (Daudu et al., 2022). A survey of machinery manufacturers reveals that most companies are privately and domestically owned. Company owners started their businesses for several reasons including encouragement by the family, participation in related courses or their personal aspirations. The companies produce machines mainly for crop production, postharvest handling and processing, including threshing, shelling and milling. Larger equipment, such as tractors, is imported. Manufacturers face several challenges that must be addressed for the sector to thrive. Lack of capital was most frequently mentioned as barrier to entry. Other constraints include the high cost of raw materials, erratic power supply, inadequate training, insecurity, bad roads and insufficient commitment on the part of policymakers.

Digitalization

Nigeria's telecommunications infrastructure and digital agricultural services (DAS) remain underdeveloped, limiting their impact on farmers. Targeted policies and investments are needed to improve connectivity, business models and digital skills (Philip and Ndirpaya, 2020). While mobile phone access is widespread, reliable and affordable connectivity is hindered by high costs, regulatory hurdles, cable theft and erratic electricity. Despite hosting Africa's second-largest number of DAS, most remain small in scale. Preliminary evidence shows DAS can boost smallholder income and output, but more research is needed to link these gains to specific technologies. Mobile money adoption also remains low. For sustainable digitalization in agriculture, the private sector must lead, with government support to upgrade telecom infrastructure, including fiber networks and last-mile coverage. Training programs to enhance digital skills and scalable business models are crucial for the long-term success of D4AG in Nigeria.

The digital agricultural platform AgroMall demonstrates the potential impact of DAS on the functioning of agricultural markets (Philip and Philip, 2024). AgroMall connects farmers to buyers and provides services like farming advice, weather updates, input access, digital payments and transport, leveraging digital technologies to improve supply chain management, data collection and advisory services. This has enhanced efficiency, transparency and inclusivity while reducing barriers such as poor infrastructure and high market margins. Key motivations include cost optimization, direct farmer-buyer interactions and facilitating finance access using precision farming for data-driven decisions. Despite successes, challenges remain, particularly for farmers without mobile phones, financial literacy, or land and a notable gender gap, as few registered farmers are women. Recommendations include policies to provide targeted support for female farmers and investments in rural infrastructure—such as transport and electricity— to improve connectivity and reduce transaction costs for all stakeholders.

While adoption of DAS in Nigeria remains limited, digital technologies are widely used across the country's agricultural value chain. A survey of extension agents, input suppliers and output dealers found extensive use of digital tools in their work (Baumüller et al., 2023a). Mobile phones are the most commonly used tools, particularly smartphones which are used by 63% of respondents on average, in particular extension agents and input suppliers. Extension agents employ the widest range of digital technologies, utilizing diverse mobile phone functions to interact with a broad network of value chain actors and share a variety of information. Input and output dealers primarily use digital tools to reduce transaction costs and improve networking and information exchange. However, intermediaries still prefer face-to-face interactions for certain tasks, such as training and price discussions. Digital marketing platforms could capitalize on the digital skills and networks of intermediaries to improve service delivery and enhance access to smallholder farmers in remote areas.

Further up the value chain, digital technologies are widely adopted in Nigeria's agro-processing sector, particularly through computer-controlled automation. This demonstrates the transformative potential of digital technologies across the entire food and agriculture sector, extending beyond agricultural production.

Skill development

While students are generally satisfied with the quality of ATVET in Nigeria, further investments in practical training, digital skills, school facilities and female engagement are needed (Daudu et al., 2024). Nigeria's National Policy on Education includes a

framework for agricultural vocational training. A survey of students shows that nearly half of participants come from rural farming backgrounds. Women are better represented in Nigeria's ATVET system than in other countries studied (Kenya, Benin, Mali), making up almost half of students and 30% of teachers. Most students aim to become agripreneurs, work in extension services, or join agricultural research organizations with only 11% aspiring to government jobs. Students praised the courses' relevance, qualified teachers and practical components but highlighted challenges, including inadequate facilities, limited internet and computer access and insufficient digital skills training. Addressing these gaps will require increased public investment.

KEY TAKE AWAYS FROM PARI RESEARCH IN NIGERIA

Scaling innovations through platforms: Innovation platforms in Nigeria improve access to seeds, pest control and training. For example, cassava platforms benefit women and smallholders, while rice platforms link farmers to improved varieties and processors.

Livestock growth: Improved feed systems and infrastructure are needed to boost productivity and profitability in Nigeria's livestock sector, alongside policies to reduce feed costs and strengthen veterinary services.

Aquaculture potential: Investments in feed, fingerlings and infrastructure can help Nigeria's aquaculture meet domestic demand, reduce imports and strengthen food security.

Mechanization growth: The private sector drives mechanization, but challenges like limited capital, poor infrastructure and inadequate training persist. Investments in transport, maintenance, vocational training and supportive policies are essential to boost progress.

Digitalization: Nigeria's agricultural digital services remain underdeveloped. Improving connectivity, digital skills and rural infrastructure is key to scaling platforms like AgroMall, which connects farmers to buyers and inputs.

REFERENCES

Baumüller, H., Ikpi, U., Jumpah, E.T., Kamau, G.M., Kergn, A.O., Mose, L.O., Nientao, A., Omari, R., Phillip, D., Salasya, B.D., 2023a. Building digital bridges in African value chains: Exploring linkages between ICT use and social capital in agricultural marketing. Journal of Rural Studies 100, 103002.

Baumüller, H., Kubik, Z., Getahun, T.D., 2023b. Mechanization and automation in Africa's agroprocessing sector: Implications for employment and skill needs. ZEF, Bonn.

Daudu, C., Abdulhakeem, A., Usman, A., Fatunbi, O., 2024. Building Skills and Research- Extension Linkages for Sustainable Agricultural Transformation: Insights from Nigeria. FARA, Accra.

Daudu, C. et al. 2022. Opportunities and Challenges for Local Agricultural Machinery Manufacturers: Insights from Nigeria. FARA, Accra.

Daudu, C., Ndirpaya, Y.D., Issa, F., Fatunbi, O., 2020. Mechanization and Skill Development for Productivity Growth, Employment and Value Addition - Insight from Nigeria. FARA, Accra.

Daum, T. et al. 2020. Perceived effects of farm tractors in four African countries, highlighted by participatory impact diagrams. Agron. Sustain. Dev. 40, 47.

Daum, T., Villalba, R., Anidi, O., Mayienga, S.M., Masakhwe, S.M., Gupta, S., Birner, R., 2021. Uber for tractors? Opportunities and challenges of digital tools for tractor hire in India and Nigeria. World Development 144, 105480.

Hinrichsen, E., Walakira, J.K., Langi, S., Ibrahim, N.A., Tarus, V., Badmus, O., Baumüller, H., 2022. Prospects for Aquaculture Development in Africa: A review of past performance to assess future potential. ZEF, Bonn.

REFERENCES (CONT.)

Obayelu, A.E., 2023. Livestock Feed Development Pathway in Nigeria: Drivers, Challenges, and Opportunities. AKADEMIYA2063, Kigali.

Philip, D., Abubakar, B.Y., Magaji, M.D., 2016. Status of Agricultural Innovations, Innovation Platforms, and Innovations Investment. FARA, Accra.

Philip, D., Jayeoba, O.O., Ndirpaya, Y.D., Malomo, G., Ekong, E., 2018. Scaling Strategies for Agricultural Innovation in Nigeria. FARA, Accra.

Philip, D., Ndirpaya, Y.D., 2020. Digitalization in Agriculture, Food and Nutrition - A Case Study of Nigeria. FARA, Accra.

Philip, D., Philip, B., 2024. Understanding the drivers and distributional effects of digital agricultural platforms in Africa: A case study of Agromall. FARA, Accra.

Phillip, D., Jayeoba, O.O., Ndirpaya, Y.D., Oluwole, F., 2018. Innovation Opportunities in the Rice Value Chain in Nigeria. FARA, Accra.

Walakira, J.K., Hinrichsen, E., Tarus, V., Langi, S., Ahmad, N., Badmus, O., Aziz, A., Baumüller, H., 2023. Scaling aquaculture for food security and employment in Africa:Insights from Egypt, Kenya and Nigeria. ZEF, Bonn.

All studies are available at www.r4ai.org.

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