

KENYA

Agrifood System Change and PARI Research on Innovations

INTRODUCTION

Government expenditure on agriculture in Kenya has been consistently below the expected 10% allocation threshold of the national budget of the 2014 Malabo Declaration. For the past 5 years, Kenya has only allocated 3% of its annual budget to the agriculture sector with the trend showing a declining trajectory (see Figure 1). Efforts have been made to improve the agricultural performance in the country, notably through the development of innovative pathways to sustainable food systems transformation. These initiatives range from technological advancements, institutional frameworks to policy reforms (see Table 1). However, these plans are unlikely to achieve their full potential if not translated into action. Agriculture value added growth rate in the past 5 years was low (2.8%) with significant fluctuations possibly compounded by various global shocks that keep on affecting the country, such as climatic variability and market shocks. Concerted efforts including financing are, therefore, required. 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.

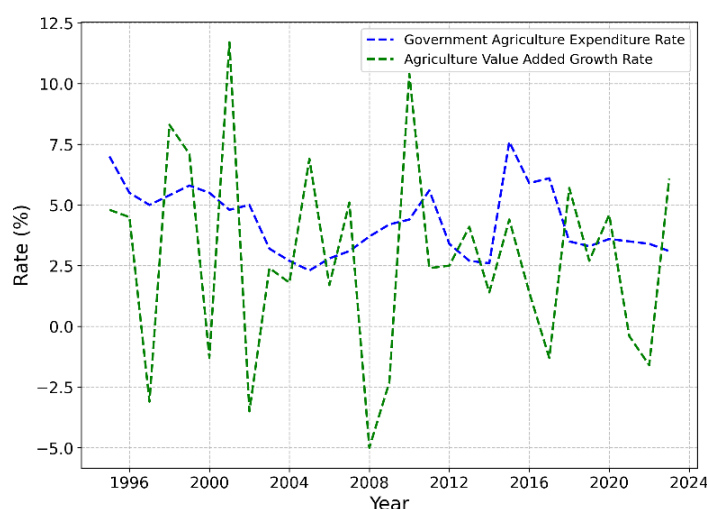


Figure 1: Trend of government agriculture expenditure and value added growth rate in Kenya¹

Table 1. Summary of innovative pathways to sustainable food systems transformation for Kenya²

Category	Key Innovations	Implementation objectives/Strategies
Institution and policy frameworks	<ul style="list-style-type: none"> Develop and implement right-based policy framework. 	<ul style="list-style-type: none"> Develop and implement policies that ensure access to safe, nutritious food and double smallholder productivity Promote policies that protect indigenous seeds and traditional knowledge, reducing dependency on corporate-controlled inputs.
	<ul style="list-style-type: none"> Develop county-level Nutrition Action Plans aligned with national frameworks to promote dietary diversity and food safety. 	<ul style="list-style-type: none"> Integrate nutrition education into school curricula and public health campaigns. Support school meal programs to provide diverse, nutritious food to children.

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

² Source: Authors' compilation from https://www.unfoodsystemshub.org/docs/unfoodsystemslibraries/national-pathways/kenya/2021-09-27-en-kenya-fss-dialogue-series-final-report-.pdf?sfvrsn=109d50c_1, accessed on 11 March 2025



Technological innovations	<ul style="list-style-type: none"> Digital agriculture solutions 	<ul style="list-style-type: none"> Deploy mobile applications to deliver real-time market and input information to farmers. Scale digital extension services to reach rural farmers, especially youth and women. Invest in geospatial tools (GIS, GPS, drones) for land use monitoring and planning.
	<ul style="list-style-type: none"> Irrigation technologies 	<ul style="list-style-type: none"> Promote climate-smart irrigation technologies to reduce water wastage.
	<ul style="list-style-type: none"> Climate smart agriculture 	<ul style="list-style-type: none"> Scale up greenhouse and vertical farming for smallholders to diversify production. Promote agroforestry, reforestation, and afforestation to restore ecosystems.
	<ul style="list-style-type: none"> Agro-processing and value addition 	<ul style="list-style-type: none"> Provide training and incentives for youth and SMEs in value addition. Establish cold chain and storage infrastructure to minimize losses. Invest in processing facilities across counties.
	<ul style="list-style-type: none"> Early warning systems 	<ul style="list-style-type: none"> Implement early warning systems to support farmers in planning for climate shocks. Develop data-driven decision-making frameworks for disaster preparedness and response.

PARI CONTRIBUTIONS

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

Innovations in value chains

The cultivation of Orange Fleshed Sweet Potato (OFSP) has expanded in Kenya through a multi-stakeholder initiative. To further support OFSP, policies should promote marketing, value-addition centers and the involvement of health actors for outreach (KALRO et al., 2017). Kenya Agricultural and Livestock Research Organizations (KALRO)-Kakamega, in collaboration with CIP and local farmers, strengthened the OFSP value chain in Busia and Bungoma districts. The initiative aimed at combating vitamin A deficiency by involving farmers, seed multipliers, traders, extension agents, processors, media and community organizations. Activities included developing technologies, improving planting material production, providing agronomic training, pest and disease management and training in postharvest handling, storage and marketing. These efforts transitioned OFSP cultivation from subsistence to commercial levels. **Adopting improved fodder can significantly boost productivity in Kenya's dairy sector, increasing smallholder farmers' incomes and doubling household milk consumption** (KALRO et al., 2017). Despite the importance of dairy farming as a key income source, average daily milk production per cow remains low due to poor animal husbandry and

feeding practices. To address this, a USAID-supported innovation introduced practices to enhance fodder production and conservation, including high-nutrient indigenous grasses, improved grass varieties and protein-rich legumes. The initiative's success is attributed to USAID's financial and technical support and the collaborative learning culture within dairy farming communities. To further scale productivity, recommendations include promoting innovations, encouraging farmer groups to engage in commercial dairy feed production, adopting technologies like Total Mixed Rations and strengthening partnerships among farmers, development partners and national governments.

Improved seeds have the potential to boost agricultural productivity, enhance nutrition and meet consumer preferences, yet many Kenyan farmers remain reluctant to adopt new hybrid varieties (Christinck et al., 2018; PARI, 2019). Seeds with novel traits, such as earlier-maturing varieties for relay cropping or those better adapted to changing moisture and temperature conditions, offer promising options for farmers and their market partners (KALRO et al., 2017). Despite these benefits, adoption in Kenya has been low. Key reasons include concerns over poor seed germination and the widespread



presence of counterfeit seeds in the market, which undermine farmers' trust in hybrid varieties.

Farmer organizations in Kenya play a key role in advancing agricultural development but face several challenges that limit their potential (Wortmann-Kolundžija, 2019). One major issue is limited access to relevant market information, which weakens their competitive advantage. Additionally, the structure and size of these organizations can impact member commitment and engagement. Social factors such as trust and fostering an entrepreneurial mindset also play a crucial role in their performance. To function effectively, farmer organizations must align their activities with clear objectives and member needs. Adopting best practices, encouraging community participation and building structural social capital—such as stronger value chain connections—can enhance collective power and motivate members to engage more positively.

Farmer innovations

Kenyan farmers have demonstrated strong innovation capacity to address agricultural production challenges. Support is needed to validate these innovations, assist with commercialization and empower women innovators (Tambo, 2018). A farmer innovation contest organized by PARI highlighted a wide range of innovations, particularly in livestock production, crop management and storage. Most innovations (79%) adapted existing technologies to better suit local conditions, while the others were entirely original. Key drivers of innovation included curiosity, reducing costs, increasing production and improving quality. Farmers typically invested minimal financial resources (USD 20 or less) in developing these innovations. Most innovators reported improved yields and reduced production costs and almost two thirds knew others who had adopted their ideas. However, more support is needed to validate innovations and commercialize those with market potential. Women innovators were underrepresented, contributing only 30% of submissions. Greater efforts are required to encourage women's participation and showcase their contributions.

Platforms like the Indian Honey Bee Network have facilitated the transfer and adaptation of grassroots innovations to African contexts (Gupta et al., 2019). Kenyan farmers successfully adopted such innovations, including a food processing machine, a

seed sowing device and the Bullet Santi, a small tractor. As part of the technology transfer process, Indian innovators visited Africa to demonstrate these solutions and adapt them to local conditions. For instance, the Bullet Santi was modified for greater stability to suit African soil types. The network also provided training on assembly, supply chain management and market access. Key factors in this success included collaboration among research institutions, the social capital of the network and local ownership of the technology. To expand this model, the Honey Bee Network is supporting the creation of a similar platform in Africa. Ensuring its success will require addressing institutional challenges such as intellectual property rights and policies on grassroots innovations. Additional steps include linking students to the network, mobilizing volunteers, translating resources and leveraging social media to engage entrepreneurs and share knowledge.

Livestock

Kenya's dairy sector is vital for food security, nutrition and income generation but faces structural challenges that hinder its full potential (Makini et al., 2019; Mose et al., 2020). Key issues include limited access to improved breeds, high feed costs, inadequate pastures and fodder, low-quality livestock nutrition, diseases, pests, droughts and weak extension and veterinary services, particularly in the camel value chain. To address these constraints, several innovations have been proposed:

- A low-cost breeding program using artificial insemination (AI) to improve breeds, though awareness about AI's benefits remains limited.
- Strengthened extension services and farmer training on conserving feed resources, especially for pastures affected by drought.
- Development of nutrient-rich hay and crop varieties, such as indigenous grasses and protein-rich legumes.
- Community-led initiatives to prevent rangeland degradation caused by overgrazing.
- Enhanced veterinary services and improved collection infrastructure, including cooling facilities and transport.
- Focus on quality and food safety, particularly within formal marketing channels.

Research in these areas is therefore imperative to identify strategies to address these challenges (Makini et al., 2019).



Innovations in Kenya's milk supply chain could boost productivity and reduce food safety hazards, including cold chain technologies and solar power (Salvatierra-Rojas et al., 2018). Smallholder farmers typically supply milk to cooperatives, which collect and deliver it to dairy plants. However, poor hygiene practices and the lack of cooling systems at farms and cooperatives increase the risk of microbial contamination. A solar-powered milk cooling system offers a cost-effective solution, preserving milk quality for 6 to 16 hours and reducing food safety risks. This innovation is especially suitable for off-grid areas, utilizing renewable energy. Farmers also benefit from reduced milk losses and higher prices, increasing their incomes. Despite its potential, challenges such as ice availability, maintenance costs and limited supply of solar cooling units must be addressed to scale up this innovation.

Aquaculture

Kenya's aquaculture sector, though small compared to global standards, highlights the impact of government commitment and international competition on production growth (Hinrichsen et al., 2022; Walakira et al., 2023). As the eighth-largest aquaculture producer in Africa by volume, the sector experienced rapid growth between 2010 and 2014, driven by the Economic Stimulus Program (2008–2014), which led to a five-fold increase in production. However, growth slowed after the program ended and governance devolved in 2013, shifting aquaculture responsibilities to counties, many of which deprioritized the sector. Since 2019, production has rebounded due to rising domestic demand and large-scale commercial investments. However, cheap frozen imports, particularly from China, pose economic challenges for local producers. Kenya's experience underscores the need for targeted government policies to support aquaculture. Short-term solutions include fostering private sector engagement, improving access to affordable feeds and fingerlings and addressing logistical hurdles for domestic producers.

Mechanization

Mechanization in Kenya's crop production remains limited due to institutional and structural barriers (Makini et al., 2017, 2020b). In key sectors like banana and rice, mechanization is mostly used for land preparation (ploughing and harrowing) and transport. A major challenge is funding, as most farmers

purchase tractors using personal savings or loans, while publicly owned tractors are funded through government grants. With no subsidies for tractor financing, commercial banks play a leading role in providing credit. Publicly owned tractor users are more likely to benefit from after-sales services compared to those with privately owned tractors. To promote mechanization, measures are needed to expand access to machinery dealers, increase financing and strengthen extension services.

Mechanization and automation are widely adopted in Kenya's agroprocessing sector. The new technologies have shifted workers' tasks rather than causing significant job losses, necessitating training to help employees adapt (Baumüller et al., 2023b). A survey of manufacturers revealed that all firms use machinery for processing and packaging and 85% employ computer controlled automation, with most equipment imported from Europe and Asia. Reported benefits include improved product quality, greater efficiency, cost savings and reduced food waste. While 67% of firms consider their staff qualified to operate these systems, skill gaps in technical and computer skills persist. Automation has not led to widespread job cuts—only 27% of firms reduced staff after major investments, while 45% reported job gains. Workers, particularly in automated firms, are often reassigned to new tasks. To help workers adapt to evolving technologies, targeted training programs to build technical skills are crucial, along with social safety nets to address potential job losses.

Mechanization training in Kenya is offered at various education levels, but more practical training and stronger industry linkages are needed to enhance educational opportunities (Makini et al., 2020b). Training is primarily conducted in universities and technical and vocational training (TVET) colleges, offering both long- and short-term courses. Public institutions generally have more experience, better infrastructure and greater course flexibility compared to private institutions. Universities focus on agricultural engineering, while TVET colleges offer certificates and diplomas in automotives and mechanical engineering. Enrollment in these programs is predominantly male. Students feel that more time should be allocated to college programs and internships and industry partnerships should be expanded to better align training with market needs.

Kenya's agricultural machinery manufacturing sector is small but growing, with potential to compete with



imports through improved skills, regulated imports, reduced costs and assured quality (Kamau et al., 2022a). A survey of machinery manufacturers for crop production, post-harvest handling and livestock production found that most enterprises are privately owned and cater to smallholder farmers. To reduce market risks, 62% of manufacturers produce machines on demand, focusing on post-harvest equipment like forage choppers, milling and shelling machines, while tractors are predominantly imported. Most companies offer on-the-job training, but few are affiliated with local education institutions. To boost competitiveness, measures should include reducing electricity prices and taxes, improving access to finance, strengthening links with training institutes, regulating foreign machinery imports, enforcing quality certification standards and offering business skills training.

Digitalization

Often referred to as the Silicon Savannah, Kenya is a leader in agricultural digitalization, supported by government policies, innovation hubs, angel investors and a tech-savvy population (Makini et al., 2020a). The mobile payment system M-Pesa is the most successful mobile money platform in Africa and Kenya hosts the largest number of digital agricultural services (DAS) on the continent. One prominent example is Twiga Foods (Mulinge et al., 2024a), a company leveraging digital technologies to coordinate sourcing from smallholder farmers and supply products to small vendors in Nairobi. This innovation has improved supply chain efficiency, reduced marketing risks for farmers and stabilized prices. However, to reach farmers effectively, Twiga Foods depends on a network of agents, underscoring the critical role of human intermediaries in managing the first mile and building trust with farmers.

Despite successes, only a few digital agricultural services (DAS) in Kenya have reached scale, with most remaining small and fragmented. Scaling up DAS requires a user-centric approach that addresses user preferences and needs (Kieti et al., 2022, 2021). Key factors for users include tool efficiency—such as easy access to information—and loyalty, driven by the platform's quality and reliability. Policies should focus on expanding DAS accessibility, raising awareness of their benefits and ensuring affordability. Additionally, improving infrastructure and building user capacity through skills training are essential. Lessons from

Kenya's dairy sector emphasize that DAS success also depends on broader conditions within which they operate, such as access to feed and transport infrastructure (Bateki et al., 2021; Daum et al., 2022c).

Beyond DAS, digital technologies are widely used by extension agents, input suppliers and output dealers in Kenya to support their activities (Baumüller et al., 2023a; Kamau et al., 2022b). Mobile phones, particularly smartphones, are the most commonly used tools, with 76% of respondents—mainly extension agents but also dealers—reporting their use. Extension agents employ the broadest range of digital technologies, leveraging mobile phone features to interact with value chain actors and share diverse information. Input and output dealers primarily use digital tools to lower transaction costs and improve networking and information exchange. However, intermediaries still prefer face-to-face interactions for tasks such as training and price discussions. Digital marketing platforms could build on the digital skills and networks of intermediaries to enhance service delivery and expand access to smallholder farmers in remote areas.

Further up the value chain, digital technologies are widely adopted in Kenya's agroprocessing 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

Kenya is implementing national strategies to reform ATVET. While students generally report satisfaction with training quality, further investments in practical training and efforts to engage more women are needed (Mulinge et al., 2024b). A survey of students in agricultural training programs revealed that most participants come from rural farming backgrounds. About half of them aim to work in private, public, or third-sector extension services, while others aspire to become agripreneurs or ministry staff). Most students find the training relevant and of good quality, with widespread use of digital tools. However, many expressed a desire for more hands-on, practical components in their courses. Women remain underrepresented in the ATVET system, accounting for only 39% of surveyed students and 30% of teachers, highlighting the need for targeted efforts to close the gender gap in agricultural education.



Youth aspirations

Contrary to the common belief that young people are disengaged from agriculture, many Kenyan youth are open to participating in the sector, particularly as part of mixed-livelihood strategies (LaRue et al., 2021). Binary questions about farming, such as fulltime farming versus no farming, can be misleading, as studies framed this way often conclude that youth prefer livelihoods outside farming. A survey of Kenyan youth revealed that most envision farming playing a role in their future, though few aspire to farm exclusively. Instead, they see farming as one component of a mixed livelihood strategy, combining income from both on-farm and off-farm activities. Agricultural policies and programs for youth should recognize this flexibility, supporting the linkages between these livelihood pillars—for example, using income from farming to fund business investments and vice versa. This calls for more holistic policy approaches that reflect the realities of youth livelihoods.

KEY TAKE AWAYS FROM PARI RESEARCH IN KENYA

Improved seed systems: Adoption of improved seeds in Kenya remains low. Strengthening decentralized seed systems, improving seed certification and ensuring distribution through trusted networks are essential to rebuilding trust and boosting adoption.

Farmer innovation: Kenyan farmers develop cost-effective innovations and adapt Indian technologies via platforms like the Honey Bee Network. Support for commercialization, women's participation and local ownership is crucial.

Mechanization in production: Adoption of agricultural machinery in Kenya remains limited due to high costs and lack of financing. Expanding access to machinery, improving repair services and supporting the local manufacturing sector are key to addressing these barriers.

Mechanization in processing: Mechanization and automation in Kenya's food and beverage manufacturing sector boosts efficiency, quality and reduces waste. Addressing skill gaps through targeted training and social safety nets is essential for worker adaptation.

Digitalization: Kenya is a leader in agricultural digital services (DAS), such as M-Pesa and Twiga Foods, but scaling requires improving rural internet access, digital literacy and affordability challenges.

Youth and skill development: Many Kenyan youth see farming as part of mixed livelihoods rather than a sole occupation. Policies should promote vocational training, practical skills and entrepreneurship, ensuring youth are prepared for modern agriculture.

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All studies are available at www.r4ai.org.

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