Leveraging livestock sector innovations for a resilient and sustainable food system in Africa

Mahamadou Tankari and Katrin Glatzel

Mahamadou Tankari is a Senior Scientist in the Department of Policy Innovation at AKADEMIYA2063. Previously, he worked at the International Food Policy Research Institute (IFPRI) in Senegal where he carried out policy-oriented research as Research Coordinator. He holds a PhD in Economics from the University of Pau, France.

mtankari@akademiya2063.org

Katrin Glatzel is the Director of Policy Innovation at AKADEMIYA2063 and Program Head of the Malabo Montpellier Panel. Prior to that, she was a Research Fellow at the International Food Policy Research Institute (IFPRI) in Senegal and worked as a Research Officer at Imperial College London, where she continues to be a Visiting Researcher. She holds a PhD in Environmental Research from Imperial College London and MSc Public Management and Governance from the London School of Economics and Political Science.

kglatzel@akademiya2063.org

Abstract

Animal husbandry plays a significant role in Africa's food systems, supporting the livelihoods of an estimated 268 million people in 36 African countries and making an important contribution to food security and nutrition. However, to meet the increasing demand for animal-sourced products, more needs to be done to elevate the role of the livestock sector through context-specific technology development and adoption as well as targeted policy innovations for a sustainable increase in production and productivity. This article draws on the experiences of Senegal and Tunisia in elevating livestock to a sectoral policy priority, as well as concrete examples of technology development across the continent. These interventions could contribute significantly to Africa's food systems transformation, create important employment opportunities in rural areas, and strengthen overall economic growth and development.

Introduction

Livestock is an integral part of Africa's food system, contributing significantly to food security and nutrition while generating important employment opportunities and income. Animal-sourced products in the form of dairy, meat and eggs contain – in addition to protein – essential micronutrients such as vitamins A, D and E, and zinc, as well as highly bio-available iron and amino acids. With respect to employment and income, evidence shows that livestock is the primary livelihood of an estimated 268 million people in 36 African countries (FAO, 2018). Most of these households earn an income from the sale of live animals, meat, milk and eggs, allowing them to buy food as well as agricultural inputs, such as seed, fertilisers and pesticides. In addition, exports of live animals and animal-sourced products generate important foreign exchange revenues. For example, in Somalia, the exports of bovines, sheep and goats have represented over two thirds of total exports in recent years (OEC, 2019).

Moreover, livestock contributes to agricultural production by supplying inputs, including organic fertiliser and farm power. The importance of prioritising the livestock sector for a resilient and sustainable food system is well reflected in African continental and global policy frameworks. For instance, under the African Union (AU) Agenda 2063, as part of Aspiration #1 "to achieve a prosperous Africa based on inclusive growth and sustainable development", goals 1, 3 and 5 reflect African governments' commitment to enhance livestock production and promote policies that contribute to value addition in livestock to meet several targets, including the doubling of agricultural productivity. At the global level, livestock contributes to all 17 Sustainable Development Goals (SDGs) and is directly linked to 8 SDGs, in particular SDG 1, SDG 2 and SDG 3. Within the SDGs, the need for strengthening the livestock sector is highlighted as a key element to achieve food and nutrition security and overall sustainable economic development. As this article shows, elevating the role of the livestock sector through context-specific technology development and adoption, as well as targeted policy innovations for a sustainable increase in production and productivity, could significantly contribute to Africa's food system transformation.

Livestock sector challenges

Demand for and consumption of livestock products have steadily increased in Africa due to robust and sustained economic growth over the past two decades – coupled with population growth, rising incomes, a growing middle class, and urbanisation, all driving a shift in dietary habits. The estimated average consumption of 19 kg of meat and 44 kg of milk in 2013 is set to increase to 26 kg and 64 kg, respectively, in 2050. However, under current trends African producers will be unable to sustainably satisfy this growing demand. This is largely due to challenges that include unsustainable production practices, the impacts of climate change, as well as limited adoption of appropriate technologies along the value chain. Without dramatically transforming the sector, estimates show that between 2030 and 2050, one tenth to one fifth of the beef, pork, poultry and milk consumed in Africa will come from outside the continent (Baker *et al*, 2013).

Goats with herder, Ethiopia (Photo: Waddington)

Climate change affects rainfed fodder (pasture) and water availability, increasing seasonal fluctuations in production, while higher frequencies and intensities of droughts and floods cause greater livestock mortality, as well as a decrease in productivity and a fall in the quality of forage. Temperature changes and varying rainfall levels can also affect the severity and distribution of diseases and parasites, impacting animal health. The livestock sector faces the additional challenge of meeting sustainability targets as it is a significant contributor to global human-induced greenhouse gas emissions through the production of feed and other inputs, as well as downstream operations for transport, cooling, storage and processing of livestock products (FAO, 2016). In addition, livestock overgrazing can lead to biodiversity loss through a reduction in plant cover, which negatively affects the population sizes of wild herbivores and predators. Poor manure management practices, especially from large-scale livestock farms, can further amplify nutrient pollution (soil, water and air), while the imprudent use of manure can reduce soil fertility and lead to excess minerals and nitrates in surface and underground water resources. Finally, a lack of adoption of basic biosecurity standards for human and animal health is another challenge preventing especially small livestock keepers and pastoralists from market participation and trade.

Technology development and dissemination in the livestock sector

Strengthening the livestock sector to contribute to food system transformation requires the challenges outlined above to be addressed in a targeted manner through technology development, dissemination and adoption at different stages of the value chain. Technology adoption can help to intensify the production of animal-sourced foods, increase value addition during processing and profit during wholesaling/retailing, while ensuring an efficient distribution of products to consumers.

At the production level

Technologies can improve various aspects of productivity. For instance, in the animal feed sector, technologies are being developed in Africa which, when disseminated and shared widely, can provide more nutritious feed contributing to animal health and productivity. For example, the International Center for Tropical Agriculture (CIAT) has developed new varieties of *Brachiaria* and *Panicum*, two local grass genera, to provide higher land and animal productivity. The grasses are high yielding, adaptable to poor soils, drought and flood resistant, and more palatable and nutritious (Odhiambo, 2016). Preliminary data from *Brachiaria* test plots in Kenya showed an increase in milk yields of 15–40 percent and an average of 36 percent in Rwanda. In addition, cattle fed on *Brachiaria* instead of elephant grass (*Cenchrus purpureus*) in Rwanda benefitted from a daily increase in average body weight of 205 grams over a 12-week period (González *et al*, 2016; Ghimire *et al*, 2015).

With respect to animal health, several African laboratories develop and produce vaccines for zoonoses and other livestock diseases. Digital solutions such as mobile phones and geographic information systems (GIS) offer additional opportunities to facilitate famers' access to these vaccines. For instance, in Ghana, CowTribe delivers animal vaccines and other livestock-related last-mile services and information to farmers via SMS, including

on disease outbreaks. Farmers using the CowTribe service – many of whom were living on less than USD 1 a day – have been able to add an estimated USD 300 to their annual household income (Malabo Montpellier Panel, 2019).

Moreover, technological interventions such as artificial insemination (AI) can help to improve the genetics for more sustainable livestock production. Africa has a very diverse stock of livestock well adapted to the harsh conditions under which they live, including the diseases to which they are exposed. New breeds can be created by crossing local breeds with more productive breeds originating from either within Africa or outside. By using technologies such as juvenile in-vitro fertilisation and egg transfers, AI and semen sexing, livestock keepers can gain access to better genetic material and improve the genetic composition of their herds (Enahoro *et al*, 2019). Improving the genetic composition can sustainably increase the overall productivity of animals, thereby sustainably intensifying production of different animal-sourced products including meat, milk and eggs.

At commercialisation, processing and marketing levels

Technology adoption in the processing, commercialisation and marketing stages of the livestock value chain has many benefits in terms of building a resilient and sustainable food system, benefitting small-scale livestock keepers in particular. A project by East African Dairy Development (EADD) that introduced a network of milk hubs to collect milk from farmers, measure it, test it for quality control and store it in chillers prior to sale and transportation to major processors in the area, enabled farmers to negotiate good prices for their produce. Dairy income per household increased by 164 percent in Uganda, 124 percent in Kenya and 64 percent in Rwanda (East Africa Trade and Investment Hub, 2019). The milk hubs also provided an opportunity to buy and sell inputs and supplies such as feed, vaccines and other farm hardware, and for farmers to access additional services such as veterinarians and transporters.

Technology can also enhance access to reliable and up-to-date information related to markets, such as when and where to buy livestock inputs or sell live animals or livestock products, how much to sell and at what prices (Malabo Montpellier Panel, 2019). The widespread use of mobile phones combined with increasing satellite and satellite television capacities can accelerate the development of solutions meeting calculated decision-making needs among livestock producers, and provide an opportunity to formalise markets. In Kenya, for instance, the Livestock Information Network and Knowledge System (LINKS) aims to fill this gap by collecting and disseminating (by text message) information on prices and any other information relevant to livestock producers (Njuki & Sanginga, 2013).

At the processing level, there are many indigenous techniques that are used traditionally to process animal-sourced foods to increase their shelf-life and ease transportation requirements. For example, meat is dried, salted or smoked, broiler chickens are plucked or eviscerated, and milk can be cooled, pasteurised or soured. More complex processes include hanging and chilling meat, as well as the production of milk powder, butter, cheese and yogurt. Their widespread dissemination and use of technology can contribute to strengthening food systems. In Mauritania, a camel milk dairy founded in 1989 now produces over 20 different products out of camel, cow and goat milk. The milk is collected at three collection centres from over 2,000 livestock herders and nomadic pastoralists, 15 percent of whom are women, some dispersed as far as 800 km from Nouakchott. The company has created over 200 direct jobs at the dairies and additional employment opportunities for milk collectors in Mauritania's Trarza and Brakna regions (Gaye, 2008).

At consumption level

Finally, technologies can help to ensure the safety and quality of animal-sourced products for improved food security and nutrition. For instance, in the dairy sector, interventions can include the training of farmers, hawkers, traders and dairy cooperatives on the application of higher hygiene standards (Alonso *et al*, 2018). In addition, technologies can be used to facilitate the testing, transport and safe storage of animal-sourced products. One example is the Inclusive Dairy Enterprise (TIDE) in Uganda – by investing in improved handling methods and equipment for analysing the quality of milk, a significant improvement in the quality of milk was made (Daburon & Ndambi, 2019). Furthermore, the adoption of sophisticated technologies, such as biofortification and food fortification, can increase the supply of nutrients by manipulating the production of milk, meat and eggs to provide additional nutritional benefits. In Mozambique, the delivery of biofortified vitamin A-rich orange-fleshed sweet patotoes (OSP) resulted in doubling of vitamin A intakes, with vitamin A-rich OSP providing almost all of the total vitamin A intakes for children (Hotz *et al*, 2012).

Examples of policy innovation in Senegal and Tunisia

Senegal

Livestock is an important component of Senegal's agriculture sector, contributing approximately 30 percent to agricultural gross domestic product (GDP), creating employment opportunities, improving livelihoods, and crucially food security and nutrition outcomes. In fact, innovative policies have been designed and implemented by the Government since the 2000s, to sustainably increase livestock production by creating an enabling environment for technology adoption. For instance, under the New Sectoral Initiative for the Development of Livestock (NISDEL) implemented by the Ministry of Livestock and Animal Production (MEPA) between 2004 and 2008, the Government committted to improve overall livestock farming conditions; accelerate the modernisation and sustainable diversification of production systems; guarantee the quality and traceability of animal-sourced products; and provide support for local producers to access international markets (Ministere de l'Agriculture de l'Elevage et de l'Hydrolique, 2004). In fact, through targeted policies livestock imports were reduced significantly, in particular those of poultry, with Senegal being self-sufficient since 2018. By strengthening food safety requirements and animal health protection, securing pastoral farming and intensifying production through the creation of modern private farms, the livestock sector contributes significantly towards a more sustainable and resilient food system in Senegal. Noterworthy are the Centres d'impulsion et de modernisation de l'elevage (CIMEL) and the Fonds d'appui à la stabulation (FONSTAB), a funding mechanism that became operational in 2007. NISDEL has enabled the adoption of different technologies at different stages of the livestock value chain. While at the production level, the CIMEL have an explicit focus on the genetic improvement of breeds, infrastructure modernisation, and animal health protection; and the livestock sector component of the Grande offensive pour la nourriture et l'abondance (GOANA) promotes insemination technologies to boost milk yields of crossbred cows (Ayabagabo, 2012). In 2013, the National Livestock Development Plan (PNDE) was adopted. It envisioned an increase in the performance of the livestock sector to meet national demand for animal-sourced products and to improve the livelihoods of livestock value chain actors. To implement the policy, technology was widely adopted along the value chain to increase productivity and improve food safety standards. In 2016, the PNDE was revised to align its objectives more closely with the Plan for an Emerging Senegal (PSE), the country's economic and social development policy framework for the medium and long term. PSE actions for the livestock sector include the improvement of productivity and competitiveness while strengthening the processing, conservation and marketing of livestock products.

A dairy farm, Northern Cape province, South Africa (Photo: Williams)

Tunisia

With a contribution to agricultural GDP estimated at 40 percent, the livestock sector plays a significant role in the transformation of Tunisia's food system. Several innovative policies implemented by the Government have moved Tunisia towards self-sufficiency in milk since 1999 and a low overall reliance on cattle, sheep and goat meat imports, with the share of imported meat being less than 3 percent. Techonology adoption at different stages of the livestock value chain has been at the heart of livestock sector policy under the different economic and social development plans and strategies (FAO, 2017). Measures put in place by the Government, such as tax incentives for private investment and processing bonuses, have facilitated technology adoption at production and processing levels (Chebbi *et al*, 2019). With the Government creating a more favourable enabling investment environment, private sector actors have invested in new milk industrial units such as the Délice dairy plant in Sidi Bouzid with a processing capacity of 500,000 litres per day and the Utique dairy plant in Bizerte with a processing capacity of 300,000 litres per day (Sakly *et al*, 2014). Tunisia's national food industry strategy 2016 is another example of the Government's commitment to food system transformation. Through targeted policy innovation in the livestock sector, it seeks to drive technology adoption for greater productivity, nutrition, health and employment opportunities. The strategy aims to upgrade the opportunities for value addition and food safety in the livestock sector, especially to generate more opportunities to tap into larger export markets. The Government also promoted product quality along the supply chains through the development of labelling, traceability and certification systems and the adoption of the Hazard

Analysis Critical Control Point (HACCP) (Ministère de l'Industrie de l'Energie et des Petites et Moyennes Entreprises, 2016). Throughout its policies, Tunisia has emphasised the sustainable intensification of livestock sector production and productivity. For example, under its national development strategy, Tunisia 2020, and within the plan's industrialisation and value chain development pillars, the Government has committed itself to apply modern breeding technologies, such as AI, to increase the number of pure breed dairy cows while maintaining local and cross breeds.

Conclusions

Africa's livestock sector has the potential to make a significant contribution in building a sustainable and resilient food system in a post-COVID-19 (coronavirus disease 2019) era, which must put the sector at the forefront of the African continental and global development policy agenda. However, to truly leverage this potential there is a need to address some of the most pressing challenges impacting the sector, including climate change and persistently low productivity, that inhibit its contribution to meeting overall development targets. Technoloy adoption at each stage of the livestock value chain can help to sustainably strengthen the sector and its role within the food system. Examples from across the continent show that there are numerous technology interventions across Africa, including indigenous technologies, that have proven to be effective. Their widespread dissemination and adoption has the potential to transform the livestock sector as we know it and contribute to food system transformation on the continent. To do so, commitment at the highest level coupled with evidence-based policy innovation to create an enabling environment needs to be created through innovative policy making in the livestock sector. The examples of Senegal and Tunisia show that strong commitment from government to improve the livestock sector through policy innovations is a key enabler in transforming the livestock sector through technology adoption.

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