in partnership with

Gordon Institute of Business Science
Centre for African Management and Markets

AFRICAN AGRITECH:

THE STATE OF PLAY AND POTENTIAL FOR PROSPERITY

AFRICA: BUILD, CONNECT AND THRIVE

IMAGE: fotofabrika – stock.adobe.com

Centre for African Management and Markets (CAMM)
CAMM at the Gordon Institute of Business Science (GIBS) conducts academic and practitioner research and provides strategic insight on African markets. Our purpose is captured in our mission of "Build. Connect. Do." We are proud to be one of the centres at the heart of GIBS, ranked as the African continent's leading business school. This embeddedness provides a credible and respected base, and a powerful network of researchers, practitioners, academics, and policy workers throughout the continent. Our footprint is driven by our conviction that Africa's innovation and competitiveness is intimately connected to traversing borders with Africa-wide trade, cross-border investment activity, and pan-African business initiatives.

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Dr Tinashe is an experienced commodities analyst and agricultural value chain and trade specialist who has worked as a researcher and practitioner in the private sector. His areas of expertise include agribusiness and value chain development, market and trade analysis, agro-food system analysis, research, and policy advocacy. Tinashe earned a PhD Agricultural Economics at the University of Pretoria, was the inaugural recipient of the Agricultural Economics Association of South Africa's Bax D. Nomvete bursary, and a Bill & Melinda and Melinda Gates Foundation scholar. He is currently Research Director at Africa Network of Agricultural Policy Research Institutes (ANAPRI).

Nerissa Pillay
Nerissa holds a Bachelor of Arts in Marketing and an Honours degree in Strategic Communication from the University of Johannesburg. After joining Aspen Pharmacare as a project manager, she completed a Postgraduate Diploma Business Administration at GIBS, graduating with distinctions in six subjects. She followed this with her MBA at GIBS, specialising in consulting. In 2023 Nerissa joined economics advisory firm Boundless World, where her work focuses on market entry and market access strategies.

IMAGE: scharfsinn86 – stock.adobe.com

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FOREWORD

Africa is growing in multiple ways. For starters, the continent's population is increasing rapidly. An expanding and youthful population presents both challenges and extraordinary opportunities. Growth also applies economically. But that is not universal. While nearly half of the globe's 20 fastest-growing economies are in Africa, many economies are stuck.

In partnership with the GIBS Centre for African Management and Markets (CAMM), DHL Express Sub-Saharan Africa has set about trying to understand how we can make sure that megatrends like growth are harnessed for a better Africa in the future. In this paper, we explore the role of agriculture

Growth needs to be fuelled. People and economies rely on ever-increasing productivity from the farming industry. Indeed, innovation has given us greater and greater output per square metre of farmland. However, development has not been uniform.

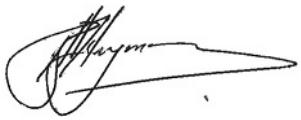
This paper seeks to capture the current landscape of African agriculture, crystallise the most important challenges, and then highlight the most promising solutions.

Hearteningly, we found no shortage of centres of excellence that are taking farming to new heights in Africa. Digital technology such as drones and AI are revolutionising everything from fire monitoring to pest control. The burgeoning field of biocontrol is returning the soil and the organisms that live in it to its nourishing best. And novel business models are connecting farmers to distributors and, eventually, consumers in ingenious new ways. Supply chains are adapting as farmers and consumers do the same.

I extend my sincere appreciation to the authors of this research paper for their dedication, insight, and scholarly rigour. Their work represents a significant contribution to our understanding of the future of Africa's agricultural landscape, which is crucial as we brace for growth in the region's population.

Hennie Heymans

CEO, DHL Express Sub-Saharan Africa



1. INTRODUCTION

Advances in our ability to generate food have been among humankind's most staggering achievements. In 1950, we asked our farmers to nourish 2.5 billion people.[1] Today, we rely on increasingly tech-savvy farmers to put food on the table for more than 8 billion of us.

IMAGE: scharfsinn86 – stock.adobe.com

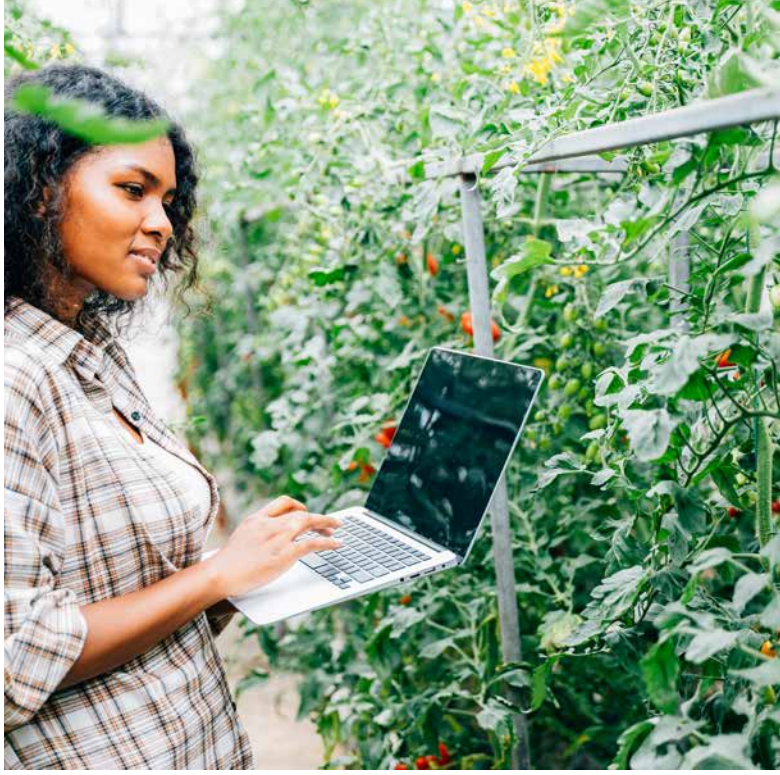


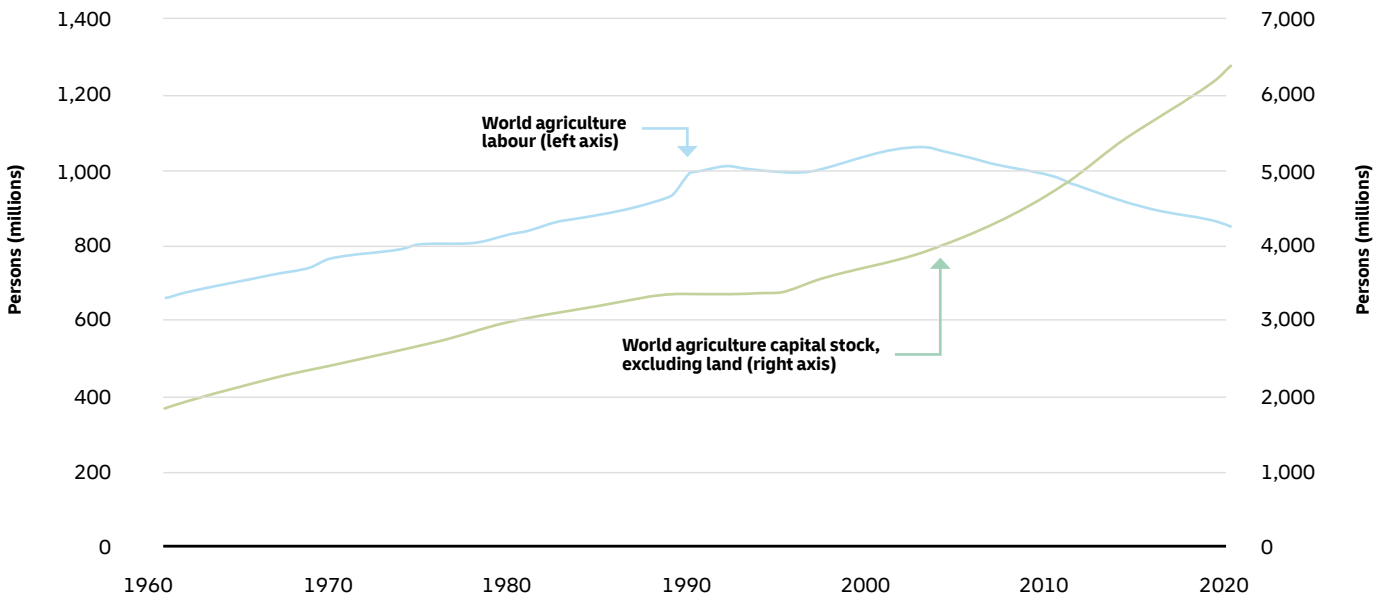
IMAGE: Sorapop – elements.envato.com

To put a monetary value on the productivity gain, over the six decades to 2020, the globe's total output of "crops, livestock, and aquaculture commodities grew from a gross value of $1.1 trillion to $4.3 trillion" in constant 2015 dollars.[2]

This seismic shift has been enabled largely by ingenuity. Smarter, more efficient machines, farming techniques, plant varieties and feeds for herds all make it possible to produce more calories from a given area of land and number of workers.

In fact, despite the global population growing, the number of people employed in agriculture has been decreasing steadily since the early 2000s. In contrast, the global capital stock in agriculture, excluding land, has taken off.[3]

FIGURE 1
WORLD AGRICULTURAL LABOUR AND CAPITAL STOCK

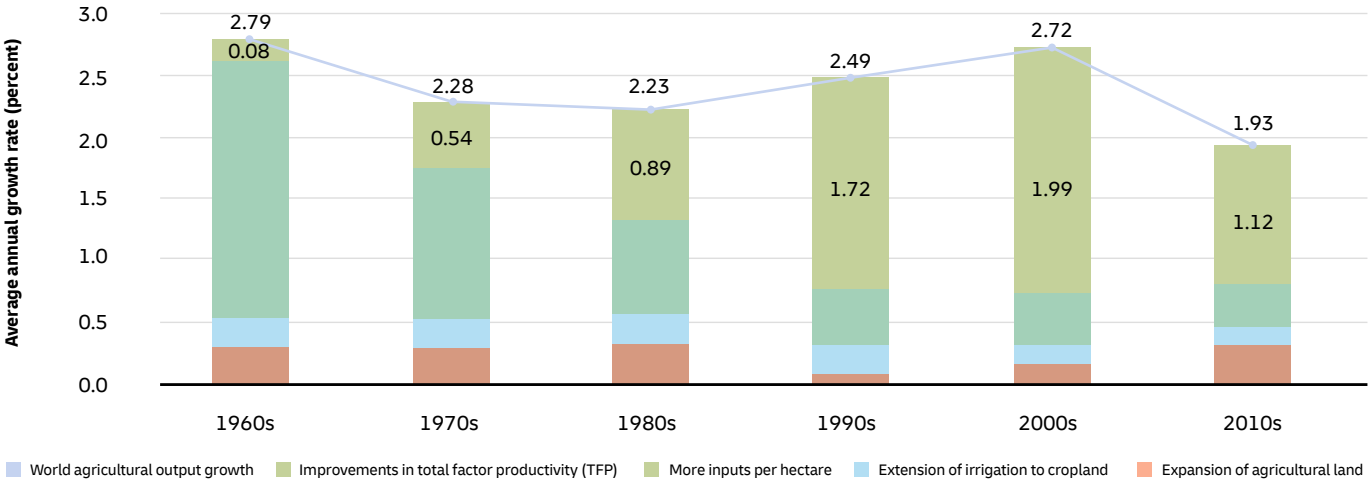


Source: Jelliffe, J. et al. (2024).
Note: Agricultural capital includes structures, machinery, breeding stock, and tree stock, but excludes land.

Technology – be it better harvesters, novel tools like drones, or new business models – has increasingly efficiency gains in farming. Between the 1960s and 1980s, output growth was largely a result of using more inputs – land, labour and materials. In the decades since, we have seen a far more impressive sort of growth: total factor productivity (TFP) has come to dominate progress. This metric shows how efficiently we can put these inputs to use to generate more output. We are getting more and more food not because of more land use or elbow grease; we are using land, labour, and capital better and better.

1 A century of world population trends: 1950 to 2050. In World Population Prospects 2022. United Nations (2022).
2 Jelliffe, J., Fuglie, K. & Morgan, S. (2024). Global Changes in Agricultural Production, Productivity, and Resource Use Over Six Decades. United States Department of Agriculture (USDA) Economic Research Service.
3 Ibid.

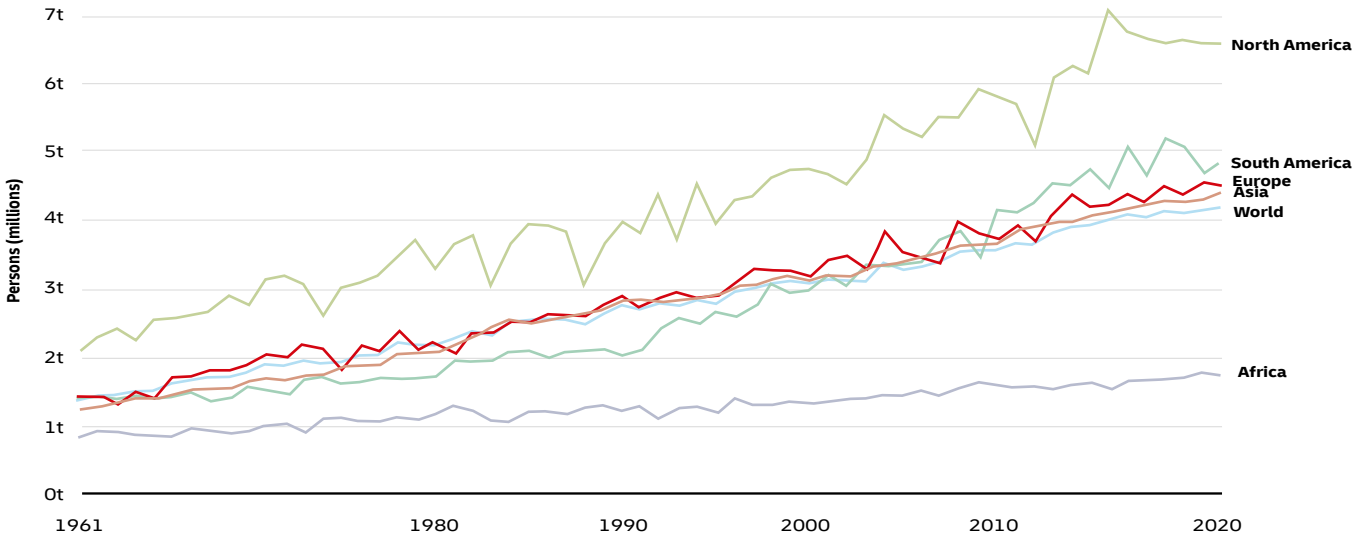
FIGURE 2
WORLD AGRICULTURAL PRODUCTIVITY GROWTH AND CONTRIBUTING FACTORS



Source: Jelliffe et al. (2024).
Note: Total factor productivity (TFP) is the ratio of total output to the total land, labour, capital and material inputs used to generate that output.

Africa's need to ramp up agricultural efficiency is starkly illustrated by cereal yields. More advanced economies in Europe especially, but including the US, have meant greater output from a given amount of land, number of workers, and amount of dollars invested in capital. Africa has improved but below the world average.

FIGURE 3
CEREAL YIELDS (TONNES PER HECTARE) BY REGION



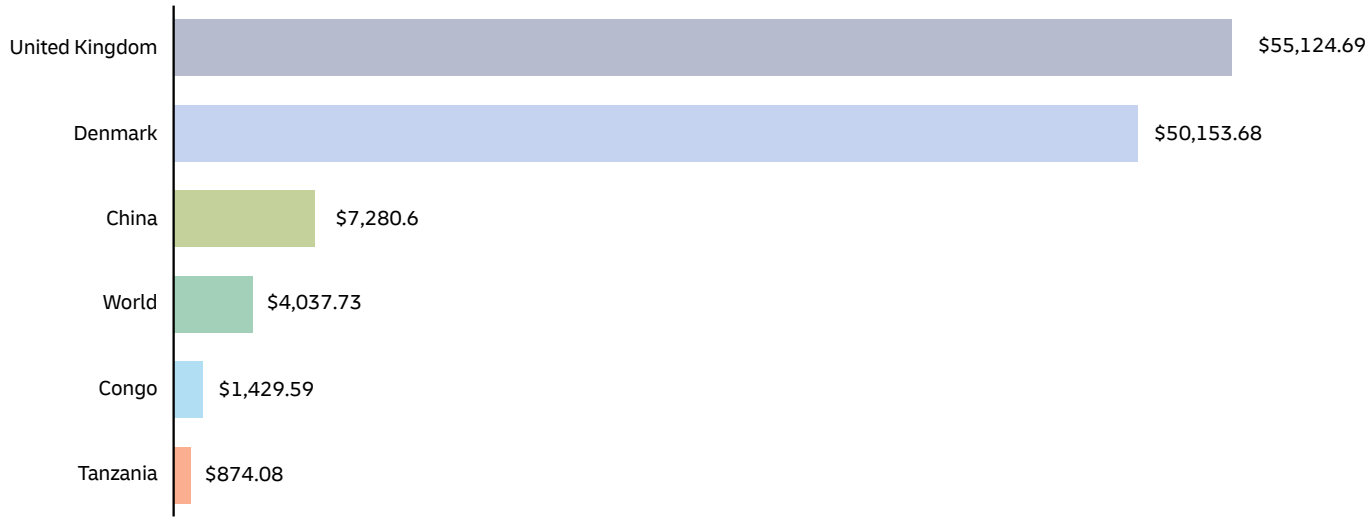
Source: Ritchie, H. (2024). Cereal yields have increased in all regions, but Africa lags behind. Our World in Data.

Thus far, African agriculture has relied more heavily than other regions on generating additional output by recruiting additional land. This route to growth has several major drawbacks. For one, there is a limit to the amount of arable land. Second, the more land used, the greater the environmental impact. In fact, "habitat loss is the biggest threat to the world's wildlife. Nearly all habitat loss is driven by the expansion of agriculture. We chop down forests and convert wild grasslands into farmland to grow crops and raise livestock."[4]

We can find an aspirational example with a comparison of cereal yields in sub-Saharan Africa and South Asia between 1980 and 2018. Over this spell, both regions expanded output admirably. However, SSA relied far more heavily on more and more land use, while South Asia generated efficiency, improving its yield per hectare.

[4] Ritchie, H. (2021). To protect the world's wildlife we must improve crop yields – especially across Africa. Our World in Data.

FIGURE 4
AGRICULTURAL VALUE ADDED PER WORKER



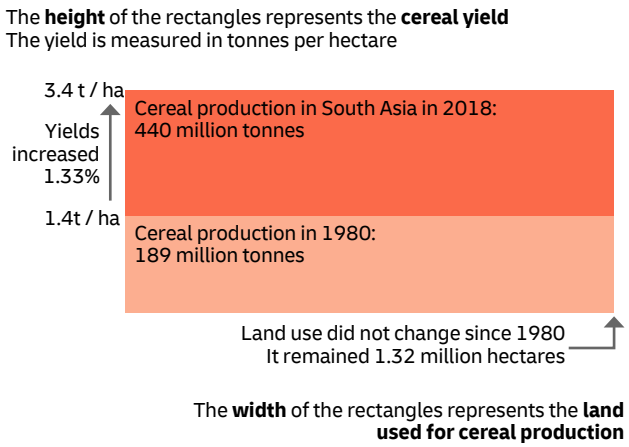
Source: Ritchie, H. (2022). Increasing agricultural productivity across sub-Saharan Africa is one of the most important problems this century. Our World in Data.

There is good news. African agriculture is moving in the right direction. "Sub-Saharan Africa achieved the highest rate of growth in agricultural production value (crops and livestock) of any region in the world since 2000, expanding by 4.3% per year in real [inflation-adjusted US dollars (USD)] between 2000 and 2018, roughly double that of the prior three decades. The world average over the same period was 2.7% per year. Agricultural value added per worker in real 2010 USD rose from $846 in 2000 to $1,563 in 2019, a 3.2% annual rate of growth."[5]

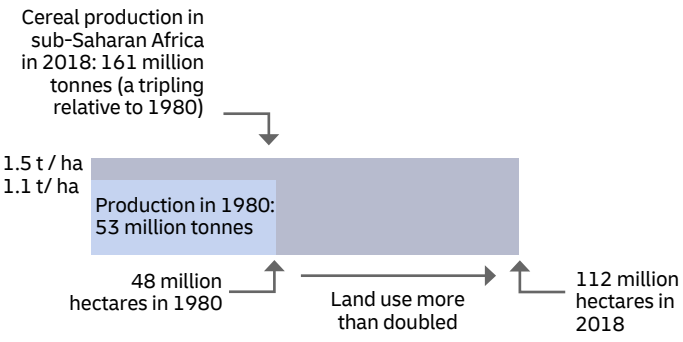
In this whitepaper, we present the current state of agriculture, paying special attention to the potential that agricultural technology ("agritech" hereafter) has to turn African farming into a global powerhouse that forms the foundation of prosperity in the years to come.

FIGURE 5
INCREASES IN CROP YIELDS BASED ON ADDITIONAL LAND USE VERSUS GREATER EFFICIENCY, 1980 VERSUS 2018

South Asia achieved all of its increased food production through higher yields



Sub-Saharan Africa increased food production mostly through the expansion of land



Source: Ritchie, H. (2022).

[5] Jayne, T. S., Fox, L., Fuglie, K., & Adelaja, A. (2021). Agricultural productivity must improve in sub-Saharan Africa. Science, 372(6546), 1045-1047.

2. AFRICA'S AGRICULTURAL IMPERATIVE

Farming has particular importance in Africa. While on a continent like North America, farming makes up just a small proportion of GDP, and this figure is rapidly declining in Asia, Africa has long relied on agriculture for around 15% of output. This is compared to a world average of just 5%.[6] For Africa to thrive, African agriculture must feed growth.

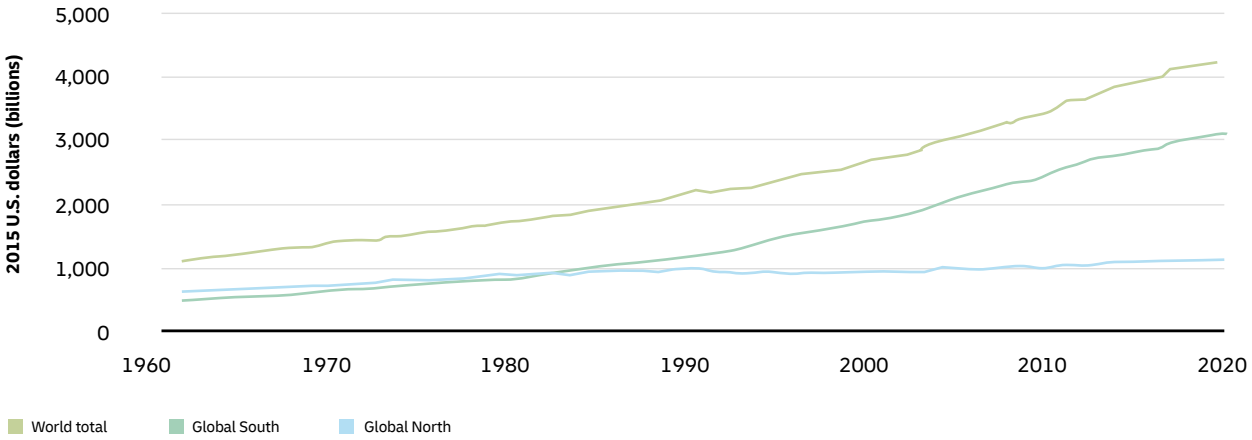
IMAGE: Dewald – stock.adobe.com

[6] Suri, T., & Udry, C. (2022). Agricultural technology in Africa. Journal of Economic Perspectives, 36(1), 33-56.

In one sense, agriculture is moving towards Africa. Between 1960 and today, we can chart an extraordinary shift in world agricultural output from the global north to the global south. "From 1961 to 2020, the global agricultural sector underwent vast transformations in production, productivity, and resource use. Agricultural output increased nearly fourfold, and the global population grew 2.6 times, resulting in a 53-percent increase in agricultural output per capita. Food prices, adjusted for inflation, declined compared with overall prices, allowing global diets to be more affordable and diverse."[7]

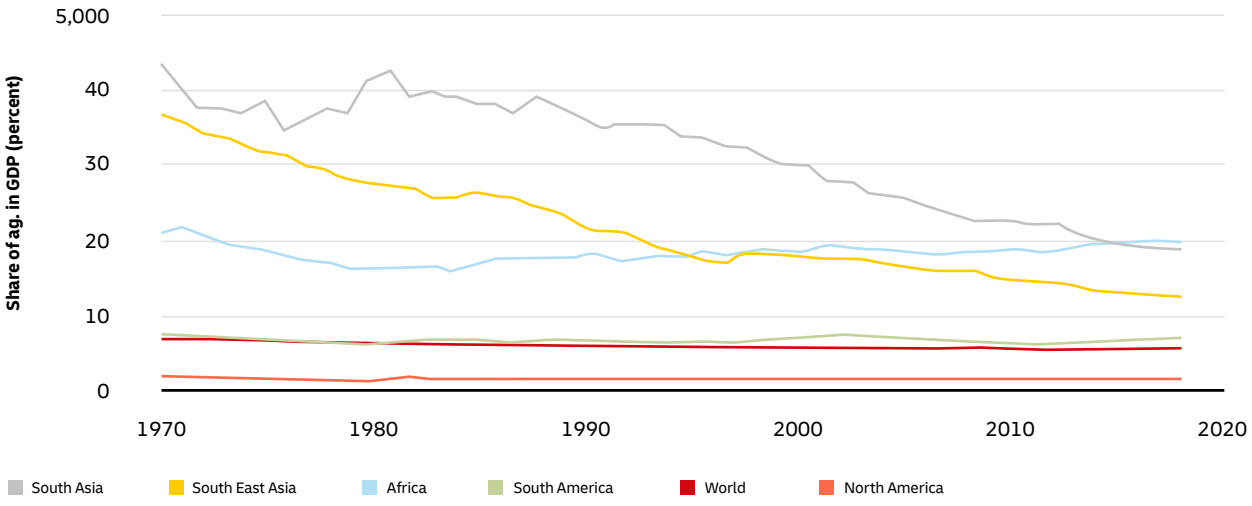
As of 2020, the global south was the source of nearly three-quarters of the globe's total agricultural output, up from less than half in 1960.

FIGURE 6
WORLD AGRICULTURAL OUTPUT BY HEMISPHERE



Source: Jelliffe et al. (2024).
Note: Values are represented in purchasing power parity dollars, which means that a given quantity of agricultural product will have the same purchasing power. The Global South consists of Africa, Latin America and the Caribbean, and Asia except high-income countries of East Asia. The Global North consists of Canada, the United States, Europe, Australia and New Zealand (Oceania), and high-income countries of East Asia.

FIGURE 7
SHARE OF GDP MADE UP BY AGRICULTURE BY REGION



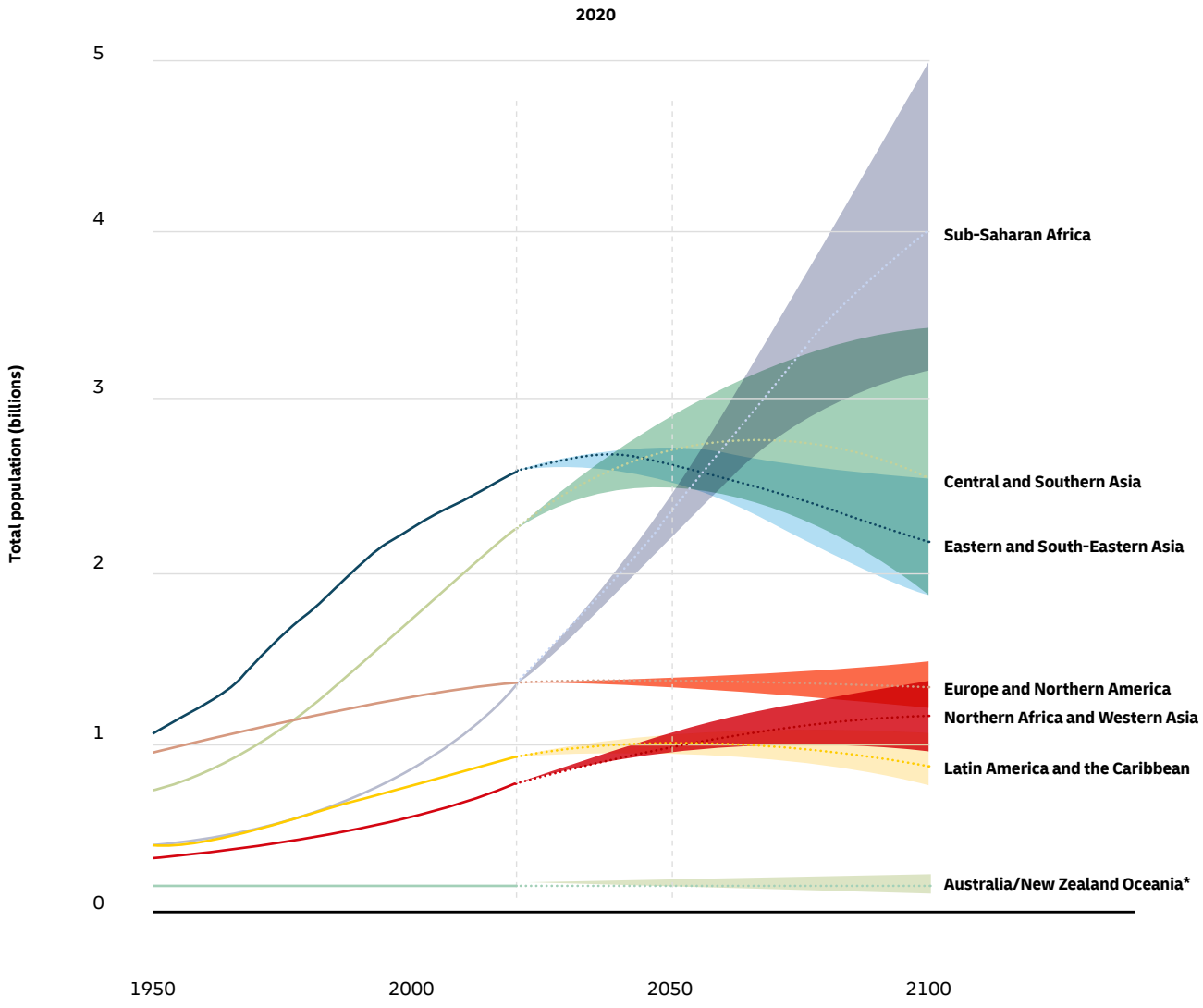
Source: Suri, T., & Udry, C. (2022). Agricultural technology in Africa. Journal of Economic Perspectives, 36(1), 33-56.

[7] Jelliffe et al. (2024).

IMAGE: Confidence – stock.adobe.com

Additionally, Africa is growing fast. In fact, more than half of the projected global increase of 2 billion people between 2020 and 2050 will be "from countries in sub-Saharan Africa... and such a proportion is projected to be about 90% in 2050-2100."[8] In the context of agriculture, this is a booming, youthful population that will need plenty of sustenance if the continent is going to take advantage of a demographic dividend.

FIGURE 8
POPULATION GROWTH AND GROWTH PROJECTIONS BY REGION



Source: Gu, D., Andreev, K., & Dupre, M. E. (2021). Major trends in population growth around the world. China CDC Weekly, 3(28), 604.

[8] Gu, D., Andreev, K., Dupre, M.E. Major trends in population growth around the world. China CDC Weekly. 2021 Jul 9;3(28):604-613.

TECH IS THE TICKET

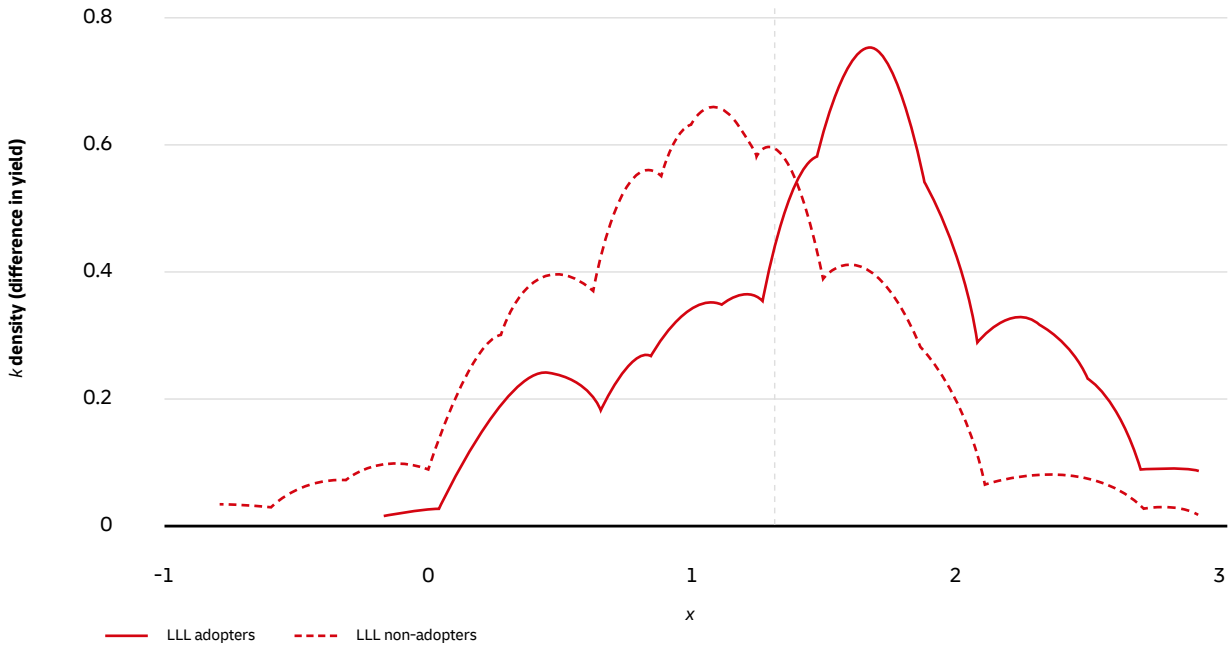
The most potent way to harness the power of farming to feed Africa's long-term prosperity is with technology.

At a universal and fundamental level, we know how important nitrogen fertilisation has been. "The doubled increase of food production worldwide was partially attributed to a 6.9-fold increase in nitrogen fertilization and a 3.5-fold increase in phosphorous fertilization in the 1990s."[9]

In India, laser land levelling (LLL) – a technology that uses lasers to level fields by moving soil from high points to low points for improved water efficiency and crop risk reduction – resulted in "an increment of 12% and 16% in rice yield and net income, respectively, for LLL adopters in comparison to the non-adopters of LLL."[10]

IMAGE: Dusan Kostic – stock.adobe.com

FIGURE 9
IMPROVED YIELDS AS A RESULT OF LASER LAND LEVELLING (LLL)



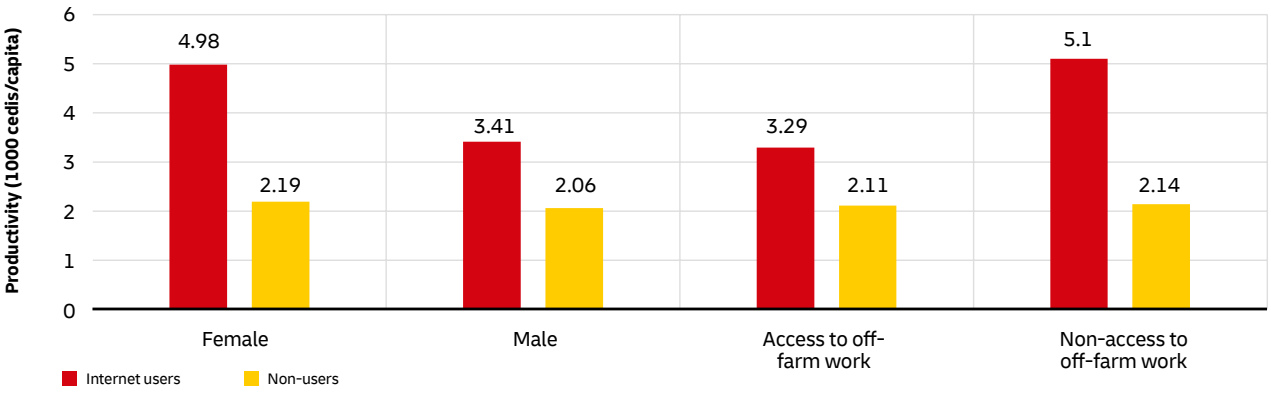
Source: Pal et al. (2022).

Research from Ethiopia found that "households using improved agricultural technologies had on average 23 031 birr (over 180 US dollars) higher annual farm income compared to those households not using such technologies."[11]

In Ghanaian aquaculture, something as simple as internet access has been shown to boost fish production. Based on the mass of fish harvested per hectare over 12 months, as valued in Ghanaian cedis, internet access has the ability to more than double the output per person on a family farm.[12] The results were stronger in the case of female heads of households and in circumstances where farmers have no access to alternative work opportunities.

[9] Liliane, T. N., & Charles, M. S. (2020). Factors affecting yield of crops. Agronomy-climate change & food security, 9.
[10] Pal, B. D., Kapoor, S., Saroj, S., Jat, M. L., Kumar, Y., & Anantha, K. H. (2022). Adoption of climate-smart agriculture technology in drought-prone area of India – implications on farmers' livelihoods. Journal of Agribusiness in Developing and Emerging Economies, 12(5), 824-848.
[11] Wordofa, M. G., Hassen, J. Y., Endris, G. S., Aweke, C. S., Moges, D. K., & Rorisa, D. T. (2021). Adoption of improved agricultural technology and its impact on household income: a propensity score matching estimation in eastern Ethiopia. Agriculture & Food Security, 10, 1-12.
[12] Twumasi, M. A., Jiang, Y., Zhou, X., Addai, B., Darfor, K. N., Akaba, S., & Fosu, P. (2021). Increasing Ghanaian fish farms' productivity: Does the use of the internet matter?. Marine Policy, 125, 104385.

FIGURE 10
INTERNET USE AND FARM PRODUCTIVITY RELATIONSHIP BY GENDER COMPOSITION AND AVAILABILITY OF OFF-FARM WORK



Source: Twumasi et al. (2021).

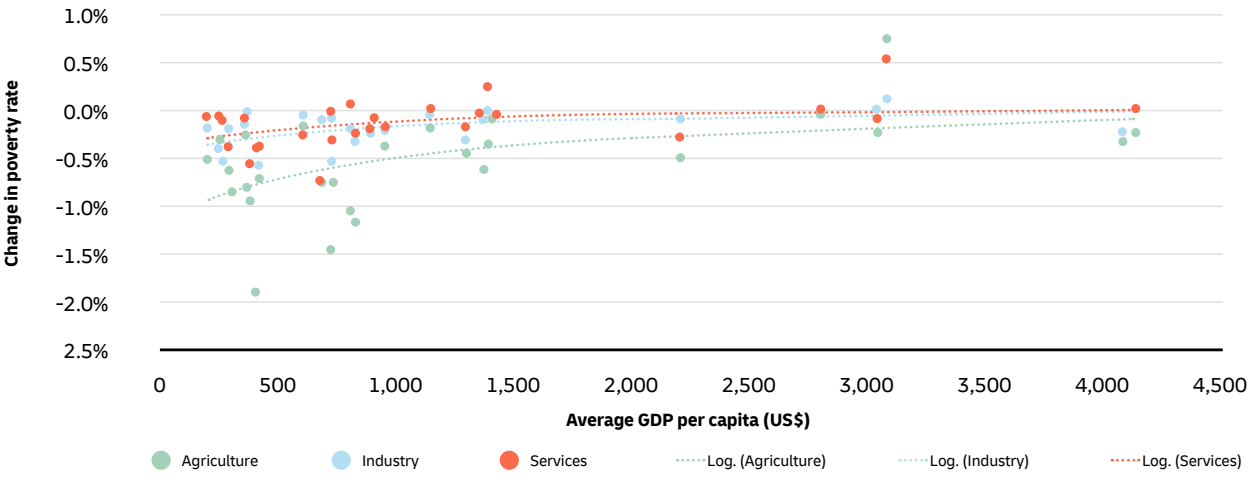
In Nigeria, the adoption of improved rice varieties by small-hold farmers has shown tremendous results. The provision of appropriate high-yielding seed varieties to a sample of 250 rice farmers in southwest Nigeria resulted in 452 kg more rice grains per hectare of rice farms.[13] The authors of the study concluded, "strengthening extension services using new strategies like electronic and social media may be more effective than the conventional method of extension delivery."

Technology's expansion, including the coming into its own of artificial intelligence (AI) and reduced costs, brings impressive scope for farmers to get more from less. This is a critical frontier for African agriculture to be a decisive contributor to prosperity in the years to come.

FARMING AND POVERTY

A more efficient agriculture sector has particular importance for developing nations. Even small improvements in farming productivity have an outsized impact on poverty. For low-income countries, "a 1 percent increase in agricultural total factor productivity (TFP) results, on average, in a 1 percent decline in the share of the population living in extreme poverty – roughly double the impact of a comparable increase in productivity in industry or services."[14]

FIGURE 11
PERCENTAGE REDUCTION IN POVERTY FOR A ONE PERCENTAGE POINT INCREASE IN TFP OF A SECTOR FOR COUNTRIES WITH DIFFERENT LEVELS OF GDP PER CAPITA



Source: Jayne et al. (2021).
Notes: The dots and dashed trend lines show the effect on poverty reduction from TFP growth by sector for different countries. At low levels of national income, agricultural TFP growth (red dots and dashed line) has a significantly stronger effect on poverty reduction than TFP growth in industry and services (blue and yellow dashed lines, respectively).

[13] Bello, L. O., Baiyegunhi, L. J., & Danso-Abbeam, G. (2021). Productivity impact of improved rice varieties' adoption: case of smallholder rice farmers in Nigeria. Economics of Innovation and New Technology, 30(7), 750-766.
[14] Jayne et al. (2021).

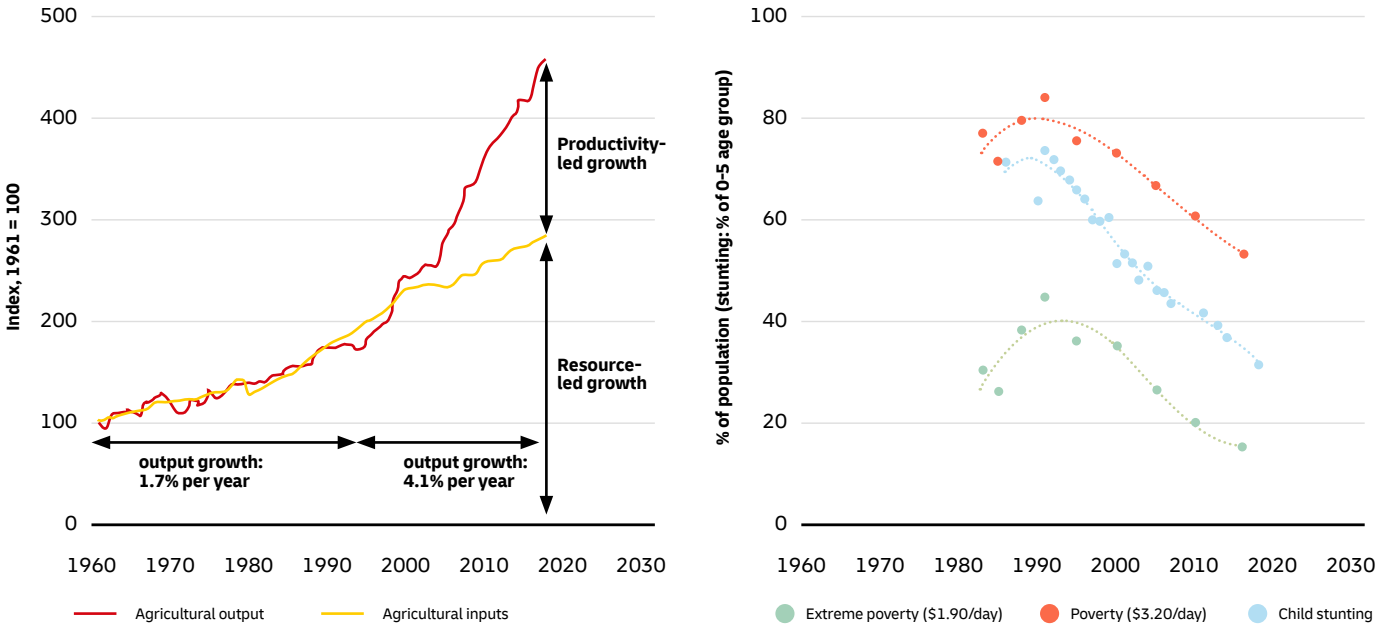
BOOMING BANGLADESH

Data from Bangladesh captures the poverty-reducing power of more efficient farming methods. The South Asian nation was among the poorest in the world in 1971 when it gained independence from Pakistan. It was highly food insecure and required food aid. However, from the mid-1990s, "a combination of factors, including macroeconomic reforms, market liberalization, and adoption of new agricultural technologies, led to a more than doubling of the agricultural growth rate after 1996. Important innovations included improved crop varieties, techniques for aquaculture production and marketing, availability of low-cost equipment for groundwater irrigation, and an emphasis on inclusive adult education and training.[15]

"Between 1991 and 2016, the share of the population living on less than US$3.20/day/capita fell from 84 percent to 53 percent, and between 1991 and 2018, the share of children under five years old suffering from stunting declined from 74 percent to 31 percent. Productivity-led growth in agriculture not only raised farm household incomes, but it reduced the real cost of food and stimulated demand for non-farm goods and services. Non-farm employment grew more rapidly than farm employment nationally and in rural areas. Farm families began to devote more of their labor to non-farm activities and diversify their sources of income."

IMAGE: Susmit – stock.adobe.com

FIGURE 12
AGRICULTURAL OUTPUT GROWTH IN BANGLADESH, ATTRIBUTED TO ADDITIONAL RESOURCE USE VERSUS GREATER PRODUCTIVITY (LEFT); EXTREME POVERTY, POVERTY AND CHILD STUNTING IN BANGLADESH OVER TIME (RIGHT)



Source: Jayne et al. (2021).
Note: In the mid-1990s, the average rate of growth in agricultural production in Bangladesh increased from around 1.7 percent per year to more than 4 percent per year. As agricultural growth accelerated, poverty and child stunting began to decline. The prevalence of child stunting in the 0-5 age group fell from 74 percent in 1991 to 31 percent by 2018. Agricultural TFP became the dominant source of agricultural growth in the 2000s, achieved through smallholder adoption of innovations in rice, aquaculture, and vegetable production systems.

[15] Jayne et al. (2021).

IMAGE: Eric Isselée – stock.adobe.com

ETHIOPIA'S EXAMPLE

Africa is a vast and varied place where averages can mislead. Among several success stories is Ethiopia. The highly agriculture-dependent nation has suffered through drought and famine multiple times since 1950.[16] An estimated 400,000 lives were lost to starvation in 1984/1985.[17] This despite high growth potential, with its fertile soil, adequate climate, and large labour force.

Ethiopia began harnessing this potential in the mid-1990s. Its policy is termed "agricultural development-led industrialization" (ADLI). Formulated in 1991, this was a macroeconomic strategy aimed at starting from the base, smallholder agriculture, and building prosperity generally. The "programme entailed three main strategies: expansion of agricultural technologies; investment in agricultural infrastructure, including inputs; and boosting rural non-agricultural sectors."[18]

ADLI started with the basics. "In its first decade, ADLI was implemented with a relatively narrow focus on providing off-the-shelf fertilizer packages, improving access to inputs and credit, and providing extension services."[19]

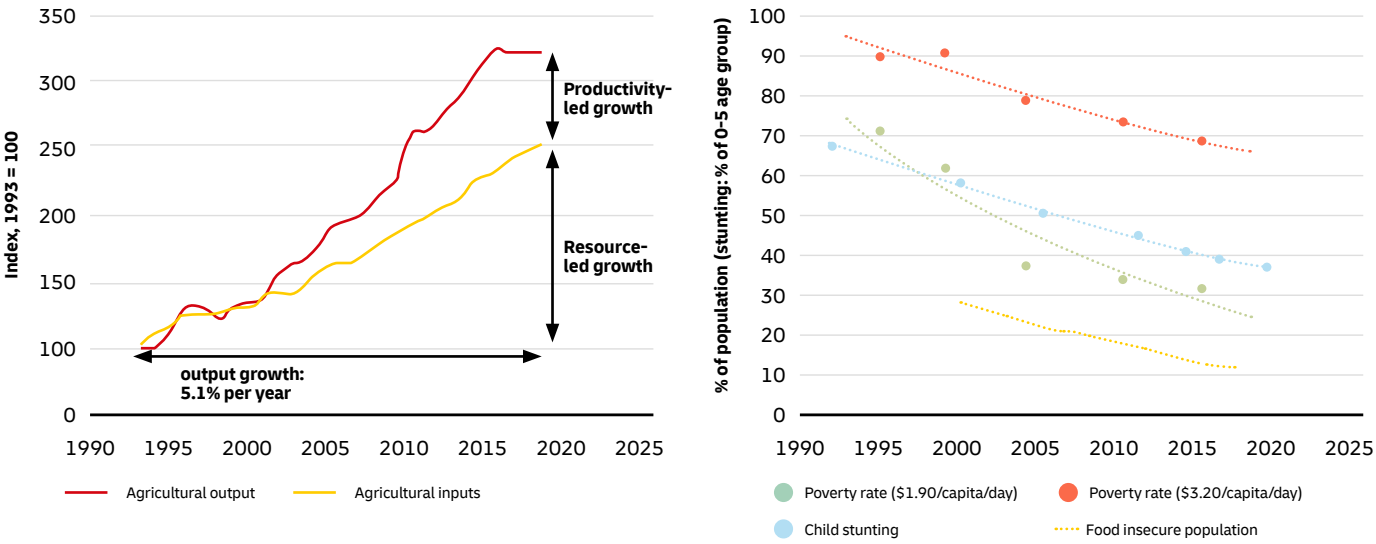
With time, ADLI evolved to emphasise more complex and varied needs. These include agricultural research, the design and operationalisation of growth corridors, a productive safety net programme, and a voluntary resettlement programme.[20] With new iterations of the programme, the government liberalised agricultural markets, invested further in research, and built rural transport infrastructure.[21]

All of this came at a cost. Between 2001 and 2017, spending on agriculture was 9.4% of the Ethiopian government's total.[22] But there is evidence it paid off. Over the three decades to 2020, Ethiopia injected substantial efficiency and output into its agriculture sector and slashed poverty.

16 Alemayehu Tegegn, D. (2023). The trigger of Ethiopian famine and its impacts from 1950 to 1991. Cogent Arts & Humanities, 10(1), 2264017.
17 De Waal, A. (1997). Famine crimes: Politics and the disaster relief industry in Africa.
18 OECD/Policy Studies Institute (2020). The evolution of rural development policies in Ethiopia. In Rural Development Strategy Review of Ethiopia: Reaping the Benefits of Urbanisation, OECD Publishing, Paris. Bloomington, IN: Indiana University Press.
19 Rohne Till, E. (2022). Agriculture for Economic Development in Africa: Evidence from Ethiopia (p. 98). Springer Nature.
20 Zewdie, B. (2015). Analyses of agricultural development led industrialization (ADLI) policy's effectiveness in Ethiopia. Journal for Studies in Management and Planning, 1(11), 201-220.
21 Dorosh, P. A. & Rashid, S. (Eds.). (2012). Food and agriculture in Ethiopia: Progress and policy challenges. Philadelphia: University of Pennsylvania Press.
22 CountrySTAT (2020). FAO.

IMAGE: Eric Isselée – stock.adobe.com

FIGURE 13
AGRICULTURAL OUTPUT GROWTH IN ETHIOPIA, ATTRIBUTED TO ADDITIONAL RESOURCE USE VERSUS GREATER PRODUCTIVITY (LEFT); POVERTY, FOOD SECURITY, AND CHILD STUNTING IN ETHIOPIA OVER TIME (RIGHT)



Source: Jayne et al. (2021).

"In the 15 years to 2019, driven by investment in agriculture, industry and infrastructure, the economy grew on average 7 per cent annually per capita, according to World Bank data, one of the fastest rates in the world. Although it was still relatively poor, with a nominal per capita gross domestic product of roughly $950 in 2020, years of growth had put it on the cusp of lower middle-income status."[23]

The Economist captured the Ethiopian so-called economic miracle at the end of 2021: "One of the most extraordinary growth records over the past two decades was to be found, perhaps surprisingly, in the horn of Africa. Real GDP per person in Ethiopia, the second-most-populous country in Africa, rose by an average annual rate of 9.3% from 1999 to 2019, just 0.4 percentage points less than China's pace of growth."

Ethiopia's agriculture sector accounts for over 40% of GDP, 90% of export earnings, and 96% of rural employment.[24]

No two African nations are the same. No two agriculture policies should be the same. However, Ethiopia's experience is one of several case studies that confirm the importance of agriculture as a boon for prosperity and a reminder that it can be done.

[23] Schipani, Andres & Pilling, David. After the war ends, can Ethiopia's economic 'miracle' get back on track? Financial Times (20/06/2022).
[24] Biru, W. D., Zeller, M., & Loos, T. K. (2020). The impact of agricultural technologies on poverty and vulnerability of smallholders in Ethiopia: a panel data analysis. Social Indicators Research, 147(2), 517-544.5-019-02166-0. In Wordofa, M. G., Hassen, J. Y., Endris, G. S., Aweke, C. S., Moges, D. K., & Rorisa, D. T. (2021). Adoption of improved agricultural technology and its impact on household income: a propensity score matching estimation in eastern Ethiopia. Agriculture & Food Security, 10, 1-12.

3. BIOCONTROL: WHERE BIOLOGY MEETS BUSINESS

Modern agriculture is nothing short of a technological marvel. The cucumbers and cattle we rear today bear little resemblance to the ones that roamed wild before farming met science. Wild bananas, for example, are small, mostly full of seeds and unpalatable to most of us. It is with the marriage of our own genetic, breeding and chemical mastery that we have come to expect perfectly yellow, appealingly curved, and magnificently ripened bananas on store shelves – and at every season of the year as a global market.

IMAGE: bit24 – stock.adobe.com

Far from just a culinary delight and aesthetic treat, this ability to enhance crops and herds has made modern life possible. The calorific needs of more than 8 billion people are met chiefly by large-scale farming, with advanced agronomic techniques that are backed by support industries ranging from wide-reaching scientific research to engineering, robotics, AI, and specialised logistical operations.

That is not about to change. However, how we deploy our technological wits is undergoing an important and much-needed turn or, rather, a return to what our forefathers relied on.

Conventional agronomic practices rely heavily on synthetic fertilisers and agrochemicals to enable crop yields. This is highly effective. However, we need to adapt. Crops are under increasing pressure from pests and diseases. They suffer ever-progressing nutrition-related health issues. Modern agronomic practices have much to gain from a more regenerative approach. This means working with nature rather than against it.

Described broadly by the term "biocontrol", this new angle remains unapologetically scientific while recruiting natural solutions to meet modern farming problems. So, we're utilising solutions nature has developed for millennia (one does not see agrochemicals being needed in a lusciously growing forest, but we need them on our crops).

This is an integrative solution. Synthetic chemicals have a place. We can limit their use and sometimes eliminate them wherever an alternative natural process can be harnessed efficiently.

IMAGE: showcake – stock.adobe.com

THE BASICS OF BIOCONTROL

"Conventional farming is very much about using agrochemicals, but these can sometimes be a hammer when we need a toolbox," explains Dr Mike Niland. "We need some chemical hammers in farming, unless it's an organic operation, but there are more and more ways in which we can – and must – shift to a more nuanced methodology based on biological inputs in conventional farming and, for example, develop soil health and support the ecosystem a crop is grown in, rather than degrading it. For example, there are instances where we can move from using harsh but effective fungicides or pesticides to instead using a fungus or virus that prevents the disease or only kills the specific pest in question."

There is also a great deal to be gained by making plants healthier in the first place. "In many places, we have pushed our soil so hard for so long that the plants are now less able to defend themselves because their health relies on the soil they grow in being healthy first," Niland goes on. "We can deal with this by using more fertilisers. However, it is often better to focus on building soil health. This means improving microbial profiles in soil, ensuring soils are not compacted, and balancing nutrition in soils to make it available to plants, rather than the nutrition being locked up in forms which plants can't access.

"This is increasingly the case as laws and regulations come in globally to drive this. Governments and regulatory bodies are more active than ever with limits like minimum residual levels

(MRL) of agrochemicals on foods to protect consumers. This means farmers don't have the choice of simply using more pesticides. We have to make the crops and the environment we grow them in more resilient on their own.

"It all begins with the soil. That is the priority before we address the root itself. Think of the roots as anchors for the plant that doubles as highways, which transport water and minerals up so they get to the leaves."

It is really the likes of fungi and bacteria underground that do most of the work people often expect the root to do for the plant. This is where some very cool work is going on – promoting the plant-microbe interactions at the root. Without microbes on roots, plants would not have developed beyond basic plants like ferns, and we would not have anything with a flower or a fruit to harvest. We are getting this ecosystem working better at a micro level. When we do that, we have healthier soil and healthier crops, with the need for fewer harsh chemicals.

Of course, this all resides in a commercial setting. Healthy soil is all for nought if the only bananas it sustains are small, heavily seeded and unpalatable. "We aren't doing this as charity or pure science," Niland continues. "We are driving improved agronomic output on the backdrop of a tightening regulatory framework and ever-more pressured commercial and yield needs."

BIOCONTROL IN ACTION

An iconic and early example of biocontrol in African agriculture is the recruitment of wasps to feed off worms, specifically mealybug worms. These tiny pests are highly resistant to insecticides, being well protected by a waxy coating. The parasitic wasp *Anagyrus lopezi*, which evolved in South America alongside cassava, was imported from South America to sub-Saharan Africa in the 1980s as a natural insecticide.

"About two millimetres long, the parasitic wasp lays its eggs inside the mealybug's body. When the larvae hatch, they eat their way out of the mealybugs, slowly mummifying and killing them. Scientists estimate that a single female wasp can kill up to 200 mealybugs during the two to three weeks that it lives."[25]

That is microbial biocontrol. Biocontrol often happens at a microbial level. One example is the deployment of viruses to control pests. One such pest with the power to decimate crops in Africa is the fall armyworm.

Viruses are highly targeted in that they tend only to impact one species, which means they have no impact on humans, livestock or indeed other beneficial insects at all. They have been proven to be highly effective at managing fall armyworm populations.

Anagyrus lopezi

[25] Than, K. (2014). Parasitic wasps unleashed on insect pests. Inside Science. American Institute of Physics.

The worm's larvae ingest certain viruses that kill them, leaving the plant and other organisms unharmed. When death occurs days later, the "skin ruptures, releasing millions of infectious virus particles. When many larvae are living close together, they can infect each other and create an outbreak."[26] Additionally, if they do not die straight away, it has been shown that subsequent generations of that insect can remain infected, making them weaker and more susceptible to stresses in their environment, such as pesticides, which can increase the mortality of the pest.

This can be combined with other modes of action, such as a fungus (e.g. *Metarhizium rileyi*), which enters the fall armyworm by a spore of the fungus that is sprayed out in a field, coming in contact with its cuticle or ingested. "Once on the insect, the spore germinates, and the fungal hyphae grow and multiply through the insect's body, eventually killing the larvae by internal tissue destruction. Between two and four days after the initial infection, the larva stops feeding and dies five to seven days later. Once the larva has died, the fungus sporulates, therefore having the ability to remain in the environment and re-infect the next generation of pests."[27]

"Here is another benefit of biocontrol," Niland explains. "Multiple modes of action give you the best chance of not just killing one generation of pests. You can sustainably suppress and prevent pests returning by deploying the power of nature without killing predatory beneficial insects that naturally suppress a pest, and multiple modes of action maintain the susceptibility of pests to pesticides at low rates."

Biocontrol is not just about protecting crops from pests. It is also about stimulating plant health and boosting its ability to thrive and grow. "Microbes do what most people think roots do," Niland explains. "The root is a highway that brings water and nutrients up to the plant and takes sugars down to feed the microbes. Microbes bring the nutrients to the root for transportation. It's symbiotic.

"*Trichoderma asperellum* is a good example. This is a fungus that has been isolated and introduced into soil for all sorts of benefits. It prevents soil-borne disease. Other isolates of *Trichoderma* can even help prevent some diseases above the ground on flowers, leaves and fruits. Underground, however, it promotes growth and improves the efficiency with which plants utilise nutrients. All of this also reduces the stress the plant is under, making it better resistant to all challenges, including disease and pollution."

It is also safe, low-cost, and effective for a variety of crop species.[28]

"We can get more specific than that, too," Niland says. "Much like an athlete taking creatine to improve muscle recovery after training, we can use specific biostimulants such as targeted amino acids, fatty alcohols, or plant steroids to target or boost particular plant functions. One actively supports root development, for example, while another improves photosynthesis, and another drives quality pollen development to improve fruit set."

SAFETY FOR HUMANS

So, if these bio-agents kill worms and diseases in plants, are they dangerous to humans? Dr Niland explains. "There are rigorous controls in place. Before you have a biocontrol measure registered, it has to be proven safe for people. We must also demonstrate that we are not introducing a foreign agent that will become a pest in its own right.

"A nice example using Bt (*Bacillus thuringiensis*), a bacterium that makes a set crystal protein which kills caterpillar pests in crops. Bt is able to kill moth larvae because they have a highly alkaline stomach, which is needed for the crystal protein to unravel and become effective. But it is irrelevant to humans because we have an acidic stomach, so it cannot have an impact."

IMAGE: Daniela – stock.adobe.com

[26] Beneficial insects: NPV (nucleopolyhedrovirus) (n.d.). Queensland Government. Farms, fishing and forestry.
[27] Andermatt PHP (n.d.). Nomu-Protec.
[28] Yao, X., Guo, H., Zhang, K., Zhao, M., Ruan, J., & Chen, J. (2023). Trichoderma and its role in biological control of plant fungal and nematode disease. Frontiers in microbiology, 14, 1160551.

4. MORNING ON AN AFRICAN FARM

Farming is a pursuit for those who readily roll up their sleeves to do whatever is needed, at whatever time of day or night, in any weather conditions. As much a calling as a profession, it has always demanded hard physical work, scientific knowledge, and business acumen to succeed. However, these days, another facet has become a necessity. Farmers also need to be tech entrepreneurs. Based on a real farm in the Midlands region of South Africa's KwaZulu-Natal province, the following segment captures a typical morning for the farm owner-manager as relates to only local technology deployed on the farm.

IMAGE: YuriArcursPeopleimages – elements.envato.com

IMAGE: Panumas – stock.adobe.com

A DAY IN THE LIFE ON A TECH-ENABLED FARM

Waking at dawn will likely always be a part of farm life. Be it the cock's crow or an alert from an AI fire-detection system, the reason is partly cultural. Farming starts early.

A scan of monitoring systems might follow shortly after morning coffee and hearty farm-style toast. The agritech farmer might begin with a look at the fire-detecting thermal cameras. These do the job once only performed by multiple watch towers spread across the valley, operated by people with binoculars. People who got tired, fell asleep, and often went for long spells not checking behind them.

AI-powered cameras can cover 360 degrees every three minutes. Powerful cameras can pick up evidence of fires and set off alerts at a base station, informing farmers.

Firehawk is a South African service provider with operations in Chile, Brazil, Malawi, and Ghana. It chiefly monitors timber plantations but also some sugar cane.

With alerts set to arrive by smartphone, this check-in would simply be a function of farmerly diligence.

For similar reasons, our farmer might also check his soil moisture, but not with a walk across the fields. Again, via laptop or smartphone.

Probes buried across the land measure moisture levels at a chosen number of depths. Depending on the time of year, the crop, and prior experience, an algorithm will guide our farmer on whether and how much to water his crops.

AquaCheck is a South African hardware provider of moisture monitoring. It also measures the soil temperature. Integration with GPS inserts the location element. Information can be beamed out via telemetry for relevant number-crunching.

Our commercially minded farmer might also have linked his soil-monitoring system to his accounting system. Cape Town-based Moneyworks is a local provider who can help here.

Founder and CEO Hardy Jonck explains, “Things like soil monitoring produce excellent data for the business management role. But only if the farmer uses it. That’s where we come in. Once the farmer’s technology flags the need for, let’s say, more fertiliser, that information can come directly to us. We can then include manually created data to close the loop on costs. This way, the farmer can do some detailed cost accounting, understanding which areas of his farm are costing what to cultivate.”

With time, agronomists can get more and more accurate with their forecasts and plans for how much fertiliser to purchase and when. This saves the farmer time and money.

Next, our farmer might glance at his sap levels. Sap monitoring is like performing blood tests on plants. It provides data on nutrient levels, update capacity, and general plant health. This means early detection of all sorts of deficiencies, giving the farmer the chance to act early.

Whether pH levels, carbohydrate uptake or magnesium levels, sap data provides a wealth of information. A local success story is OmniSap. “Omnia’s state-of-the-art laboratory, Chemtech, is the only analytical lab worldwide with ISO17025 accreditation specifically for sap analysis. Omnia offers the OmniSap analytical service in South Africa, as well as in Australia, Namibia, Kenya, Zimbabwe, Zambia, and Mozambique.

“OmniSap also promotes environmental stewardship by optimising Nutrient Use Efficiency (NUE) and Water Use Efficiency (WUE), thereby reducing risk for the producer as well as the environment.”[29]

It may also be that time of the year for our farmer to deploy bugs. An increasingly useful method of biocontrol, farmers can distribute the right sort of natural predators in the correct numbers to control pests.

A local collaboration does just this using drones. Skybugs, from Aerobotics, combines its drone technology with the biological assets of FieldBUGS. In this case, our farmer may need to drop *Phytoseiulus persimilis* to prevent, control and manage spider mites on citrus, grapes, dates, cannabis, pome fruit, blueberries, strawberries, and various vegetable crops.

Benefits include per-tree level accuracy, the ability to reach dense crops and the tops of trees across any terrain, a speed 25 times faster than manual release, and the ability to cover more than 200 hectares per day by drone.

It is only 8 am, and our KZN farmer has already used or interacted with a dozen locally developed agritech solutions, each making his farm better, the industry larger, and the local economy stronger.

IMAGE: Es sarawuth – stock.adobe.com

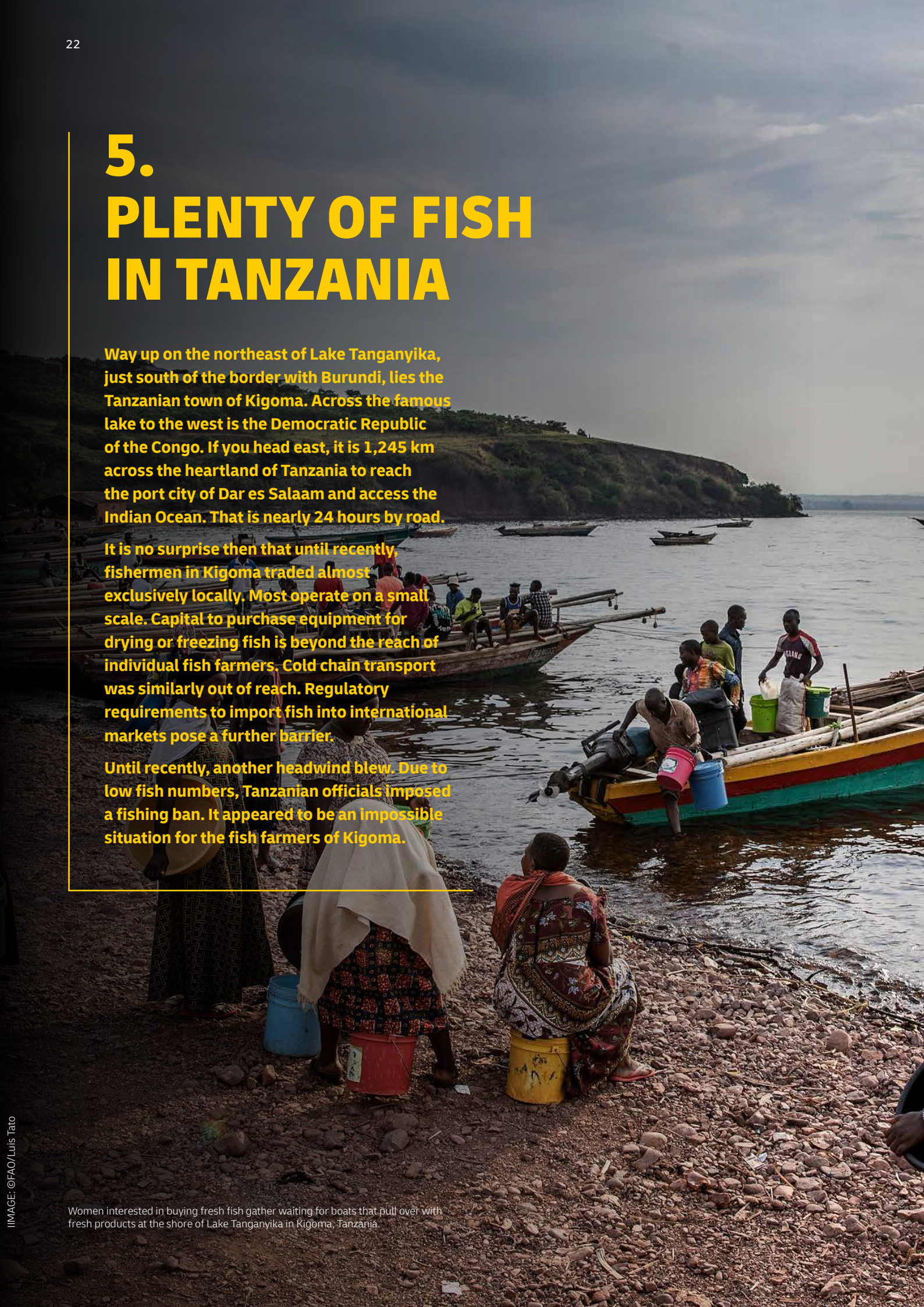
[29] Omnia Nutriology (n.d.). OmniSap.

5. PLENTY OF FISH IN TANZANIA

Way up on the northeast of Lake Tanganyika, just south of the border with Burundi, lies the Tanzanian town of Kigoma. Across the famous lake to the west is the Democratic Republic of the Congo. If you head east, it is 1,245 km across the heartland of Tanzania to reach the port city of Dar es Salaam and access the Indian Ocean. That is nearly 24 hours by road.

It is no surprise then that until recently, fishermen in Kigoma traded almost exclusively locally. Most operate on a small scale. Capital to purchase equipment for drying or freezing fish is beyond the reach of individual fish farmers. Cold chain transport was similarly out of reach. Regulatory requirements to import fish into international markets pose a further barrier.

Until recently, another headwind blew. Due to low fish numbers, Tanzanian officials imposed a fishing ban. It appeared to be an impossible situation for the fish farmers of Kigoma.



Women interested in buying fresh fish gather waiting for boats that pull over with fresh products at the shore of Lake Tanganyika in Kigoma, Tanzania.

IMAGE: ©FAO/Luis Tato

TEACH A PERSON TO DISTRIBUTE

Then things changed. In 2019, the fishing ban was lifted. Local agents and exporters were licensed to export fish. Fish farmers eagerly reactivated their boats and cast their nets once again. Soon, they were supplying local markets again.

That's when DHL noticed an opportunity. Its global footprint and access to technology could just be the lever between the fish farmers of Kigoma and international markets.

Logistics were such that freezing the fish would be uneconomical. The team began investigating options to dry and vacuum-pack the harvest.

Local markets already existed for intermediaries to purchase and dry the fish. DHL saw an opportunity to expand further. What if the fish could be vacuum-packed, weighted, and distributed around the world?

DHL began researching the opportunity, using Kigoma as the test site. A visit in March 2019 enabled stakeholder engagement and fact-finding. By 2020, the town was home to the fully fledged service point for project "Fish Commerce".

DHL sourced vacuum-packing machines from China and installed them alongside digital scales and labelling machines. This meant the fish could be packaged and placed in ordinary DHL shipping boxes. The company also provided local SMEs with training to ensure the quality of the product met the high standards of international markets.

Jamil Athuman Halfan Mkuyu, the managing director of Mkuyu Fish Export, an intermediary in Kigoma, explains. "After DHL came on board to help us with the shipping of our products, it solved our logistics concerns. DHL also noticed that we were using the incorrect packaging for our products. DHL brought the correct boxes, and it helped me showcase my brand and products to my customers in a professional manner.

"My business was able to grow significantly. I am pleased to say that my growth trajectory spiked when I became part of DHL. The team of experts at DHL really helped us, and today, our business continues to grow. When our products reach the USA, our customers are very pleased.

"I am happy to use DHL as my Express partner because of the way they ship my products. For instance, I export fish, and because the fish are fragile, they tend to break easily, but the packaging DHL provides means my product is intact when it reaches customers... DHL has helped me connect with customers from the United States, Australia, and Canada, and we also transport to the United Kingdom."

DHL also introduced its own approval matrix to ensure quality, as well as ensuring regulatory compliance for overseas destinations.

A worker weighs bags of dried fish for international export at a DHL logistics hub in Kigoma, Tanzania

IMAGE: ©FAO/Luis Tato

Shipping of this nature would ordinarily require small entrepreneurs to have a credit account. However, DHL was able to lower this barrier and provide the service on a cash basis. Digital waybills also mean that brokers and fish farmers can track deliveries and see when they arrive at their final destination.

Paul Makolosi, DHL Country Manager for Tanzania and Kenya, has been integral to the Fish Commerce project. "The work that DHL has been doing in Kigoma with the SMEs has seen the SMEs grow their volumes," he explains. "We wanted to balance that growth with sustainable fishing. We realised that the Fisheries Department in Kigoma lacked patrol boats. That risked unsustainable use of the resources in the Lake, in accordance with the United Nations Sustainable Development Goals."

SMALL FISH TO BIG POND

With the system established in Kigoma, DHL expanded to 21 countries across sub-Saharan Africa, including Nigeria, South Sudan, and Kenya. The initiative also won a DHL Global CEO Award.

The lessons accumulated from this process suggest more types of fish and even dried snails could go from local to global.

6. AI AND AGRITECH: THE NEXT GLOBAL FRONTIER

IMAGE: jirsak – stock.adobe.com

MALTHUS VERSUS TECHNOLOGY

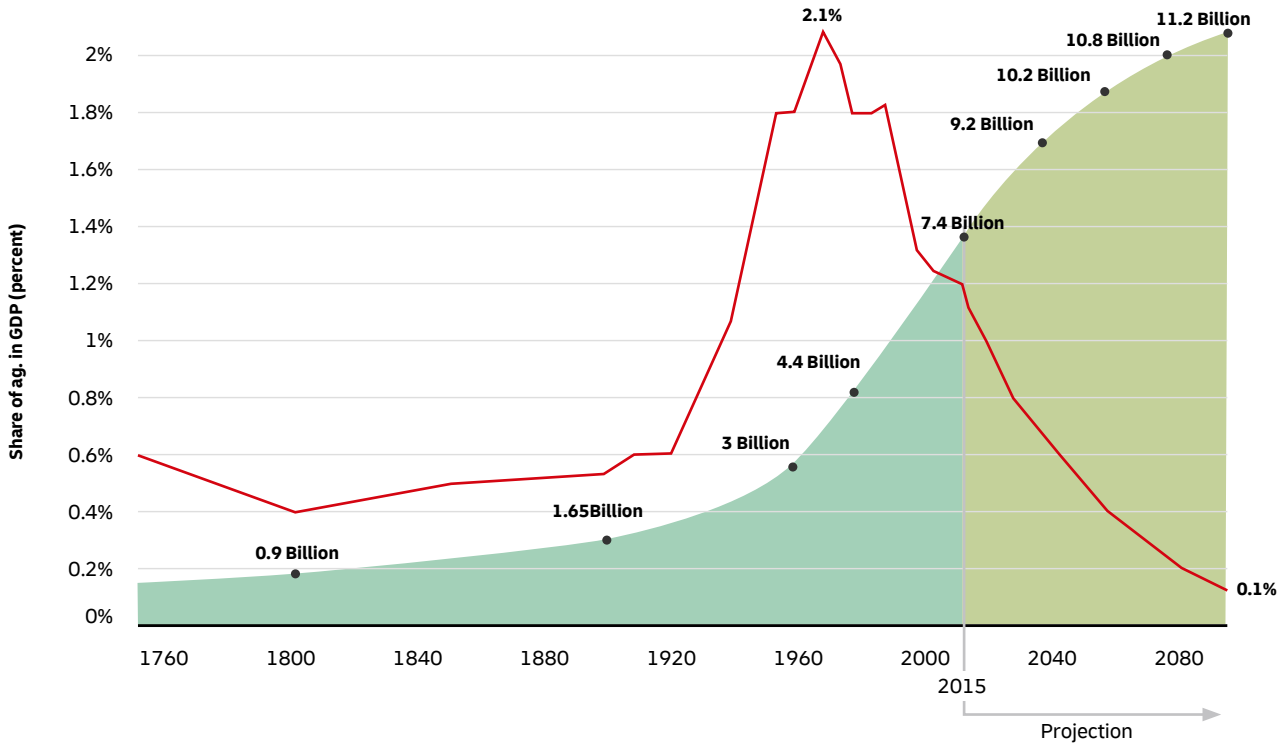
"The power of population," proclaimed English economist Thomas Malthus in his seminal 1798 book, "is indefinitely greater than the power in the earth to produce subsistence for man."[30]

According to his model, sustained improvements in prosperity are impossible. Any improvements in productivity simply result in population growth, which negates any growth in real income per person. A dismal view of the world.

Malthus was particularly glum about agriculture. By his estimation, populations tend towards increase geometrically, doubling every two to three decades, while food production can only ever increase arithmetically, in a straight line. The upshot of such a calculation is that populations can follow their tendency without steadily impoverishing themselves.

Fortunately, Malthus was dead wrong...eventually. He was writing at a time when just fewer than 1 billion of us occupied the planet. A century later, in 1900, we were up to 1.65 billion, and living standards had only increased modestly. Over the century that followed, that figure was up to just over 6 billion.[31]

FIGURE 14
WORLD POPULATION AND POPULATION GROWTH RATE

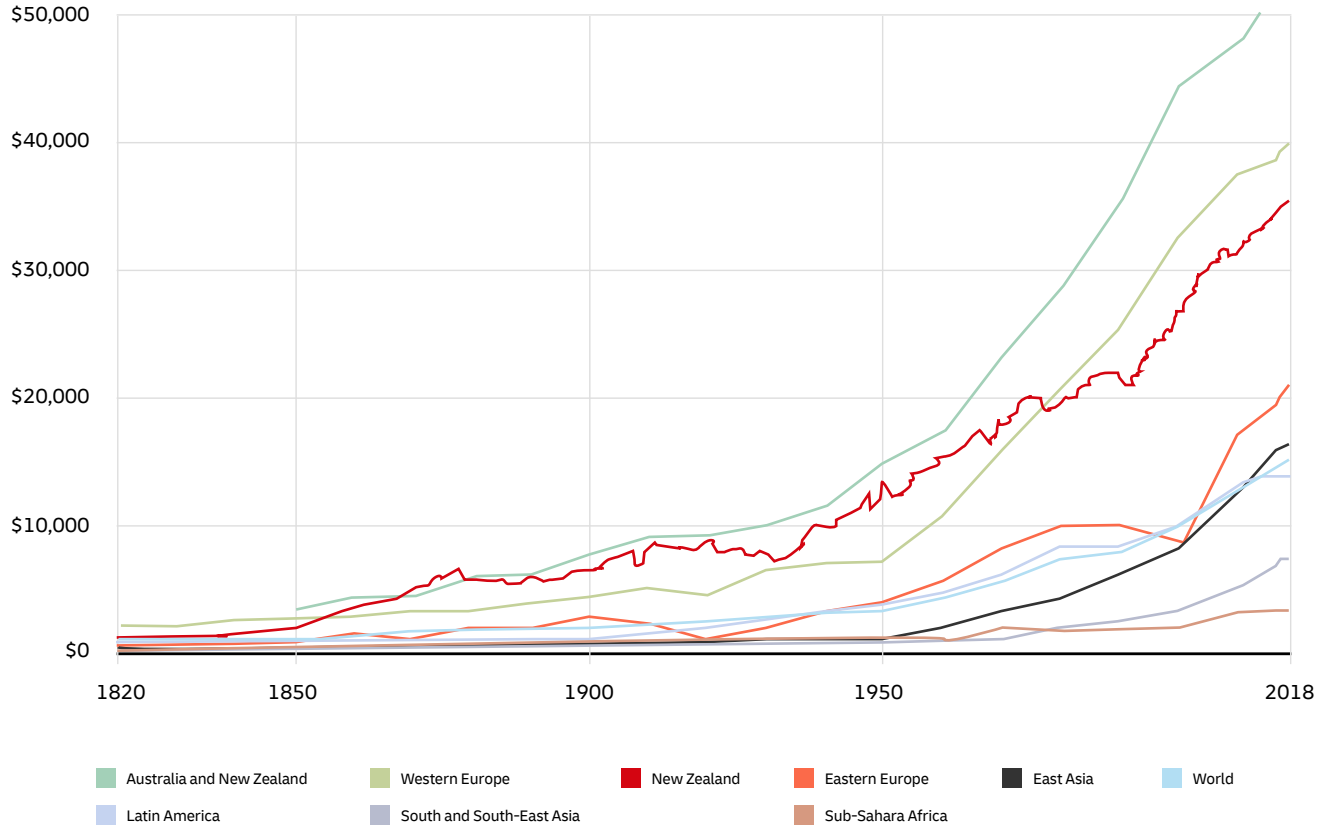


Source: Mesterházy et al. (2020). Forecast beyond 2015.

30 Malthus, T. R. (2018). An essay on the principle of population: The 1803 edition. Yale University Press.
31 Mesterházy, Á., Oláh, J., & Popp, J. (2020). Losses in the grain supply chain: Causes and solutions. Sustainability, 12(6), 2342.

Had Malthus's analysis been accurate, the best we could have hoped for was to retain the same level of prosperity over these two centuries. In reality, during this spell, many regions saw GDP grow far faster than population growth. Therefore, GDP per capita – a sound proxy for prosperity – increased.

FIGURE 15
GDP PER CAPITA (CONSTANT 2011 US DOLLAR PRICES) BY REGION



Source: Maddison Project. (2018). Groningen Growth and Development Centre.

As Figure 15 above shows, not all regions participated equally in this bonanza of prosperity. The region labelled "Western Offshoots", covering the US, Canada and Australia, enjoyed the lion's share of the improvements in quality of life. Western Europe was in second place. Sub-Saharan Africa, which makes up the bulk of the region covered in this report, failed to keep up.

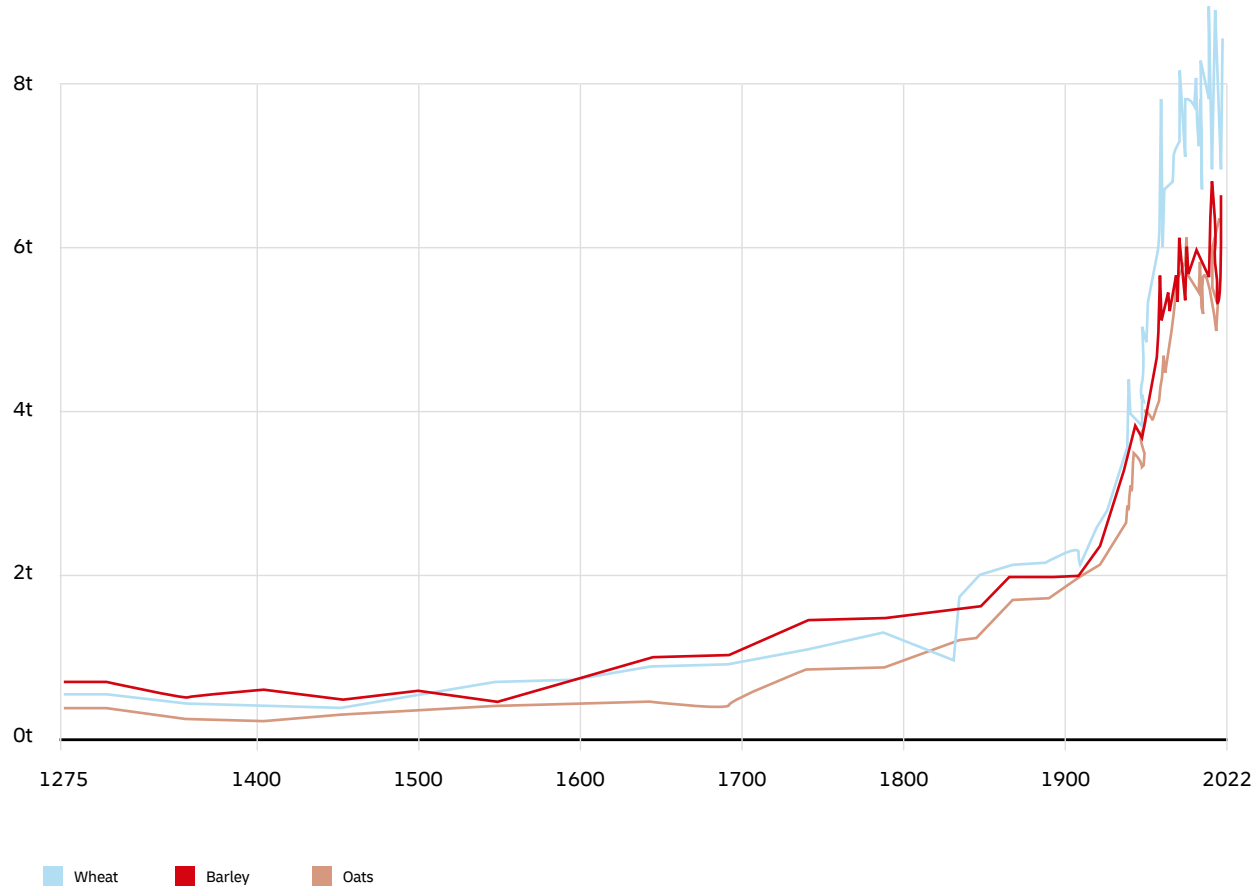
What was it that disproved Malthus? He had failed to properly forecast ingenuity. In 1800, an upper-class American household lived a rural lifestyle and moved about on horseback. "By 1900, that same household had access to electricity, coal, telephones, trains, steamships, trolleys, and bicycles. Cars were just beginning to hit the market."[32] Ford's Model T only hit the road in 1908, making motoring more affordable with mass production.

[32] University of Colorado Boulder University Libraries (n.d.). The History of Western Science: Industrial Revolutions (1800s).

Just a century after that, we're in a world of iPhones, remote work, and McDonald's.

Part of Malthus's miscalculation was a failure to accurately appreciate our ability to obtain more calories from less land. One might forgive him this. For hundreds of years leading up to 1800, farmers scarcely became more productive. It was only after Malthus's death and, in particular, with the technological boom from the mid-20th century, that yields improved exponentially. For example, in the UK, wheat yields improved from about 1 tonne per hectare to nearly nine times that in 2022.[33]

FIGURE 16
LONG-RUN CEREAL YIELDS IN THE UNITED KINGDOM



Source: Ritchie, H. (2022).

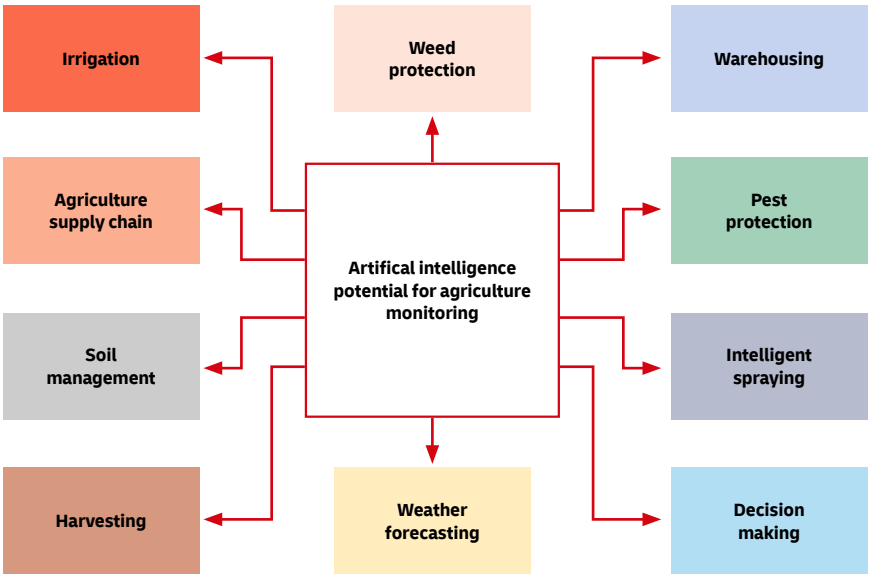
AI IN ACTION

Malthus could not possibly have imagined the latest driver of productivity growth in farming. Artificial intelligence (AI) is behind quantum leaps in farming efficiency. It is helping farmers to do everything from selecting the best seeds for conditions and forecasting the weather to aiding soil quality and conducting three-dimensional laser scans to evaluate crop health.[34]

IMAGE: jzapp2photo – stock.adobe.com

[33] Ritchie, H., & Roser, M. (2024). Increasing agricultural productivity across sub-Saharan Africa is one of the most important problems this century. Our World in Data.
[34] Javaid, M., Haleem, A., Khan, I. H., & Suman, R. (2023). Understanding the potential applications of Artificial Intelligence in Agriculture Sector. Advanced Agrochem, 2(1), 15-30.

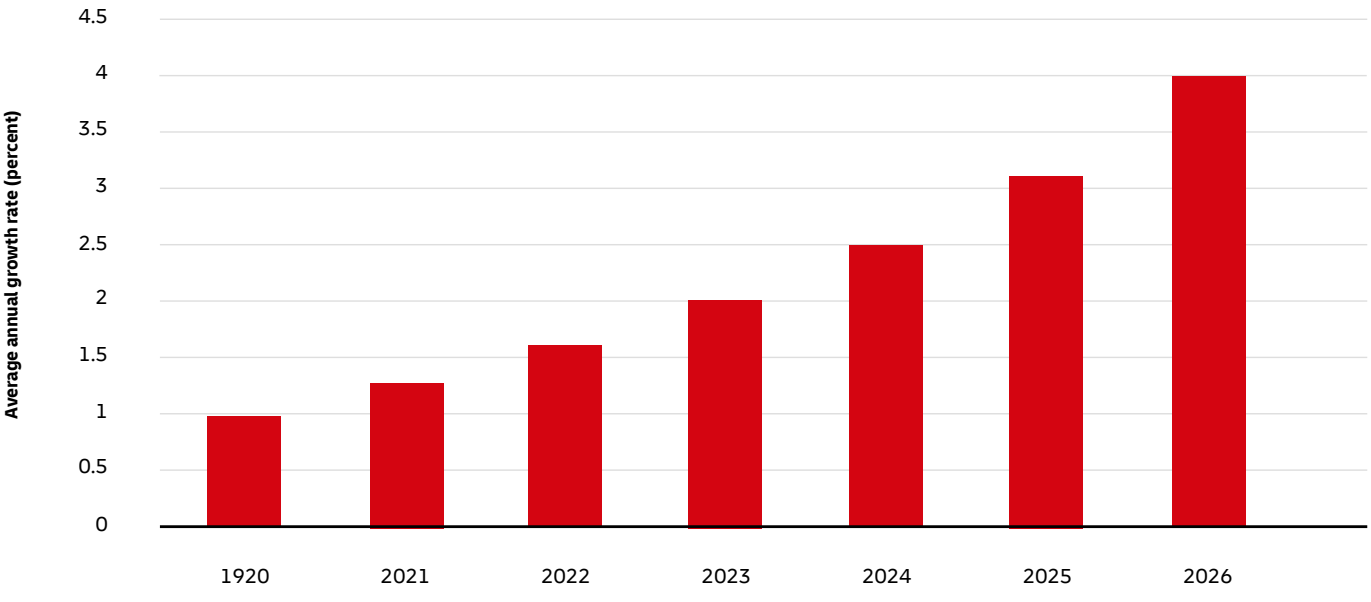
FIGURE 17
SOME AI POTENTIAL FOR AGRICULTURAL MONITORING



Source: Javaid et al. (2023).

AI in agriculture is growing steadily. The market is set to reach double its 2023 valuation by 2026.[35]

FIGURE 18
PROJECTED MARKET VALUE OF AI IN AGRICULTURE



Source: AlZubi et al (2023).

[35] AlZubi, A. A., & Galyna, K (2023). Artificial intelligence and Internet of Things for sustainable farming and smart agriculture. IEEE Access.

Hamed et al. provide a snapshot of the ways in which AI is enhancing productivity and sustainability in agriculture:[36]

1

PRECISION AGRICULTURE:

"AI-powered sensors and drones provide real-time data on soil conditions and crop health, enabling precise interventions. For example, farms that adopted AI-driven irrigation systems reported up to a 20% increase in crop yields due to optimised water usage."

2

PREDICTIVE ANALYTICS:

"Machine learning algorithms can forecast weather patterns, pest outbreaks, and disease spread. For instance, AI models analysing historical climate data and current weather conditions have been shown to enhance the accuracy of crop yield predictions and support timely decision-making."

3

ROBOTICS AND AUTOMATION:

"AI-driven robots and autonomous vehicles are increasingly used for planting, harvesting, and weeding. These technologies not only reduce the reliance on manual labour but also improve efficiency and precision in agricultural operations."

4

DATA-DRIVEN DECISION-MAKING:

"AI systems integrate data from various sources, including satellite imagery and IoT sensors, to provide actionable insights for farm management. This data-driven approach enables farmers to make informed decisions regarding crop management, resource allocation, and risk mitigation."

USE CASES

A 2021 study covering the US and Canada found that weeds cause an annual production loss of around 10 billion kg for just a single crop: winter wheat. That amounts to around $2 billion.[37] Weeds compete with crops for space and nutrients. Removing them by hand is slow. Now, AI can do much of it.

John Deere's See & Spray Ultimate system resembles a traditional sprayer. Except that attached to its arms, which spread out on each side of the tractor, are 36 AI-powered cameras. This enables the system to pick out weeds individually and conduct precision strikes with the minimum necessary volume of herbicide to kill the alien vegetation.

The system is currently only set up to work with corn, soybeans, and cotton, and is limited to the US. Fundamentally, nothing prevents it from being adapted to African markets. John Deere uses a database of 300,000 images of weeds to enable the AI brain to identify them.

Why not add drones? Canadian firm Precision AI has done just that. Trained on images of 15,000 plant species, the six-year-old business's aerial drones can distinguish corn, wheat, and soybeans from weeds, picking up any offending plant bigger than about half a sesame seed, they claim. Flying at an altitude of between 1.2m and 1.6m, these drones can deploy herbicides with an estimated 96% accuracy.

How can you get more precise than that? We can attach lasers to the AI system. That is what Seattle-based firm Carbon Robotics has done with their LaserWeeder. As per the John Deere system, this is a terrestrial tool. In this case, herbicides are eliminated in favour of thermal lasers that kill weeds. The dead plant matter is then simply composted back into the soil. CEO Paul Mikesell reckons the system can zap 100,000 weeds per hour.

Sales of the Nvidia GPU-powered system began in North America in 2022, and expansion into Europe is the next goal. The company claims a payback period between one to three years, submillimetre accuracy, and compatibility with over 100 crops.

[36] Hamed, M. A., El-Habib, M. F., Sababa, R. Z., Al-Hanjor, M. M., Abunasser, B. S., & Abu-Naser, S. S. (2024). Artificial Intelligence in Agriculture: Enhancing Productivity and Sustainability. International Journal of Engineering and Information Systems, 8(8), 1-5.
[37] Flessner et al. (2021). Potential wheat yield loss due to weeds in the United States and Canada. Weed Technology, 35(6), 916-923.

AI, drones, and lasers. What next? Space? Yes. A collaboration between the University of Pretoria and the Council for Scientific and Industrial Research (CSIR) has used images snapped by the Copernicus Sentinel-2 satellite to generate smart maps that distinguish maize plants from weeds. Highlighting the crops in green and weeds in red, farmers can target areas struggling with weeds for efficient elimination.

In the work written up and published by Physics and Chemistry of the Earth, the method is 95% accurate. "The classification matrix consistently showed that weeds were detected with high user and producers' accuracy of 95%. These results indicate the utility of the enhanced spectral configuration of Sentinel-2 data in the early detection of weeds in maize farms."[38]

This system has the potential to be used far more widely. It could be adapted to "land use and land cover changes, biodiversity monitoring, water resource management, wildfire monitoring, detecting grass nutrients to understand animal grazing patterns, and even climate change impact assessments."[39]

Professor Abel Ramoelo, an expert in Earth observation who is involved in the project, sees "an opportunity for the South African National Space Agency (SANSA) to start looking at satellite applications for societal relevance, and to encourage the development of our own systems and our own satellites that are launched under the auspices of South Africa."[40]

Model of a Sentinel-2 satellite

IMAGE: Rama, CC BY-SA 2.0 FR <https://creativecommons.org/licenses/by-sa/2.0/fr/deed.en>, via Wikimedia Commons

AlZubi and Galyna[41] provide a useful summary of cutting-edge applications of AI in agriculture by category. Here we sample a portion of their table:

TABLE 1
AI APPLICATIONS AND THEIR USES

Category	Tool/Company	Description
Climate conditions monitoring	allMETEO	A gateway for managing Internet of Things (IoT) micro weather sensers, gathering data in real-time, making a weather map, and offering an [application programming interface] API for simple data transmission.
Agricultural machines/drones	Sky Squirrel	A drone system intended to increase crop productivity and lower expenses. A drone's path is preprogrammed by users, and computer vision is used to capture photographs... The collected data and photographs are then combined and analysed by algorithms to produce a comprehensive report on the health and condition of crops.
Livestock monitoring and management	Cowlar	A smart neck collar for tracking the temperature, activity, and other behaviour traits of dairy cows. It employs a solar-powered base unit and a minimally intrusive, waterproof monitoring device that are both comfortable for the animal. To accurately diagnose oestrus, it may track body movement patterns and gait.
Crop and soil health management	Trace Genomics	By analysing a soil sample's DNA and comparing it to a sizable soil DNA database, a soil monitoring system employs a machine learning technique to create a health report for the sample.

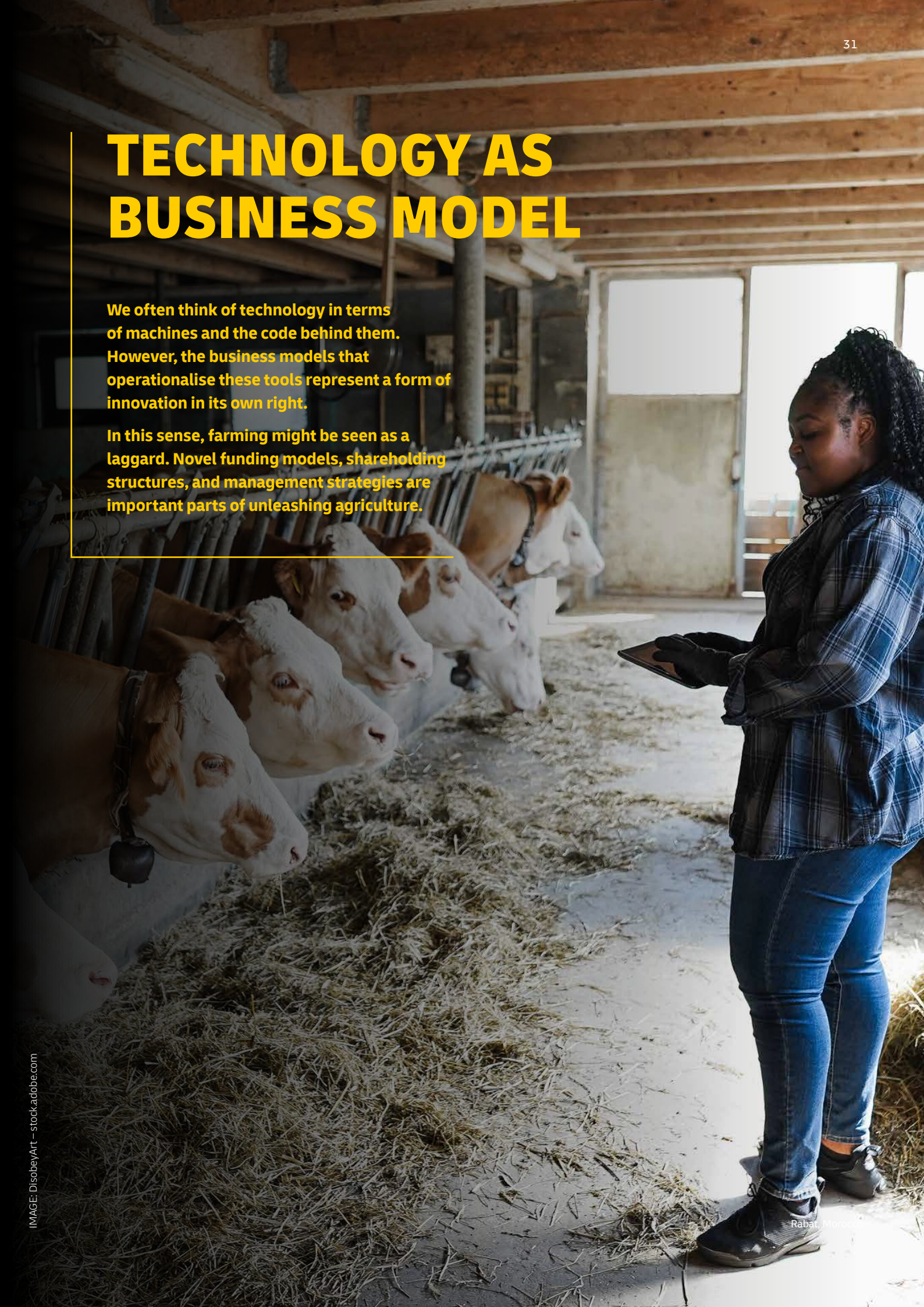
Source: AlZubi et al. (2023).

[38] Mkhize, Y., Madonsela, S., Cho, M., Nondlazi, B., Main, R., & Ramoelo, A. (2024). Mapping weed infestation in maize fields using Sentinel-2 data. Physics and Chemistry of the Earth, Parts A/B/C, 134, 103571.
[39] Ramoelo, A., Cho, M., & Mkhize, Y. (2024). UP and CSIR pioneer maps for maize farmers to enable precision weeding. LeadUP Podcast: Up close with the new VC. University of Pretoria.
[40] Ibid.
[41] AlZubi et al. (2023).

TECHNOLOGY AS BUSINESS MODEL

We often think of technology in terms of machines and the code behind them. However, the business models that operationalise these tools represent a form of innovation in its own right.

In this sense, farming might be seen as a laggard. Novel funding models, shareholding structures, and management strategies are important parts of unleashing agriculture.



Rabat, Morocco

IMAGE: DisobeyArt – stock.adobe.com

SEEDS OF AN IDEA

Ayanda Majola was building her career in corporate finance when she had a stark realisation. She knew very well how advanced South Africa's financial sector is. Having completed her Chartered Accountancy articles with Investec, she remained at the financial powerhouse for a spell in structured leveraged finance before a move to Deutsche Bank. But there, Majola could feel the vast divide between the office towers of Sandton in Johannesburg and the working, saving, investing public.

"My mom was retiring," she explains. "This is a major liquidity event. You work your whole life, building a pension, and then have to make critical decisions on how to use that money to finance your retirement. This brought home the reality of how most South Africans strive to make the most of their savings."

And it wasn't just a case of specialist skills. "In helping my mom, I realised there was a limited range of options," Majola says. "Traditional assets are good. There's a decent selection available from reputable firms. However, I felt like there were gaps."

Specifically, Majola struggled to find efficient ways to participate in tangible investments that make sense to everyone. An exchange-traded fund (ETF) in a basket of Wall Street stocks is one thing. A very useful way to invest. However, the productivity behind the listed product happens far away in an intangible way.

Majola engaged in some hands-on market research through discussions with stokvels. Given her background, her suggested products make sense: derivatives, shares and the like. "We pitched some sexy financial products," she recalls. "Stokvel members found those interesting. But not compelling. Their questions suggested they wanted straightforward fundamentals.

IMAGE: Supplied

AYANDA MAJOLA, CO-FOUNDER AND CEO OF SV CAPITAL

Where will our money go? What are we investing in? How much will we make?"

Majola could see the benefits. Apart from the clarity and proximity of what the stokvel members were describing, a product like this would introduce a new level of diversification. As Majola brainstormed with her business partner, the pair landed on the idea that would become SV Capital: a transparent, simple way for anyone to invest in agriculture.

CULTIVATING A BUSINESS

Farming has traditionally been a difficult industry to invest in. Small farms are hugely labour-intensive and inefficient. Large farms are very difficult to fractionalise, expensive, and highly illiquid. They need special skills, vast capital, and (as this report highlights) the latest technology. They also tend to be held by generations of families or owned by large corporations, some of which are listed.

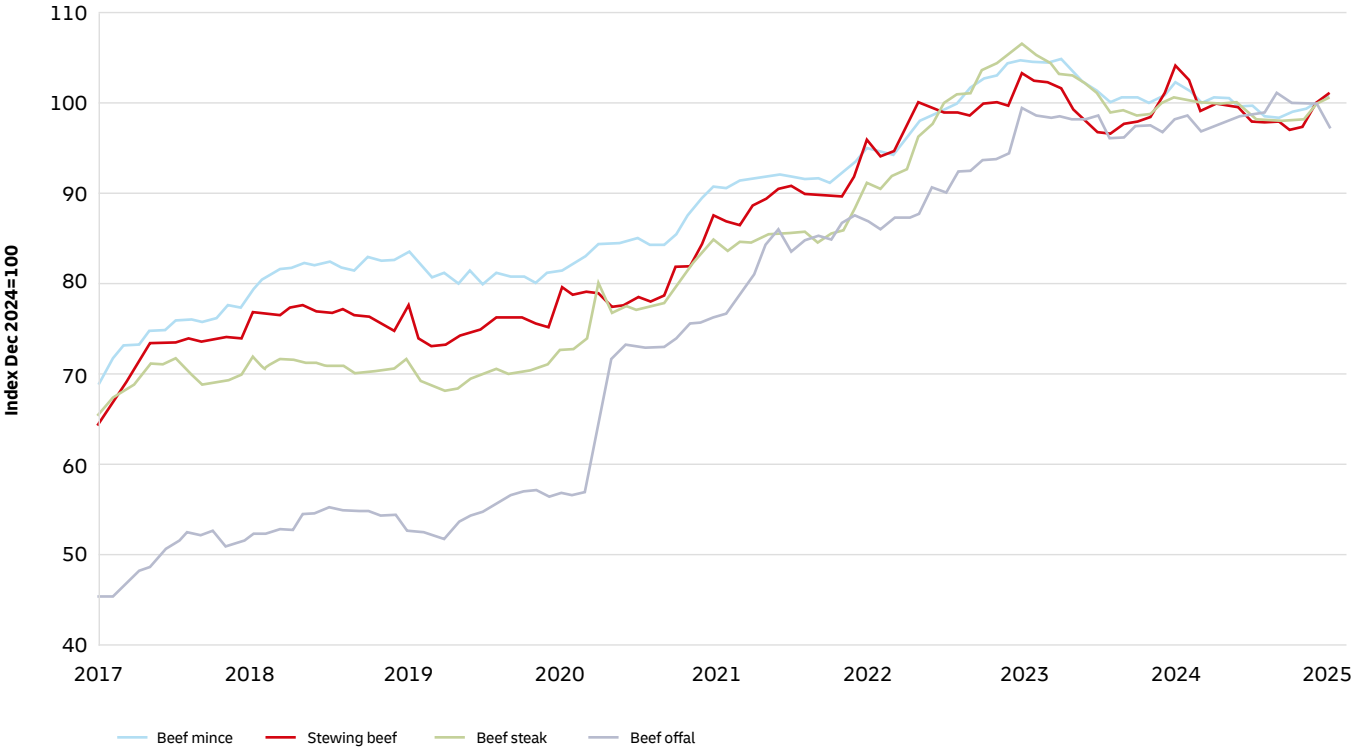
In short, Majola struggled to see a neat, practical way for people like her mom to invest in farming. That's where she and her co-founder applied their financial minds.

In 2017, Majola co-founded SV Capital with a straightforward premise: to create a platform allowing investors to purchase fractional stakes in a herd of livestock. The value would be determined by weight and market prices. The animals would be reared on a feedlot by experienced farmers. At the end of the spell, once ready for slaughter, the livestock would be sold to an abattoir based on new weights and market prices, and a return would be generated for shareholders.

HOW IT WORKS

Majola and her business partner determined that the optimal starting weight for the cattle is between 200kg and 230kg. With a highly specialised diet, the cattle can put on approximately 1.9kg per day. Once each cow reaches between 450kg and 500kg, it is time to sell and realise the gains. This process takes approximately 120 days, meaning the capital can be deployed over three cycles per year.

FIGURE 19
BEEF PRICES IN SOUTH AFRICA BY CUT



Source: Stats SA (2025). P0141 Consumer Price Indices, all urban areas.

Neither co-founder came from a farming background, so the key was to partner with the right experts to take care of the husbandry. SV Capital now partners exclusively with Beefcor, a large and established feedlot operator.

Investments happen over 12-month cycles. At the end of each one-year period, investors provide maturity instructions to either pay the money out or reinvest for another year.

SV Capital has been able to provide an average annual return of 14.5%. They charge a 20% performance fee, which is calculated after the 12 months. The performance fee is effective if the benchmark rate of 13% is achieved. If the returns exceed the benchmark rate, the returns above the benchmark will be split 80% to the investor and 20% to SV Capital.

A minimum investment of R500 makes this a viable option for many South Africans. Investors do not have specific claims on individual animals. Each fractional investment in issue is a claim on the value of the herd as a totality.

IMAGE: sandsun – stock.adobe.com

RISK MANAGEMENT

Majola and her business partners continue to puzzle over ways to improve risk management. “These are living, physical assets,” she explains. “Cattle can get sick. They’re also open to natural disasters.”

One common concern: what if some cattle die? SV Capital has a 99% guarantee in place with Beefcor. This assumes that, on average, one cow in 100 will die. Anything over and above that is for the farmer’s risk.

Another risk that applies to all farmers is the fluctuating market price. Like all farming investors, SV Capital clients can only get the market price on the day they sell. Majola has explored the idea of call options and put options to mitigate. However, that all attracts a premium. “The best way to manage this is with the ability to stay in the market,” she concludes. “If your business is designed to see out the downs and enjoy the ups, you can participate in the long-term gains. That’s where our focus is.”

Majola cites multiple obstacles she has had to overcome, including security. Stock theft is a reality in South African agriculture. Part of the solution is to team up with a full-service partner with the scale and expertise to implement the proper security measures.

BOVINE BENEFITS

The SV Capital model offers advantages that mainstream investments cannot. One is the tangible nature of the assets. This appeals to many investors, who value knowing their capital directly supports South African farming operations. You can see and track the growth of the cows in a way that one cannot do with a listed share or bond.

This speaks to the diversification element. If you are looking for an asset that exhibits a low correlation with an ETF holding technology stocks, owning a fraction of a herd of cattle is certainly an option. This can contribute to a portfolio's overall risk-return profile.

Majola is eager to add a positive contribution to the economy. This is a novel structure through which to raise capital to fund farming activities. It is also a model that allows many ordinary South Africans to participate directly by owning their own fraction of a herd of cattle, but without the heavy capital investment that is typically required to access an efficient farming operation.

"Our investment is effectively working capital for a professional farm," Majola continues. "Farmers are constantly in need of reliable sources of capital. We also enable local employment. Our partner farmers stimulate the local economy with jobs and buy buying from local suppliers."

WHAT'S NEXT?

SV Capital has gradually introduced more technology into the business. The original website was relatively simple. Now, there is an app and systems are integrated. Clients can manage their investments digitally.

Several announcements are planned for the near future. Cattle are already fitted with RFID chips, which allows for the possibility of weighing them in the pen and recording their weights automatically.

"We could even give clients the power to view their investments live," says Majola. We could have a camera providing a live feed or even a drone to conduct regular visits to check the herd."

Majola distils what she believes to be the major challenge for the agriculture industry in South Africa. "There is no middle ground. We have a small number of major owners of agricultural assets, from farms to distribution networks. And then we have subsistence farmers. There is very little in between those two. The major players have the power to move the market. And small farms simply aren't efficient enough. We are able to plug into the benefits of scale by partnering with a professional outfit. That is not an option for subsistence and small farmers.

"Commercial innovations like SV Capital's model, alongside tech-driven democratisation of investing, could empower small farmers and help to revolutionise the industry."

IMAGE: AnnaStills – elements.envato.com

SEEDING GROWTH IN AFRICAN AGRICULTURE: 5 SUCCESS STORIES

BY WANDILE SIHLOBO AND TINASHE KAPUYA

By 2050, more than a quarter of the world's population will be African. That is a lot of mouths to feed and a lot of people in need of jobs. African agriculture has the potential to meet these needs, but it is held back by limited investment and lagging technology adoption.

These five success stories showcase the policies, technologies, and investment strategies that are tackling the biggest challenges in African agriculture to drive growth. From tractor-leasing apps to improved fish farming methods, these case studies show that the right strategies can supercharge the sector to ensure food security and improve livelihoods across the continent.

IMAGE: Miha Creative – stock.adobe.com

IMAGE: baliukhpavlo – elements.envato.com

CASE STUDY 1:

"UBER-FOR-TRACTORS"

Africa's tractor market is large and growing, but small-scale farms, which make up the majority of African agriculture, remain largely unmechanised. Digital tractor-leasing platforms offer a powerful solution.

THE FACTS

In 2024, Africa's agricultural tractor market size was estimated at **US$3.5 BILLION**[42]

...and is projected to grow by another **US$400 MILLION** by 2029[43]

Farm power in Africa is about

65% human

25% draught (i.e. animals)

10% engine-based[44]

THE RISE OF TRACTOR-LEASING PLATFORMS

A new type of digital platform, often dubbed "Uber-for-tractors", is enabling smallholder farmers to access previously unaffordable machinery. Examples include:[45]

TROTRO TRACTOR, which has benefitted an estimated 16,539 farmers with 14,784 hectares ploughed

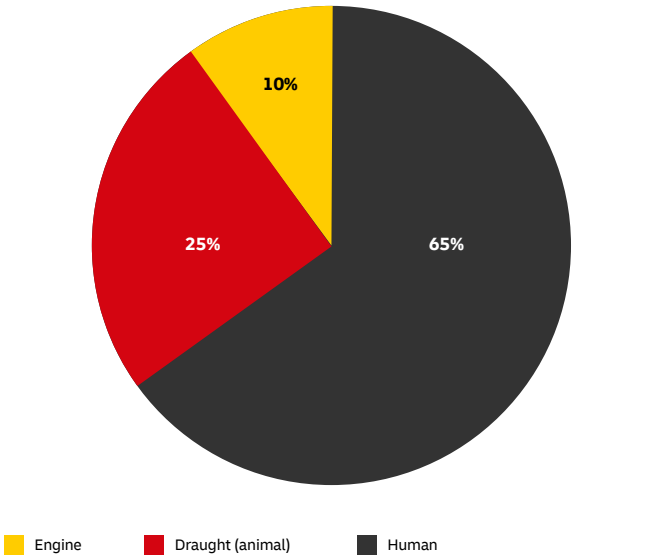
ETC AGRO 21,453 farmers with 52,156 hectares ploughed

HELLO TRACTOR 41,000 farmers with over 140,000 hectares ploughed

Collectively, these platforms operate in nine countries across Africa. Each platform runs a slightly different business model. For instance, Hello Tractor partners mainly with equipment sellers, whereas TROTRO Tractor works directly with operators and smallholder farmers. Hello Tractor's partnerships with equipment sellers form a core part of its business model, as it seeks to create a demand pull through its digital app that links equipment sellers/owners, operators and smallholder farmers through community-based booking agents, who rent out their equipment through the app. Smallholder farmers book their slots through a booking agent, and Hello Tractor creates batches of these booking requests within a region to ensure profitable demand aggregation for equipment owners and operators.

42 ITC Trade Map (2024).
43 Africa Agricultural Tractor Market Size (2024-2029). (2023). Mordor Intelligence.
44 African Union Commission (2022). CAADP Third Biennial Review Report. African Union Commission. (2023). The 3rd CAADP Biennial Review Report.
45 Removing Roadblocks Lessons Learned in Leveraging Digital Technology to Increase Smallholder Farm Mechanization (2021). AGRA.

FIGURE 20
FARMS RELY HEAVILY ON HUMAN LABOUR IN AFRICA



Source: CAADP (2023).

Advanced mechanisation makes sense for large commercial farmers who operate at scale, but tractors are often inaccessible for small-scale farmers. Given that African farming is largely small-scale, tractor adoption remains low compared to other continents.

AN OLD IDEA, A NEW APPROACH

The tractor-leasing model is not entirely new. In Zimbabwe, for example, in the 1990s, a state-driven initiative called the District Development Fund leased tractors and equipment to smallholder farmers. However, the new leasing service model has two unique features.

1.
PRIVATE SECTOR CAPITAL-DRIVEN.

For instance, Hello Tractor has partnered with John Deere to provide farm machinery leasing services in Nigeria. This partnership, which started through Hello Tractor's participation in John Deere's Startup Collaborator programme, is part of the John Deere Strategy and the Ag & Turf Division's Leap Ambitions, which seeks to ensure 100% of new small agricultural equipment is connectivity-enabled by 2026.

2.
DIGITAL TECHNOLOGIES.

Digital leasing apps allows farmers to access leasing services without phone calls. As farmers become more adept at digital apps and internet connectivity improves in much of rural Africa, these technologies will progressively shift away from the use of community-based booking agents and USSD toll-free technology. These work on relatively simple feature phones, with no need for a smartphone.

REAPING THE GAINS

The potential efficiency gains and cost savings are significant. Leasing platforms are estimated to be a third of the amount paid to manual labour, and up to 40 times more efficient.[46]
When Hello Tractor signed a deal to manage a fleet of 10,000 tractors supplied to Nigeria by John Deere, it reckoned this would bring 22 million acres of land into production and 2 million new jobs.

THE STONE IN THE SOIL

Research shows that the benefits of leasing platforms are only possible if farmers are digitally literate and have the smartphone app.[47]
In the Nigerian case, both digital literacy and network coverage were limiting factors that prevented farmers from fully realising the benefits of the digital tractor-leasing platforms. The use of community-based booking agents and USSD toll-free technology has been key to addressing these limitations thus far and ensuring access to machinery by farmers lacking digital savvy and farmers who are in areas with poor internet connectivity.

[46] Kalejaiye, D. (2023). Uber for tractors: Transforming the agricultural sector in Africa. The Borgen Project.
[47] Daum et al. (2021). Uber for tractors? Opportunities and challenges of digital tools for tractor hire in India and Nigeria. World Development, 144, 105480.

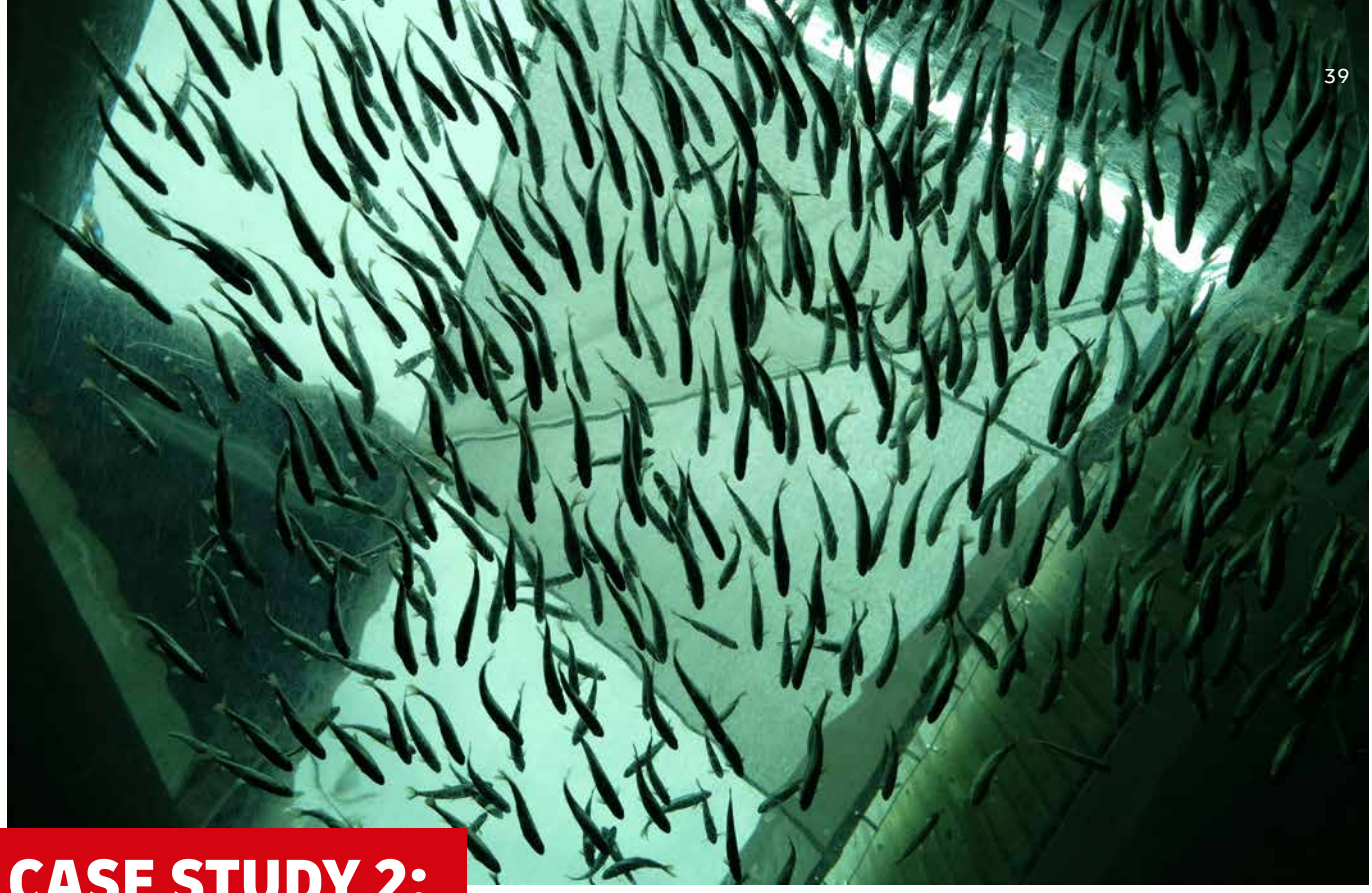


IMAGE: bruce warrington – unsplash.com

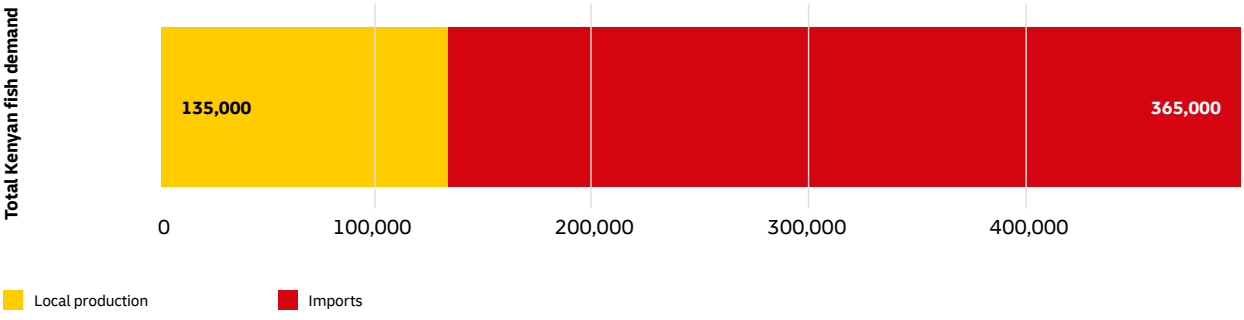
CASE STUDY 2:

CAGE CULTURE IN KENYA'S FISHERIES

Kenya's fisheries sector directly and indirectly supports about 2 million people, but output is too low to meet local demand. Fishers, traders, and related businesses lose out to cheap Chinese imports that fill the deficit. With demand growing, the missed opportunity is significant.

THE OPPORTUNITY

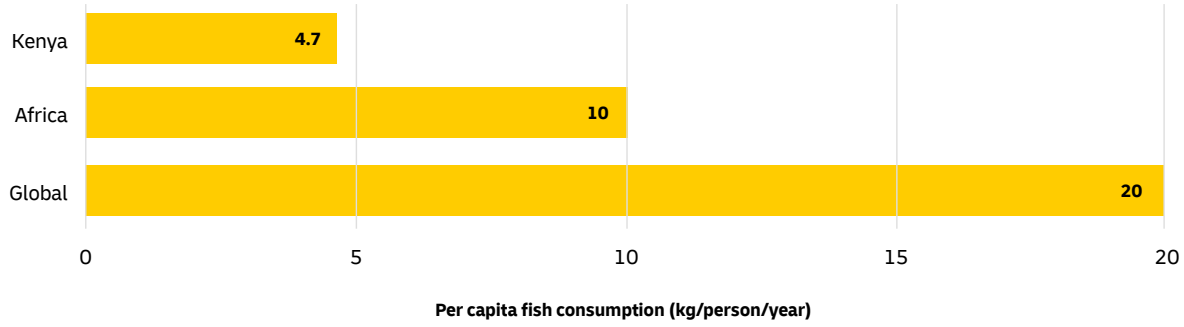
FIGURE 21
TOTAL KENYAN FISH DEMAND



Source: South African Agriculture: Current Realities and future expectations. Baseline Agricultural Outlook: 2024-2033 (2024). BFAP.

Historically, around a quarter of Kenya's fish demand is met by local production. The bulk of imports, around 70%, are from China and are produced at scale and a lower cost.

FIGURE 22
PER CAPITA FISH CONSUMPTION (KG PER PERSON PER YEAR)



Source: BFAP (2024).

Kenya's per capita fish consumption is less than half the average on the continent and far below the global average, but with income levels and population size projected to grow, demand for fish is set to boom.

SUPPLY-SIDE CHALLENGES

Domestic supply has been contracting, owing mainly to:

1.

Reduced capture from Lake Victoria, which is troubled by overfishing, pollution, and the influence of foreign species.

2.

The high cost of fish feed, meaning that imports land at lower than the cost of local production. Feed costs are exceptionally high because Kenya cannot competitively produce its own feed raw materials. Raw materials for feed production, such as soybean meal and maize, are imported, which elevates the cost of producing fish locally.

IMAGE: Mint_Images – elements.envato.com

GOVERNMENT INTERVENTION

The Kenyan Government has implemented two measures to address these challenges.

1.

TARIFF WAIVERS ON RAW MATERIAL IMPORTS.

To lower the cost of producing fish feed locally, the Government zero-rated duties on:

58,250 TONNES	126,300 TONNES	225,950 TONNES
of soybeans	of soybean meal	of yellow maize

These Tariff Rate Quotas (TRQs) were implemented from 1 November 2021. This waived tariffs and resulted in a cost saving of US$17.1 million between November 2021 and February 2024.

2.

HIGHER LEVIES ON IMPORTED FISH.

From 1 July 2023, tariffs on imported fish increased from 10% to 35%. The Government also imposed an excise duty of 20% of CIF (cost, insurance, and freight) price or KES100,000/tonne.

IMAGE: Bluesandisland – elements.envato.com

CAGE CULTURE BRINGS IN A BETTER CATCH

The Kenyan Government's interventions have led to new investments in cage culture as part of a broader industry-wide import replacement initiative, which seeks to improve farm incomes and enhance food security through local production. Cage culture is an intensive fish farming system that suspends mesh enclosures in water bodies. This production system is predominantly practised in Lake Victoria, having only been adopted as recently as 2010. However, it started gaining more prominence in 2020, and as a result:

1.
Output increased by almost 80% from 13,174 tonnes in 2021 to 23,560 tonnes in 2023, in response to the Government's import replacement policies (e.g. tariff waivers on feed raw materials and tariff increases on imported fish).

2.
The medium- and large-scale private sector (such as Victory Farm, a market leader in cage farming) added an additional 10,000 tonnes of capacity worth US$21.8 million.

3.
2,500 smallholder farmers and 350 medium-scale farmers added new capacity.

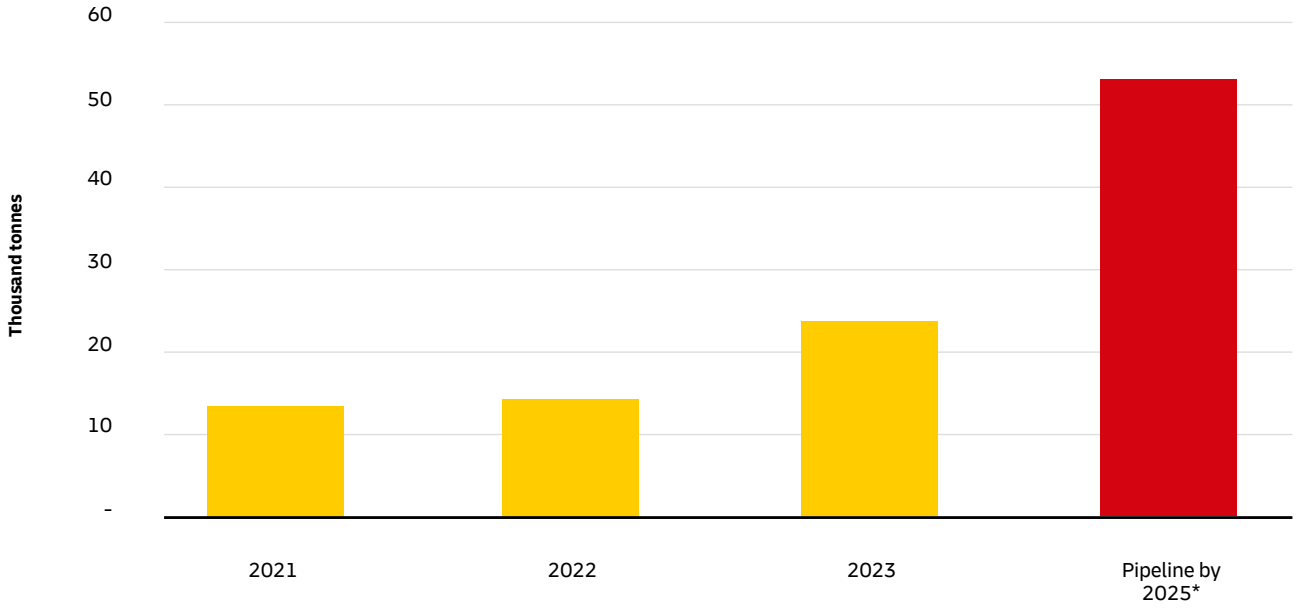
4.
Imports from China declined from an average of 8.6% of total freshwater fish supply to 1.8% by 2023.

5.
The replacement of Chinese imports resulted in US$31 million gross value added from caged fish production.

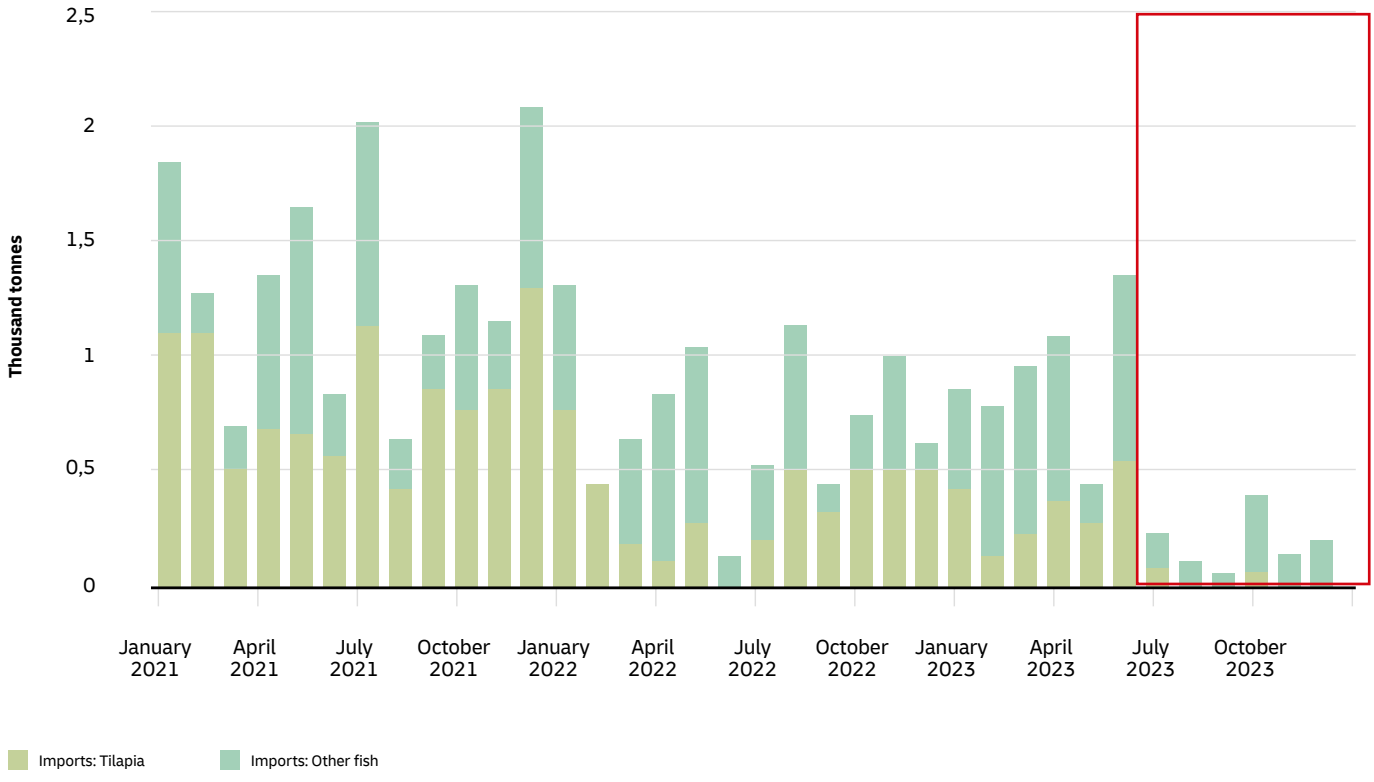
The aquaculture industry in Kenya is an example of how governments on the African continent are pursuing import replacement policies that incentivise investment from medium- to large-scale agribusinesses. However, these interventions must be measured and balanced through a sustainable and market-led approach. In that sense, developing an "infant industry" needs to be timebound with clear timelines for agribusiness firms to become globally competitive.

FIGURE 23
EXPANDING LOCAL PRODUCTION AND REDUCING IMPORT RELIANCE

Expansion in caged aquaculture production in Kenya



Reduction in fish import dependence in Kenya



Source: Samboko, P. C., Zulu-Mbata, O., & Chapoto, A. (2018). Analysis of the animal feed to poultry value chain in Zambia. Development Southern Africa, 35(3), 351-368.

IMAGE: Africa Studio – stock.adobe.com

CASE STUDY 3:

TANZANIA'S SEED OIL STRATEGIES

Many African governments have rolled out policies designed to reduce reliance on imports by boosting local production of staple goods. Tanzania has focused on developing and expanding the sunflower seed value chain. Since 2017, policy intervention has driven a boom in sunflower seed processing, with over 200,000 tonnes of private-sector investment in the sector.

OILING THE WHEELS

From 2017, as part of Tanzania's Agro-Industrialization Development Flagship (TAID) programme, the Government introduced:

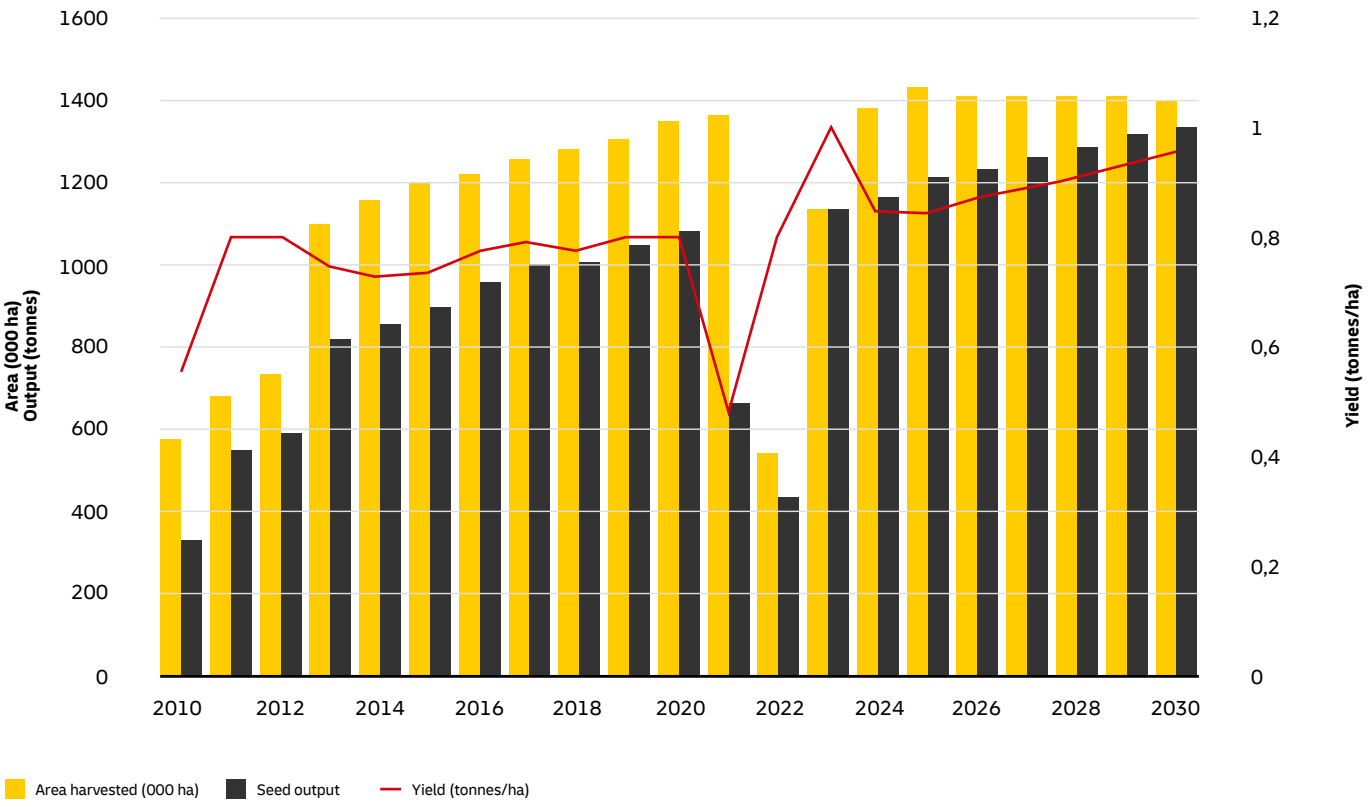
1.

A range of tax exemptions on solvent extraction (extracting oil from seeds) processing plants and oil refining equipment.

2.

Increased import tariffs on crude sunflower oil and palm oil (a sunflower oil alternative).

FIGURE 24
TANZANIA'S SUNFLOWER PRODUCTION



Source: BFAP (2024). Forecast 2025 to 2030.

EXAMPLES OF NEW INVESTMENT

As a result of these interventions, private businesses, like the ones below, doubled down on the sector, investing heavily in new processing plants and machinery.

TABLE 2
NEW INVESTMENT IN SUNFLOWER SEED PROCESSING CAPACITY

Company	Additional info	Location	New capacity (tonnes of seed per year)
Kahama Cotton Company Limited (KCCL)	Dual capacity – cottonseed and sunflower seed	Kahama	45,000
Gilitu Enterprises Limited	A grains and oilseeds processing agribusiness	Shinyanga	30,000
Nyarusai Limited	An integrated agribusiness involved in sunflower crushing and refining of crude oil	Kahama	10,000

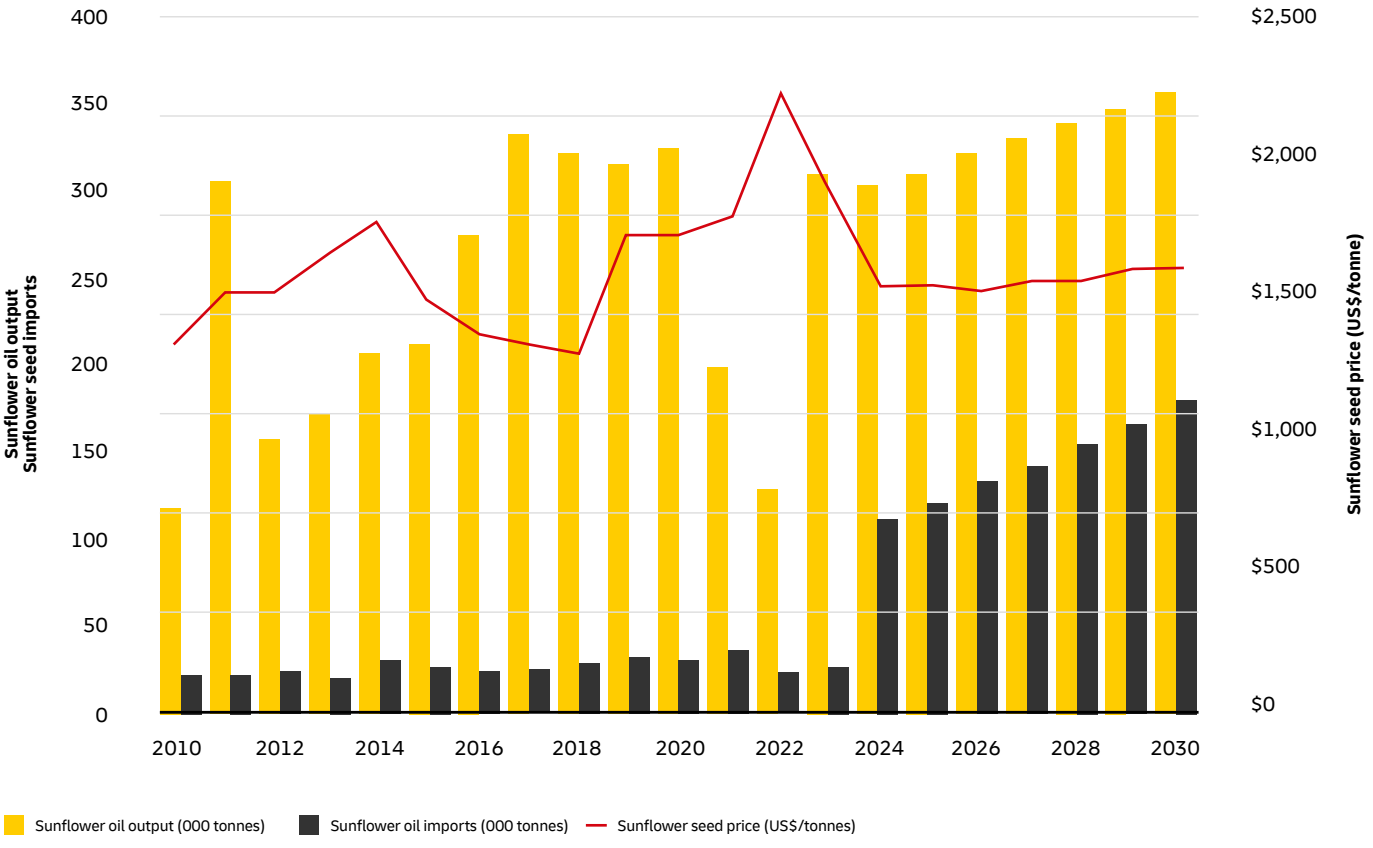
Source: BFAP (2024).

IMAGE: Rolf Nussbaumer/Danita Delimont – stock.adobe.com

BEYOND OIL: DIVERSIFYING THE VALUE CHAIN

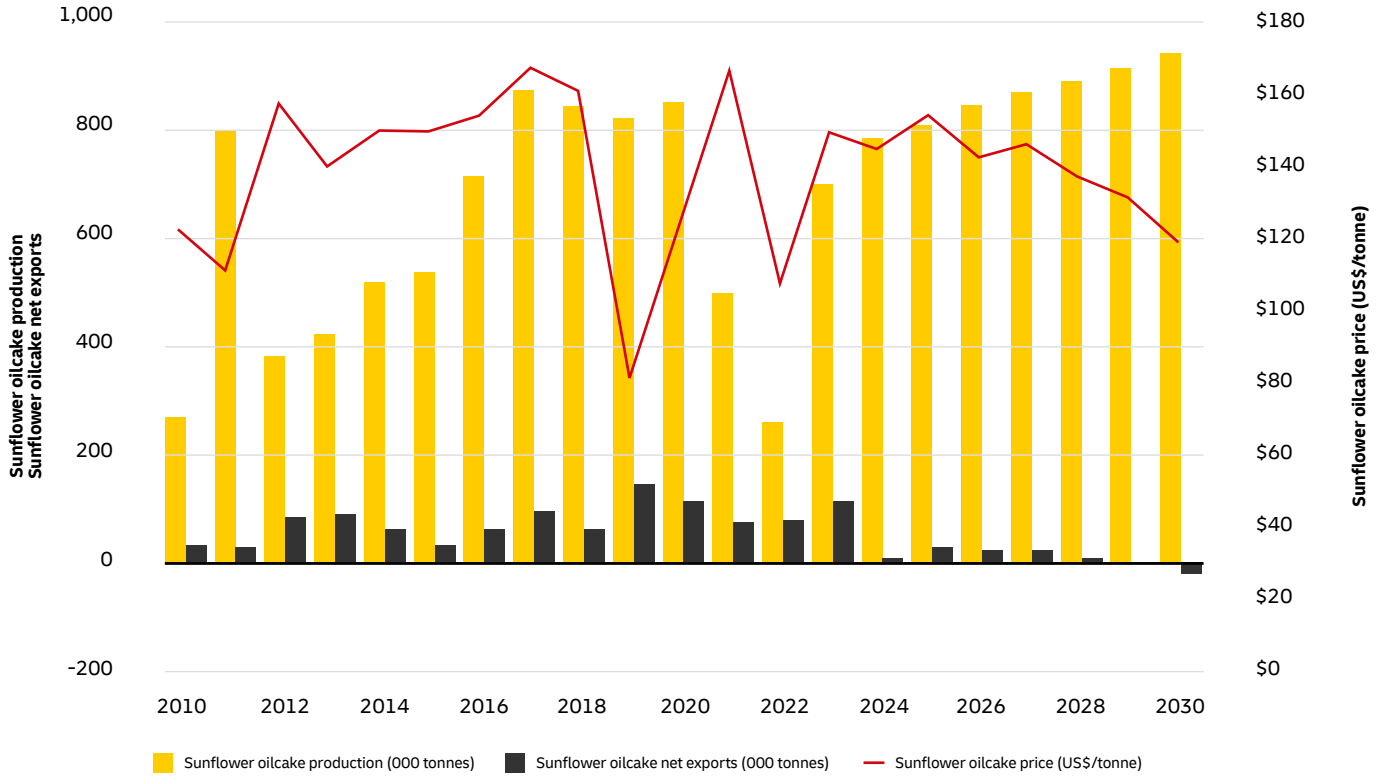
When sunflower seeds are pressed to extract oil, what remains is an oil-rich cake that can be used as animal feed. However, it is possible to extract a further 10% of the oil in a sunflower cake. This leaves you with a de-oiled cake, which can also be used as animal feed, and some extra oil. Below are the growth trends in sunflower oil and oilcake (used in livestock feed) in Tanzania from 2024 to 2030.

FIGURE 25
TANZANIA'S SUNFLOWER OIL DOMESTIC OUTPUT, IMPORTS AND PRICE OVER TIME



Source: Source: BFAP (2024). Forecast 2025 to 2030.

FIGURE 26
TANZANIA'S SUNFLOWER OILCAKE DOMESTIC OUTPUT, IMPORTS AND PRICE OVER TIME



Source: BFAP (2024). Forecast 2025 to 2030. Projection beyond 2022.

The Qstek Sunflower Company, a sunflower seed processing business in the Manyoni district, invested in a sunflower cake solvent extraction plant to squeeze as much value as possible from its resources, increase business diversity, and strengthen its value chain.

The company procures all its seed from contracted farmers in the Singida, Dodoma, and Manyara regions. It has 100 labourers (40 permanent, 60 casual) and a machinery investment of TZS865 million.

HARD-PRESSED

The Tanzanian tax policies are a welcome opportunity that helps local businesses compete with cheaper imported sunflower oil, but the sector is hampered by:

1.

A lack of ready availability of quality sunflower seed. Despite growth in sunflower seed production, there is still a shortage of seed to meet the growing demand of processors.

2.

Inefficient farming. Farmers often do not use the optimum seed. Many lack access to appropriate fertiliser, and soil management tends not to be up to date.

3.

The high price of Tanzanian sunflower oil, with competing palm oil product landing at relatively cheaper prices than locally produced sunflower oil.

4.

Nuisance taxes, which range from statutory fees and government taxes, all of which increase the cost of procuring seed from the farmgate to the factory door.

Businesses can tackle these challenges by organising and supporting smallholder farmers or even engaging in sunflower farming directly to ensure the availability of affordable, quality seed. Investing in technology, like Qstek's sunflower cake solvent extraction plant, can also create new income streams. This analysis of the Qstek Sunflower Company extrapolates on the sector's position.

TABLE 3 SWOT ANALYSIS FOR QSTEK

SWOT Analysis for Qstek	.
Strengths	**Weaknesses**
Produce highest quality refined oil (export quality)	Lack of readily available, quality seed – with most farmers yet to adopt higher yielding hybrid seed
Operate an efficient, modern processing plant	Failure to penetrate export market
Installed a sunflower cake solvent extraction plant	Inadequate security to guarantee capital
Network of 25,000+ sunflower farmers	Lack of capital to procure seed and support farmers
Located close to sunflower farmers	
Partner with public and private bodies that support the sector	
Fully compliant with regulators and governing bodies	
Opportunities	**Threats**
Exploit the local market with a steady supply of quality, affordable oil	Climate change
Exploit the export market – Africa and beyond	Poor quality of seed
Support smallholder farmers to secure supply	Cheaper imported edible oil
Tax-based incentives	Increase of government statutory fees and taxes
Engage in farming to ensure the availability of seed	

Source: Kapuya, T., Sihlobo, W., Mpenda, Z., Njagi, T. & Mukarati, J. (2024). Medium to large-scale agribusiness firms in Africa: triggers, drivers, and investment strategies defining private sector-led growth Accelerating the Private Sector for Food Systems Transformation in Africa (2024). In Maina, S. (Ed.), Alliance for a Green Revolution in Africa (pp 27-46). AGRA.

IMAGE: Dusan Petkovic – stock.adobe.com

CASE STUDY 4:

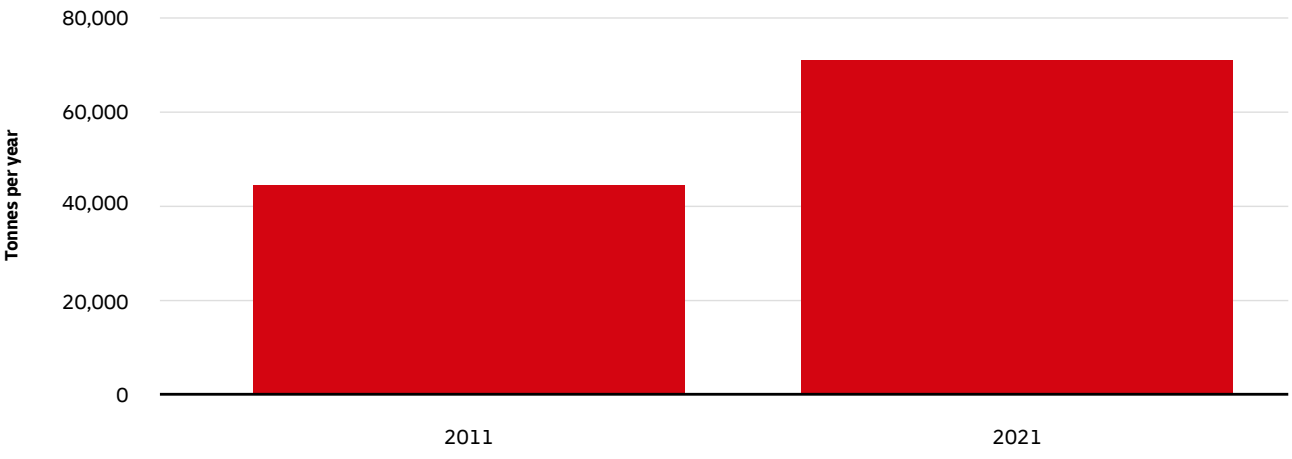
ZAMBIA'S POULTRY SUPPLY CHAIN

Poultry consumption is booming in Zambia.[48] As the demand for poultry rises, so does the need for poultry feed and the soybeans that go into that feed. Businesses have responded by investing in vertical integration across the poultry supply chain. To take better advantage of these new market conditions, smallholder farmers can employ technology that will boost soybean yields.

ZAMBIA'S SHIFTING APPETITES

Both beef and poultry have been appearing on more plates in Zambia over the past decade, but poultry is soaring ahead as a driver of meat consumption. While beef consumption grew by 1.5% a year between 2012 and 2021, poultry consumption has grown by 57% over roughly the same period.[49]

FIGURE 27 ZAMBIA'S POULTRY CONSUMPTION



Source: FAO (2024).

[48] UN Food and Agriculture Organisation (2024). FAO Stat Database.
[49] Ibid.

VERTICAL INTEGRATION IN ACTION

The booming poultry demand has driven expansive investment from medium- and large-scale agribusiness, particularly through the vertical integration of feed and poultry production. Here are some examples.

1.

Tiger Animal Feeds, Zambia's largest specialised animal feed producer, has expanded into breeding chicks for ZamChick, its vertically integrated poultry unit.

2.

Nutri Feeds Zambia, an animal feed producer, has established a breeder farm (Ross Breeders Zambia Ltd) to supply parent birds and broiler (meat) chicks.

3.

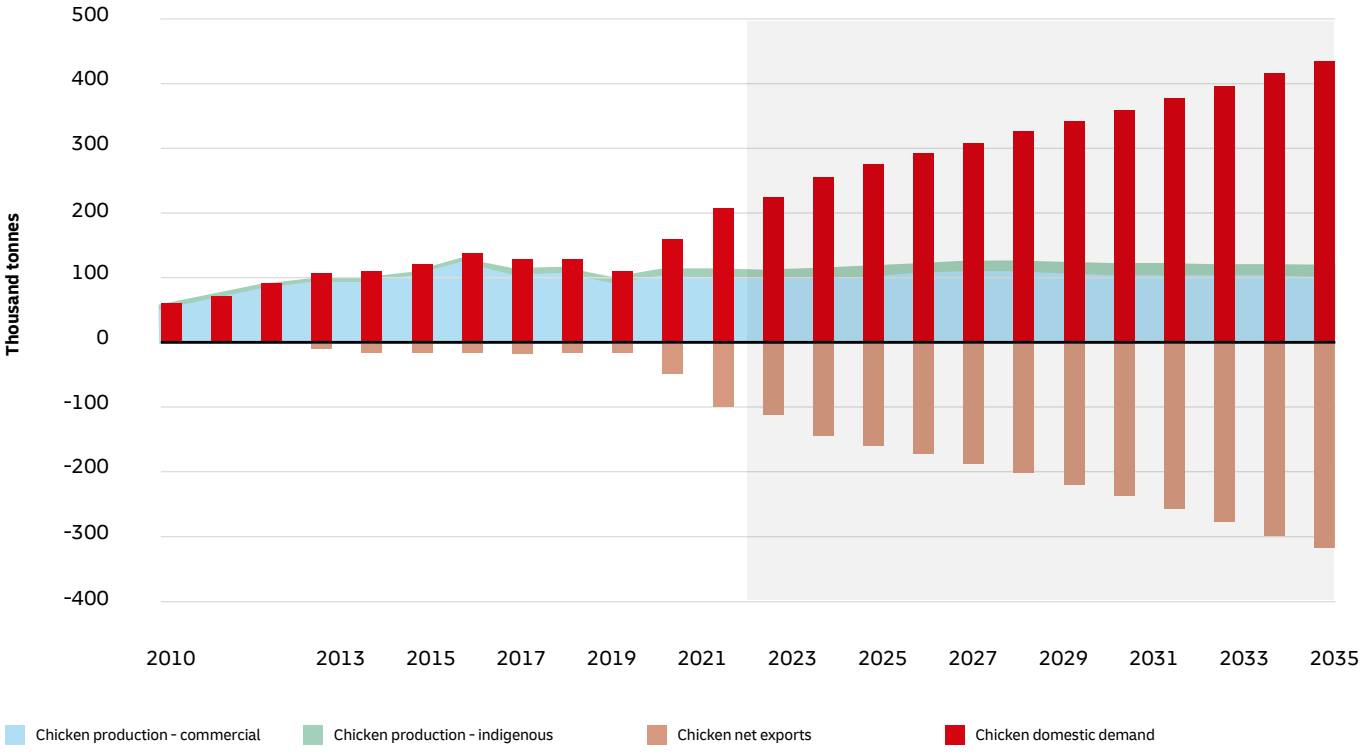
Zambeef Products PLC, which produces poultry, beef, grains, and dairy products, established Novatek Animal Feeds as a subsidiary in 2008.

4.

Zamhatch Ltd, a chicken breeding business, invested in an on-farm feed mill at a hatchery in Mpongwe.

This strategy boosts feed sales, provides a steady supply of quality feed for poultry farms, and generates cost efficiencies and additional revenue streams across the supply chain. The opportunity for producing is necessitated by a need to support an increase in poultry production to meet growing demand, which will more than double from 212,000 tonnes in 2023 to 440,000 tonnes by 2035 (see Figure 26 below).

FIGURE 28
ZAMBIA'S CHICKEN PRODUCTION, DEMAND AND IMPORTS OVER TIME



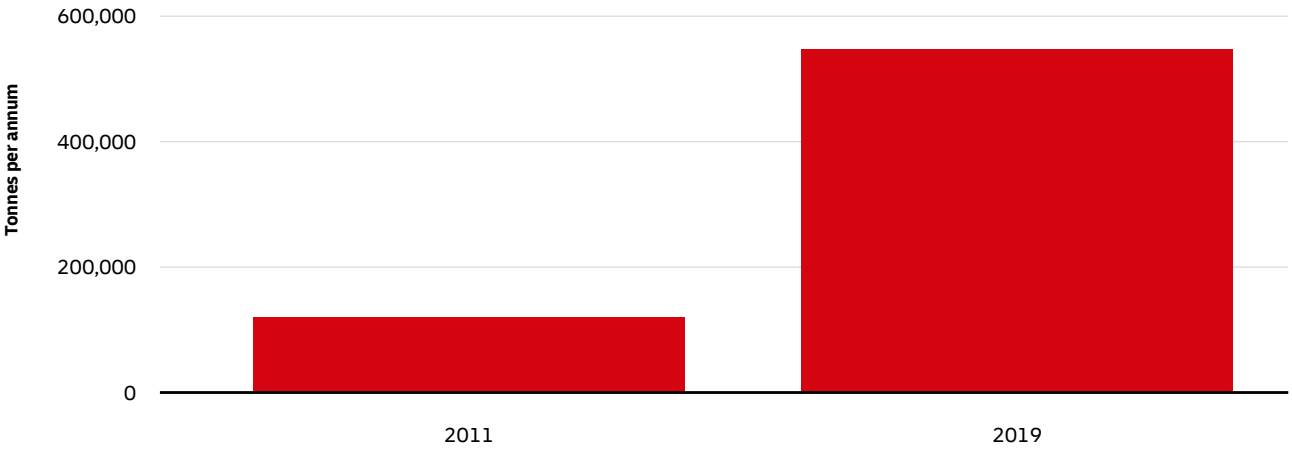
Source: IAPRI (2024).

IMAGE: stevanovicigor – elements.envato.com

THE SOYBEAN SURGE

Working backwards through the supply chain, it is clear how investment in the feed and poultry sectors is stimulating growth at every level.

FIGURE 29 ZAMBIA'S SOYBEAN CRUSHING CAPACITY



Source: Technoserve (2011); Mulenga et al. (2020).

Feed production has surged, with national output increasing by 117% between 2010 and 2014.[50]

Soybean crushing capacity grew by around 340% between 2011 and 2019 to an annual capacity of 550,000 tonnes.[51]

TABLE 4 CRUSHING CAPACITY FROM THE LARGEST SOYBEAN PROCESSORS

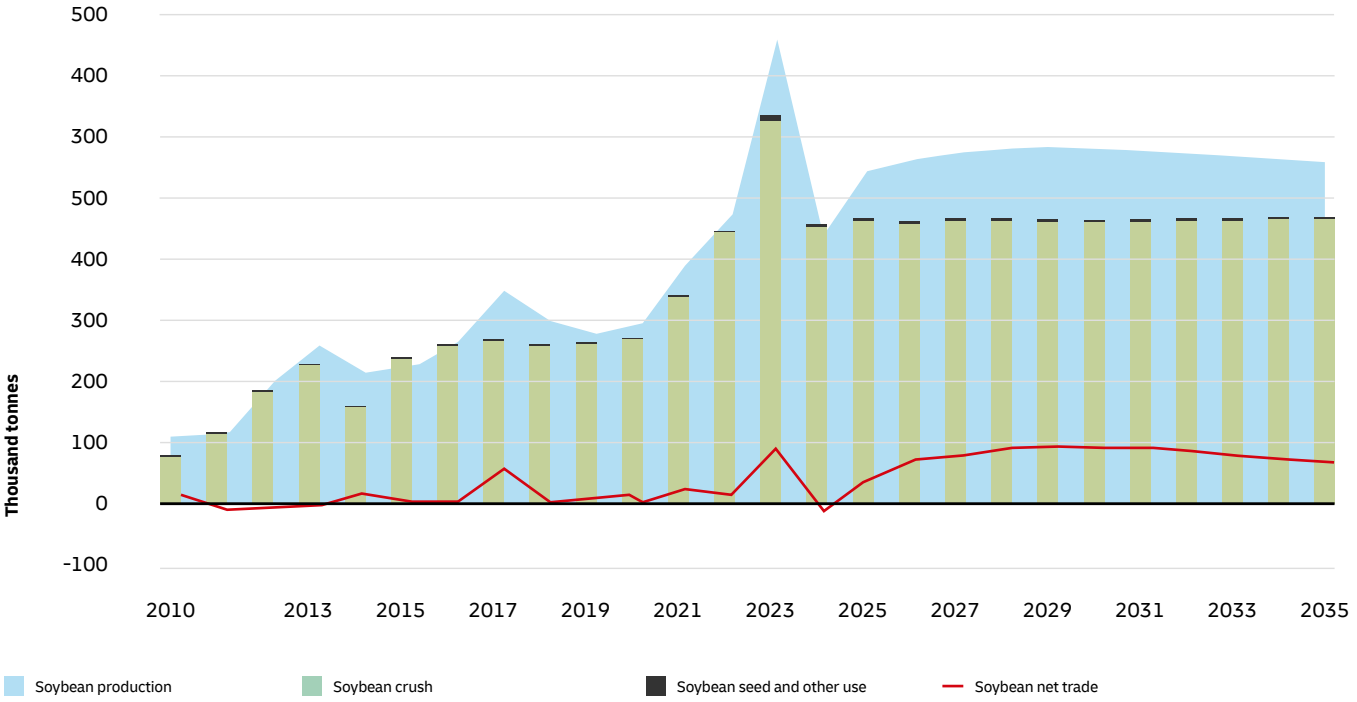
Name	Additional info	Crushing capacity (tonnes per annum, 2024)
Global Industries Limited (GIL)	Established with investment from India	360,000
ETG Parrogate	A subsidiary of ETG	156,000
Mount Meru Millers Zambia (MMMZ)	A subsidiary of Mount Meru Group, an integrated multinational agribusiness	200,000

Source: Kapuya et al. (2024).

[50] Samboko, P. C., Zulu-Mbata, O., & Chapoto, A. (2018). Analysis of the animal feed to poultry value chain in Zambia. Development Southern Africa, 35(3), 351-368.
[51] Southern Africa Soy RoadmanP Zambia value chain analysis (2011). Techniserve; Mulenga, B. P., Banda, A., Kasoma-Pele, W., Chapoto, A., & Lusaka, Z. (2020). Soyabean value chain analysis in Zambia. Lusaka: Indaba Agricultural Policy Research Institute (IAPRI).

Soybean output has all but doubled in the last decade.[52] Smallholder farmers have been key to this growth and now account for 40% to 45% of output, up from 17% in the 2014/15 season.[53] This results from smallholders shifting land away from traditional cash crops like cotton, which have been in steady decline over the past 10 to 12 years.

FIGURE 30 SOYBEAN PRODUCTION TRENDS IN ZAMBIA

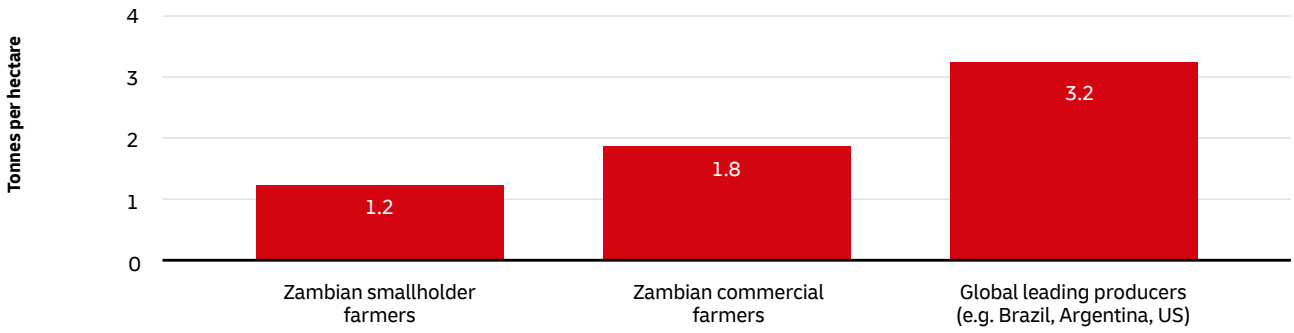


Source: BFAP (2024). Forecast 2024 to 2035.

THE OPPORTUNITY

Zambian smallholder farmers can take advantage of rising soybean demand[54] by increasing yields. Current yields are much lower than those of their competitors, indicating considerable room for improvement. By adopting higher-yielding seed varieties, new technologies, and improved agronomic practices, smallholders can boost productivity and capture a large share of the growing market.

FIGURE 31 AVERAGE YIELDS OF SOYBEAN FARMERS



Source: USDA (2024); BFAP (2024).

[52] USDA (2024).
[53] IAPRI (2024).
[54] Zambia Country Summary (2024). USDA.; South African Agriculture: Current Realities and future expectations. Baseline Agricultural Outlook: 2024-2033 (2024). BFAP.

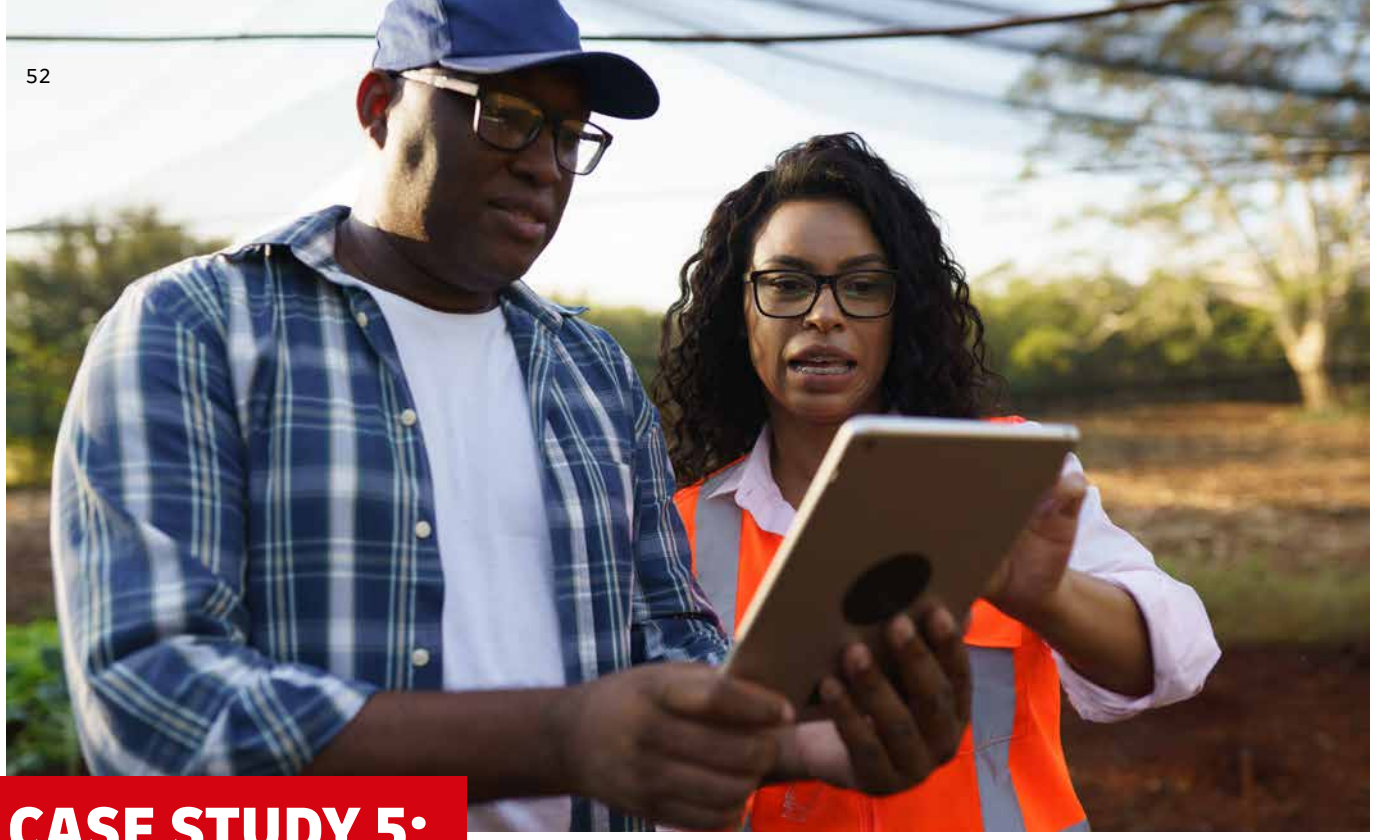


IMAGE: Brastock – stock.adobe.com

CASE STUDY 5:

MOBILE AGRITECH FOR FARMERS

Digital technologies are changing the game for African smallholder farmers. A range of mobile tools and online platforms are directly connecting farmers with service providers, suppliers, aggregators, agro-dealers, and retailers. As a result, new and innovative business models are emerging that shorten supply chains and make shareholder farming more profitable.

EXAMPLE 1: E-VOUCHERS

Governments and other funders regularly provide smallholder farmers with subsidies for inputs like fertiliser and seed. E-vouchers offer a cashless solution to distribute this capital. They can be sent to farmers via SMS and authenticated by agro-dealers (typically sellers of seed and fertiliser) using a mobile app.

E-vouchers make it easier for farmers to access capital when they need it, allow funders to track and monitor inputs, and appear to boost outputs. In Zambia, for example, e-vouchers have helped the Government's Farmer Input Support Programme (FISP) to reach over 1.2 million smallholder farmers and contribute to a 10% to 15% increase in agricultural output in 2019.[55]

Platforms that support e-vouchers include:

1.

M-PESA

A mobile money service launched in Kenya by Vodacom and Safaricom

2.

M-KULIMA

Vodacom Tanzania's digital platform for farmers

[55] Fertile Ground for Digitalisation: Adopting Digital Technologies to Improve Farming and Food Security in Africa. (2023). USDA.

EXAMPLE 2: MEZZANINE

Mezzanine is an agritech developer and a subsidiary of the Vodafone Group. It builds B2B and B2C platforms that help enterprise and smallholder farmers connect with buyers, input suppliers, credit providers, and information.

Their platform eVuna (formerly Connected Farmer):

1. Supports more than 100,000 smallholder farmers in East Africa.

2. Has generated over US$1 million of credit finance.

3. Facilitated an 80% productivity growth for smallholder farmers.

4. Increased average income by $600 per farmer.[56]

SIGNAL LOSS

The digital revolution holds great promise for African agriculture, but its potential is constrained. Although 80% of Africans live in areas with mobile internet access, usage rates are among the lowest in the world at just 24%.[57] This is related to a combination of poverty and high data costs. Lagging internet infrastructure and poor-quality digital services in some regions further limit the reach of digital solutions.

TABLE 5 SOME AGRITECH PLATFORMS AND WHAT THEY CAN DO

Name	Country	Function	Farmer reach
DigiFarm	Kenya	A platform that connects farmers with a range of product and service providers. Owned by Safaricom.	1.43 million
FarmCrowdy	Nigeria	A crowd-funding platform that allows middle- and upper-income Nigerians to invest in pre-vetted smallholder farms.	298,000
AgroMall	Nigeria	An IT-led platform that facilitates connections across the value chain (e.g. between farmers and banks) and provides farmers with business intelligence.	1.7 million
Twiga Foods	Kenya	A mobile-based B2B e-commerce platform that allows vendors to buy fresh fruit and vegetables directly from farmers. Twiga works with over 140,000 vendors.	1,000+
AgroCenta	Ghana	1. AgroTrade – an end-to-end supply chain management solution. 2. AgroCenta – a tool that identifies buyers and negotiates the terms of sale on behalf of farmers for a 30% commission.	45,000

Source: eVuna (2024).

[56] eVuna. (2025).
[57] Begazo, T., Blimpo, M., & Dutz, M. (2023). Digital Africa: Technological transformation for jobs. World Bank Publications.

CONCLUSION

Farming is an unsung hero. Through good weather and bad, market highs and lows, farmers quietly generate our breakfast, lunch and dinner. Aptly, these are the calories our bodies and brains need to innovate. And innovate we must if agriculture is to feed prosperity for Africa.

Be it crop-spraying drones, AI-powered fire detection, or simply expanded use of the fertilisers that have been boosting yields for decades, turning agriculture into agritech is not a nice-to-have. With a youthful and growing population, agritech in Africa is a necessary condition to thrive.

IMAGE: Ruslan Ivantsov – stock.adobe.com

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