

Smart Farming for Food Security: Enhancing Agri-Technology in Africa for Efficiency and Sustainability

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Table of Contents

Abstract..... 3

1.0 Introduction 3

2.0 Food Security in Africa: Opportunities and Challenges 6

3.0 Enhancing Agri-Technology in Africa for Efficiency and Sustainability 8

4.0 Conclusion 12

References 14

Smart Farming for Food Security?: Enhancing Agri-Technology in Africa for Efficiency and Sustainability

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Abstract

This paper discusses how Africa can achieve food security by enhancing agri-technology. The paper argues that the ideal of food security is yet to be realized in Africa undermining the continent's development efforts. Consequently, the paper posits that agri-technology is an efficient, smart, sustainable and resilient approach that can enhance food security in Africa for Sustainable Development. The paper defines agri-technology and examines how this idea can strengthen food security in Africa. It also discusses the progress made towards embracing agri-technology in Africa and challenges thereof. In addition, the paper suggests interventions towards enhancing agri-technology in Africa for efficiency and sustainability.

1.0 Introduction

The ideal of food security exists when every person has access to enough safe and nutritious food for normal growth and development, and an active and healthy life¹. Further, it has been pointed out that food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life². The state of food security involves several dimensions including availability of sufficient quantities of food

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¹ World Food Programme., 'Food security - what it means and why it matters' Available at <https://www.wfp.org/stories/food-security-what-it-means-and-why-it-matters#:~:text=Jean%2DBaptiste%20Joire-What%20is%20food%20security?,threatens%20people's%20lives%20or%20livelihoods>. (Accessed on 21/09/2025)

² World Bank Group., 'What is Food Security?' <https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security> (Accessed on 21/09/2025)

of appropriate quality³; access by individuals to adequate resources for acquiring appropriate foods for a nutritious diet⁴; utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met⁵; and stability of food supply at all times⁶.

It has been argued that food security is a key determinant for the realization of the human right to food towards Sustainable Development⁷. Achieving the human right to food is a critical part of health, development and the well-being of all individuals⁸. For example, better nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases including diabetes and cardiovascular disease and longevity⁹. It has been correctly noted that the food we take provides nutrients that are essential for the growth, development and maintenance of body functions¹⁰. Achieving food security is therefore key for human health, well-being and progress towards Sustainable Development. The United Nation's *2030 Agenda for Sustainable Development* envisions a world where food is sufficient, safe, affordable and nutritious¹¹. Sustainable Development Goal (SDG) 2 seeks to end hunger, achieve food security, and improved nutrition and promote sustainable agriculture¹².

³ Food and Agriculture Organization of the United Nations., 'Food Security' Available at https://www.fao.org/fileadmin/templates/faoitally/documents/pdf/pdf_Food_Security_Cocept_Note.pdf (Accessed on 21/09/2025)

⁴ Ibid

⁵ Ibid

⁶ Ibid

⁷ Muigua. K., 'Achieving the Right to Food for Sustainable Development in Kenya.' Available at <https://kmco.co.ke/wp-content/uploads/2018/08/Achieving-the-Right-to-Food-for-Sustainable-Development-in-Kenya-Presentation-African-Population-and-Health-Research-Center-APHRC-Campus-24th-July-2018.pdf> (Accessed on 21/09/2025)

⁸ World Health Organization., 'Nutrition' Available at https://www.who.int/health-topics/nutrition#tab=tab_1 (Accessed on 21/09/2025)

⁹ Ibid

¹⁰ How Does Food Impact Health?., Available at <https://www.takingcharge.csh.umn.edu/how-does-food-impact-health> (Accessed on 21/09/2025)

¹¹ United Nations General Assembly., 'Transforming Our World: the 2030 Agenda for Sustainable Development.' 21 October 2015, A/RES/70/1., Available at <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> (Accessed on 21/09/2025)

¹² Ibid, Sustainable Development Goal 2

Despite being a key ideal globally, realising food security remains a challenge in most countries. Millions of people globally are experiencing acute levels of food insecurity¹³. According to the Food and Agriculture Organization of the United Nations (FAO), achieving food security remains a challenge globally with millions of people facing food insecurity, hunger and malnutrition especially in developing countries¹⁴. This challenge is affecting millions of people especially in rural areas, where extreme poverty and food insecurity remain deeply entrenched¹⁵. It has been pointed out that vulnerable populations, particularly women, youth and indigenous peoples, are disproportionately affected by food insecurity¹⁶. In light of the foregoing, it has become necessary to promote smart, sustainable, efficient and resilient production of food to meet the nutritional requirements of local and global populations¹⁷.

This paper discusses how Africa can achieve food security by enhancing agri-technology. The paper argues that the ideal of food security is yet to be realized in Africa undermining the continent's development efforts. Consequently, the paper posits that agri-technology is an efficient, smart, sustainable and resilient approach that can enhance food security in Africa for Sustainable Development. The paper defines agri-technology and examines how this idea can strengthen food security in Africa. It also discusses the progress made towards embracing agri-technology in Africa and challenges thereof. In addition, the paper suggests interventions towards enhancing agri-technology in Africa for efficiency and sustainability.

¹³ World Food Programme., 'Food security – what it means and why it matters' Op Cit

¹⁴ Food and Agriculture Organization of the United Nations., 'The State of Food Security and Nutrition in the World 2024- 2024 – Financing to end hunger, food insecurity and malnutrition in all its forms' Available at <https://openknowledge.fao.org/server/api/core/bitstreams/d5be2ffc-f191-411c-9fee-bb737411576d/content> (Accessed on 21/09/2025)

¹⁵ Ibid

¹⁶ Ibid

¹⁷ Benton. T. G., 'Food Security.' *Encyclopedia of Applied Sciences.*, Volume 2, 2nd Edition., (2017), pp 19-22

2.0 Food Security in Africa: Opportunities and Challenges

Achieving food security is a crucial agenda for Africa. According to the African Union, food security and human development are inextricably linked in Africa¹⁸. For example, food security ensures productivity, nutrition, resilience and empowerment for the people of Africa towards human progress and development¹⁹. It has been argued that realising food security is a core component of human development and progress in Africa since food access and entitlements are critical for reinforcing essential human capabilities²⁰. By achieving food security, it is possible to ensure that the people of Africa are well-nourished and are able to exercise their freedoms and capabilities in different domains, which is at the core of human development²¹. The demand for food in Africa is increasing, driven by a range of population and demographic changes including population growth, changes in population structure, consumption growth, and urbanization²². As a result, it has been argued that achieving food security in Africa and globally requires more than simply increasing yields, but also demands changes in farming systems to promote the sustainable, and resilient production of food to meet the nutritional requirements of local and global populations²³.

Africa has numerous opportunities to achieve food security. For example, the continent holds approximately 60 per cent of the world's potential land for agricultural expansion²⁴. Africa's vast arable and uncultivated land provides immense opportunities for

¹⁸ African Union., 'Food Security' Available at <https://au.int/en/auc/priorities/food-security> (Accessed on 22/07/2025)

¹⁹ Ibid

²⁰ Conceicao. P et al., 'Toward a food secure future: Ensuring food security for sustainable human development in Sub-Saharan Africa' Available at <https://www.sciencedirect.com/science/article/pii/S030691921600021X> (Accessed on 22/09/2025)

²¹ Ibid

²² Benton. T. G., 'Food Security.' Op Cit

²³ Ibid

²⁴ Food security in Africa: Current efforts and challenges., Available at <https://www.brookings.edu/articles/food-security-strengthening-africas-food-systems/> (Accessed on 22/09/2025)

agricultural expansion and food production²⁵. In addition, the abundance of freshwater sources in Africa including major rivers and lakes can support agriculture and food production including through irrigation towards achieving food security in the continent²⁶. Further, it has been argued that improvements in democracy and political stability in most African countries have enhanced the prospects for renewed food production, distribution and purchase²⁷. This has enabled free and open markets and private investments in food production²⁸. Further, the abundance of renewable sources of energy in Africa including solar and wind energy provides opportunities to foster food security through clean energy for cooking, powering food production systems, reducing post-harvest losses, and enhancing market access for smallholder farmers²⁹.

Despite having immense potential to achieve food security, attaining this ideal remains a challenge in Africa. It has been pointed out that Africa is not on track to meet the food security and nutrition targets stipulated under SDG 2 with millions of people in the continent suffering from moderate to severe levels of food insecurity, hunger and undernourishment³⁰. It is estimated that nearly one in five people living in Africa is hungry³¹. Africa has therefore been classified as the most food-insecure region in the world³². Food insecurity in Africa is driven by several challenges including extreme

²⁵ African Development Bank Group., 'Feed Africa' Available at https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Brochure_Feed_Africa_-En.pdf (Accessed on 22/09/2025)

²⁶ Ibid

²⁷ Food and Agriculture Organization of the United Nations., 'Knowledge and Information for Food Security in Africa' Available at <https://www.fao.org/4/w9290e/w9290e01.htm> (Accessed on 22/09/2025)

²⁸ Ibid

²⁹ He. J et al., 'Green economic growth, renewable energy and food security in Sub-Saharan Africa' *Energy Strategy Reviews.*, Volume 55, September 2024

³⁰ Food and Agriculture Organization of the United Nations., 'Africa Regional Overview of Food Security and Nutrition' Available at <https://openknowledge.fao.org/server/api/core/bitstreams/c6c81d5f-e337-4b3e-8330-555c9ed0e741/content> (Accessed on 22/09/2025)

³¹ AUDA-NEPAD., 'Ending hunger in Africa: The elimination of hunger and food insecurity on the African by 2025: Conditions for success' Available at <https://www.nepad.org/caadp/publication/ending-hunger-africa-elimination-of-hunger-and-food-insecurity-african-2025> (Accessed on 22/09/2025)

³² World Vision., 'Africa hunger crisis: Facts, FAQs, and how to help' Available at <https://www.worldvision.org/hunger-news-stories/africa-hunger-famine-facts> (Accessed on 22/09/2025)

weather events and climate change, recurrent outbreaks of pests and diseases, limited availability and adoption of yield-increasing technologies and conflicts³³. Further, it has been argued that food insecurity in Africa is caused by a variety of interlinked challenges including instability and related population displacements, the impact of weather extremes including climate change, disrupted food systems, limited food production, barriers to regional trade and poor policy choices³⁴. Food insecurity undermines the productivity, resilience and health of the people of Africa³⁵. Consequently, it is imperative for Africa to build resilient, efficient, smart and sustainable food systems in order to achieve food security.

3.0 Enhancing Agri-Technology in Africa for Efficiency and Sustainability

With Africa facing food security challenges, agriculture provides a viable pathway towards reversing this trend. Agriculture is one of the most important economic activities in Africa³⁶. It is a vital sector that promotes food security, provides jobs for millions of people in Africa and contributes significantly to the continent's economic growth³⁷. It is estimated that agriculture accounts for nearly 17 percent of Africa's economic output while generating livelihoods for over 70 percent of households all over Africa³⁸. Therefore, leveraging Africa's vast expanses of fertile, uncultivated land can strengthen food systems towards enhancing food security, reducing hunger and improving human well-being and economic growth all over the continent³⁹. It has been argued that Africa has numerous favourable factors that strengthen agriculture including vast arable and

³³ Food security in Africa: Current efforts and challenges., Op Cit

³⁴ World Bank Group., 'Enhancing Food and Nutrition Security in the Sahel and Horn of Africa' Available at <https://www.worldbank.org/en/results/2024/01/04/enhancing-food-and-nutrition-security-in-the-sahel-and-horn-of-afe-africa> (Accessed on 22/09/2025)

³⁵ African Union., 'Food Security' Op Cit

³⁶ African Development Bank Group., 'Agriculture and agro-industries' Available at <https://www.afdb.org/en/topics-and-sectors/sectors/agriculture-agro-industries#:~:text=Agriculture%20is%20a%20major%20source,Read%20more> (Accessed on 22/09/2025)

³⁷ African Development Bank Group., 'Feed Africa' Available at https://www.afdb.org/sites/default/files/news_documents/ader_2024_-_chapter_2_en.pdf (Accessed on 22/09/2025)

³⁸ Ibid

³⁹ Ibid

uncultivated land, abundance of freshwater, plenty of sunshine throughout the year, fertile soils and a huge working population engaged in the agricultural sector⁴⁰.

Despite its huge agricultural potential, Africa has yet to fully harness the agricultural sector to ensure food security. The continent's agricultural sector faces mounting challenges and vulnerabilities that hinder attainment of food security. For example, Africa is heavily reliant on rain-fed agriculture and as a result, extreme weather events including droughts undermine its capacity to produce food fuelling food insecurities and exposing millions of people to hunger⁴¹. In addition, climate change impacts agricultural productivity and food security in Africa by turning areas once perfectly suitable for agriculture production into deserts and modifying rain patterns, increasing uncertainty and reducing yields⁴². Further, it has been argued that high prices for imported foods and essential inputs, such as fertilisers, affect agricultural productivity in Africa⁴³. It has also been pointed out that poor agricultural practices such as overgrazing, mono-cropping, continuous cropping, frequent rangeland burning, and over-use or clearance of woodlands and forests are prevalent in Africa⁴⁴. These practices have adverse environmental impacts including loss of soil and other natural resources, land degradation, changes in natural habitats and ecosystems, reduced ecosystem services such as water infiltration, loss of agro-biodiversity and wild biodiversity as well as decrease in land productivity leading to poor harvests, food shortages and food insecurity⁴⁵. Further, limited availability and adoption of yield-increasing technologies –

⁴⁰ Ibid

⁴¹ Kemoe. L et al., 'How Africa Can Escape Chronic Food Insecurity Amid Climate Change' Available at <https://www.imf.org/en/Blogs/Articles/2022/09/14/how-africa-can-escape-chronic-food-insecurity-amid-climate-change> (Accessed on 22/09/2025)

⁴² Mendez-Parra. M., & Ayele. Y., 'How African Integration Can Help Achieve Food Security.' Available at <https://odi.org/en/insights/how-african-integration-can-help-to-achieve-food-security/> (Accessed on 22/09/2025)

⁴³ African Development Bank Group., 'Feed Africa' Op Cit

⁴⁴ Woodfine. A., 'Using Sustainable Land Management Practices to Adapt to and Mitigate Climate Change in Sub-Saharan Africa' Available at https://www.ipcinfo.org/fileadmin/user_upload/terrafrica/docs/SLM_SUB-SAHARAN_AFRICA.pdf (Accessed on 22/09/2025)

⁴⁵ Ibid

have exposed fragilities of Africa's agricultural systems, undermining the ability to meet the food demand of its rising population⁴⁶.

In light of the foregoing challenges, it has become increasingly vital to strengthen the agricultural sector in Africa by making it more smart, resilient, efficient and sustainable towards achieving food security. In order to achieve this goal, there is need for a large-scale dissemination of productivity-increasing technology in the agricultural sector in Africa⁴⁷. It has been argued that farmers need support for the adoption of modern technologies in order to ensure resilient and sustainable agriculture and food systems⁴⁸. Technology is therefore key in enhancing agricultural productivity and food security in Africa.

The adoption and use of technology to boost productivity, efficiency and sustainability in agriculture has been termed as agri-technology⁴⁹. It has been argued that the application of technology has the capacity to transform agriculture and address some of the key obstacles facing food security in Africa⁵⁰. Agri-technology provides effective approaches towards increasing farm productivity, ensuring food security and tackling poverty⁵¹. By embracing technology, it is possible to boost food security by increasing yields, reducing agricultural exposure to environmental shocks including droughts and floods, producing more nutritious crops, reducing human labour requirements, and promoting long-term sustainability and stability of agriculture and food production⁵². Advances in technology have led to the emergence of agri-technologies including robots,

⁴⁶ Food security in Africa: Current efforts and challenges., Op Cit

⁴⁷ African Development Bank Group., 'Bank Group vision in agriculture' Available at <https://www.afdb.org/en/topics-and-sectors/sectors/agriculture-agro-industries/bank-group-vision> (Accessed on 22/09/2025)

⁴⁸ African Development Bank Group., 'Feed Africa' Op Cit

⁴⁹ Food and Agriculture Organization of the United Nations., 'Agricultural technology ecosystems in East Africa: Taking stock in Kenya, Rwanda and Uganda' Available at <https://openknowledge.fao.org/server/api/core/bitstreams/96eab0b4-bb4a-44ac-a067-1c6b2b5e5498/content> (Accessed on 22/09/2025)

⁵⁰ Ibid

⁵¹ Ruzzante. S., 'Adoption of Agricultural Technology in the Developing World: A Meta-Analysis of the Empirical Literature' *World Development.*, Volume 146, October 2021

⁵² Ibid

temperature and moisture sensors and aerial imaging among others⁵³. These technologies are enhancing efficiency and sustainability in agricultural production enabling farmers and businesses to be more profitable, safer, resilient and environmental-friendly⁵⁴.

Agri-technology can therefore transform the agricultural sector in Africa by ensuring smart farming systems for efficiency and sustainability. For example, robotic technologies enable more reliable monitoring and management of natural resources including air, water and soil thus improving yields and reducing the environmental impacts of agriculture⁵⁵. Further, by applying agri-technology, it is possible to reduce the use of water, fertilizer, and pesticides, thus reducing the prices of food⁵⁶. In addition, embracing indigenous agri-technologies including crop rotation, agroforestry, use of drought- and heat-resistant crops, integrated pest control systems, water harvesting and irrigation can foster high-yielding, climate resilient, and adaptive agricultural practices in Africa⁵⁷. Further, agri-technologies can mechanize food production thus ensuring safety while also boosting food production⁵⁸.

Adopting agri-technology is therefore a viable option towards boosting agricultural productivity and food security in Africa. However, inadequate investments undermine the ability of Africa to utilise agri-technology for food security⁵⁹. Further, since most agricultural production in Africa occurs at small-scale levels, most farmers lack adequate resources and capacity to adopt agri-technology⁶⁰. Insufficient policy and regulatory environments also hinder the adoption of agri-technology through measures such as

⁵³ Agriculture Technology., Available at <https://www.nifa.usda.gov/topics/agriculture-technology> (Accessed on 22/09/2025)

⁵⁴ Ibid

⁵⁵ Ibid

⁵⁶ Ibid

⁵⁷ Climate Champions. 'How Regenerative Agriculture Can Increase Africa's Food Production.' Available at <https://climatechampions.unfccc.int/call-to-action-for-climate-resilient-sustainable-food-systemsinafrica/> (Accessed on 22/09/2025)

⁵⁸ Ruzzante. S., 'Adoption of Agricultural Technology in the Developing World: A Meta-Analysis of the Empirical Literature' Op Cit

⁵⁹ African Development Bank Group., 'Feed Africa' Op Cit

⁶⁰ Ibid

technology development and transfer⁶¹. In light of these challenges, it is imperative to enhance agri-technology in Africa for efficiency and sustainability.

4.0 Conclusion

The agricultural sector in Africa provides immense opportunities to achieve food security in Africa. However, several challenges including heavy reliance on rain-fed agriculture, adverse climatic events, poor storage and transportation of food, poor agricultural practices and inadequate adoption of technology undermine the potential of the agricultural sector in Africa⁶². Technology therefore provides an opportunity to make the agricultural sector more smart, efficient and sustainable. Agri-technology has the capacity to increase agricultural yields, reduce agricultural exposure to environmental shocks including droughts and floods, produce more nutritious crops, reduce human labour requirements, and promote long-term sustainability and stability of agriculture and food production⁶³. It is therefore important to strengthen public and private investments in agri-technology including research and development for agricultural technologies in order to fully harness agri-technology in Africa⁶⁴. Further, it is imperative to support farmers including small-scale farmers through access to technology and training and capacity building on agri-technology in order to enable them embrace technology for enhanced agricultural production⁶⁵. In addition, there is need for African countries to put in place appropriate legal, policy and institutional frameworks that can enhance the adoption of agri-technology⁶⁶. Africa should also harness global and continental opportunities in agri-technology including through boosting intra-African

⁶¹ Agricultural Technology in Africa., Available at https://voxdev.org/sites/default/files/2024-04/Agricultural_Technology_Africa_Issue_1.pdf (Accessed on 22/09/2025)

⁶² African Development Bank Group., 'Feed Africa' Op Cit

⁶³ Ruzzante. S., 'Adoption of Agricultural Technology in the Developing World: A Meta-Analysis of the Empirical Literature' Op Cit

⁶⁴ Agricultural Technology in Africa., Op Cit

⁶⁵ African Development Bank Group., 'Feed Africa' Op Cit

⁶⁶ Ibid

trade in food under the African Continental Free Trade Area (AfCFTA) towards achieving regional food security⁶⁷.

Enhancing agri-technology in Africa for efficiency and sustainability is thus a viable and practical solution that can strengthen smart farming for food security.

⁶⁷ Badiane. O., '2022, A Year of Crisis: What Does it Mean for African Trade and Food Security?' Available at <https://www.foodfortransformation.org/full-article/2022-a-year-of-crisis-what-does-it-mean-for-african-trade-and-food-security.html> (Accessed on 22/09/2025)

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World Vision., 'Africa hunger crisis: Facts, FAQs, and how to help' Available at <https://www.worldvision.org/hunger-news-stories/africa-hunger-famine-facts>