

Enhancing Technology Development and Transfer in Africa for Sustainability

Kariuki Muigua

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Abstract

This paper critically discusses the need to enhance technology development and transfer in Africa. It argues that technology development and transfer is key in accelerating the Sustainable Development agenda in Africa. The paper defines technology development and transfer. It also examines the achievements made and setbacks facing technology development and transfer in Africa. The paper further offers ideas towards enhancing technology development and transfer in Africa for sustainability.

1.0 Introduction

Technology plays a key role in sustainability¹. Technology is deemed vital to catalyzing innovation; promoting industrial and economic growth; and effecting social changes and human development to improve lives². Access to technology is directly correlated with economic, social, and environmental productivity³. Eco-friendly technologies have a significant impact on the environment, as well as the economy⁴. Such technologies can aid in reducing greenhouse gas emissions, the amount of waste produced and the amount of money spend⁵. Technology is also a major enabler of competitiveness in almost all

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¹ United Nations Economic Commission for Africa., 'Advancing Technology Transfer for Sustainable Development in Africa' Available at https://www.uneca.org/sites/default/files/TCND/STIF2023/Advancing_Technology_Transfer.pdf (Accessed on 10/06/2024)

² Ibid

³ African Development Bank Group., 'Technology Transfer for Green Growth in Africa' Available at <https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/African%20Development%20Report%202012%20-%20Technology%20Transfer%20for%20Green%20Growth%20in%20Africa.pdf> (Accessed on 10/06/2024)

⁴ Nichols. M., 'How Can Technology Save the Environment?' Available at <https://born2invest.com/articles/technology-save-environment/> (Accessed on 10/06/2024)

⁵ Ibid

sectors⁶. Advances in technology often open up new opportunities that drive innovation, emergence of new companies, and improvement in the productivity and efficiency of existing ones⁷.

Most countries are now using science and technology to identify the answers to achieving a sustainable future and solving the environmental problems that they are facing⁸. The United Nations *2030 Agenda for Sustainable Development*⁹ recognizes the role of technology in realizing the Sustainable Development Goals (SDGs) including achieving food security; promoting good health and well-being; fostering access to affordable and clean energy; building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation and combating climate change¹⁰. It has been noted that achieving the SDGs requires action on a number of fronts, including harnessing and maximizing the potential of science and technological innovation for Sustainable Development¹¹. These technologies include carbon capture and storage systems, more efficient irrigation methods, essential medicines, household water purification devices, and manufacturing processes that minimize waste and pollution¹².

⁶ United Nations Economic Commission for Africa., 'Harnessing Emerging Technologies: the Cases of Artificial Intelligence and Nanotechnology' Available at <https://www.uneca.org/sites/default/files/TCND/AFSTIF2021/Emerging-technologies-for-Sustainable-VK1.pdf> (Accessed on 11/06/2024)

⁷ Ibid

⁸ Nasscom Community., 'Role of Science and Technology in Building a Sustainable Future.' Available at <https://wire19.com/role-of-science-and-technology-in-building-a-sustainable-future/> (Accessed on 10/06/2024)

⁹ 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 10/06/2024)

¹⁰ Ibid

¹¹ Harvard Kennedy School., 'Technology Innovation for Sustainable Development (2011-present).' Available at <https://www.hks.harvard.edu/centers/mrcbg/programs/sustsci/activities/programinitiatives/innovation> (Accessed on 10/06/2024)

¹² Ibid

Due to the importance of technology in sustainability, there has been an increasing attention in recent years towards transfer of green technologies to developing countries¹³. It has been argued that African countries need to make presence, acquire and absorb relevant eco-friendly technologies in order to meet their various social-economic development imperatives as outlined in Africa Union's Agenda 2063 and the Sustainable Development agenda¹⁴. Enhancing technology development and transfer is therefore key in fostering sustainability in Africa.

This paper critically discusses the need to enhance technology development and transfer in Africa. It argues that technology development and transfer is key in accelerating the Sustainable Development agenda in Africa. The paper defines technology development and transfer. It also examines the achievements made and setbacks facing technology development and transfer in Africa. The paper further offers ideas towards enhancing technology development and transfer in Africa for sustainability.

2.0 Technology Development and Transfer: Definition and Elements

Technology development and transfer has been defined as a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders including governments, private sector entities, financial institutions, non-governmental organization (NGOs), and research/education institutions¹⁵. Technology development and transfer encompasses diffusion of technologies and technology cooperation across and within countries¹⁶. It also entails the process of learning to understand, utilize and replicate the technology, including the capacity to choose and adapt to local conditions and integrate it with

¹³ African Development Bank Group., 'Technology Transfer for Green Growth in Africa' Op Cit

¹⁴ United Nations Economic Commission for Africa., 'Advancing Technology Transfer for Sustainable Development in Africa' Op Cit

¹⁵ Intergovernmental Panel on Climate Change., 'The International Dimension in Technology Development and Deployment: Technology Transfer' Available at https://archive.ipcc.ch/publications_and_data/ar4/wg3/en/ch2s2-7-3.html (Accessed on 11/06/2024)

¹⁶ Ibid

indigenous technologies¹⁷. Technology development and transfer can also be understood as a planned and deliberate movement of a specific technology between two or more entities, in which the transferor and the recipient are identifiable, and their respective motives and purposes can be comprehended in most cases¹⁸.

Technology development and transfer therefore involves processes that distribute technology from its place of origin to more people and places¹⁹. It comprises not only the movement of tangible goods and services but also the exchange of ideas and concepts²⁰. It has been pointed out that technology development and transfer must be aligned to the goal of Sustainable Development when being utilized as a sustainability tool²¹.

Technology development and transfer requires meaningful and effective actions including technology needs and needs assessments; technology information; enabling environment; capacity building; and mechanisms for technology transfer²². In addition, it has been pointed out that technology transfer capacity must recognize and must be pegged on certain criteria including: the ability to utilize/man/manage imported proprietary hardware²³; the comprehensive understanding of imported proprietary technology involving the ability to alter, improve or otherwise retrofit the technology for local conditions or to bypass a problem without recourse to the supplier²⁴; the ability to originate technology at all levels including research and development, bench scaling,

¹⁷ Ibid

¹⁸ United Nations Economic Commission for Africa., 'Advancing Technology Transfer for Sustainable Development in Africa' Op Cit

¹⁹ Corsi. A et al., 'Technology Transfer for Sustainable Development: Social Impacts Depicted and Some Other Answers to a Few Questions' *Journal of Cleaner Production.*, Volume 245, February 2020

²⁰ Ibid

²¹ Ibid

²² Global Environment Facility., 'Transfer of Environmentally Sound Technologies' Available at https://www.thegef.org/sites/default/files/publications/GEF-TechTransfer-lowres_final_2.pdf (Accessed on 11/06/2024)

²³ United Nations Climate Change., 'Capacity Building for Technology Transfer in the African Context: Priorities and Strategies' Available at https://unfccc.int/files/documentation/workshops_documentation/application/pdf/maya.pdf (Accessed on 11/06/2024)

²⁴ Ibid

piloting and commercial transfer²⁵; and the ability to influence global thinking on local technology and foreign technology development programmes²⁶.

It has been noted that technology development and transfer can help sustain natural resources and improve the livelihoods of people who depend on those resources²⁷. Further, it has been argued that increasing water scarcity and the attendant unreliability of water supply coupled with competition for land arising from other non-agricultural demands necessitate the need for technology development and transfer²⁸. When properly sourced and managed, technology development and transfer can enhance land productivity and tackle problems of food and water insecurity²⁹.

Technology transfer plays an increasingly critical role in the global response to the challenges of climate change and of the global environment³⁰. According to the Intergovernmental Panel on Climate Change (IPCC), technology development including improvement and reassessment of existing technologies, is urgently needed to: limit or reduce anthropogenic greenhouse gas emissions; absorb greenhouse gases by protecting and increasing greenhouse gas sinks; adapt human activities to the impacts of climate change; and monitor, detect, and predict climate change and its impacts³¹. It further notes that as the greenhouse gas emissions in developing countries are increasing with their population and economic growth, rapid transfer, on a preferential basis, to developing countries, of technologies that help to monitor, limit, or adapt to climate change, without hindering their economic development, is an urgent requirement for sustainability³².

²⁵ Ibid

²⁶ Ibid

²⁷ African Development Bank Group., 'Technology Transfer for Green Growth in Africa' Op Cit

²⁸ Ibid

²⁹ Ibid

³⁰ Global Environment Facility., 'Transfer of Environmentally Sound Technologies' Op Cit

³¹ Intergovernmental Panel on Climate Change., 'Technology Development and Transfer' Available at https://archive.ipcc.ch/ipccreports/far/wg_III/ipcc_far_wg_III_chapter_08.pdf (Accessed on 11/06/2024)

³² Ibid

The role of technology development and transfer in sustainability is acknowledged by the *United Nations Framework Convention on Climate Change (UNFCCC)*³³. The Convention requires states to promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic greenhouse gas emissions³⁴. It also requires developed countries to take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and knowhow to other parties, particularly developing country parties, to enable them to implement their climate change goals³⁵. UNFCCC therefore envisions technology development and transfer between developed and developing countries in order to strengthen the global response towards climate change.

Similarly, the *Paris Agreement*³⁶ recognizes the role of technology development and transfer in sustainability. The Paris Agreement acknowledges the specific needs and special situations of the least developed countries with regard to funding and transfer of technology³⁷. Parties to the Paris Agreement share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions³⁸. It requires states to strengthen cooperative action on technology development and transfer with developed countries being at the forefront in promoting technology development and transfer to developing countries³⁹.

³³ United Nations Framework Convention on Climate Change., United Nations 1992., Available at https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveg.pdf (Accessed on 11/06/2024)

³⁴ Ibid, article 4 (1) (c)

³⁵ Ibid, article 4 (5)

³⁶ Paris Agreement., United Nations, 2015., Available at https://unfccc.int/sites/default/files/english_paris_agreement.pdf (Accessed on 11/06/2024)

³⁷ Ibid

³⁸ Ibid, article 10 (1)

³⁹ Ibid, article 10 (3)

Technology development and transfer is therefore vital for sustainability.

3.0 Technology Development and Transfer in Africa: Opportunities and Challenges

According to IPCC, technology development and transfer is particularly important to developing countries⁴⁰. As a result, there has been an increasing attention in recent years towards transfer of green technologies to developing countries⁴¹. Technology development and transfer has been associated with decreased inputs of water, energy, fertilizer and pesticides and increased crop yields⁴². Technology development and transfer in Africa has the potential to enhance agricultural practices through improved irrigation and soil management techniques⁴³. Further, it has been noted that technology development and transfer in Africa can improve the sustainability of water supply and sewerage services⁴⁴.

Technology development and transfer has been identified as one of the levers through which African products and markets can gain competitiveness⁴⁵. This process can enhance the transfer of technical information, tacit know-how and performance skills, technical materials or equipment, jointly or as individual elements, with the intent of enabling the technological or manufacturing capacity African countries⁴⁶. For example, technology development and transfer has been identified as a possible solution in accelerating development of Africa's pharmaceutical production base⁴⁷. Therefore,

⁴⁰ Intergovernmental Panel on Climate Change., 'The International Dimension in Technology Development and Deployment: Technology Transfer' Op Cit

⁴¹ African Development Bank Group., 'Technology Transfer for Green Growth in Africa' Op Cit

⁴² Ibid

⁴³ Ibid

⁴⁴ African Development Bank Group., 'Technology Transfer to Boost Sustainability of Water Supply and Sewerage Services' Available at <https://www.afdb.org/fr/news-and-events/technology-transfer-to-boost-sustainability-of-water-supply-and-sewerage-services-14065> (Accessed on 11/06/2024)

⁴⁵ AUDA-NEPAD., 'How Technology Transfer Can Advance Local Production to Improve Access of Quality-Assured Medical Products in the Time of COVID-19' Available at <https://www.nepad.org/featured-promoted-items/how-technology-transfer-can-advance-local-production-improve-access-of> (Accessed on 11/06/2024)

⁴⁶ Ibid

⁴⁷ Ibid

African countries can leverage on the substantial potential of technology development and transfer to drive socio-economic growth and development in the continent⁴⁸.

The need for technology development and transfer is recognized under the United Nations *2030 Agenda for Sustainable Development*⁴⁹. SDG 17 recognizes that the Sustainable Development agenda can only be realized through strong global partnerships and cooperation on a number of areas including technology development and transfer⁵⁰. It encourages states to enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms⁵¹. It also urges developed countries to promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed⁵². Realizing the targets of SDG 17 is key in enhancing technology development and transfer in Africa for sustainability.

Africa Union's *Agenda 2063*⁵³ also recognizes the role of technology development and transfer for sustainability. Agenda 2063 acknowledges the role of science and technology in achieving the aspiration of a prosperous Africa based on inclusive growth and Sustainable Development⁵⁴. It further acknowledges that well educated citizens and skills revolution underpinned by science, technology and innovation is a vital priority for Sustainable Development in Africa⁵⁵. According to Agenda 2063, Africa's partners have

⁴⁸ Ibid

⁴⁹ United Nations General Assembly., 'Transforming Our World: the 2030 Agenda for Sustainable Development.' 21 October 2015, A/RES/70/1., Op Cit

⁵⁰ Ibid

⁵¹ Ibid

⁵² Ibid

⁵³ Africa Union., 'Agenda 2063: The Africa we Want' Available at https://au.int/sites/default/files/documents/33126-doc-framework_document_book.pdf (Accessed on 11/06/2024)

⁵⁴ Ibid

⁵⁵ Ibid

a crucial role to play in supporting the continent's development efforts through technology development and transfer in accordance with national needs and interests⁵⁶. Enhancing technology development and transfer in Africa is therefore vital in achieving the vision, aspirations, and goals of Agenda 2063 towards sustainability.

The *Digital Transformation Strategy for Africa*⁵⁷ also sets out the need for technology development and transfer in Africa for sustainability. It recognizes that technology is key in transforming traditional socioeconomic sectors in Africa⁵⁸. The Strategy seeks to harness digital technologies and innovation to transform African societies and economies to promote Africa's integration, generate inclusive economic growth, stimulate job creation, break the digital divide, and eradicate poverty for the continent's socio-economic development and ensure Africa's ownership of modern tools of digital management⁵⁹. It also urges African countries to leverage national and international technology development and transfer processes in order to achieve digital transformation in the continent⁶⁰. Digital transformation has been identified as an essential driver for development in Africa⁶¹. The availability and use of digital technologies is strongly linked to economic growth, innovation, job creation, and inclusion, at both the national and regional levels⁶². It is therefore necessary for African countries to enhance technology development and transfer in order to realize the digital transformation agenda in the continent for sustainability⁶³.

⁵⁶ Ibid

⁵⁷ African Union., 'The Digital Transformation Strategy for Africa (2020-2030)' Available at <https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf> (Accessed on 11/06/2024)

⁵⁸ Ibid

⁵⁹ Ibid

⁶⁰ Ibid

⁶¹ The World Bank Group., 'Digital Transformation Drives Development in Africa' Available at <https://www.worldbank.org/en/results/2024/01/18/digital-transformation-drives-development-in-afe-afw-africa> (Accessed on 11/06/2024)

⁶² Ibid

⁶³ Ibid

Technology development and transfer is therefore a key priority in Africa. It has been noted that since Africa's share of the world's research and development output remains low and most African countries are marginal producers of new technologies, domestic as well as international technology development, acquisitions and transfers can serve as a critical means to help narrow technology gaps and accelerate technological advances in African countries towards socio-economic development⁶⁴. In addition, it has been observed that the technology development and transfer landscape in Africa has undergone dynamic change and development in recent years driven by improvement in related policy framework, rapid technological changes, and the development of technology sectors and markets in African countries⁶⁵. However, the ability to effectively embrace technology development and transfer in Africa is hindered by challenges such as inadequate human and institutional capacity, social factors that inhibit change, inadequate financial resources to purchase, operate, and maintain new technologies, and higher initial capital costs in the case of some technology options⁶⁶. It is vital to address these challenges in order to enhance technology development and transfer in Africa for sustainability.

4.0 Conclusion

Technology is vital for development in Africa. It can catalyze innovation, promote industrial and economic growth, and effect social changes and human development to improve lives⁶⁷. Technology can also help to sustain natural resources and improve livelihoods for people who depend on such resources⁶⁸. Leveraging on technology can also help countries tackle the environmental problems that they are facing including climate change, biodiversity loss, and pollution⁶⁹. It is therefore necessary to enhance technology development and transfer in Africa for sustainability.

⁶⁴ United Nations Economic Commission for Africa., 'Advancing Technology Transfer for Sustainable Development in Africa' Op Cit

⁶⁵ Ibid

⁶⁶ Intergovernmental Panel on Climate Change., 'The International Dimension in Technology Development and Deployment: Technology Transfer' Op Cit

⁶⁷ United Nations Economic Commission for Africa., 'Advancing Technology Transfer for Sustainable Development in Africa' Op Cit

⁶⁸ African Development Bank Group., 'Technology Transfer for Green Growth in Africa' Op Cit

⁶⁹ Nasscom Community., 'Role of Science and Technology in Building a Sustainable Future.' Op Cit

In order to enhance technology development and transfer in Africa, it is vital for countries to adopt appropriate policies that will foster this process including those on intellectual property rights⁷⁰. These rights are an important instrument at the research and development level. They help assure the ownership over intellectual findings and the capacity to control the use of intellectual property in line with an institution's mission and core values⁷¹. They are also a powerful business tool to gain position on the market and exclusivity over a new product or process⁷². Intellectual property rights can therefore influence technology development and transfer. It has been noted that stronger protection of intellectual property rights can encourage innovation, technology development, and transfer⁷³. It is therefore key for African countries to adopt effective policies with regard to protection of intellectual property rights in order to enhance technology development and transfer in the continent for sustainability.

Technology development and transfer in Africa can also be enhanced by strengthening research and development in the continent⁷⁴. It has been noted that governments in Africa need to put in place the necessary support policies and legal frameworks that will encourage both academia and industry to collaborate in technology development and transfer initiatives⁷⁵. These measures include competitive funding that requires collaboration between academia and industry, regulation that encourage the development and adoption of clean technologies by firms, the appropriate intellectual

⁷⁰ World Intellectual Property Organisation., 'Intellectual Property and Technology Transfer' Available at <https://www.wipo.int/web/technology-transfer#:~:text=Technology%20transfer%20supports%20the%20life,the%20research%20and%20development%20level>. (Accessed on 11/06/2024)

⁷¹ Ibid

⁷² Ibid

⁷³ United Nations Industrial Development Organisation., 'The Role of Intellectual Property Rights in Technology Transfer and Economic Growth: Theory and Evidence' Available at https://www.unido.org/sites/default/files/2009-04/Role_of_intellectual_property_rights_in_technology_transfer_and_economic_growth_0.pdf (Accessed on 11/06/2024)

⁷⁴ United Nations Economic Commission for Africa., 'Mechanisms to Promote Development and Dissemination of Clean and Environmentally Sound Technologies in Africa' Available at <https://sustainabledevelopment.un.org/content/documents/1247eca.pdf> (Accessed on 11/06/2024)

⁷⁵ Ibid

property rights that balance the interests of technology developers and users and a common platform for sharing and exchanging knowledge and best practices on technology development and transfer⁷⁶. It is also necessary for African countries to establish or expand regional or national technology research centers to develop technologies for basic infrastructure, energy efficiency, and alternative energy sources, agriculture, forestry, and water resources among other key sectors that are vital for sustainability⁷⁷.

In addition, it is imperative to enhance knowledge flows, innovation, and capacity building in Africa⁷⁸. Technology development and transfer not only comprises of hardware but also encompasses the flow of knowledge⁷⁹. It has been noted that knowledge, expertise and experience for generating, managing, utilizing, and maintaining technology are key for effective technology development and transfer⁸⁰.

Developed countries, and international institutions can also support technology development and transfer initiatives in Africa through funding⁸¹. Funding is key in supporting the costs associated with technology development and transfer activities⁸². It has been noted that these costs may include training and any royalties and licensing fees where the owners of the technologies may not be willing to waive the costs associated with clean technology transfer⁸³. Further, consideration should also be given to opportunities for regional cooperation around green technology and knowledge-based

⁷⁶ Ibid

⁷⁷ Intergovernmental Panel on Climate Change., 'Technology Development and Transfer' Op Cit

⁷⁸ African Development Bank Group., 'Technology Transfer for Green Growth in Africa' Op Cit

⁷⁹ Ibid

⁸⁰ Ibid

⁸¹ United Nations Economic Commission for Africa., 'Mechanisms to Promote Development and Dissemination of Clean and Environmentally Sound Technologies in Africa' Op Cit

⁸² Ibid

⁸³ Ibid

initiatives in order to enhance technology development and transfer in Africa for sustainability⁸⁴.

Enhancing technology development and transfer in Africa for sustainability is a goal that is achievable and therefore should be pursued.

⁸⁴ African Development Bank Group., 'Technology Transfer for Green Growth in Africa' Op Cit

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World Intellectual Property Organisation., 'Intellectual Property and Technology Transfer' Available at <https://www.wipo.int/web/technology-transfer#:~:text=Technology%20transfer%20supports%20the%20life,the%20research%20and%20development%20level>