Embracing Science, Technology and Innovation for Sustainable Development

Kariuki Muigua

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Kariuki Muigua*

Abstract

The paper critically evaluates the role of science, technology and innovation in promoting Sustainable Development. It argues that these concepts play a fundamental role in realizing the Sustainable Development agenda and the Sustainable Development Goals. The paper explores specific ways through which science, technology and innovation have enhanced Sustainable Development. It further discusses the problems facing realization of Sustainable Development through science, technology and innovation and proposes solutions to these concerns. The paper argues a case for embracing science, technology and innovation in order to accelerate the realization of Sustainable Development across the globe.

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1.0 Introduction

The concept of Sustainable Development seeks to balance social, environmental and economic targets[1]. It aims to ensure that human welfare is taken care of while also seeking to make certain that environmental resources are utilized in a manner that promotes protection and conservation for the sake of future generations[2]. Sustainable Development is also viewed as development that meets the needs of the present without compromising the ability of future generations to meet their own needs[3]. This idea has been adopted as the global blueprint for development as envisaged by the United Nations in its 2030 Agenda for Sustainable Development[4]. The 2030 Agenda for Sustainable Development stipulates 17 Sustainable Development Goals (SGDs) which sets out a universal call to action to end poverty protect the planet and ensure that all people enjoy peace and prosperity by 2030[5]. The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all[6]. They address the global challenges facing the world including those related to poverty, inequality, climate change, environmental degradation, peace and justice[7].

Sustainable Development is a vital concept with global implications. Realizing Sustainable Development is essential in improving the quality of life for people and the planet by attaining economic prosperity, social equity and environmental protection[8]. It

[1] Holden. E., Linnerud. K., & Banister. D., 'The Imperatives of Sustainable Development.' (2017) 25 Sustainable Development, 213
[2] Muigua. K., 'Achieving Sustainable Development, Peace and Environmental Security.' Glenwood Publishers Limited, 2015
[3] World Commission on Environment and Development., 'Our Common Future.' Oxford, (Oxford University Press, 1987)
[44] United Nations General Assembly., 'Transforming Our World: The 2030 Agenda for Sustainable Development.' 21 October 2015, A/RES/70/1
[5] Ibid
[6] United Nations., 'Sustainable Development Goals.' Available at https://www.un.org/sustainabledevelopment/sustainable-development-goals/ (Accessed on 07/08/2023)
[7] Ibid
[8] Muigua. K., 'Nurturing Our Environment for Sustainable Development.' Glenwood Publishers Limited, 2016

has been asserted that achieving the Sustainable Development Goals is essential in improving lives and transforming the world for the better[9].

However, it has been observed that there has been slow progress in achieving most of the targets stipulated by the Sustainable Development Goals such as ending poverty, achieving food security, promoting good health and well-being, combating climate change and fostering peace[10]. Despite the ambitious plan set forward by the Sustainable Development Goals, many countries including Kenya are still facing social injustices such as gender inequalities and economic disparities between the rich and the poor resulting in many people facing challenges in accessing quality and adequate food, health services, quality education, clean water and sanitation and affordable and clean energy[11]. Further, environmental problems are still widespread as evidenced by pollution of water sources, poor solid waste management and industrial pollution, actions which result in climate change concerns[12]. These factors necessitate a re-evaluation of the polices, plans and programs designed towards realizing the Sustainable Development agenda.

The paper discusses the role of science, technology and innovation in fostering Sustainable Development. It has been argued that science, technology and innovation are vital tools in promoting Sustainable Development[13]. The United Nations Development Programme further acknowledges that creativity, knowhow, technology and financial resources from all of society is necessary to achieve the SDGs in every context[14]. The paper critically examines ways through which science, technology and innovation can

[9] United Nations General Assembly., 'Transforming Our World: The 2030 Agenda for Sustainable Development.' Op Cit
[10] United Nations., 'Sustainable Development Progress Chart 2022.' Available at https://unstats.un.org/sdgs/report/2022/Progress-Chart-2022.pdf (Accessed on 07/08/2023)
[11] Muigua. K., 'Achieving Sustainable Development, Peace and Environmental Security.' Op Cit
[12] Ibid
[13] Sustainability., 'The Impact of Science and Technology on Sustainable Future.' Available at https://blog.se.com/sustainability/2023/03/15/the-impact-of-science-and-technology-on-sustainable-future/#:~:text=Science%20and%20technology%20for%20a%20sustainable%20future%20are%20likely%20to,health%20needs%20worldwide%20while%20protecting (Accessed on 07/08/2023)
[14] UNDP., 'The SDGs in Action.' Available at https://www.undp.org/sustainable-development-goals (Accessed on 07/08/2023)

promote Sustainable Development. It argues a case for embracing science, technology and innovation in order to accelerate the attainment of Sustainable Development across the globe.

2.0 Role of Science, Technology and Innovation in Achieving Sustainable Development

In the context of Sustainable Development, science has been described as the process of understanding how humans interact with the natural environment[15]. Environmental science studies the mechanisms and processes underlying our interactions with the natural environment, the implications for the environment of the complexity and uncertainty brought on by economic, technological and social change[16]. Environmental technology on the other hand can be understood as the process of applying the understanding obtained from environmental science to address environmental challenges[17]. It allows the application of scientific knowledge towards taking the actions necessary to prevent, prepare for, or mitigate environmental risks[18]. Technology entails both soft technology which refers to information, training, research and capacity building and hard technology comprising of equipment and machinery[19]. Innovation in the field of Sustainable Development and refers to the process of developing and adopting new processes, products and technologies that are environment- friendly and aimed at addressing societal concerns such as food security, health, climate change and energy by

[15] Voulvoulis. N., 'The Contrasting Roles of Science and Technology in Environmental Challenges.' *Critical Reviews in Environmental Science and Technology*, Available at https://www.researchgate.net/publication/331388362_The_contrasting_roles_of_science_and_technology_in_environmental_challenges (Accessed on 07/08/2023)

[16] Walls. A et al., 'Convergence between Science and Environmental Education.' Science, Volume 344, No. 6184

[17] Voulvoulis. N., 'The Contrasting Roles of Science and Technology in Environmental Challenges.' Op Cit

[18] Ibid

[19] Srinivas. H., 'Introduction: Technology and Environment' available at http://www.gdrc.org/techtran/introduction.html (Accessed on 07/08/2023)

promoting effective remedies to these challenges[20]. Innovation is a key driver of sustainability[21]. It has been asserted that science, technology and innovation can provide effective solutions to most, if not all, environmental problems facing the world[22].

Science, technology and innovation plays a critical role in achieving the sustainable development goals. It can enhance productivity and induce a dynamic transformation of the economy, increasing growth rates and the number of decent jobs while reducing fossil-based energy consumption[23]. In addition, through science, technology and innovation, it is possible to develop essential drugs and improve health and medical care, achieve food security through sustainable agricultural methods and raising agricultural productivity, improve the safety of housework, and increase the safety of reproduction[24]. It has also been asserted that eco-friendly technology is poised to have a significant impact on the environment, as well as the economy, in the near future[25]. Such technology can aid in reducing emissions, the amount of waste produced and the amount of money spend[26].

Achieving the Sustainable Development Goals requires action on a number of fronts, including harnessing and maximizing the potential of science and technological innovation[27]. Examples of such technologies include carbon capture and storage systems, more efficient irrigation methods, essential medicines, household water purification

[20] Silvestre. B., & Tirca. D., 'Innovations for Sustainable Development: Moving towards a Sustainable Future.' *Journal of Cleaner Production*, 2018
[21] Ibid
[22] Huesemann. M.H., 'Can Pollution Problems Be Effectively Solved by Environmental Science and Technology? An Analysis of Critical Limitations, Ecological Economics, Volume 37, Issue 2, May 2001, pp, 271-287
[23] United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Available at https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/CDP-excerpt-2013-3.pdf (Accessed on 07/08/2023)
[24] Ibid
[25] Nichols. M., 'How Can Technology Save the Environment?' Available at https://born2invest.com/articles/technology-save-environment/ (Accessed on 07/08/2023)
[26] Ibid
[27] Harvard Kennedy School., 'Technology Innovation for Sustainable Development (2011-present).' Available at https://www.hks.harvard.edu/centers/mrcbg/programs/sustsci/activities/program-initiatives/innovation (Accessed on 07/08/2023)

devices, and manufacturing processes that minimize waste and pollution[28]. It has been argued that advancing a nation's capacity in science, technology and innovation and their effective application in social, economic and environmental dimensions of development are essential factors for expanding peoples' capabilities and achieving Sustainable Development[29].

The role of science, technology and innovation in realizing Sustainable Development is increasingly being acknowledged[30]. 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 facing[31]. The United Nations 2030 Agenda for Sustainable Development recognizes the role of science, technology and innovation in achieving the Sustainable Development Goals 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 change[32]. It advocates for enhanced international cooperation on and access to science, technology and innovation including knowledge sharing, capacity building, development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries in order to enhance Sustainable Development[33].

The *Rio Declaration on Environment and Development*[34] further acknowledges the role of science, technology and innovation in the Sustainable Development agenda. It

[28] Ibid
[29] [29] United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Op Cit
[30] 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 07/08/2023)
[31] Ibid
[32] United Nations General Assembly., 'Transforming Our World: The 2030 Agenda for Sustainable Development.' Op Cit
[33] Ibid
[34] United Nations General Assembly., 'Report of the United Nations Conference on Environment and Development: Rio Declaration on Environment and Development.' A/CONF.151/26 (Vol. I)

encourages states to cooperate towards strengthening endogenous capacity-building for Sustainable Development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies[35]. The *Paris Agreement*[36] also recognizes the role of science, technology and innovation in climate change mitigation and adaptation. It calls for the use of scientific knowledge in planning, policies and implementation in relation to climate change adaptation and mitigation actions; technology development and transfer and accelerating, encouraging and enabling innovation in order to improve global resilience to climate change and foster Sustainable Development[37].

The role of science, technology and innovation in Sustainable Development is also captured in Kenya. The *Constitution of Kenya* requires the state to recognise the role of science and indigenous technologies in the development of the nation[38]. In addition, the *Environmental Management and Co-ordination Act* encourages the use of suitable technologies to minimize pollution and adoption of innovative conservation practices in order to realize sound management of the environment[39]. The *Climate Change Act* also envisages the role of scientific knowledge about climate change, technology transfer and technological innovations relevant to climate change including promoting low carbon technologies and uptake of technologies that support low carbon and climate resilient development in fostering effective climate change mitigation and adaptation in Kenya towards Sustainable Development[40].

Science, technology and innovation are thus vital in fostering Sustainable Development.

[35] Ibid, Principle 9
[36] United Nations Framework Convention on Climate Change., 'Paris Agreement.' Available at https://unfccc.int/sites/default/files/english_paris_agreement.pdf (Accessed on 07/08/2023)
[37] Ibid
[38] Constitution of Kenya, 2010., Article 11 (2) (b)., Government Printer, Nairobi
[39] Environmental Management and Co-ordination Act., No. 8 of 1999, Government Printer, Nairobi
[40] Climate Change Act., No. 11 of 2016, Government Printer, Nairobi

3.0 Realizing Sustainable Development through Science, Technology and Innovation: Promises and Problems

Science, technology and innovation has aided the realization of Sustainable Development in various fields. Agricultural research, innovation and technology has enhanced food production and improved the resilience of the agricultural sector to the effects of climate change[41]. Advancements in precision agriculture, farm automation, genetics, water management technology including water efficient irrigation technologies and post-harvest management and storage of food have enabled smarter, safer and more productive farming[42]. It has been asserted that technology and innovation provide the agricultural sector with an opportunity to increase productivity while promoting better management of natural resources[43]. This is vital in ensuring long-term viability of the agricultural sector and reducing the negative environmental impacts of production, such as pollutants and waste[44]. Sustainable agriculture production systems also take into account how to adapt to climate change and mitigate greenhouse gas emissions[45]. Science, technology and innovation have thus enhanced realization of food security which is an essential component of the Sustainable Development agenda[46].

Further, science, technology and innovation have enabled development essential drugs and vaccines thus improving health and medical care[47]. It has been argued that science, technology and innovation are the keys to achieving Sustainable Development in developing countries by improving their health systems and mitigating negative

[41] Muigua. K., 'Nurturing our Environment for Sustainable Development.' Op Cit
[42] Mass Challenge., 'Agriculture Innovation: 10 Tech Trends to Watch in 2023.' Available at https://masschallenge.org/articles/agriculture-innovation/ (Accessed on 08/2023)
[43] Organisation for Economic Co-operation and Development., 'Innovation for a more Sustainable and Prosperous Agriculture.' Available at https://www.oecd.org/agriculture/topics/agricultural-productivity-and-innovation/ (Accessed on 08/08/2023)
[44] Ibid
[45] Ibid
[46] UNDP., 'Goal 2: Zero Hunger.' Available at https://www.undp.org/sustainable-development-goals/zero-hunger?gclid=CjwKCAjw44mlBhAQEiwAqP3eVvpUd-R_KxFJ8xEotjf6tFCHYfOZ0EISOZ5qBngYBSIgPCoPXLypPxoCpGkQAvD_BwE (Accessed on 08/08/2023)
[47] United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Op Cit

environmental impacts that jeopardize people's health[48]. According to the World Health Organization, science, technology and innovation accelerate progress in primary health care, addressing poverty-related diseases, and disease outbreak early warning and response[49]. Research, development, innovation, data and digital health can help deliver effective primary health care thus aiding in the fight against diseases[50]. Science, technology and innovation enhance access to treatments, vaccines, and health-related technologies[51]. The importance of science, technology and innovation in the health sector has been recently witnessed through life saving treatments and development of vaccines in the ongoing global fight against the COVID-19 pandemic[52]. Science, technology and innovation are therefore integral in ensuring good health and well-being for all and addressing future health emergencies and infectious disease outbreaks[53].

In addition, science, technology and innovation are key drivers in the realization of Sustainable Development Goal 7 that seeks to ensure universal access to affordable and clean energy[54]. Science, technology and innovation enable access to clean and more efficient sources of energy including solar, wind and thermal power[55]. This role is recognized under the United Nations 2030 Agenda for Sustainable Development which

[48] United Nations., 'World Health Day 2022: Science, Technology and Innovation help improve Health in the Least Developed Countries.' Available at https://www.un.org/technologybank/news/world-health-day-2022-science-technology-and-innovation-help-improve-health-least-developed (Accessed on 08/08/2023)
[49] World Health Organization., 'Stronger Collaboration, Better Health: Global Action Plan for Healthy Lives and Well-being for All.' Available at https://www.who.int/initiatives/sdg3-global-action-plan (Accessed on 08/08/2023)
[50] United Nations Economic and Social Council., 'Using Science, Technology and Innovation to Close the Gap on Sustainable Development Goal 3, Good Health and Well-Being.' E/CN.16/2021/2
[51] Ibid
[52] UNCTAD., 'Science, Technology and Innovation efforts to address COVID-19.' Available at https://unctad.org/topic/commission-on-science-and-technology-for-development/covid-19 (Accessed on 08/08/2023)
[53] United Nations Economic and Social Council., 'Using Science, Technology and Innovation to Close the Gap on Sustainable Development Goal 3, Good Health and Well-Being.' Op Cit
[54] UNDP., 'Goal 7: Affordable and Clean Energy.' Available at https://www.undp.org/sustainable-development-goals/affordable-and-clean-energy?gclid=CjwKCAjw44mlBhAQEiwAqP3eVvpUd-R_KxFJ8xEotjf6tFCHYfOZ0EISOZ5qBngYBSIgPCoPXLypPxoCpGkQAvD_BwE (Accessed on 08/08/2023)
[55] Ibid

seeks to enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy; energy efficiency and advanced and cleaner fossil-fuel technology, and investment in energy infrastructure and clean energy technology[56]. Investing in Science, technology and innovation is thus integral in promoting clean, affordable and sustainable sources of energy including renewable energy[57].

Science, technology and innovation have also enhanced global efforts in the fight against climate change[58]. It has been observed that the reality of global climate change has heightened the critical importance of science and technological innovation to achieve Sustainable Development goals[59]. An effective and sustainable response to climate change demands the best, most up-to-date scientific assessments of the issue, made in a holistic and multi-disciplinary way[60]. Cleaner technologies, including cleaner energy technologies such as renewable energy, have an important role to play in addressing climate change[61]. Further, innovations such as electric cars are helping to curb climate change since such vehicles do not directly emit greenhouse gases unlike conventional internal combustion engine vehicles[62]. Advancements in technology are also accelerating carbon sequestration by capturing, removing and storing carbon dioxide from the earth's

[56] United Nations General Assembly., 'Transforming Our World: The 2030 Agenda for Sustainable Development.' Op Cit
[57] Muigua. K., 'Delivering Clean and Affordable Energy for All.' Available at http://kmco.co.ke/wp-content/uploads/2021/05/Delivering-Clean-and-Affordable-Energy-for-All-Kariuki-Muigua-Ph.D-24th-April-2021-1.pdf (Accessed on 08/08/2023)
[58] United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Op Cit
[59] United Nations Department of Economic and Social Affairs., 'Forum on Climate Change and Science and Technology Innovation.' Available at https://www.un.org/en/desa/forum-climate-change-and-science-and-technology-innovation (Accessed on 08/08/2023)
[60] Ibid
[61] Ibid
[62] Hausfather. Z., 'Factcheck: How Electric Vehicles Help to Tackle Climate Change.' Available at https://www.carbonbrief.org/factcheck-how-electric-vehicles-help-to-tackle-climate-change/ (Accessed on 08/08/2023)

atmosphere practices such as carbon capture and storage thus aiding in curbing climate change[63].

Science, technology and innovation have also fostered sustainable waste management practices helping to curb pollution thus preventing its impacts on human health and the environment and contributing to the attainment of Sustainable Development[64]. Smart waste technologies have promoted efficient industrial and solid waste management systems through the development of tools and processes that tackle the main challenges of waste management, such as cleaning, collecting, transporting, recovery, recycling and final disposal[65]. Sustainable waste management is vital in realizing Sustainable Development by curbing the effect of industrial and solid waste on food, water, human health and the climate[66].

From the foregoing, it is evident that science, technology and innovation are crucial in fostering Sustainable Development. However, these phenomena have been described as a double- edged sword capable of both doing and undoing environmental damage[67]. Most environmental challenges such as global warming and climate change can be attributed to technological innovations since they are majorly caused by industrial pollution and fuel emissions from motor vehicles[68]. It has also been observed that while technologies can be successful in solving specific environmental challenges such as pollution, they cause unavoidable negative environmental impacts elsewhere or in the

[63] nationalgrid., 'What is Carbon Sequestration?' Available at https://www.nationalgrid.com/stories/energy-explained/what-carbon-sequestration (Accessed on 08/08/2023)
[64] Bordt. M., Rosa. J.M., & Boivin. J., 'Science, Technology and Innovation for Sustainable Development.' Available at https://www.oecd.org/science/inno/37450421.pdf (Accessed on 08/08/2023)
[65] Guerra. P., 'Technological Innovation in Solid Waste Management: The Digital Revolution is Transforming the Way We See and Handle our Waste.' Available at https://blogs.iadb.org/agua/en/technological-innovation-in-solid-waste-management-the-digital-revolution-is-transforming-the-way-we-see-and-handle-our-waste/ (Accessed on 08/08/2023)
[66] Elsheekh. K. M., 'Achieving Sustainable Development Goals from the Perspective of Solid Waste Management Plans.' *Journal of Engineering and Applied Sciences*, Volume 68, No. 9 (2021)
[67] Muigua. K., 'Utilising Science and Technology for Environmental Management in Kenya.' Available at http://kmco.co.ke/wp-content/uploads/2020/04/Utilising-Science-and-Technology-for-Environmental-Management-in-Kenya.pdf (Accessed on 08/08/2023)
[68] Ibid

future[69]. In addition, it has been asserted that it is intrinsically impossible to design industrial processes and innovations that have no negative environmental impacts[70]. For example, it has been argued that the manufacture of electric vehicles, an innovation heralded for being environment- friendly, results in environmental concerns that have climate change implications[71]. The manufacture of batteries used in electric cars comes from mining activities that have environmental cost due to the toxic fumes released during the mining process and the water-intensive nature of the activity[72].

Further, the role of science, technology and innovation in Sustainable Development is yet to be fully embraced especially in developing countries due to factors such as inadequate funding and investment and poor government policy[73]. As a result, these countries are lagging behind in achieving Sustainable Development goals such as food security; good health and well- being; clean water and sanitation; affordable and clean energy and climate action[74]. Challenges and barriers to technology transfer have also hindered effective application of science, technology and innovation in promoting Sustainable Development especially in developing countries[75]. These challenges include inadequate incentives, cost of new technologies, capacity challenges including inadequate

[69] Huesemann. M., 'Can Pollution Problems be Effectively Solved by Environmental Science and Technology? An analysis of Critical Limitations.' Ecological Economic, Volume 37, Issue 2 (2001)
[70] Ibid
[71] Lakshmi. R. B., 'The Environmental Impact of Battery Production for Electric Vehicles.' Available at https://earth.org/environmental-impact-of-battery-production/ (Accessed on 08/08/2023)
[72] Ibid
[73] United Nations., 'Science, Technology and Innovation for Sustainable Development in the Global Partnership for Development Beyond 2015.' Available at https://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/28_thinkpiece_science.pdf (Accessed on 08/08/2023)
[74] UNDP., 'New Africa SDGs Report Shows Slow Progress, Calls for Greater Action to Meet Targets.' Available at https://www.undp.org/africa/press-releases/new-africa-sdgs-report-shows-slow-progress-calls-greater-action-meet-targets#:~:text=The%202022%20Africa%20SDGs%20report,(Partnerships%20for%20the%20Goals).&text=Africa%20has%20made%20slow%20progress,of%20quality%20education%20for%20all. (Accessed on 08/08/2023)
[75] Johnson. D., & Kristina. M. L., 'Challenges to Technology Transfer: A Literature Review of the Constraints on Environmental Technology Dissemination.' *Colorado College Working Paper No. 2009-07*

infrastructure and governance conditions[76]. It is necessary to address these challenges in order to fully embrace science, technology and innovation for Sustainable Development.

4.0 Way Forward

There is need to fully embrace science, technology and innovation in order to actualize the Sustainable Development agenda. One way through which this can be achieved is investing in science, technology and innovation which are essential factors for economic development and social progress and fostering Sustainable Development by building greener and more inclusive societies[77]. It has been asserted that there is need for governments to put in place action-orientated science, technology and innovation programmes that are aligned to development strategies to meet the ambitions of the Sustainable Development Goals[78]. This can be achieved through investments in clean energy sources including renewable energy, sustainable agricultural practices to enhance productivity and health care[79]. There is also need for developed countries and international financial institutions such as the World Bank to enhance funding and investment in developing countries in sectors such as infrastructure, energy, education, agriculture and health care in order to help them achieve the Sustainable Development Goals[80].

In addition, it is imperative to integrate science, technology and innovation considerations into public policy goals and decisions in order to realize Sustainable

[76] Ibid
[77] UNESCO., 'Investing in Science, Technology and Innovation.' Available at https://en.unesco.org/themes/investing-science-technology-and-innovation (Accessed on 08/08/2023)
[78] United Nations Economic and Social Commission for Asia and the Pacific., 'Science, Technology and Innovation for Sustainable Development.' E/ESCAP/72/32
[79] United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Op Cit
[80] United Nations., 'What is Financing for Sustainable Development?' Available at https://financing.desa.un.org/about/what-financing-sustainable-development (Accessed on 08/08/2023)

Development[81]. Through such integration, science, technology and innovation will be pursued with the broader development agenda towards achieving Sustainable Development[82]. In Kenya, the Vision 2030 development blueprint acknowledges the role of science, technology and development in raising productivity and efficiency levels across the economic, social and political pillars[83]. It calls for increased scientific research, development and adoption of technology and innovation in order to accelerate economic development in Kenya[84]. Embracing science, technology and innovation in public policy goals and development agenda is vital in realizing Sustainable Development[85].

It is also pertinent to promote regional and international collaboration in order to fully embrace science, technology and innovation for Sustainable Development. Regions such as Asia and the Pacific have been lauded for collaboration through the establishment of science parks, tech clusters and innovation hubs that have fostered a dynamic, vibrant and collaborative ecosystem for science, technology and innovation[86]. Other regions including Africa can follow this example in order to embrace science, technology and innovation. Further, it has been pointed out that collaboration through technology transfer is vital in fostering Sustainable Development especially in developing countries[87]. Technology transfer enables distribution of technologies and innovations from their place of origin to other places[88]. It can thus enable the transfer of technologies thus are essential in areas such as health care, agriculture, energy and climate change

[81] United Nations., 'Science, Technology and Innovation for Sustainable Development in the Global Partnership for Development Beyond 2015.' Op Cit
[82] Ibid
[83] Government of Kenya.,' Sessional paper On Kenya Vision 2030.' Available at https://vision2030.go.ke/wp-content/uploads/2018/05/Sessional-paper-No.-10-of-2012-On-Kenya-Vision-2030.pdf (Accessed on 08/08/2023)
[84] Ibid
[85] United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Op Cit
[86] United Nations Economic and Social Commission for Asia and the Pacific., 'Science, Technology and Innovation for Sustainable Development.' Op Cit
[87] 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, No. 1 (2020)
[88] Gunsel. A., 'Research on Effectiveness of Technology Transfer from a Knowledge Based Perspective.' *Social and Behavioral Sciences*, Volume 207, No. 20 (2015)

mitigation and adaptation towards meeting the Sustainable Development needs of developing countries[89]. It is thus vital for countries to embrace collaboration through technology transfer and remove barriers affecting effective transfer of technology in order to realize Sustainable Development[90].

Lastly, it is imperative for countries to enhance their overall science, technology, technical capacity and technical capabilities[91]. This can be achieved through advanced education and training, improved infrastructure, equipment, and through strengthening linkages with actors in the productive sectors[92]. These among other measures are vital in enabling countries to fully embrace science, technology and innovation for Sustainable Development.

5.0 Conclusion

Science, technology and innovation are crucial factors in achieving Sustainable Development[93]. These components have improved agriculture thus promoting food security; promoted the development essential drugs and vaccines thus improving health and medical care; enhanced access to affordable and clean energy including renewable sources of energy; fostered sustainable waste management practices and enhanced the global response to the threat of climate change[94]. However, concerns such as inadequate funding and investments, poor government policies, challenges in technology transfer and capacity inadequacies have hindered the ability of countries especially in the developing world from fully adopting science, technology and innovation for Sustainable

[89] Corsi. A et al., 'Technology transfer for Sustainable Development: Social Impacts Depicted and Some Other Answers to a Few Questions.' Op Cit
[90] Ibid
[91] United Nations Economic and Social Commission for Asia and the Pacific., 'Science, Technology and Innovation for Sustainable Development.' Op Cit
[92] Government of Kenya.,' Sessional paper On Kenya Vision 2030.'
[93] United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Op Cit
[94] Ibid

Development[95]. Addressing these problems calls for increased funding and investments; integrating science, technology and innovation considerations into public policy goals and decisions; promote regional and international collaboration through measures such as technology transfer and enhancing the science, technology, technical capacity and technical capabilities of countries through measures as education, training and infrastructure development[96]. This will enable effective utilization of science, technology and innovation as tools for fostering Sustainable Development. Embracing science, technology and innovation for Sustainable Development is a quest worth pursuing.

[95] United Nations., 'Science, Technology and Innovation for Sustainable Development in the Global Partnership for Development Beyond 2015.' Op Cit

[96] United Nations Economic and Social Commission for Asia and the Pacific., 'Science, Technology and Innovation for Sustainable Development.' Op Cit

References

Bordt. M., Rosa. J.M., & Boivin. J., 'Science, Technology and Innovation for Sustainable Development.' Available at https://www.oecd.org/science/inno/37450421.pdf

Climate Change Act., No. 11 of 2016, Government Printer, Nairobi

Constitution of Kenya, 2010., Government Printer, Nairobi

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, No. 1 (2020)

Elsheekh. K. M., 'Achieving Sustainable Development Goals from the Perspective of Solid Waste Management Plans.' *Journal of Engineering and Applied Sciences*, Volume 68, No. 9 (2021)

Environmental Management and Co-ordination Act., No. 8 of 1999, Government Printer, Nairobi

Government of Kenya.,' Sessional paper On Kenya Vision 2030.' Available at https://vision2030.go.ke/wp-content/uploads/2018/05/Sessional-paper-No.-10-of-2012-On-Kenya-Vision-2030.pdf

Guerra. P., 'Technological Innovation in Solid Waste Management: The Digital Revolution is Transforming the Way We See and Handle our Waste.' Available at https://blogs.iadb.org/agua/en/technological-innovation-in-solid-waste-management-the-digital-revolution-is-transforming-the-way-we-see-and-handle-our-waste/

Gunsel. A., 'Research on Effectiveness of Technology Transfer from a Knowledge Based Perspective.' *Social and Behavioral Sciences*, Volume 207, No. 20 (2015)

Harvard Kennedy School., 'Technology Innovation for Sustainable Development (2011-present).' Available at https://www.hks.harvard.edu/centers/mrcbg/programs/sustsci/activities/program-initiatives/innovation

Hausfather. Z., 'Factcheck: How Electric Vehicles Help to Tackle Climate Change.' Available at https://www.carbonbrief.org/factcheck-how-electric-vehicles-help-to-tackle-climate-change/

Holden. E., Linnerud. K., & Banister. D., 'The Imperatives of Sustainable Development.' (2017) 25 Sustainable Development, 213

Huesemann. M., 'Can Pollution Problems be Effectively Solved by Environmental Science and Technology? An analysis of Critical Limitations.' Ecological Economic, Volume 37, Issue 2 (2001)

Huesemann. M.H., 'Can Pollution Problems Be Effectively Solved by Environmental Science and Technology? An Analysis of Critical Limitations, Ecological Economics, Volume 37, Issue 2, May 2001, pp, 271-287

Johnson. D., & Kristina. M. L., 'Challenges to Technology Transfer: A Literature Review of the Constraints on Environmental Technology Dissemination.' *Colorado College Working Paper No. 2009-07*

Lakshmi. R. B., 'The Environmental Impact of Battery Production for Electric Vehicles.' Available at https://earth.org/environmental-impact-of-battery-production/

Mass Challenge., 'Agriculture Innovation: 10 Tech Trends to Watch in 2023.' Available at https://masschallenge.org/articles/agriculture-innovation/

Muigua. K., 'Achieving Sustainable Development, Peace and Environmental Security.' Glenwood Publishers Limited, 2015

Muigua. K., 'Delivering Clean and Affordable Energy for All.' Available at http://kmco.co.ke/wp-content/uploads/2021/05/Delivering-Clean-and-Affordable-Energy-for-All-Kariuki-Muigua-Ph.D-24th-April-2021-1.pdf

Muigua. K., 'Nurturing Our Environment for Sustainable Development.' Glenwood Publishers Limited, 2016

Muigua. K., 'Utilising Science and Technology for Environmental Management in Kenya.' Available at http://kmco.co.ke/wp-content/uploads/2020/04/Utilising-Science-and-Technology-for-Environmental-Management-in-Kenya.pdf

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/

nationalgrid., 'What is Carbon Sequestration?' Available at https://www.nationalgrid.com/stories/energy-explained/what-carbon-sequestration

Nichols. M., 'How Can Technology Save the Environment?' Available at https://born2invest.com/articles/technology-save-environment/

Organisation for Economic Co-operation and Development., 'Innovation for a more Sustainable and Prosperous Agriculture.' Available at https://www.oecd.org/agriculture/topics/agricultural-productivity-and-innovation/

Silvestre. B., & Tirca. D., 'Innovations for Sustainable Development: Moving towards a Sustainable Future.' *Journal of Cleaner Production*, 2018

Srinivas. H., 'Introduction: Technology and Environment' available at http://www.gdrc.org/techtran/introduction.html

Sustainability., 'The Impact of Science and Technology on Sustainable Future.' Available at https://blog.se.com/sustainability/2023/03/15/the-impact-of-science-and-technology-on-sustainable-future/#:~:text=Science%20and%20technology%20for%20a%20sustainable%20future%20are%20likely%20to,health%20needs%20worldwide%20while%20protecting

UNCTAD., 'Science, Technology and Innovation efforts to address COVID-19.' Available at https://unctad.org/topic/commission-on-science-and-technology-for-development/covid-19

UNDP., 'Goal 2: Zero Hunger.' Available at https://www.undp.org/sustainable-development-goals/zero-hunger?gclid=CjwKCAjw44mlBhAQEiwAqP3eVvpUd-R_KxFJ8xEotjf6tFCHYfOZ0EISOZ5qBngYBSIgPCoPXLypPxoCpGkQAvD_BwE

UNDP., 'Goal 7: Affordable and Clean Energy.' Available at https://www.undp.org/sustainable-development-goals/affordable-and-clean-energy?gclid=CjwKCAjw44mlBhAQEiwAqP3eVvpUd-R_KxFJ8xEotjf6tFCHYfOZ0EISOZ5qBngYBSIgPCoPXLypPxoCpGkQAvD_BwE

UNDP., 'New Africa SDGs Report Shows Slow Progress, Calls for Greater Action to Meet Targets.' Available at https://www.undp.org/africa/press-releases/new-africa-sdgs-report-shows-slow-progress-calls-greater-action-meet-targets#:~:text=The%202022%20Africa%20SDGs%20report,(Partnerships%20for%20the%20Goals).&text=Africa%20has%20made%20slow%20progress,of%20quality%20education%20for%20all.

UNDP., 'The SDGs in Action.' Available at https://www.undp.org/sustainable-development-goals

UNESCO., 'Investing in Science, Technology and Innovation.' Available at https://en.unesco.org/themes/investing-science-technology-and-innovation

United Nations Committee for Development Policy., 'Science, Technology and Innovation for Sustainable Development.' Available at https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/CDP-excerpt-2013-3.pdf

United Nations Department of Economic and Social Affairs., 'Forum on Climate Change and Science and Technology Innovation.' Available at https://www.un.org/en/desa/forum-climate-change-and-science-and-technology-innovation

United Nations Economic and Social Commission for Asia and the Pacific., 'Science, Technology and Innovation for Sustainable Development.' E/ESCAP/72/32

United Nations Economic and Social Council., 'Using Science, Technology and Innovation to Close the Gap on Sustainable Development Goal 3, Good Health and Well-Being.' E/CN.16/2021/2

United Nations Framework Convention on Climate Change., 'Paris Agreement.' Available at https://unfccc.int/sites/default/files/english_paris_agreement.pdf

United Nations General Assembly., 'Report of the United Nations Conference on Environment and Development: Rio Declaration on Environment and Development.' A/CONF.151/26 (Vol. I)

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

United Nations., 'Science, Technology and Innovation for Sustainable Development in the Global Partnership for Development Beyond 2015.' Available at https://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/28_thinkpiece_science.pdf

United Nations., 'Sustainable Development Goals.' Available at https://www.un.org/sustainabledevelopment/sustainable-development-goals/

United Nations., 'Sustainable Development Progress Chart 2022.' Available at https://unstats.un.org/sdgs/report/2022/Progress-Chart-2022.pdf

United Nations., 'What is Financing for Sustainable Development?' Available at https://financing.desa.un.org/about/what-financing-sustainable-development

United Nations., 'World Health Day 2022: Science, Technology and Innovation help improve Health in the Least Developed Countries.' Available at https://www.un.org/technologybank/news/world-health-day-2022-science-technology-and-innovation-help-improve-health-least-developed

Voulvoulis. N., 'The Contrasting Roles of Science and Technology in Environmental Challenges.' *Critical Reviews in Environmental Science and Technology*, Available at https://www.researchgate.net/publication/331388362_The_contrasting_roles_of_science_and_technology_in_environmental_challenges

Walls. A et al., 'Convergence between Science and Environmental Education.' Science, Volume 344, No. 6184

World Commission on Environment and Development., 'Our Common Future.' Oxford, (Oxford University Press, 1987)

World Health Organization., 'Stronger Collaboration, Better Health: Global Action Plan for Healthy Lives and Well-being for All.' Available at https://www.who.int/initiatives/sdg3-global-action-plan