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Harnessing technology to foster biodiversity conservation for Sustainable Development

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Abstract

Conservation of biodiversity is among the major global environmental concerns. The quality and quantity of biodiversity is affected by human activities, habitat destruction, pollution and climate change. These challenges create the need for efficient mechanisms aimed at conserving biodiversity in order to realize Sustainable Development. The paper discusses the role of technology in biodiversity conservation. It argues that technology can foster effective biodiversity conservation. The paper examines various technologies that can be harnessed to foster biodiversity conservation for Sustainable Development.

1.0 Introduction

The *Convention on Biological Diversity* defines biodiversity as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, which includes diversity within species, between species and of ecosystems[1]. Biodiversity is comprised of several levels, starting with genes, then individual species, then communities of creatures and finally entire ecosystems,

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[1] Convention on Biological Diversity, United Nations 1992, available at *https://www.cbd.int/doc/legal/cbd-en.pdf* (Accessed on 24/08/2023)

such as forests or coral reefs, where life interplays with the physical environmen [2] .Biodiversity plays a huge role in not only environmental processes but also in provision of ecosystem resources for all living organisms, including human beings[3]. It is essential for the processes that support all life on earth, including humans[4]. It has been pointed out that biodiversity is key to the proper functioning of earth systems; and to the delivery of those ecosystem services that are crucial to human dignity and well-being including the provision of water and food; soil fertility; maintenance of the 'genetic library of biodiversity' – an irreplaceable source of new innovations, pharmaceuticals and chemicals; and climate regulation – among others[5]. Conservation of biodiversity is therefore very essential.

Conservation of biodiversity has emerged as among the major global environmental concerns [6] . Biodiversity declines due to human activities, habitat destruction, pollution, and climate change [7] . Biodiversity conservation is threatened by human activities that have

[2] Carrington. D., 'What is Biodiversity and Why Does it Matter to Us?' Available at *https://www.theguardian.com/news/2018/mar/12/what-is-biodiversity-and-why-does-it-matter-to-us* (Accessed on 24/08/2023)
[3] Muigua. K., 'Conserving Biodiversity for a Better Future' available at *http://kmco.co.ke/wpcontent/uploads/2021/06/Conserving-Biodiversity-for-a-Better-Future-Kariuki-Muigua-June-2021.pdf*
[4] The Royal Society., 'Why is Biodiversity Important?' Available at *https://royalsociety.org/topics-policy/projects/biodiversity/why-is-biodiversity-important/* (Accessed on 24/08/2023)
[5] United Nations Educational, Scientific and Cultural Organization., 'Conserving Biodiversity for Life and Sustainable Development.' Available at *http://www.unesco.org/new/en/mediaservices/singleview/news/conserving_biodiversity_for_life_and_sustainable_development/* (Accessed on 24/08/2023)
[6] Geneletti. D., 'Biodiversity Impact Assessment of Roads: An Approach Based on Ecosystem Rarity' *Environmental Impact Assessment Review* 23 (2003) 343–365
[7] Ibid

the potential of affecting both the quality and quantity of natural habitats[8]. Fostering biodiversity conservation is therefore a crucial element in ensuring long-term sustainability and resilience of ecosystems [9]. The United Nations 2030 Agenda for Sustainable Development recognizes the loss of biodiversity as one of the biggest challenges that humanity is currently facing [10]. Sustainable Development Goal 15 seeks to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss[11]. Conservation of biodiversity is thus vital in the Sustainable Development agenda[12].

The paper discusses the role of technology in biodiversity conservation. It argues that technology can foster effective biodiversity conservation. The paper examines various technologies that can be harnessed to foster biodiversity conservation for Sustainable Development.

[8] Ibid
[9] Rands. M et al., 'Biodiversity Conservation: Challenges Beyond 2010.' Available at *http://www.indiaenvironmentportal.org.in/files/biodiversity%20conservation.pdf* (Accessed on 24/08/2023)
[10] United Nations., 'Transforming Our World: The 2030 Agenda for Sustainable Development.' Available at *https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf* (Accessed on 24/08/2023)
[11] Ibid
[12] Ibid

2.0 Role of Technology in Biodiversity Conservation

Technology is essential in fostering biodiversity conservation[13]. While technological development has been a key driver of climate change and biodiversity loss, technology can also be harnessed to enhance biodiversity conservation[14]. It has been asserted that the role that computational tools and technology can play in helping monitor, model and respond to the challenges of global biodiversity loss is enormous[15]. Decrease in ecosystems and species survival threatens long-term biodiversity health thus urgent conservation measures and innovative technologies are essential[16].

Knowledge and technology allow conservationists to achieve major impacts from tracking and protecting a single species to better managing whole ecosystems [17] . Technology can promote a multifaceted approach towards conservation through monitoring natural areas, making real time observations and managing field operations thus enabling conservationists to gain new, better and

[13] Joppa. L., 'Technology for Nature Conservation: An Industry Perspective.' Available at *https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=39b01bca795dc2b9587f04dc82330c5bd37b9f23* (Accessed on 24/08/2023)

[14] Wellers. D, et al., 'Technology for Preserving Biodiversity.' Available at *https://www.sap.com/insights/viewpoints/technology-for-biology-preserving-*biodiversity.html#:~:text=Working%20alone%20or%20in%20combination,illegal%20poaching%20and%20habitat%20destruction. (Accessed on 24/08/2023)

[15] Joppa. L., 'Technology for Nature Conservation: An Industry Perspective.' Op Cit

[16] Ibid

[17] International Union for Conservation of Nature., 'Knowledge, Innovation and Technology for Impact in Conservation.' Available at *https://civicrm.iucn.org/civicrm/mailing/view?id=3158&reset=1* (Accessed on 24/08/2023)

predictive insights into the health of an ecosystem[18]. Application of technological innovation to the challenge of conserving and restoring biodiversity can aid in repairing the planet and the well-being of every species on it and create a future that's more environmentally and economically stable and resilient[19].

Digital tools provide access to a network of data and information that is integrated, allowing for more efficient monitoring and analysis of the environment and ecosystems[20]. Technological innovation can facilitate biodiversity and environment conservation promoting Sustainable Development[21]. The growth of information and communication technology and global interconnectedness poses a great opportunity to promote biodiversity conservation especially in remote areas[22]. The emergence of smart technological systems linked to the internet presents some unique opportunities to address challenges associated with biodiversity to ensure an equitable, environmentally sustainable, and healthy society biodiversity conservation which is key in moving towards a sustainable society for the future[23]. Digital engineering can enhance the efficiency of

[18] Gopala. A., 'Role of Technology in Conservation.' Available at *https://www.thehindu.com/education/role-of-technology-in-conservation/article65544747.ece (Accessed* on 24/08/2023)
[19] Wellers. D, et al., 'Technology for Preserving Biodiversity.' Op Cit
[20] The Conservation., 'Digital Technologies for Biodiversity Protection and Climate Action: Solution or COP Out?.' Available at https://theconversation.com/digital-technologies-for-biodiversity-protection-and-climate-action-solution-or-cop-out-196107 (Accessed on 24/08/2023)
[21] Ibid
[22] Ibid
[23] Degawan. M., 'Digital Tools Can Help to Preserve Natural Environments, But they Must Empower Local Communities.' Available at *https://raeng.org.uk/blogs/digital-tools-can-help-to-preserve-natural-*

natural resource management by enabling real-time monitoring and data collection, supporting community engagement, and allowing organisations to store, analyse and visualise data[24].

Technology is therefore crucial in biodiversity conservation. It is imperative to harness technology in order to foster biodiversity conservation for Sustainable Development.

3.0 Harnessing Technology to Foster Biodiversity Conservation for Sustainable Development

It has been asserted that leveraging digitalization is key to moving towards a sustainable society in the future[25]. Smart technologies are game-changing tools whose integration realizes Sustainable Development [26] . The emerging technologies include artificial intelligence, remote sensing, and big data analytics, which ease adoption and comprehension of ecosystems and species dynamics[27]. Further, digital tools allow real-time monitoring and data-driven decision-making, harnessing conservation practitioners to develop more effective strategies for protecting biodiversity[28]. Remote sensing technologies and artificial intelligence algorithms are essential in monitoring biodiversity changes, while collaborations between scientists, policymakers, and local communities ensure successful implementation and shared responsibility for biodiversity

environments-but-they-must-empower-local-communities (Accessed on 24/08/2023)

[24] Ibid

[25] Adamczyk. M., 'Technology and Sustainable Development: Towards the Future?.' *Entrepreneurship and Sustainability Issues*, Volume 6, No. 4 (2019)

[26] Ibid

[27] Ibid

[28] International Union for Conservation of Nature., 'Knowledge, Innovation and Technology for Impact in Conservation.' Op Cit

conservation[29]. Technology has been applied to identify individual animals, follow their movements, identify and locate animal and plant species, and assess the status of their habitats[30]. Through this, it is possible to determine threats to the survival of species and habitats and design measures towards conserving them[31].

In addition, technologies such as digital monitoring of coastal and freshwater resources can help to ensure water quality, protecting and restoring habitats, preventing overfishing, and controlling non-native species invasions[32]. Further, developments in machine learning have also allowed researchers to process large amounts of data more efficiently and enable more informed policy decision-making[33]. It has also been argued that machine learning, artificial intelligence and robotics all have a role to play in building more sustainable fishing practices[34]. Other notable examples include efforts by technological companies such as Microsoft towards aggregating data from satellites, ground-based devices, and user-sourced data into an environmental database for artificial intelligence (AI)-powered analysis to answer questions about planetary health and sustainability[35]. Some of the potential biodiversity applications of this approach include providing wildlife biologists with habitat information and accurate measurements of forest borders to support preservation efforts[36].

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[29] Ibid
[30] Pimm. S., 'Emerging Technologies to Conserve Biodiversity.' *Trends in Ecology & Evolution*, Volume 30, Issue 11 (2015)
[31] Ibid
[32] Degawan. M., 'Digital Tools Can Help to Preserve Natural Environments, But they Must Empower Local Communities.' Op Cit
[33] Ibid
[34] Ibid
[35] Wellers. D, et al., 'Technology for Preserving Biodiversity.' Op Cit
[36] Ibid

In addition, technologies such as smartphone applications can aid farmers, hikers, landowners, and other nature lovers to monitor, manage, and report on biodiversity challenges, from detecting sick trees to tracking wildlife abundance and catches over time[37]. Applying machine learning to their data can help in understanding how pathogens spread, what areas might be at risk of a crop die-off, where streams are being overfished, and other key issues in biodiversity conservation[38]. It has further been observed that new technologies, from robots and drones to sensors that can be attached to an insect, are evolving to focus on a particular animal or habitat, with the potential of moving from detecting species at risk to defending their homes[39].

Technology is therefore a viable tool of biodiversity conservation. However, despite the efficacy of technology, it has been observed that biodiversity conservation is not leveraging on the digital tools to address environmental challenges[40]. Insufficient biodiversity data hinders a resilient ecosystem[41]. Without comprehensive data on biodiversity, it becomes challenging to accurately assess the impact of human activities on these ecosystems and make informed decisions to protect and manage them effectively[42]. Additionally,

[37] Sheppard. A, et al., 'Indigenous-Led Technology Solutions Can Boost Biodiversity and Ensure Human Rights (Commentary).' Available at *https://news.mongabay.com/2020/07/indigenous-led-technology-solutions-can-boost-biodiversity-and-ensure-human-rights-commentary/* (Accessed on 24/08/2023)
[38] Ibid
[39] Wellers. D, et al., 'Technology for Preserving Biodiversity.' Op Cit
[40] Monfort. J, & Magrath. M., 'A Comprehensive Overview of Technologies for Species and Habitat Monitoring and Conservation.' Available at *https://rest.neptune-prod.its.unimelb.edu.au/server/api/core/bitstreams/ebf47d64-7bb1-59a1-957a-b58863675c8b/content* (Accessed on 25/08/2023)
[41] Ibid
[42] Ibid

understanding the intricate relationships between different species within an ecosystem is essential for predicting and mitigating potential ecological disruptions caused by factors such as climate change or invasive species[43].

Harnessing technology is therefore integral in fostering biodiversity conservation. By harnessing the power of emerging technologies, transformative governance can be achieved, leading to more efficient and sustainable conservation practices[44]. Technology can foster biodiversity conservation towards climate change mitigation and attainment of Sustainable Development[45].

4.0 Conclusion

Biodiversity plays an important role in supporting life on earth[46]. It contains all the ingredients that are vital for survival including food and water[47]. However, problems such as human activities, habitat destruction, pollution, and climate change are affecting the quality and quantity of biodiversity[48]. Biodiversity conservation is therefore a crucial element in ensuring long-term sustainability and resilience of ecosystems[49]. Technology and digital tools such as Artificial Intelligence, remote sensing, data monitoring and machine learning can enhance biodiversity conservation[50]. There is need to harness

[43] Ibid
[44] Wellers. D, et al., 'Technology for Preserving Biodiversity.' Op Cit
[45] Ibid
[46] The Royal Society., 'Why is Biodiversity Important?' Op Cit
[47] United Nations Educational, Scientific and Cultural Organization., 'Conserving Biodiversity for Life and Sustainable Development.' Op Cit
[48] Geneletti. D., 'Biodiversity Impact Assessment of Roads: An Approach Based on Ecosystem Rarity' Op Cit
[49] Rands. M et al., 'Biodiversity Conservation: Challenges Beyond 2010.' Op Cit
[50] Adamczyk. M., 'Technology and Sustainable Development: Towards the Future?.' Op Cit

technology in order to foster biodiversity conservation for Sustainable Development.

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Sheppard. A, et al., 'Indigenous-Led Technology Solutions Can Boost Biodiversity and Ensure Human Rights (Commentary).' Available at *https://news.mongabay.com/2020/07/indigenous-led-technology-solutions-can-boost-biodiversity-and-ensure-human-rights-commentary/*

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https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

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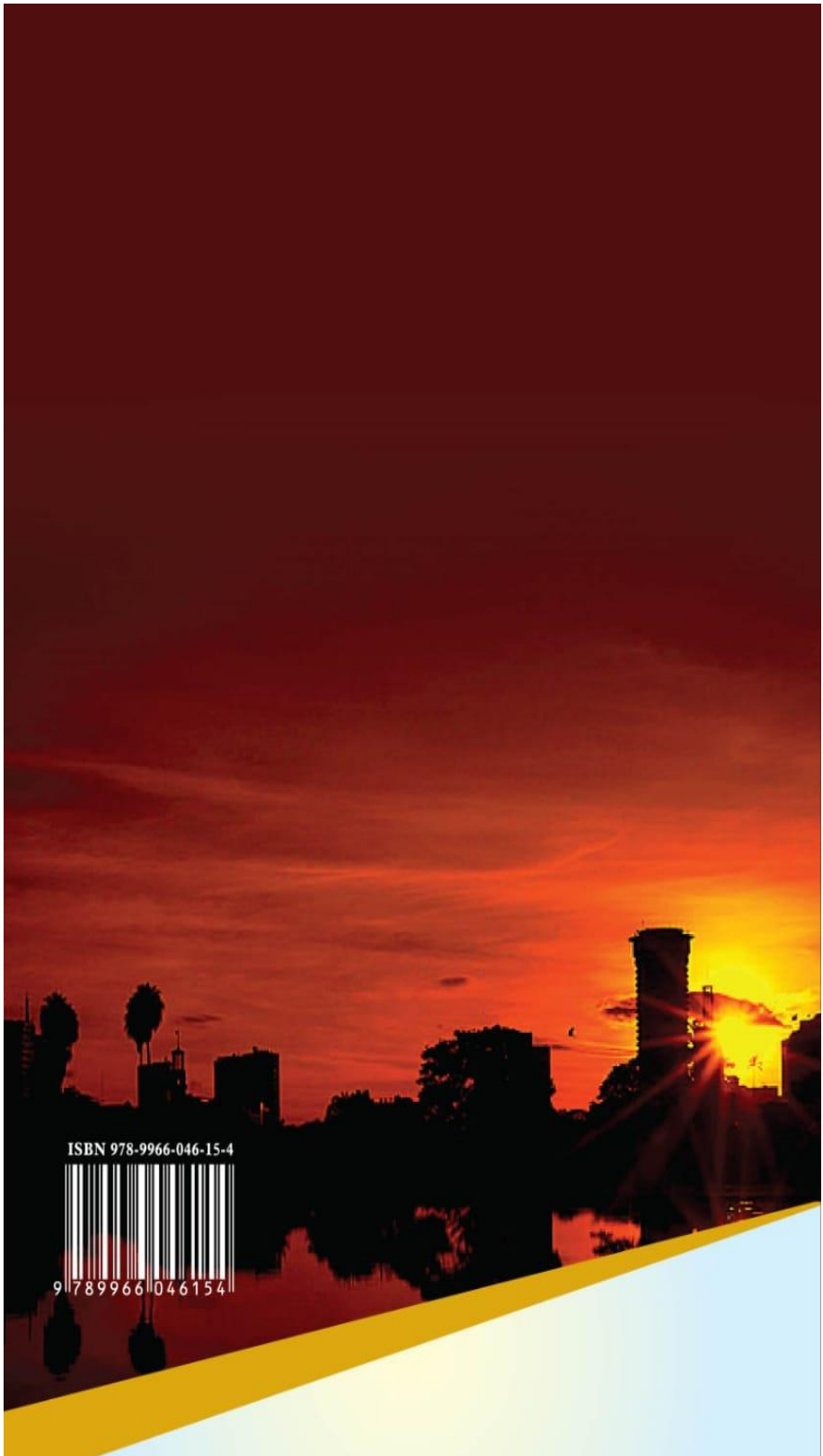

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