Adopting Holistic Approaches to Biodiversity Conservation and Water Resources Management for Sustainable Development

---

Kariuki Muigua

Adopting Holistic Approaches to Biodiversity Conservation and Water Resources Management for Sustainable Development

Kariuki Muigua*

Abstract

This paper discusses the connection between biodiversity conservation and water resources management as part of efforts towards achieving sustainable development goals. The author argues that unless countries adopt holistic approaches that not only take into consideration water scarcity challenges as a problem affecting only human beings but also as part of a bigger problem associated with climate change and biodiversity loss, efforts to protect water resources will bear minimal success.

1. Introduction

Water and wetlands are fundamental to life, livelihood, food security and sustainable development. Water is required for domestic, agricultural, hydro-power, thermal power, navigation and recreation. It is especially an important factor of production in the agricultural sector.[1] Indeed, it has been argued that "water is the primary medium through which we will feel the effects of climate change", considering that water is one of the most important natural resources for the existence of life – from our day-to-day personal activities such as drinking and washing, to wider societal uses such as in agriculture, industry and manufacturing.[2]

Kenya is considered a water scarce country hence the need for enhanced conservation of the water resources and wetlands in the country.[3] This paper mainly focuses on freshwater resources and

PhD in Law (Nrb), FCIArb (Chartered Arbitrator), LL. B (Hons) Nrb, LL.M (Environmental Law) Nrb; Dip. In Law (KSL); FCPS (K); Dip. In Arbitration (UK); MKIM; Mediator; Consultant: Lead expert EIA/EA NEMA; BSI ISO/IEC 27001:2005 ISMS Lead Auditor/ Implementer; Advocate of the High Court of Kenya; Senior Lecturer at the University of Nairobi, School of Law [November 2021].

[1] 'Water and Food Security | International Decade for Action "Water for Life" 2005-2015' <https://www.un.org/waterforlifedecade/food_security.shtml> accessed 11 September 2021 Sharifi Moghadam, E., Sadeghi, S.H.R., Zarghami, M. and Delavar, M., 'Water-Energy-Food Nexus as a New Approach for Watershed Resources Management: A Review' (2019) 7 Environmental Resources Research 129.

[2] websitefeedbacklondon@hsf.com, 'COP26 and Water – Safeguarding a Vital Resource' (*Herbert Smith Freehills | Global law firm*, 1 November 2021) <https://www.herbertsmithfreehills.com/lang-de/insight/cop26-and-water-%E2%80%93-safeguarding-a-vital-resource> accessed 8 November 2021.

[3] 'Kenya's Water Crisis - Kenya's Water In 2021' (*Water.org*) <https://water.org/our-impact/where-we-work/kenya/> accessed 11 September 2021.

wetlands due to their more direct importance to human survival. It is estimated that fresh waters comprise only 0.01% of the water on Earth, with lakes, reservoirs and rivers covering approximately 2.3% (and freshwater wetlands encompassing an estimated 5.4–6.8%) of the global land surface area, excluding large ice sheets.[4]

In the course of the meeting of Governments and United Nations agencies at the COP26 in Glasgow, the United Nations' World Meteorological Organization reported that 'data over the past 20 years shows that the amount of water stored on or near the land surface such as soil moisture as well as snow and ice has dropped at a rate of 1 centimetre a year, with huge ramifications for water security.[5]

According to a report launched in October 2021 by the United Nations' World Meteorological Organization dubbed '*The State of Climate Services 2021: Water*', 'climate change is expected to increase water-related hazards such as droughts and floods while the number of people living with water stress is expected to soar due to growing scarcity and population growth'.[6]

This paper critically analyses the connection between biodiversity conservation and water resources management, both important components of efforts towards achieving sustainable development agenda. It offers recommendations on best international practices that can ensure fulfilment of the human right to water and conservation of aquatic biodiversity.

2. Linking Biodiversity Conservation and Water Resources

The *Convention on Biological Diversity (CBD) Aichi Target* 14 provides that 'by 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, should have been restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable. The *CBD Aichi Target 11* also requires that States should ensure that, "by 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular

[4] Reid AJ and others, 'Emerging Threats and Persistent Conservation Challenges for Freshwater Biodiversity' (2019) 94 Biological Reviews 849, 851.

[5] Farge E, 'Leaders Link Tackling Water and Climate at COP26 as Crisis Looms' *Reuters* (2 November 2021) <https://www.reuters.com/business/environment/leaders-link-tackling-water-climate-cop26-crisis-looms-2021-11-02/> accessed 8 November 2021.

[6] Farge E, 'UN Weather Agency Warns of Water Crisis without Urgent Reforms' *Reuters* (5 October 2021) <https://www.reuters.com/business/environment/un-weather-agency-warns-water-crisis-without-urgent-reforms-2021-10-05/> accessed 8 November 2021; Organization (WMO) WM and World Meteorological Organization (WMO), *2021 State of Climate Services (WMO-No. 1278)* (WMO 2021).

importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes".[7]

While biodiversity "can be termed as the variations among living biota performing their ecological functions in the terrestrial marine and other freshwater ecosystems and the other ecological complexities where they are living such as intraspecific diversity, interspecific diversity and diverse biota in the ecosystems", aquatic biodiversity is a comprehensive term used to refer to the freshwater ecosystems with lakes, ponds, reservoirs, rivers, streams, groundwater, and wetlands".[8]

Arguably, water resources and aquatic biodiversity are intimately interrelated and interdependent and thus require an integrated management and conservation approach.[9] The need for their conservation is informed by the fact that both provide a wide range of functions and have intrinsic value as well as provide for the sustenance of human populations, as a result of which degradation of water quality, depletion of water resources and loss of aquatic biodiversity are prominent features of the environmental landscape requiring urgent attention at global and national scales.[10] The quality of water directly affects the ecosystem health including biotic and non-biotic communities living within the aquatic biodiversity.[11] This is because water, as the human's most valuable natural resource, is essential to all basic human needs, including food, drinking water, sanitation, health, energy and shelter and its proper management is the most pressing natural resource challenge of all.[12]

As already pointed out, 'water, poverty and environment are intrinsically connected and the poor are the most vulnerable to environmental risk factors such as unsafe water and climate change.[13]

---

[7] Unit B, 'Aichi Biodiversity Targets' (18 September 2020) <https://www.cbd.int/sp/targets/> accessed 8 September 2021.

[8] Irfan S and Alatawi AMM, 'Aquatic Ecosystem and Biodiversity: A Review' (2019) 09 Open Journal of Ecology 1.

[9] Mary Alkins-Koo, Floyd Lucas, Lorraine Maharaj, Shobha Maharaj, Dawn Phillip, Wayne Rostant and Sharda Surujdeo-Maharaj, 'Water Resources and Aquatic Biodiversity Conservation: A Role for Ecological Assessment of Rivers in Trinidad and Tobago'; Nakano, Shin-ichi. *Aquatic Biodiversity Conservation and Ecosystem Services*. Springer Berlin Heidelberg, 2016,1.

[10] *Ibid*,1.

[11] Kumar A and Jha C, 'Fishes as Environmental Indicators of Riverine Ecosystem' (2020) 17 Life Science Journal.

[12] Secretariat of the Convention on Biological Diversity. 2010. *Drinking Water, Biodiversity and Development: A Good Practice Guide*. Montreal, 1.

[13] Bonnardeaux D, 'Linking Biodiversity Conservation and Water, Sanitation, and Hygiene: Experiences from Sub-Saharan Africa' [2012] Washington, DC: Africa Biodiversity Collaborative Group, USAID, 5.

Arguably, the availability and predictability of water resources can have direct impacts on food and energy systems and vice versa, where the water-energy-food (WEF) nexus is intricately linked to everyday life.[14] It has been observed that aquatic ecosystems (rivers, lakes, groundwater coastal waters, seas) support the delivery of crucial ecosystem services, such as fish production, water provisioning and recreation.[15] In addition, key ecosystem services are also connected to the hydrological cycle in the river basin, for example water purification, water retention and climate regulation, and while most of these water related ecosystem services can be directly appreciated by people and quantified, some, especially regulating and maintenance services, are less evident but all ecosystem services have to be considered for the sustainable use and management of water resources.[16]

3. Factors Affecting Water Resource Availability and Use

Water scarcity is considered to be one of the greatest challenges facing mankind in the 21st Century thus calling for more sustainable use.[17] It is estimated that over 1.2 billion people, or almost one-fifth of the world's population, live in areas of physical scarcity, and 500 million people are approaching this situation.[18] In addition, it has been documented that about 1.6 billion people, or almost one quarter of the world's population, face economic water shortage (where countries lack the necessary infrastructure to take water from rivers and aquifers).[19] For instance, Kenya is classified as a water-scarce country where it is estimated that the country has a per capita availability below 1000 m3 annually.[20] With these figures, it is estimated that out of the population

[14] Pradhanang SM, 'Water-Energy-Food Nexus', *Water-Energy-Food Nexus* (American Geophysical Union (AGU) 2017) <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/9781119243175.ch13> accessed 26 August 2021.
[15] Cardoso A, 'Assessing Water Ecosystem Services for Water Resource Management' (2016) 61 Environmental Science & Policy, 194.
[16] *Ibid*, 194.
[17] 'International Decade for Action "Water for Life" 2005-2015. Focus Areas: Water Scarcity' <https://www.un.org/waterforlifedecade/scarcity.shtml> accessed 28 August 2021; La Banque Africaine Ddp And Bankgroup A, 'The Africa Water Vision for 2025: Equitable and Sustainable Use of Water for Socioeconomic Development'; 'Water Shortages Could Affect 5bn People by 2050, UN Report Warns' (*the Guardian*, 19 March 2018) <http://www.theguardian.com/environment/2018/mar/19/water-shortages-could-affect-5bn-people-by-2050-un-report-warns> accessed 28 August 2021; 'Are We Running out of Water?' (*the Guardian*, 18 June 2018) <http://www.theguardian.com/news/2018/jun/18/are-we-running-out-of-water> accessed 28 August 2021.
[18] 'International Decade for Action "Water for Life" 2005-2015. Focus Areas: Water Scarcity' <https://www.un.org/waterforlifedecade/scarcity.shtml> accessed 28 August 2021.
[19] Ibid.
[20] Mulwa F, Li Z and Fangninou FF, 'Water Scarcity in Kenya: Current Status, Challenges and Future Solutions' (2021) 8 Open Access Library Journal 1.

of 50 million, 32 percent of Kenyans rely on unimproved water sources, such as ponds, shallow wells and rivers, while 48 percent of Kenyans lack access to basic sanitation solutions, with these challenges being especially evident in rural areas and urban slums where people are often unable to connect to piped water infrastructure.[21]

The 2018 World Water Development Report documented that humans use about 4,600 cubic km of water every year, of which 70% goes to agriculture, 20% to industry and 10% to households.[22] While water is considered to be the most renewable of all the Earth's resources covering nearly three-quarters of the planet's surface by way of oceans, and in the polar ice caps and mountain glaciers[23], water quality deterioration has been attributed to water logging, salinization, groundwater mining, and pollution from industrial waste, poorly treated sewage, and runoff of agricultural chemicals, combined with poor household and community sanitary conditions (which contribute to disease and malnutrition).[24] In most developing countries, the situation is aggravated by rapid population growth, economic development and urbanization, all of which affect the stakeholders' ability to provide adequate sanitation services.[25]

Kenya's *National Spatial Plan 2015-2015*[26] highlights some of the challenges facing water bodies which include: *Pollution due to urban and industrial waste disposal, which reduces water quality leading to loss of biodiversity through deaths of aquatic plants and animals.[27] Notably, most of the affected rivers are those that flow within the commercial and residential areas.[28] Water bodies also face a constant danger of siltation following increased soil erosion especially during rainy seasons. Uncontrolled sinking of boreholes diminishes underground water.[29] Diversion of water*

[21] 'Kenya's Water Crisis - Kenya's Water In 2021' (*Water.org*) <https://water.org/our-impact/where-we-work/kenya/> accessed 28 August 2021.
[22] 'Water Shortages Could Affect 5bn People by 2050, UN Report Warns' (*the Guardian*, 19 March 2018) <http://www.theguardian.com/environment/2018/mar/19/water-shortages-could-affect-5bn-people-by-2050-un-report-warns> accessed 28 August 2021.
[23] 'Are We Running out of Water?' (*the Guardian*, 18 June 2018) <http://www.theguardian.com/news/2018/jun/18/are-we-running-out-of-water> accessed 28 August 2021.
[24] Rosegrant MW, *Water Resources in the Twenty-First Century: Challenges and Implications for Action*, vol 20 (Intl Food Policy Res Inst 1997), 1.
[25] Mulwa F, Li Z and Fangninou F, 'Water Scarcity in Kenya: Current Status, Challenges and Future Solutions' (2021) 08 OALib 1, 2.
[26] Republic of Kenya, The National Spatial Plan 2015-2045.
[27] Ibid, p.98.
[28] The National Spatial Plan 2015-2045, p.98.
[29] Ibid, p.98.

mainly for agricultural purposes either upstream, or downstream, reduces the flow and level of water leading to water use conflict.[30]

It is imperative to note that water scarcity does not only affect human beings but also biodiversity, especially the aquatic biodiversity.[31] Considering that water is a key driver of economic and social development while it also has a basic function in maintaining the integrity of the natural environment, and only one of a number of vital natural resources, it is imperative that water issues are not considered in isolation.[32]

4. Approaches to Effective Biodiversity Conservation and Water Resources Management

While access to a regular supply of safe water is a basic human right, access to water resources and usage are directly related to the control and management rights.[33] It is worth noting that as far as access to water resources is concerned, the earliest legal frameworks in Kenya were enacted to alienate control of water resources by Africans, and these included the *Water Ordinance of 1929,* which vested all water resources on the Crown, effectively denying the local communities the universal water rights of access and control that they had enjoyed in the pre-colonial period.[34] The

[30] Ibid, p.98.

[31] Verones F and others, 'Biodiversity Impacts from Water Consumption on a Global Scale for Use in Life Cycle Assessment' (2017) 22 The International Journal of Life Cycle Assessment 1247; Vörösmarty CJ and others, 'Global Threats to Human Water Security and River Biodiversity' (2010) 467 nature 555; Johnson N, Revenga C and Echeverria J, 'Managing Water for People and Nature' (2001) 292 Science 1071; McLAUGHLIN DW, 'Land, Food, and Biodiversity' (2011) 25 Conservation Biology 1117; Sabater S and Barceló D, *Water Scarcity in the Mediterranean: Perspectives under Global Change*, vol 8 (Springer Science & Business Media 2010); Darwall W and others, 'Freshwater Biodiversity: A Hidden Resource under Threat', *Wildlife in a changing world: an analysis of the 2008 IUCN Red List of Threatened Species* (IUCN Gland, Switzerland 2009); Nabi G and others, 'The Crisis of Water Shortage and Pollution in Pakistan: Risk to Public Health, Biodiversity, and Ecosystem' (2019) 26 Environmental science and pollution research 10443; Albert JS and others, 'Scientists' Warning to Humanity on the Freshwater Biodiversity Crisis' (2021) 50 Ambio 85; García-Vega D and Newbold T, 'Assessing the Effects of Land Use on Biodiversity in the World's Drylands and Mediterranean Environments' (2020) 29 Biodiversity and Conservation 393; Daga VS and others, 'Water Diversion in Brazil Threatens Biodiversity' (2020) 49 Ambio 165; Seeteram NA and others, 'Conserving Rivers and Their Biodiversity in Tanzania' (2019) 11 Water 2612.

[32] 'International Decade for Action "Water for Life" 2005-2015. Focus Areas: Integrated Water Resources Management (IWRM)' <https://www.un.org/waterforlifedecade/iwrm.shtml> accessed 29 August 2021.

[33] See Rosegrant MW, *Water Resources in the Twenty-First Century: Challenges and Implications for Action*, vol 20 (Intl Food Policy Res Inst 1997).

[34] Carpenter S, Baldwin E and Cole DH, 'The Polycentric Turn: A Case Study of Kenya's Evolving Legal Regime for Irrigation Waters' (2017) 57 Natural Resources Journal 101; Shurie MM, Mwaniki B and Kameri-Mbote P, 'Water Permit Systems, Policy Reforms and Implications for Equity in Kenya' [2017] Project Country Report. Output from the REACH Programme.

loss of control rights over natural resources also affected other resources including forests and water.[35]

In the current world, it is considered best practice in water resources planning to integrate water quantity and quality management for both groundwater and surface water, while incorporating a full understanding of how the natural resources and the people of a basin are impacted by various levels of development or by adopting new resource use policies.[36] Subsequently, land use as well as land and vegetation management are thus issues that need to be considered in water resources planning and management, all best done in a highly participative way, involving all the major stakeholder groups, and in a way that achieves a balance between the level of economic development and the consequent impact on the natural resource base of a river basin as agreed by the stakeholders.[37]

The *Water Act, 2016* was enacted to provide for the regulation, management and development of water resources and water and sewerage services in line with the Constitution.[38] The Act requires the Cabinet Secretary responsible for water, following public participation, to formulate every five years, a National Water Resource Strategy which should contain, among other things, details of-existing water resources and their defined riparian areas; measures for the protection, conservation, control and management of water resources and approved land use for the riparian area; minimum water reserve levels at national and county levels; institutional capacity for water research and technological development; functional responsibility for national and county governments in relation to water resources management and any other matters the Cabinet Secretary considers necessary.[39]

The *National Policy on Groundwater Development and Management 2013* has the objectives to *ensure a planned and coordinated approach in surface and groundwater planning and development including conservation of water for ecosystems maintenance and to develop mitigation measures on the impact of climate change, among others*.

[35] Mogaka, H., 'Economic Aspects of Community Involvement in Sustainable Forest Management in Eastern and Southern Africa,' *Issue 8 of Forest and social perspectives in conservation*, IUCN, 2001,74.
[36] Millington P, 'Integrated River Basin Management: From Concepts to Good Practice' (The World Bank 2006), 3.
[37] *Ibid*, 3.
[38] S. 3, Water Act, No. 43 of 2016.
[39] S. 10, Water Act, No. 43 of 2016.

The *National Horticulture Policy,2012* mandates the government to *provide incentives for investments in water conservation, efficient water use and recycling.*

The next section discusses participatory approaches that may be adopted as a way of striking a balance between the need to meet the human right to water and conservation of aquatic biodiversity and foster Environmental Democracy in biodiversity conservation matters.

4.1. Ecosystem Services Approaches for Biodiversity Conservation

Arguably, the importance of ecosystem services may help incentivize conservation and sustainable management of lands and waters outside of protected areas.[40] As a result, ecosystem services are increasingly incorporated into explicit policy targets and can be an effective tool for informing decisions about the use and management of the planet's resources, especially when trade-offs and synergies need to be taken into account.[41] The Millennium Ecosystem Assessment defined ecosystem services as the benefits people obtain from ecosystems and are co-produced by the interactions between ecosystems and societies.[42]

The CBD Aichi Target 14 states that: '*By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable'*.[43]

4.2. Payment for Water Ecosystem Services

Payments for Ecosystem Services (PES) is used to refer to a situation where a beneficiary or user of an ecosystem service makes a direct or indirect payment to the provider of that service, with the idea that whoever preserves or maintains an ecosystem service should be paid for doing so.[44] Ecosystems-forests, mountains, wetlands, agricultural land, freshwater—provide a variety of

[40] Ingram JC, Redford KH and Watson JEM, 'Applying Ecosystem Services Approaches for Biodiversity Conservation: Benefits and Challenges' [2012] S.A.P.I.EN.S. Surveys and Perspectives Integrating Environment and Society <https://journals.openedition.org/sapiens/1459> accessed 23 August 2021.

[41] Balvanera, P., Quijas, S., Karp, D.S., Ash, N., Bennett, E.M., Boumans, R., Brown, C., Chan, K.M., Chaplin-Kramer, R., Halpern, B.S. and Honey-Rosés, J., 'Ecosystem Services', *The GEO handbook on biodiversity observation networks* (Springer 2017).

[42] *Ibid*, 42.

[43] *Ibid*, 42.

[44] 'Payments for Ecosystem Services' <https://www.sdfinance.undp.org/content/sdfinance/en/home/solutions/payments-for-ecosystem-services.html> accessed 29 August 2021.

services that are economically valuable: fresh water supply for human settlements (e.g. by filtering the water from contaminants); irrigation and power generation; or storm protection and pollination.[45] The provision of such services might require communities living in the proximity of the ecosystem to undertake or not to undertake certain activities. To complete these tasks in the absence of regulatory provision, the communities need a financial incentive and the Payments for Ecosystem Services (PES) is the mechanism that governs these payments. In other words, PES involves a series of payments to land or other natural resource owners in return for a guaranteed flow of ecosystem services or certain actions likely to enhance their provision over and above what would otherwise be provided in the absence of payment.[46]

The Payment for Ecosystem Service (PES) is preferred for its ability to not only incorporate various stakeholders but also its ability to incorporate voluntary economic incentives and market-based instruments which are superior to the conventional command and control approaches of watershed and natural resource management and works on the principle that upstream resource managers are rewarded for good resource stewardship through economic incentives to guarantee sustainable delivery of ecosystem services downstream.[47]

Based on the experiences of other jurisdictions in application of PES in watershed services, it has been suggested that in the implementation of existing and new PES schemes: First, PES schemes need to take into account the institutional and social conditions prevailing in the area. The interventions needed to a more efficient PES usually entail the degree of coordination between stakeholders and strategic allocation of roles and responsibilities among institutions involved; second, it is important to understand the effect of uncertainty due to the limited knowledge about the interaction between ecosystem properties and provision of services in the decision-making process and the design of the PES scheme; and lastly, current experiences need to be constantly revised and improved and new efforts need to be explored in order to sustain the flow of watershed services over time as a basis for sustainable development.[48] It has also been suggested that implementation of the PES scheme should be done with the development of other complementary

[45] *Ibid.*
[46] *Ibid.*
[47] Langat D, 'Guidelines for Establishing Payment for Ecosystem Services Schemes in Kenya' (KEFRI, 2017).
[48] Cremaschi DG, Lasco RD and Delfino RJP, 'Payments for Watershed Protection Services: Emerging Lessons from the Philippines' (2013) 6 Journal of sustainable development 90.

activities in different areas: conservation, environmental education, increasing the participation of people living within the forest or at the buffer zones, among others.[49]

While PES transactions are unique, depending on the ecosystem service and the stakeholders involved, they share certain characteristics which include: ability of the economic incentive to influence land use decisions and ecosystem service provision; opportunity for individual ecosystem service providers (sellers) to receive direct or indirect benefits from the beneficiaries of the service (buyers); extent to which the service being provided can be expressed in terms of measurable quality or quantity; transactions are voluntary but legally-binding; ecosystem services are well-defined and valued; and payments are conditional on continued provision of the ecosystem service by the provider.[50]

SDG 6 on clean water and sanitation acknowledges the place of PES in financing clean water and sanitation by providing that the most important funding source for investing in drinking water and sanitation services consists of household contributions, via tariffs paid to service providers and via self-supply (meaning that they arrange for their water and sanitation in the community or at the household level).[51]

4.3. Integrated River Basin Management

Arguably, the causal link between Water, Sanitation and Hygiene (WASH) and ecosystem health and integrity is clearer when dealing with freshwater ecosystems, where over-abstractions of freshwater for multiple uses, coupled with non-point source pollution from agriculture and poorly-designed sanitation facilities, or lack thereof, threaten the sustainability of water sources and the ecosystem services the water resource provides.[52] This calls for management approaches that strike a balance between these uses of freshwater resources, to ensure that while human beings dependent on a particular freshwater body have access to sufficient and quality water for their own

[49] Espinosa C, 'Payment for Water-Based Environmental Services: Ecuador's Experiences, Lessons Learned and Ways Forward. IUCN Water, Nature and Economics Technical Paper No. 2, IUCN—The World Conservation Union' [2005] Ecosystems and Livelihoods Group Asia, Colombo, 27.
[50] Langat D, 'Guidelines for Establishing Payment for Ecosystem Services Schemes in Kenya' (KEFRI, 2017), 3.
[51] 'Goal 6: Clean Water and Sanitation' <https://www.sdfinance.undp.org/content/sdfinance/en/home/sdg/goal-6--clean-water-and-sanitation.html> accessed 29 August 2021.
[52] Reid, A.J., Carlson, A.K., Creed, I.F., Eliason, E.J., Gell, P.A., Johnson, P.T., Kidd, K.A., MacCormack, T.J., Olden, J.D., Ormerod, S.J. and Smol, J.P., 'Emerging Threats and Persistent Conservation Challenges for Freshwater Biodiversity' (2019) 94 Biological Reviews 849, 9.

consumption and uses, the aquatic biodiversity reliant on the same are not exposed to dangers that affect their existence. Thus, good quality and sufficient quantity of water are essential not just to the human communities' basic and economic needs but also to the riverine ecosystem, and further downstream, to the estuarine and marine ecosystems.[53] Human communities should, therefore, reduce anthropogenic activities such as poor land management which can negatively affect the riverine ecosystem, causing unintended consequences to human and wildlife communities alike.[54]

To achieve the foregoing, it is recommended for countries to adopt an Integrated River Basin Management (IRBM) approach which has been defined to mean coordinated planning, development, management and use of land, water and related natural resources within hydrologic boundaries.[55]

This is similar to the Integrated Water Resource Management (IWRM), an integrated approach whereby river basins/catchments are managed in a holistic manner and it has been defined as 'a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems'.[56] Integrated River Basin Management (IRBM) emphasizes cross-disciplinary coordination of water, land and related resources in a river basin, watershed or catchment to achieve long-term sustainability.[57] IRBM is based on the principle that naturally functioning river basin ecosystems, including accompanying wetlands and groundwater systems, are the source of freshwater and, therefore, management of river basins must include the maintenance of ecosystem functioning as a paramount goal on the one hand, and on the other hand, IRBM includes human interests and managing activities on the basin scale.[58]

---

[53] *Ibid*, 9.
[54] *Ibid, 9.*
[55] Watson N, 'Integrated River Basin Management: A Case for Collaboration' (2004) 2 International Journal of River Basin Management 243, 243.
[56] Bonnardeaux D, 'Linking Biodiversity Conservation and Water, Sanitation, and Hygiene: Experiences from Sub-Saharan Africa' [2012] Washington, DC: Africa Biodiversity Collaborative Group, USAID, 6.
[57] 'Integrated River Basin Management' (*International RiverFoundation*) <https://riverfoundation.org.au/our-programs/integrated-river-basin-management/> accessed 29 August 2021.
[58] Evers M, 'Integrative River Basin Management: Challenges and Methodologies within the German Planning System' (2016) 75 Environmental Earth Sciences 1085.

Arguably, the success of integrated water management strategies depends on striking a balance between human resource use and ecosystem protection.[59] Notably, the basic elements of these integrated approaches are a basin-wide planning scope, attention to management of surface and subsurface water and to water quantity, water quality and environmental integrity as an inseparable entity, where there should be an emphasis on the relations between land use and water resources and to the integration of natural limitations, social and economic demands and legal, political and administrative processes.[60] It has been suggested that effective river basin planning and management can have benefits as wide as poverty alleviation, sustainable development, access to energy, healthy ecosystems, gender equality and thriving livelihoods.[61] In addition, IRBM involves all stakeholders involved in river basin planning and management collaboratively to develop an agreed set of policies and strategies to achieve a balanced approach to land, water, and natural resource management.[62] It also focuses on adopting best practices to overcome various management challenges from community use to environmental science, economics, urban planning or business management, while putting the focus back onto achieving healthy river ecosystems with wide-ranging benefits for all communities, economies and biological processes within it.[63]

It has been suggested that key issues for a comprehensive approach for an IRBM and its successful implementation involve, *inter alia*: the integration of policies, decisions and costs across sectoral interests such as industry, agriculture, urban development, navigation, fishery management and conservation, amongst other things through poverty reduction strategies; a long-term vision for the river basin, agreed to by all the major stakeholders, strategic decision-making at the river basin scale and active participation by all relevant stakeholders in well-informed and transparent planning and decision-making processes; and a solid basis of knowledge of the river basin and the natural and socio-economic forces that influence it.[64]

---

[59] Vörösmarty, C.J., McIntyre, P.B., Gessner, M.O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S.E., Sullivan, C.A., Liermann, R.C. and Davies, P.M., 'Rivers in Crisis: Global Water Insecurity for Humans and Biodiversity' (2010) 467 Nature 555, 2.

[60] Jaspers FG, 'Institutional Arrangements for Integrated River Basin Management' (2003) 5 Water policy 77, 78.

[61] 'Integrated River Basin Management' (*International RiverFoundation*) <https://riverfoundation.org.au/our-programs/integrated-river-basin-management/> accessed 29 August 2021.

[62] *Ibid.*

[63] *Ibid.*

[64] Evers M, 'Integrative River Basin Management: Challenges and Methodologies within the German Planning System' (2016) 75 Environmental Earth Sciences 1085.

5. Conclusion

As acknowledged at the 2021 Conference of Parties meeting at Glasgow (COP26), tackling climate change must go hand in hand with addressing water challenges, as water availability not only affects human lives but also biodiversity.[65] It has been argued that ecosystem health is inherently linked to water management, sanitation and agriculture as these aspects influence water availability and quality, and the loss of biodiversity can reduce the provision of ecosystem services essential for human well-being. Therefore, sustainable sanitation and water management is crucial for a more sustainable ecosystem management in the future.[66]

The availability and quality of water can adversely be affected by a number of environmental factors including land degradation, pollution, over-use and global-warming and sin turn, water quality and quantity can affect human health directly, through causing or preventing water-borne diseases and illness, and indirectly, by impacting on productive ecosystems, such as agriculture and fisheries, on which livelihoods depend.[67]

As already pointed out, rivers, water resources and aquatic biodiversity are intimately interrelated and interdependent whereby water quality and habitat quality affect the composition, diversity and, therefore, health of aquatic ecosystems.[68] There is a need for an integrated approach to biodiversity conservation and water resources management as healthy functional aquatic ecosystems can provide benefits in terms of improved water quality as well as water production.[69] For this reason, the success of integrated water management strategies depends on striking a balance between human resource use and ecosystem protection.[70] Notably, the benefits of water provision on economic productivity comes with adverse effects on ecosystems and biodiversity, with potentially

[65] Manishka, 'Sanitation and Water for All at COP26' (*Sanitation and Water for All (SWA)*, 2 November 2021) <https://www.sanitationandwaterforall.org/news/sanitation-and-water-all-cop26> accessed 8 November 2021.
[66] Oguh, C.E., Obiwulu, E.N.O., Umezinwa, O.J., Ameh, S.E., Ugwu, C.V. and Sheshi, I.M., 'Ecosystem and Ecological Services; Need for Biodiversity Conservation-A Critical Review' [2021] Asian Journal of Biology 1.
[67] BirdLife International, International B, 'An Introduction to Conservation and Human Rights for BirdLife Partners', 6.
[68] Mary Alkins-Koo, Floyd Lucas, Lorraine Maharaj, Shobha Maharaj, Dawn Phillip, Wayne Rostant and Sharda Surujdeo-Maharaj, 'Water Resources and Aquatic Biodiversity Conservation: A Role for Ecological Assessment of Rivers in Trinidad and Tobago'; Nakano, Shin-ichi. *Aquatic Biodiversity Conservation and Ecosystem Services*. Springer Berlin Heidelberg, 2016, 6.
[69] *Ibid*, 6.
[70] Vörösmarty, C.J., McIntyre, P.B., Gessner, M.O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S.E., Sullivan, C.A., Liermann, R.C. and Davies, P.M., 'Rivers in Crisis: Global Water Insecurity for Humans and Biodiversity' (2010) 467 Nature 555, 2.

grave but unquantified costs.[71] As a result, any interventions to reverse these trends to protect aquatic biodiversity and ensure the sustainability of water delivery systems should put in place frameworks to diagnose the primary threats to water security at a range of spatial scales from local to global.[72] It has been observed that the mismanagement and degradation of ecosystems is a root cause of water insecurity and as a result, to tackle water insecurity, there is a need for governments to tackle biodiversity loss through ensuring healthy soils, forests, wetlands, grasslands and other ecosystems which provide vital hydrological services that can reduce water-related disaster risks and improve water availability and quality.[73] Arguably, conserving or restoring natural ecosystems, or enhancing the creation of natural processes in modified or artificial ecosystems, can be a sustainable solution to water insecurity and may be more cost-effective than grey-infrastructure alternatives.

Adopting holistic approaches to biodiversity conservation and water resources management for Sustainable Development is the way to go.

References

'Are We Running out of Water?' (*the Guardian*, 18 June 2018) <http://www.theguardian.com/news/2018/jun/18/are-we-running-out-of-water> accessed 28 August 2021.

'Goal 6: Clean Water and Sanitation' <https://www.sdfinance.undp.org/content/sdfinance/en/home/sdg/goal-6--clean-water-and-sanitation.html> accessed 29 August 2021.

'Integrated River Basin Management' (*International RiverFoundation*) <https://riverfoundation.org.au/our-programs/integrated-river-basin-management/> accessed 29 August 2021.

'International Decade for Action "Water for Life" 2005-2015. Focus Areas: Water Scarcity' <https://www.un.org/waterforlifedecade/scarcity.shtml> accessed 28 August 2021.

'International Decade for Action "Water for Life" 2005-2015. Focus Areas: Integrated Water Resources Management (IWRM)' <https://www.un.org/waterforlifedecade/iwrm.shtml> accessed 29 August 2021.

[71] *Ibid*, 2.
[72] *Ibid*, 2.
[73] OECD (2019), *Biodiversity: Finance and the Economic and Business Case for Action*, report prepared for the G7 Environment Ministers' Meeting, 5-6 May 2019, 30.

'Kenya's Water Crisis - Kenya's Water In 2021' (*Water.org*) <https://water.org/our-impact/where-we-work/kenya/> accessed 11 September 2021.

'Payments for Ecosystem Services' <https://www.sdfinance.undp.org/content/sdfinance/en/home/solutions/payments-for-ecosystem-services.html> accessed 29 August 2021.

'Water and Food Security | International Decade for Action "Water for Life" 2005-2015' <https://www.un.org/waterforlifedecade/food_security.shtml> accessed 11 September 2021.

'Water Shortages Could Affect 5bn People by 2050, UN Report Warns' (*the Guardian*, 19 March 2018) <http://www.theguardian.com/environment/2018/mar/19/water-shortages-could-affect-5bn-people-by-2050-un-report-warns> accessed 28 August 2021.

'Water Shortages Could Affect 5bn People by 2050, UN Report Warns' (*the Guardian*, 19 March 2018) <http://www.theguardian.com/environment/2018/mar/19/water-shortages-could-affect-5bn-people-by-2050-un-report-warns> accessed 28 August 2021.

Albert, J.S., Destouni, G., Duke-Sylvester, S.M., Magurran, A.E., Oberdorff, T., Reis, R.E., Winemiller, K.O. and Ripple, W.J., 'Scientists' Warning to Humanity on the Freshwater Biodiversity Crisis' (2021) 50 Ambio 85.

Balvanera, P., Quijas, S., Karp, D.S., Ash, N., Bennett, E.M., Boumans, R., Brown, C., Chan, K.M., Chaplin-Kramer, R., Halpern, B.S. and Honey-Rosés, J., 'Ecosystem Services', *The GEO handbook on biodiversity observation networks* (Springer 2017).

BirdLife International, International B, 'An Introduction to Conservation and Human Rights for BirdLife Partners'.

Bonnardeaux D, 'Linking Biodiversity Conservation and Water, Sanitation, and Hygiene: Experiences from Sub-Saharan Africa' [2012] Washington, DC: Africa Biodiversity Collaborative Group, USAID.

Cardoso A, 'Assessing Water Ecosystem Services for Water Resource Management' (2016) 61 Environmental Science & Policy, 194.

Carpenter S, Baldwin E and Cole DH, 'The Polycentric Turn: A Case Study of Kenya's Evolving Legal Regime for Irrigation Waters' (2017) 57 Natural Resources Journal 101.

Cremaschi DG, Lasco RD and Delfino RJP, 'Payments for Watershed Protection Services: Emerging Lessons from the Philippines' (2013) 6 Journal of sustainable development 90.

Daga, V.S., Azevedo-Santos, V.M., Pelicice, F.M., Fearnside, P.M., Perbiche-Neves, G., Paschoal, L.R., Cavallari, D.C., Erickson, J., Ruocco, A.M., Oliveira, I. and Padial, A.A., 'Water Diversion in Brazil Threatens Biodiversity' (2020) 49 Ambio 165.

Darwall W and others, 'Freshwater Biodiversity: A Hidden Resource under Threat', *Wildlife in a changing world: an analysis of the 2008 IUCN Red List of Threatened Species* (IUCN Gland, Switzerland 2009).

Espinosa C, 'Payment for Water-Based Environmental Services: Ecuador's Experiences, Lessons Learned and Ways Forward. IUCN Water, Nature and Economics Technical Paper No. 2, IUCN—The World Conservation Union' [2005] Ecosystems and Livelihoods Group Asia, Colombo, 27.

Evers M, 'Integrative River Basin Management: Challenges and Methodologies within the German Planning System' (2016) 75 Environmental Earth Sciences 1085.

Farge E, 'Leaders Link Tackling Water and Climate at COP26 as Crisis Looms' *Reuters* (2 November 2021) <https://www.reuters.com/business/environment/leaders-link-tackling-water-climate-cop26-crisis-looms-2021-11-02/> accessed 8 November 2021.

Farge E, 'UN Weather Agency Warns of Water Crisis without Urgent Reforms' *Reuters* (5 October 2021) <https://www.reuters.com/business/environment/un-weather-agency-warns-water-crisis-without-urgent-reforms-2021-10-05/> accessed 8 November 2021.

García-Vega D and Newbold T, 'Assessing the Effects of Land Use on Biodiversity in the World's Drylands and Mediterranean Environments' (2020) 29 Biodiversity and Conservation 393.

Ingram JC, Redford KH and Watson JEM, 'Applying Ecosystem Services Approaches for Biodiversity Conservation: Benefits and Challenges' [2012] S.A.P.I.EN.S. Surveys and Perspectives Integrating Environment and Society <https://journals.openedition.org/sapiens/1459> accessed 23 August 2021.

Irfan S and Alatawi AMM, 'Aquatic Ecosystem and Biodiversity: A Review' (2019) 09 Open Journal of Ecology 1.

Jaspers FG, 'Institutional Arrangements for Integrated River Basin Management' (2003) 5 Water policy 77.

Johnson N, Revenga C and Echeverria J, 'Managing Water for People and Nature' (2001) 292 Science 1071.

Kumar A and Jha C, 'Fishes as Environmental Indicators of Riverine Ecosystem' (2020) 17 Life Science Journal.

La Banque Africaine Ddp and Bankgroup A, 'The Africa Water Vision for 2025: Equitable and Sustainable Use of Water for Socioeconomic Development'.

Langat D, 'Guidelines for Establishing Payment for Ecosystem Services Schemes in Kenya' (KEFRI, 2017).

Manishka, 'Sanitation and Water for All at COP26' (*Sanitation and Water for All (SWA)*, 2 November 2021) <https://www.sanitationandwaterforall.org/news/sanitation-and-water-all-cop26> accessed 8 November 2021.

Mary Alkins-Koo, Floyd Lucas, Lorraine Maharaj, Shobha Maharaj, Dawn Phillip, Wayne Rostant and Sharda Surujdeo-Maharaj, 'Water Resources and Aquatic Biodiversity Conservation: A Role for Ecological Assessment of Rivers in Trinidad and Tobago'.

McLAUGHLIN DW, 'Land, Food, and Biodiversity' (2011) 25 Conservation Biology 1117.

Millington P, 'Integrated River Basin Management: From Concepts to Good Practice' (The World Bank 2006).

Mogaka, H., 'Economic Aspects of Community Involvement in Sustainable Forest Management in Eastern and Southern Africa,' *Issue 8 of Forest and social perspectives in conservation*, IUCN, 2001.

Mulwa F, Li Z and Fangninou FF, 'Water Scarcity in Kenya: Current Status, Challenges and Future Solutions' (2021) 8 Open Access Library Journal 1.

Nabi, G., Ali, M., Khan, S. and Kumar, S., 'The Crisis of Water Shortage and Pollution in Pakistan: Risk to Public Health, Biodiversity, and Ecosystem' (2019) 26 Environmental science and pollution research 10443.

Nakano, Shin-ichi. *Aquatic Biodiversity Conservation and Ecosystem Services*. Springer Berlin Heidelberg, 2016.

OECD (2019), *Biodiversity: Finance and the Economic and Business Case for Action*, report prepared for the G7 Environment Ministers' Meeting, 5-6 May 2019, 30.

Oguh, C.E., Obiwulu, E.N.O., Umezinwa, O.J., Ameh, S.E., Ugwu, C.V. and Sheshi, I.M., 'Ecosystem and Ecological Services; Need for Biodiversity Conservation-A Critical Review' [2021] Asian Journal of Biology 1.

Organization (WMO) WM and World Meteorological Organization (WMO), *2021 State of Climate Services (WMO-No. 1278)* (WMO 2021).

Pradhanang SM, 'Water-Energy-Food Nexus', *Water-Energy-Food Nexus* (American Geophysical Union (AGU) 2017) <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/9781119243175.ch13> accessed 26 August 2021.

Reid, A.J., Carlson, A.K., Creed, I.F., Eliason, E.J., Gell, P.A., Johnson, P.T., Kidd, K.A., MacCormack, T.J., Olden, J.D., Ormerod, S.J. and Smol, J.P., 'Emerging Threats and Persistent Conservation Challenges for Freshwater Biodiversity' (2019) 94 Biological Reviews 849.

Republic of Kenya, The National Spatial Plan 2015-2045.

Rosegrant MW, *Water Resources in the Twenty-First Century: Challenges and Implications for Action*, vol 20 (Intl Food Policy Res Inst 1997).

Sabater S and Barceló D, *Water Scarcity in the Mediterranean: Perspectives under Global Change*, vol 8 (Springer Science & Business Media 2010).

Secretariat of the Convention on Biological Diversity. 2010. *Drinking Water, Biodiversity and Development: A Good Practice Guide*. Montreal, 1.

Seeteram, N.A., Hyera, P.T., Kaaya, L.T., Lalika, M. and Anderson, E.P., 'Conserving Rivers and Their Biodiversity in Tanzania' (2019) 11 Water 2612.

Sharifi Moghadam, E., Sadeghi, S.H.R., Zarghami, M. and Delavar, M., 'Water-Energy-Food Nexus as a New Approach for Watershed Resources Management: A Review' (2019) 7 Environmental Resources Research 129.

Shurie MM, Mwaniki B and Kameri-Mbote P, 'Water Permit Systems, Policy Reforms and Implications for Equity in Kenya' [2017] Project Country Report. Output from the REACH Programme.

Unit B, 'Aichi Biodiversity Targets' (18 September 2020) <https://www.cbd.int/sp/targets/> accessed 8 September 2021.

Verones, F., Pfister, S., Van Zelm, R. and Hellweg, S., 'Biodiversity Impacts from Water Consumption on a Global Scale for Use in Life Cycle Assessment' (2017) 22 The International Journal of Life Cycle Assessment 1247.

Vörösmarty, C.J., McIntyre, P.B., Gessner, M.O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S.E., Sullivan, C.A., Liermann, R.C. and Davies, P.M., 'Rivers in Crisis: Global Water Insecurity for Humans and Biodiversity' (2010) 467 Nature 555.

Water Act, No. 43 of 2016, Laws of Kenya.

Watson N, 'Integrated River Basin Management: A Case for Collaboration' (2004) 2 International Journal of River Basin Management 243.

websitefeedbacklondon@hsf.com, 'COP26 and Water – Safeguarding a Vital Resource' (*Herbert Smith Freehills | Global law firm*, 1 November 2021) <https://www.herbertsmithfreehills.com/lang-de/insight/cop26-and-water-%E2%80%93-safeguarding-a-vital-resource> accessed 8 November 2021.