Integrating Biodiversity Conservation Across Food, Energy and Financial Systems for Sustainability

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Abstract

Threats like overdevelopment and deforestation endanger biodiversity, which leads to socioeconomic problems despite its vital role in delivering essential services. The significance of sustainable strategies that strike a balance between resource consumption and conservation is highlighted by the relationship between ecosystem services and economic stability. Mismanagement of renewable projects presents risks as nations seek to increase renewable energy while reducing biodiversity loss. It is critical to change energy use and assess energy sources impartially. Additionally, because of transition risks, businesses need to adjust to biodiversity-friendly practices. Investing in natural capital and increasing resource efficiency are two ways to support green economies, particularly in industries that rely on biological resources. This paper examines how sustainability can be improved by integrating biodiversity conservation into the food, energy, and financial systems.

1. Introduction

Since biodiversity was taken into consideration separately by the IUCN, the environmental aspect of sustainability has mostly concentrated on managing renewable resources rather than biodiversity.[1] At the Millennium Summit in 2000, the UN launched the Millennium Development Project, which marked the beginning of its focus on sustainable development. The conservation of biodiversity was not explicitly addressed by the Millennium Development Goals (MDGs), which placed an emphasis on the sustainable management of ecosystems and natural resources.[2] 157 nations signed the Convention on Biological Diversity (CBD) in 1992, acknowledging the value of biodiversity for ecosystem services and sustainable agricultural systems.[3] In particular, Goals 14 and 15 of the 2015

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[1] Niesenbaum RA, 'The Integration of Conservation, Biodiversity, and Sustainability' (2019) 11 Sustainability 1.
[2] Ibid.
[3] Ibid.; see also Reyers B and others, 'Finding Common Ground for Biodiversity and Ecosystem Services' (2012) 62 BioScience 503.

Sustainable Development Goals (SDGs) address the preservation and value of biodiversity, further integrating biodiversity and sustainability.[4]

Essential socio-cultural and economic services like food, water, shelter, medicine, energy, and aesthetic value depend on biodiversity.[5] Yet, problems like overdevelopment, deforestation, and ignorance are having a negative impact on biodiversity, leading to the extinction of species, the destruction of habitats, and the degradation of ecosystems.[6] At the moment, socioeconomic downturns result from the natural resources' regeneration rate being much slower than its consumption rate.[7] A sustainable strategy for biodiversity conservation is required to address this, with the goal of striking a balance between the benefits and drawbacks of resources. People's quality of life could be lowered, poverty could worsen, and economic conditions could degrade further if biodiversity is not sustainably preserved.[8]

Economic reliance on nature is explained by ecosystem services, which have their roots in economics and the natural sciences.[9] Provisioning, regulating, and supporting services are provided by a healthy ecosystem. The supply of these services is determined by the ecological production function, and calculating their monetary value aids in identifying trade-offs and effects on the state of the economy.[10] Businesses that depend on ecosystem services face serious risks as biodiversity loss diminishes their availability.[11]

Two of the biggest issues facing humanity in the twenty-first century are ensuring universal food security and protecting biodiversity. Generally speaking, these difficulties are thought to entail a trade-off, particularly in the Global South's farming environments.[12] As countries step up their efforts to tackle climate change, they face the twin challenges of increasing the production of renewable energy

[4] Ibid.; see also Stafford-Smith M and others, 'Integration: The Key to Implementing the Sustainable Development Goals' (2017) 12 Sustainability Science 911.
[5] Gul E and Chaudhry IS, 'Socio-Economic Context of Saving Biodiversity' (2016) 4 Journal of Environmental Management and Tourism 37.
[6] Ibid.
[7] Ibid.
[8] Ibid.
[9] Steindl T, Küster S and Hartlieb S, 'Pricing Firms' Biodiversity Risk Exposure: Empirical Evidence from Audit Fees' (2025) 29 Journal of Industrial Ecology 828.
[10] Ibid.; see also Niesenbaum RA, 'The Integration of Conservation, Biodiversity, and Sustainability' (2019) 11 Sustainability 1.
[11] Ibid.; see also Dong H and others, 'Does Natural Resource Dependence Restrict Green Development? An Investigation from the "Belt and Road" Countries' (2024) 255 Environmental Research 119108.
[12] Hanspach J and others, 'From Trade-Offs to Synergies in Food Security and Biodiversity Conservation' (2017) 15 Frontiers in Ecology and the Environment 489.

and tackling the loss of biodiversity.[13] Although the move away from fossil fuels has the potential to reduce the stress that climate change is placing on biodiversity, there are risks associated with this change. The expansion of renewable energy sources could jeopardise biodiversity if not carefully controlled.[14]

Dependency on fossil fuels leads to climate change, which poses a serious threat to ecosystems, and poorly designed renewable energy projects can also cause habitat fragmentation. We are encouraged by the nexus approach to recognise these links and look for integrated solutions.[15] The "Nexus" represents the connections and interdependencies between other industries, such as energy, and biodiversity conservation.[16]

Energy consumption in modern society is very high and keeps rising as the population and level of wealth increase. Natural areas and biodiversity are frequently negatively impacted by the production and consumption of energy.[17] It is essential that society create a future energy mix that incorporates alternative sources in order to lessen its dependency on coal, oil, and gas.[18] Different viewpoints on what makes up a sustainable energy portfolio are probably going to be generated through this process, which emphasises the necessity of an unbiased assessment of the advantages and disadvantages of different energy sources.[19]

Companies face transition risks in addition to the physical risks associated with biodiversity loss, as stakeholders like regulators and customers put pressure on them to slow biodiversity loss and switch to more biodiversity-friendly business practices.[20] The two main tactics for creating "green" economic sectors and moving towards a green economy are investing in natural capital and improving energy

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[13] 'Mainstreaming Biodiversity into Renewable Power Infrastructure' (*OECD*, 29 January 2024) <https://www.oecd.org/en/publications/mainstreaming-biodiversity-into-renewable-power-infrastructure_357ac474-en.html> accessed 29 October 2025; see also WCMC, UNEP. "Mainstreaming of Biodiversity into the Energy and Mining Sectors: An Information Document for the 21st Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-21)." (2017).

[14] Ibid.

[15] Directory S, 'Biodiversity Conservation Nexus → Term' (*Energy → Sustainability Directory*) <https://energy.sustainability-directory.com/term/biodiversity-conservation-nexus/> accessed 29 October 2025.

[16] Ibid.; see also Fleurke F and Paiement P, 'Are Renewable Energy Technologies Compatible with Biodiversity Conservation? The Energy–Conservation Legal Nexus', *Climate Technology and Law in the Anthropocene* (Bristol University Press 2025) <https://bristoluniversitypressdigital.com/edcollchap-oa/book/9781529232912/ch002.xml> accessed 29 October 2025.

[17] Brook BW and Bradshaw CJA, 'Key role for nuclear energy in global biodiversity conservation' (2015) 29 Conservation Biology 702.

[18] Ibid.

[19] Ibid.

[20] Steindl T, Küster S and Hartlieb S, 'Pricing Firms' Biodiversity Risk Exposure: Empirical Evidence from Audit Fees' (2025) 29 Journal of Industrial Ecology 828.

and resource efficiency.[21] For industries like agriculture, forestry, and fisheries that rely on biological resources, the former is a key tactic. For industries like manufacturing, transportation, and construction that rely on the transformation of natural capital, the latter is essential to lowering resource intensity and environmental impact.[22]

This paper critically discusses the prospects and challenges in integrating and entrenching biodiversity conservation across food, energy and financial systems as a way of promoting sustainability.

2. Impact of Biodiversity Loss on Food, Energy and Financial Systems: Challenges and Prospects

Different incentives, information frictions, and equity concerns make policy design for biodiversity conservation and ecosystem services both complex and full of opportunities.[23] These complexities are highlighted by Payments for Ecosystem Services (PES), where effective targeting of areas, enforcing conditions through dependable monitoring, setting payment levels appropriately, and managing participant and benefit tracking are all necessary for successful outcomes.[24] The consideration of counterfactuals and spillovers is necessary due to issues like leakage and dynamic responses. It is possible to overcome the drawbacks of individual strategies and promote adaptive management by combining different policy tools, such as price-based instruments and regulatory measures.[25] Advocating for transparent, accountable decision-making frameworks requires clear objectives, instrument interactions, and periodic review mechanisms—especially in the face of ecological uncertainty.[26]

Together with the integration of water, energy, and food nexus thinking, the intersection of ecosystems, livelihoods, and the economy is becoming a prominent area of scholarly inquiry.[27] The

[21] Gasparatos A and others, 'Renewable Energy and Biodiversity: Implications for Transitioning to a Green Economy' (2017) 70 Renewable and Sustainable Energy Reviews 161.
[22] Ibid.
[23] Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70.
[24] Ibid.; see also Wang P and Wolf SA, 'A Targeted Approach to Payments for Ecosystem Services' (2019) 17 Global Ecology and Conservation e00577.
[25] Ibid.
[26] Ibid.; see also Handoyo S, 'Public Governance and National Environmental Performance Nexus: Evidence from Cross-Country Studies' (2024) 10 Heliyon e40637; Gardner TA and others, 'Transparency and Sustainability in Global Commodity Supply Chains' (2019) 121 World Development 163; Shi T, 'Ecological Economics as a Policy Science: Rhetoric or Commitment towards an Improved Decision-Making Process on Sustainability' (2004) 48 Ecological Economics 23; Cairney P, Timonina I and Stephan H, 'How Can Policy and Policymaking Foster Climate Justice? A Qualitative Systematic Review' (2023) 3 Open Research Europe 51.
[27] Reyers B and others, 'Finding Common Ground for Biodiversity and Ecosystem Services' (2012) 62 BioScience 503.

goal of this system-thinking approach is to highlight the relationships between policy and decision-making in order to minimise unintended consequences and negative externalities when addressing common issues on a local and global scale.[28]

As the demand for food, energy, and water rises due to urbanisation, climate change, population growth, and environmental degradation, the world faces a major resource management challenge.[29] As a remedy, the water–energy–food (WEF) nexus has surfaced, emphasizing the interdependencies and connections between these systems and the ecosystems that sustain them.[30] The WEF nexus seeks to improve resource efficiency and support sustainable development by encouraging integrated resource management and cooperation between stakeholders, scientists, and policymakers.[31] This strategy reduces environmental effects, increases resilience to upcoming difficulties, and guarantees the long-term availability of vital resources.[32] The successful application of the WEF nexus approach requires active cooperation between government organisations, the commercial sector, academia, and civil society.[33]

Global biodiversity loss and ecosystem degradation have been greatly exacerbated by the growth of agriculture, and this trend is likely to continue in the absence of efficient management techniques.[34] It is important to understand which elements endure during agricultural conversion and to acknowledge that biodiversity can be preserved in agricultural landscapes. The dynamics influencing the preservation of biodiversity and methods for efficient management are important questions.[35] In order to align with human well-being, progress in these areas will be controversial and require cooperation across research, ecosystem policy, and conservation science disciplines.[36] Even though integration may

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[28] Ibid.
[29] Rhouma A and others, 'Trends in the Water–Energy–Food Nexus Research' (2024) 16 Sustainability 1162.
[30] Ibid.
[31] Ibid.; see also 'A Review of Water-Energy-Food Nexus Frameworks, Models, Challenges and Future Opportunities to Create an Integrated, National Security-Based Development Index - ScienceDirect' <https://www.sciencedirect.com/science/article/pii/S2772427125000506> accessed 29 October 2025; 'Driving Climate Resilience through the Water-Energy-Food Nexus in Kenya' (*SEI*) <https://www.sei.org/features/driving-climate-resilience-through-the-water-energy-food-nexus-in-kenya/> accessed 29 October 2025; Richelle B, Mao F and Liebe U, 'Towards Equitable, Integrated, and Adaptive Water-Energy-Food Nexus Research in Africa: A Systematic Literature Review' (2025) 115 Environmental Impact Assessment Review 108043;
[32] Ibid.
[33] Ibid.; see also Olarewaju OO and others, 'Integrating Sustainable Agricultural Practices to Enhance Climate Resilience and Food Security in Sub-Saharan Africa: A Multidisciplinary Perspective' (2025) 17 Sustainability 6259.
[34] Norris K, 'Agriculture and Biodiversity Conservation: Opportunity Knocks' (2008) 1 Conservation Letters 2.
[35] Ibid.
[36] Ibid.; see also Gavin MC and others, 'Effective Biodiversity Conservation Requires Dynamic, Pluralistic, Partnership-Based Approaches' (2018) 10 Sustainability 1846.

seem like a difficult goal, funding and research efforts are making progress in addressing these problems.[37]

Financing decisions continue to worsen the loss of biodiversity worldwide, despite growing awareness of the financial and economic risks associated with it.[38] Regulation imposing restrictions on the exploitation of nature, concentrating on local risks resulting from biodiversity impacts, scaling biodiversity finance using its secondary benefits, and co-leading the development of biodiversity finance by financial decision-makers are the four guiding principles for incorporating biodiversity into financial decision-making. This strategy will assist in lessening the adverse effects of biodiversity loss.[39]

Financial markets are also subject to (physical and transitional) biodiversity risks. In reality, risks to biodiversity account for over half of the market value of the major stock exchanges.[40] Thus, there could be severe financial repercussions if biodiversity risks are underestimated or ignored. Therefore, it is essential to comprehend whether and how financial markets price biodiversity risks.[41]

Gaining a better understanding of the role that biodiversity plays in a Green Economy and the potential financial costs and benefits of its conservation requires identifying the hidden "green-economic" trade-offs associated with the expansion of renewable energy.[42] There is some understanding of the nature of these trade-offs, but in order to steer the shift to a green economy without having detrimental effects on biodiversity, a stronger body of evidence and suitable assessment/planning tools will be needed.[43]

[37] Ibid.
[38] Nedopil C, 'Integrating Biodiversity into Financial Decision-making: Challenges and Four Principles' (2023) 32 Business Strategy and the Environment 1619.
[39] Ibid.
[40] Steindl T, Küster S and Hartlieb S, 'Pricing Firms' Biodiversity Risk Exposure: Empirical Evidence from Audit Fees' (2025) 29 Journal of Industrial Ecology 828.
[41] Ibid.
[42] Gasparatos A and others, 'Renewable Energy and Biodiversity: Implications for Transitioning to a Green Economy' (2017) 70 Renewable and Sustainable Energy Reviews 161.
[43] Ibid.

3. Integrating Biodiversity Conservation Across Food, Energy and Financial Systems for Sustainability: Way Forward

The relationship between environmental sustainability and human well-being is highlighted by the 17 interconnected Sustainable Development Goals (SDGs) in the 2030 Agenda.[44] It asserts that environmental sustainability is crucial for social and economic advancement and emphasises that the health and management of natural capital are necessary for the accomplishment of these goals.[45]

The establishment of quantifiable success indicators is essential for the successful integration of biodiversity conservation and sustainability goals. The creation and use of quantitative metrics to evaluate the results of these coordinated efforts is a top research priority.[46] Despite the existence of numerous criteria and indicators for biodiversity conservation in forest management, many of them require thorough species inventories, which can be difficult to carry out. There may be more practical ways to estimate biodiversity, such as by evaluating indicator species or structural indicators like stand complexity.[47] Quantifying biodiversity across different ecosystems and implementing adaptive management strategies that integrate continuous monitoring and research should be the main areas of future study.[48] Evaluation of conservation efforts and socioeconomic factors, such as poverty alleviation and sustainable resource use, must be done concurrently for integration to be effective.[49]

Connecting biophysical changes to human well-being through ideas like the ecosystem-services framework, which divides nature's contributions into provisioning, regulating, supporting, and cultural services, is necessary for a decision-oriented integration of ecology and economics.[50] This framework helps decision-makers understand how ecosystem changes affect social and economic outcomes. Because species diversity helps people become more resilient to shocks, especially those brought on by climate change, biodiversity is essential.[51] When ecosystems and biodiversity are framed as natural capital, upkeep and restoration are seen as long-term investments that will ensure social equity,

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[44] Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70.
[45] Ibid.
[46] Niesenbaum RA, 'The Integration of Conservation, Biodiversity, and Sustainability' (2019) 11 Sustainability 1.
[47] Ibid.
[48] Ibid.
[49] Ibid.; see also Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70; see also Wu, Tong. "Integrating biodiversity conservation with poverty reduction: A socioeconomic perspective." *Bulletin of the Ecological Society of America* 90, no. 1 (2009): 80-86.
[50] Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70.
[51] Ibid.

economic stability, and ecological integrity across generations. This aligns environmental stewardship with sustainable development.[52]

One of the main causes of the decline in biodiversity worldwide is agriculture. A comprehensive grasp of how land use affects ecosystem services is necessary to address this in a sustainable future vision.[53] Understanding patterns in biodiversity, creating management plans, and investigating how biodiversity affects ecosystem function all depend on conservation science.[54] For agricultural landscapes to be managed effectively and to guarantee food security, poverty reduction, and environmental preservation, research from the social and agricultural sciences must be integrated.[55]

Production of food and fibre uses about 40% of the Earth's surface, and this percentage is predicted to increase, posing serious threats to biodiversity and the environment.[56] Maintaining traditional agroecosystems and advancing regenerative sustainable agriculture practices are essential to reducing these risks.[57] Community-based outreach and demonstration should be used to promote these, emphasizing that they can improve yields over the long run without the need for outside or governmental enforcement.[58] Furthermore, sustainable development depends on increasing awareness of biodiversity and how to manage it. Future agricultural practices require fostering a sense of community and individual appreciation for agricultural biodiversity and putting policies in place to measure agrobiodiversity and biodiversity.[59]

Cooperation and research and innovation funding are necessary to address the difficulties in integrating biodiversity and agroecosystem practices to promote sustainable food security. Undoubtedly, highlighting the necessity of cooperation and funding for research and innovation is crucial to creating suitable technologies and policies.[60]

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[52] Ibid.
[53] Norris K, 'Agriculture and Biodiversity Conservation: Opportunity Knocks' (2008) 1 Conservation Letters 2; see also Dem P and others, 'Integrating Biodiversity and Ecosystem Services in Land Use Change Assessment through Sustainability Indicator' (2025) 114 Environmental Impact Assessment Review 107971.
[54] Ibid.
[55] Ibid.; see also Agrawal A and Redford KH, *Poverty, Development, and Biodiversity Conservation: Shooting in the Dark?*, vol 26 (Wildlife Conservation Society New York 2006) <https://www.academia.edu/download/91260595/Agrawal_Redford_WP26.pdf> accessed 28 October 2025.
[56] Niesenbaum RA, 'The Integration of Conservation, Biodiversity, and Sustainability' (2019) 11 Sustainability 1.
[57] Ibid.
[58] Ibid.
[59] Ibid.
[60] Rapiya M, Truter W and Ramoelo A, 'The Integration of Land Restoration and Biodiversity Conservation Practices in Sustainable Food Systems of Africa: A Systematic Review' (2024) 16 Sustainability 8951.

To enable African researchers to tackle regional issues, policymakers should concentrate on providing infrastructure and funding for regional research institutions.[61] In order to address food security and climate change, collaborative efforts are crucial. Policies should support the conservation of biodiversity and agroecological practices, providing farmers with incentives to use sustainable farming practices.[62] Resilience will be increased by incorporating traditional methods and indigenous knowledge. Future studies should look into the socioeconomic factors that contribute to food insecurity and develop specialized adaptation plans.[63] Investing in cutting-edge technologies, such as smart agriculture, is essential for increasing output and minimising environmental damage. To assess the efficacy of policies and practices, monitoring frameworks should be established.[64]

Large-scale integration of sustainable agricultural practices necessitates ambitious legislative measures, farmer-led innovation, equitable funding, and continuous oversight.[65] To break down systemic barriers and make investments in scalable and locally based solutions, stakeholders—including governments, researchers, practitioners, and donors—must work together.[66] Food security can be greatly increased by reframing traditional farming methods that prioritize soil conservation and nutrition.[67] It is also crucial to make sure local varieties have access to propagation materials. However, issues like a lack of funding and human resources may prevent communities from realising the full potential of biodiversity. [68] To fully benefit from biological diversity, stakeholders and agencies must work together to develop social capital in local governance and community institutions.[69]

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[61] Ibid.

[62] Ibid.; see also Vikas and Ranjan R, 'Agroecological Approaches to Sustainable Development' (2024) 8 Frontiers in Sustainable Food Systems <https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2024.1405409/full> accessed 28 October 2025; Olarewaju OO and others, 'Integrating Sustainable Agricultural Practices to Enhance Climate Resilience and Food Security in Sub-Saharan Africa: A Multidisciplinary Perspective' (2025) 17 Sustainability 6259; Sahoo S and others, 'Review of Climate-Resilient Agriculture for Ensuring Food Security: Sustainability Opportunities and Challenges of India' (2025) 25 Environmental and Sustainability Indicators 100544.

[63] Ibid.; see also Masango, C.A. and Mbarika, V.W., "Indigenous knowledge application in increasing food security: A measure to consider?" *Inkanyiso: Journal of Humanities and Social Sciences* 14, no. 1 (2022): 1-10; see also Ngongolo K and Kyando M, 'Biodiversity Conservation and Socio-Economic Development for Africa's Harmonious Future: A Scoping Review' (2025) 2 BMC Environmental Science 11.

[64] Ibid.

[65] Olarewaju OO and others, 'Integrating Sustainable Agricultural Practices to Enhance Climate Resilience and Food Security in Sub-Saharan Africa: A Multidisciplinary Perspective' (2025) 17 Sustainability 6259.

[66] Ibid.

[67] 'Proceedings of the Workshop on Forests for Poverty Reduction: Opportunities with CDM, Environmental Services and Biodiversity' <https://www.fao.org/4/ae537e/ae537e0e.htm> accessed 29 October 2025.

[68] Ibid.

[69] Ibid.

Environmental degradation is caused by nature's economic invisibility in traditional accounting, which needs to be addressed for sustainability policies to be effective.[70] The need to integrate ecological considerations into economic decision-making is underscored by initiatives such as the Economics of Ecosystems and Biodiversity (TEEB) and the 2019 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment, which highlight the dependence of human well-being on natural capital and ecosystem services.[71] Poor policy decisions can result from misconceptions, so institutional channels are required to incorporate valuation into planning and budgeting procedures. Although they need the right context and design, market-based conservation strategies like Payments for Ecosystem Services have promise.[72] Restructuring economies towards low-carbon, circular, and green models that take into account planetary boundaries is ultimately necessary for a successful sustainability transition. Institutional and cultural barriers that impede cooperative problem- solving must also be addressed.[73]

In order to achieve the Sustainable Development Goals (SDGs), economic models that respect biophysical limits and prioritize inclusion and innovation must replace linear and resource-depleting consumption patterns.[74] This transition is guided by three interconnected paradigms: the Low-Carbon Economy, which primarily aims to mitigate greenhouse gas emissions but also requires sustainable management of ecosystems and social equity; the Circular Economy, which encourages durability and resource efficiency through sustainable design; and the Green Economy, which emphasises low carbon, resource efficiency, and social inclusion.[75] The low-carbon framework fits into the larger green and circular economies, and these strategies are interrelated. To achieve sustainability and reduce environmental impacts, effective policy must combine a variety of tools.[76]

[70] Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70.
[71] Ibid.
[72] Ibid.; see also Kieslich M and Salles J-M, 'Implementation Context and Science-Policy Interfaces: Implications for the Economic Valuation of Ecosystem Services' (2021) 179 Ecological Economics 106857; Newell, R., "The climate-biodiversity-health nexus: a framework for integrated community sustainability planning in the Anthropocene." *Frontiers in Climate* 5 (2023): 1177025.
[73] Ibid.
[74] Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70.
[75] Ibid.
[76] Ibid.

Although biodiversity conservation is essential to human survival, it frequently clashes with human development and activity.[77] By including biodiversity conservation into frameworks for sustainable development, this conflict can be lessened. Biodiversity science has a long history, but it has taken a while to develop into a discipline that can handle today's problems, in part because of a lack of interdisciplinary cooperation.[78] Reconciliation ecology seeks to find constructive ways for humans and other species to coexist in order to ease the conflict between conservation and development. Policies for conservation and development must be informed by ongoing research in this field.[79]

Diversified technologies and resources, adaptive governance that includes monitoring and revision, and an acceptance of reliance on life-supporting systems are all characteristics of a sustainable economy.[80] In order to guarantee that progress towards the Sustainable Development Goals (SDGs) stays within the bounds of the Earth system and is adaptable to change, this strategy connects economic transformation to resilience and planetary boundaries.[81]

Ecosystem services from global biodiversity conservation can generate economic benefits, but it is essential to measure, value, and map these services in order to pinpoint areas where conservation benefits human economies and biodiversity at the same time.[82] By using data, maps, classifications, and scenarios to enhance decision-making on environmental issues, the Ecosystem Services (ES) concept is essential for incorporating environmental considerations into public policy.[83]

It is recommended that policymakers give priority to three areas: incorporating natural capital accounting into national fiscal analyses; enacting hybrid policy mixes for carbon pricing that incorporate green finance and targeted standards; and creating science–policy interfaces to improve

[77] Niesenbaum RA, 'The Integration of Conservation, Biodiversity, and Sustainability' (2019) 11 Sustainability 1; see also Fisher J and Rucki K, 'Re-conceptualizing the Science of Sustainability: A Dynamical Systems Approach to Understanding the Nexus of Conflict, Development and the Environment' (2017) 25 Sustainable Development 267.
[78] Ibid.; see also Evans MC, 'Re-Conceptualizing the Role (s) of Science in Biodiversity Conservation' (2021) 48 Environmental Conservation 151.
[79] Ibid.; see also Naeem, S., Bunker, D.E., Hector, A., Loreau, M. and Perrings, C., "Introduction: the ecological and social implications of changing biodiversity. An overview of a decade of biodiversity and ecosystem functioning research." (2009): 3-13; see also Liu J and others, 'Systems Integration for Global Sustainability' (2015) 347 Science 1258832.
[80] Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70.
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[82] Naidoo R and others, 'Global Mapping of Ecosystem Services and Conservation Priorities' (2008) 105 Proceedings of the National Academy of Sciences 9495.
[83] Kieslich M and Salles J-M, 'Implementation Context and Science-Policy Interfaces: Implications for the Economic Valuation of Ecosystem Services' (2021) 179 Ecological Economics 106857.

planning and budgetary decision-making.[84] In the meantime, the research community should concentrate on improving integrated assessments of social-ecological systems, creating transparent Artificial Intelligence (AI) while keeping an eye on environmental effects, and closing the gap between theory and practice.[85] Long-term success for businesses depends on adopting circular economy models, making investments in nature-based solutions, and integrating nature into risk disclosures.[86] When used together, these tactics can support conservation and bring economic structures into line with ecological sustainability, which will be advantageous to both people and the environment.[87]

4. Conclusion

An economic approach to biodiversity conservation and ecosystem service delivery can offer justification for incorporating conservation goals into policy.[88] Additionally, this strategy might make it easier to generate additional revenue using market-based instruments. However, it is important to recognise and convey the inherent difficulties and constraints related to the design and valuation of these policy tools.[89] Integrating biodiversity conservation across Food, Energy and Financial Systems for Sustainability is an imperative that should be achieved.

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[84] Ma L, Hong L and Liang X, 'Integrating Ecological and Economic Approaches for Ecosystem Services and Biodiversity Conservation: Challenges and Opportunities' (2025) 6 Ecologies 70; see also Anjanappa, J., Samant, S. and Thakur, B., "Mainstreaming Biodiversity into Power Sector Planning and Policy to Deliver Better Outcomes for Nature and the Climate." *Available at SSRN 4965343* (2024).

[85] Ibid.

[86] Ibid.; see also Stefanakis, A.I., Calheiros, C.S. and Nikolaou, I., "Nature-based solutions as a tool in the new circular economic model for climate change adaptation." *Circular Economy and Sustainability* 1, no. 1 (2021): 303-318.

[87] Ibid.; see also Santangeli, A., Toivonen, T., Pouzols, F.M., Pogson, M., Hastings, A., Smith, P. and Moilanen, A., "Global change synergies and trade-offs between renewable energy and biodiversity." *Gcb Bioenergy* 8, no. 5 (2016): 941-951.

[88] Hansjürgens B, Kehl C and Loft L, 'The Economic Approach to Ecosystem Services and Biodiversity: Policy Design and Institutions Matter' (2016) 25 GAIA - Ecological Perspectives for Science and Society 174.

[89] Ibid.

'Proceedings of the Workshop on Forests for Poverty Reduction: Opportunities with CDM, Environmental Services and Biodiversity' <https://www.fao.org/4/ae537e/ae537e0e.htm> accessed 29 October 2025.

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