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The Nexus Between Green Finance, Biodiversity Conservation, and Sustainable Development: A Review

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Abstract

The accelerating loss of biodiversity has become one of the most critical sustainability challenges of the twenty-first century, with profound ecological, social, and economic implications. Ecosystem degradation threatens essential services such as food security, water availability, climate regulation, and overall economic stability, thereby undermining the foundation of sustainable development. Despite increasing global awareness, conventional public financing mechanisms remain insufficient to address the scale and urgency of biodiversity loss, highlighting the need for alternative and complementary funding approaches. In this context, green finance has emerged as a promising mechanism for mobilizing private capital and integrating environmental considerations into financial decision-making. This paper, titled "The Nexus Between Green Finance, Biodiversity Conservation, and Sustainable Development: A Review," adopts a narrative synthesis approach to examine the evolving relationship between financial systems and biodiversity conservation. Drawing on peer-reviewed literature, policy reports, and global sustainability frameworks, the study provides a comprehensive assessment of how green finance instruments are being expanded beyond their traditional climate focus to incorporate biodiversity-related objectives. The review explores key financial instruments, including green bonds, blended finance, and innovative nature-based mechanisms, and evaluates their potential to support ecosystem conservation, restoration, and sustainable resource management. It further highlights critical challenges, such as the absence of standardized biodiversity metrics, valuation difficulties, weak governance structures, and the risk of greenwashing, which continue to limit the effectiveness of biodiversity finance. The findings underscore the importance of understanding the nexus between green finance, biodiversity conservation, and sustainable development, emphasizing the need for stronger institutional

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frameworks, improved data systems, and policy alignment. The paper concludes by identifying key research and policy directions, including the development of robust biodiversity indicators and enhanced collaboration among stakeholders. Ultimately, advancing biodiversity-inclusive green finance is essential for achieving long-term ecological sustainability and resilient economic development.

Keywords: Green Finance**,** Biodiversity Conservation**,** Sustainable Development**,** Environmental Finance**,** Nature-Based Solutions

1. Introduction

Biodiversity lies at the heart of life on Earth, forming the natural foundation upon which ecosystems function and human societies thrive. From the food we consume to the air we breathe and the water we rely on, ecosystem services are deeply rooted in the richness and resilience of biodiversity. Healthy ecosystems regulate climate, maintain soil fertility, support pollination, and provide countless other benefits that sustain economic activities and human well-being. However, this vital natural capital is under increasing threat.

In recent decades, the world has witnessed an alarming decline in biodiversity, driven largely by human activities such as deforestation, land-use change, pollution, climate change, and unsustainable exploitation of natural resources (Cui et al., 2022; IPBES, 2019). This rapid loss of biodiversity is no longer just an environmental issue—it has become a pressing economic and financial concern. Degraded ecosystems weaken the very systems that support production, increase vulnerability to climate risks, and ultimately undermine long-term sustainable development.

Against this backdrop, global attention has increasingly shifted toward the need for urgent and coordinated action. International frameworks such as the Kunming–Montreal Global Biodiversity Framework highlight the importance of mobilizing substantial financial resources to halt and reverse biodiversity loss. Yet, despite growing awareness, a significant financing gap persists. Public sector funding alone is far from sufficient to meet biodiversity conservation needs, with estimates suggesting a shortfall of hundreds of billions of dollars annually (OECD, 2020). This gap underscores the necessity of engaging private capital and innovative financial mechanisms.

It is within this context that green finance has emerged as a critical tool in bridging the divide between environmental sustainability and economic growth. Green finance encompasses a broad range of financial instruments, policies, and investment approaches designed to support environmentally sustainable outcomes while maintaining financial returns. Traditionally, green finance initiatives have focused primarily on climate change mitigation and adaptation. However, there is a growing recognition that biodiversity conservation must also be integrated into financial systems if truly sustainable development is to be achieved (Ma et al., 2023; Roy, 2023).

The evolving discourse now emphasizes the interconnectedness—or nexus—between green finance, biodiversity conservation, and sustainable development. Green finance not only provides the necessary funding for conservation efforts but also incentivizes responsible business practices, supports nature-based solutions, and promotes long-term resilience in both

ecological and economic systems. Understanding this nexus is essential for designing policies and financial strategies that can effectively address environmental challenges while fostering inclusive growth.

In light of these developments, this paper provides a comprehensive review of the role of green finance in promoting biodiversity conservation and advancing sustainable development. It explores the theoretical underpinnings of green finance, examines key financial instruments and mechanisms, reviews empirical evidence from existing studies, and highlights the policy opportunities and challenges associated with aligning financial systems with biodiversity goals.

2. Theoretical Foundations and Evolution of Green Finance

The idea of green finance is built on a simple but powerful realization: financial systems do not just support economic activity—they actively shape environmental outcomes. The way capital is allocated, the types of projects that receive funding, and the incentives embedded within financial markets all influence how natural resources are used and managed. Early scholars viewed green finance as a response to market failures, particularly the tendency of markets to overlook environmental costs. By channeling funds toward environmentally responsible investments, green finance was seen as a corrective mechanism—one capable of aligning economic decisions with ecological sustainability (Labatt & White, 2002, as cited in Cowan, 2024). In this sense, financial instruments are not merely tools for raising capital; they also serve as subtle yet powerful governance mechanisms that can reshape corporate behavior and long-term investment priorities.

In its early stages, both the theory and practice of green finance were largely centered on climate change. Much of the attention was directed toward financing renewable energy projects, improving energy efficiency, and reducing carbon emissions. While these efforts remain critical, an exclusive focus on climate risks has gradually revealed important gaps. In particular, the issue of biodiversity loss—equally urgent but often less visible—received comparatively limited attention. Recent scholarship has begun to challenge this imbalance, emphasizing that sustainable development cannot be achieved without addressing the ongoing degradation of ecosystems and natural habitats (Ma et al., 2023).

Unlike climate change, which is often discussed in global and measurable terms such as carbon emissions, biodiversity presents a more complex challenge. Its impacts are frequently localized, its value is difficult to quantify, and ecological systems often respond in unpredictable, non-linear ways. For instance, the loss of a single species can trigger cascading effects across an entire ecosystem, yet such risks are not easily captured within traditional financial models. These unique characteristics make it more difficult to integrate biodiversity considerations into financial decision-making processes, thereby slowing the pace at which capital flows toward biodiversity conservation (Zhang et al., 2024).

Despite these challenges, the discourse around green finance is gradually evolving. Evidence from bibliometric and systematic reviews indicates a clear shift toward a more holistic understanding of sustainability—one that recognizes the interconnectedness of environmental, social, and economic systems. Increasingly, green finance is being linked to a broader set of global development priorities, particularly the Sustainable Development Goals (SDGs). Of special relevance are SDG 15 (Life on Land) and SDG 14 (Life Below Water),

which directly address biodiversity conservation and ecosystem health (Donohue et al., 2025).

Within this expanding framework, the concept of biodiversity finance has emerged as a natural extension of green finance. Biodiversity finance focuses specifically on mobilizing financial resources for the conservation, restoration, and sustainable management of ecosystems. While it builds on the principles of green finance, it also introduces new complexities. Effective biodiversity financing requires tailored measurement tools, robust governance structures, and innovative risk assessment approaches that reflect the unique dynamics of ecological systems (OECD, 2020; Zhang et al., 2024).

Taken together, these developments highlight a growing recognition of the nexus between green finance, biodiversity conservation, and sustainable development. Financial systems are no longer viewed as passive supporters of environmental initiatives but as central actors in driving sustainability transitions. Understanding this nexus is essential for designing financial strategies that not only address climate change but also safeguard biodiversity and ensure the long-term resilience of both natural and economic systems.

3. Green Finance Instruments Supporting Biodiversity Protection

3.1 Green Bonds and Biodiversity-Linked Debt Instruments

Green bonds have become one of the most visible and widely discussed instruments within the green finance space, largely because of their capacity to attract substantial funding from both institutional and government investors. In their early development, green bonds were primarily used to support climate-related projects such as renewable energy, energy efficiency, and low-carbon transportation. This focus was not accidental—it reflected the relative ease with which climate-related outcomes, particularly reductions in greenhouse gas emissions, could be measured and reported (Flammer, 2021; Tang & Zhang, 2020).

Over time, however, growing awareness of biodiversity loss as a serious environmental and economic risk has encouraged a shift in how green bonds are structured and utilized. Increasingly, issuers are beginning to expand the scope of green bond financing to include projects that directly or indirectly support biodiversity conservation. These include initiatives such as ecosystem restoration, sustainable forestry, watershed management, biodiversity-friendly agriculture, and other nature-based solutions (Getachew et al., 2024; OECD, 2020).

From a conceptual standpoint, green bonds appear particularly suitable for biodiversity financing. Their structure allows funds to be specifically allocated to designated projects, often over long-time horizons—an important feature given that ecological restoration and conservation efforts typically require sustained investment before meaningful outcomes can be realized (Maltais & Nykvist, 2020). In addition, the requirement for transparency through reporting and disclosure helps build trust among investors, who are increasingly concerned about the credibility of environmental claims.

Beyond simply providing funding, green bonds may also influence the behavior of issuing organizations. Evidence suggests that companies issuing green bonds tend to improve their environmental practices and governance standards. For example, some studies find that such firms demonstrate better environmental performance and greater accountability, while others show that issuing green bonds can signal a genuine commitment to sustainability, thereby

enhancing reputation and reducing environmental impact (Tang & Zhang, 2020; Flammer, 2021). Although much of this evidence is based on climate-focused investments, there is growing belief that similar benefits could extend to biodiversity conservation—provided that bonds are intentionally designed with biodiversity objectives in mind (Ma et al., 2023).

Despite these promising developments, concerns remain about how effective green bonds truly are in delivering meaningful biodiversity outcomes. One key issue is that biodiversity goals are often not clearly defined within green bond frameworks. In many cases, they are grouped under broader environmental categories, making it difficult to assess their specific impact (Zhang et al., 2024). Unlike carbon emissions, which can be measured using relatively standardized metrics, biodiversity is far more complex. It lacks a single universal indicator, and its value varies across ecosystems and locations, making it challenging to establish clear benchmarks and performance measures (OECD, 2020).

These challenges have raised questions about the integrity of some green bond initiatives. There is a growing concern that, without clear standards and accountability mechanisms, some bonds may be labeled as "green" without delivering substantial environmental benefits—a practice often described as greenwashing (Ma et al., 2023; Roy, 2023). In such cases, biodiversity risks being overshadowed by climate-focused priorities, despite its equally critical role in sustaining ecosystems and supporting long-term development.

In response, both scholars and policymakers are calling for stronger frameworks to guide the use of green bonds in biodiversity financing. This includes the development of clear taxonomies that explicitly incorporate biodiversity criteria, improved disclosure standards, and alignment with emerging global initiatives such as the Taskforce on Nature-related Financial Disclosures (TNFD) (TNFD, 2023). Strengthening these areas is seen as essential to ensuring that green bonds not only grow in volume but also deliver real and measurable ecological benefits. Ultimately, their success in supporting biodiversity will depend on how well projects are selected, monitored, and evaluated over time (Maltais & Nykvist, 2020; Zhang et al., 2024).

3.2 Blended Finance and Private Capital Mobilization

Addressing biodiversity loss on a meaningful scale requires far more resources than public funding alone can provide. As a result, the involvement of the private sector has become increasingly important. One approach that has gained significant attention is blended finance, which combines public, philanthropic, and private funds to support environmental projects. By sharing risks across different actors, blended finance can make biodiversity-related investments more attractive to private investors who might otherwise be hesitant due to uncertainty and long payback periods (OECD, 2020).

Biodiversity projects often face unique challenges, including long investment horizons, unpredictable returns, and ecological uncertainties. These factors can discourage conventional investors, who typically prefer projects with clearer and quicker financial returns. Blended finance helps to address this gap by using public or concessional funds to reduce risks, thereby encouraging private participation.

Another emerging area of interest is the idea of generating financial returns from biodiversity itself. New models are being explored where investors can benefit from conservation outcomes through mechanisms such as biodiversity credits or performance-based payments

(Journal of Financial Economics, 2024). While these approaches are promising in theory, there is still limited empirical evidence on how well they work in practice or whether they can be scaled effectively. This highlights an important area for future research.

3.3 Innovative and Nature-Based Financial Mechanisms

In addition to traditional green finance instruments, there is a growing interest in more innovative, nature-based approaches to financing biodiversity conservation. These mechanisms aim to directly link financial incentives with ecological outcomes, thereby encouraging more sustainable interactions with the natural environment. Examples include biodiversity credits, debt-for-nature swaps, and payments for ecosystem services (PES), all of which seek to incorporate the value of ecosystems into economic decision-making (UNEP, 2023).

Biodiversity credits, in particular, have attracted considerable attention in recent years. Similar in concept to carbon credits, they represent measurable conservation or restoration outcomes that can be traded or purchased by organizations seeking to offset their environmental impact (OECD, 2020). The idea is to create a market where ecological improvements have financial value, thereby attracting investment into conservation activities. However, biodiversity is inherently more complex than carbon. Differences in ecosystems, species, and local conditions make it difficult to standardize measurements or ensure equivalence across projects. As a result, strong regulatory frameworks, clear baselines, and rigorous monitoring systems are essential to maintain credibility and avoid superficial conservation efforts (Bull et al., 2023; Zhang et al., 2024).

Debt-for-nature swaps offer another pathway, particularly for developing countries with high biodiversity and significant debt burdens. Under this arrangement, a portion of a country's external debt is reduced or restructured in exchange for commitments to invest in environmental conservation (Essers et al., 2021). This approach can provide dual benefits—easing financial pressure while supporting biodiversity protection. However, its success depends heavily on effective governance, transparency, and alignment with national development goals (UNEP, 2023).

Payments for ecosystem services (PES) represent one of the more established approaches. In this model, individuals or communities are compensated for managing natural resources in ways that generate environmental benefits, such as preserving biodiversity, improving water quality, or storing carbon (Wunder et al., 2018). When well designed, PES schemes can encourage sustainable land use and provide income for local communities. However, challenges remain. Poorly implemented programs may fail to deliver lasting environmental benefits or may unintentionally widen social inequalities, particularly if access to payments is uneven or monitoring is weak (Engel et al., 2022).

Across all these mechanisms, one issue consistently stands out: the importance of strong governance and reliable measurement systems. Without clear rules, transparent monitoring, and effective enforcement, even the most innovative financial tools may fall short of their intended goals (Bull et al., 2023; Roy, 2023). In addition, differences in institutional capacity across countries mean that successful implementation is often uneven, with better outcomes typically observed in regions with stronger regulatory systems and greater technical expertise (Investing in the Wealth of Nature, 2024).

Recent discussions increasingly emphasize that these innovative approaches should not replace traditional green finance instruments but rather complement them. When combined with tools such as green bonds and blended finance, nature-based mechanisms can enhance the overall effectiveness of biodiversity financing. Ultimately, achieving meaningful progress will require a careful balance—bringing together sound ecological knowledge, well-designed financial instruments, and strong institutional support to ensure that financial investments translate into lasting environmental and developmental benefits.

4. Empirical Evidence on Green Finance and Biodiversity Outcomes

Empirical research that directly links green finance to biodiversity outcomes is still relatively scarce, especially when compared to the large body of studies focused on climate-related issues. This gap is not surprising. For many years, sustainable finance has largely concentrated on areas such as carbon emissions, energy transition, and pollution control—domains where measurement is more straightforward and data are more readily available. Biodiversity, by contrast, is more complex and less easily quantified. Even so, a growing number of studies are beginning to shed light on how green finance can influence biodiversity, often in indirect but meaningful ways.

At the firm and regional levels, emerging evidence suggests that green finance policies can shape biodiversity outcomes by influencing how companies behave, where they invest, and how they approach environmental responsibility. For instance, Zhang et al. (2025), using firm-level data from China, show that green finance policies can significantly reduce firms' exposure to biodiversity-related risks. Their findings indicate that companies operating in regions with stronger environmental regulations and higher awareness tend to respond more proactively to green credit policies. These firms often adjust their production methods and investment choices in ways that are more environmentally responsible. What this suggests is that even when biodiversity is not explicitly targeted, financial incentives can still encourage practices that are beneficial to ecosystem health.

Supporting this view, other empirical studies highlight that green credit policies and sustainable lending frameworks tend to improve overall environmental performance. This improvement can, in turn, benefit biodiversity. For example, when banks apply environmental screening to lending decisions, they are less likely to finance activities that harm ecosystems—such as deforestation-heavy industries—and more likely to support projects that promote sustainable land use and efficient resource management (Ma et al., 2023). While such studies often focus on indicators like pollution reduction or emission control, the broader environmental improvements they capture frequently translate into reduced pressure on natural habitats.

Looking at the bigger picture, macro-level studies also point to the role of green finance in reshaping investment patterns across sectors. Evidence suggests that regions with more developed green finance systems tend to experience lower levels of ecological degradation and more efficient use of land resources, particularly where institutional frameworks are strong (Zhang et al., 2024). In this sense, financial systems act as important channels through which environmental policies—biodiversity conservation included—are translated into real economic outcomes.

That said, the relationship between green finance and biodiversity is far from straightforward. Scholars consistently emphasize that it is complex, context-specific, and sometimes non-

linear. Reviews of the literature reveal considerable variation in how studies are conducted, the indicators they use, and the regions they focus on. This diversity makes it difficult to directly compare findings or draw broad conclusions about the overall impact of green finance on biodiversity (Bibliometric and Systematic Review, 2024).

One of the biggest challenges lies in measurement. Unlike carbon emissions, which can be tracked using relatively standardized metrics, biodiversity does not have a single, universally accepted indicator. As a result, many studies rely on proxy measures—such as land-use changes, ecological risk indices, or general environmental performance scores—which only capture parts of the biodiversity picture (OECD, 2020). While these proxies are useful, they make it harder to isolate the specific effects of green finance on biodiversity outcomes.

Institutional and governance factors also play a crucial role. Evidence suggests that green finance tends to be more effective in environments where regulations are well enforced, reporting systems are transparent, and both firms and investors are environmentally conscious (Zhang et al., 2025). In contrast, in settings where governance is weak, the impact of green finance may be limited, as harmful environmental practices can continue despite the availability of green financial tools.

Overall, the empirical literature points to a cautious but optimistic conclusion. Green finance does appear to support biodiversity conservation, but often indirectly—through improved environmental practices, better investment decisions, and stronger governance—rather than through direct, measurable conservation outcomes. While these findings are encouraging, there is still much work to be done. Advancing this field will require better data, more consistent measurement frameworks, and stronger analytical methods capable of capturing the long-term and complex nature of biodiversity change. Strengthening this evidence base is essential if green finance is to move beyond a promising idea and become a truly effective and accountable driver of sustainable development.

5. Policy Implications and Governance Challenges

From a policy perspective, integrating biodiversity into green finance frameworks requires coordinated action across financial regulators, governments, and market participants. Recent policy initiatives, including biodiversity-inclusive taxonomies and disclosure frameworks such as the Taskforce on Nature-related Financial Disclosures (TNFD), aim to enhance transparency and risk assessment related to nature loss (TNFD, 2023). Scholars argue that such frameworks are essential for embedding biodiversity considerations into financial decision-making.

However, challenges persist. The lack of standardized biodiversity metrics complicates risk disclosure and impact assessment, increasing the risk of greenwashing (Roy, 2023). Additionally, differences in institutional capacity and regulatory environments across countries affect the effectiveness of green finance policies, particularly in developing economies where biodiversity is most threatened but financial markets are less mature.

6. Conclusion and Future Research Directions

This review demonstrates that green finance has significant potential to support biodiversity protection and sustainable development by mobilizing capital, reshaping incentives, and integrating ecological considerations into financial systems. The literature reflects notable

progress in conceptual development, financial innovation, and policy experimentation. Nonetheless, biodiversity finance remains less developed than climate finance, with persistent gaps in measurement, governance, and empirical evidence.

Future research should focus on developing standardized biodiversity metrics, improving data availability, and conducting longitudinal studies to assess long-term ecological and financial outcomes.

Policymakers should prioritize regulatory coherence, disclosure standards, and institutional capacity building to ensure that green finance delivers tangible biodiversity benefits. By strengthening these foundations, green finance can evolve into a powerful tool not only for climate mitigation but also for safeguarding the natural capital upon which sustainable development depends.

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