Biodiversity Finance

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We are grateful to Andrew Karolyi, Steve Lydenberg, John Tobin, as well as seminar participants at Columbia, Cornell, Wharton, Yale, the Federal Reserve Board, Deutsche Bundesbank, ESSEC, Norwegian School of Economics (NHH), University of Amsterdam, University of Mannheim, University of Zurich, University of Georgia (Terry), University of Pittsburgh (Katz), Dalhousie University, Alliance Bernstein, Osmosis Investment Management, the Alliance for Research on Corporate Sustainability (ARCS), the ESG and the Future of Business Conference at Fordham University, the HKU-TLV Summer Finance Forum, and the PRI Academic Seminar Series for helpful comments and suggestions. We thank Yangyang Wang for excellent research assistance.

Abstract

The use of private capital to finance biodiversity conservation and restoration is a new practice in sustainable finance. This study sheds light on this new practice. First, we provide a conceptual framework that lays out how biodiversity can be financed by i) pure private capital and ii) blended financing structures. In the latter, private capital is blended with public or philanthropic capital, whose aim is to de-risk private capital investments. The main element underlying both types of financing is the “monetization” of biodiversity, that is, using investments in biodiversity to generate a financial return for private investors. Second, we provide empirical evidence using deal-level data from a leading biodiversity finance institution. We find that projects with higher expected returns tend to be financed by pure private capital. Their scale is smaller, however, and so is their expected biodiversity impact. For larger-scale projects with a more ambitious biodiversity impact, blended finance is the more prevalent form of financing. While these projects have lower expected returns, their risk is also lower. This suggests that the blending—and the corresponding de-risking of private capital—is an important tool for improving the risk-return tradeoff of these projects, thereby increasing their appeal to private investors. Finally, we examine a set of projects that did not make it to the portfolio stage. This analysis suggests that, in order to be financed by private capital, biodiversity projects need to meet a certain threshold in terms of both their financial return and their biodiversity impact. Accordingly, private capital is unlikely to substitute for the implementation of effective public policies in addressing the biodiversity crisis.

Keywords: biodiversity finance, natural capital, blended finance, impact investing, sustainable finance, public good

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1. Introduction

Biodiversity loss is one of the grand challenges our society is facing. A recent study by the WWF (2022) reports an average 69% decline in global populations of mammals, fish, birds, reptiles, and amphibians since 1970, referring to the current situation as a "code red" alert for humanity (p. 6). The loss of biodiversity represents an existential threat to the global economy, as more than half of the world's GDP is dependent on nature and the services it provides (United Nations 2022). Moreover, the climate and biodiversity crises are deeply intertwined. Meeting the goals of the Paris Climate Agreement depends on the successful conservation, restoration, and management of biodiversity (United Nations 2022).[1] In short, protecting biodiversity is critically important and urgent—it is important for the planet, our health and well-being, as well as the world's economy.

Biodiversity provides many services to humans. These include stabilizing the climate, enhancing food supplies, contributing to the development of medicines, providing spiritual sustenance, among many other. Most of these services are provided as public goods. That is, their consumption is non-rival, as they are available to everyone in a particular region and those unwilling to pay cannot be excluded from consuming the public good. A long-standing literature in public economics shows that the efficient provision of public goods is challenging, as the free-rider problem, along with the preference revelation problem, have proven hard to overcome (e.g., Heal 2000). In a nutshell, the key challenge is that self-interested individuals prefer to consume the public good without paying for it, and it is difficult to persuade them to reveal how much they

[1] The importance and urgency of biodiversity conservation is stressed, e.g., by the United Nations' Biodiversity Finance Initiative (BIOFIN), the Taskforce on Nature-related Financial Disclosures (TNFD), as well as numerous other organizations and forums such as the Conference of the Parties to the UN Convention on Biological Diversity (COP 15) and the 2023 World Economic Forum in Davos. For example, at the 2023 World Economic Forum, the WWF announced the launch of its Biodiversity Risk Filter, an online tool that seeks to help companies and investors mitigate biodiversity-related risks and prepare for the reforms that follow the new Global Biodiversity Framework. Relatedly, the UN Environment Programme (UNEP) and S&P Global announced the launch of the Nature Risk Profile, a new methodology for analyzing companies' impacts and dependencies on nature.

are willing to pay, as they realize that what they respond will influence how much they will be required to pay. This free-rider problem also implies that biodiversity as a public good is likely undervalued and underprovided. Despite these obstacles, there are frameworks within which we can hope to mitigate these challenges and enhance biodiversity protection.

Potential solutions to preserve and restore biodiversity include i) *intergovernmental measures* such as the Convention on Biological Diversity (CBD) and other global treaties, ii) *government measures* that aim to regulate the quantity of natural capital (e.g., by establishing protected areas, introducing technology standards, or adopting cap-and-trade programs) and the price of natural capital (e.g., through tax incentives and subsidies that encourage more sustainable production or consumption patterns), and iii) *biodiversity finance*. While intergovernmental and governmental mechanisms play an important role in the public provision of biodiversity (e.g., Barrett 2022), the implementation of these mechanisms is not without challenges (e.g., Dasgupta 2021), which calls for other ways to help protect biodiversity.

In this regard, biodiversity finance is gaining momentum in practice and public policy. Yet, many investors feel underinformed about the risks and opportunities related to biodiversity (World Economic Forum 2023). Similarly, academic research on biodiversity finance remains nonexistent, as highlighted by Karolyi and Tobin-de la Puente's (2023) recent call for research in biodiversity finance. As they note, "there are no studies in the top tier journals in Finance that have framed the risks related to biodiversity loss, how those risks might be priced, or how the private financing flows need to be intermediated" (p. 1). This research gap was further echoed in Laura Starks's Presidential Address at the 2023 American Finance Association Meetings (Starks 2023). It is likely due to both i) a lack of awareness on how private capital can contribute to biodiversity conservation and restoration, and ii) a lack of data on biodiversity finance.

Our study aims to fill this gap by i) introducing a conceptual framework that lays out how private capital can contribute to biodiversity conservation, and ii) providing first evidence on biodiversity finance. In doing so, we aim to lay the ground and stimulate future research on biodiversity finance.

First, we provide a conceptual framework that lays out how biodiversity conservation can be financed by i) pure private capital and ii) blended finance. In the latter, private capital is "blended" with public or philanthropic capital, whose aim is to subsidize and de-risk private capital investments. The main element underlying both types of financing is the "monetization" of biodiversity, that is, using investments in biodiversity to generate a financial return for private investors. This monetization comes in different flavors—for example, the preservation of pollinators (such as bees, beetles, and butterflies) can enhance the farmland's productivity; the preservation of coastal ecosystems helps prevent floodings; the preservation of forest ecosystems can generate carbon credits—and provides a direct mechanism through which biodiversity conservation projects can attract private capital.

Second, we empirically examine this new asset class. To do so, we obtained access to the proprietary database of a recognized leader in biodiversity finance, which we refer to as "Biodiversity Investment Manager" (BIM) for confidentiality reasons. This database covers the 33 biodiversity finance deals that were closed by BIM between 2020 and 2022. For each deal, the database provides detailed information about the underlying biodiversity project, the expected biodiversity impact, the deal structure, the expected financial return (target IRR), and the financial risk of the project.

Our analysis of these biodiversity deals provides several insights. First, we observe that about 60% of the deals are financed by pure private capital, while the remaining 40% are blended finance deals. This underscores the importance of both forms of financing. Second, the deals that have a higher expected financial return tend to be financed by pure private capital (on average, their target IRR is 15%, compared to 12% for blended finance deals). Their scale is smaller, however, and so is their expected biodiversity impact. For larger-scale projects with a more ambitious biodiversity impact, blended finance is the more prevalent form of financing. While these projects have lower expected returns than those funded by pure private capital, they are also less risky (as measured by the potential deviation from the IRR). This suggests that the blending—and the corresponding de-risking of private capital—is an important tool for improving the risk-return tradeoff of these projects, thereby increasing their appeal to private investors. Overall, our findings point toward a tradeoff between financial returns and biodiversity impact, with implications for the type of financing. Profitable projects can be viably financed by pure private capital but tend to have lower biodiversity impact. Projects with higher biodiversity impact tend to be less profitable but can nevertheless appeal to private investors through blending. As such, our results suggest the existence of a three-dimensional "risk-financial return-biodiversity return frontier."

Finally, BIM also granted us access to information on biodiversity projects that were under consideration for inclusion into their portfolios but were ultimately discarded. Compared to the projects that made it to the portfolio stage, these projects tend to be less profitable and have lower biodiversity impact to begin with. This suggests that i) a certain risk-return threshold needs to be met for the deal to appeal to private investors, and ii) the biodiversity impact needs to be sufficiently favorable for blended finance to be applicable. These findings suggest that private capital (either as standalone or in blended form) is unlikely to provide a silver bullet against the biodiversity crisis, but can nevertheless be a useful addition to the toolbox. Arguably, while private investing can help close the financing gap and contribute to the conservation and restoration of biodiversity, it is unlikely to substitute for the implementation of effective public policies.

Naturally, we caution that our results are obtained from a small sample of biodiversity deals. Given the lack of data on biodiversity deals (Karolyi and Tobin-de la Puente 2023), we see this evidence as a first step in understanding biodiversity finance. Our hope is that, as biodiversity finance grows, new datasets will become available that will allow researchers to shed additional light on this new asset class.

This study makes several contributions to the academic literature. First, by exploring how private investing can contribute to the protection of biodiversity, it adds to the sustainable finance literature whose focus has been primarily on climate finance (e.g., Bolton and Kacpercyk 2021, 2022, Flammer 2021, Hong, Karolyi, and Scheinkman 2020, Ilhan, Krueger, Sautner, and Starks 2023, Krueger, Sautner, and Starks 2020, Pastor, Stambaugh, and Taylor 2022, Sautner et al. 2023). Second, our work contributes to the environmental economics literature that studies the economics of biodiversity conservation (Dasgupta 2021, Heal 2003, 2004, 2020), and the public provision of this public good through intergovernmental and governmental mechanisms (e.g., Barrett 2022). Third, our study aims to spur follow-up work on the financing of biodiversity, in keeping with the initial effort of Karolyi and Tobin-de la Puente (2023). Fourth, our study relates to the work by Garel, Romec, Sautner, and Wagner (2023) and Giglio, Kuchler, Stroebel, and Zeng (2023), who examine how biodiversity risks affect equity prices.

The remainder of this paper is organized as follows. Section 2 discusses the public good aspect of biodiversity. Section 3 provides a conceptual framework that lays out how private capital can contribute to biodiversity protection. Section 4 describes the data and presents the results. Section 5 concludes and discusses avenues for future research.

2. Biodiversity finance: financing the protection of a public good

Biodiversity is a measure of the variability that exists in "living" natural capital, and hence represents a feature of natural capital. Natural capital can be defined as "the world's stocks of natural assets, which include geology, soil, air, water and all living things" (World Forum on Natural Capital 2021). Natural capital offers a wide range of valuable services—often called ecosystem services—that benefit humans. These services include food, water, plants used for medicine, natural flood defenses, carbon storage, pollination of crops, recreational enjoyment, among many others. Biodiversity helps raise the productivity and resilience of these ecosystem services.

While the economic value of biodiversity is evident, protecting biodiversity poses a challenge as most of the ecosystem services are public goods (Dasgupta 2021, Heal 2020). That is, their consumption is nonrival, and those unwilling to pay cannot be excluded from consuming the public good. This free-rider problem also implies that biodiversity as a public good is likely undervalued and underprovided. For this reason, biodiversity finance—along with intergovernmental and governmental mechanisms—can play an important role in the support of biodiversity.

Historically, the conservation and restoration of biodiversity has been primarily financed through public funding and private philanthropic giving. Various public funding instruments are used to finance biodiversity conservation, including debt-for-nature swaps, official development assistance (ODA), sovereign biodiversity bonds (e.g., sovereign ocean bonds, rhino bonds, and others), payments for ecosystems services (PES), and biodiversity offsets, among others.[2] Private

[2] For more information about public funding instruments, see Deutz et al. (2020), OECD (2020), and Tobin-de la Puente and Mitchell (2021).

philanthropic donors include environmental nonprofit organizations such as the Environmental Defense Fund (EDF), The Nature Conservancy (TNC), and the World Wildlife Fund (WWF), among others. Despite the use of public funding and private philanthropic funding, a large financing gap for the protection of biodiversity remains. TNC estimates a $722-967 billion per year of additional financing that is needed to close the financing gap and effectively address the biodiversity crisis (TNC 2020). With the aim of closing this financing gap, a third practice in biodiversity finance has emerged in recent years: private investing in natural capital. While still in its infancy, private investing in natural capital is a rapidly growing, yet not well-understood financing mechanism. Importantly, it raises a puzzling question: how can the conservation and restoration of biodiversity yield financial returns for investors? In the next section, we turn to this question.

3. Private investing in natural capital—a conceptual framework

3.1 Asset types and monetization mechanisms

From the private capital market's perspective, it is critical to understand how the conservation and restoration of biodiversity yields financial returns for investors. Typical monetization mechanisms would include the transformation of natural capital (e.g., logging and mining). Yet, in the case of biodiversity finance, revenues need to be generated from *protecting* as opposed to transforming natural capital. While this question may seem puzzling at first, generating financial returns from biodiversity conservation is feasible—it requires the bundling of biodiversity with private goods whose value it enhances (Heal 2003, 2004).

To name a few examples, the protection of natural parks, wildlife, and coral reefs increases income from ecotourism and the value of real estate around the protected area. Sustainable agriculture and fisheries can enhance the local communities' revenues by both increasing productivity (e.g., through improved soil fertility, increase in pollinators, prevention of overfishing) and the prices that can be charged for biodiversity-friendly products. The protection of coastal ecosystems and green infrastructures in urban areas helps prevent flooding and damages to private (and public) property from climate events. Also, given that biodiversity helps nature absorb emissions—providing so-called nature-based solutions to climate change—its protection allows the relevant actors (such as investors and corporations) to earn carbon credits. Table 1 provides a more systematic overview of the different types of natural capital assets, along with the corresponding monetization mechanisms.

---- Insert Table 1 about here ----

Private investments in biodiversity span all types of natural capital assets. As an illustration, Table 2 provides examples of biodiversity funds by natural capital asset types.[3]

---- Insert Table 2 about here ----

3.2 Types of financing

a. Pure private capital and blended finance

Private investments in biodiversity can be grouped into two broad categories: pure private capital and blended finance. The former is akin to investing private capital in traditional asset classes. In the latter, private capital is blended with public or philanthropic capital, whose aim is to subsidize and de-risk private capital investments.

In both cases, private investors can gain i) direct financial returns from their investments in natural capital, ii) indirect financial returns from gaining biodiversity or carbon credits for their investments in natural capital, and iii) biodiversity returns (from their investments' biodiversity impact).

[3] Note that certain biodiversity funds span more than one natural capital asset types.

The direct financial returns are the monetary gains that are directly generated by their investments in natural capital and ecosystem services. Given the bundling of biodiversity with private goods, these direct financial returns are obtained through the monetization mechanisms described in Section 3.1.

In addition to the direct financial returns, investors may also benefit from indirect financial returns in the form of biodiversity credits or carbon credits from their investments in natural capital. Biodiversity and carbon credits are commonly used in biodiversity finance. As biodiversity plays an important role in reducing carbon emissions, the protection of biodiversity can generate carbon credits, which further improves the attractiveness of such investment for investors who aim to fulfill their carbon pledges.[4]

Lastly, investments in the conservation and restoration of biodiversity also yields "biodiversity returns." Investors vary in their preference for biodiversity returns. While traditional investors may only value their investments' (direct and indirect) financial returns, other investors—so-called "impact investors"—also value the non-financial returns gained from their investments in natural capital. The extent to which impact investors value financial versus non-financial returns varies across investors. Indeed, a large heterogeneity exists across impact investors (e.g., Gibson-Brandon et al. 2022, Heeb et al. 2023).[5]

In the case of blended financing structures, grants and concessional funding help subsidize the biodiversity investments from private capital investors and hence increase their overall (financial and biodiversity) returns. In addition to subsidizing private capital investments, blending

[4] Carbon and biodiversity credits are not without challenges, however. Concerns have been raised about the measurement and valuation of these credits, and their potential for greenwashing practices, among others (e.g., Bloomberg 2022, S&P Global 2021, The Guardian 2023, West et al. 2020).
[5] Conceptually, traditional investors can be viewed as a special case of impact investors who allocate zero value to non-financial returns.

also aims to de-risk such investments. In what follows, we discuss the de-risking mechanisms used in blended finance.

b. De-risking mechanisms of blended finance

As mentioned above, the aim of blended finance is to subsidize and de-risk private capital investments, thereby improving the risk-return profile of such investments. Blending is typically used when the expected biodiversity impact is high, but the financial return is too low to be financed by pure private capital. As such, blending helps attract private capital, even from investors who may not value the non-financial returns gained from biodiversity impact.

In practice, there are several de-risking mechanisms through which blending can improve the risk-return profile of private investments. In the following, we distinguish between de-risking mechanisms at the i) fund level and ii) project level.

De-risking mechanisms at the fund level

Biodiversity funds are typically structured as partnerships with one general partner (GP) making the investment and multiple limited partners (LP) investing capital. Each LP commits a specific amount to the fund by the closing date. Once the closing date is reached, the investment process begins. Payments are made by the LPs during the life cycle of the fund through drawdown notices that apply to all LPs at a pro rata of their capital contributions. If an LP defaults on one of the payments, the GP can request additional drawdowns from the other LPs. In such cases, the required capital contribution of each LP is increased on a pro-rata basis to cover the amount that remains to be funded.

At the fund level, there are three different mechanisms through which blended financing can de-risk private capital investments: i) seniority, ii) preferred rate of return, and iii) financial guarantees.

- *Seniority*. Private investors can be granted a higher seniority compared to other LPs who provide capital for the blending. For example, development finance institutions—such as MIGA, USAID, and SIGA—can commit the initial tranche of capital as junior LPs.[6] This in turn can "crowd in" private investors who would commit capital as senior LPs. Due to their seniority, private investors are paid first, which reduces the risk of their investment.
- *Preferred rate of return*. Relatedly, the fund can allow for a different preferred rate of return (that is, the minimum return LPs must receive before the profits can be shared with the GP), such that the preferred rate is higher for private investors relative to other LPs who provide capital for the blending.
- *Financial guarantees*. Finally, development finance institutions (such as MIGA, USAID, and SIDA) or other entities may provide financial guarantees that compensate private investors in case the preferred rate of return is not achieved by the fund.

In addition to these de-risking mechanisms at the fund level, blended financing structures can also feature de-risking mechanisms at the project level, which we describe next.

De-risking mechanisms at the project level

At the project level, de-risking mechanisms fall into three broad categories: i) concessional finance, ii) ex-ante risk mitigation, and iii) ex-post risk mitigation.[7]

- *Concessional finance*. In the case of concessional finance, public or philanthropic funders (including philanthropic foundations, donors, multi-donor funds, and

[6] MIGA refers to the World Bank's Multilateral Investment Guarantee Agency, USAID the U.S. Agency for International Development, and SIDA the Swedish International Development Agency.
[7] See Earth Security (2021) for a more detailed discussion of these de-risking mechanisms at the project level, along with several practical examples.

development finance institutions) provide grants or funding at below-market rates to the investee to "crowd in" private capital investments. Concessional capital can also be granted conditional on the achievement of specific key performance metrics (so-called "impact-linked loans" or "results-based financing"), which provides investors with some guarantee that their investments would help bring about the project's intended environmental and social impact.

- *Ex-ante risk mitigation*. In addition to concessional finance, the provision of i) design and preparation grants and ii) technical assistance grants can help de-risk the project ex ante. These grants are typically provided by philanthropic foundations, donors, and multi-donor funds. *Design and preparation grants* aim to improve the viability of a project before securing the necessary financing. These grants are used to support the proof of concept, establish a baseline, establish a monitoring and verification system, develop a pipeline, resolve some ambiguity and uncertainty about the project's outcome, and provide the pre-commercial funding needed prior to the investment stage. *Technical assistance grants* are used to build the technical capacity of investees and their key stakeholders such as local communities that may be crucial to the successful implementation and ultimately the commercial viability of the project. They can also be used to build capacity in other areas such as financial management, contracting, business model development, or impact monitoring and evaluation. These grants are often provided by donors through a dedicated fund that runs in parallel to the actual investment (Earth Security 2021).
- *Ex-post risk mitigation*. Financial guarantees and risk insurance provide additional ways to de-risk biodiversity projects. These mechanisms operate ex post, as they

protect private investors against realized losses from the project. The guarantor—often a development finance institution such as MIGA, USAID, SIDA—commits to cover the losses (in full or in part) that may arise from the project. This reduces the risk of private investments, thereby increasing the appeal of biodiversity projects for private investors. Another potential benefit of guarantees is that private investors may remain committed to the investment even after the guarantees expire, and hence foster the financial sustainability of such investments.

As the above considerations illustrate, the de-risking of private investment through blended finance comes in different flavors. While a variety of de-risking mechanisms exist, their objective is always the same: act as a catalyst in attracting private capital by improving the risk-return tradeoff of biodiversity projects. Importantly, these de-risking mechanisms can foster "additionality" if they lead to the financing of new biodiversity projects that would not have been undertaken otherwise.[8]

A summary of the above discussion is provided in Table 3, which compiles the different returns and de-risking mechanisms of biodiversity investments, and in Figure 1, which illustrates the structure of biodiversity finance deals.

---- Insert Table 3 and Figure 1 about here ----

4. Private investing in natural capital—first empirical evidence on biodiversity finance

4.1 Data

To study private investments in biodiversity, we obtained access to the proprietary database of a recognized leader in biodiversity finance, and sustainable finance more broadly. As mentioned

[8] Additionality is an important challenge in sustainable finance. For a discussion of this challenge in the context of green financing, see Flammer (2020).

above, we refer to this company as "Biodiversity Investment Manager" (BIM) for confidentiality reasons. BIM is a private equity firm that is fully dedicated to sustainable investing. BIM and its affiliates have about $30 billion in assets under management. It is active throughout the world, and its clientele comprises both individual and institutional investors. BIM offers equity and fixed income investment strategies to its clients, and helps finance projects and companies at any stage of their life cycle.

While BIM is active in several areas of sustainable investing, we focus on their biodiversity finance deals. BIM invests in biodiversity projects throughout the world and across nearly all natural capital asset types. These projects are financed using blended finance as well as pure private capital investments.

The database covers all 33 biodiversity finance deals that were closed by BIM between 2020 and 2022.[9] Note that these deals are still ongoing (their average maturity is 8 years) and hence we do not have information about their realized performance. The data are very detailed. For each deal, we were granted access to BIM's internal documentation that contains a wealth of information about the underlying biodiversity project, the expected biodiversity impact, the deal structure, the expected financial return, and BIM's risk assessment, among others.

Out of the 33 biodiversity finance deals, 19 deals (58%) were financed by pure private capital, while the remaining 14 deals (42%) were financed through blended finance. In what follows, we characterize these deals across many dimensions.

4.2 Deals by natural capital asset types

Table 4 provides a breakdown of the 33 biodiversity finance deals by natural capital asset types.

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[9] In addition, we were granted access to a set of deals that were under consideration but ended up being discarded by BIM's management. We study these deals in Section 4.8.

Note that the BIM deals span the full set of natural capital asset types listed in Table 1, except for ‘urban parks and other green infrastructures in urban areas.’ The deals are almost equally distributed across the two broad categories land (48.5% of the deals) and sea (51.5%). Within the land category, the main natural asset types are ‘agriculture: soil and pollinators’ (24.2%) and ‘forests’ (18.2%). Within the sea category, the main ones are ‘fisheries’ (30.3%), ‘coastal ecosystems’ (9.1%) and ‘oceans, incl. coral reef’ (9.1%).

---- Insert Table 4 about here ----

In the last four columns of Table 4, we distinguish between blended finance deals and deals that are financed by pure private capital. As is shown, the distribution across the different natural capital asset types is similar in both groups. At the margin, the land category tends to be more prevalent among blended finance deals (57.1%), while it is less prevalent among deals financed by pure private capital (42.1%).

4.3 Deals by countries

Table 5 provides a breakdown of the deals based on the countries of the biodiversity projects. As can be seen, most of the projects are undertaken in Latin America and the Caribbean (30.3%), Asia (24.2%), and Africa (18.2%). The distribution is again comparable across blended finance deals and deals that are financed by pure private capital.

---- Insert Table 5 about here ----

Figure 2 provides a visualization of the biodiversity projects’ location on the world map. Darker-shaded areas indicate a greater number of projects. Figure 3 provides separate maps for blended finance deals (panel A) and deals that are financed by pure private capital (panel B).

---- Insert Figures 2 and 3 about here ----

4.4 Deals by financing structure

In Table 6, we provide a breakdown of the deals based on their financing structure. Equity is the more prevalent form of financing (33.3% of the deals), followed by a mix of equity and debt (24.2%) and debt with profit sharing (18.2%). In the latter case, the interest paid on the debt is performance-based. It is typically specified as a floor interest rate plus a percentage of the project's EBITDA (sometimes subject to a cap). Other deals are financed through VERPA (voluntary emission reduction purchase agreement), either as standalone (12.1%), or combined with equity (6.1%). In VERPA-based financing, the investors purchase ownership of the carbon credits that are generated by the project.

---- Insert Table 6 about here ----

In the last four columns of Table 6, we distinguish between blended deals and pure private capital deals. As is shown, equity (28.6% of the blended deals and 36.8% of the pure private capital deals) and a mix of equity and debt (28.6% and 28.1%, respectively) remain the more prevalent forms of financing for both types of deals. VERPA-based financing is found among both types as well (14.3% and 21.1%, respectively). One nuance is that VERPA-based financing is more likely to be combined with equity for blended deals, while it is more likely to be used as standalone for pure private capital deals.

4.5 Deal characteristics

Table 7 provides the means and standard deviations for various deal characteristics across all BIM deals, and separately for blended finance deals and deals financed by pure private capital. The last column reports the *p*-value of the difference-in-means test comparing blended finance deals vs. pure private capital deals.

---- Insert Table 7 about here ----

As can be seen from panel A, the average biodiversity deal has a maturity of 7.9 years, a deal size of $22.8M, and a ticket size (that is, the amount invested by each investor) of $6.6M, out of which $3.2M (52%) is in the form of equity, $2.8M (35%) in the form of debt, and $0.6M (13%) in the form of VERPA-based financing. When comparing blended deals vs. pure private capital deals, the main difference is that blended deals tend to be larger—the average deal size is $29.2M compared to $18.2M ($p$-value = 0.074). This indicates that the blending helps scale up biodiversity investments. We also observe that blended deals tend to rely on a larger share of debt financing and a smaller share of VERPA-based financing, although these differences are not significant at conventional levels.

For each deal, the database provides the target IRR. For about two-thirds of the deals, the BIM documentation also includes a sensitivity analysis that assesses the downside risk of the project, that is, the IRR under the pessimistic scenario. We use the deviation from the target IRR as a measure of the project's risk. We report both metrics in panel B. As can be seen, deals that have a higher target IRR tend to be financed by pure private capital. On average, their target IRR is 14.7%, compared to 11.9% for blended finance deals. The difference is significant in statistical terms (p-value = 0.026). While blended finance deals have lower expected returns, they tend to have lower risk as well. On average, their potential deviation from the target IRR is 6.9% compared to 7.4% for deals that are financed by pure private capital. When computing the ratio of the target IRR to the potential deviation from the target IRR—similar in spirit to a Sharpe ratio—we find no significant difference between the two types of deals (p-value = 0.846). Overall, this suggests that the de-risking from the blending helps improve the risk-return tradeoff of these projects, thereby increasing their appeal to private investors.

Panel C provides metrics that capture the environmental and social impact of the biodiversity deals. A clear pattern emerges, in that the blended deals are significantly more impactful along multiple dimensions. First, the total impact area (e.g., in terms of reforestation and habitat conservation) is expected to be larger. On average, it is expected to be 114,798 hectares for blended deals compared to 26,844 hectares for pure private capital deals (p-value = 0.098). Similarly, blended finance deals are expected to reduce greenhouse gas (GHG) emissions by 9.5 million tons of CO2 equivalent (tCO2e), compared to only 2.6 million tCO2e for pure private capital deals (p-value = 0.096). What is more, the number of beneficiaries (that is, individuals who benefit from the project) is expected to be 19,133 people for blended deals, compared to 5,185 for pure private capital deals ($p = 0.025$). The number of new jobs created is also expected to be higher for blended finance deals (3,358) compared to pure private capital deals (838), although the difference is not significant at conventional levels (p-value = 0.279). Finally, the share of deals that are expected to be certified by third-party organizations—such as EcoVadis, the Forest Stewardship Council (FSC), and the Climate, Community, and Biodiversity (CCB) Standards, among others—is about the same across both types of deals.

Panel D further shows that the differences in Panel C are not merely reflective of the larger size of the blended finance deals. When scaling the above metrics by the size of the deal, we find that blended finance deals have a larger impact per dollar invested. In particular, on a per dollar basis, the total impact area, the reduction in GHG emissions, and the number of beneficiaries are 4.3 to 4.9 times larger for blended finance deals.[10]

Overall, the evidence from Table 7 indicates that, while deals that have a higher expected financial return are more likely to be financed by pure private capital, they tend to be smaller in

[10] While these differences are large in economic terms, they are not significant at conventional levels. Arguably, such finer differences are harder to detect given the small sample size.

scale and have lower biodiversity impact. For larger-scale projects with a more ambitious biodiversity impact, blended finance is the more prevalent mode of financing. While these projects have lower expected returns, they are also less risky. This suggests that the blending—and the corresponding de-risking of private capital—is an important tool for improving the risk-return tradeoff of these projects, thereby increasing their appeal to private investors.

4.6 ESG assessments

In addition to the quantitative information provided in Table 7, the BIM database also includes qualitative assessments of the biodiversity deals along several ESG dimensions. For each ESG dimension, the assessment is specified on a scale from 1 to 3 (1 referring to "Low," 2 referring to "Medium," and 3 referring to "High"). The means and standard deviations of these assessments are provided in Table 8. In panel A (ESG assessment), a higher score represents a more positive assessment. In panel B (ESG risk), a higher score represents higher risk. In panel C (ESG risk management), a higher score represents a more positive assessment of the risk management process.

---- Insert Table 8 about here ----

As can be seen from panel A, the ESG assessments are especially favorable with regard to environmental dimensions, including 'natural ecosystems,' 'sustainable product lands & seascapes,' and 'climate change mitigation.' This underscores the importance of biodiversity for the environment and the mitigation of climate change. Relatedly, the ESG risks in panel B tend to be assessed between low and medium. In particular, the categories 'pollution control, energy and water use risk' and 'biodiversity conservation risk' are rated favorably, in keeping with the nature of biodiversity projects. This is further reflected in the quality of the ESG risk management processes in panel C, which tend to be rated between medium and high.[11]

4.7 Key performance indicators (KPIs)

The 33 biodiversity finance deals described above were closed between 2020 and 2022. Since they are currently ongoing—their average life cycle is about 8 years (see Table 7)—we do not have data on their realized performance. However, BIM does monitor these projects on a regular basis. In addition to standard financial metrics (e.g., IRR), BIM uses a set of key performance indicators (KPIs) that capture the biodiversity, environmental, and social performance of the projects. The list of KPIs is provided in Table 9.

---- Insert Table 9 about here ----

This list of KPIs is insightful. Indeed, a key challenge in biodiversity finance is how to come up with metrics that are relevant and informative as to the biodiversity impact of the underlying projects (Karolyi and Tobin-de la Puente 2023). BIM relies on a series of metrics pertaining to i) the achievement of internationally recognized certifications, ii) sustainable productive lands and seascapes (e.g., hectares of reforestation and afforestation), iii) climate change mitigation (e.g., volume of GHG emissions that are avoided, reduced, or sequestered), and iv) natural ecosystems (e.g., hectares of land under conservation or restoration). In addition to these environmental and biodiversity metrics, BIM also tracks a set of KPIs pertaining to the social performance of the biodiversity projects, including metrics of i) community engagement, ii) livelihood and decent work, and iii) diversity and inclusion.

[11] Due to the coarse, three-category answers underlying the ratings, these qualitative data are not well suited to detect differences across groups of deals. And indeed, in the last six of columns of Table 8, we see little variation in these ratings across the blended finance and pure private capital deals.

4.8 Deals that were discarded by BIM

In addition to the 33 in-portfolio deals described above, BIM also granted us access to a set of deals that were under consideration for portfolio inclusion but were ultimately discarded by BIM's management. While the information available for these deals is sparser, it nevertheless includes a set of relevant variables that can be used to characterize the selection process.

In total, we have relevant information for 32 of the discarded deals. In Table 10, we contrast these 32 deals ("discarded deals") vis-à-vis the 33 deals that made it to the portfolio stage ("portfolio deals") on the basis of several characteristics. The last column provides the *p*-value of the difference-in-means test for each characteristic.

---- Insert Table 10 about here ----

As is shown, the discarded deals tend to be both less profitable and less impactful. Specifically, their average target IRR is 11.3% (compared to 13.5% for in-portfolio deals, *p*-value = 0.035), their average total impact area is 19,684 hectares (compared to 73,408 hectares, *p*-value = 0.006), their average GHG emissions reduction is 1.3 million tCO2e (compared to 5.7 million tCO2e, *p*-value = 0.096), their average number of beneficiaries is 3,727 people (compared to 11,623 people, *p*-value = 0.045), and their average number of new jobs created is 1,192 (compared to 1,846, *p*-value = 0.652). This suggests that, in order to be financed by private capital—either as standalone or in blended structures—deals need to cross a certain threshold in terms of both their financial return and biodiversity impact. Accordingly, private capital is unlikely to be a realistic option for a potentially large set of biodiversity projects.

5. Conclusion

The biodiversity crisis poses a critical threat to the world economy. According to a recent report of the World Bank (2021), the collapse of ecosystem services provided by nature—such as wild pollination, the provision of food from marine fisheries and timber from native forests—could result in a decline in global GDP of $2.7 trillion annually by 2030. This led David Malpass, the president of the World Bank Group, to conclude that "[p]reserving nature and maintaining its services are critical for economic growth" (World Bank 2021).

In light of this urgency, ambitious goals have been set such as the "30 by 30" worldwide initiative (that is, the protection of 30% of land and 30% of oceans by 2030), which was agreed upon in December 2022 at the COP 15 meeting of the UN Convention on Biological Diversity. Nevertheless, while public measures are crucial in addressing the biodiversity crisis, massive amounts of funding are required to effectively address the crisis (TNC 2020). In this regard, biodiversity finance could play an important role by helping mobilize private funding for the protection and restoration of biodiversity.

Although biodiversity finance is getting traction among investors, little is known about this new practice. The objective of this study was to shed light on this practice. In a nutshell, our contribution is twofold. First, we introduce a conceptual framework that lays out how biodiversity can be financed by pure private capital and blended financing structures. The main element underlying both types of financing is the "monetization" of biodiversity, that is, the extent to which investments in biodiversity can generate a financial return for private investors. Second, we provide first evidence on biodiversity finance. Using deal-level data from BIM, we show that projects with higher expected returns tend to be financed by pure private capital. Their scale is smaller, however, and so is their expected biodiversity impact. For larger-scale projects with a more ambitious biodiversity impact, blended finance is the more prevalent form of financing. While these projects have lower expected returns, their risk is also lower. This suggests that the blending—and the corresponding de-risking of private capital—is an important tool for improving the risk-return tradeoff of these projects, thereby increasing their appeal to private investors. Finally, we examine a set of projects that were under consideration by BIM, but did not make it to the portfolio stage. These projects tend to have lower financial and biodiversity returns. This suggests that, in order to be financed by private capital—either as standalone or in blended structures—biodiversity projects need to exceed a certain threshold in terms of both their financial return and biodiversity impact. Accordingly, while private capital can help close the financing gap and contribute to the conservation and restoration of biodiversity, it is unlikely to provide a panacea against the biodiversity crisis.

More broadly, an important question is how to scale up private investments in biodiversity. While blended financing can help enhance the risk-return tradeoffs of such investments, other hurdles are likely to hamper the growth of this market. First, information asymmetries (and the corresponding information acquisition costs) are likely to be substantial. On one hand, project-holders ("sellers") and their local NGO partners have limited knowledge about international investors' preferences and requirements in terms of eligibility criteria and reporting KPIs. On the other hand, international investors ("buyers") know little about local markets and the challenges of biodiversity projects. Second, these challenges are compounded by the lack of common frameworks that could be used to assess biodiversity projects and provide a basis for third-party certification. Such frameworks are difficult to design due to the inherent challenges in measuring biodiversity benefits, as well as the projects' other societal benefits (e.g., community economic development). Arguably, making progress on these dimensions is likely to help foster the growth of this market.

Lastly, our study is subject to two main limitations. First, our empirical analysis is based on a sample of 33 biodiversity finance deals. While these deals provide helpful insights, we caution that they need not be representative of the broader population of biodiversity deals. In this regard, our hope is that, as biodiversity finance continues to grow and more comprehensive datasets become available, future work will be able to provide larger-scale evidence on this new phenomenon. Second, since the deals we examined are still ongoing, we do not have data on their ex-post performance nor biodiversity impact. Rather, our analysis is based on ex-ante projections at the time the deals were closed. We again hope that, as time passes and post-completion data become available, future work will shed additional light on the financial performance and biodiversity impact of such investments. More broadly, a key objective of this study was to lay the ground and stimulate future research on biodiversity finance. In this regard, we very much echo Karolyi and Tobin-de la Puente's (2023) initial call for research in biodiversity finance.

References

Barrett, S., 2022, A biodiversity hotspots treaty: the road not taken, *Environmental and Resource Economics* 83(4), 937–954.

Bloomberg, 2022, Junk Carbon Offsets Are What Make These Big Companies 'Carbon Neutral' (Bloomberg: New York, NY).

Bolton, P., and M. T. Kacperczyk, 2021, Do investors care about carbon risk? *Journal of Financial Economics* 142(2), 517–549.

Bolton, P., and M. T. Kacperczyk, 2022, Global pricing of carbon-transition risk, *Journal of Finance*, forthcoming.

Dasgupta, P., 2021, The Economics of Biodiversity: The Dasgupta Review (United Kingdom Her Majesty's Treasury: London, UK).

Deutz, A., G. M. Heal, R. Niu, E. Swanson, T. Townshend, Z. Li, A. Delmar, A. Meghji, S.A. Sethi, and J. Tobin-de la Puente, 2020, Financing Nature: Closing the Global Biodiversity Financing Gap (The Paulson Institute, The Nature Conservancy, and the Cornell Atkinson Center for Sustainability).

Earth Security, 2021, The Blended Finance Playbook for Nature-Based Solutions (Earth Security: London, UK).

Flammer, C., 2020, Green bonds: effectiveness and implications for public policy, Kotchen, M., J. H. Stock, and C. Wolfram, eds., *NBER Environmental and Energy Policy and the Economy* (University of Chicago Press: Chicago, IL), 95–128.

Flammer, C., 2021, Corporate green bonds, *Journal of Financial Economics* 142(2), 499–516.

Garel, A., A. Romec, Z. Sautner, and A. F. Wagner, 2023, Do investors care about biodiversity? Swiss Finance Institute Research Paper No. 23–24.

Gibson-Brandon, R., S. Glossner, P. Matos, P. Krueger, and T. Steffen, 2022, Do responsible investors invest responsibly? *Review of Finance* 26(6), 1389–1432.

Giglio, S., T. Kuchler, J. Stroebel, and X. Zeng, 2023, Biodiversity risk, NBER Working Paper 31137.

Heal, G. M., 2000, Nature and the Marketplace: Capturing the Value of Ecosystem Services (Island Press: Washington, DC).

Heal, G. M., 2003, Bundling biodiversity, *Journal of the European Economic Association* 1(2), 137–175.

Heal, G. M., 2004, Economics of biodiversity: an introduction, *Resource and Energy Economics* 26(2), 105–114.

Heal, G. M., 2020, The economic case for protecting biodiversity, NBER Working Paper 27963.

Heeb, F., J. F. Kölbel, F. Paetzold, and S. Zeisberger, 2023, Do investors care about impact? *Review of Financial Studies* 36(5), 1737–1787.

Hong, H., G. A. Karolyi, and J. Scheinkman, 2020, Climate Finance, *Review of Financial Studies* 33(3), 1011–1023.

Ilhan, E., P. Krueger, Z. Sautner, and L. T. Starks, 2023, Climate risk disclosure and institutional investors, *Review of Financial Studies* 36(7), 2617–2650.

Karolyi, G. A., and J. Tobin-de la Puente, 2023, Biodiversity finance: a call for research into financing nature, *Financial Management* 52(2), 231–251.

Krueger, P., Z. Sautner, and L. T. Starks, 2020, The importance of climate risks for institutional investors, *Review of Financial Studies* 33(3), 1067–1111.

OECD, 2020, A Comprehensive Overview of Global Biodiversity Finance (Organisation for Economic Cooperation and Development: Paris, France).

Pastor, L., R. F. Stambaugh, and L. A. Taylor, 2022, Dissecting green returns, *Journal of Financial Economics* 146(2), 403–424.

Sautner Z., L. Van Lent, G. Vilkov, and R. Zhang, 2023, Firm-level climate change exposure, *Journal of Finance* 78(3), 1449–1498.

S&P Global, 2021, Carbon Offsets Prove Risky Business for Net Zero Targets (S&P Global: New York, NY).

Starks, L. T., 2023, Sustainable finance and E, S, & G issues: values versus value (presidential address at the 2023 American Finance Association Meetings), *Journal of Finance* 78(4), 1837–1872.

The Guardian, 2023, Revealed: More than 90% of Rainforest Carbon Offsets by Biggest Certifier are Worthless, Analysis Shows (The Guardian: London, UK).

TNC, 2020, Closing the Nature Funding Gap: A Finance Plan for the Planet (The Nature Conservancy: Arlington, Virginia).

Tobin-de la Puente, J., and A. W. Mitchell (eds.), 2021, The Little Book of Investing in Nature (Global Canopy: Oxford, UK).

United Nations, 2022, The State of Finance for Nature in the G20 (United Nations Environment Programme: Nairobi, Kenya).

West, T. A. P., J. Boerner, E. O. Sills, E. F. Lambin, and A. Kontoleon, 2020, Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon, *Proceedings of the National Academy of Sciences* 117(39), 24188–24194.

Work Economic Forum, 2023, Biodiversity Finance - Internalize the Externality (World Economic Forum: Davos, Switzerland).

World Bank, 2021, Protecting Nature Could Avert Global Economic Losses of $2.7 Trillion Per Year (World Bank Group: Washington, DC).

World Forum on Natural Capital, 2021, What is Natural Capital? (World Forum on Natural Capital: Edinburgh, Scotland).

WWF, 2022, Living Planet Report 2022 (World Wildlife Fund: Washington, DC).

Figure 1. Structure of biodiversity finance deals

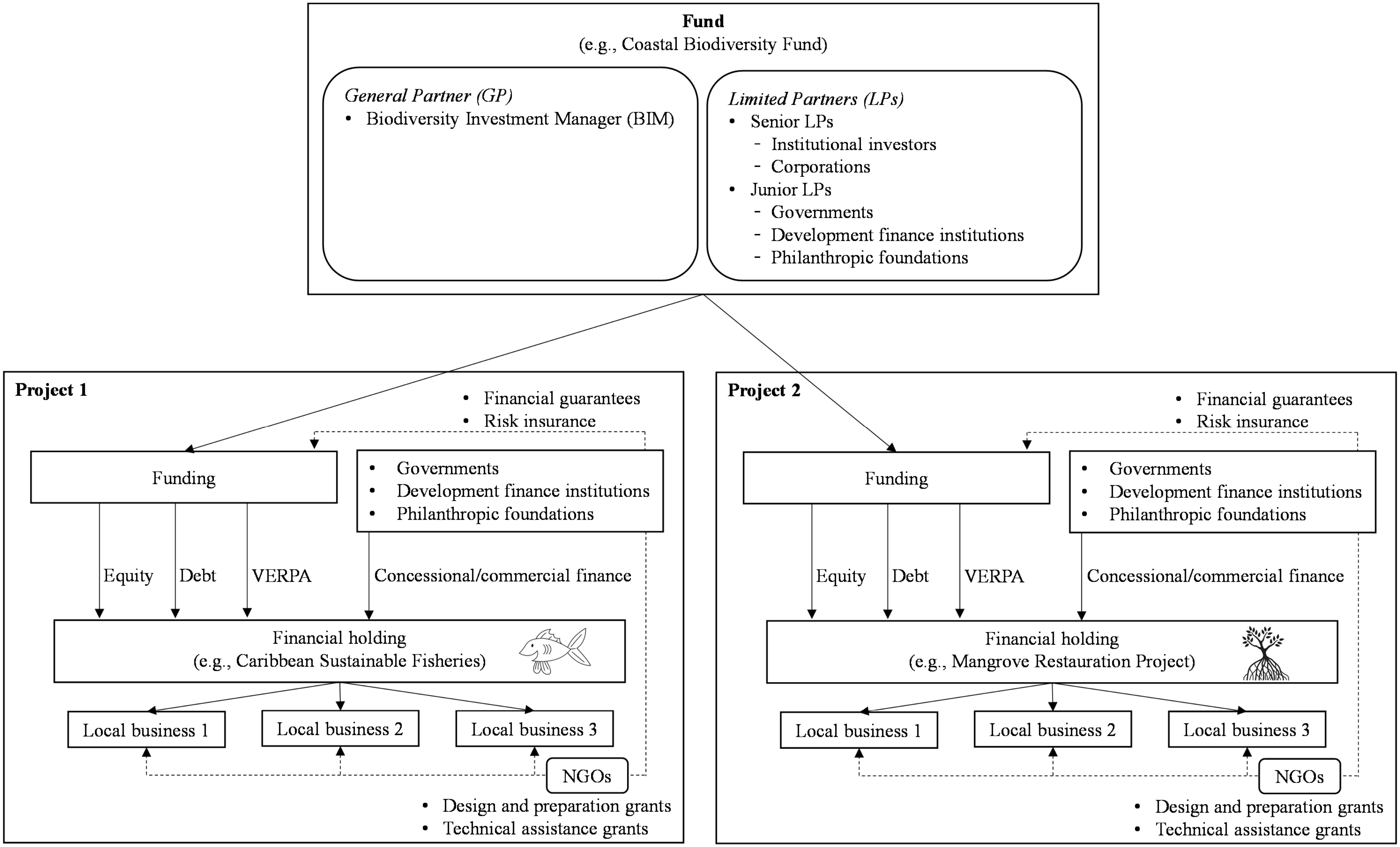
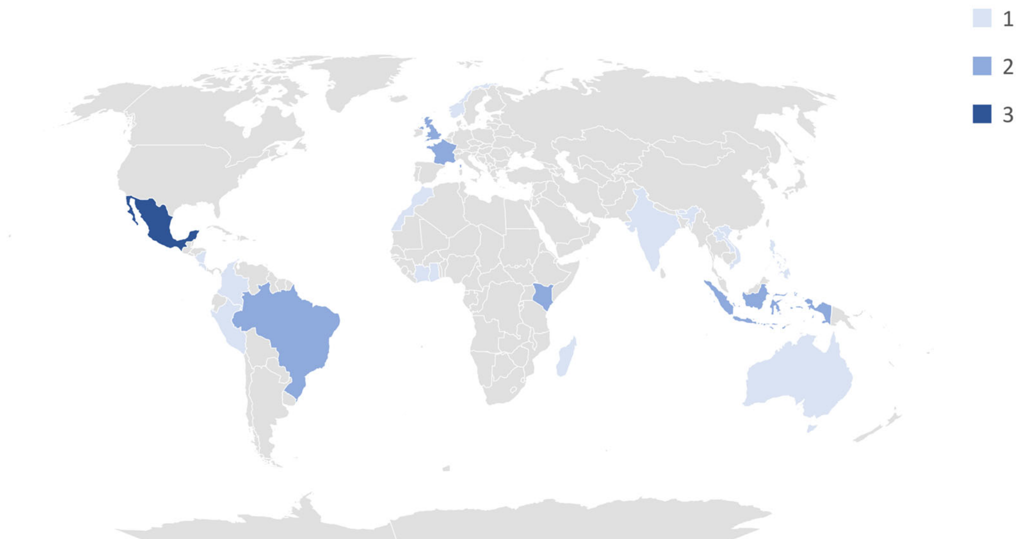


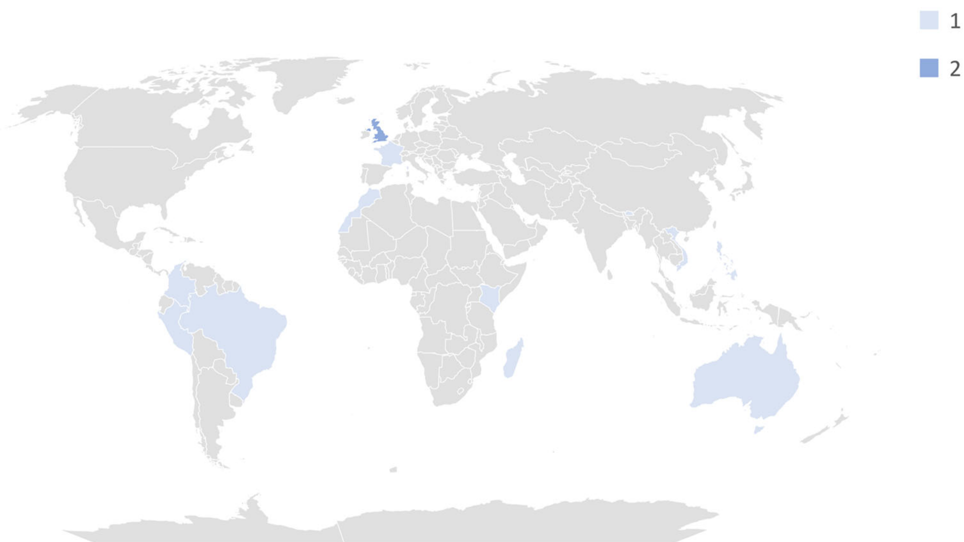
Figure 2. Biodiversity finance deals by countries



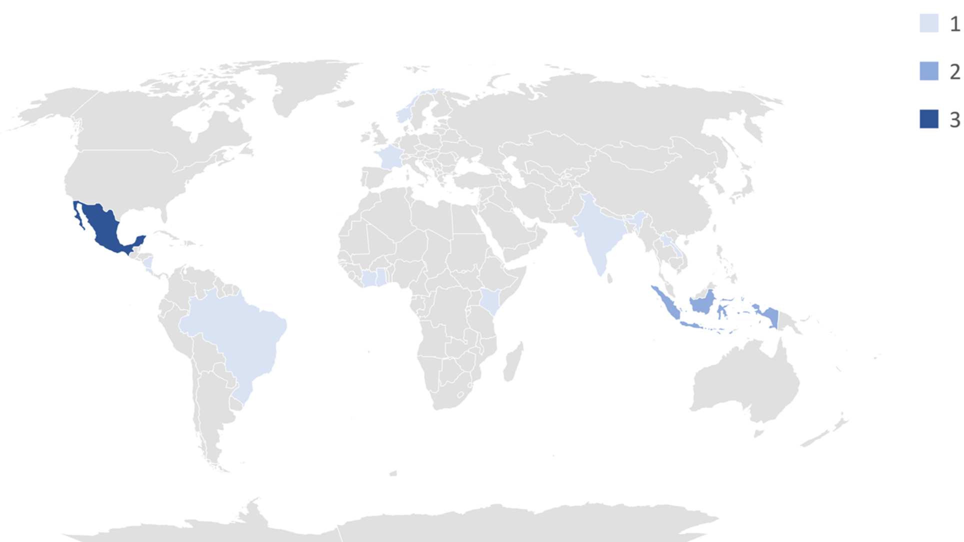
Notes. This figure plots the number of biodiversity finance deals of BIM by countries. Darker-shaded areas indicate a greater number of deals.

Figure 3. Types of biodiversity finance deals by countries

A. Blended finance



B. Pure private capital



Notes. This figure plots the number of biodiversity finance deals of BIM by type of deals and countries. Panel A refers to bended finance deals. Panel B refers to deals financed by pure private capital. Darker-shaded areas indicate a greater number of deals.

Table 1. Natural capital asset types and monetization mechanisms of ecosystem services

Natural capital asset types	Monetization mechanisms of ecosystem services
A. Land	
Agriculture: soil and pollinators	Agricultural productivity; price of farmland; certification as "biodiversity-friendly" agricultural products (higher prices); carbon credits; fire suppression; water quality
Forests	Ecotourism (hotel nights, tour guide services); carbon credits (carbon capture and storage); biodiversity credits; health; recreational value; bioprospecting for medicine; certification as "biodiversity-friendly" wood (higher prices); hydropower (pay for success)
Urban parks and other green infrastructures in urban areas	Value of real estate (proximity to park, green roofs provide heat isolation); prevention of flooding; carbon credits (carbon capture and storage); recreational value (e.g., birdwatching tours, sports activities, etc.)
Natural parks & wildlife protection	Ecotourism (hotel nights, tour guide services); value of real estate around the park; biodiversity credits
Genetic resources	Protection against diseases (humans, plants, food, animals); bioprospecting for medicine; biodiversity credits
B. Sea	
Watersheds	Green infrastructure services; water purification
Coastal ecosystems	Ecotourism (hotel nights, tour guide services); value of real estate (prevention of coastal flooding); carbon credit (carbon capture and storage); biodiversity credits; food production
Fisheries	Food production; certification as "biodiversity-friendly" seafood products (higher prices)
Oceans (incl. coral reef)	Ecotourism (hotel nights, tour guide services); carbon credits; biodiversity credits; value of real estate (prevention of hurricanes and coastal flooding)

Notes. This table provides examples of monetization mechanisms of ecosystem services by natural capital asset types.

Table 2. Examples of biodiversity funds

Natural capital asset types	Examples of biodiversity funds
A. Land	
Agriculture: soil and pollinators	Agri3 Fund; &Green Fund; Eco.business Fund; Food Securities Fund; HSBC Pollination Climate Asset Management; Land Degradation Neutrality Fund; Livelihoods Carbon Fund 3; L'Oreal Fund for the Regeneration of Nature; Madagascar Sustainable Landscapes Fund; Moringa Fund; Nature+ Accelerator Fund; responsAbility Fair Agriculture Fund; Responsible Commodities Facility; SLM Australia Livestock Fund; Terra Bella Colombia Fund; Tropical Landscape Finance Facility
Forests	Africa Forest Carbon Catalyst; Africa Sustainable Forestry Funds I-II; Althelia Biodiversity Fund Brazil; Althelia Climate Funds; Cloud Forest Blue Energy Mechanism; Ecotrust Forest Funds I-III; Eco.business Fund; Forest Resilience Bond; Forestry and Climate Change Fund; HSBC Pollination Climate Asset Management; Livelihoods Carbon Fund 3; L'Oreal Fund for the Regeneration of Nature; Lyme Conservation Opportunities Fund; Lyme Forest Funds I-V; Madagascar Sustainable Landscapes Fund; Mobilising Finance for Forests; Moringa Fund; Nature+ Accelerator Fund; Restoration Seed Capital Facility; SLM Silva Fund; Smallholder Forestry Vehicle; Socio-Climate Benefits Fund Facility; Terra Bella Colombia Fund; Tropical Asia Forest Funds; Tropical Landscape Finance Facility; Working Forest Fund
Urban parks and other green infrastructures in urban areas	Border Impact Bond; DC Water Environmental Impact Bond; Atlanta Environmental Impact Bond
Natural parks & wildlife protection	Althelia Climate Funds; Eco.business Fund; L'Oreal Fund for the Regeneration of Nature; Madagascar Sustainable Landscapes Fund; Tropical Landscape Finance Facility; Wildlife Conservation Bond
Genetic resources	Madagascar Sustainable Landscapes Fund
B. Sea	
Watersheds	Border Impact Bond; DC Water Environmental Impact Bond
Coastal ecosystems	Althelia Sustainable Ocean Fund; Nature+ Accelerator Fund; Belize Blue Bonds; Livelihoods Carbon Fund 3; L'Oreal Fund for the Regeneration of Nature; Mesoamerican Reef Fund
Fisheries	Althelia Sustainable Ocean Fund; Aqua Spark; Belize Blue Bonds; Eco.business Fund; L'Oreal Fund for the Regeneration of Nature; Meloy Fund for Sustainable Community Fisheries; Mesoamerican Reef Fund; Seychelles Blue Bond
Oceans (incl. coral reef)	Althelia Sustainable Ocean Fund; Belize Blue Bonds; Global Fund for Coral Reefs; HSBC Pollination Climate Asset Management; Mesoamerican Reef Fund; Nature+ Accelerator Fund; Seychelles Blue Bond

Notes. This table provides examples of biodiversity funds by natural capital asset types.

Table 3. Returns and de-risking mechanisms of biodiversity investments

A. Returns

Direct financial returns

Indirect financial returns

- Biodiversity credits
- Carbon credits

Biodiversity returns

B. De-risking mechanisms

Fund level de-risking mechanisms

- Seniority
- Preferred rate of return
- Financial guarantees

Project level de-risking mechanisms

- Concessional finance
- Ex-ante risk mitigation
    - Design and preparation grants
    - Technical assistance grants
- Ex-post risk mitigation
    - Financial guarantees
    - Risk insurance

Notes. This table summarizes the returns and de-risking mechanisms of biodiversity investments discussed in Section 3.

Table 4. Biodiversity finance deals by natural capital asset types

	All (N = 33)		Blended finance (N = 14)		Pure private capital (N = 19)	
	# Deals	Percent	# Deals	Percent	# Deals	Percent
Land	16	48.5%	8	57.1%	8	42.1%
Agriculture: soil and pollinators	8	24.2%	3	21.4%	5	26.3%
Forests	6	18.2%	3	21.4%	3	15.8%
Natural parks & wildlife protection	1	3.0%	1	7.1%	0	0.0%
Genetic resources	1	3.0%	1	7.1%	0	0.0%
Sea	17	51.5%	6	42.9%	11	57.9%
Watersheds	1	3.0%	0	0.0%	1	5.3%
Coastal ecosystems	3	9.1%	0	0.0%	3	15.8%
Fisheries	10	30.3%	4	28.6%	6	31.6%
Oceans (incl. coral reef)	3	9.1%	2	14.3%	1	5.3%
Total	33	100.0%	14	100.0%	19	100.0%

Notes. This table reports the number and percentages of biodiversity finance deals by natural capital asset types. The statistics are reported for all BIM deals (first two columns), and separately for blended finance deals (middle two columns) and deals financed by pure private capital (last two columns).

Table 5. Biodiversity finance deals by countries

	All (N = 33)		Blended finance (N = 14)		Pure private capital (N = 19)	
	# Deals	Percent	# Deals	Percent	# Deals	Percent
Africa	6	18.2%	3	21.4%	3	15.8%
Ghana	1	3.0%	0	0.0%	1	5.3%
Ivory Coast	1	3.0%	0	0.0%	1	5.3%
Kenya	2	6.1%	1	7.1%	1	5.3%
Madagascar	1	3.0%	1	7.1%	0	0.0%
Morocco	1	3.0%	1	7.1%	0	0.0%
Asia	8	24.2%	3	21.4%	5	26.3%
Bhutan	1	3.0%	1	7.1%	0	0.0%
India	1	3.0%	0	0.0%	1	5.3%
Indonesia	2	6.1%	0	0.0%	2	10.5%
Laos	1	3.0%	0	0.0%	1	5.3%
Philippines	1	3.0%	1	7.1%	0	0.0%
Vietnam	1	3.0%	1	7.1%	0	0.0%
Multiple countries	1	3.0%	0	0.0%	1	5.3%
Europe	5	15.2%	3	21.4%	2	10.5%
France	2	6.1%	1	7.1%	1	5.3%
Norway	1	3.0%	0	0.0%	1	5.3%
United Kingdom	2	6.1%	2	14.3%	0	0.0%
Latin America and Caribbean	10	30.3%	3	21.4%	7	36.8%
Bahamas	1	3.0%	0	0.0%	1	5.3%
Brazil	2	6.1%	1	7.1%	1	5.3%
Colombia	1	3.0%	1	7.1%	0	0.0%
Costa Rica	1	3.0%	0	0.0%	1	5.3%
Mexico	3	9.1%	0	0.0%	3	15.8%
Nicaragua	1	3.0%	0	0.0%	1	5.3%
Peru	1	3.0%	1	7.1%	0	0.0%
Oceania	1	3.0%	1	7.1%	0	0.0%
Australia	1	3.0%	1	7.1%	0	0.0%
Multiple continents	3	9.1%	1	7.1%	2	10.5%
Total	33	100.0%	14	100.0%	19	100.0%

Notes. This table reports the number and percentages of biodiversity finance deals by countries. The statistics are reported for all BIM deals (first two columns), and separately for blended finance deals (middle two columns) and deals financed by pure private capital (last two columns).

Table 6. Biodiversity finance deals by type of financing

	All (N = 33)		Blended finance (N = 14)		Pure private capital (N = 19)	
	# deals	Percent	# deals	Percent	# deals	Percent
Equity	11	33.3%	4	28.6%	7	36.8%
Equity + Debt	8	24.2%	4	28.6%	4	21.1%
Equity + Debt with profit sharing	1	3.0%	0	0.0%	1	5.3%
Equity + VERPA	2	6.1%	2	14.3%	0	0.0%
Debt	1	3.0%	1	7.1%	0	0.0%
Debt with profit sharing	6	18.2%	3	21.4%	3	15.8%
VERPA	4	12.1%	0	0.0%	4	21.1%
Total	33	100.0%	14	100.0%	19	100.0%

Notes. This table reports the number and percentages of biodiversity finance deals by type of financing. The statistics are reported for all BIM deals (first two columns), and separately for blended finance deals (middle two columns) and deals financed by pure private capital (last two columns). VERPA refers to voluntary emission reduction purchase agreements.

Table 7. Biodiversity deal characteristics

	All			Blended finance			Pure private capital			Difference in means
	N	Mean	Std. dev.	N	Mean	Std. dev.	N	Mean	Std. dev.	*p*-value
A. Deal size and financing										
Maturity (years)	33	7.94	3.03	14	7.93	2.70	19	7.95	3.32	0.986
Deal size ($ million)	33	22.84	17.47	14	29.15	18.39	19	18.19	15.63	0.074*
Ticket size ($ million)	33	6.62	3.86	14	7.24	3.99	19	6.17	3.79	0.443
Equity ($ million)	33	3.21	4.00	14	3.44	4.45	19	3.04	3.74	0.781
Debt ($ million)	33	2.79	4.20	14	3.65	4.34	19	2.16	4.08	0.320
VERPA ($ million)	33	0.62	1.62	14	0.14	0.53	19	0.97	2.03	0.147
% Equity	33	0.52	0.44	14	0.50	0.44	19	0.53	0.46	0.881
% Debt	33	0.35	0.42	14	0.47	0.46	19	0.26	0.39	0.172
% VERPA	33	0.13	0.33	14	0.03	0.11	19	0.21	0.42	0.124
B. Financial performance and risk										
Project return (target IRR)	33	13.52%	3.68%	14	11.88%	2.86%	19	14.72%	3.81%	0.026**
Project risk (deviation from target IRR)	20	7.18%	5.22%	8	6.94%	6.13%	12	7.34%	4.81%	0.872
Project return / project risk	20	2.51	1.32	8	2.44	1.54	12	2.56	1.22	0.846
C. Environmental and social impact										
Total impact area (ha, expected)	17	73,408	167,115	9	114,798	226,016	8	26,844	27,805	0.098*
GHG emissions reduction (1,000 tCO2e, expected)	18	5,665	8,649	8	9,469	11,900	10	2,622	2,824	0.096*
# Beneficiaries (expected)	13	11,623	11,779	6	19,133	13,812	7	5,185	3,710	0.025**
# New jobs created (expected)	15	1,846	4,273	6	3,358	6,693	9	838	1,050	0.279
Certification (1/0 dummy)	33	0.79	0.42	14	0.79	0.43	19	0.79	0.42	0.980

D. Environmental and social impact relative to deal size

Total impact area / deal size	17	2,793	1,375	9	3,849	2,522	8	1,606	790	0.433
GHG emissions reduction / deal size	18	233.59	72.30	8	306.06	138.73	10	175.62	70.40	0.386
# Beneficiaries / deal size	13	724.56	271.10	6	966.54	544.54	7	517.14	213.66	0.432
# New jobs created / deal size	15	130.03	101.42	6	271.56	254.82	9	35.69	12.74	0.270

Notes. This table reports the mean and standard deviation of several deal characteristics across all BIM deals and separately for blended finance deals and deals financed by pure private capital. VERPA refers to voluntary emission reduction purchase agreements. Total impact area is measured in hectares (ha). Greenhouse gas (GHG) emissions are measured in 1,000 metric tons of CO2 equivalent (tCO2e). The last column reports the *p*-value of the difference-in-means test comparing blended finance deals vs. deals financed by pure private capital. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 8. ESG assessments

	All			Blended finance			Pure private capital		
	N	Mean	Std. dev.	N	Mean	Std. dev.	N	Mean	Std. dev.
A. ESG assessment									
Sustainability	27	2.78	0.42	12	2.75	0.45	15	2.80	0.41
Environmental	28	2.79	0.42	12	2.75	0.45	16	2.81	0.40
Social	27	2.48	0.58	10	2.40	0.52	17	2.53	0.62
Governance	18	1.78	0.73	8	1.50	0.76	10	2.00	0.67
Natural ecosystems	24	2.25	0.74	12	2.17	0.83	12	2.33	0.65
Sustainable product lands & seascapes	27	2.37	0.63	13	2.38	0.77	14	2.36	0.50
Climate change mitigation	24	2.17	0.87	11	2.18	0.87	13	2.15	0.90
Circular economy	20	1.75	0.97	9	1.78	0.97	11	1.73	1.01
Socio-economic development	25	2.24	0.72	10	2.00	0.67	15	2.40	0.74
Livelihoods and decent work	26	2.38	0.57	10	2.40	0.52	16	2.38	0.62
Climate adaptation	20	1.45	0.69	9	1.33	0.50	11	1.55	0.82
Inclusion	24	1.96	0.81	10	1.50	0.53	14	2.29	0.83
Quality of I&ESG management	17	1.71	0.59	8	1.50	0.76	9	1.89	0.33
Business ethics	19	1.68	0.75	8	1.25	0.46	11	2.00	0.77
B. ESG risk assessment									
ESG risk	11	2.00	0.63	5	2.00	0.71	6	2.00	0.63
Environmental risk	18	1.89	0.68	8	2.00	0.76	10	1.80	0.63
Social risk	18	2.06	0.64	8	2.13	0.83	10	2.00	0.47
Governance risk	18	2.06	0.64	8	2.13	0.64	10	2.00	0.67
Country risk and governance risk	9	2.22	0.67	5	2.60	0.55	4	1.75	0.50
Business ethics risk	10	2.00	0.67	5	2.00	0.71	5	2.00	0.71
Legal and regulatory E&S compliance risk	10	1.70	0.48	5	1.60	0.55	5	1.80	0.45
Certifications and standards risk	9	1.78	0.44	4	2.00	0.00	5	1.60	0.55
Environmental and social assessment and management risk	10	2.00	0.47	5	2.20	0.45	5	1.80	0.45

Pollution control, energy and water use risk	10	1.80	0.63	5	2.00	0.71	5	1.60	0.55
Biodiversity conservation risk	10	1.50	0.71	5	1.40	0.89	5	1.60	0.55
Human resources policies & procedures risk	10	1.90	0.57	5	2.00	0.71	5	1.80	0.45
Health & safety at work risk	10	2.20	0.63	5	2.40	0.55	5	2.00	0.71
Community health, safety and security risk	10	1.80	0.63	5	2.00	0.71	5	1.60	0.55
Land tenure and land use change risk	10	2.00	0.82	5	2.40	0.89	5	1.60	0.55
Indigenous peoples’ rights and interests risk	8	1.75	0.89	4	2.00	1.15	4	1.50	0.58
Stakeholder engagement and grievance management risk	10	1.70	0.67	5	1.40	0.55	5	2.00	0.71
Gender risk	9	1.78	0.67	4	1.50	0.58	5	2.00	0.71
Cultural heritage risk	7	1.14	0.38	3	1.00	0.00	4	1.25	0.50
C. ESG risk management									
ESG risk management	24	2.50	0.51	10	2.60	0.52	14	2.43	0.51
Environmental risk management	17	2.06	0.24	8	2.13	0.35	9	2.00	0.00
Social risk management	17	2.06	0.24	8	2.13	0.35	9	2.00	0.00
Governance risk management	17	2.00	0.00	8	2.00	0.00	9	2.00	0.00
Country risk and governance management	8	2.00	0.00	3	2.00	0.00	5	2.00	0.00
Business ethics management	10	2.00	0.00	5	2.00	0.00	5	2.00	0.00
Legal and regulatory E&S compliance management	10	2.00	0.00	5	2.00	0.00	5	2.00	0.00
Certifications and standards management	10	2.00	0.00	5	2.00	0.00	5	2.00	0.00
Environmental and social assessment and management	9	2.11	0.33	5	2.20	0.45	4	2.00	0.00
Pollution control, energy and water use management	10	2.10	0.32	5	2.00	0.00	5	2.20	0.45
Biodiversity conservation management	9	2.00	0.00	5	2.00	0.00	4	2.00	0.00
Human resources policies & procedures management	11	2.00	0.00	6	2.00	0.00	5	2.00	0.00
Health & safety at work management	10	2.00	0.00	5	2.00	0.00	5	2.00	0.00
Community health, safety and security management	9	2.11	0.33	4	2.25	0.50	5	2.00	0.00
Land tenure and land use change management	9	2.00	0.00	4	2.00	0.00	5	2.00	0.00
Indigenous peoples’ rights and interests management	8	2.00	0.00	4	2.00	0.00	4	2.00	0.00
Stakeholder engagement and grievance management	10	2.10	0.32	5	2.20	0.45	5	2.00	0.00
Gender management	9	2.00	0.00	4	2.00	0.00	5	2.00	0.00
Cultural heritage management	7	2.00	0.00	3	2.00	0.00	4	2.00	0.00

Notes. This table reports the mean and standard deviation of several ESG dimensions that were qualitatively assessed on a scale from 1 to 3. These statistics are reported across all BIM deals and separately for blended finance deals and deals financed by pure private capital. In panel A (ESG assessment), a higher score represents a more positive assessment. In panel B (ESG risk), a higher score represents higher risk. In panel C (ESG risk management), a higher score represents a more positive assessment of the risk management process.

Table 9. Key performance indicators (KPI)

A. Environmental

Certification

- Internationally recognized certifications achieved

Sustainable productive lands and seascapes

- Area of reforestation/afforestation (including agroforestry) [ha]
- Hectares of land under sustainable management (production or conservation/restoration) [ha]
- Hectares of land under sustainable productive management [ha]
- Carbon sequestration practices

Climate change mitigation

- Total GHG emissions avoided/reduced or sequestered [tCO2e]
- Avoided/reduced greenhouse gas emissions [tCO2e]
- Tons of GHG sequestered [tCO2e]
- Tons of GHG sequestered that led to the generation of verified tradable carbon units [tCO2e]
- Tons of GHG avoided/reduced that led to the generation of verified tradable carbon units [tCO2e]

Natural ecosystems

- Hectares of land under conservation or restoration [ha]
- Volume of waste treated or valued [metric tons]

B. Social

Community engagement

- Community engagement events held [#]
- Number of people attending community engagement events [#]

Livelihoods and decent work

- Number of employees [#]
- Employees expressed in full-time equivalent [#]
- People with their main source of income provided by the project (excluding direct employees), [#]
- People expected to benefit directly from the project (excluding employees) [#]
- Households benefitting directly from livelihoods generated by the project (excluding employees and individual beneficiaries) [#]

Inclusion

- Gender ratio for management roles [%]
- Gender ratio for senior executive roles [%]
- Gender ratio at board level [%]
- Ratio of female employees [%]

Notes. This table provides the list of key performance indicators (KPI) used by BIM to track the biodiversity, environmental, and social performance of their biodiversity deals on an annual basis.

Table 10. Deals that were discarded by BIM

	In-portfolio deals			Discarded deals			Difference in means
	N	Mean	Std. dev.	N	Mean	Std. dev.	*p* -value
A. Financial performance							
Project return (target IRR)	33	13.52%	3.68%	32	11.29%	4.60%	0.035**
B. Environmental and social impact							
Total impact area (ha, expected)	17	73,408	167,115	28	19,684	43,148	0.006***
GHG emissions reduction (1,000 tCO2e, expected)	18	5,665	8,649	12	1,253	2,094	0.096*
# Beneficiaries (expected)	13	11,623	11,779	11	3,727	3,899	0.045**
# New jobs created (expected)	15	1,846	4,273	12	1,192	2,813	0.652

Notes. This table reports the mean and standard deviation of several deal characteristics across all BIM deals that made it to the portfolio stage ("in-portfolio deals") and BIM deals that were discarded ("discarded deals"). Total impact area is measured in hectares (ha). Greenhouse gas (GHG) emissions are measured in 1,000 metric tons of CO2 equivalent (tCO2e). The last column reports the *p*-value of the difference-in-means tests comparing in-portfolio deals vs. discarded deals. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

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