Financing Nature Repair: A Literature Review

A Report Prepared for the Alluvium Foundation

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Introduction

The Need for Private Investment

As the Kunming-Montreal Global Biodiversity Framework (United Nations, 2021) charts a course towards living in harmony with nature by 2050, the role of private finance becomes increasingly pivotal. This ambitious vision, fostered by the United Nations Biodiversity Conferences (United Nations, 2022), will not only require conserving and restoring natural habitats but also realigning global financial flows to support these conservation efforts. The Framework starkly notes the necessity of doubling investments in biodiversity to $US384 billion annually by 2025, and tripling investments to meet the Paris Agreement's target of 1.5 °C climate change and neutral land degradation by 2030.

To achieve this, target 14 of the Framework underscores the imperative of integrating biodiversity values across all government levels and sectors. Furthermore, Target 19 sharpens this focus, advocating for the mobilisation of resources from all quarters – international, domestic, public, and private. This includes "leveraging private finance, promoting blended finance, implementing strategies for raising new and additional resources, and encouraging the private sector to invest in biodiversity, including through impact funds and other instruments" (International Finance Corporation, 2023).

Despite this clear call to action, private investment lags behind, contributing around US$26 billion annually, which is 17% of total annual finance flows into nature conservation and repair. To close the finance gap, it is estimated that private investment would need to increase from 17% to 50% of total finance flows per annum (UNEP, 2023). This represents a significant challenge and underscores an urgency to find ways to make private investment in biodiversity and ecosystem management, conservation, and repair (i.e., "nature repair") attractive.

Who are Private Investors?

While the investor landscape is varied and complex, private investors could be broadly categorised as either *institutional* or *retail*. An institutional investor buys, sells, and manages securities such as stock options, bonds, commodities, currencies, futures contracts, and property or infrastructure funds on behalf of its clients, members, or shareholders. Institutional investors can be mutual funds, hedge funds, pension/superannuation funds, sovereign wealth funds, endowment funds, insurance companies, foundations, banks, large private equity and venture capital firms, and family offices. Their customers may include asset managers, firms, high net-worth individuals, banking customers, or superannuation accounts, to name a few (Australian Bureau of Statistics, 2022; Chen, 2021; Gurrola-Perez et al., 2022; Pandey & Sane, 2019).

An institutional investor has to meet a certain threshold in terms of funds under management and they are subject to less regulation and thus can engage in riskier and more illiquid investments (i.e., low ability to quickly convert an asset to cash without significantly affecting its price). In terms of size, about 80% of equity market capital in the U.S. is held by institutions (Chen, 2021). For Australia, the numbers are fairly similar – domestic institutional investors (excluding superannuation funds) hold about 30% of Australian listed equities, and superannuation funds just under 30% (Business Council of Australia, 2019). Due to public sentiment and government regulation, there is an increasing need for institutional investors to consider Environmental, Social, and Governance (ESG) factors when making portfolio decisions, however their primary role is to make as much capital return on their client's investment as possible.

Retail investors make up most of the remaining market. Retail investors are generally individuals, households, or firms that invest their own money. They may use brokers or exchanges as intermediaries in many markets. Retail brokers or exchanges buy and sell in markets on behalf of their clients or may have their own off-market funds that mirror market instruments which retail investors can invest in. The capital required from retail investors is usually much less than institutional investors. They are also subject to more regulation and restrictions and the instruments they can invest in are usually more liquid. While retail investors may have a range of reasons for investing, including motivation to improve the environment, for the purposes of this report, we assume that capital return on their investments is of equal or greater importance (Australian Bureau of Statistics, 2022; Chen, 2021; Gurrola-Perez et al., 2022; Pandey & Sane, 2019).

What Do They Invest In?

Institutional and retail investors invest in a broad range of financial instruments which can also be categorised into two broad categories: equity and debt. Equity usually involves ownership of a portion of a company or asset. The most obvious example would be purchasing shares in a public company or fund listed on the stock exchange or purchasing shares in a private company or project through a private agreement. The most common form of debt instrument is a bond, where an organisation issues a bond to raise money for a project. Investors loan a portion of money and receive interest payments and the return of their initial principal after a given timeframe. Investors may also loan money directly to specific projects or organisations in private arrangements (Australian Bureau of Statistics, 2022; Chen, 2021; Gurrola-Perez et al., 2022; Pandey & Sane, 2019).

The Wider Context

Private investors exist within complex social and economic systems. Individual firms and investors not only exist within financial markets but operate within *natural* environments. The business practices of firms, and investment choices of investors, can directly or indirectly cause harm *to* nature (through fossil

fuel consumption, fossil fuel generation, land clearing, water contamination etc.). Conversely, firms, markets, and investments can also be affected *by* nature degradation. For example, drought and soil quality can affect goods and services such as food production or tourism. Firms, markets, and investments are also subject to public sentiment about how they address these nature-based risks. These dynamics could lead to changing investor preferences that create demand for sustainable investment choices or disclosure of ESG policies. These changing preferences could also affect the pricing and profitability of firms within markets, and as a consequence, returns for investors.

Apart from the above actors, there are communities, firms, projects, or organisations whose core activities are intertwined with nature maintenance and repair, either as providers or recipients. They may be offering management, development, products, services, research, assistance, or resources to projects. Or they may help to bring about and promote the reduced biodiversity footprints of firms through offering consultancy or certifications (e.g., Certified B Corporation, the Rainforest Alliance "Green Frog"). While many of these entities may be non-profit, it is likely that as the market for nature repair expands, so will for-profit opportunities for providers of nature repair. Last, there are also consumers who dictate the demand for eco-friendly products and services these entities provide.

All of this takes place in a governance landscape that is shaped by "supranational" organisations (e.g., multilateral groups like the European Union), international agencies (e.g., the International Monetary Fund), governments, and regulators and who delineate the "rules of the game" through targets, policy frameworks, and initiatives. These rules can drastically affect financial flows into nature repair (Pandey & Sane, 2019; Puydarrieux & Mésenge, 2018).

As can be seen, private investors navigate a complex political, social, and business landscape which needs consideration when identifying the causes of the lack of investment in nature repair. This report attempts to simplify and clarify this landscape to help identify barriers and enablers of private funding for nature repair.

Financial Mechanisms for Closing the Finance Gap

The following section summarises a broad set of mechanisms for financing nature repair: the systems or arrangements that enable the flow, management, and allocation of financial resources within economies.

Current Mechanisms

The United Nations Environment Programme's (UNEP) *State of Finance for Nature 2024* report pools several sources of data to estimate financial flows into nature repair. As seen in Table 1, public finance provides the lion's share of the funding (approximately 73% of total funding), predominantly in

sustainable agriculture, forestry and fishing. For private financing, biodiversity offsets are the funding mechanism of choice (68% of private funding or 18% of total funding). Carbon markets and equity impact investments make up a very small proportion of private funding flows.

It is arguable that funding flows channelled through non-governmental (NGOs) and philanthropic organisations, multilateral development banks, and bilateral cooperation could be classified as *supporting* mechanisms rather than private finance flows. This is because it is not clear that these funds are invested in for profit. However, they may support or encourage for-profit private investment. For example, nature repair projects may receive initial grants from these supporting organisations at below-market rates. Alternatively, they may guarantee or insure the projects. These actions help reduce the risk for private investors (Flammer et al., 2025). These *blended* or *hybrid* financing mechanisms are discussed in the report.

Table 1. Summary of finance flow estimates, 2022 US$ billion

Financial flow category	Financial flow sub-category	Description	Estimate	Share of total flows
Private	Biodiversity offsets	Investment in programmes that compensate for unavoidable impacts of development projects	11.7	18 %
	Regenerative agriculture	Farming approaches to restore and improve soil health, biodiversity and ecosystems	1.5	2 %
	Equity Impact investing	Equity and debt investments to generate positive, measurable ESG impacts and financial returns	0.7	1 %
	Carbon markets	Voluntary transactions in carbon markets that involve nature-based solutions to carbon reduction, including REDD+	0.04	0.1 %
Supporting	Conservation NGOs	Expenditures reported by 5 largest conservation NGOs	1.9	3 %
	Philanthropy	Grants and non-grants reported by philanthropic foundations	0.7	2 %
Public	Domestic government expenditure	Sustainable agriculture, forestry and fishing including subsidies to sustainable fisheries	41.5	65 %
		Protection of biodiversity and landscape	3.8	6 %
		Environmental policy and other	0.7	1 %
	Official Development Assistance	Bilateral and multilateral aid in support of sustainability, biodiversity, climate change mitigation or desertification	1.2	2 %

Note. Abbreviations: ESG = Environmental, Social, and Governance, REDD+ = Reducing Emissions from Deforestation and Forest Degradation, NGOs = Non-Government Organisations, DAC = Development Assistance

Committee, GEF = Global Environment Facility, GCF = Green Climate Fund. Table adapted from UNEP (2024) *Growing the Green*

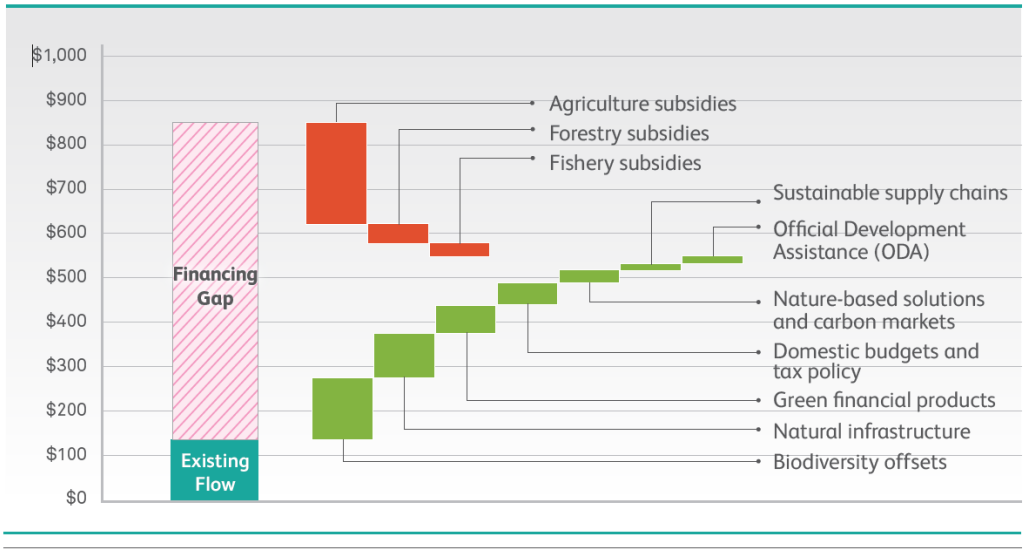
While in-depth estimates of Australia's current financial flows into nature repair seem to be lacking, a PwC report estimates that Australian financial flows into nature repair are currently worth $AU9.9 billion. However, they also note issues such as a lack of spending on threatened species conservation, some schemes lacking measurable outcomes for biodiversity (e.g., NSW Biodiversity Offsets Scheme), and financial flows to harmful activities (e.g., fossil fuel subsidies) far outweighing positive flows into activities. By 2050, investment flows into nature repair in Australia could be worth $AU171 billion.

Potential Mechanism Growth

In their report *Financing nature: Closing the Global Biodiversity Financing Gap*, Deutz et al. (2020) not only offers similar estimates of the size of current mechanisms, but also estimates the size and growth of future mechanisms[1]. There are three primary ways investors can help with closing the nature repair funding gap: 1) divestment from nature-damaging investments, 2) direct or "pure" investment in nature-repair initiatives or financial instruments, 3) blended or hybrid investments with governments or supporting institutions to that help de-risk projects (Deutz et al., 2020; Flammer et al., 2025; Pandey & Sane, 2019). Figure 1 shows how both scaling up private finance mechanisms and eliminating government subsidies that have encouraged industry to engage in nature damaging practices can close the finance gap.

[1] Analysis and selection of financial and policy mechanisms by Deutz et al. (2020) was based on the UNDP BIOFIN Catalogue of Finance Solutions and screened using the following criteria: The mechanism is currently in use at a significant scale (more than US$ 0.5 billion per year); has the potential to deliver substantial amounts of new funding on a consistent basis (more than US$ 5 billion per year and a potential compound annual growth rate of at least 2.5%); and has a realistic policy and/or market pathway to scaling in order to meet its potential. Note, these mechanism categories may be slightly different to the United Nations Environment Programme's (2022) categorisations in Table 1.

Figure 1. Estimate of growth in financing resulting from scaling up proposed mechanisms by 2030 (2019 US$ billion per year)



Note. Figure reproduced from Deutz et al., (2020) *Financing nature: Closing the global biodiversity financing gap.* Copyright 2020 the Paulson Institute. Reproduced with permission and available at https://www.paulsoninstitute.org/conservation/financing-nature-report/

Given that quantitative comparisons of the viability of different financial mechanisms are lacking, in Table 2 we have adapted data from Deutz et al. (2020) to estimate the growth potential of each of these mechanisms, as well as their overall contribution to closing the finance gap in 2030. This may serve as an estimate of the relative importance of each mechanism and a potential guide to prioritising where to focus reducing barriers. As seen, biodiversity offsets that compensate for biodiversity damage, along with trading biodiversity-related credits in the carbon market, show substantial growth potential. These may increase in size between 18 and 31 times the current level (though biodiversity offsets are set to make a larger overall future contribution at 36% compared to 6 – 9% for carbon credits)[2]. Beyond offsets and credits, natural infrastructure such as watersheds show potential to garner more private investment in the future, especially as exchanges and markets become more commonplace. "Green" financial instruments, such as equity, debt, and convertible securities, emerge as promising avenues for private investment over the midterm, growing by 8.1 – 14.7 times and contributing 7% – 20% of 2030 funds. Sustainable supply chains, though large in current private investment, exhibit limited growth potential, perhaps due to their current level of maturity. It is also important to acknowledge supporting organisations, including government agencies and international development institutions, who also play

[2] It should be noted that as of December 2023, the Australian Government passed nature repair legislation which will be used to develop biodiversity "certificates", rather than offsets. These will be able to be earned by nature repair projects and traded in markets, but will not be able to be used to offset harm to nature elsewhere (C. Smith et al., 2023). Since this is a very recent update, it is not clear whether this would constitute a biodiversity offset in the Deutz et al. (2020) framework. However, in the report we treat them as a mechanism most similar to offsets and credits.

a crucial role in attracting private investment by offering initial funds to new projects and mitigating risks for further private investment (Deutz et al., 2020; Karolyi & Tobin-de la Puente, 2023). Domestic public budgets and tax policies constitute a significant portion of the current and future contributions (23 – 33%). In particular, eliminating government subsidies that incentivise environmentally harmful practices could reduce the funding needed for nature repair. Investment risk management by financial institutions could also mitigate the need for nature repair spending. This includes understanding nature-related risk, avoiding investments with negative impacts on biodiversity, and investing in areas that have positive impacts. However due to a lack of data, the future growth or contribution was not estimated by Deutz et al. (2020). Overall, there are diverse strategies and mechanisms available to address the finance gap for nature repair. In the next section we address the barriers (and also some enablers) to these types of private investments in nature repair.

Table 2. Estimated Positive and Negative Flows to Biodiversity Conservation

A. Mechanisms that increase capital flows into biodiversity conservation

Financial and Policy Mechanisms	**2019** *US$ billion / year*	**2030** *US$ billion / year*	**Mechanism Growth** *US$ billion / year*	**Mechanism Growth** *Fold change from 2019*	**Proportion of 2030 Funding** *%*
Biodiversity offsets	6.3 – 9.2	162.0 – 168.0	155.7 – 158.8	25.7 – 18.3x	36 – 36%
Domestic budgets and tax policy	74.6 – 77.7	102.9 – 155.4	28.3 – 77.7	1.4 – 2.0x	23 – 33%
Natural infrastructure	26.9	104.7 – 138.6	77.8 – 111.7	3.9 – 5.2x	23 – 30%
Green financial products (incl. PES)	3.8 – 6.3	30.9 – 92.5	27.1 – 86.2	8.1 – 14.7x	7% – 20%
Nature-based solutions / carbon markets	0.8 – 1.4	24.9 – 39.9	24.1 – 38.5	31.1 – 28.5x	6 – 9%
Official development assistance	4.0 – 9.7	8.0 – 19.4	4 – 9.7	2.0 – 2.0x	2 – 4%
Sustainable supply chains	5.5 – 8.2	12.3 – 18.7	6.8 – 10.5	2.3 – 2.3x	3 – 4%
Philanthropy / conservation NGOs	1.7 – 3.5	Not Estimated*			
Total	**123.6 – 142.9**	**445.7 – 632.5**	**323.8 – 493.1**	**3.6 – 4.4x**	**100%**

B. Mechanisms that decrease the overall need for funding to be spent on biodiversity conservation

Financial and Policy Mechanisms	**2019** *US$ billion / year*	**2030** *US$ billion / year***	**Mechanism Decrease** *US$ billion / year***	**Mechanism Decrease** *Percent change from 2019*
Harmful subsidy reform (agriculture, fisheries, and forestry)	542.0 – 273.9	268.1 – 0***	273.9 – 542.0***	49 – 100%***
Investment risk management			Data not available	

Table adapted from Deutz et al., (2020) *Financing nature: Closing the global biodiversity financing gap.* Copyright 2020 the Paulson Institute. Reproduced with permission and available at https://www.paulsoninstitute.org/conservation/financing-nature-report/ PES = Payments for Ecosystem Services. Figures to the left and right of the dashes represent lower and upper bound scenarios, respectively. Note, these mechanism categories may be slightly different to the United Nations Environment Programme's (2022) categorisations in Table 1.

* While future flows for philanthropy and conservation NGOs are seen as highly catalytic for mobilising private sector financial flows, it was determined by Deutz et al. (2020) that they did not pass the threshold for inclusion as a main mechanism for scaling up to close the financing gap.

** 2019 U.S. dollars

*** Assumes a global subsidies reform scenario that phases out by 2030 the most harmful subsidies as described by OECD

Barriers and Enablers of Private Investment in Nature Repair

Private Finance Investment Decisions

To understand the barriers to private investment, it is important to understand what private investors value and how they make decisions. In their model of renewable energy policy and investment, Wüstenhagen and Menichetti (2012) show that risk and return are the bedrock of investment decisions. Investors typically weigh the levels of risk and return of potential investment opportunities, opting for those that offer the best return for a given level of risk. This is also known as evaluating risk-adjusted returns. Portfolio theory extends this concept by suggesting that risk may be reduced through diversification – combining different styles of assets that are unlikely to rise and fall in value at the same time, to yield a more favourable overall risk profile. In this context, integrating non-traditional biodiversity assets into a conventional asset portfolio could form part of this diversification (Pandey & Sane, 2019). However, since investment decisions involve people, private financiers are not completely immune to individual or group emotions, biases, or beliefs. These *cognitive* or *behavioural* aspects of finance may affect decisions such as what risks are deemed relevant and what investment classes are attractive.

Profitability

While there is a reported willingness from investors to prioritise the environment in their investment decisions, the private capital flows into these nature repair markets have remained small, illiquid, and geographically constrained. The most obvious reason for this may be that private investors may not anticipate strong capital returns relative to perceived risks. Investments in nature repair have historically been evaluated as having high risk and low return (Dempsey & Suarez, 2016; Lambooy & Levashova, 2011; UNEP, 2023). Examining deal-level decisions within a leading biodiversity finance institution, Flammer et al. (2025) found that projects needed to meet thresholds in terms of both their biodiversity impact and financial return to make it to the portfolio stage. They also found that projects financed with purely private capital had higher expected returns but less scale for nature repair impact. This suggests that nature repair investment opportunities need to be able to demonstrate their worth in terms of nature repair impact, but most importantly, in terms of profitability.

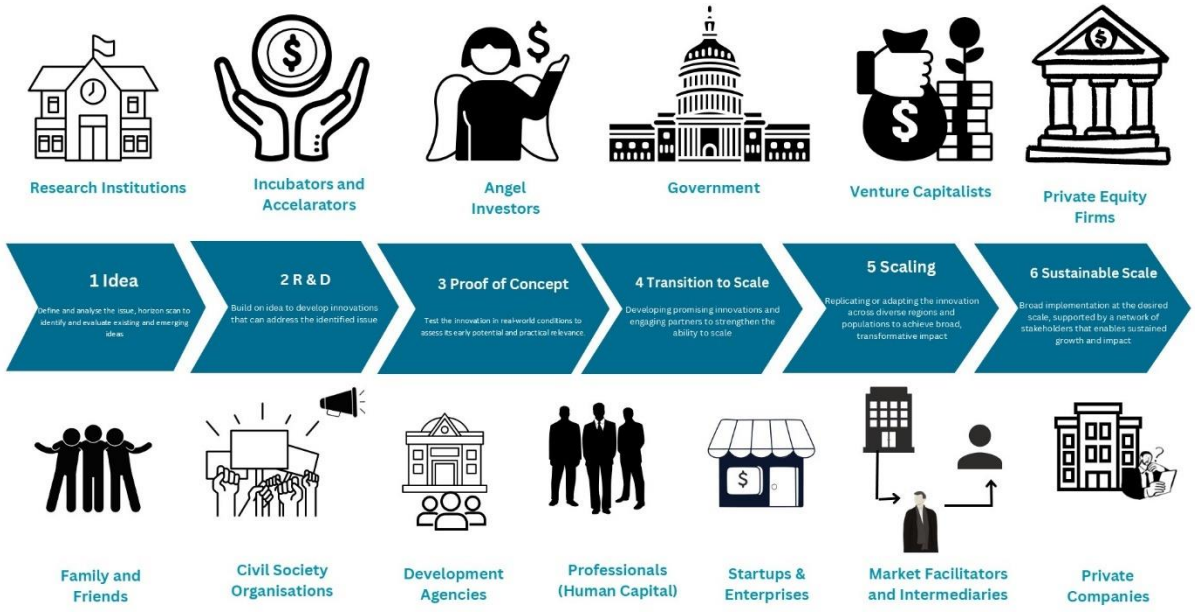
Certain projects may be more likely to be profitable in the near term, and therefore be more likely to attract pure private investment. Two reviews tracked the development of markets and corporate investment in ecosystem services in the first decade of the millennium (Bishop et al., 2009; Meijerink et al., 2007). They concluded that significant private sector engagement was likely only when clear financial returns from ecosystem management are evident. Examples included profits from ecotourism or the sale of goods like timber. Whereas ecosystems that function as public goods, such as wetlands

or beaches, where financial returns are not obvious or feasible, were less likely to attract finance from the private sector. The UK Dasgupta (2021) review also concluded that private investments that are directed towards making existing business activities more sustainable, such green infrastructure or eco-tourism, have clearer paths to profitability. Financial returns from conservation and restoration projects were often too small in size to lure significant financial investments and were seen as risky or an expense rather than an investment (Dasgupta, 2021; Vardon et al., 2019). The distinction between such projects may be important in understanding the types of biodiversity projects that can realistically garner pure private investment in the near term. In situations where a clear business case cannot be made, or where interests of investors and conservationists are misaligned, then blended finance or regulatory intervention may be necessary to motivate private finance to act (Dempsey & Suarez, 2016).

Asset Scale and Maturity

New investments differ in their risk and profitability depending on the maturity of the sector, the product or technology being developed, or its ability to scale. According to Wüstenhagen & Menichetti (2012), these factors will attract different types of investors at different stages of the innovation chain. Generally, in the initial phases of innovation the scale of projects is smaller, costs are higher, and projects need longer to demonstrate profit. As a sector innovates and matures, the dynamics change: more market demand is generated, costs drop, and profits may increase. Likewise, the types of investors willing to invest will differ along this innovation chain: public funding through grants or those close to the project (colloquially known as “friends, fools, and family”) is common in the beginning, along with angel investing and venture capital. Private equity, project finance, and listing on public markets become more common in later stages. Because of this, the attractiveness of nature repair projects will differ depending on the investor’s type, experience, and risk appetite. Figure 2 outlines the types of financial investors likely to invest at different stages along the innovation chain.

Figure 2. Types of investors along the innovation chain



Adapted from https://www.idiainnovation.org/ecosystem-actors

Several reviews and reports have suggested that a challenge for private sector entrepreneurship and investment in nature repair lies in the small scale of projects. This often extends the setup duration for each project and leads to high initial setup costs associated with designing and implementing financial products or solutions, particularly those that are customised or complex (Dasgupta, 2021; UNEP, 2023). There are also other transaction costs related to due diligence, legal fees, and project monitoring on small-scale projects (Lambooy & Levashova, 2011). In an economic analysis, Quesada (2015) found that even in more established biodiversity markets, the initial expenses associated with establishing agreements still can be a significant barrier. For example, it is often costly to establish payment for ecosystem services or mitigation banks, which offset the environmental impacts that result from development or land-use demand. These costs may be generated through having to determine clear ecological targets and the resources needed to achieve them. Along with these higher costs, the longer timeframes needed to yield returns means there is a lack of liquidity in these projects. Therefore, the lack of ease with which an asset can be converted into cash without significantly affecting its price might cause some investors to demand higher returns to compensate for the perceived additional risk or divert their investments to more liquid options (Brears, 2022; Polzin, 2017).

Scaling up such projects may also be challenging due to the complex range of stakeholders involved. In structured entities such as government agencies and corporations, decision-making often adheres to a top-down approach, with higher authorities dictating and lower-level entities implementing.

However, the top-down approach encounters challenges when applied to natural assets, which are intricately linked to local communities. For example, about 1/3 of all energy used in Sweden, including 60% of district heating, is bioenergy (i.e., the transformation of biomass, other waste, and waste heat to heating, power and cooling). A case study found that a top-down governance approach including agenda setting, policy goals, and economic mechanisms needed to be balanced with bottom-up governance which included the private sector, citizens, and various groups of stakeholders at the municipal level. It was also noted that there was already a high degree of trust and acceptance of municipality leadership and support for bioenergy, which contributed to the success (Hansen & Berlina in Puydarrieux & Mésenge, 2018). Therefore top-down hierarchical structures, particularly those managed remotely or centrally, might lack the necessary local insights and flexibility to adapt to unique circumstances. However, bottom-up approaches need significant social coordination, and are difficult in environments of political instability and low trust. These complexities may factor into private investor risk assessments and valuations. A recent review of finance literature on biodiversity, Zwieten (2021) suggests that development banks or international funds that fit into our category of "supporting organisations" could be further utilised to manage, guarantee, or insure projects. This may help to mitigate some of these risks and complexities for private investors. As projects scale to market, there is also the potential that instruments such as derivatives could be used to transfer risk from project owners to the market.

Market Pricing

Private finance and financial markets predominantly operate based on the principles of supply and demand, where prices are shaped by these forces. However, as highlighted by Puydarrieux and Mésenge (2018) in their study on the implementation of payments for environmental services and offsets, financial markets frequently struggle to determine accurate prices for assets associated with natural capital and biodiversity. This is due to a failure to internalise externalities produced by biodiversity. It is difficult to adjust the market price of a good or service related to biodiversity to reflect its true cost or value (i.e., internalise), because they are often not monetary or quantifiable, and benefit third parties. This challenge, acknowledged for over a decade, continues to be a major obstacle impeding greater private investment in these areas (Dasgupta, 2021; Meijerink et al., 2007).

More specifically, it has been observed by researchers worldwide that markets often fail to accurately price biodiversity assets due to their public good characteristics (Arlaud et al., 2018; Pandey & Sane, 2019; Puydarrieux & Mésenge, 2018). Biodiversity has societal benefits (i.e., positive externalities) but quantifying these benefits in economic terms is complex (Arlaud et al., 2018). These complexities include 'non-excludability', which means that individuals can generally benefit from biodiversity without paying for it. Further, it is difficult to establish property rights over nature and charge people for use – for example, everyone can enjoy a clean and healthy environment, and it is difficult to exclude people from benefiting from it. This can limit the availability of such assets to the market or discourage market

participation. In addition, there is ‘non-rivalry’ in that nature can be enjoyed by an unlimited number of individuals without diminishing its availability. This defies the conventional supply-demand dynamics of markets, which are crucial for asset valuation. Without market prices to signal value and scarcity, and with the benefits of biodiversity often externalised, it becomes difficult to ascertain the financial value of assets, which in turn affects investment decisions and resource allocation (Arlaud et al., 2018; Arriagada & Perrings, 2011; Bishop, 2013; Dasgupta, 2021; Meijerink et al., 2007; Pandey & Sane, 2019; Puydarrieux & Mésenge, 2018). Indeed, a recent survey found that only 20% of investors believe that nature-related issues impact on cash flows, although this number is higher (44%) when investors were asked if nature-related physical risks have financial consequences (Gjerde et al, 2025).

Ecosystems can provide immense value to businesses. Although this value needs to be more clearly articulated and connected to the private goods they enhance. Flammer et al. (2025) provide some suggestions of how ecosystem products and services can provide economic value for example through ecotourism, certification (allowing for higher pricing), creation of carbon credits, increasing the value of real estate (e.g. by mitigating the effects of natural disasters). Furthermore, Forrest Trends (von Hase & Cassin, 2018) have produced a resource document outlining the complex theory and practice of *bundling* different goods or services from one ecosystem project for sale on offset or credit markets or *stacking* ecosystem goods and services by separating the benefits into separate payments. These approaches are meant to help better compensate sellers and provide measurable ecosystem outcomes, however they come with challenges. This relates to confusion about terms and concepts and measurement issues including a lack of additionality (the environmental benefits should be additional to the normal course of events), accounting asymmetry (e.g., differences in accounting on impact and offset sides of deals) and the complexity of ecosystems themselves. These issues may deter sellers and buyers from participating.

Besides the impact of *positive* externalities on asset valuation and investor confidence, another barrier to reducing investments harmful to nature is the failure to incorporate *negative* externalities into market pricing. These are adverse effects stemming from investments, where the responsibility is not shouldered by the investors. They are instead transferred to others in the form of environmental degradation, health impacts, or economic costs. Without adequate regulation or other market interventions to internalise this externality, the market price may not be able to reflect the true cost of the asset, and therefore investors will not be incentivised to invest less in environmentally harmful goods and services. Furthermore, the often unpredictable and non-linear impacts of environmental degradation pose substantial challenges for accurately quantifying and pricing the associated external costs (Kedward et al., 2020).

In summary, market prices struggle to reflect the true value of nature-related assets due to their unique characteristics. This makes investors hesitant to invest in biodiversity, while harmful investments continue to pass on hidden costs to others. The unpredictable and indirect nature of harm and benefits to the environment adds to the difficulty of placing a clear financial value on these costs. However,

recent work has shown that there are (indirect) ways to account for the nature-related assets' financial value.

Risk Management

The financial sector has only recently begun to recognise the significance of biodiversity-related financial risks to their investment portfolios. Many financiers do not understand their potential impact or the associated financial risks of climate and nature on their investments (United Nations, 2023), and a survey of market participants showing the majority do not believe these risks to be correctly priced by the financial markets (Giglio et al., 2023, see also Garel et al., 2025). There is also a lack of awareness and understanding of the importance of biodiversity conservation among firms (Chavan, 2020), a lack of firm accountability for nature harm, and insufficient alignment with strategic biodiversity goals (Romain et al., 2021; Smith et al., 2020). This highlights the need for comprehensive risk management related to nature in the private sector.

Risk management includes actions taken by financial institutions to understand risk related to their investments, avoid investments that may have negative impacts on biodiversity, and invest in areas that have positive biodiversity impacts. Importantly, investment risk management *now* could reduce the need for spending on nature repair *later* (Deutz et al., 2020; Karolyi & Tobin-de la Puente, 2023). Corporate accountability and transparency that acknowledges nature risk factors is important to motivate change within firms and sectors and to gain further attention from private investors. A lack of transparent risk assessment hinders corporate biodiversity commitments and makes it challenging to assess if businesses are genuinely managing their environmental impacts and risks. First, risk assessment acts as a benchmarking process used to compare progress over time or cross-sectionally between firms and sectors. Second, it can be used to help set targets, which can drive corporate action. And third, evidence-based corporate commitments (based on accurate risk assessment) can help private investors factor in biodiversity footprints of firms into their own risk assessments and portfolio choices (Addison et al., 2019).

Private investors' risk assessments are critical to their investment and portfolio decsions. Factoring in nature-related risk into risk assessments could trigger divestment or diversification from sectors or portfolios that harm nature or are at risk from nature, and provide an incentive to direct capital into greener sectors (Addison et al., 2019). Similar to what many investors have done in the climate space, nature risk considerations from scenario-based risk assessments could be incorporated into investor due diligence processes and asset valuation. However, in the past there has been limited guidance available from larger bodies for nature-based reporting (Bishop, 2013) and still a lack of specialist knowledge-sharing on biodiversity dependencies and outcomes (Principles for Responsible Investment, 2023). However, very recent evidence suggests that things may be changing, with a survey of companies reporting about 40% of investors consider nature-related risks when investing (Gjerde et al, 2025).

Understanding Risks to Firms and Investments from Nature Disrepair

Kedward et al. (2020) have suggested that risks to firms and investors from ecosystem decline include *physical risks* (e.g., from nature to business, such as severe weather occurrences); *transition risks* (e.g., to firm's operations and bottom line from abrupt policy alterations or regulations); and *liability risks* (e.g., legal actions against firms or projects that contribute to environmental harm). However, for many firms or investors, these risks might only be considered significant when they directly or obviously threaten operations or bottom lines (Addison et al., 2019). For example, this could include natural disaster risks to insurance companies or pests' effects on food crops.

Moreover, a study of fortune 500 firms' biodiversity protection policies found that certain sectors are more proactive in adopting specific biodiversity mitigation policies. The utility sector was more likely to have specific biodiversity mitigation policies because this sector includes providers of essential services like electricity, water, and gas, they might face more obvious and higher risks associated with biodiversity loss. In contrast, the highest revenue sector, the financial sector, was shown to have the lowest adoption of biodiversity-related policies (Bigger et al., 2021). This may be because private investors are unaware of the importance of nature for their investment decisions. In one study, researchers, using data from debt securities and listed shares from French financial institutions' portfolios, quantitatively assessed impact on land and freshwater biodiversity (excluding marine environments). They found 42% of the market value of securities (like stocks and bonds) are issued by companies that have a high or very high reliance on at least one of these ecosystem services. Further, every company had some level of dependence on all 21 ecosystem services included in the study. This was due to their interconnected business operations and supply chains (Romain et al., 2021). This maps very closely to what we see in the Australian market where almost 40% of the Australian economy has a high to very high *direct* dependency on nature (Australian Conservation Foundation, 2022).

It is likely that there are significant indirect risks to firms within private investors' portfolios that may not be quantified accurately (Giglio et al., 2023, Principles for Responsible Investment, 2023). Therefore, it is important that investors become acutely aware of the potential for biodiversity loss to affect their portfolio companies, and by extension their own profitability. The private sector will need access to tools to better recognise and quantify biodiversity loss as a material business risk. By doing this, the potential impacts of nature disrepair on firms or portfolios would be visible to firms, empowering them to take action, and this visibility will help investors in their evaluation of risk (Bishop, 2013; Pandey & Sane, 2019).

Identifying risks to firms and investments from nature can be challenging due to their long-term and unpredictable nature, making it counter-intuitive to consider the costs or benefits of investing (or not investing) in biodiversity over time (Lambooy & Levashova, 2011). Discounting is a critical concept in finance, particularly when considering projects or decisions that have long-term implications. Discount rates are used to determine the present value of future returns on an investment. Given that returns

over time incur risk (e.g., projects fail, markets change), the discount rate adjusts these future returns by the perceived risk to determine whether they are attractive enough in today's terms. For example, a natural habitat restoration project can add benefits (e.g., better biodiversity, cleaner water, and more ecotourism) and mitigate risks (e.g., flooding, loss of biodiversity, job loss). However, these will materialise gradually over time. If a high discount rate is used, the present value of these future benefits or risk mitigations drops significantly. This is because a high discount rate prioritises immediate benefits/risk reductions over future benefits/risk reductions. As a result, the project might not look financially worthwhile in present value terms. In contrast, a low discount rate reduces the value of benefits/risk reduction in the distant future less than a high discount rate would, potentially making the project appear more financially attractive in present value terms.

Historically, standard environmental accounting approaches for estimating discount rates tended to result in the under-valuation of biodiversity projects due to the very long-term nature of the expected yields and uncertain levels of risk (Freeman & Groom, 2013). As a hyperbolic example, it would be counterproductive to use discount rates determined by standard market comparisons with the yields of a 30-year AA-rated corporate bond and apply this rate to the 100- or 200-year cash flow of a biodiversity project. Although today there have been inroads into this. The United Nations System of Environmental-Economic Accounting is being accepted as the international statistical standard for natural capital accounting and is being rolled out by the Australian Government. This system can help to determine discount rates, among other important accounting metrics (United Nations Department of Economic and Social Affairs, 2020). However, its implementation in Australia is still in early stages and does not seem to have a strong foothold in the private sector. Although the Responsible Investment Association Australasia has a nature working group engaging with the private sector dedicated to the following areas: 1. Awareness and education for investors; 2. Nature-related risks and exposures; 3. Activating nature-related investment opportunities; 4. Strategy and systems; 5. Corporate engagement; and 6. An external reference group (Responsible Investment Association Australasia, n.d.).

Thus, it will be important to identify and raise awareness of the risks of nature disrepair in sectors such as finance and in firms where the risks are least obvious or understood. Accurate accounting for nature-based risks, especially over time, will also help private investors to evaluate the attractiveness of investing in certain firms and projects.

Understanding Harm to Nature Caused by Firms and Investments

There are also barriers in terms of quantifying firms' and investors' effect *on* nature. A study of investors found that a lack of metrics added to a lack of clarity on how to acurately measure firms' biodiversity impacts (Principles for Responsible Investment, 2023). Without clear metrics and indicators, firms or industries as a whole may not be able to prioritise or understand the significance of their actions related to biodiversity (Bigger et al., 2021) or whether their operations and investments align with goals related to preserving biodiversity (Romain et al., 2021). Indicators can also foster agreement on the exact

amount of funding required to tackle biodiversity issues, and who is responsible, both locally and globally (Dasgupta, 2021; Zwieten, 2021). For example, biodiversity expenditure reviews have allowed the country of Ireland to more strategically plan conservation policies (Morrison et al., 2021).

Again, the long-term and complex nature of ecosystems hampers the development of accurate measures of firms' and investors' effect *on* nature An analysis of multiple case studies of companies from varying countries, sectors, and biodiversity investment-types concluded that operational incentives cause focus on short-term activities over addressing the interdependencies between their companies and nature (T. W. Smith et al., 2020). At national level, Dasgupta (2021) noted a major impediment to assessing benefits and risks related to biodiversity was the short-term vision of many financial actors. Because timeframes related to environmental risks and benefits could span generations, firms' or investors' responsibilities to future generations can be discounted or passed off as a matter of ethics rather than a finance industry issue. Therefore, there may be a need to account for the *moral or psychological value* of ecosystem harm in measuring the benefits and risks of projects or investments. For example, future risk/benefit analyses may need to include other metrics such as subjective well-being or basic need satiation in addition to traditional growth measures such as risk-adjusted returns on investment or gross domestic product (Dasgupta, 2021; Freeman & Groom, 2013; Gowdy et al., 2010).

Taskforce on Nature-related Financial Disclosures

Recently, the recommendations of the Taskforce on Nature-related Financial Disclosures (TNFD) have provided a much-needed framework to aid greener investment choices. The TNFD is a risk management and disclosure framework for firms and financial institutions which is in line with the global policy goals of the Kunming-Montreal Global Biodiversity Framework. It provides guidance and suggested requirements for firms to disclose the organisation's governance of nature-related dependencies, impacts, risks and opportunities; the material effects of these on the organisation's business model, strategy and financial planning; the process used by the organisation to identify, assess, prioritise and monitor nature-related dependencies, impacts, risk and opportunities; and the metrics and targets used to assess and manage them (TNFD, 2023b). The Taskforce (TNFD, 2023a) has also provided guidance on the identification and assessment of nature related issues. Its LEAP approach includes relevant frameworks to assess nature-related issues, including listing the types of biodiversity initiatives that could be invested in and the investment types. Likewise, the International Finance Corporation (2023) has provided a guide for choosing and planning biodiversity finance decisions. This includes mapping decisions and aligning them to the Green Bond and Green Loan Principles and key outcomes of the Global Biodiversity Framework. These initiatives will aid transparency and productive decision making for firms and investors.

Third-party certifications (e.g., Wildlife Habitat Council Certification or ISO 14001) can also help with risk transparency by independently measuring a firms' progress towards biodiversity targets in their

operations. The benefits of this include opperational changes and target-setting by firms and increased credibility due to their independent nature. Importantly, the increased standardisation they provide affects the ease with which private investors can screen potential investments and do due diligence, potentially leading to portolio choices that support nature (Dasgupta, 2021).

In summary, the literature indicates firms and the financial sector have been slow to identify and account for nature's impact, and also the effect on nature from business and investment decisions. It remains to be seen how relatively new biodiversity risk management frameworks, such as the TNFDs as well as the Australian Government's Nature Repair Market will assist with identifying and communicating biodiversity risks to financial markets.

Behavioural Finance: The Emotional Landscape of Investment Decisions

Investment decisions may not solely be based on objective, dispassionate assessments of risk and return. A behavioural finance perspective highlights the role of investor emotions and less-rational decision-making (Polzin, 2017; Wüstenhagen & Menichetti, 2012). For example, investor behaviour can be influenced by a bias towards confirming past knowledge and a preference for past behaviours. This "path dependence" in uncertain or novel situations (like for-profit investment in nature repair) could mean investors will revert to the status quo, and potentially overlook opportunities for innovation (Pandey & Sane, 2019). For instance, they may perceive less risk in familiar territories such as mining and oil production than in less familiar domains like payments for ecosystem services. Improving access to information about biodiversity financing may be a simple but helpful intervention in this regard, as psychological studies have shown that mere repeated exposure to stimuli builds familiarity, which increases positive preferences towards those stimuli (Zajonc, 2001).

Individual beliefs, values-driven ideologies, industry norms, and vested interests can play a role in investment judgements and decisions. For example, an economic study of credit rating analysts showed that analysts who were not aligned with the current U.S. president's party were more likely to adjust corporate credit ratings downward. This negatively affected security prices and changed investor and firm decisions (Kempf & Tsoutsoura, 2018). There is also evidence that such psychological factors fuel scepticism about human created climate change and the actions needed to combat it. A psychological review by Hornsey and Lewandowsky (2022) showed that the strongest demographic predictor of climate scepticism is right-leaning political orientation. Additionally, personal values that prioritise the individual over the collective and endorse the free market are moderately correlated with rejecting climate science. In multinational studies, it can also be seen that the relationship between political conservatism and climate scepticism is strongest in countries where economic reliance on fossil fuels is highest (e.g., U.S. and Australia). Together this suggests that the extent to which 1. individuals, firms, and the private finance industry have right-leaning and free market values; and 2. they are in territories where the stakes of decarbonisation or nature repair are high, this determines how much psychological resistance there may be to a change in private finance norms or sweeping regulatory change.

Hornsey and Lewandowsky (2022) provide strategies for reducing climate scepticism. In Table 4, we give examples for how this could be applied to those in the finance industry who have vested interests or values that could act as barriers to investing in nature repair.

Table 4. Six strategies for reducing psychological barriers to investing in nature repair

1. Values-based framing: Where climate scepticism is predominantly seen among politically right-leaning individuals, messages promoting private finance for biodiversity may resonate more with conservative financiers if framed around values like national economic strength, free market innovation, or personal responsibility.
2. Focussing on co-benefits: Rather than focussing on environmental benefits of investments, emphasise benefits such as promoting jobs, stimulating innovation or improving public health
3. Using allies within trusted communities: People are more likely to be persuaded by people from groups they trust. Sceptical investors may be more likely to be persuaded by respected figures in the investment community.
4. Norms: People are more inclined to behave in certain ways when they believe that respected peers are doing the same. Because they tap into our social instincts, norms-based approaches can be effective regardless of political beliefs.
5. Communicating consensus: A strong scientific consensus—97% of climate scientists—supports that climate change is real and primarily driven by human activity. Effectively conveying this agreement can positively shape public attitudes, beliefs, and behaviours toward climate action.
6. Embedding: People tend to adopt behaviours they see practiced by others. Because they leverage our inherent social tendencies, norm-based strategies can be effective across the political spectrum.

Note. Table adapted from *A toolkit for understanding and addressing climate scepticism.* Hornsey and Lewandowsky (2022).

Industry Level Issues

Standardisation and Institutionalisation

In finance, standardisation refers to the process of establishing common standards or norms to ensure that financial transactions, instruments, and processes are uniform across different markets or sectors. When financial practices, markets, or products become established and accepted as formal and regulated entities within the financial system, this is referred to as institutionalisation. This can involve the creation of laws and regulations that formalise market practices, the establishment of regulatory

bodies to oversee financial activities, or the widespread adoption of certain financial instruments within the market.

For at least 10 years, there have been consistent calls for stronger standardisation of metrics and accounting systems in the realms of ecosystem services, green bonds, and international finance. This aids decision-making, builds stronger markets, and informs regulatory environments (Bishop, 2013; Jakle, 2013). Standardised metrics can help demonstrate the financial viability and positive outcomes of biodiveristy projects, which may draw more investors into these vehicles. Moreover, establishing standardised metrics and efficient payment mechanisms for ecosystem services can encourage more landowners to participate (Jakle, 2013).

The Dasgupta (2021) review recently found that there is still a lack of standardised data regarding financial investments in nature repair. This includes inconsistent definitions related to ESG that ensure consistent implementation across the financial sector. Being able to compare, analyse, and aggregate firm data on ESG investments would provide crucial information about returns and project impacts at an industry (or higher) level. Importantly it would also provide proof-of-concept, as a proven track record has been found to be crucial in attracting further private financial investment (Pandey & Sane, 2019), and so far there is shortage of market deal track records (UNEP, 2023).

Individual projects have specified units of biodiversity (see Wende et al., 2018 for examples of biodiversity units in the context of offsetting). In Australia, there are examples such as South Pole's EcoAustralia Credit Australian Biodiversity Unit (ABU) which aligns with state-level policies. They describe it as a:

"a South Pole-standardised unit that represents 1.5 m^2 of protected land delivering biodiversity outcomes for Australian flora and fauna species. ABUs are a division of the larger biodiversity units used on the state-based Native Vegetation Credit Registers, termed a Biodiversity Equivalence Unit (BEU) in Victoria and a Significant Environmental Benefit (SEB) in South Australia. The state-based units vary in land area based on complex evaluations of vegetation quality, habitat types and expected improvements on the site. The issued BEUs/SEBs are divided into standardised 1.5 m^2 ABUs by Vegetation Link, an independent third party, who manage the ABU registry to ensure transparent allocation to EcoAustralia™ buyers." (South Pole, 2024)

Economic analysis has shown that the slow growth of such standardised measures that define tradeable biodiversity units has challenged the growth of nature repair markets (Quesada, 2015). However, the Wallacea Trust (2023) has been working on a globally tradable biodiversity unit methodology. Quesada (2015) called for the establishment of a global registry which could provide standardisation, aid decision making, and increase market confidence for biodiversity credits. An example of improvements in this area is the S&P Global (2023) environmental registry. The registry allows for the management of all global carbon, water, and biodiversity credits in a centralised, market-based registry. This can be utilised

by project developers who list credits, buyers sourcing credits, or regulators and standards bodies. In Australia, one of the elements of the new Nature Repair Legislation is provision for a market to be created where biodiversity certificates can be created and traded. As mentioned earlier, certificates, and the details of the underlying projects on which they are based, will be publicly available on a register (C. Smith et al., 2023).

In other areas, the lack of standardisation of ecosystem service valuations, can lead to inconsistencies in reporting and monitoring, and subsequenly increased cost and risk profiles. Additionally, the criteria and standards for green bonds has been slow to become universally standardised, leading to investor skepticism and hesitancy (Jakle, 2013). Thus, continuing to demonstrate of financial viability and nature repair impact through standardisation will help draw more investors into these mechanisms and stimulate market growth.

Standardised metrics also have applications that extend far beyond the firm and local markets, such as enhancing state and national reports and inventories (Bishop, 2013). These data can help determine regulations and policies needed at a national level and also serve as benchmarks to inform national or global targets for biodiversity impact and investment quality. This is crucial, considering that inconsistent data on climate change, environmental degradation, and biodiversity finance standards have led to poor investment policies in the past. Thus, standardisation should help governments clearly define financial targets and environmental goals (Brears, 2022). Institutionalisation often follows standardisation, as clear measurement, targets, and standards can communicate the need for the development of institutions to enforce these standards. Therefore, an important initial step to improving nature repair finance is standardisation of market practices, for which the finance community shares a high degree of responsibility.

Knowledge Gaps

The finance sector may lack the knowledge or capacity to manage or invest in unfamiliar and complex programs such payments for ecosystem services or new biodiversity markets (Lambooy & Levashova, 2011; Polzin, 2017). While experts exist, there has historically been barriers to the exchange of information between the business sector and conservation experts (Lambooy & Levashova, 2011). Alliances between conservationists and businesses are sometimes hindered by language barriers (Zwieten, 2021). For example, what different entities count as “biodiversity expenditure” has generated considerable debate across Ireland (Morrison et al., 2021). In case studies of the Business and Biodiversity Offset Program, the meaning of terminologies (e.g., “mitigation”, “compensation”, “offsets”, “no net loss”, and “net gain”) varied between countries and stakeholders. This caused confusion and misunderstanding during discussions (Wende et al., 2018). Therefore, collaboration to garner agreement about common terms and language for finance and nature repair is crucial.

There seems a clear need for capacity development and knowledge-sharing, which may include training programs, information campaigns, and collaborations between financial institutions and experts (Arlaud et al., 2018; Chavan, 2020; Global Canopy, 2021; Polzin, 2017). However, Arlaud et al. (2018) point out that achieving buy-in from diverse stakeholders can be challenging. One example of successful collaboration is The Forum on Natural Capital Accounting for Better Policy Decisions in The Netherlands. This brings together natural capital accountants, policy experts, businesses, and government to discuss available data and future data needs for green recovery policies (Vardon et al., 2019; Waves, n.d.).

Mechanisms

We now move to understanding the barriers to scaling up the mechanisms for funding nature repair.

Biodiversity and Carbon Offset Markets

Biodiversity offsets are a financial mechanism that is generally "mandated by governments to compensate for unavoidable damage to biodiversity by a development project when the cause of damage proves difficult or impossible to eliminate" (Deutz et al., 2020, p. 21). This involves compensating for lost biodiversity and the funds being reinvested in projects that lead to no net-loss, or a net-gain, in biodiversity. They are part of government policies that place limits on the amount of biodiversity loss or carbon output projects or industries can produce. According to Deutz et al. (2020) 42 countries have offset policies in various stages of maturity. If scaled effectively and if policies are *enforced*, this mechanism has the potential to have the second largest growth and the largest total private contribution of funds to nature repair by 2030 at 36% per year.

Biodiversity offset projects face coordination challenges. Nature repair projects need to obtain the informed consent of many stakeholders (communities, landowners etc.) who may have to accept trade-offs or uncertainty. For example, there is also uncertainty from service providers about whether financing will be available for the full duration of a project (Githiru et al., 2015; Zwieten, 2021).

Measurement issues also hamper offsetting efforts. In a local case study of biodiversity offset schemes for Australian forests, it was found that measuring the effectiveness of the scheme was challenging (Ferguson et al., 2016). This was related to inconsistent or insufficient measurement of equivalence. For example, if a certain area of forest was cleared, an equivalent area needed to be conserved or restored elsewhere. It also related to additionality, in that the scheme needed to show the environmental benefits were additional to the normal course of events. Several strategies for tracking these factors, and making projects more attractive to private investors, have been proposed and implemented in some cases. For example, national or state biodiversity funds or initiatives can support development of projects, measures, and efforts to certify that certain areas are being managed. As noted earlier, the Australian government has recently made inroads to establishing a biodiversity market, including the

National Environmental Standards and the Nature Repair Act (2023) which provide the framework for a "world-first national, voluntary, legislated Nature Repair Market" (Australian Government Clean Energy Regulator, 2023b).

Risk for private investors may also be reduced by requiring offsets to be banked into savings accounts, where trade is restricted until benefits are proven. But this could be restricting for landowners who do the conservation work, as they might have to wait a long time for any rewards, unless the government covers the risks (Ferguson et al., 2016). This highlights the complexities of attempting to please all sides of biodiversity offset transactions.

Biodiversity repair efforts can also form part of the carbon credit trading market because nature repair contributes to carbon emission reduction. This mechanism, also called *Nature-Based Solutions*, has one of the largest estimated growth potentials (29 – 31-fold increase) and could make a moderate overall contribution to funding by 2030 (7 – 8%). Similar to biodiversity offsets, credits can be voluntarily purchased by organisations or projects to offset emissions caused by biodiversity loss or disruption that are difficult or impossible to reduce. Consequently, nature repair programs that are shown to reduce the net effect of the emissions are then funded through the sale of these carbon credits. Conversely, organisations or projects which work to reduce carbon emissions (related to biodiversity, for our context) can be issued carbon credits for units of carbon that have successfully abated. Governments may buy these credits, or they may be sold through exchanges or on secondary markets (Flammer et al., 2025).

While several countries have immature carbon emissions trading schemes, China's is set to be the largest moving forward. Economic analysis has shown that the regional pilot scheme from 2009 – 2015 lead to a 16.7% reduction in total emissions. Overall, there was no significant change in output and export due to the program. At a finer-grained level, employment and capital input was negatively affected and productivity was positively affected (Cui et al., 2021). In Australia and other countries such as the U.S., full roll out of a carbon and biodiversity trading markets have been hampered by political disagreement. However, the Carbon Farming Initiative Act 2011 and the Carbon Farming Initiative Rule 2015 enabled the Australian Government Clean Energy Regulator (2023a) to establish the Australian Carbon Credit Units Scheme. This has allowed the issuing of carbon units that could be sold to the Government or to private investors. Australia's biodiversity offsets schemes are at the State level, for example the somewhat specialised (voluntary) Reef Credit Scheme in Queensland.

Green Financial Instruments

Nature-related "green" financial products and instruments are perhaps the most promising intermediate-timeframe solution for private "impact" investing in nature repair (Karolyi & Tobin-de la Puente, 2023). These instruments include equity (e.g., shares, units in trusts or funds, capital investment in/ownership of firms or projects); debt (e.g., bonds, loans); and convertible securities (e.g., debt in the form of loans

given to new projects which can be converted into equity after a set period, often used by angel investors or venture capitalists).

As an example of a debt instrument, Karolyi and Tobin-de la Puente (2023) describe a nature-related bond. Credit Suisse served as the general partner or structurer of a $364 million placement of Belize's "Blue Bonds" in 2021. The bond aims at restoring Belize's marine environment and was given a Moody's AA rating, which is the second highest bond quality rating. It was also deemed a very low credit risk due to assurances on political risk from the U.S. International Development Finance Corporation Office of Structured Finance & Insurance, as well as The Nature Conservancy's confirmation of the bond's conservation goals. This example highlights the importance of collaboration between conservationists, governments, supporting de-risking organisations, and private investors to ensure the success of these financial instruments. Table 5 lists a number of other biodiversity-related bonds.

The Australian green bond market, founded in 2014, is also growing rapidly. In order of volume, bonds are issued by state treasuries (for projects such as Melbourne Water's Western Treatment Plant); financial corporations such as banks; non-resident organisations known as "kangaroo issuers" (may be "supranational" issuers such as the European Union); and non-financial corporations (Schwartz, 2023). The Australian Government issued the first Federal Green Treasury Bond in June 2024 and currently has $9 billion of green Treasury Bonds on issue (Australian Office of Financial Management, 2025).

Table 5. Examples of biodiversity-relevant bonds

Bond Type	Company	Finance
Green bond	Klabin, Brazilian paper company	Claims USD 53 million for Sustainable Forest Management (SFM) (forestry); USD 61.3 million SFM (certification); USD 5.6 million (native forests) USD 2.6 million (ecological parks)
Green bond	Stora Enso, Finland	Published a Green Bond Framework which includes projects related to Forest Stewardship Council and Programme for the Endorsement of Forest Certification-certified forests among its eligible categories, signalling its intention to enter the market
Green bond	France (government)	16% of EUR 9.7 billion for biodiversity conservation (outstanding at the end of 2017) Sovereign Green OAT, i.e. EUR 1.55 billion
Environmental impact bond	Louisiana Coastal Master Plan (project)	USD 40 million for coastal-protection investment
Environmental impact bond	DC Water	USD 25 million for building storm-water run-off infrastructure
Social and sustainable bond	Danone	EUR 300 million partly for “sustainable” agriculture
Sustainable bond	PT Royal Lestari Utama (Barito Pacific and Michelin)	USD 95 million “sustainable” rubber-joint venture in Indonesia
Sustainability awareness bond	European Investment Bank (EIB)	EUR 500 million for sustainable water projects

Note. Table reproduced from OECD (2019) *Biodiversity: Finance and the economic and business case for action.* https://www.oecd.org/en/publications/biodiversity-finance-and-the-economic-and-business-case-for-action_a3147942-en.html

The green bond market is diverse. This heterogeneity comes from a broad range of issuers, numerous potential categories for suitable projects, and a diverse array of criteria and potential metrics for evaluating the environmental impact of the bond. This suggests there is complexity in formulating effective standards for such bond markets (Bartels et al., 2016). If there are too many of these investment types, investors may struggle to understand which investments are most relevant to biodiversity and how best to measure their impact (Pandey & Sane, 2019). Further, there is a lack of standardisation or institutionalisation in these markets (Christiansen et al., 2025), which cause barriers to private investment. Bartels et al. (2016) suggest it is important for all market actors to improve their understanding of green bonds; proper dialogue and coordination is needed between all actors to develop standards; and governance institutions need to be equipped to endorse and apply standards once developed (e.g., understanding total financial and environmental value of a green bond). Furthermore, Christiansen et al. (2025) argue that only a very small proportion of green bonds proceeds, somewhere between 3 and 5%, are used to target biodiversity outcomes.

Regarding examples of equity, private investors can buy shares in many companies with green mandates or goals. On a larger scale, ethical and green investment funds are available to be invested in. In the past five years, the number of new sustainable funds being launched in Australia has doubled compared to the previous five years. By volume, this includes mutual funds, super funds, and exchange traded funds. However, many sustainable funds include biodiversity as one of a number of environmentally- and socially- related issues. Indeed, MSCI (2024) identified only 24 ‘pure play’ biodiversity funds –defined as those that explicitly incorporate biodiversity within their names or investment strategies. All of these funds were domiciled in Europe. Table 6 provides some examples of pure-play biodiversity funds and the types of investments they hold.

Table 6. Examples of pure-play biodiversity equity funds

Fund name	Inception	Fund size (millions of USD)	Investment mandate
AXA IM ACT Biodiversity Equity ETF	September 2022	407	Sustainable investments including companies that reduce or limit human impacts on biodiversity
AXA WF Biodiversity Fund	April 2022	214.4	Companies whose operations are aligned with one or more SDGs and contribute to the preservation or restoration of biodiversity
BNP Paribas Ecosystem Restoration Fund	June 2021	35.9	Companies involved in ecosystem and natural capital restoration and preservation.
Lombard Odier Planetary Transition Fund	March 2020	291.8	Companies that will benefit from regulatory and innovative shifts addressing planetary boundaries, including climate change.
Ossiam Food for Biodiversity ETF	December 2020	1.6	Reducing the impact on biodiversity in the food and agriculture sectors
UBAM Biodiversity Restoration Fund	September 2021	50	Companies that themselves or their supply chains are reducing biodiversity loss

Ecosystem Services and Natural Infrastructure

Payments for ecosystem services are “Voluntary financial flows between service users and providers conditional on agreed rules of resource.” (UNEP, 2023, p. 9). The concept of ecosystems as a service derives from the idea of indirect use value, as ecosystems often support and safeguard economic activity. As understanding of the synergies between business and the environment grows, so too do opportunities for custodians, owners, or managers of ecosystems (e.g., farmers or landowners) to sell the sustainable management of these resources as a service to businesses who benefit from them. For example, eco-tourism relies on the health of ecosystems, and organic food production relies on the land and crops being free of synthetic chemicals and fertilisers.

Table 7. Finance mobilised by ten large Payment for Ecosystem Service programmes

Country	Name of programme	Year start	Objectives	Finance mobilised
Australia	Environmental Stewardship Programme	2007	Biodiversity conservation, habitat restoration, nationally threatened species	USD 5.19 million per year (2007-17 average)
Brazil	Green Grants programme (Bolsa Verde)	2011	Sustainable use of protected areas, improved environmental management and poverty reduction	USD 33.8 million (2011-13 average)
China	Sloping Land Conversion Programme (Grain for Green)	1999	Reducing soil and water erosion by targeting and converting marginal farmland to forest or grassland	USD 4.9 billion per year (USD 69 billion by end of 2014)
China	Natural Forest Conservation Programme	1998	Protection and restoration of natural forests	USD 4.7 billion in 2015
Costa Rica	Pago por Servicios Ambientales	1996	Carbon storage, hydrological services, protection of biodiversity and landscapes	USD 42.4 million in 2012
Ecuador	*Socio Bosque*	2008	Forest conservation, carbon storage	USD 7.9 million in 2015
Mexico	Biodiversity PES	2003	Forest conservation, biodiversity conservation	USD 22.3 million in 2016
Mexico	Payments for Hydrological Services	2003	Forest conservation, hydrological services	USD 28.2 million in 2016
United States	Conservation Reserve Programme	1985	Wildlife-habitat benefits, water-quality benefits, on-farm soil-retention benefits	USD 1.8 billion in 2017
United States	Catskills	1997	Hydrological services, habitat restoration, environmentally friendly farming	USD 167 million per year

Note. Table reproduced from OECD (2019) *Biodiversity: Finance and the economic and business case for action.* https://www.oecd.org/en/publications/biodiversity-finance-and-the-economic-and-business-case-for-action_a3147942-en.html.

Watersheds are also a critical natural infrastructure for businesses and communities. While Deutz et al. (2020) classified payments for ecosystem services as a Green Financial Product, the UNEP (2022) estimated payments for ecosystem services as a separate mechanism, contributing around 2% to current private funding. It is estimated there are about 300 payments for ecosystem services schemes globally. Table 7 lists 10 large schemes.

There are difficulties in valuing payments for ecosystem services. First, it is challenging to motivate private investors to invest in ecosystem services or natural infrastructure when they have been accustomed to receiving the benefits of these services for free. Additionally, in typical market transactions, prices indicate the value of goods and services. However, ecosystem services are not traded in financial markets and so their value is generally not as evident to private investors. National economic accounting frameworks like gross domestic product do not account for the value of ecosystem services due to their absence in market exchanges, thereby failing to represent the genuine economic contribution of these services accurately (Bishop & Hill, 2014).

Because ecosystem services programmes have generally operated at a local level, this has limited their reach and funding potential (Bishop & Hill, 2014). These challenges have led to payments for ecosystem services being perceived as risky, less profitable, and generally viewed as an add-on to an underlying asset rather than a primary investment (e.g., coupled with purchases of land or traditional commodities; Parker & Cranford, 2010). Increasingly, exchanges are being established for payments for ecosystem services. For example, DCCEEW's Platform for Land and Nature Repair (PLANR) allows landholders to assess and plan environmental projects, their carbon sequestration potential, and then connect with potential buyers of their services through an online marketplace.

Other potential areas of growth regarding the ecosystem as a service includes the protection of natural infrastructure such as watersheds. This includes the protection and restoration of natural landscapes to lessen the impacts of weather and to provide other important human benefits (Environmental Defence Fund, n.d.). While currently natural infrastructure such as watersheds are almost entirely publicly funded, there are potential opportunities for private investment. This includes user-driven investments which could include payments for ecosystem services related to watersheds, or water quality offset trading (Deutz et al., 2020).

Bishop and Hill (2014) show that most payments for ecosystem services initiatives operate at a national or subnational level and Bigger et al. (2021) suggest that "Private investment in biodiversity-enhancing projects is small, geographically constrained, and in a perpetual state of "proof of concept"" (p. 193). A global mechanism to recognise the value of ecosystem services could potentially increase the size and scope of projects and generate enough interest from private investors. Though such a mechanism may run into significant issues with standardisation. This is in part due to the diverisity of natural systems and the societies in which they exist, and thus the diversity of schemes that need to be developed to manage these. Given this, it is unlikely that a common biophysical metric could be defined, and this

leads to difficulties in standardising approaches to service selection, funding, and measuring success. Because habitats lie across national borders, scaling to a global level would require widespread and sustained support from governments, communities, businesses, funders, and other stakleholders. For example, river systems often cross several international borders. In these cases, there may be problems with being able to define and measure biodiversity-related services across these differring environments. Geopolitically, it could be difficult to develop a standardised trading system, to manage different stakholders, and to obtain buyin from different governments (Bishop & Hill, 2014).

Also, currently, there is a lack of a global exchange for potential buyers and suppliers to find payments for eccosystem services, register transactions, and monitor prices and trading volumes (Bishop & Hill, 2014). However, the OECD Policy Instruments for the Environment database has recently added biodiversity-relevant instruments including payments for ecosystem services and biodiversity offsets. This database tracks finance and revenue related to biodiversity-related economic instruments (OECD, n.d.). This is an important step forward in measuring the impact of payments for ecosystem services and providing avenues for information-sharing.

Finally, there may be opportunities to exploit synergies by bundling different ecosystem services and blended finance solutions. This has been done in the past with mechanisms like REDD1: Reducing Emissions from Deforestation and Forest Degradation (Bishop & Hill, 2014). Bundling is discussed under “Market Pricing” above and blended finance is discussed under “Supporting Organisations and Blended Finance” below.

Sustainable Supply Chains

Sustainable supply chains, though one of the largest categories of private investment currently, shows small growth potential and overall contribution to total finance by 2030. This may be because it represents a mechanism which has already received attention from private firms in response to consumer pressure and ESG mandates. As a result, there have been significant corporate pledges to eliminate deforestation from supply chains over the last few years. However, the UNEP (2023) provides several recommendations for improving supply chains including: improving corporate policies and internal standards; utilising sustainability standards and certifications; corporate funding of green improvements within their supply chains (e.g., developing production standards and ability to track impacts from producer to consumer); and an immediate focus on soy, palm oil, cattle, and forest products.

Supporting Organisations and Blended Finance

Supporting organisations act as an important source of funding for biodiversity. This may include offering seed funding, often in the form of grants or loans, or other resources in the earlier phases of project development. This may include funding or other resources for research and pilot projects to provide

proof-of-concept and to help projects become market-ready. Supporting organisations could be local or global investment funds; development banks (e.g., the World Bank) or agencies (the Australian Agency for International Development, U.S. Agency for International Development, the Swedish International Development Agency); and trusts (e.g., the Global Environment Facility). Supporting organisations are often funded through multilateral agreements. For our context, they have the purpose of funding and developing projects with less focus on a financial return and more focus on biodiversity and social outcomes (Flammer et al., 2025).

These supporting institutions can play a pivotal role in attracting private investment to projects where it may be too risky to invest without them. In the case of blended finance arrangements, supporting organisations may partner with governments and private investors to fund and develop large-scale biodiversity projects. For example, they may act as coordinators or *general partners* to coordinate the creation of new investment funds to fund specific projects. Or they may provide initial funds as *junior partners*. The advantage here is that private investors, usually *senior partners*, will tend to get paid first, relative to other investors (Flammer et al., 2025). At the project level, supporting organisations help design and prepare funds, provide technical assistance, provide guarantees or risk insurance, and concessional finance at below market rates (Earth Security, 2021). For example, the World Bank Multilateral Investment Guarantee Agency (n.d.) provides political risk insurance and credit enhancement for cross-border private sector investors and lenders. This protects projects and private investments against losses related to breach of contract, currency inconvertibility and transfer restriction, expropriation, war and civil disturbance, and non-honouring of financial obligations. This helps de-risk projects for private investors.

It has been highlighted in research, books, and government reviews that blended finance is integral to incentivising private investment. However, challenges arise from working in the early stages of projects. This includes high failure rates, issues with aggregating disparate projects, and a lack of technical assistance and capacity in some less-developed regions (Brears, 2022; Dasgupta, 2021; Wüstenhagen & Menichetti, 2012).

Again, issues of consistent measurement arise with supporting organisations involved in complex, often multilateral, biodiversity projects. For example, the Global Environment Facility is the chief financial mechanism for the Convention on Biological Diversity and is a trust that provides grants, blended financing, and policy support to help developing countries address their environmental priorities and adhere to international environmental conventions. A study of this initiative noted difficulties with comparing data across different projects or funding sources (Aguilar, 2015). The study found that a lack of transparency reduced investor confidence because of a lack of consistent labelling. In that different donors or organisations used different criteria to label funding as biodiversity related. Another accounting issue was that often projects had multiple objectives, and it could be challenging to account for the portion of funding specifically dedicated to biodiversity. This can lead to issues such as double counting, which could overestimate funds dedicated to biodiversity, and can mislead investors as to the

actual financial commitments or nature impacts and to a misallocation of resources (Aguilar, 2015). Thus, developing shared labelling and accounting practices would be a positive step towards standardisation and increasing private investor confidence.

Policy and Governance

This section addresses how government policy mechanisms can be used to encourage private investment in nature repair.

Domestic Public Budgets and Tax Policy

As seen in Table 1, domestic budgets and tax policy represent a large proportion of current and estimated future nature repair funding. As this area is already more mature than other mechanisms, the growth rate is not expected to be as high as some other mechanisms. Apart from funding nature repair for the public good, governments have an important role to play in redirecting private investment away from harmful practices, particularly in the near-term, and reducing the amount of funding needed for nature repair. In many countries, subsidies that are given to the agriculture, fishing, and forestry industries incentivise behaviours that are harmful to nature (e.g., tax breaks, fuel rebates, and accelerated depreciation on farm equipment may incentivise land clearing). Therefore, eliminating or reforming these types of incentives could reduce the need for funding of nature repair by up to US$542 billion per year (Deutz et al., 2020; Karolyi & Tobin-de la Puente, 2023).

The OECD has developed tools and guidance for how to identify environmentally harmful subsidies (Matthews & Karousakis, 2022). This involves first scoping (i.e., defining which subsidies should be included in the test of harm), screening (i.e., finer-grained sorting), data gathering, and assessment of the extent of harm to biodiversity. In the last two points, the OECD acknowledges that generating accurate quantitative measures of harm, given the complexity of possible benefits and harms, is probably not possible in many cases. They instead suggest a more qualitative “traffic light” system that can categorise harms as *low, medium,* or *high*.

An Australian Government Department of Agriculture, Fisheries, and Forestry report suggests that for harmful subsidy reform to happen sustainably for all stakeholders, domestic subsidies need to be removed in step with multilateral efforts to remove barriers to global trade (e.g., food tariffs). Together this would not only reduce carbon emissions and protect biodiversity, but could even improve food production and prices (Fell et al., 2022). This suggests that for domestic subsidy removal to be effective and not be harmful to private industry, multilateral alignment in policy reform is needed.

Apart from harmful subsidy reform, it is clear that public funding and tax reforms can help projects garner more support from private finance, particularly in the area of research and innovation. An article on policy barriers and policy implementation by Polzin (2017) provided reccomendations for which

policy responses are necessary to facilitate the financing of low-carbon innovation. These may be factors that are also relevent to biodiversity innovation. Overall policy recommendations included: more public-private research; development and demonstration (RD&D) partnerships between government, research institutions, and private companies; RD&D tax-system reform (e.g., tax credits); advocacy coalitions with financiers; mission-driven public investments; and stimulus to increase demand for cleaner energy products or services. Some of these factors are discussed below.

Setting and Communicating Targets

The United Nations (2023) has determined that governments lack critical targets to boost ambition from the finance sector, as many financial funds are not in alignment with the legally binding international treaty on climate change, the Paris Agreement. Setting and communicating targets is a key part of this process because it signals the values of a society, shows commitment to those values, generates public pressure on stakeholders to meet those standards, informs policy decisions, and acts as a set of shared goals that can foster coordinated efforts by various stakeholders (Pandey & Sane, 2019; Puydarrieux & Mésenge, 2018).

One of the important roles of settng and communicating targets is to show a commitment to certain values. Traditionally, there has been inconsistent political and public awareness or recognition of the diverse value of ecosystems (Bishop et al., 2009). Without a more comprehensive understanding of the trade-offs between business, the environment, and the economy, varied stakeholders cannot efficiently understand or adjust their activities (Vardon et al., 2019). Also, governments, the business world, and conservationists have historically not seen biodiversity as a *business asset* to be conserved and managed, thereby limiting the attractiveness of nature repair to private investors (Lambooy & Levashova, 2011). Another potential barrier is the lack of clear identification and exclusion of unequivocally unsustainable activities, like deforestation (Kedward et al., 2020.)

Beyond a need to more fully agree on the problems at hand, a barrier to setting effective targets is agreeing on the exact amount of funding required by private investors to close the nature repair finance gap. As has been pointed out in this review, unreliable methods to quantify financing data in the realm of biodiversity is part of the problem (Zwieten, 2021). While Target 19 of the Kunming-Montreal Global Biodiversity Framework sets broad goals for financing nature repair, such as “Leveraging private finance, promoting blended finance, implementing strategies for raising new and additional resources, and encouraging the private sector to invest in biodiversity, including through impact funds and other instruments”, the targets need to be further translated into more specific goals and thresholds for investors and investees (Principles for Responsible Investment, 2023).

Given the unique complexity of nature and ecosystems, and the broad range of stakeholders involved in its maintenance and repair, there is ambiguity about the rights and responsibilities of these stakeholders. This hinders goalsetting and scalability (Brears, 2022). Therefore, specific goals need to

be set around roles and responsibilities, particularly in the context of payments for ecosystems services. The success of financial mechanisms has been shown to be influenced by the governance of ecosystems. Often, the rights of local, poorer stakeholders are not factored into goals and decision-making (Bishop et al., 2009). In a study of conservation finance initiatives, there were significant uncertainties and requests for clarification about policies concerning the use of public lands for conservation banking and habitat credit exchanges. Thus, clearer policy frameworks and guidelines were needed to address these ambiguities and make conservation on public lands more transparent and effective (Jakle, 2013). In this regard, authors have pointed to the importance of better accountability measures at a national level to determine who is responsible (Vardon et al., 2019), and to use business-friendly language to help delineate business roles and responsibilities (T. W. Smith et al., 2020).

Mandates and Regulation

It is also clear from the report that relying solely on voluntary targets from the private investment community will be insufficient. This is because economic entities prioritise their own private interests over biodiversity in most cases, there is a failure to internalise the externalities of nature disrepair, and there is a perception of a lack of profitability or high risk in nature repair investments (Arlaud et al., 2018). Policy that reduces risk for private investors may help incentivise private investment (Principles for Responsible Investment, 2023).

Globally, there is a lack of regulation or requirement to disclose nature-related risk, (UNEP, 2023) or formal interpretations from securities and exchange regulators about the materiality of nature-related risk in company filings. This lack of clarity can hinder businesses from understanding the importance of nature disrepair to their opperations and bottom line (Bishop, 2013). As discussed in the risk management section, disclosure of this kind could act as an incentive for firms to reduce their impact on nature, due to scrutiny from investors and customers. The Taskforce on Nature-related Financial Disclosures (2023b) has recently provided guidance on how volunrary disclsoure may be conducted, which is a step towards standardisation in this regard, and over 500 companies globally have committed to disclosure on nature-related risks through the TNFDs.

A pressing need is proper government intervention to internalise externalities related to nature-based risks. This includes both risk *to* businesses and investments and risk *from* business and investment decisons. Without intervention, the prices and allocation of funds in the financial markets will not reflect the true costs and benefits to society. For example, if the costs of externalities like pollution *from* business activities are not reflected in government regulation, these costs are unlikely to be incorporated into market prices, leading to investment in ventures that appear profitable, but may actually be harmful to the environment. Therefore, fiscal measures (e.g., taxes), standards, regulations, and market mechanisms are needed to internalise aspects of investment not reflected in markets (Dasgupta, 2021). In terms of risks *to* business, there is also a need to mandate disclosure of systemic

environmental risks. This transparency will help investors better assess portfolio risk exposure (Global Canopy, 2021; Pandey & Sane, 2019). Having clear legal mandates will also help countries to create a conducive environment for mechanisms such as biodiversity offsetting, thereby attracting more private financial investments (Wende et al., 2018).

It will also be important to make informed decisions about how to implement and enforce such mandates. Without a system of legal liabilities for environmental damages, there is little incentive for businesses or investors to change their habits (Bishop & Hill, 2014). However, changes need to be mindful of the fact that people and business entitites are used to getting ecosystem services for free, and there is a lack of confidence about the profitability and risks associated with investment. Therefore mandates should be implemented and enforced with this in mind, as punitive measures for non-compliance can sometimes undermine market integrity and deter investment (Quesada, 2015). Given this, it will be important to complement mandates with voluntary principles and guidelines (Pandey & Sane, 2019).

While many of these approaches to policy making imply the better use of quantitative data to aid decision making, Kedward et al. (2020) have suggested an alternative approach. Instead of focusing on only plausible scenarios based on mathematical models, policy makers should use precautionary approaches that focus on worst-case scenarios and use discretion, experience, heuristics, and general direction-setting to construct policies in order to address worst-case scenarios. One example may be the identification and exclusion of clearly unsustainable activities like deforestation from asset purchase programmes and collateral operations. While it is unlikely the private finance community will accept *only* heuristic decision making over quantitative data, it points to the fact that proactive policy decisions may benefit from diverse ways of approaching the problem.

Other Policy Initiatives for Investment

Along with mandates, there need to be more robust approaches to government initiatives to incentivise private investment in nature repair. Governments play an indispensable role in funding and coordinating investments required for nature repair. This is, in part, because of the risks associated with smaller projects and less mature markets, and the private sector's dependence on government-funded research and development in early phases of new technologies and markets (Brears, 2022; Dasgupta, 2021).

The UK Dasgupta (2021) review found insufficient long-term government investment for nature repair which has caused missed opportunities for blended financing. Potentially this is because of competing political demands or a lack of policy and regulation. However, the review points to the importance of developing efficient project pipelines for blended finance, from initial feasibility, to planning and implementation, to monitoring and reporting. Attracting varied forms of private investor types at the most appropriate stage of a project's maturity is also important (Wüstenhagen & Menichetti, 2012). One

example is the EcoEnterprises Fund, which offers venture capital to agribusiness startups that protect and restore biodiversity, to help them scale their projects (Dasgupta, 2021).

There have been calls for governments and fnancial institutions to develop better indicators (e.g., essential biological variables, global biodiversity indicators, and scalable composite indicators) that encapsulate the entire biodiversity management process. This includes indicators that capture initial resources allocated, actions taken, and tangible outcomes in biodiversity and profitability (Addison et al., 2019). Similarly, it is important to adopt a rigorous approach to instrument design that aligns with clear policies, and that are percieved as credibile and predictable by private investors, as Polzin (2017) recognises the importance of aligning with investor expectations to aid uptake.

Indicators that can serve as international comparisons are also important to encourage participation by private investors. For example, a strong gross domestic product growth rate can attract domestic and foreign investment. However, current economic growth models often neglect natural capital. If a country relies on coal or other materials for growth, this is usually interpreted as a rise in productivity. However, given the dependency on biodiversity for productivity, not accounting for this interdependency paints a simplistic picture, and may lead to harmful policy decisions and continued ‘brown’ investments. Therefore, it is important to integrate biodiversity into national accounts. Initiatives like the OECD's greening productivity measurement is an environmentally-adjusted multifactor productivity measure which can aid as a nation-level comparison, incentivise greener policies and regulation, and motivate decision-making for private investors (Dasgupta, 2021; OECD, 2023; Vardon et al., 2019).

Globally, the United Nations Development Fund’s Biodiversity Finance Initiative works with 40 countries to develop sustainable accounting and finance plans. They focus on country-level assessments and developing guidance on how to use finance mechanisms or instruments (e.g., taxes and subsidies) to deliver sustainability goals. Their aim is to ‘lay the groundwork for full institutionalization of the biodiversity finance plan’ (Arlaud et al., 2018). This seems a step in the right direction to improve accountability, transparency, and capacity. Locally, the Australian government’s Department of Climate Change, Energy, the Environment and Water (2023) is developing a ‘world-first’ nature repair market with the aim of rewarding landholders who restore and protect nature (i.e., payments for ecosystem services) and provide streamlined options for businesses to invest in nature. These serve as positives examples of policy development and global collaboration.

Geopolitical Issues

Despite positve signs of global collaboration, several geopolitical issues are also important to consider. Even with more global collaboration, there remain inneficiencies with spending on nature repair projects. Poor returns or negative press about the effectiveness of projects could reduce investor confidence. Zwieten (2021) found that the distribution of funds do not consistently align with conservation needs. For instance, financing is often allocated close to the financier's location, rather than on the basis of

genuine need. Investors might lean towards investing in areas with a proven track record or existing infrastructure and institutional backing to reduce risk. National donors may favor countries where they have strategic geopolitical interests. This means that sometimes financial investment does not reach regions that most need it, and therefore projects might be less effective. However, businesses and investors can have well-founded scepticism regarding whether increased financial investments will lead to improved ecosystem management outcomes. Projects are often in countries with weak goverance or regulation (Lambooy & Levashova, 2011). A country's institutional environment, including its legal system and the presence of corruption, may affect perceptions of how effectively investments can be managed (Bishop et al., 2009). Therefore, there is a need to ensure transparency and address (or insure against) corruption. Indicators such as Transparency International's Corruption Perception Index may aid in private investors' risk assessment (Dasgupta, 2021). It also highlights the importance of accurate reporting on project outcomes, and on-going investment in monitoring, evaluation, and reporting. Supporting organisations outlined previously can help in a development capacity or to insure against these risks.

In summary, policy plays a critical role in incentivising private investment in nature repair. Governments will need to set clearer targets and communicate these targets well to attract private investment. However, political consensus on understanding ecosystems' value and the roles and responsibilities for funding biodiversity is sometimes unclear. Unreliable data may further complicate progress. Mandating and incentivising regulations to address nature-related risks can drive private sector funding as well as initiatives like government-led investments, tax reforms, and demand generation for eco-friendly products. Clearly, a combined effort of public and private sectors is needed to foster investment in nature repair and sustainable practices, as well as collaboration and diplomacy at a global level.

Conclusion

In conclusion, the barriers to private investment are varied, but seem to group around three main themes: 1. investment attractiveness, 2. knowledge and information, and 3. policy factors. The reluctance to invest heavily in nature repair for profit stems from a complex interplay of actual and perceived high risk and low returns, a lack of standardised, measurable impact indicators, and a lack of policy targets that align with global climate and biodiversity commitments.

Despite expressed investor interest in nature repair, private investors expect capital returns on their investments, however nature repair markets have remained limited. This is particularly due to the barriers to being able to reflect the value of nature repair in market prices. The complexity of ecosystems and ecosystem services compounds this issue. Investors are not just influenced by the direct profitability of nature repair projects, but also by their broader understanding of risk. This includes regulatory stability, transparency, and the likelihood of long-term success. These aspects may be informed by cognitive biases and behavioural factors, such as the tendency to favour short-term gains over long-

term sustainability, or to underestimate the risks associated with biodiversity loss to portfolios or businesses within portfolios. Because of these factors, nature repair investments are often considered high risk with low return.

Policy measures can play a pivotal role in reshaping these perceptions by setting clear targets, incentivising, or mandating participation by private investors, and fostering a market environment where nature repair investments are as transparent and standardised as traditional assets.

Ultimately, bridging the gap between the current state of private investment in biodiversity and the desired influx of capital requires a concerted effort. This will include efforts to align financial mechanisms and instruments with conservation needs, provide clear and reliable mechanisms and instruments, and enforce policy frameworks that support and promote sustainable financial flows. To achieve this alignment much collaboration is needed, from target-setting to political advocacy, from national and local initiatives to industry capacity-building. Such collaboration will not only help to enhance the attractiveness and profitability of nature repair projects but also ensure that investments contribute effectively to the global endeavour of biodiversity preservation and restoration.

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