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Chapter 12 in Forests and People in Global Transformational Change

Transforming Forest Finance and Investment

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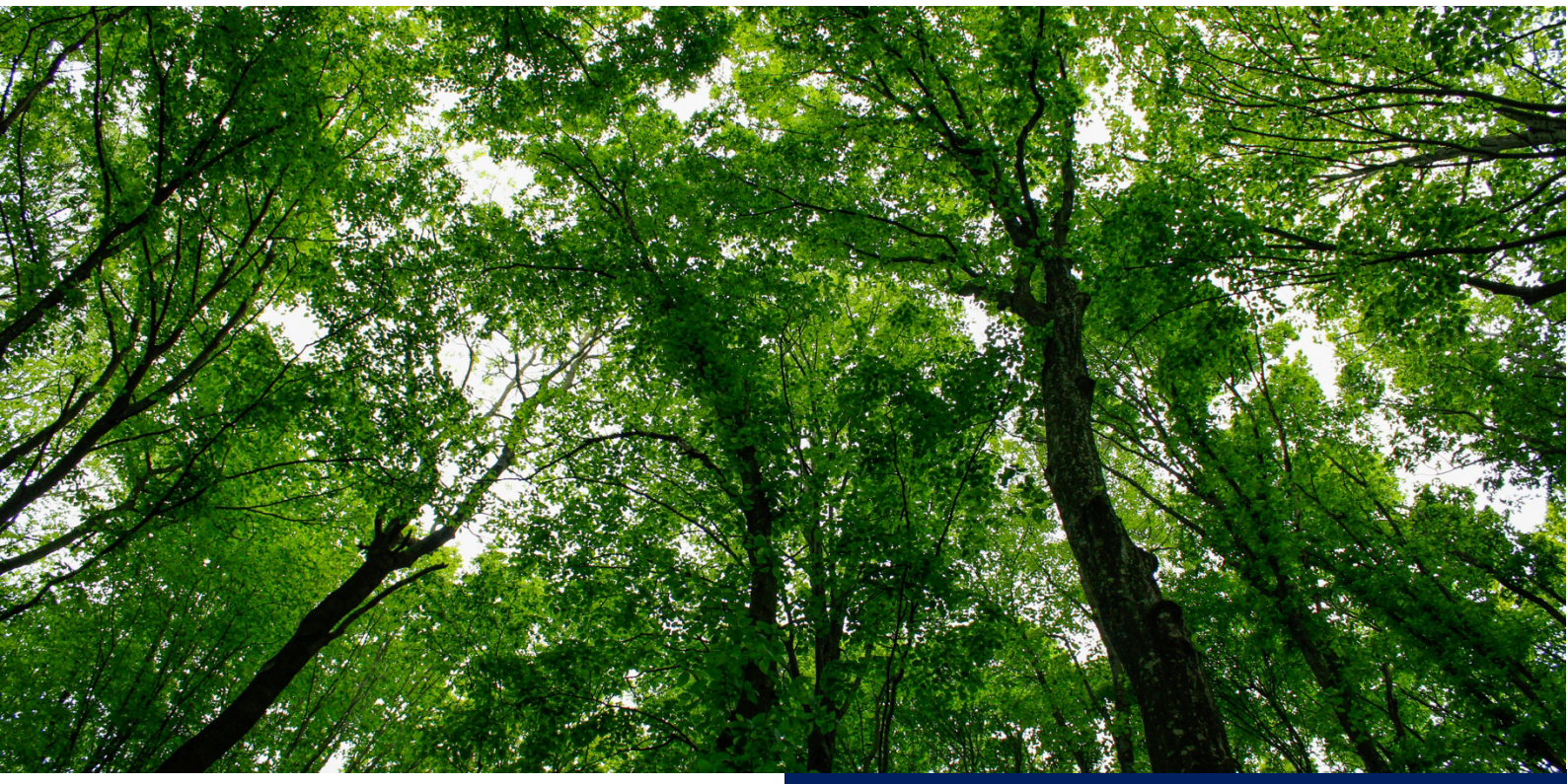

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Working paper

Transforming Forest Finance and Investment

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Abstract

Finance, economics and forestry have a long-standing relationship. Historically, academics have taken a straightforward anthropocentric approach; primarily interested in maximising sustainable yield, more recently they have also focused on eco-services. Reproducing this market logic of current forest finance is detrimental to ecological integrity. This chapter explores how private finance can transform into an ecocentric approach. Such a transformation requires finance to be guided by explicit public objectives and system-level directionality rather than project-level risk–return optimisation. An ecocentric approach building on Nature-based Solutions starts with the objective of regeneration. While private finance in its current form has limited potential, a transformed financial system could complement public forest finance. We develop four principles for good stewardship and seven steps for transformative finance.

Keywords: Forest regeneration, Common goods, Transformative finance, Impact investment, Stewardship.

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12.1 Introduction

Forests are central to addressing the intertwined crises of climate change, biodiversity loss and ecosystem degradation. Yet the financial systems that increasingly shape land use and resource allocation remain poorly aligned with the ecological dynamics of forests. While forests provide a wide range of public and common goods, financial decision-making continues to prioritise short-term, extractive returns and simplified metrics such as timber yield or carbon storage. This creates a structural mismatch: the ecological functions of forests depend on long time horizons, diversity and regeneration, whereas finance is organised around liquidity, risk-adjusted returns and monetisable outputs.

In response to ecosystem degradation, there has been a growing push to mobilise private capital for forest conservation and restoration, particularly through Nature-based Solutions (NbS) and related financial instruments. Although these developments have expanded the scope of forest finance, they often reproduce existing market logics, focusing on investability rather than ecological integrity. As a result, many investments fail to address the underlying drivers of degradation or to support the conditions required for long-term stewardship.

This chapter argues that aligning finance with forest regeneration requires more than scaling existing instruments. It calls for a transformation of the financial system itself, in which finance is guided by explicit public objectives and embedded within governance structures that prioritise ecological sustainability and social inclusion. Building on insights from common-pool resource theory (e.g. Ostrom 2010) and systems thinking (e.g. Gunderson & Holling 2002, Meadows 1999), the chapter develops a framework for transformative forest finance that shifts the focus from project-level optimisation to system-level directionality.

The chapter proceeds as follows. Section 12.2 sets out the main challenge for forest finance and investment, highlighting the two main components required for this transformation. Section 12.3 develops a conceptual framework for good stewardship, drawing on theories of commons governance and nested systems, and offers four principles for good stewardship. Section 12.4 analyses current trends and investment practices in forest finance, highlighting their limitations and contradictions. It looks at three types of forest finance with concrete examples and judges these in regards to the four stewardship principles. Section 12.5 then presents a three-level framework for transformative finance, identifying the institutional and systemic changes required to align financial flows with forest regeneration. In the final level we offer seven steps for transformative finance. Section 12.6 concludes by reiterating the conditions for a just and effective forest finance transformation. In the Annex, we provide a simple model contrasting current private finance (maximising yield) and regenerative finance (putting regeneration first).

12.2 The Main Challenge for Forest Finance and Investment

The nexus between forestry, economics and finance has a deep historical lineage, with roots traceable to the early applications of land rent theory and investment science. As early as the thirteenth century,

forest resources were critical to industrial operations, such as those at Sweden's Stora Kopparberg copper mine, which marks one of the earliest recorded examples of forests being capitalised as investment assets (Chudy & Cubbage 2020). In the nineteenth century, formal economic valuation tools such as the Faustmann formula laid the groundwork for calculating the land expectation value, which became a cornerstone of forest investment decisions, particularly for timber rotation strategies (Chudy & Cubbage 2020). This evolution cemented forests as providers of timber and strategic financial assets.

Parallel to these developments, private finance's engagement with natural resources matured considerably. Bibliometric analyses reveal a significant increase in interdisciplinary scholarship exploring the resource–finance–growth nexus, highlighting both the risks of resource dependence and the opportunities for sustainable investment (Ali et al. 2023).

The focus in policy and investment debates has shifted since the 1980s from timber yield maximisation to a broader understanding of the multiple functions of forests (Hartman 1976). These include ecosystem service valuation, climate mitigation and livelihood provision. Within this context, NbS have emerged as an investment framework that integrates ecological restoration with economic and social objectives. NbS are defined as actions that protect, sustainably manage and restore ecosystems to address societal challenges while delivering biodiversity and human well-being benefits (Cohen-Shacham et al. 2016). Forest-based NbS such as reforestation, afforestation, forest landscape restoration and agroforestry link ecological and financial value through instruments such as carbon credits, results-based payments and conservation finance (Yin 2024). Yet these interventions entail trade-offs between environmental integrity and social outcomes, particularly when large-scale, carbon-focused projects undermine local rights, equity or livelihoods (Salvatori & Pallante 2021, Wijsman et al. 2025). Recognising and managing these trade-offs is essential if NbS are to serve as effective and just investment pathways for sustainability.

The Kunming-Montreal Global Biodiversity Framework (GBF), adopted at COP15 in December 2022, catalysed government interest in mobilising private finance. The GBF calls for closing the biodiversity financing gap by 2030, including scaling up public and private investment in NbS (CBD 2022). This policy shift has prompted a re-evaluation of what role private capital could play in financing public goods such as forest ecosystems.

Consequently, private investors are increasingly entering the nature restoration space, driven by growing concerns over biodiversity loss and climate change as well as increased interest in the potential for financial returns (Begemann et al. 2023). Tools such as biodiversity risk disclosures, science-based targets and green finance instruments steer investor behaviour toward nature-positive strategies (McKenzie et al. 2025). Seminal reports, including the UN's *State of Finance for Nature* (UNEP 2023, 2024, 2026), indicate a significant rise in private capital directed toward NbS but also stress that current investments still fall short of global targets.

Mechanisms such as biodiversity offset markets and carbon credits are emerging; without strong governance, however, these risk favouring cost-efficient solutions that are ecologically suboptimal (Zu Ermgassen & Löfqvist 2024). This dilemma is especially acute in forest finance. Mixed-species forests – valued for their ecological resilience – often underperform financially compared to monocultures, highlighting the inherent tension between ecological restoration and financial return (Knoke 2008, Knoke et al. 2005). What is overlooked in many economic assessments is that past performance does not guarantee future returns: many forest ecosystems, particularly single-species plantations, are increasingly vulnerable to climate change, pest and disease outbreaks and biodiversity loss (Seliger et al. 2023).

These dynamics point to a structural mismatch between ecological systems and the financial system. Incremental improvements in forest management or disclosure cannot resolve a system that rewards short-term extraction while ecosystems regenerate over decades. Addressing this mismatch not only requires better forest governance, but also a transformation of the financial logic through which forests are valued, financed and governed. Given this complexity, public sector leadership and adequate governance structures are frequently cited as essential in ensuring that forest restoration serves both ecological and economic goals.

A shift in institutional arrangements is important to achieve transformative change of the financial system. Key components of this transformation are:

(1) Allocation role – from profit-oriented to mission- or impact-driven;
(2) Risk management function – from historical volatility to forward-looking systemwide measures, including ecological risk.

This chapter explores the feasibility of and conditions for mobilising private finance for forest conservation and restoration and develops an institutional framework that enables private capital to steward ecological and investment value.

12.3 Principles for Good Stewardship

This section aims to understand what conditions enable financial actors to act as good stewards. We first discuss the common-good characteristics of nature and the limiting factors of current market mechanisms. We then explore common-pool resource theory and systems thinking. Based on these ideas, we propose four principles for good forest finance stewardship.

12.3.1 Nature As a Common Good

In the standard market–government dichotomy, where private and public goods are considered, nature is regarded as an ecological public good (Kedward et al. 2022, 2023). Ostrom (2010) expands this dichotomy by introducing common-pool resources and toll goods. Table 12.1 outlines the four broad types of goods offered to citizens in society. These types are distinguished by the ability to prevent individuals who have not paid for a good from consuming it (excludability) and the extent to which an individual's consumption of a good reduces the amount of that good for others (subtractability or

rivalry). Natural resources such as forests, fisheries and water systems are best understood as common-pool resources: they are difficult to exclude others from using and one person's use diminishes the availability for others.

Table 12.1 Types of goods offered to citizens

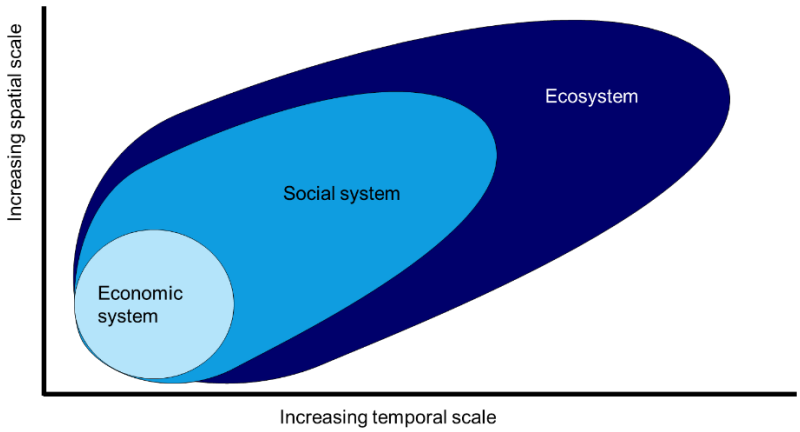
		Subtractability of use	
		High	**Low**
Excludability of use	**High**	*Common-pool resources*: water systems, fisheries, forests, global climate	*Public goods*: justice, defence, knowledge
	Low	*Private goods*: food, clothing, cars	*Toll goods*: theatres, private clubs, daycare centres

Source: Adapted from Ostrom (2010)
Note: Excludability of use refers to difficulty of excluding potential beneficiaries from using the good. Subtractability of use indicates extent to which consumption is at expense of other citizens.

For finance the most important private good characteristic is that forests can deliver (private) revenue streams through timber production and/or conversion of forestland to other land uses with economically higher potential benefits. This leads to the (classic) problem of conflicting private financial (short-term) interests that incentivise overharvesting and deforestation with (long-term) public good interests that deliver public forest services. These services can be supporting (nutrient cycling, soil formation, primary production), provisioning (food, fresh water, wood and fibre, fuel), regulating (climate, flood, disease, water purification) and cultural (aesthetic, spiritual, educational, recreational). Sometimes they can be translated into (private) income streams but not in all cases.

While investments in nature are increasing (see Section 12.4), this trend risks reframing nature as a marketable asset in the current financial system setting. Nature is fundamentally part of the ecological domain, not the economic domain (Schoenmaker & Stegeman 2023). Pre-empting our suggestion for transforming private finance is a shift from profit-orientation (the economic logic of the market) to mission- or impact-orientation (the social and environmental logic of society and nature). Figure 12.1 illustrates how the economy is nested within society, which is nested within the ecosystem. Market optimisation occurs within a narrow, short-term and often spatially constrained logic, whereas ecological systems operate across long timescales and planetary boundaries.

Figure 12.1 Spatial and temporal scales of the economic, social and ecological systems



Source: Schoenmaker & Stegeman (2023)

Both time (temporal scale) and geographical area (spatial scale) can be long and extensive for ecosystems that impact the economic equilibrium. Depending on the ecosystem, changes can take minutes, hours, days, years, decades or millennia; effects can range from select species to local populations to whole planetary boundaries (Gunderson & Holling 2002).

For societies, these changes in time and space are more extensive than for economic systems but smaller than for ecological changes – the average lifetime of a civilisation (defined as a society with agriculture, multiple cities, military dominance in its geographical region and a continuous political structure) is 336 years (Krznaric 2020), with differences ranging from decades to centuries. Cultures and traditions do not change that fast (it can take centuries like civilisations), while economic policies and contracts can change overnight. The scope, expressed in the number of people concerned, can also differ markedly; the longer changes take, the more people are affected. Within a social system, economic interactions occur: market transactions, redistribution and regeneration. These are generally short-term, directed chiefly at short-term interests. These economic interactions also interfere with societal and ecological changes.

Economics should relate to these different domains and make clear how these different domains (economy, society and ecology) interact and contribute to the well-being of humans now and in the future. The nesting of these domains is important to highlight. Planetary boundaries (Richardson et al. 2023) are the hard boundaries for humanity. Therefore, biophysical integrity (a flourishing planet) should be economics' overriding guiding (or limiting) principle. Inclusiveness (Acemoglu & Robinson 2012) is the goal of the social domain, where inclusiveness consists of solidarity and agency. The economic domain optimises output as efficiently as possible within this context. Without a flourishing planet and inclusiveness, efficient market interactions (the goal of the economic domain) make no sense.

Table 12.2 describes key attributes of the three domains: what it aims to deliver, which actors are involved, how actors interact, how achievements are expressed, the relevant criterion for judging

success and the type of commodity (Schoenmaker & Stegeman 2023). From an anthropocentric view, these domains are interlinked in how they provide broad welfare (wellbeing, sustainability and equity). The approach to achieving this differs per domain.

Table 12.2 Domains and their attributes

DOMAINS	ATTRIBUTES					
	Goal function	**Actors**	**Interactions between actors**	**Terms in which goal is expressed**	**Criterion for success**	**Type of commodity**
Ecology	Flourishing planet	Groups of households, communities, and firms, including future generations	Collective decision-making	Biophysical boundaries	Preservation and regeneration	Common and public goods
Society	Inclusive society	Groups of households, communities, and firms	Collective decision-making	Output (public and club goods), fair distribution (including social foundations)	Solidarity and agency	Public and toll goods
Economy	Output (and consumption)	Individual households and firms	Market exchange	Output (GDP)	Efficiency	Private goods

Source: Schoenmaker & Stegeman (2023).

Forest finance and investment refer primarily to the ecological and economic domains of Table 12.2 with differing and potentially conflicting interaction mechanisms and criteria.[1] The interaction mechanism for forests (as a common good in the ecological domain) is collective decision-making, while that for finance and investment (as a private transaction in the economic domain) is market exchange between private parties. The criteria for the two domains are also different: preservation and regeneration versus efficiency based on the profit motive. The Annex provides a simple model highlighting this tension.

By preservation, we mean that the burden of human activities on the ecosystem is kept within planetary boundaries (Richardson et al. 2023). By regeneration, we mean the ecosystem's capacity to recover and restore itself, thereby delivering ecosystem services for future generations (Morseletto 2020).

Forest finance governance is by nature mixed. Building on Ostrom (2010), who challenges the binary thinking of 'market vs. state' by demonstrating that both polycentric and community-based governance often outperform in managing common-pool resources, we pose here that forest finance must be a combination of governance factors. Ostrom's research shows that self-organising communities under certain conditions such as trust, local knowledge, clear rules, monitoring and sanctions can sustainably manage forests and fisheries. Crucially, governance arrangements must be tailored to specific ecological and social contexts. 'One-size-fits-all' market mechanisms or state interventions often fail.

1 On the social side, we abstract here from the fact that forests are often the habitat of local (Indigenous) communities, who are affected by choices about conservation, restoration or deforestation. See also Commonland (2020, 2024) on the four returns (financial, social, natural and inspirational) of landscape restoration.

Claassen (2024) adds a normative-political dimension by arguing that ownership entails power and thus responsibilities. When private actors control assets that structurally affect others (e.g. communities or ecosystems), those affected have a legitimate claim to representation. This certainly relates to forests. Claassen distinguishes between the *regulation model*, in which the state acts on behalf of the public, and the *incorporation model*, in which non-owners are given direct representation in decision-making. Especially where state regulation is weak, captured or ineffective – as is often the case in forest governance – representation at the level of ownership is necessary for non-owners. For forests, this implies that local communities, future generations and ecological interests must have a voice in their management (Camino et al. 2023).

Together, Ostrom (2010) and Claassen (2024) illustrate that markets alone cannot ensure sustainable forest stewardship. Market-based approaches (e.g. carbon credits, biodiversity offsets) may internalise some ecological values but they fail to address power asymmetries, long-term regeneration and collective ownership claims. Effective stewardship thus depends on recognising and embedding governance mechanisms that (1) allow for local and polycentric control and (2) ensure representation of affected non-owners, including nature itself.

This leads us to a key conclusion: current market mechanisms may have a role in financing forest conservation and restoration but their reach is inherently limited. These limits arise:

- **Ontologically**: nature is not a commodity; it exists independently of human valuation.
- **Temporally**: while markets prioritise short-term returns, ecosystems regenerate over long timescales.
- **Normatively**: markets fail to guarantee fairness, accountability or democratic representation.
- **Governance-wise**: effective stewardship often requires collective decision-making beyond bilateral exchange.

Markets can complement strong governance frameworks but they cannot substitute for them. This implies that financial decision-making must be assessed not only by efficiency criteria, but also by preservation and regeneration criteria. Where investment rules conflict with these objectives, the rules rather than ecosystems must change. Where ecological stakes are high and rights diffuse, incorporating public oversight, democratic accountability and community control is essential.

12.3.2 Governance and Institutional Design: From Market Logic to Commons Stewardship

The private finance model in the Annex demonstrates that forest conservation, restoration and regeneration is structurally misaligned with most private financial return models. Conservation and restoration do not yield immediate, appropriable cash flows and are often designed to avoid the very extractive dynamics upon which market finance depends. This misalignment invites a different approach: not how to fit conservation and restoration into financial markets, but how to design governance frameworks that embed finance within broader public objectives for common-pool resources (such as fisheries, forests and aquifers). The theory of common-pool resource (CPR)

governance, particularly the work of Ostrom (1990, 2010), offers an institutional foundation for such an approach.

Ostrom challenges the dichotomy of markets and states by empirically demonstrating that local communities can sustainably govern CPRs such as forests, fisheries and irrigation systems when supported by robust institutional arrangements. These arrangements are neither purely market-based nor centrally planned; they are polycentric, context-sensitive and built on collective governance. Ostrom (1990, p. 90–102) identifies eight design principles underpinning successful CPR management:

(1) Clearly defined boundaries;
(2) Congruence between appropriation and provision rules and local conditions;
(3) Collective-choice arrangements;
(4) Effective monitoring;
(5) Graduated sanctions;
(6) Accessible conflict-resolution mechanisms;
(7) Minimal recognition of rights to organise;
(8) Nested enterprises for larger systems.

These principles have direct relevance to forest finance. Restoration typically concerns landscapes with diffuse benefits, complex tenure systems and long ecological timeframes – features that make top-down governance brittle and market coordination ineffective. Effective restoration depends on multi-scalar, participatory governance with embedded feedback and accountability mechanisms. This is especially important given the limitations of existing market instruments such as carbon credits, which often incentivise short-term, single-metric optimisation (Knoke 2008).

Further, systems theorist Meadows (1999) identifies a hierarchy of ‘leverage points’ to intervene in complex systems. High-impact interventions, such as altering the system's goals or modifying its operational rules, offer greater potential for lasting transformation than adjusting parameters or improving metrics. In the case of finance for restoration, this implies that changing the underlying goals and rules of financial engagement is more transformative than expanding existing financial flows.

A central insight here is that transformation requires interventions at the level of goals and rules, not merely at the level of instruments. Capital flows follow these goals and rules; they do not define them. This insight is central to later discussions on transformative finance in Section 12.5.

12.3.3 Institutional Framework for Stewardship

Finance must be restructured to support stewardship rather than extraction. Following Ostrom’s design logic and Meadows’ systems thinking, we propose four stewardship principles for determining when and how finance can support forest conservation and restoration.

Principle 1: Define and Regulate Regeneration Objectives as a Public Function

The first principle is to clearly and democratically define the objectives of forest conservation and restoration, including their spatial, temporal and ecological scope. Whether focused on biodiversity, hydrological resilience or climate mitigation, these objectives should be treated as public mandates and defined in a way that reflects local knowledge and long-term ecological thresholds (Chausson et al. 2023, Ostrom 2005). This corresponds to Meadows' (1999) call for intervening at the level of system goals.

Moreover, regulation must ensure that regeneration outcomes are sufficient, efficient and just, in line with ecological economics principles (Daly 1992): sufficient to preserve critical ecological functions, efficient in allocating scarce resources and just in distributing benefits and burdens. This framing acknowledges that conservation and restoration are often collective societal objectives, not commercial products to be optimised.

Principle 2: Assess the Possibility of Bounded, Aligned Private Returns

Once objectives are established, the next question is whether a private return that is bounded (meaning limited to non-extractive, goal-consistent activities) and aligned with those objectives can be generated. Regarding the model in the Annex, this would mean permitting certain forms of Q (harvest) and/or c (commodified benefit), only where they support rather than undermine restoration outcomes (Equations 12.3 and 12.7 in the Annex). Examples include selective harvesting, non-timber forest products, carbon sequestration credits and payments for ecosystem services (Gómez-Baggethun & Ruiz-Pérez 2011, Meyer 2020).

Importantly, such returns must not reintroduce the incentive to increase Q beyond sustainable limits. This calls for strong governance to cap, monitor and adapt extraction levels. Where this cannot be credibly assured, private finance risks driving degradation through misplaced incentives – a phenomenon already observed in parts of the voluntary carbon market (Zu Ermgassen & Lofqvist 2024).

Principle 3: If No Viable Private Return Exists: Public Financing Regeneration

When conservation or regeneration projects are too costly or unable to monetise returns – for instance, in rewilding, biodiversity corridors or soil rehabilitation – they should be publicly financed. This reflects the economic reality that conservation and restoration often deliver non-rivalrous, non-excludable benefits: clean water, habitat connectivity, carbon sinks and cultural value. Such projects fail the private finance test not because they lack value but because they lack price.

In the logic of the private finance model in the Annex, this equates to a situation where $Q \approx 0$ and P (price of the harvest) is undefined or insufficient. The investor's expected return r^{forest} becomes negligible or negative. In such cases, public or philanthropic capital must bear the cost, a legitimate function of public finance in the service of public goods (Daly 1992, Seddon et al. 2021).

This approach recognises that many ecosystem services are non-rivalrous and non-excludable, and hence unfit for market allocation. As Hess & Ostrom (2007) note, such services often fall into the category of 'knowledge commons' or 'ecological commons' that require stewardship, not ownership. Moreover, relying on markets alone will systematically underfund projects with high social or ecological returns but low financial yields (Zu Ermgassen et al. 2024).

Principle 4: Where Possible, Structure Finance Within a Nested Governance System
Where aligned private returns are possible (Principle 2), finance should be mobilised within a nested, commons-compatible governance system. This involves structuring NbS with safeguards, participatory mechanisms and ecological monitoring embedded throughout the investment's lifecycle.

Projects framed as NbS should include:

- Participatory design and oversight;
- Clear benefit-sharing mechanisms;
- Independent ecological monitoring and reporting;
- Legal safeguards for communities and ecosystems.

This corresponds to Ostrom's (1990) call for nested enterprises and multi-level governance: local actors must retain control over the rules, while higher-level institutions support coordination, enforcement and conflict resolution. It also aligns with the normative incorporation arguments of Claassen (2024).

Such structures counterbalance finance's reductive tendencies, ensuring that returns remain aligned with ecological and social goals. This enables finance to play a supporting role in conservation and restoration without dictating their form or trajectory – a key shift away from the linear extraction logic of the model in the Annex.

The standard investment model assumes that assets generate extractable returns. As shown in the Annex, this logic is poorly suited to forest conservation and regeneration, which often require patience, restraint and co-benefits that are difficult to monetise. Commons theory and systems thinking provide a pathway beyond this limitation. By structuring conservation and restoration as governance challenges and embedding finance within clearly defined public objectives and nested institutions, mobilising capital is possible without subordinating ecosystems to financial logic. Conservation and restoration, then, are not products awaiting investment but shared societal commitments that may use private finance in some contexts, provided that the commons govern it.

12.4 Role of Forest Finance and Investment

We first look at trends in nature investments and provide an overview of such financial instruments. Exploring proposed solutions reveals the need to expand beyond financial logic. We then distinguish three models of private (and mixed) nature investments and showcase each using concrete examples. We then assess these three examples in regards to the four stewardship principles (Section 12.3.3).

12.4.1 Trends in Nature Investments

In recent years, nature has increasingly been reframed within the financial system as an emerging asset class. This trend is partly driven by growing ecological scarcity and the perception of nature-related investments as potential hedges against assets with negative environmental impact.

Recent assessments of nature finance show a rapidly expanding but still highly uneven landscape of financial instruments. The *State of Finance for Nature 2026* report provides the most comprehensive overview to date, distinguishing public, private, philanthropic and blended instruments by their objectives and risk profiles (UNEP 2026). It shows that the majority of current finance for nature remains public, while private finance concentrates on activities with clearer revenue streams, such as sustainable agriculture, forestry production and carbon-related mechanisms. Philanthropic and blended instruments play a catalytic role, particularly in early-stage conservation, restoration and institutional capacity building. Table 12.3 provides an overview of financial instruments.

Table 12.3 Overview of financial instruments for nature by objective

Objective	Public finance (~USD 197 bn)	Private finance (~USD 23.4 bn)	Philanthropy (~USD 0.27 bn)	Blended finance
Conservation (protection, avoided loss)	Protected area budgets; public land acquisition; conservation subsidies	Conservation-linked bonds; offsets (where revenues exist)	Core funding for conservation NGOs; land trusts; community stewardship	Guarantees and concessional capital to crowd in private investment
Restoration and regeneration	Public grants and restoration programmes; rural development funds	Very limited (long payback, high uncertainty)	Grants for pilots, experimentation and scaling	Vehicles combining public concessional capital with patient private finance
Sustainable production and use	Support schemes for sustainable forestry and agriculture; extension services	Equity and debt for certified forestry, agroforestry and sustainable value chains	Support for standards, certification and producer organisations	Risk-sharing facilities and first-loss capital
Carbon and ecosystem services	Public procurement of ecosystem services; results-based payments	Carbon markets; biodiversity credits (where monetised)	Funding for methodology development and integrity safeguards	Public–private facilities linking ecosystem revenues to conservation
Enabling conditions (governance, data, capacity)	Policy design; land-use planning; monitoring systems	Minimal, except where linked to investability	Core funding for institutions, data platforms and community capacity	Technical assistance facilities linked to investment programmes

Source: UNEP (2026). Note: Estimates are indicative and based on aggregated global data for 2023. Categories overlap and cannot be strictly additive. Data availability and definitions vary across instruments, particularly for private and blended finance.

Despite the growing diversity of instruments, the distribution of capital across objectives and financial actors reveals a persistent structural imbalance. Public finance overwhelmingly dominates in volume and is responsible for most conservation, restoration and enabling conditions, while private finance remains concentrated in activities with monetisable revenue streams, such as certified production systems and carbon-related mechanisms. Philanthropic finance is marginal in scale, yet plays a disproportionately important role in early-stage experimentation, governance and capacity building. Blended finance (meaning the strategic use of public or philanthropic capital to mobilise private sector investment in sustainable development projects) occupies an intermediate position, but its scale

remains limited and its effectiveness depends on continued public support. Together, these patterns suggest that current nature finance largely adapts financial instruments to existing market logics rather than adapting financial logics to ecological requirements. This misalignment underscores the limits of incremental financial innovation and motivates the need for a transformative finance framework that explicitly addresses directionality, investment rules and system-level change (Section 12.5.3).

There is a growing interest in NbS, which are promoted as approaches that can deliver ecological restoration alongside social and economic benefits. According to the International Union for Conservation of Nature, NbS are 'actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits' (Cohen-Shacham et al. 2016). As Seddon et al. (2021) emphasise, NbS must simultaneously contribute to biodiversity and human well-being to be distinguished from Nature Climate Solutions (NCS), which focus primarily on carbon mitigation. Forest management, afforestation and reforestation qualify as NbS only when they demonstrably enhance biodiversity and community well-being; otherwise, they are better understood as NCS interventions. This distinction is crucial for finance: investors often seek short-term, measurable returns, whereas genuine NbS require long-term commitment to ecological integrity and social inclusion, which are harder to monetise and monitor.

Recent analyses underscore that not all forest-related interventions qualify as genuine NbS. Lozano et al. (2025) show that forest-based NbS encompass a spectrum of approaches – from ecosystem protection and restoration to multifunctional production systems – and that their outcomes for carbon storage, biodiversity and human well-being vary widely. Many large-scale carbon-oriented projects prioritise sequestration efficiency over ecological integrity or social inclusion, blurring the boundary between NCS and NbS. This diversity highlights the importance of governance, scale and management intensity in determining whether forest investments contribute to climate and biodiversity goals or merely to carbon accounting.

Forestry-based NbS in particular, such as Improved Forest Management, afforestation and reforestation, have drawn the interest of institutional investors seeking to align portfolios with climate targets while generating predictable cash flows through mechanisms such as carbon credits.

According to the United Nations Environment Programme (2023), global annual investments in NbS reached approximately USD 200 billion in 2022, a third of the USD 542 billion required annually to meet biodiversity, climate and land degradation goals by 2030. Of this, only 17 per cent originated from private sources, illustrating the current limits of market mobilisation and the structural financing gap in ecological investment. This trend is taking shape within a broader shift in the financial sector, as ecological degradation becomes internalised not primarily as a moral imperative but as a financial risk. Frameworks such as the Taskforce on Nature-related Financial Disclosures (TNFD 2023) and the Network for Greening the Financial System (NGFS 2023) exemplify this logic, treating biodiversity loss and ecosystem service degradation as material risks to portfolio performance and long-term economic stability.

The conceptual shift from nature as commons to nature as capital reflects the prevailing logic of financialised ecological governance (i.e. influenced or dominated by financial thinking). The financial logic centres on commodification: assigning market value to ecosystem functions to render them legible, investable and tradeable (Gómez-Baggethun & Ruiz-Pérez 2011, Chapter # of this volume). This framing has facilitated the emergence of nature as an asset class but raises critical questions regarding its appropriateness and sufficiency. The monetisation of ecosystem services, while helpful in creating financial incentives for conservation and restoration, risks abstracting nature from its socio-cultural and intrinsic values, particularly in communities where traditional ecological knowledge and subsistence economies prevail (Chausson et al. 2023). If the target is to protect or restore nature, public approaches (e.g. through a state forestry organisation) are by definition less complex: it does not require monetisation, hence no difficult assessment of benefits and costs. Crude assumptions based on macro data are often enough. Transaction costs of public action (including budgeting, surveillance and control mechanisms to ensure appropriate spending and reduce corruption risks) are lower than the costs of marketisation.

Critically, this logic hinges on the ability to generate cash flows from natural systems (see Equation 12.5 in the Annex). Where ecosystem conservation and restoration do not necessarily produce immediate or quantifiable financial returns, as in the cases of biodiversity corridors or wetland rehabilitation, private financing often falls short. This asymmetry reinforces a structural bias: destruction is often profitable (e.g. logging, extractive agriculture), whereas conservation and restoration are costly.

One proposed solution involves blended finance mechanisms, in which public or philanthropic actors absorb early-stage risks or provide concessional capital to crowd in private investment (Finance Earth 2021). These mechanisms can de-risk projects with long payback periods or unproven revenue models by offering first-loss capital, technical assistance or outcome-based payments, yet their scalability remains constrained by the limited availability of concessional funds and by the complexity of structuring transactions that align different risk-return expectations. Another avenue is the development of more robust risk-sharing instruments such as guarantees, insurance-like structures and green securitisation to address the long-term and uncertain nature of returns from NbS (EIB & EC 2023). These approaches face several barriers, including methodological disputes around how to measure and verify ecosystem benefits, the absence of standardised data to price nature-related risks and the persistent bias of financial regulation toward short-term, liquid assets (Haya et al. 2023). As a result, financial innovation in NbS remains marginal compared with the scale of investment required.

Another proposed solution is impact- or mission-driven finance, what we call transformative finance. Transformative finance seeks to move beyond the optimisation (risk-return) logic. Penna, Schot and Steinmueller (2023) define it as investment guided by rules that alter the directionality of innovation systems toward sustainability, drawing on the Transformative Innovation Policy Consortium.

These current trends reveal a pattern: financial innovation focuses on making nature investable rather than making finance ecologically fit for purpose. Without a shift in directionality, valuation rules and risk assessment, expanding nature finance risks reproducing the very dynamics that drive degradation.

12.4.2 Examples of Private and Mixed Nature Investments

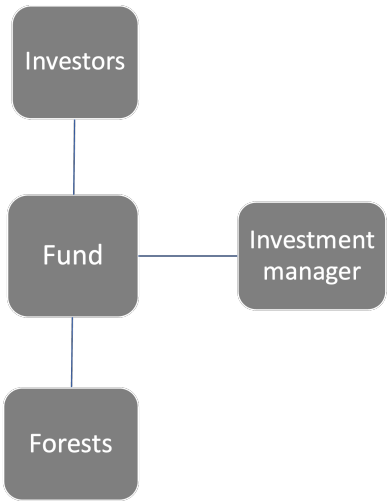
Private nature investments come in different forms. To provide insight into how these work and the inherent pressure for achieving financial return, we distinguish the following main models:

(1) Private finance with full market-related return;
(2) Private finance with low-stable return;
(3) Blend of public and impact-driven private finance (blended finance).

We showcase these models with concrete examples of nature investments. The first is based on the current profit-oriented financial model, the second reflects long-term investors that also look at systemwide ecological risks and the third involves impact-driven financial institutions. We illustrate the income stream, sustainability profile and structure and governance of these nature investments; we also report on controversies.

Nature investments can be held by institutional investors, such as pension funds, insurance companies and investment firms, as part of a diversified investment portfolio. The asset classes in such a diversified portfolio comprise equities, bonds and alternative assets such as real estate and infrastructure. Nature investments can be part of the real estate or infrastructure asset class. Figure 12.2 shows the common structure of a nature investment fund, which invests in nature assets (e.g. forests or land), run by an investment manager with institutional investors participating.

Figure 12.2 Fund structure



12.4.2.1Private Forestry Investment Firm: FIA Timberland Investments

Forest Investment Associates (FIA), established in 1986, is a US-based investment management firm that specialises in timberland and forestry investments (Forestinvest.com 2025). The geographic reach of FIA's Timberland Investments is primarily North America (US and Canada). It also invests in South America (Brazil and Chile) and several European countries (Sweden, Finland and the Baltic states). FIA has over 850,000 ha of timberland under management.

Income stream

Historically, FIA has reported average annual returns ranging from 8 to 12 per cent for its timberland investment portfolios. The most significant income source for FIA comes from the sale of timber, both from thinnings (selective logging of trees) and final harvests. In addition to timber, FIA have also generated income from non-timber forest products such as mushrooms, berries and other forest-derived products. As part of sustainable forest management, FIA may engage in carbon credit markets by implementing practices that enhance carbon sequestration. Selling carbon credits can provide an additional source of income. FIA may also earn income by leasing land for recreational activities such as hunting, fishing and eco-tourism.

Sustainability profile

FIA's mission is to provide high-quality, sustainable forest investments that deliver superior performance (Forestinvest.com 2025). According to FIA, they adhere to sustainable forestry principles, including responsible harvesting practices, reforestation efforts and biodiversity maintenance. They also claim to engage with local communities regarding its operations, promoting transparency and addressing concerns related to land use and resource access. FIA also indicates that they conduct regular assessments to monitor the ecological impacts of its forestry practices, ensuring compliance with ecological standards and improving outcomes. Finally, FIA seeks certification from recognised bodies such as the Forest Stewardship Council.

Structure and governance

FIA operates through closed-end funds.[2] These funds have a set investment period, during which capital is raised and invested in timberland. After this period, the fund enters a harvesting and exit phase, aiming to return capital and profits to investors. Institutional investors can buy participations in the closed-end funds. FIA could also manage separate accounts for large institutional investors, allowing for customised investment strategies based on specific investment criteria and risk profiles. With regards to governance, FIA has a board of directors comprising experienced professionals from the forestry, investment and ecological sectors. The board is responsible for setting the overall strategy, approving major investments and ensuring compliance with regulatory and ethical standards. An internal investment committee evaluates potential timberland acquisitions and management strategies.

2 Closed-end funds raise capital by issuing a fixed number of shares at their initial public offering and then invest that capital in various assets (e.g. timberland). Unlike open-ended funds, closed-end funds do not continuously issue or redeem shares; instead, investors buy and sell existing shares in the open market.

Controversies

FIA faces several controversies. First, investors and stakeholders have raised concerns about the adequacy of the firm's reporting on its timberland management and the ecological consequences of its operations.[3] Second, FIA's acquisitions and management of timberland have occasionally led to conflicts with local communities over land use. FIA faced backlash, for example, after acquiring a significant tract of land in Eastern Europe, where local environmental groups claimed that the firm's logging operations threatened community access to resources and disrupted local ecosystems.[4] Third, there have been allegations that some of FIA's operations do not fully align with the sustainable forestry practices it promotes. This includes questions about the integrity of its certification process.[5]

12.4.2.2 Private Insurance Company: ASR Dutch Farmland Fund

ASR Dutch Farmland Fund is a long-standing fund for Dutch farmland managed by the Dutch insurance company ASR (asrrealestate.nl 2024a, 2024b). In 2020, it was opened to external institutional investors. The Farmland Fund is the largest private landowner in the Netherlands and leases over 38,000 ha of farmland to farmers. Although this example does not relate to forestry, we include the Farmland Fund as it fits the typology of low-return nature-based investments by long-term institutional investors.

Income stream

Farming is a capital-intensive (high land prices) and low-margin (low milk prices) business in the Netherlands. Tenants (i.e. the farmers) can therefore only afford a relatively low annual lease payment. The direct income from leases has been an annual rent of 2 per cent over the last 12 years. Due to changing demands from farmers and other parties (e.g. urban development), the Farmland Fund can capitalise on these developments by strategically acquiring and selling land. This strategic land policy, combined with rising land prices, has resulted in an annual capital growth of 2 to 4 per cent over the last 12 years. The combined return of rent income and capital growth is thus 4 to 6 per cent. The internal rate of return target is 4 per cent. The Farmland Fund provides a stable long-term return and a good diversification opportunity (low correlation with other common asset classes) to institutional investors.

Sustainability profile

The mission of the Farmland Fund is to create perpetual value for its investors and society by investing in sustainable and fertile farmlands, recognising the systemwide ecological risk of soil degradation (Lukomnik & Burckart 2026, Schoenmaker & Schramade 2023). Through responsible stewardship, the Fund provides long-term leases (with durations exceeding twenty years) and engages with farmers to pass on land in better condition to the next generation of farmers. The Fund supports sustainable agricultural practices. About 25 per cent of the Fund's land portfolio meets the new

3 Source: 'Investors Demand Greater Transparency from Forestry Investment Associates,' Timberland Investor, April 2022.

4 Source: 'Local Communities Clash with Investors Over Forest Access,' European Environmental Law Review, July 2020.

5 Source: 'Sustainable Forestry or Greenwashing? The Case of FIA,' Forest Watch Journal, October 2021.

sustainability criteria. It offers a discount on green leases for farmers that meet the ASR's new sustainability criteria. The target is 90 per cent green leases for renewals. The Fund measures soil quality with the Open Bodemindex (Open Soilindex).

Structure and governance
ASR Real Estate runs the ASR Dutch Farmland Fund. The legal owner of the Fund's assets is ASR Dutch Farmland Custodian, which holds the assets on behalf of the investors for their risk and account. External investors can buy participations in the Fund and are entitled to the economic benefits (dividends and capital growth). They have the standard fund governance rights through the annual meeting of investors, which approves the three-year business plan and accounts and votes on the appointment or dismissal of the auditor, valuer and the Fund manager. Importantly, investors have no direct or indirect say over farmers.

ASR Real Estate has a regional network of *rentmeesters* (stewards), who are in direct contact with the farmers. The long duration of lease contracts, the promotion of green leases and ASR's sustainability policies contribute to aligning farmers' and investors' interests in sustainable agricultural practices, preserving long-term ecological and economic value.

Controversies
Critics argue that while the Fund promotes sustainable farming practices, the actual impact on the environment can be mixed. The pressure to maximise yields can lead to practices that exacerbate soil degradation and water scarcity. Moreover, intensive farming, often associated with large-scale agricultural investments, can threaten biodiversity. These are general concerns voiced by the Intergovernmental Panel on Climate Change and the European Environment Agency (EEA). There are no specific controversies reported regarding ASR Dutch Farmland Fund.

12.4.2.3 Blended Finance: River Wyre NFM Project
The River Wyre Natural Flood Management (NFM) Project in Lancashire represents one of the first attempts in the UK to finance natural flood management through a structured blend of public and private finance. The Project comprises a delivery plan of several interventions over 70 hectares, spread across more than 10 land holdings (see below at sustainability profile).

Income Stream
The income stream is anchored in a novel contractual arrangement that monetises ecosystem services. Triodos Bank UK, a mission-driven bank, arranged an £850,000 nine-year loan facility, provided by nine impact-oriented private investors. This loan is structured to be drawn down over the initial three years of the project and to be repaid between years four and nine (greenfinanceinstitute.com 2025). Revenue for loan repayment is secured through nine-year contractual agreements with five anchor buyers – Flood Re, United Utilities, the EEA, Wyre Council and the Northwest Regional Flood and Coastal Committee – who compensate the project for the delivery of ecosystem services, including flood mitigation, water quality improvement and carbon sequestration (greenfinanceinstitute.com

2025). The return on the loan facility provided by the impact investors is below market return at 1 to 2 per cent.

In addition to private investment, the project also benefits from substantial public grant funding. The Woodland Trust, for example, has committed £627,500 to support woodland and hedgerow planting. These grants play a vital role in de-risking the investment and supporting non-revenue generating aspects of the intervention, such as biodiversity enhancement.[6] In this blended model, the total income is therefore a combination of ecosystem service payments from buyers and non-repayable grant contributions from philanthropic or public actors.

Sustainability Profile

The River Wyre Project is recognised as a leading example of using NbS for catchment-scale flood management. The project aims to mitigate downstream flood risk through over 1,000 natural interventions across 70 ha of land. These include the creation of 39 hectares of new woodland, the construction of 42 ponds and scrapes, the installation of 1,710 leaky dams, and 10 km of bunded hedgerows.[7] The hydrological function of these interventions is to delay runoff and increase infiltration, thereby reducing peak flows and associated flood risk.

Beyond its hydrological benefits, the sustainability profile includes substantial contributions to climate change mitigation and biodiversity. The woodland and hedgerow plantings contribute to carbon sequestration and habitat creation. The project is structured to reward participating landowners for delivering measurable biodiversity outcomes, with bonus payments available for meeting or exceeding ecological targets (greenfinanceinstitute.com 2025).

In recognition of its contribution to sustainability, the project was awarded 'Nature and Biodiversity Project of the Year' at the 2023 Edie Sustainability Awards.[8] Its contribution to local climate adaptation and biodiversity has been highlighted as a model for similar projects across the UK and Europe.

Structure and Governance

To manage the complexity of multiple income streams, stakeholders and risk profiles, the project established a bespoke structure through a special purpose vehicle, the Wyre Catchment Community Interest Company (CIC). This not-for-profit CIC holds contractual obligations to both buyers and investors, and is responsible for managing incoming payments and delivering outgoing services. This legal separation ensures that financial liabilities are ring-fenced from the Rivers Trust and Wyre Rivers Trust, allowing for clear accountability and financial transparency.

The governance model includes robust stakeholder collaboration. The project brings together public agencies, private companies, environmental non-governmental organisations (NGOs) and local

6 Source: Case Studies – Investing in Nature LCR
7 Souce: Case Studies – Investing in Nature LCR
8 Source: The Rivers Trust

landowners. Key delivery partners include the Rivers Trust, Wyre Rivers Trust, United Utilities, Flood Re and the EEA. Farmers participate voluntarily and enter into nine-year agreements to host interventions on their land. They receive maintenance payments and are incentivised to maintain ecological performance (greenfinanceinstitute.com 2025).

This governance model reflects an emerging approach in environmental finance, where multi-stakeholder coordination is necessary to structure long-term, contract-based delivery of public goods through private land stewardship.

Controversies

At the time of writing, there are no known controversies associated with the River Wyre NFM Project. The project has received consistent support from its local stakeholders and has been positively evaluated in public discourse for its pioneering approach to ecosystem services finance. Notably, it is often cited in policy and research circles as a prototype for future natural capital investment vehicles. However, as with all such experimental finance models, future scrutiny may arise concerning the durability of ecosystem service payments and the scalability of the contractual structure (with many parties involved).

12.4.3 Assessment of Nature Investment Projects Against Stewardship Principles

On paper, all projects state a regeneration objective that promises sustainable environmental practices. However, the proof of the pudding is in the eating. In the case of FIA's commercial timberland funds, several breaches of sustainable forestry practices have been reported. The ASR Dutch Farmland Fund incentivises farmers to adopt sustainable farming practices. This is backed up by the fact that 90 per cent of new leases have been green leases (based on nature-inclusive agriculture). For the River Wyre NFM Project, the regeneration objective – protecting the floodplain with clear ecological targets – is enshrined in the project structure and the payment schedule.

The high target returns of FIA's timberland funds are extractive and not aligned with sustainable forestry standards. The tension in our simple model between maximising timber harvesting (Equation 12.2 in the Annex) and staying within ecological limits (Equation 12.3) is present. The starting point for the Farmland Fund is what farmers can reasonably afford; this is complemented by income from strategic selling and buying land in the portfolio. In both cases, there is no need for public funding. The River Wyre project has aligned, albeit limited, private returns with additional public and donor funding.

Finally, local participation is a clear challenge for privately financed projects. Such local participation is lacking in FIA's timberland funds. The Farmland Fund reaches out to farmers via a regional network of stewards, but farmers have no say in the governance of the fund. Local participation is fully embedded in the River Wyre Project. Our overall assessment is that FIA Timberland Investments is not compliant with the stewardship principles, the ASR Farmland Fund is largely compliant and the River Wyre Project is fully compliant. Table 12.4 provides an overview of our assessment.

Table 12.4 Assessing nature investment cases against stewardship principles

Investment project	Stewardship principles				
	Regeneration objective	**Aligned private returns**	**Public financing**	**Nested governance**	**Overall**
FIA Timberland Investments	Yes, but breaches	No	Not needed	No, local participation is lacking	Not compliant
ASR Dutch Farmland Fund	Yes, with incentives	Yes	Not needed	Partial, stewards' network	Largely compliant
River Wyre NFM Project	Yes, enshrined in project	Yes	Yes	Yes, fully embedded in the structure	Fully compliant

Note: The assessment is provided by the authors.

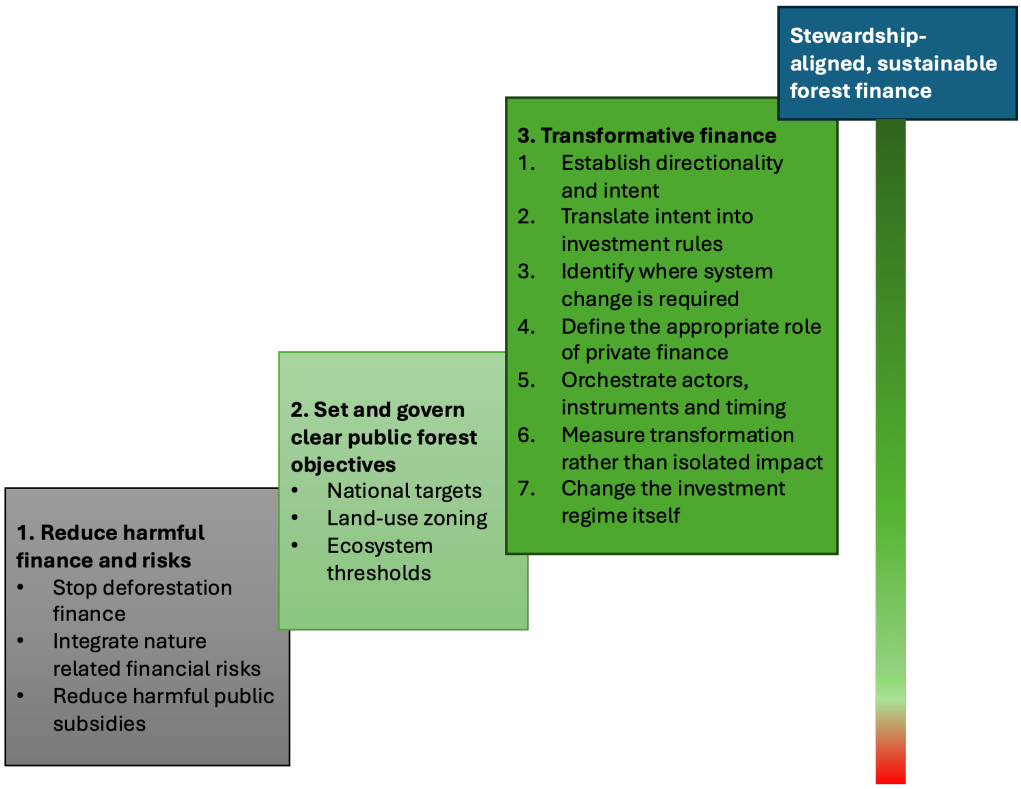
12.5 Transformative Change

The cases illustrate how current financial models align or misalign with the stewardship principles. Building on these empirical insights, we show the need for interventions in the financial (and wider governance) system to achieve transformative change in forestry practices (IPBES 2024). To align finance with forest restoration, we need to reverse the dominant supply-driven logic of 'investable projects'. Instead, finance should respond to clearly defined ecological and social priorities. Conservation and restoration finance must begin not with where capital can be profitably deployed, but with where conservation and restoration are most needed, most effective and most just.

The proposed interventions can be divided into three levels (see Figure 12.3). At the macro level, public and private income streams and incentives need to be redirected. This includes stopping harmful subsidies and having the right regulations (such as deforestation law) in place. It also requires the right (long-term) risk assessments for portfolios of biodiversity loss due to deforestation (Section 12.5.1). At the second level, public objectives need to be clear and backed up by national plans, which are currently lacking for many countries (Section 12.5.2). At the third level, the question is not only how to allocate finance, but how finance itself must change. This requires a transformative approach to private finance (Section 12.5.3).

Figure 12.3 depicts the three levels in the transformation of forest finance, which are not necessarily all in place, but starting at level 3 (private finance) without working on level 1 and 2 might be more difficult. The end goal is stewardship-aligned, sustainable forest finance.

Figure 12.3 Three levels for transformative change of forest finance



12.5.1 Reducing Harmful Finance

At the macro level, aligning finance with forest conservation and restoration not only requires ecological diagnostics but also structural shifts in economic policy and regulation. Chief among these is the redirection of public incentives. Currently, vast sums of government support continue to flow toward practices that directly or indirectly incentivise deforestation. A landmark study by McFarland et al. (2020) found that across just twelve countries, agricultural subsidies contributing to deforestation amount to over USD 273 billion annually, mostly through support for commodity crops linked to forest loss such as soy, palm oil and beef. These subsidies reduce production costs and increase profit margins for land-intensive agriculture, reinforcing land-use change over conservation. There is ample evidence that such subsidies function as 'perverse incentives', undermining conservation and restoration goals (Köder and Burger 2022). A meta-review by Fletcher et al. (2022) stresses that subsidy reform, particularly through conditionality mechanisms and targeted repurposing, is among the most effective tools to reduce deforestation while maintaining rural livelihoods. Repurposing can include shifting subsidies toward agroecology, forest stewardship programmes, or payments for ecosystem services, which directly incentivise regeneration rather than extraction.

The EU has begun to complement subsidy reform with regulatory tools. The EU Deforestation Regulation (EUDR), adopted in 2023, represents a significant advance. It prohibits the placement of commodities such as soy, palm oil, beef, wood and rubber on the EU market if they are not deforestation-free and have not been produced in a legally compliant manner. Importers must comply with stringent due diligence obligations, tracing their supply chains to specific plots of land and

demonstrating that production does not involve deforestation after 31 December 2020 (EC 2023). This shifts the burden of proof from consumers to producers and traders, creating powerful upstream incentives to avoid high-risk land-use practices. Unfortunately, weakening and delay in implementation are not helping to get the fruits of this regulation any time soon.

Scholarly analyses emphasise the potential of the EUDR to reshape market behaviour by standardising sustainability requirements across global value chains (Meijer 2023). Yet challenges remain, particularly regarding smallholder inclusion, enforcement capacity in producer countries and the risk of trade diversion. Complementary measures such as technical assistance, inclusive monitoring systems and harmonised definitions of forest degradation are essential for full impact.

Beyond market-based regulation, forest protection is also supported by spatial governance mechanisms such as land-use zoning, forest moratoria and ecological thresholds embedded in national law. For example, Brazil's Forest Code mandates minimum forest cover on private land, though enforcement remains uneven. Such policies establish legal baselines for conservation and enable the identification of areas where restoration is not only desirable but legally required (Stickler et al. 2013).

In combination, these instruments, regulatory bans, subsidy reforms, legal thresholds and landscape-level planning form a layered governance architecture for forest protection. When effectively implemented, they not only reduce the financial attractiveness of deforestation but also create the policy certainty required to unlock long-term investment in restoration. This level establishes the directionality of forest finance, corresponding to Step 1 in the transformative finance framework developed in Section 12.5.3.

12.5.2 From Public Objectives to Fit-for-Purpose Finance

The next level after identifying priority landscapes is to articulate clear and enforceable public objectives for forest conservation and restoration. While global frameworks such as the Bonn Challenge and the UN Decade on Ecosystem Restoration provide overarching direction, most national policies remain fragmented or insufficient. Following the GBF, all signatories to the Convention on Biological Diversity (CBD) were expected to submit by 2024 updated National Biodiversity Strategies and Action Plans (NBSAPs) aligned with the framework's twenty-three global targets for 2030. The results have been poor. By end of 2025, three years after Kunming-Montreal, only 66 of 196 parties had submitted revised plans (UNEP 2025).

Despite the emphasis within the GBF on national ownership and multi-stakeholder coordination, many NBSAPs remain declarative and disconnected from operational governance structures and investment plans. As noted in recent analysis, these plans often do not reflect the lessons learned from the Aichi Targets and suffer from persistent implementation gaps due to weak capacity, limited resources and fragmented institutional arrangements (Zhang et al. 2025). Moreover, solely assessing biodiversity progress at the national level risks overlooking transboundary impacts and cumulative global effects – potentially undermining collective sustainability efforts (Selomane et al. 2025).

This implementation gap poses a direct threat to the effective mobilisation and alignment of finance. Without clearly mandated restoration objectives, finance risks flowing to projects that are politically expedient or financially attractive rather than ecologically and socially necessary. Countries must urgently transform their biodiversity strategies into binding, operational frameworks. These should define the scope, spatial targets and delivery mechanisms for forest restoration, while also specifying the expected role of public, blended and private finance.

Importantly, public objectives must differentiate between areas where private investment is feasible and where public finance (e.g. through a state forestry organisation) is indispensable. Conservation and restoration of forests for biodiversity, hydrological regulation or climate resilience, where benefits are largely non-market and public, will require sustained public investment through national budgets, development banks or multilateral funds.[9] In contrast, some forms of conservation and restoration that integrate economic land use, such as agroforestry, sustainable timber or high-integrity ecosystem service markets, may be suitable for private or blended finance, provided that safeguards and equity mechanisms are in place.

In many countries, however, this differentiation is lacking. Conservation and restoration are not yet embedded in national investment strategies nor are there frameworks to evaluate whether specific projects should rely on private capital or public funds. Establishing this distinction is not merely technical: it is a political and institutional decision that governs how risks, benefits and responsibilities are distributed. Financial actors need predictability and legitimacy in these decisions to allocate capital effectively.

Thus, public authorities must do more than set aspirational goals; they must define actionable targets, articulate what financial logic applies to each and provide the institutional frameworks to ensure capital flows are fit for purpose. Without this foundation, neither private markets nor blended finance instruments can deliver a just and ecologically sound framework for forest conservation and restoration. These public objectives and national plans form the basis for translating intent into investment rules, corresponding to Step 2 of transformative finance.

12.5.3 Transformative Finance: A Step-by-Step Logic for Forest-System Change

Transformative finance differs from conventional and ‘sustainable’ finance not by the instruments it uses but by the *logic* that guides financial decisions. Rather than optimising within existing markets, transformative finance deliberately seeks to reorient socio-ecological systems toward sustainability. The allocation role changes from profit-oriented to impact- or mission-driven and the risk management function from historical volatility to a forward-looking system approach (Lukomnik & Burckart 2026, Schoenmaker & Schramade 2023). Drawing on the transformative investment literature and deep-transitions theory, this section develops a step-by-step logic for applying

9 An example is biodiversity financing by the European Investment Fund, a subsidiary of the European Investment Bank: https://www.eif.org/press/all/eib-group-promotes-biodiversity-in-europe-with-eur60-million-guarantee-for-sienna-investment-managers-fund.

transformative finance to forests. The steps below do not replace earlier governance discussions; they build on them by specifying what they imply for financial decision-making.

Step 1: Establish Directionality and Intent

The starting point of transformative finance is *intentionality*. Investments are to be guided by explicit societal and ecological objectives rather than by risk–return optimisation. Penna, Schot and Steinmueller (2023) conceptualise this as directionality: financial returns should follow from contributing to system change, not vice versa. In deep-transitions terms, this means actively supporting the emergence of new socio-technical trajectories while weakening those that reproduce unsustainable outcomes (Schot & Kanger 2018).

For forest finance, this implies that funding decisions must be anchored in clearly articulated goals such as restoration, resilience, biodiversity protection and social inclusion. These goals should be defined politically and institutionally before private finance is mobilised. This sequencing is consistent with Sections 12.5.1 and 12.5.2, which emphasise the primacy of public objectives, national plans and governance frameworks in shaping forest outcomes. If the state does not manage to set these goals, private finance may establish intentional goals by themselves (as some mission-driven banks have been doing).

Step 2: Translate Intent Into Investment Rules

Intentionality only becomes operative when translated into concrete investment rules. Penna, Schot and Steinmueller (2023) argue that transformative investment requires a redefinition of appraisal and valuation practices, including attention to long-term system effects, non-monetary values and fundamental uncertainty.

Applied to forests, this means moving away from investment rules that reward short-term extractive revenues (timber yields, land appreciation or narrowly defined carbon credits) and toward rules that value long-term ecosystem integrity, social legitimacy and systemic effects. Such rules reflect the public-good character of forests and the limits of commodification, a point already developed in Section 12.3 in relation to conservation finance and NbS.

Step 3: Identify Where System Change Is Required

Transformative finance focuses on the *structures* that reproduce unsustainable outcomes rather than isolated projects. In finance, these structures include profitability expectations: a financial system geared towards maximising returns while minimising risks. In forest systems, these structures include perverse incentives for land conversion, weak enforcement of land-use regulation, mispricing of ecological risk and institutional fragmentation.

From a deep-transitions perspective, finance should therefore target leverage points that can destabilise deforestation-driven regimes and stabilise regenerative alternatives (Schot & Kanger 2018). This reinforces Section 12.5.1's earlier argument that redirecting incentives and removing

harmful subsidies are prerequisites for effective private-finance mobilisation, where private finance has a role and an obligation (Step 4).

Step 4: Define the Appropriate Role of Private Finance
Only once directionality, rules and system targets are clear can the role of private finance be specified. Transformative investment theory explicitly rejects the assumption that all sustainability challenges can or should be solved through markets (Penna, Schot and Steinmueller 2023). In forest finance, this implies differentiation:

- Where activities generate mixed public and private value, private and blended finance can play a supportive role, scaling regenerative forestry, agroforestry and sustainable timber value chains under strong safeguards;
- Where benefits are predominantly public and non-market, direct public investment and collective governance are often more appropriate than attempting to engineer investable nature markets.

This distinction is essential to avoid over-financialisation of forests and aligns with the governance-first logic developed in Section 12.3.

Step 5: Orchestrate Actors, Instruments and Timing
Only at this stage does orchestration (strategic coordination) become central. Transformative finance requires the coordinated deployment of different forms of capital over time, aligned with transition phases. This corresponds with the orchestration literature, which highlights the role of intermediaries in aligning actors, resources and expectations across ecosystems.

From a transitions perspective, financial actors can function as *system intermediaries*, shaping networks, standards and learning processes rather than merely allocating capital (Naidoo 2020, Steffen & Schmidt 2021). In forest systems, orchestration typically involves:

- Concessional capital (provided by government, multilateral development banks or philanthropy at below market rates) to de-risk experimentation;
- Patient capital (with long-term orientation) to scale viable regenerative models;
- Mainstream finance only once governance, verification and revenue models are robust.

Importantly, orchestration here is not neutral coordination but a directional activity aligned with previously defined system goals.

Step 6: Measure Transformation Rather Than Isolated Impacts
Transformative finance requires evaluation frameworks that capture *system effects*, not just project-level outputs. Penna, Schot and Steinmueller (2023) emphasise the need for transformative outcome indicators that assess contributions to regime change, institutional learning and long-term resilience.

In forest finance, this implies moving beyond single metrics such as tonnes of CO_2 toward integrated indicators that reflect biodiversity, social outcomes and landscape-level change. This directly addresses the risks of carbon-centric approaches highlighted in Section 12.2.

Step 7: Change the Investment Regime Itself
Finally, transformative finance is explicitly reflexive: it seeks to change the rules of finance itself. Penna, Schot and Steinmueller (2023) identify enabling conditions such as revised fiduciary norms, new appraisal standards and regulatory reform as integral to transformation.

In the forest context, this means embedding long-term stewardship, participation and ecological integrity into financial and legal arrangements. Forest finance and investment thus becomes part of a broader institutional shift rather than a niche add-on to existing markets.

12.6 Conclusion: Conditions for a Just and Effective Role of Finance in Forest Conservation Restoration, Regeneration

This chapter has shown that forest finance and investment, while often discussed in investment terms, is fundamentally a matter of governance. Forests are not merely carbon sinks or economic assets; they are common goods that provide ecological, social and cultural value far beyond what can be captured in financial metrics. They have value by themselves, not only based on the (monetary) value for human economic activity. As such, their stewardship requires a governance framework grounded in public responsibility, collectively defined objectives and ecological limits.

From this perspective, the default approach to financing forest conservation and restoration should be public finance (e.g. through a state forestry organisation). Given the non-excludable and non-rivalrous nature of most ecosystem services provided by forests, such as biodiversity protection, water regulation and climate stability, conservation and restoration efforts meet the classical criteria for public goods. In line with ecological economic principles, it is both economically sound and ethically warranted for the state to play a leading role in funding their regeneration.

In practice, however, this logic is often undermined. Private finance continues to shape land use in ways that are frequently detrimental to forest ecosystems. Perverse subsidies and weak regulation permit capital to flow toward deforestation and degradation. Redirecting these flows is essential, but such redirection depends on the presence of clear and enforceable governance: national targets, legal frameworks, ecological baselines, local participation and credible enforcement mechanisms.

At the same time, public finance remains chronically inadequate. Government contributions to NbS currently fall well short of what is needed to halt biodiversity loss and restore ecosystems (UNEP 2024). In this context, private finance may be mobilised to complement public efforts, but only under strict conditions. It cannot substitute for public responsibility; instead, it must operate within a framework shaped by public objectives, equity considerations and ecological constraints. To execute

this responsibility, governments not only need to allocate funds and set the right governance, they need to have the adequate knowledge to do so.[10]

The public-good characteristics of forest conservation and restoration impose specific requirements on the use of private finance. These include limits on extractive returns, alignment with restoration goals and safeguards that ensure investments remain consistent with the regenerative capacity of nature. Private capital should be utilised not because it is readily available but because it can serve a clearly defined public interest.

When such conditions are met, private finance can play a supportive role under public leadership and directionality – for example, in blended finance models for agroecological landscapes, regulated ecosystem service schemes or sustainable forestry on degraded lands. However, its effectiveness depends on its orientation. Forest conservation and restoration cannot become a new arena for speculative or high-return finance. Instead, it must be a space of ecological care, democratic control and long-term commitment. In many cases direct public investment through nested governance structures may make more financial sense than creating nature markets aimed at attracting private capital (e.g. when common pool resources cannot be efficiently commodified and governed due to high transaction costs).

The central insight of this chapter is therefore not that more finance is needed, but that finance must be guided by directionality, bounded by public objectives and evaluated by its contribution to system change. Without this transformation, private finance will remain structurally misaligned with forest conservation and regeneration.

10 In developing countries, they often do not have the adequate funds (there are other priorities), lack capacity and people in power often benefit from weak governance (corruption).

References

Acemoglu, D. and Robinson, J. (2012). *Why Nations Fail*. New York: Crown Business.

Ali, A., Ramakrishnan, S., Faisal, F. et al. (2023). 'Bibliometric analysis of finance and natural resources: past trend, current development, and future prospects'. *Environment, Development and Sustainability*, 25(11): 13035–13064.

ASR Real Estate (2024a). 'Prospectus January 2024: ASR Dutch Farmland Fund'. Utrecht: ASR.

ASR Real Estate (2024b). 'Factsheet Q1 2024: ASR Dutch Farmland Fund'. Utrecht: ASR.

Begemann, A., Dolriis, C. and Winkel, G. (2023). 'Rich forests, rich people? Sustainable finance and its links to forests'. *Journal of Environmental Management*, 326: 116808.

Camino, M., Aceves, P., Alvarez, A. et al.(2023). 'Indigenous Lands with secure land-tenure can reduce forest-loss in deforestation hotspots'. *Global Environmental Change*, 81: 102678.

Chausson, A., Welden, E., Melanidis, M. et al. (2023). 'Going beyond market-based mechanisms to finance nature-based solutions and foster sustainable futures'. *PLOS Climate*, 2(4): e0000169.

Chudy, R. and Cubbage, F. (2020). 'Research trends: Forest investments as a financial asset class'. *Forest Policy and Economics,* 119: 102273.

Claassen, R. (2024). 'Property as power: A theory of representation'. *Journal of Social Philosophy*, 1–19.

Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (Eds.) (2016). *Nature-based solutions to address global societal challenges.* Gland: International Union for Conservation of Nature (IUCN).

Commonland (2020). 'Calculating the Value of 4 Returns Landscape Restoration. Towards a comprehensive method to put monetary value on the 4 Returns'. Commonland: Amsterdam.

Commonland (2024) 'Towards financing large-scale holistic landscape restoration in Europe. Recommendations for EU policy actors to attain inspirational, social, natural and financial returns'. Commonland: Amsterdam.

Convention on Biological Diversity (CBD). (2022), *Kunming-Montreal Global Biodiversity Framework.* CBD: Montreal.

Daly, H. (1992). 'Allocation, distribution, and scale: towards an economics that is efficient, just, and sustainable'. *Ecological Economics,* 6(3): 185–193.

Dietz, S. and Neumayer, E. (2007). 'Weak and strong sustainability in the SEEA: Concepts and measurement'. *Ecological Economics*, 61(4): 617–626.

European Commission (2023). 'EU Deforestation Regulation – Questions and Answers'. Brussels, European Commission.

European Investment Bank and European Commission (2023). *Investing in nature-based solutions: State-of-play and way forward for public and private financial measures in Europe.* Luxembourg and Brussels.

Finance Earth (2021). 'A Market Review of Nature-Based Solutions: An Emerging Institutional Asset Class'. Review commissioned by the Green Purposes Company. London: Finance Earth.

Forestinvest.com (2025). 'Stewards of Sustainable Forests'. https://www.forestinvest.com/.

Fletcher, R., Dressler, W., Anderson, Z. and Büscher, B. (2022). 'Conservation Basic Income: A Non-market Mechanism for Just Conservation'. *Biological Conservation,* 272: 109648.

Foley, J., DeFries, R., Asner, G. et al. (2005). 'Global consequences of land use'. *Science,* 309(5734): 570–574.

Gómez-Baggethun, E. and Ruiz-Pérez, M. (2011). 'Economic valuation and the commodification of ecosystem services'. *Progress in Physical Geography*, 35(5): 613–628.

Greenfinanceinstitute.com (2025). 'The Wyre River Natural Flood Management Project'. https://hive.greenfinanceinstitute.com/gfihive/revenues-for-nature/case-studies/the-wyre-river-natural-flood-management-project/.

Gunderson, L. and Holling, C. (2002). *Panarchy: Understanding Transformations in Human and Natural Systems.*, Washington, DC: Island Press.

Hartman, R. (1976). 'The Harvesting Decision When a Standing Forest Has Value', *Economic Inquiry.* 14(1): 52–58.

Haya, B., Evans, S., Brown, L. et al (2023). 'Comprehensive review of carbon quantification by improved forest management offset protocols'. *Frontiers in Forests and Global Change*, 6: 958879.

Hess, C. and Ostrom, E. (2007). *Understanding Knowledge as a Commons - From Theory to Practice.* Boston: MIT Press.

IPBES. (2024). 'Summary for Policymakers of the Thematic Assessment Report on the Underlying Causes of Biodiversity Loss and the Determinants of Transformative Change and Options for Achieving the 2050 Vision for Biodiversity of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services'. Bonn: IPBES Secretariat.

Kedward, K., zu Ermgassen, S., Ryan-Collins, J. and Wunder, S. (2022). 'Nature as an asset class or public good? The economic case for increased public investment to achieve biodiversity targets'. SSRN Working Paper. Available at SSRN: https://ssrn.com/abstract=4306836.

Kedward, K., S. zu Ermgassen, J. Ryan-Collins and S. Wunder (2023). 'Heavy reliance on private finance alone will not deliver conservation goals'. *Nature Ecology & Evolution*, 7(9): 1339–1342.

Köder, J. and Burger, A. (2022). 'Repurposing Perverse Agricultural Subsidies: Barriers and Pathways'. *Ecological Economics,* 199: 107488.

Knoke, T. (2008). 'Mixed forests and finance – Methodological approaches', *Ecological Economics*, 65(3): 590–601.

Knoke, T., Stimm, B., Ammer, C. and Moog, M. (2005). 'Mixed forests reconsidered: a forest economics contribution on an ecological concept'. *Forest Ecology and Management*, 213(1–3): 102–116.

Krznaric, R. (2020). *The Good Ancestor: A Radical Prescription for Long-Term Thinking.* New York: The Experiment.

Lozano, J., Nainggolan, D., Kofler, V. et al. (2025). 'Nature-based solutions: typologies, ecological processes and benefit valuation approaches across landscapes'. *Nature-Based Solutions*, 8: 100268.

Lukomnik, J. and Burckart, W. (2026). *Handbook of System-Level Investing.* VA: Miniver Press, McLean.

McFarland, W., Whitley, S. and Kissinger, G. (2020). 'Agricultural Subsidies and Deforestation: What Role Can Aid Play?'. ODI Working Paper. London: Overseas Development Institute.

McKenzie, E., Jones, M., Seega, N., Siimaki, J. and V. Vijay. (2025). 'Science and technical priorities for private sector action to address biodiversity loss'. *Philosophical Transactions of the Royal Society B*, 380(1917): 20230208.

Meadows, D. (1999). 'Leverage Points: Places to Intervene in a System'. Hartland, VT: Sustainability Institute.

Meijer, K. (2023). 'The EU's Deforestation Regulation and Global Commodity Chains: Towards a New Regulatory Paradigm?'. *Review of European, Comparative & International Environmental Law,* 32(1): 82–95.

Meyer, C. (2020). 'Social finance and the commons paradigm: Exploring how community-based innovations transform finance for the common good'. *Management Decision*, 58(4), 786–796.

Morseletto, P. (2020). 'Restorative and regenerative: Exploring the concepts in the circular economy'. *Journal of Industrial Ecology*, 24(4): 763–773.

Naidoo, C. P. (2020).'Relating financial systems to sustainability transitions: Challenges, demands and design features'. *Environmental Innovation and Societal Transitions,* 37: 400–417.

Network for Greening the Financial System. (2023). 'Nature-related Financial Risks: a Conceptual Framework to guide Action by Central Banks and Supervisors'. Technical Document. Paris: Banque de France.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge: Cambridge University Press.

Ostrom, E. (2005). *Understanding institutional diversity*. Princeton: Princeton University Press.

Ostrom, E. (2010). 'Beyond markets and states: Polycentric governance of complex economic systems'. *American Economic Review*, 100(3): 641–672.

Penna, C., Schot, J. and Steinmueller, W. (2023). 'Transformative investment: New rules for investing in sustainability transitions'. *Environmental Innovation and Societal Transitions,* 49: 100782.

Prescott, C. (2024). 'Perspectives: Regenerative forestry–Managing forests for soil life'. *Forest Ecology and Management*, 554: 121674.

Richardson, J., Steffen, W., Lucht, W. et al. (2023). 'Earth beyond six of nine Planetary Boundaries'. *Science Advances*, 9(37): eadh2458.

Salvatori, E. and Pallante, G. (2021). 'Forests as nature-based solutions: Ecosystem services, multiple benefits and trade-offs'. *Forests,* 12(6): 800.

Schoenmaker, D. and Schramade, W. (2023). *Corporate Finance for Long-Term Value.* Berlin: Springer.

Schoenmaker, D. and Stegeman, H. (2023). 'Can the Market Economy deal with Sustainability?'. *De Economist*, 171(1): 25–49.

Schot, J. and Kanger, L. (2018). 'Deep transitions: Emergence, acceleration, stabilization and directionality'. *Research Policy,* 47(6): 1045–1059.

Seddon, N., Smith, A., Smith, P. et al. (2021). 'Getting the message right on nature-based solutions to climate change'. *Global Change Biology*, 27(8), 1518–1546.

Seliger, A., Ammer, C., Kreft, H. and Zerbe, S. (2023). 'Diversification of coniferous monocultures in the last 30 years and implications for forest restoration: a case study from temperate lower montane forests in Central Europe'. *European Journal of Forest Research*, 142(6): 1353–1368.

Steffen, B. and Schmidt, T. (2021). 'Strengthen finance in sustainability transitions research'. *Environmental Innovation and Societal Transitions,* 41: 77–80.

Stickler, C., Nepstad, D., Azevedo, A. and McGrath, D. (2013). 'Defending Public Interests in Private Lands: Compliance, Costs and Potential Environmental Consequences of the Brazilian Forest Code in Mato Grosso'. *Philosophical Transactions of the Royal Society B,* 368(1619): 20120160.

Selomane, O., Fourie, M., Archibald, S. et al. (2025). 'Public finance allocation does not reflect biodiversity priorities'. *Current Opinion in Environmental Sustainability*, 74: 101524.

Taskforce on Nature-related Financial Disclosures (TNFD) (2023). *Recommendations of the Taskforce on Nature-related Financial Disclosures*. London: TNFD.

United Nations Environment Programme (UNEP) (2023). *State of Finance for Nature: The Big Nature Turnaround – Repurposing $7 trillion to combat nature loss*, In: *State of Finance for Nature 2023*. Nairobi: UNEP.

UNEP (2024). *State of Finance for Nature: Time to Scale Investment to Match Ambition.* Nairobi: UNEP.

UNEP (2025). *What are National Biodiversity Strategies and Action Plans (NBSAPs)?* Nairobi: UNEP.

UNEP (2026). *State of Finance for Nature 2026: Aligning public and private finance with nature-positive outcomes*. Nairobi: UNEP.

Wijsman, K., Wolff, E., Frantzeskaki,N. and Williams, S. (2025). 'Rethinking trade-offs in nature-based solutions from a social justice perspective'. *npj Urban Sustainability,* (5): 67.

Yin, R. (2024). *Global Forest Carbon; Policy, Economics and Finance* London: Routledge.

Zhang, Z., Cao, D., Ma, T., Liu, H. and Mao, Z. (2025). 'International cooperation for a biodiverse future: Opportunities and challenges under the Kunming-Montreal Global Biodiversity Framework'. *Global Ecology and Conservation*, 58: e03385.

Zu Ermgassen, S., Kedward, K., Smith, R. and Bull, J. (2024). 'Leading from the front. The Role of the Public Sector in Delivering Nature Recovery'. Grantham: Woodland Trust. Available at: www.wildbusiness.org.

Zu Ermgassen, S. and Lofqvist. S. (2024). 'Financing ecosystem restoration'. *Current Biology*, 34(9): R412–R417.

Zu Ermgassen, S., Swinfield, T., Bull, J. et al. (2025). 'Five golden rules for scientifically-credible nature markets'. preprint 25/3/2025 version, Available at: https://osf.io/preprints/socarxiv/37w8p_v1.

Annex: A simple model of private finance in forests

We develop a simple model of private finance and investment in forests to explore the inherent tensions between financial markets and ecological sustainability. Assume an investor who owns a forest asset. Her financial return r comprises the annual harvest of timber Q, which can be sold on the market at price P:

$$r^{forest} = Q \cdot P \tag{12.1}$$

Both variables are uncertain. The annual harvest Q depends on the natural conditions; a severe drought can, for example, reduce the annual harvest. The timber price P depends on market conditions when selling.

In a typical market setting, investors aim to maximise financial return. With the price exogenously given, the natural response is to increase the harvest Q:

$$\text{Max } r^{forest}(Q) \tag{12.2}$$

From an ecological perspective, however, there is a limit: the annual harvest must remain within the forest's regenerative capacity:

$$Q \leq Q^{regenerative} \tag{12.3}$$

This basic model illustrates a fundamental clash between market incentives and ecological boundaries. If the investor increases harvesting beyond regenerative capacity, driven perhaps by a drop in timber prices or poor returns elsewhere, the forest enters a state of depletion ($Q > Q^{regenerative}$).

The model shows that the principles of the market domain (Equation 12.2) and the ecological domain (Equation 12.3) can clash when the investor increases annual production beyond the regenerative capacity: $Q > Q^{regenerative}$.

This pressure intensifies if the return on forest investment r^{forest} falls below the expected market return r^{market}. In a competitive equilibrium, expected risk-adjusted returns are assumed to equalise across asset classes:

$$E[r^{forest}] = E[r^{market}] \tag{12.4}$$

If ecological integrity is the normative priority, as argued in Section 12.3, governance mechanisms must ensure that equation (12.3) is upheld. This reflects the principle of *strong sustainability* (Dietz & Neumayer 2007), where economic capital accumulation cannot substitute ecological limits.

It should be noted that it is not sufficient to check the financing conditions at the time of investment $t = 0$: $r_0^{forest} \geq r_0^{market}$ and $Q_0 \leq Q_0^{regenerative}$. Due to fluctuating timber prices in the market and changing natural conditions, these initial financing conditions may be violated during the investment period, putting pressure on annual production.

Extending the model: regenerative forestry

We extend the model to include additional ecosystem services, accounting for the broader value of forests. We call this regenerative forestry. Regenerative forestry is a whole-system approach that promotes resilient and adaptive forests with mixtures of tree species and selective harvesting, restores lost biodiversity, improves soil quality, and produces timber and other products that will help mitigate climate change (Prescott 2024). This broad definition reconciles biodiversity, soil, climate and economic aspects. While mixed trees might underperform financially in the short term, in the longer term, they might outperform, since they can increase resilience (Knoke 2008).

To model this, we introduce a new return component c: income derived from ecosystem services such as carbon sequestration, biodiversity credits or public subsidies for ecological stewardship.[11]

To capture a broader conception of value, we extend the model by introducing additional sources of return associated with ecosystem services. This includes carbon sequestration (valued via carbon credits), biodiversity restoration and public subsidies for ecological stewardship. These are increasingly recognised in 'natural capital' accounting frameworks and regenerative finance. Let c represent these additional, non-timber income streams. The return from regenerative forestry becomes:

$$r^{regforest} = r^{forest} + c = Q \cdot P + c \tag{12.5}$$

The investor now maximises:

$$\max r^{regforest}(Q, c) \tag{12.6}$$

A central question is the relationship between Q and c. In theory, they might complement each other. In practice, however, they often involve trade-offs: letting trees grow longer may reduce short-term harvest Q but increase carbon storage, resilience and long-term ecosystem service income c. Similarly, biodiverse or native forests may underperform financially in the short term compared to monocultures, but they offer greater long-term value (Knoke 2008). Thus, regenerative forestry typically involves lower extractive output and higher non-market value.

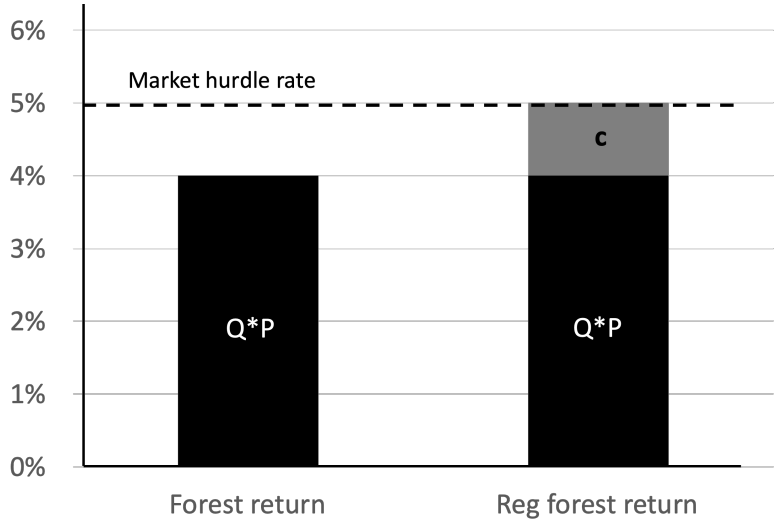
This leads to a key insight: private investment in forests may only be financially viable when ecosystem services bridge the return gap:

$$r^{forest} < r^{market} \text{ but } r^{regforest} \geq r^{market} \tag{12.7}$$

In such a case, c bridges the return gap, turning a potentially unsustainable or unprofitable investment into a viable one. Figure 12.4 illustrates this case with an example. The forest return of 4 per cent falls short of the expected market return of 5 per cent. An ecosystem service income c of 1 per cent makes the project financially viable.

11 We exclude here other sources of income often used to make NbS financially viable such as ecotourism. Not that they do not play a role but these are traditional private goods. Adding them might bring the private business case financeable, it is however analytically the same as higher timber income.

Figure 12.4 Forest vs regenerative forest return



The nature and scale of c is not automatic. It depends on several interlinked factors:

1. **Market mechanisms**: Voluntary carbon markets, biodiversity credits and other schemes can create tradable values for ecosystem services, but these markets are still nascent, fragmented and subject to credibility concerns.
2. **Public policy and subsidies**: Governments can underwrite c via direct payments (e.g. EU Nature Restoration Law), tax incentives or long-term contracts for ecosystem services. In this case, c reflects a **quasi-public good** supported by fiscal or regulatory structures.
3. **Institutional arrangements**: Credible measurement, reporting and verification frameworks are essential. Without them, the revenue stream c lacks the reliability to attract investment (Zu Ermgassen et al. 2025).
4. **Temporal aspects**: Many ecosystem service values accrue over longer timescales than timber revenues. This introduces additional financing challenges, especially under short-term investment horizons.

Moreover, specific ecological actions such as forest conservation lack a viable business model. Unlike commercial land-use change (e.g. tree plantations for timber or carbon farming) or restoration of native forests for biodiversity or watershed protection, there is, for instance, no gain in carbon sequestration.[12] These projects are essential from a planetary perspective but invisible to private finance. Without strong public support or philanthropy, they remain unfunded.

Hence, the viability of regenerative forestry as a business model depends on how well c is priced, structured and institutionalised. In its absence – or if poorly developed – private investors will fall back on maximising Q, risking ecological overshoot.

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12 This is in the end always a question what the relevant baseline is. If the baseline is deforestation, you could claim carbon sequestration. However, these kind of fictitious resulting income streams are hard to privatise.