Valuing Ecosystem Services in the Ecuadorian Amazon: Strategic Applications of ESVD-Based Benefit Transfer for Conservation Finance

Giles Jackson
Shenandoah University

Jason Doedderlein
Profuturus

Martin Mulyadi
Shenandoah University

This paper demonstrates how ecosystem service valuation can inform conservation finance strategies using the Benefit Transfer Method (BTM) and internationally recognized valuation databases. We apply the Ecosystem Services Valuation Database (ESVD) to estimate the economic value of services provided by a 60-hectare property in the Ecuadorian Amazon. Using BTM, we compare Net Present Value outcomes across three scenarios: Carbon Sequestration Only, Extractive Use, and Full Ecosystem Services. Results show that the full valuation scenario—i.e. the "True Economic Value" (TEV)—far exceeds the outcomes in both the carbon-only and extractive-use cases. By year 100, this value is 4.8 times greater than extractive use and 3.1 times greater than carbon-only, underscoring the long-term importance of intact ecosystems. We then examine financing pathways, including payments for ecosystem services (PES), biodiversity credits, conservation easements, and REDD+, and propose investment structuring options informed by ESVD-derived valuation. Drawing on recent developments, we argue for diversified, multi-service approaches that more fully capture the ecological and economic value of tropical forests.

Keywords: ecosystem services valuation, benefit transfer method, conservation finance, tropical forests, biodiversity credits

INTRODUCTION

The global economy has long been subsidized by nature, arguably "history's most exploited underpaid laborer" (DiPerna, 2023). Although some ecosystem services can be valued through existing markets (commodities such as fish, wild rice, and clean water), many remain invisible to economic systems, even though they underpin the very conditions for human life (Fletcher & Cristin, 2015; Daily & Ruckelshaus, 2022). This invisibility results in persistent mispricing of natural capital, driving the degradation of ecological systems in the pursuit of short-term financial gains.

A key challenge in rectifying this misalignment is that valuing nature is inherently complex: many services are non-market, spatially diffuse, temporally delayed, or culturally embedded. Aspects of nature are mobile, some are invisible, and many are silent. The effects of our actions on ourselves and others—including future generations—are often hard to trace and go unaccounted for, giving rise to widespread externalities (Dasgupta, 2021). Without quantification, however, the full value of natural capital cannot be represented in economic analyses, leaving both public and private decision-making blind to crucial trade-offs (Fletcher & Cristin, 2015).

Over the past two decades, there has been a shift toward mainstreaming the value of ecosystem services in economic systems, beginning with Costanza et al. (1997), whose controversial estimate of global ecosystem services at US$33 trillion per year catalyzed a movement to make nature's contributions more legible in policy and finance (Daily & Ruckelshaus, 2022). Since then, a growing body of evidence has reinforced the importance of embedding ecological value into economic logic, especially through tools such as ecosystem accounting, payments for ecosystem services (PES), and more recently, Gross Ecosystem Product (GEP) (de Groot et al., 2022; Zheng et al., 2023).

Despite these advances, biodiversity loss continues at an alarming rate. The Living Planet Index reveals an average 69% decrease in the relative abundance of monitored wildlife populations between 1970 and 2018 (WWF, 2022). Similarly, the IPBES Global Assessment Report (IPBES, 2019) finds that nearly 1 million species already face extinction, with habitat degradation and land-use change among the primary drivers. As Daily & Ruckelshaus (2022) emphasize, this ecological collapse represents not just an environmental crisis but a macroeconomic and systemic risk. Nevertheless, a 2024 Nature4Climate survey reports that global nature-negative investments still exceed US$5 billion—140 times more than investments in nature-based solutions. This disparity underscores the urgency of developing standardized, credible valuation frameworks that can reframe how we allocate capital and evaluate risk.

Continued biodiversity loss, however, presents not only an ecological and economic risk, but also a moral and distributive challenge. As Martin-López et al. (2014) demonstrate, there are clear trade-offs in the spatial distribution of ecosystem service beneficiaries, with marginalized communities often bearing the brunt of ecological decline while benefiting least from market-based returns. Recognizing these asymmetries is essential if valuation tools are to serve the goals of equity, inclusion, and intergenerational justice.

Studies have also revealed that private investment in nature remains constrained by poor data infrastructure, valuation uncertainty, and the perceived riskiness of projects with long-term paybacks (de Groot et al., 2022). As Van Raalte & Ranger (2023) argue, unlocking nature investment at scale will require the development of common metrics, robust data sources, and new platforms for channeling capital toward ecosystem protection and restoration. The transition from philanthropy to investable conservation assets—such as biodiversity credits, GEP-linked green bonds, and PES schemes—requires that ecosystem service valuation move from conceptual promise to financial utility.

The 2022 Kunming-Montréal Global Biodiversity Framework (GBF) represents an attempt to accelerate this transition. GBF Target 18 calls for phasing out harmful subsidies in a fair and equitable way, while Target 19 seeks to mobilize financial resources and stimulate innovative financing mechanisms. In practice, this means moving from one-off valuations to institutionalized ecosystem accounting systems, supported by transparent and science-based metrics.

Countries with high biodiversity, such as Ecuador, remain at the center of this global equation. Despite its protected areas system and biodiversity-related policies, Ecuador continues to experience land-use pressure and species decline (Kleeman et al., 2022). Valuation is thus not only an academic exercise—it is strategic groundwork for conservation finance.

Compounding this challenge is the underrepresentation of tropical biodiversity hotspots in valuation databases (Acharya et al., 2019). To address this, we turn to the Benefit Transfer Method (BTM)—a practical approach for applying existing valuation data to sites where primary data collection is infeasible. While imperfect, BTM enables evidence-based estimation of ecosystem service values using standardized datasets such as the Ecosystem Services Valuation Database (ESVD) (Brander et al., 2024; de Groot et al., 2022).

Building on the conceptual foundations of ecosystem services and their valuation, we apply the Benefit Transfer Method (BTM) to estimate the Total Economic Value (TEV) of ecosystem services for a 60-

hectare conservation property in the Ecuadorian Amazon, owned by Selva Vida Sin Fronteras, a non-profit Ecuadorian NGO. Drawing on ESVD data, we compare three land-use scenarios—Carbon Sequestration Only, Extractive Land Use, and Full Ecosystem Services Valuation—to provide a robust basis for investor engagement and inform strategic decisions in nature-based investment planning.

CONCEPTUALIZING ECOSYSTEM SERVICES

Ecosystem services (ES)—the benefits that humans receive from nature—have become a dominant organizing principle in global environmental policy and sustainability science (McElwee & Shapiro-Gaza, 2020). The concept gained prominence with Costanza et al.'s (1997) landmark study, which aggregated multiple valuation studies and estimated the annual value of the biosphere at US$33 trillion—nearly double the global GDP at the time. Quantifying ecosystem services in economic terms was a critical step toward ensuring they receive proper weight in decision-making alongside manufactured and financial capital.

The United Nations Millennium Ecosystem Assessment (MEA, 2005) significantly advanced public and policy awareness of ES by classifying them into four categories: provisioning services (e.g., food, water, fiber, fuel), supporting services (e.g., soil formation, primary production), regulating services (e.g., climate regulation, disease control), and cultural services (e.g., recreation, aesthetic, spiritual, and educational benefits). The MEA found that 15 of 24 ecosystem services assessed globally were in decline, signaling potentially severe consequences for human well-being and development. This catalyzed a wave of research on measuring, modeling, and mapping ecosystem services (Fisher et al., 2007).

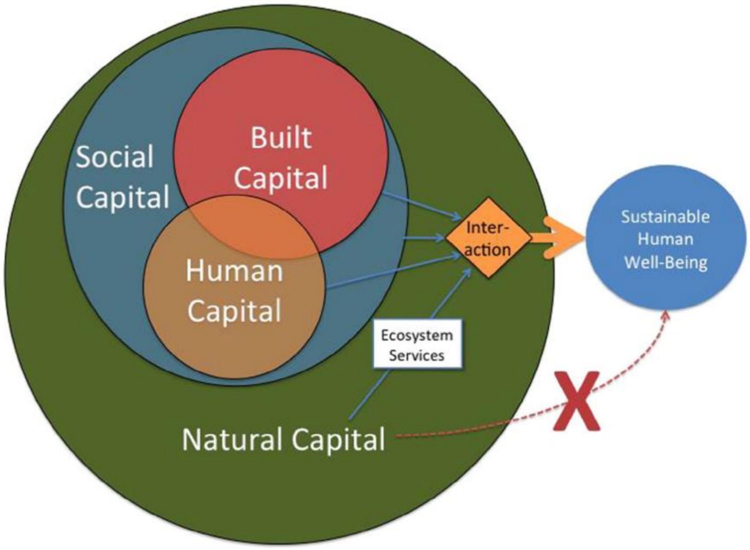
Figure 1 presents a conceptual valuation framework from the UK National Ecosystem Assessment and IPBES, which views ecosystem asset stocks (natural capital) as the foundational basis for sustaining ES flows. These interact with built, human, and social capital to generate benefits for people (Costanza et al., 2017; Ouyang et al., 2020; Vári et al., 2022).

Building on the ES concept, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) developed the more inclusive framework of Nature's Contributions to People (NCP), defined as "all the contributions, both positive and negative, of living nature (i.e., all organisms, ecosystems, and their associated ecological and evolutionary processes) to people's quality of life" (IPBES, 2024). NCP highlights the relational values of nature and explicitly incorporates indigenous and local knowledge systems in ecosystem assessment (Díaz et al., 2018).

To capture the aggregate economic value of these contributions, scholars have proposed Gross Ecosystem Product (GEP)—an analog to GDP. The goal is to capture services that are non-excludable, non-rival, and often non-tradable, yet vital for human well-being and long-term prosperity (Daily & Ruckelshaus, 2022). According to Ouyang et al. (2020): "Analogous to GDP, GEP uses market prices and surrogates for market prices to calculate the accounting value of ecosystem services and aggregate them into a measure of the contribution of ecosystems to the economy." Figure 2 illustrates the relationship between GDP and GEP, emphasizing how natural capital stocks generate ecosystem service flows that interact with built, social, and human capital to produce economic value and societal well-being.

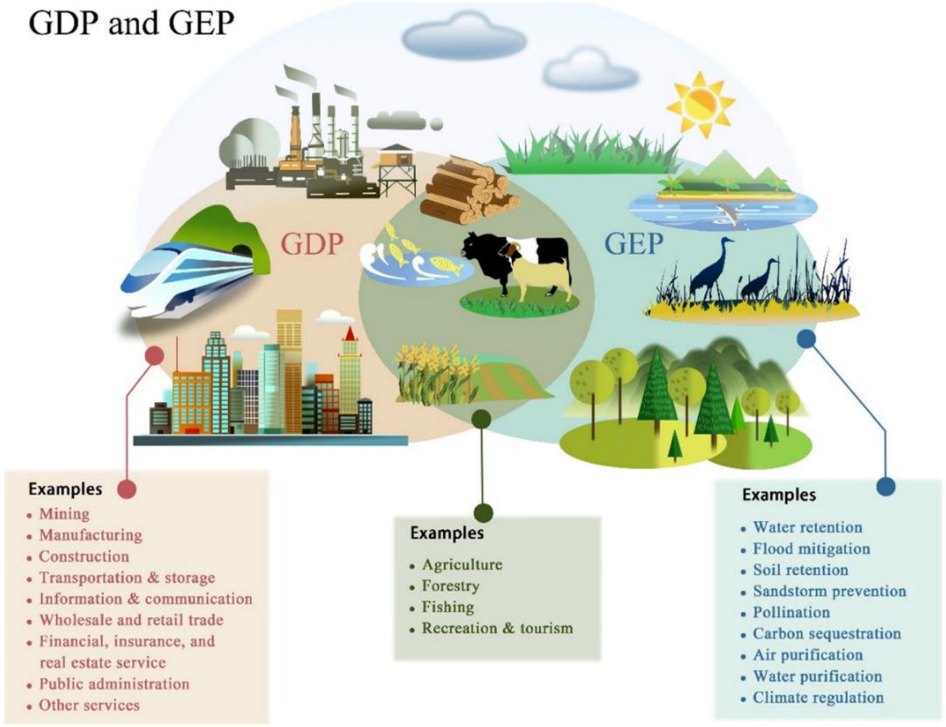
Recent pilot studies in China—now exceeding 196 GEP accounting projects at local and regional levels—illustrate the growing feasibility of integrating ecological value into economic development planning. GEP's integration into national accounting frameworks, such as the UN's System of Environmental-Economic Accounting (SEEA-EA), marks a step toward more nature-positive economic planning (Zheng et al., 2023; de Groot et al., 2022).

FIGURE 1
CONCEPTUAL VALUATION FRAMEWORK



(Costanza et al., 2017)

FIGURE 2
RELATIONSHIP BETWEEN GDP AND GEP



(Zheng et al., 2023)

ECOSYSTEM SERVICES VALUATION

Most nature-based investments remain concentrated in established economic sectors such as forestry, agriculture, aquaculture, and tourism, where revenue streams depend on marketable commodities and services. However, a growing number of investors are recognizing the significance of non-commercial benefits—such as biodiversity conservation, carbon sequestration, and cultural values—though these remain under-monetized and under-incentivized in financial markets (Van Raalte & Ranger, 2023). According to Daily & Ruckelshaus (2022), failure to integrate the full value of nature into economic planning and policy frameworks continues to drive capital misallocation, favoring short-term gains at the expense of long-term ecological resilience.

To overcome this gap, researchers emphasize the development of standardized valuation metrics and robust accounting frameworks that can stimulate investment in ecosystem services (Zheng et al., 2023). As Van Raalte & Ranger (2023) argue, scaling up ecosystem service valuation will require not only improved data infrastructure and modeling tools but also innovative policy instruments—such as Payments for Ecosystem Services (PES), biodiversity credits, and impact-based financing mechanisms—that reflect the true economic contributions of natural capital.

At the same time, concerns over valuation integrity have intensified following revelations that carbon offset markets have been exploited by bad-faith actors. For example, West et al. (2023) found that as of November 2021, at least 14.6 million carbon credits had been issued from 18 REDD+ projects, yet almost three times more carbon was offset than actually mitigated through forest preservation. This has led to calls for more transparent, verifiable, and multi-dimensional valuation methodologies, moving beyond single-metric approaches focused solely on carbon.

As Aguirre-Gutiérrez et al. (2023) emphasize, reducing nature's value to a single metric—carbon—is insufficient for ensuring ecosystem stability. They argue that valuation models must account for multiple ecosystem service dimensions, stating: "Ideally, we should be moving to a state where for any carbon project to be certified, their additionality should surpass the benefits of conserving and restoring the ecosystem to its original state… An overarching view on maintaining original ecosystem functioning and maximising as many ecosystem services as possible should be prioritized above the ongoing economic focus on carbon capture projects."

RESEARCH METHODOLOGY

In light of the challenges and opportunities outlined above, our valuation model seeks to estimate the Total Economic Value (TEV) of ecosystem services provided by a 60-hectare tropical forest parcel in the Ecuadorian Amazon, owned by the non-profit conservation organization Selva Vida Sin Fronteras. Table 1 (see below) summarizes the ecosystem services considered in our analysis, drawing on a standardized classification synthesized from established frameworks (SEEA EA, TEEB, CICES). Using Benefit Transfer Methodology (BTM) and leveraging standardized values from the Ecosystem Services Valuation Database (ESVD) (Brander et al., 2024; de Groot et al., 2022), we construct a comparative analysis across three valuation scenarios:

1. Carbon Sequestration Only Scenario – representing the baseline market-accessible value commonly used in REDD+ or voluntary offset markets;
2. Extractive Use Scenario – based on typical market valuations of resource extraction activities (e.g., timber, non-timber forest products, oil and minerals);
3. Full Ecosystem Services Scenario – incorporating the value of regulating, provisioning, supporting, and cultural ecosystem services using median values from tropical forest biomes.

The ESVD, developed under the TEEB initiative, contains over 7,000 value records from more than 1,000 studies, standardized in international dollars per hectare per year at 2020 prices. This database offers reliable, biome-specific, and globally comparable valuation coefficients, enabling evidence-based application of BTM in data-scarce settings such as the Ecuadorian Amazon (Brander et al., 2024). To derive meaningful estimates, our valuation model applies the following parameters:

- Time horizon: 100 years
- Discount rate: 3% real (aligned with conservation finance norms)
- Unit values: Median ESVD values for tropical forest biomes, differentiated by ecosystem service category
- Land area: 60 hectares, with a conservative adjustment to 55.38 hectares to account for non-productive or buffer zones
- Scenarios: Aggregated net present value (NPV) calculations per scenario, allowing direct comparison of ecosystem-based and extractive-based returns

This approach enables both per-hectare and total property-level valuation estimates, which can be used to inform investor negotiations, assess opportunity costs, and benchmark nature-positive investment returns. Crucially, it also provides a transparent, replicable method for comparing land-use strategies in contexts where primary ecological valuation is not feasible, but where decisions carry irreversible ecological and social consequences.

In the section that follows, we present the valuation model outputs and comparative scenario results, before turning to a discussion of their implications for payment mechanisms, blended finance instruments, and the broader transition toward ecosystem-based conservation economies.

TABLE 1
ECOSYSTEM SERVICES

SERVICE	**DESCRIPTION**
BIOLOGICAL CONTROL	Ecosystem contributions to the control of pests and invasive species, reducing their impact on biomass production, economic activities, and human well-being.
CARBON SEQUESTRATION	The contribution of ecosystems, such as forests, grasslands, and oceans, to the removal of carbon dioxide from the atmosphere and its storage in biomass, soils, and ocean sinks.
CARBON STOCKS	The amount of carbon stored in the biomass and soils of ecosystems such as forests, grasslands, peatlands, and oceans.
CLIMATE REGULATION	The contribution of ecosystems to regulating climate patterns at local, regional, and global scales, through the moderation of temperature, precipitation, and atmospheric composition.
CULTURAL	Non-material benefits provided by ecosystems that contribute to human wellbeing, including spiritual, aesthetic, recreational, and educational experiences.
EROSION CONTROL	The contribution of ecosystems to controlling soil erosion, preserving land productivity, and sustaining agricultural and natural systems by stabilizing soil and vegetation cover.
EXISTENCE BENEFITS	The contribution of ecosystems to human wellbeing through existence values — the satisfaction derived from simply knowing that certain ecosystems, species, or natural features continue to exist, even without direct use.
EXTREME HEAT REGULATION	The contribution of ecosystems to moderating local temperatures and reducing the intensity of extreme heat events, through processes such as shading, evapotranspiration, and surface cooling.
FOOD	Provision of food by ecosystems, including food harvested from natural ecosystems and produced by managed agricultural systems dependent on ecosystem processes.

FOOD PRODUCTION	The contribution of ecosystems in supplying resources and supporting processes necessary for the cultivation, harvest, and natural provision of food.
GAS REGULATION	The contribution of ecosystems to maintaining the balance of atmospheric gases, particularly those influencing climate stability and air quality.
GENETIC RESOURCES	Genetic material from biodiversity, encompassing wild and domesticated plants, animals, and microorganisms, that supports breeding, innovation, and ecosystem resilience.
HABITAT: REFUGIA	Areas that provide the essential resources and conditions — such as food, water, and shelter — necessary for the survival and reproduction of plants and animals.
INCREASE IN THE WATER QUALITY FOR PUBLIC SUPPLY	The contribution of ecosystems to enhancing water quality for public use by filtering, decomposing, assimilating, and detoxifying pollutants through soil, subsoil, and aquatic systems.
NATURE-BASED TOURISM	Ecosystem contributions to tourism activities where people travel to natural areas for recreation, aesthetic appreciation, or cultural experiences, generating both wellbeing benefits and economic value.
NON-FOOD RAW MATERIALS	Biotic materials provided by ecosystems that are used in human activities and industries for purposes other than human nutrition or energy production. Examples include timber, fiber, resins, and medicinal plants.
NON-TIMBER FOREST PRODUCTS	Plant and fungal materials harvested from forests without the need to cut down trees, including fruits, nuts, mushrooms, resins, and medicinal plants.
NUTRIENT CYCLING	Ecosystem processes that store, recycle, and transform essential nutrients (such as nitrogen, phosphorus, and carbon), maintaining soil fertility, supporting plant growth, and sustaining broader ecosystem functioning.
POLLINATION	Pollination services provided by wild species that contribute to the reproduction of crops and wild plants, thereby supporting species abundance and diversity beneficial to economic units.
RAINFALL	The contribution of vegetation, particularly forests, to maintaining rainfall patterns through evapotranspiration and atmospheric moisture recycling at regional and continental scales.
RAW MATERIALS	Materials derived from ecosystems, including both biotic and abiotic resources, that are used in human activities and industries, excluding uses for food or fuel. Examples include timber, fiber, minerals, and sand.
RECREATION	Contributions of ecosystems, through their biophysical characteristics and qualities, that enable people to use and enjoy the environment via direct, in-situ, physical and experiential interactions.
SOIL FORMATION	Ecosystem contributions to the maintenance and regeneration of soil properties that support plant growth, food production, and other human uses. This service focuses not on soil formation in a geological sense, but on the biological and ecological processes that maintain soil functioning for human benefit.

TIMBER	Wood products obtained from forests and trees, primarily used for construction, manufacturing, furniture-making, and other industrial and artisanal purposes.
UNKNOWN FUTURE MEDICINAL BENEFITS	Contribution of biodiversity to preserving the potential for future medicinal discoveries through the conservation of genetic and biochemical resources.
WASTE TREATMENT	Ecosystem processes that remove, transform, or store pollutants, thereby contributing to water purification, air quality regulation, and soil detoxification.
WATER REGULATION	Ecosystem contributions to regulating the flow, availability, and distribution of water, including water storage, groundwater recharge, and flood mitigation.
WILD MEAT	Meat derived from wild animals that are hunted or trapped for human consumption.

Sources: Definitions synthesized and adapted from the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA-EA 2021), The Economics of Ecosystems and Biodiversity (TEEB 2010), and the Common International Classification of Ecosystem Services (CICES V5.1, 2018). These sources provided the conceptual frameworks for the ecosystem service labels and descriptions, which have been adapted for clarity, conciseness, and consistency.

VALUATION RESULTS AND INTERPRETATION

Applying the Benefit Transfer Method (BTM) using ESVD data, we calculated the Net Present Value (NPV) of ecosystem services under three alternative land-use scenarios: (1) Carbon Sequestration Only, (2) Extractive Land Use, and (3) Full Ecosystem Services (TEV approach). For each scenario, we estimated values both on a per-hectare basis and for the full 55.38 hectares of effective land area, using a 100-year time horizon and a 3% discount rate. The resulting NPV figures are summarized in Table 2 (see below), offering an empirical basis for comparing the opportunity costs and long-term benefits of different land-use strategies.

TABLE 2
COMPARATIVE VALUATION SCENARIOS (PER HECTARE AND TOTAL NPV)

	2025^	10-yr NPV*	25-yr NPV*	50-yr NPV*	100-yr NPV*
Extractive Use Value ($2025 / ha)	$ 13,485	$ 24,242	$ 53,311	$ 93,186	$ 170,738
Extractive Use ($2025 / 55.38 ha)	$ 783,965	$ 1,409,660	$ 3,099,959	$ 5,418,666	$ 9,928,236
Carbon Sequestration Only ($2025 / ha)	$ 3,168	$ 31,168	$ 79,194	$ 158,389	$ 316,777
Carbon Sequestration Only ($2025 / 55.38 ha)	$ 167,077	$ 1,670,774	$ 4,176,936	$ 8,353,871	$ 16,707,742
Total Ecosystem Services Value ($2025 / ha)	$ 8,948	$ 89,479	$ 223,698	$ 447,395	$ 894,791
Total Ecosystem Services Value ($2025 / 55.38 ha)	$ 520,312	$ 5,203,119	$ 13,007,797	$ 26,015,595	$ 52,031,189

^Values in 2025 international dollars using PPP

*NPV values reflect a 3% discount rate and 3% inflation, with an inflation adjustment factor of 1.05 applied to convert 2023 values to 2025 dollars.

Values derived from Ecosystem Services Valuation Database (Brander et al., 2023)

The findings reveal significant divergence in estimated economic value across the three scenarios:

- **Carbon Sequestration Only Scenario**, while reflecting monetizable ecosystem service flows currently recognized in voluntary and compliance markets, yields the lowest net present value (NPV) across all timeframes, both on a per-hectare basis and in total for the property. This reinforces critiques in the literature (Aguirre-Gutiérrez et al., 2023; Daily & Ruckelshaus, 2022) that carbon-centric valuation frameworks underrepresent the broader ecological and social value of intact ecosystems.
- **Extractive Use Scenario** reflects moderate NPV levels, primarily driven by assumed market returns from timber harvesting, non-timber forest products, and hypothetical mineral or oil resource extraction. While this scenario aligns with dominant economic incentives in forest frontier areas, it fails to account for the externalized ecological and social costs associated with biodiversity loss, pollution, and ecosystem degradation (de Groot et al., 2022; Martin-López et al., 2014).
- **Full Ecosystem Services Scenario** (TEV approach) produces the highest total NPV across all timeframes, with estimated returns far exceeding those of the extractive or carbon-only pathways. This scenario captures the cumulative value of regulating services (e.g., climate stabilization, erosion control), provisioning services (e.g., genetic resources, water supply), cultural services (e.g., recreation, spiritual value), and supporting services (e.g., habitat provisioning, nutrient cycling).

The magnitude of the difference underscores the economic irrationality of undervaluing nature's non-market functions and makes a compelling case for reorienting land management toward ecosystem stewardship rather than extractive exploitation.

Importantly, the TEV scenario not only delivers higher monetary value but also presents a more resilient and diversified value portfolio, reflecting multiple service flows with varying sensitivity to market fluctuations. As such, it strengthens the investment case for conservation-oriented financing mechanisms, including Payments for Ecosystem Services (PES), biodiversity credit markets, and GEP-linked blended finance instruments (de Groot et al., 2022; Zheng et al., 2023).

Moreover, the full valuation model provides stakeholders—particularly conservation-minded investors—with a transparent, evidence-based reference point for determining a fair price per hectare. The TEV-derived estimates can also be used to inform impact measurement, performance-based disbursement schemes, and project pipeline selection criteria in biodiversity-aligned investment funds.

Crucially, the results challenge the prevailing assumption that conservation necessarily involves economic trade-offs. On the contrary, when the full value of ecosystem services is properly quantified, conservation emerges as a strategically superior land use, offering both financial and societal returns that exceed extractive alternatives—particularly when long-term horizons and systemic risks are taken into account (Daily & Ruckelshaus, 2022; de Groot et al., 2022).

In the next section, we explore how these findings could be operationalized within a range of financing and policy frameworks, including performance-linked biodiversity credits, PES schemes, and area-based investment models that prioritize ecological integrity alongside economic development.

FINANCING MECHANISMS AND POLICY APPLICATIONS

The valuation results presented above reinforce the economic logic for repositioning conservation as a financially viable and strategically superior land-use strategy, particularly when full ecosystem service flows are considered. Yet transforming this logic into investable reality depends on institutional mechanisms, valuation integrity, and financial innovation that can effectively channel capital toward ecosystem protection at scale.

Among the most promising pathways is the expansion of Payments for Ecosystem Services (PES) programs, which reward landholders or stewards for maintaining ecological functions that benefit wider society. PES mechanisms are increasingly recognized as a cornerstone of nature-based climate solutions, but their scalability hinges on the use of transparent, performance-based valuation frameworks such as the one applied in this study (de Groot et al, 2022; Zheng et al., 2023).

Closely related are emerging biodiversity and ecosystem service credit markets, which aim to create tradable assets based on ecological outcomes. However, as recent developments in the carbon offset market show, integrity, equity, and transparency must be at the core of such markets. In 2023, global transaction volume in the voluntary carbon market fell sharply—by over 60% year-on-year—largely due to declining confidence in REDD+ and renewable energy credits (Forest Trends, 2024). At the same time, scrutiny over project methodologies and revenue distribution has exposed tensions between market scalability and legitimacy, especially in biodiversity-rich regions of the Global South.

These shifts reflect a market in transition rather than in decline. As Forest Trends (2024) notes, recent developments—such as the ICVCM's approval of new Core Carbon Principles, and advance market commitments by the Symbiosis Coalition—signal a new phase of professionalization and reform. Nevertheless, they also highlight the need for valuation frameworks that go beyond carbon alone, to ensure that investment flows are not only restored but diversified across multiple ecosystem service domains.

The implications for tropical forest regions such as the Ecuadorian Amazon are especially acute. As carbon project developers and investors navigate new standards and oversight regimes, the risk of regulatory fragmentation, legal challenges, and stalled investment pipelines has increased. The Rimba Raya project in Indonesia, one of the world's largest carbon offset sites, illustrates this volatility: its license was revoked by the government in 2023 amid efforts to reclaim public revenue and rebalance profit-sharing with local communities (Lee, 2025). Similar policy shifts are unfolding in Kenya, Malawi, and Zimbabwe, where governments are moving to assert greater control over ecosystem-based revenue flows.

These dynamics underline a critical point: ecosystem service valuation must not only inform investment decisions but also anchor equitable governance frameworks. In the absence of such alignment, markets risk becoming both politically fragile and socially contested—as reflected in concerns from carbon market experts that the more governments seek to direct the flow of benefits, the more investor confidence may erode (Lee, 2025). Yet as Forest Trends (2024) emphasizes, a failure to establish integrity frameworks comes with its own risks: in 2023 alone, an estimated $750 million in climate finance for nature-based projects in the Global South evaporated, disproportionately affecting the very landscapes most vital to planetary resilience.

In response, tools such as Gross Ecosystem Product (GEP) and area-based conservation investment funds offer pathways to rebuild confidence and broaden the scope of valuation beyond carbon-centric models. GEP enables the institutional embedding of ecological value in national accounts, while conservation investment vehicles can help structure returns around multi-service performance indicators, including habitat quality, cultural service access, and biodiversity outcomes.

In the Ecuadorian case examined here, the NGO landowner's strategy to raise capital by selling shares to conservation-minded investors represents a concrete application of valuation-informed finance. Structured appropriately, such a model could be paired with performance-based PES agreements, biodiversity credit pilots, or even GEP-linked bond instruments, creating a blended financing architecture in which ecological, social, and financial returns are coherently aligned.

Ultimately, the valuation framework developed here supports a broader transformation: one in which ecosystems are recognized as productive assets, not liabilities; and in which capital is directed not toward exploitation, but toward long-term stewardship. The path forward requires not only better methods for measuring value, but also better institutional vehicles for capturing and redistributing it, ensuring that the benefits of conservation finance flow not just to global markets, but also to the people and places most essential to ecological stability.

INVESTMENT STRUCTURING OPTIONS FOR THE ECUADORIAN PROPERTY

To translate ecosystem service valuation into tangible conservation finance, Selva Vida Sin Fronteras (Selva) and its partners must consider how best to structure the investment vehicle for the 60-hectare property in the Ecuadorian Amazon. Below, we outline a set of strategic options for mobilizing capital, grounded in ESVD-based valuation methodologies. Each approach leverages the estimated economic value of the ecosystem services generated by the land, while responding to different investor profiles, legal frameworks, and conservation objectives.

Tax-Deductible Contribution

Using ESVD-Based Valuation Under this approach, the ESVD-derived Net Present Value (NPV) of ecosystem services is used to justify a tax-deductible contribution from investors. The valuation, applied over a 50-year period using a 3% discount rate, provides a transparent basis for calculating the philanthropic value of the contribution.

Advantages:

- Combines scientific rigor with fiscal incentives.
- Enhances transparency and accountability.
- Aligns with international standards for conservation valuation.

Challenges:

- Requires legal alignment with both Ecuadorian and Dutch tax regimes.
- Involves long-term management planning.
- Valuation and documentation processes may be time- and resource-intensive.

Private Sale Anchored in Ecosystem Service Valuation

Alternatively, Selva could pursue a private sale or equity investment using ESVD-based valuation as a basis for price negotiation. The ecological asset value would be documented through standardized ecosystem service metrics, providing a credible reference point for investors.

Advantages:

- Creates a benchmark for ecosystem-based asset sales in the region.
- Provides immediate liquidity for conservation goals.
- Offers a scalable model for other landowners and conservation groups.

Challenges:

- Requires investor confidence in valuation methodology and assumptions.
- May entail complex legal arrangements around ownership, stewardship, or usage rights.
- Investors may demand performance guarantees or conservation monitoring.

Conservation Easement With ESVD-Defined Valuation

This model retains Selva's ownership of the land while entering into a legally binding conservation easement that restricts development and ensures long-term ecological stewardship. The ESVD valuation would provide a basis for determining the easement's financial value—potentially enabling tax relief or philanthropic recognition.

Advantages:

- Keeps land under local or indigenous control.
- Establishes a permanent conservation mandate.
- Allows for partial tax deductions or investor recognition without full divestiture.

Challenges:

- Requires a robust legal framework for enforcement and governance.
- Long-term monitoring and compliance costs.
- Easement valuation must be carefully substantiated using defensible ESVD metrics.

Carbon Credits via REDD+ With ESVD as Baseline

While ESVD encompasses a broader range of services, it can also serve as a baseline valuation for carbon sequestration, providing a defensible metric to enhance the credibility of a REDD+ certification process. The land could be registered for carbon credits and used to access global offset markets.

Advantages:

- Establishes a recurring revenue stream through voluntary or compliance markets.
- Positions Selva as a project originator in high-integrity carbon markets.
- Builds on emerging integrity frameworks (e.g., Core Carbon Principles, VCMI).

Challenges:

- High certification costs and compliance burdens.
- Volatility in carbon credit prices.
- May require trade-offs with other ecosystem service valuation pathways.

Hybrid Investment Model

Given the complexity and opportunity of the property, a hybrid model may offer the greatest flexibility. For example, portions of the property could be allocated for tax-deductible easements, others for REDD+ carbon credit generation, while the overall valuation model provides a unified narrative for investor engagement.

Advantages:

- Diversifies funding sources and stakeholder value propositions.
- Balances short-term capital needs with long-term ecological returns.
- Allows customization to meet multiple investor and community objectives.

Challenges:

- More complex to structure and govern.
- Requires integrated planning, transparent reporting, and robust stakeholder coordination.
- Risk of strategic dilution if not aligned under a unified investment and conservation vision.

These structuring options demonstrate the financial adaptability of ecosystem service valuation in practice. As biodiversity finance markets evolve, blended strategies like those outlined here may become essential tools—not only to attract private capital, but to ensure that ecosystem protection remains locally controlled, scientifically grounded, and globally relevant.

CONCLUSION AND FUTURE DIRECTIONS

This study contributes to the growing field of ecosystem-based investment and sustainability finance by demonstrating how standardized valuation methods—specifically, the Benefit Transfer Method (BTM) using data from the Ecosystem Services Valuation Database (ESVD)—can inform practical decision-making for conservation-oriented land use. By comparing alternative scenarios for a 60-hectare property in the Ecuadorian Amazon, we highlight the considerable economic value of ecosystem services beyond market-accessible metrics like carbon and show how these valuations can be leveraged to guide investment structuring, policy development, and long-term stewardship strategies.

The analysis underscores two interrelated insights. First, when properly quantified, ecosystem services constitute a high-value asset class, one that is often underrecognized in conventional financial planning. Second, valuation alone is insufficient without mechanisms for capital mobilization, benefit-sharing, and institutional alignment. Whether through tax-deductible contributions, conservation easements, REDD+ certifications, or hybrid investment models, the translation of ecological value into financeable instruments requires an integrated strategy that balances credibility, equity, and operational feasibility.

In doing so, this work not only offers a replicable framework for similar initiatives across biodiversity-rich landscapes but also contributes to broader conversations about the future of nature-based finance, GEP integration, and post-carbon economic models. As the carbon market undergoes a period of recalibration—with new integrity standards, geopolitical shifts, and emergent risks—this study reinforces the importance of diversified valuation portfolios and multi-service conservation strategies. The risks of relying on carbon-centric mechanisms alone are increasingly evident, not just in terms of market volatility but also in equity and governance challenges.

Looking ahead, several avenues for future research emerge. First, there is a need for comparative studies across tropical forest regions to benchmark valuation outcomes and test the transferability of ESVD-based estimates under varying ecological, legal, and socio-economic contexts. Second, longitudinal studies could help evaluate the performance of different investment models over time, particularly those blending philanthropic, market-based, and community co-financing approaches. Third, future research might explore how national accounting systems—such as those aligned with SEEA and GEP frameworks—can integrate ecosystem service values into fiscal policy and infrastructure planning, including debt-for-nature swaps and biodiversity-linked sovereign instruments.

Finally, a critical frontier lies in the co-development of valuation tools and financial strategies with indigenous and local communities, ensuring that conservation finance is not only ecologically effective but also socially transformative. As biodiversity loss accelerates and global finance seeks alignment with sustainability goals, valuation-informed decision-making offers a practical and scalable path forward—grounded not only in economic theory, but in the real assets of living systems and shared planetary futures.

REFERENCES

Acharya, R.P., Maraseni, T., & Cockfield, G. (2019). Global trend of forest ecosystem services valuation — An analysis of publications. *Ecosystem Services*, *39*, 100979. https://doi.org/10.1016/j.ecoser.2019.100979

Aguirre-Gutiérrez, J., Stevens, N., & Berenguer, E. (2023). Valuing the functionality of tropical ecosystems beyond carbon. *Science & Society*, *38*(12), 1109–1111. http://doi.org/10.1016/j.tree.2023.08.012

Brander, L.M., de Groot, R., Guisado Goñi, V., van 't Hoff, V., Schägner, P., Solomonides, S., . . . Sinclair, M. (2024). Ecosystem Services Valuation Database (ESVD). Foundation for Sustainable Development and Brander Environmental Economics. Retrieved from https://www.esvd.net/

Costanza, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., . . . van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, *387*(6630), 253–260. https://doi.org/10.1038/387253a0

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., . . . Shirayama, Y. (2018). Assessing nature's contributions to people. *Science*. https://doi.org/aap8826

DiPerna, P. (2023). *Pricing the Priceless: The Financial Transformation to Value the Planet, Solve the Climate Crisis, and Protect Our Most Precious Assets.* United Kingdom: Wiley.

Dasgupta, S.P. (2021). *The Economics of Biodiversity: The Dasgupta Review.* London: HM Treasury. Retrieved from https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review

Daily, G.C., & Ruckelshaus, M. (2022). 25 years of valuing ecosystems in decision-making. *Nature*, *606*(7914), 465–466. https://doi.org/10.1038/d41586-022-01480-x

De Groot, R., Moolenaar, S., De Vente, J., De Leijster, V., Ramos, M.E., Robles, A.B., . . . Verweij, P. (2022). Framework for integrated Ecosystem Services assessment of the costs and benefits of large scale landscape restoration illustrated with a case study in Mediterranean Spain. *Ecosystem Services*, *53*, 101383. https://doi.org/10.1016/j.ecoser.2021.101383

Fisher, B., Costanza, R., Turner, R.K., & Paul, M. (2007). Defining and classifying ecosystem services for decision making, *CSERGE Working Paper EDM*, *No. 07-04*, University of East Anglia, The Centre for Social and Economic Research on the Global Environment (CSERGE), Norwich. Retrieved from https://hdl.handle.net/10419/80264

Fletcher, A., & Christin, Z. (2015). *The Value of Nature's Benefits in the St. Louis River Watershed.* Earth Economics, Tacoma, WA. Retrieved from https://www.pca.state.mn.us/sites/default/files/wq-rulecl2-2122l.pdf

Forest Trends. (2024). *A Market in Transition.* Retrieved from https://www.forest-trends.org/rd_series/resilience-dispatch-36-a-market-in-transition/

IPBES. (2019). Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. In E.S. Brondizio, J. Settele, S. Díaz, & H.T. Ngo (Eds.), *IPBES Secretariat*. Bonn, Germany. https://doi.org/10.5281/zenodo.3831673

IPBES. (2024). Annex I to decision IPBES-11/1 Scoping report for a second global assessment of biodiversity and ecosystem services. *IPBES Secretariat.* Bonn, Germany. Retrieved from https://files.ipbes.net/ipbes-web-prod-public-files/2025-02/annex_1_decision_ipbes11_1_en_ADVANCE.pdf

Kleemann, J., Koo, H., Hensen, I., Mendieta-Leiva, G., Kahnt, B., Kurze, C., . . . Fürst, C. (2022). Priorities of action and research for the protection of biodiversity and ecosystem services in continental Ecuador. *Biological Conservation*, *265*, 109404. https://doi.org/10.1016/j.biocon.2021.109404

Lee, S. (2025). An Offsets Rumble in the Jungle. *Bloomberg*. Retrieved from https://www.bloomberg.com/news/newsletters/2025-01-08/an-offsets-rumble-in-the-jungle

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., & Montes, C. (2014). Trade-offs across value-domains in ecosystem services assessment. *Ecological Indicators*, *37*, 220–228. https://doi.org/10.1016/j.ecolind.2013.03.003

McElwee, P., & Shapiro-Garza, E. (2020). Ecosystem Services. *International Encyclopedia of Human Geography* (Second Edition), pp. 45–50. https://doi.org/10.1016/B978-0-08-102295-5.10781-4

Millennium Ecosystem Assessment (MEA). (2005). *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC. Retrieved from https://www.millenniumassessment.org/documents/document.356.aspx.pdf

Ouyang, Z., Song, C., Zheng, H., Polasky, S., Xiao, Y., Bateman, I.J., . . . Daily, G.C. (2020). Using gross ecosystem product (GEP) to value nature in decision making. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(25), 14593. https://doi.org/10.1073/pnas.1911439117

Van Raalte, D., & Ranger, N. (2023). *Financing Nature-Based Solutions for Adaptation at Scale: Learning from Specialised Investment Managers and Nature Funds*. Global Center on Adaptation and Environmental Change Institute, University of Oxford. Retrieved from https://www.eci.ox.ac.uk/sites/default/files/2023-12/Financing_NbS_for_Adaptation-GCAOxford2023-finalv2.pdf

Vári, Á., Podschun, S.A., Erős, T., Hein, T., Pataki, B., Iojă, I.-C., . . . Báldi, A. (2022). Freshwater systems and ecosystem services: Challenges and chances for cross-fertilization of disciplines. *Ambio*, *51*, 135–151. https://doi.org/10.1007/s13280-021-01556-4

West, T.A.P., Wunder, S., Sills, E.O., Börner, J., Rifai, S.W., Neidermeier, A.N., . . . Kontoleon, A. (2023). Action needed to make carbon offsets from forest conservation work for climate change mitigation. *Science*. https://doi.org/ade3535

WWF. (2022). Living Planet Report 2022 – Building a nature-positive society. In R.E.A. Almond, M. Grooten, D. Juffe Bignoli, & T. Petersen (Eds.). Gland, Switzerland. Retrieved from https://wwfint.awsassets.panda.org/downloads/embargo_13_10_2022_lpr_2022_full_report_single_page_1.pdf

Zheng, H., Wu, T., Ouyang, Z., Polasky, S., Ruckelshaus, M., Wang, L., . . . Daily, G.C. (2023). Gross ecosystem product (GEP): Quantifying nature for environmental and economic policy innovation. *Ambio*, *52*(12), 1952–1967. https://doi.org/10.1007/s13280-023-01948-8