Beyond Carbon: Navigating the Path to Biodiversity Credits for Climate Action and Ecosystem Conservation

Grateful Foundation

Working Paper
January 8th, 2024

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ABSTRACT

As the global community grapples with the escalating challenges posed by climate change, the urgency to develop innovative and sustainable financial mechanisms has become paramount. This paper explores the evolution of climate finance, particularly the transition from conventional carbon credits to a broader framework encompassing biodiversity credits. By integrating biodiversity considerations into the financial landscape, this paper aims to elucidate the potential for a more holistic and effective approach to mitigating climate change and promoting ecosystem conservation.
The incorporation of biodiversity credits into climate finance is posited as a multifaceted solution that not only addresses carbon emissions but also promotes the conservation and restoration of ecosystems.
Moreover, the paper explores the intersection of blockchain technology and artificial intelligence (AI) in the context of biodiversity conservation through the innovative concept of biodiversity credits. These credits serve as a financial instrument, attracting support for projects aimed at safeguarding ecosystems, with a particular focus on the tropical forests.

"Look closely at Nature. Every species is a masterpiece, exquisitely adapted to the particular environment in which has survived. Who are we to destroy or even diminish biodiversity?" E.O. Wilson

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THE RISE OF CLIMATE FINANCE

Climate finance (also known as sustainable finance or green finance) is a financial activity that aims to safeguard the environment by bridging the gap between the financial industry and environmental protection. It refers to financial mechanisms aimed at generating, promoting, and supporting long-term production activity which has positive externalities and it is dedicated to addressing issues like pollution, and the greenhouse effect and promoting economic society coordination.

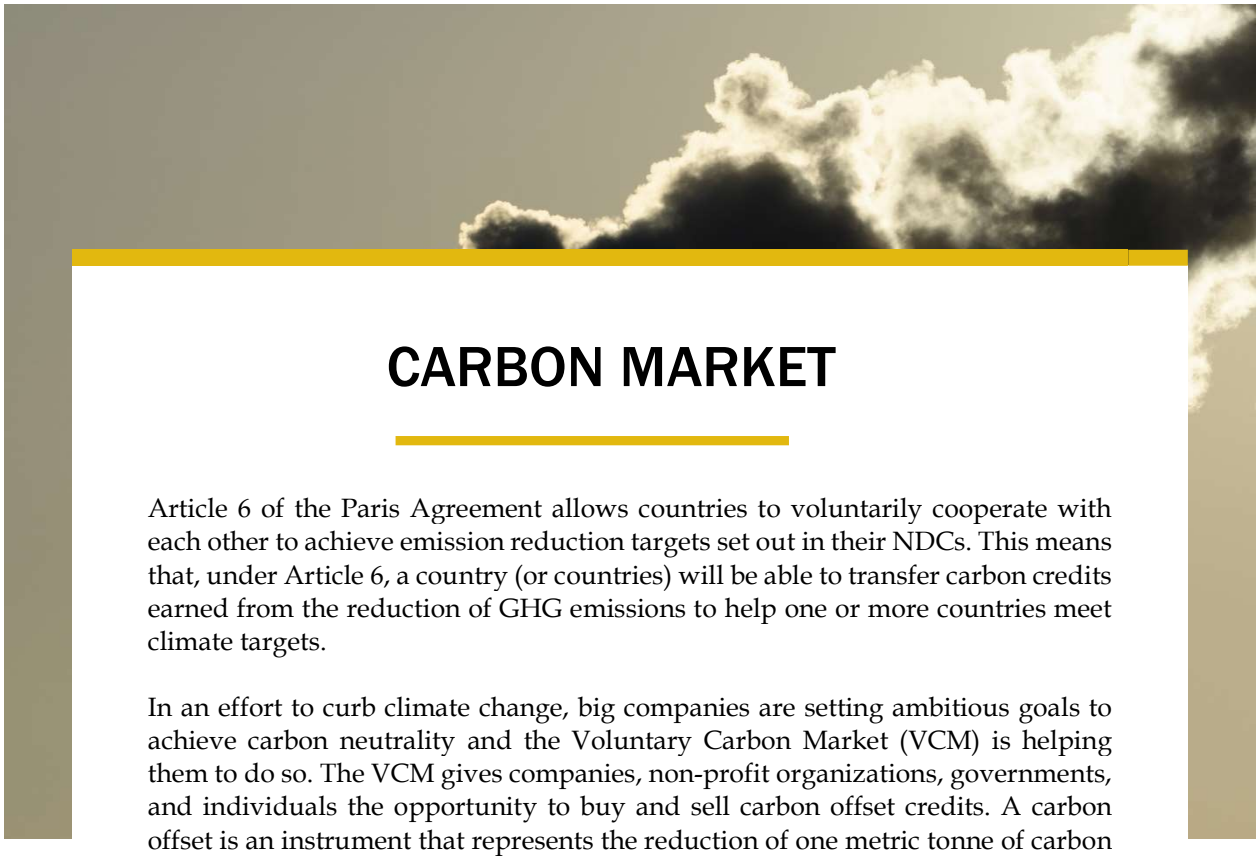
For three reasons, Climate Finance is essential:

To begin with, it supports long-term sustainable development. This means that financial instruments and related services facilitate the development and implementation of sustainable business models, investment, trade, economic, environmental, and social projects, and policies.

Secondly, it encourages banks to innovate while also reducing the danger of ecological policy violations, if a borrowing company is penalized for breaking environmental rules, its profitability and repayment capabilities will suffer, increasing the bank's or lender's risk. Following the financial crisis of 2008, businesses have prioritized economic, environmental, and social coordination over growth in shareholder value.

Climate finance promotes inclusion, gaining more users while decreasing capital costs, because Fintech businesses excel at both personalized and precise marketing. Moreover, Fintech consumers are numerous because they benefit from additional channels and reduced client acquisition costs.

While banks already have capital and brand advantages, as well as cheap lending costs, Fintech can improve a bank's ability to recognize and manage risks.
To reduce increased costs of conducting due diligence on potential investments banks can take assistance from Fintech. Combining big data with the data already available on green projects gathered by banks makes it possible to integrate information on environmental violations.



CARBON MARKET

Article 6 of the Paris Agreement allows countries to voluntarily cooperate with each other to achieve emission reduction targets set out in their NDCs. This means that, under Article 6, a country (or countries) will be able to transfer carbon credits earned from the reduction of GHG emissions to help one or more countries meet climate targets.

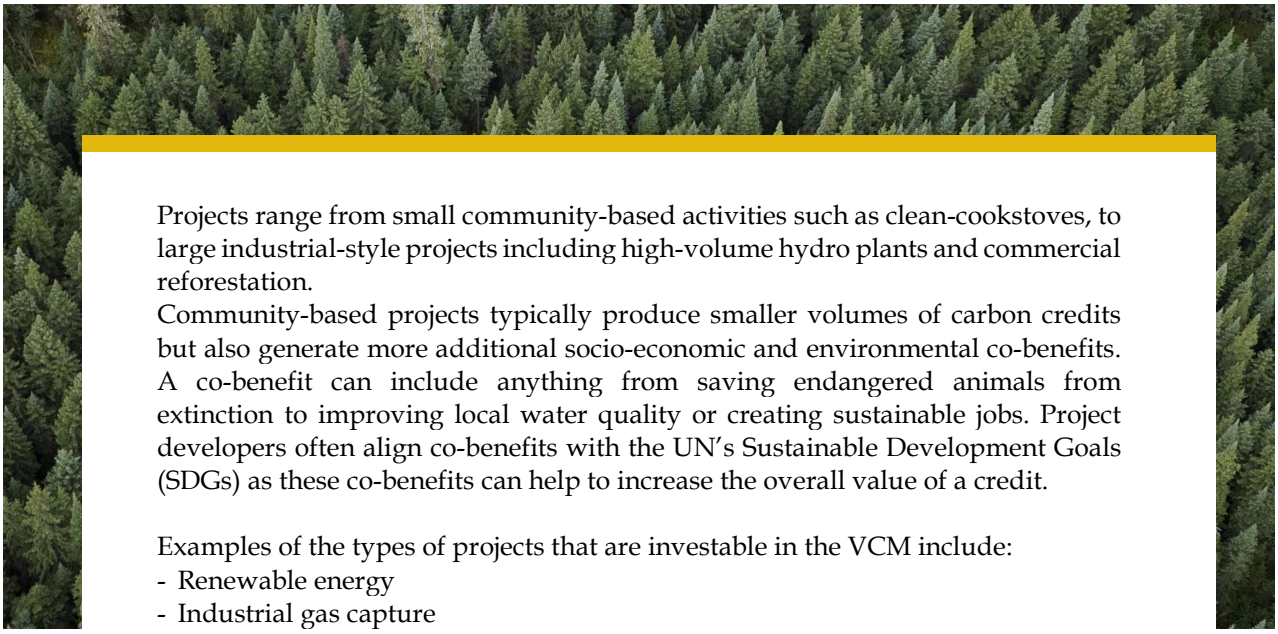
In an effort to curb climate change, big companies are setting ambitious goals to achieve carbon neutrality and the Voluntary Carbon Market (VCM) is helping them to do so. The VCM gives companies, non-profit organizations, governments, and individuals the opportunity to buy and sell carbon offset credits. A carbon offset is an instrument that represents the reduction of one metric tonne of carbon dioxide or GHG emissions. To put this in perspective, to capture one ton of CO2 emissions you would have to grow approximately 50 trees for one-year.

Companies that are unable to reach their greenhouse gas (GHG) emission targets can purchase carbon offset credits by investing in environmental projects that can avoid, reduce, or remove carbon emissions. The compliance market is regulated by national, regional, or international carbon reduction regimes. These markets operate under a cap-and-trade system where only a certain amount of 'allowances' (basically a permit that 'allows' you to emit GHGs) are created. This then limits the amount of GHGs that a country or industry can emit.

The cap represents a finite supply of allowances. You can't create or remove allowance but they can be traded. If an industry is able to achieve its mandated targets or, better yet, if they emit less than their allowance, it can sell the extra credits to someone else. The ability to trade surplus credits can financially motivate participants to reduce their overall emissions.

The voluntary carbon market functions outside of the compliance market. Those that participate in this market don't need to reduce their emissions, it's entirely voluntary. Many companies participate because they feel it is the socially responsible thing to do, because of shareholder pressure, or because it's a good PR move.

The VCM offers a wide variety of environmental projects to interested investors. The goal of all of these projects is to reduce or remove GHG emissions or carbon dioxide from the atmosphere.

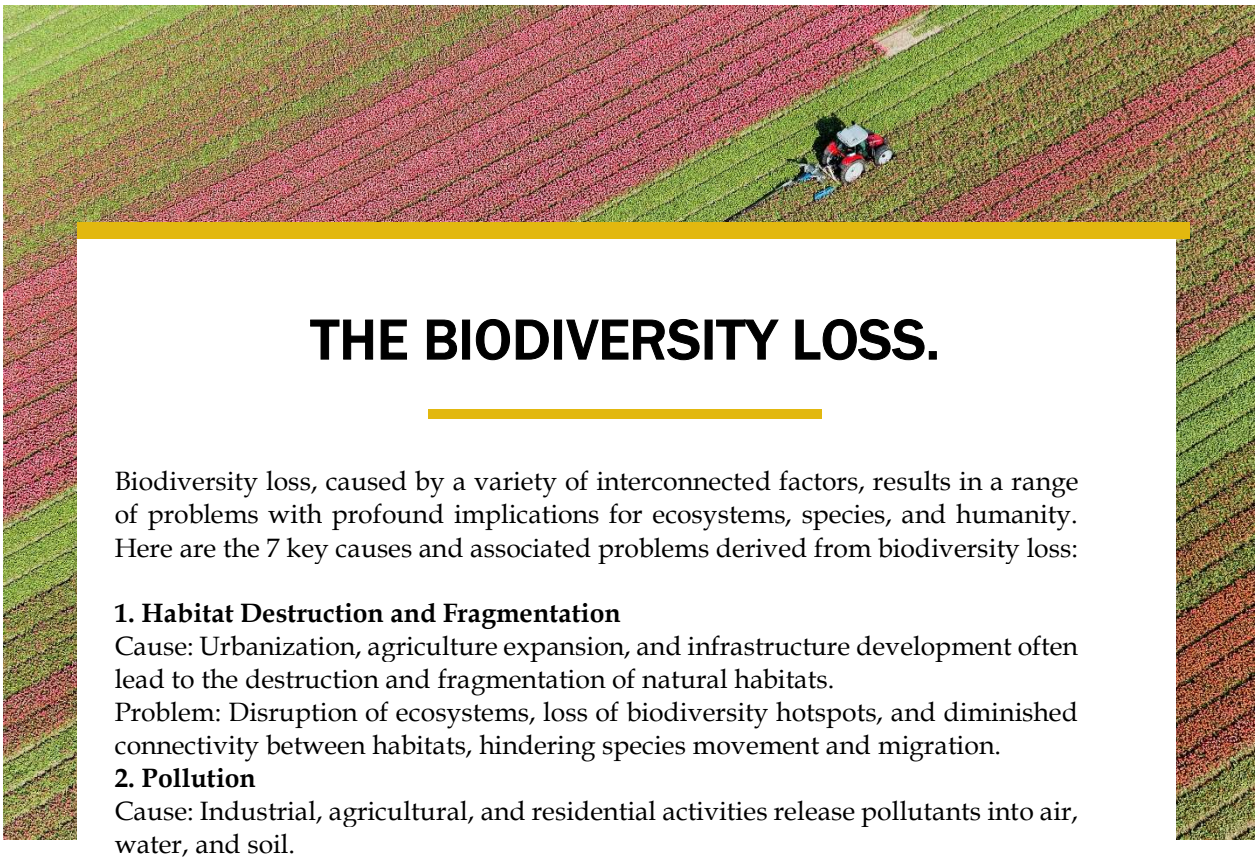


Projects range from small community-based activities such as clean-cookstoves, to large industrial-style projects including high-volume hydro plants and commercial reforestation.
Community-based projects typically produce smaller volumes of carbon credits but also generate more additional socio-economic and environmental co-benefits. A co-benefit can include anything from saving endangered animals from extinction to improving local water quality or creating sustainable jobs. Project developers often align co-benefits with the UN's Sustainable Development Goals (SDGs) as these co-benefits can help to increase the overall value of a credit.

Examples of the types of projects that are investable in the VCM include:
- Renewable energy
- Industrial gas capture
- Energy efficiency
- Forestry initiatives (avoiding deforestation)
- Clean water
- Regenerative agriculture
- Wind power
- Biogas
- Oil recycling
- Solar power
- Water filters

The pricing of carbon credits in the VCM is not as straightforward as it is in the compliance market. This is due to the many types of environmental projects that are available. Prices vary widely according to the category of the project (e.g. renewable energy vs. forestry) and even within a particular category.
There are a number of standards that use different methodologies for measuring and verifying carbon emission reduction. These standards provide a robust verification process to ensure the credibility of emission reduction projects. The most widely used standard include:
- Verra (The Verified Carbon Standard)
- Plan Vivo
- The Gold Standard
- The American Carbon Registry
- Climate Action Reserve

The purchase and sale of carbon offsets are conducted through carbon offset markets.
But it's important to underline that carbon offsets are the last recommended steps in the scale and scope of possible climate actions. Achieving carbon reductions is the priority, with offsets only to neutralise emissions that cannot be reduced. The number of offsets to purchase should be determined through carbon footprint or life-cycle analyses.
It is critical to recognise carbon offsets as a solution, not the solution, with benefits and pitfalls. Yet, they form a crucial mechanism that helps nudge organisations and communities in developing countries towards the triple bottom line. After all, the idea behind offsets is indeed that of balance.



THE BIODIVERSITY LOSS.

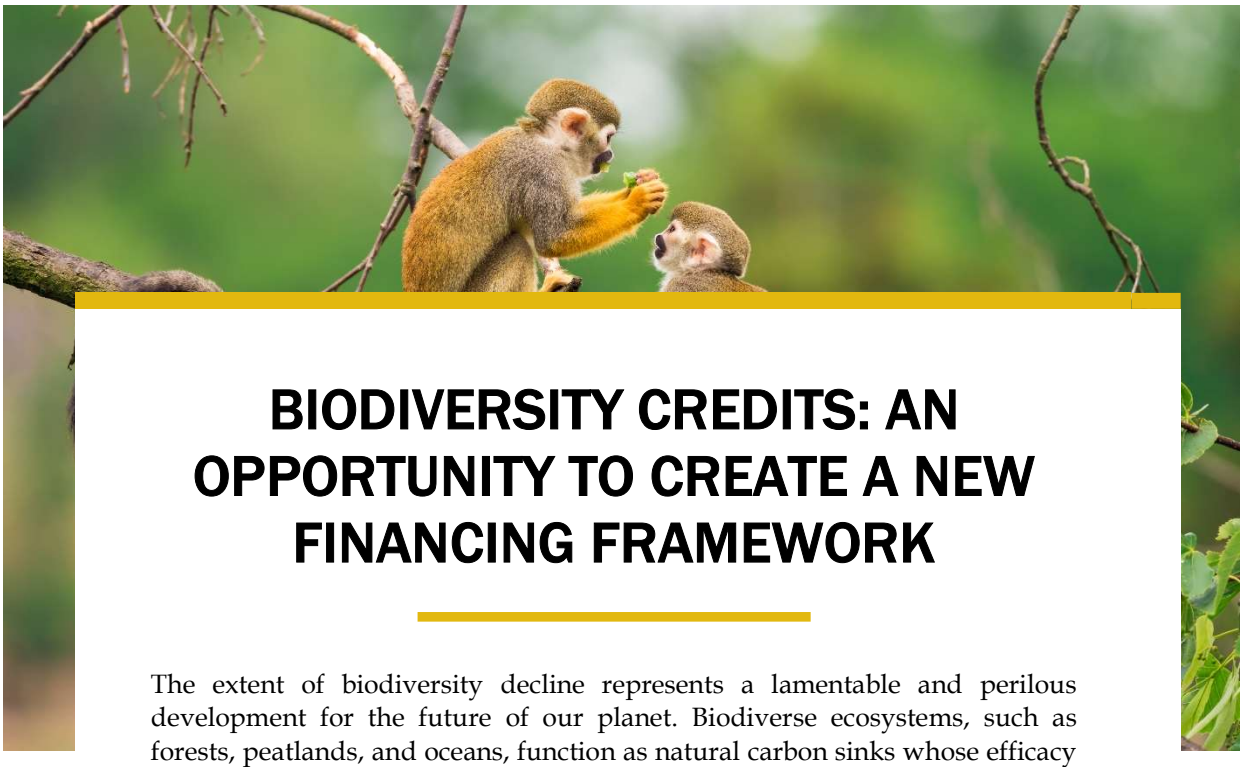
Biodiversity loss, caused by a variety of interconnected factors, results in a range of problems with profound implications for ecosystems, species, and humanity. Here are the 7 key causes and associated problems derived from biodiversity loss:

1. Habitat Destruction and Fragmentation
Cause: Urbanization, agriculture expansion, and infrastructure development often lead to the destruction and fragmentation of natural habitats.
Problem: Disruption of ecosystems, loss of biodiversity hotspots, and diminished connectivity between habitats, hindering species movement and migration.
2. Pollution
Cause: Industrial, agricultural, and residential activities release pollutants into air, water, and soil.
Problem: Adverse effects on species health, reproductive success, and habitat quality, resulting in population decline and ecosystem imbalances.
3. Climate Change
Cause: Human activities, such as burning fossil fuels and deforestation, contribute to the release of greenhouse gases, causing global temperature rise.
Problem: Altered climate patterns, habitat degradation, and stress on species unable to adapt quickly, leading to population decline and potential extinctions.
4. Overexploitation of Resources
Cause: Unsustainable hunting, fishing, logging, and harvesting of wildlife and plants for commercial or subsistence purposes.
Problem: Decline or depletion of targeted species, disruption of food chains, and negative impacts on dependent communities.
5. Invasive Species
Cause: Human-introduced species that outcompete or prey upon native species.
Problem: Displacement of native species, loss of biodiversity, and disruptions to ecosystem functions.
6. Disease
- Cause: Increased global movement of people and goods facilitates the spread of diseases among wildlife and between wildlife and humans.
- Problem: Epidemics among species, population declines, and potential transmission of diseases to humans.

7. Human Population Growth
- Cause: Increasing global population and associated demands for resources.
- Problem: Greater pressure on ecosystems, leading to habitat conversion, overconsumption, and increased competition for resources.

The consequences of biodiversity loss extend beyond environmental concerns to encompass economic, social, and cultural dimensions. Mitigating these challenges requires comprehensive strategies that address the root causes and promote sustainable coexistence with the natural world.

Biodiversity loss by Geographical Area 1970-2023. WWF, 2023



BIODIVERSITY CREDITS: AN OPPORTUNITY TO CREATE A NEW FINANCING FRAMEWORK

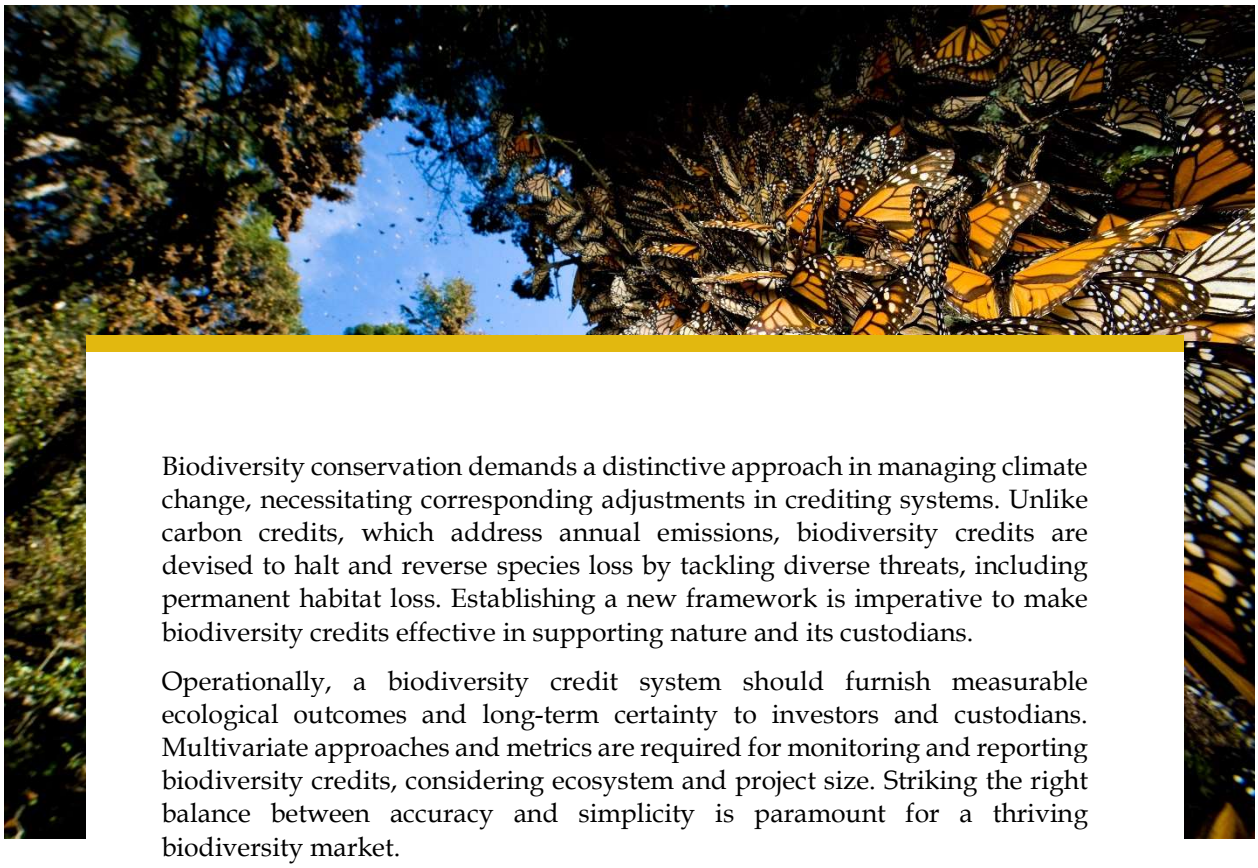
The extent of biodiversity decline represents a lamentable and perilous development for the future of our planet. Biodiverse ecosystems, such as forests, peatlands, and oceans, function as natural carbon sinks whose efficacy diminishes when under threat. Urgent measures are imperative to reverse this detrimental trend and safeguard our planet.

Unlike carbon or biodiversity offsets, which are payments made by a business to compensate for its damaging impacts on location-specific ecosystems, biodiversity credits allow companies to support nature-positive action, funding long-term conservation and restoration of nature, a higher order contribution than simply offsetting negative impact.

Voluntary biodiversity credits, signifying proactive investments from entities ranging from companies to nations and individuals for wildlife protection, could prove instrumental. However, their efficacy is contingent upon proper utilization. Drawing from the lessons of the carbon credit market, the biodiversity credit market should establish a transparent, accountable, and inclusive system from its inception.

It is crucial to recognize that biodiversity credits complement rather than compete with carbon offsets. They are designed to collaborate with the carbon market, enabling funding to reach even the smallest climate change mitigation projects aimed at protecting endangered ecosystems. Learning from the shortcomings of carbon counterparts is pivotal as biodiversity plays a pivotal role in climate action, leaving no room for delays.

While carbon offsets, despite their potential, have not fully realized their capabilities due to issues such as intermediaries, financial opacity, and a lack of standardization, replicating these pitfalls in the biodiversity market would jeopardize its future.



Biodiversity conservation demands a distinctive approach in managing climate change, necessitating corresponding adjustments in crediting systems. Unlike carbon credits, which address annual emissions, biodiversity credits are devised to halt and reverse species loss by tackling diverse threats, including permanent habitat loss. Establishing a new framework is imperative to make biodiversity credits effective in supporting nature and its custodians.

Operationally, a biodiversity credit system should furnish measurable ecological outcomes and long-term certainty to investors and custodians. Multivariate approaches and metrics are required for monitoring and reporting biodiversity credits, considering ecosystem and project size. Striking the right balance between accuracy and simplicity is paramount for a thriving biodiversity market.

Biodiversity credits must incorporate meaningful time horizons to represent conservation outcomes effectively. This entails incorporating permanence and durability components, such as conserving or restoring habitat for a specified duration or perpetuity.

Biodiversity credits, unlike carbon credits, are generated in collaboration with nature and the people safeguarding ecosystems, necessitating considerations of local social and ecological processes.

The potential of biodiversity credits in contributing to global biodiversity goals hinges on the financial needs of stakeholders, underwritten by long-term financial security and legal guarantees. Aligning process milestones, ecological milestones, and performance-based payment schedules is vital for demonstrating conservation results and unlocking incentives.

With people and communities at their core, biodiversity credit systems should adopt participatory monitoring processes that engage local communities in meaningful discussions. Transparency in land tenure arrangements and funding flows is crucial for investor assurance. Credit prices should cover the true cost of management to ensure fair compensation for all involved parties.

Preservation and restoration of natural ecosystems should be eligible crediting activities to meet Global Biodiversity Framework targets. The distinct ecological value of conservation credits may enhance their market value. Efficient corporate sector contribution requires well-designed tools, and the success of biodiversity and climate challenges is interdependent. Biodiversity markets demand bespoke arrangements, recognizing the unique nature of biodiversity conservation alongside existing ecological markets. Both challenges necessitate success for the greater benefit of our planet.

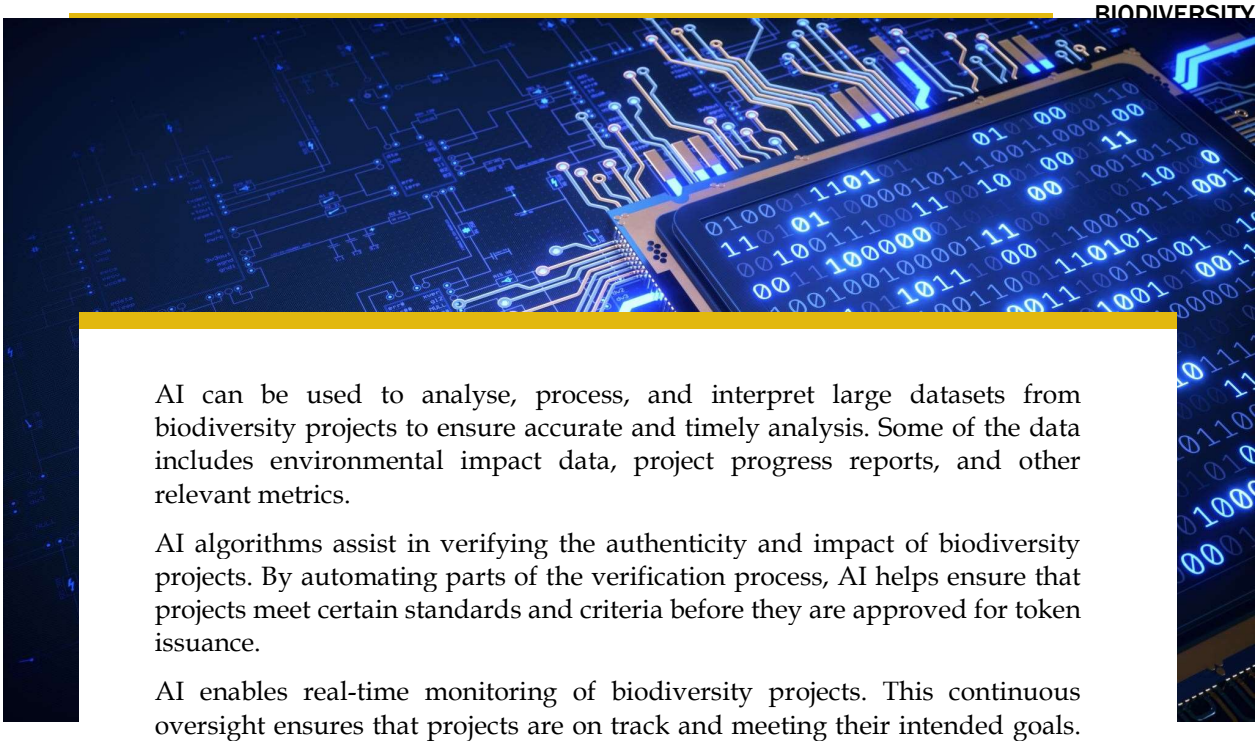
BLOCKCHAIN AND AI FOR EMPOWERING BIODIVERSITY CONSERVATION

Biodiversity credits are a conservation finance mechanism that allows individuals, companies, or governments to invest in and support biodiversity conservation projects. These projects aim to protect and restore ecosystems, often in areas facing threats such as deforestation or habitat destruction. Blockchain technology and AI can be integrated into the issuance and tracking of biodiversity credits to enhance transparency, traceability, and efficiency.

Let's consider an example related to the conservation of a tropical ecosystem, such as the Amazon rainforest. In this scenario, a conservation organization initiates a project to protect a specific area of the rainforest that is at risk due to logging, agricultural expansion, or other threats. The organization can issue biodiversity credits as a way to attract financial support for their conservation efforts.

Through blockchain technology and AI, it is possible to create a transparent and accessible system where individuals can directly invest in biodiversity projects, earning returns while safeguarding the planet's precious natural heritage.

By opening the market to consumers, biodiversity tokens have the potential to mobilise a larger segment of the population towards conservation efforts. Biodiversity Tokens are designed for easier access and lower entry points, allowing individual consumers to participate directly. This broad-based participation can have a more significant cumulative impact on biodiversity conservation compared to the more limited B2B carbon market.



AI can be used to analyse, process, and interpret large datasets from biodiversity projects to ensure accurate and timely analysis. Some of the data includes environmental impact data, project progress reports, and other relevant metrics.

AI algorithms assist in verifying the authenticity and impact of biodiversity projects. By automating parts of the verification process, AI helps ensure that projects meet certain standards and criteria before they are approved for token issuance.

AI enables real-time monitoring of biodiversity projects. This continuous oversight ensures that projects are on track and meeting their intended goals. Any deviations or issues can be quickly identified and addressed.

Integrating AI with blockchain technology enhances transparency and accountability in the token issuance process. AI can help in tracking the flow of tokens from issuance to utilisation, ensuring that they are used for their intended purpose.

AI can be used for predictive analytics, helping to forecast the potential impact and success of future biodiversity projects. This can guide decision-making and resource allocation.

Biodiversity tokens would serve as a tangible measure of the community's commitment to environmental stewardship, turning their efforts into points of pride. This approach would inspire and fund initiatives that have a direct impact on those most affected by climate change.

By linking biodiversity tokens to groups of specific conservation actions and outcomes, we can create a feedback loop that encourages ongoing environmental stewardship. Communities can see the direct benefits of their actions, not just in terms of environmental health but also in economic rewards and recognition. This model promotes deeper engagement with conservation efforts, fostering a sense of ownership and pride in sustainable practices.t investments are made in projects with the highest potential for positive impact.

EXAMPLE: ENHANCING THE TRANSPARENCY OF BIODIVERSITY CREDIT MARKET WITH BLOCKCHAIN TECHNOLOGY

To explain the use of blockchain technology in the biodiversity credits market, below is an example of the tokenization process of tropical forest conservation projects:

Project Identification and Verification:

- The conservation organization identifies a specific area within the tropical ecosystem that requires protection and restoration.
- Through satellite imagery, on-site surveys, and other verification methods, the organization ensures the legitimacy of the conservation project.

Smart Contracts on the Blockchain:

- Smart contracts are created on a blockchain platform, specifying the terms and conditions of the biodiversity credits.
- The smart contracts automatically execute transactions when predefined conditions are met, providing transparency and trust in the system.

Tokenization of Biodiversity Credits:

- Biodiversity credits are tokenized on the blockchain, representing the financial value and environmental impact of the conservation efforts.
- Each token corresponds to a specific unit of biodiversity credit, making it easier to track and trade on the blockchain.

Transaction and Funding:

- Interested individuals, companies, or governments can purchase these biodiversity credits using cryptocurrency or fiat currency.
- Transactions are recorded on the blockchain, ensuring transparency and providing a clear trail of funds.

Traceability and Monitoring:

- The blockchain maintains a transparent and immutable record of transactions and project milestones.
- Stakeholders can monitor the progress of the conservation project, ensuring that the funds are used for their intended purpose.

Verification of Impact:

- As the conservation project progresses, the organization regularly updates the blockchain with information on biodiversity improvements, reforestation activities, and other relevant data.
- Independent third parties or auditors can verify the impact by accessing the blockchain records.

Marketplace for Biodiversity Credits:

- A marketplace on the blockchain allows the trading of biodiversity credits between different parties.
- This secondary market encourages liquidity and flexibility in the conservation finance ecosystem.

By leveraging blockchain technology, this example demonstrates how biodiversity credits can be issued, traded, and monitored in a secure and transparent manner, ultimately contributing to the conservation of tropical ecosystems.

EXAMPLE: RECORDING SOUNDS OF NATURE WITH AI

AI-powered systems can be employed to record and identify the sounds of nature, including different species of animals, for the purpose of assessing and monitoring biodiversity in a given area. This approach is often referred to as acoustic monitoring or bioacoustics. Here's a step-by-step explanation of how AI can be utilized for this task:

Audio Recording Devices: Deploy audio recording devices, such as microphones or acoustic sensors, in the monitored area. These devices should be strategically placed to capture a representative sample of the ecosystem.

Continuous Recording: Set up the recording devices to operate continuously, capturing ambient sounds in the environment. This could include sounds from birds, insects, mammals, amphibians, and other wildlife.

Data Collection: Collect a large dataset of audio recordings over an extended period. The dataset serves as the input for training and developing the AI model.

Labeling and Training: Annotate the audio recordings with information about the species present in each recording. This labeled dataset is then used to train a machine learning model.

Machine Learning Model: Develop a machine learning model, often based on deep learning techniques, that can analyze audio patterns and identify the distinct sounds associated with different species. Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) are commonly used for this purpose.

Feature Extraction: Extract relevant features from the audio data, such as frequency, duration, and amplitude patterns, which can be used as input features for the machine learning model.

Training the Model: Train the machine learning model on the labeled dataset, allowing it to learn the acoustic patterns associated with various species. The model should be able to distinguish between different types of animal sounds.

Validation and Testing: Validate the trained model using a separate set of audio recordings not used during the training phase. Fine-tune the model if necessary to improve accuracy.

Real-time Monitoring: Implement the AI model in a system that can analyze audio recordings in real-time. As new recordings are obtained, the model identifies the species present in the monitored area.

Biodiversity Assessment: Analyze the results of the AI-based identification to assess the biodiversity of the monitored area. The number and variety of identified species can provide insights into the health and diversity of the ecosystem.

Alerts and Reporting: Implement an alert system that notifies conservationists or researchers of any significant changes in biodiversity levels. Additionally, generate reports that provide detailed information on the identified species and their frequency.

By combining AI with audio recording technology, this approach allows for efficient and continuous monitoring of biodiversity levels in a given area, providing valuable data for conservation efforts and ecosystem management.

INVESTCONSERVATION® BLOCKCHAIN TOKENS PUT A VALUE ON NATURE

IC Tokens® sponsor forest owners to protect precious biodiversity - making it worth more to preserve tropical forests than deforest them. At least 85% per dollar invested goes directly to conservation. Each token is linked to 1 dedicated hectare of tropical forest and the IC Tokens® holder is entitled to the contractual ownership of carbon and biodiversity for 50+ years. The token does not give the right to land ownership. Landowners earn additional royalty, 10% of the purchase price every time tokens are traded. That way landowners continue to benefit from any value gain in the token price.

Donations serve a valuable role in funding conservation. However, we need to scale up quickly and create additional incentives for private financing. Investing in IC Tokens funds conservation but also increases the value of protected reserves, creating an ongoing financial incentive to protect biodiversity. The token holder could gain from increased valuations of biodiversity and/or carbon, while the landowner benefits from the increased value of conservation lands. Landowners also receive a royalty equal to 10% of the purchase price for each follow-on trade of the token. This ensures that the landowner also benefits from potential value appreciations of tokens.

InvestConservation® ensures that more of every dollar invested goes to conservation. Blockchain technology and decentralized ledgers allow for effective contract tracing/security and tradability, reducing costs and eliminating the potential for the same hectare to be sold twice.

Early blockchain technologies such as Bitcoin, operate under a system known as "proof of work" (PoW) and consume an excessive amount of energy. IC Tokens®, are constructed using the Solana blockchain. Solana is designed to be an energy efficient network and employs a "proof of stake" (PoS) mechanism for proofing instead of PoW.

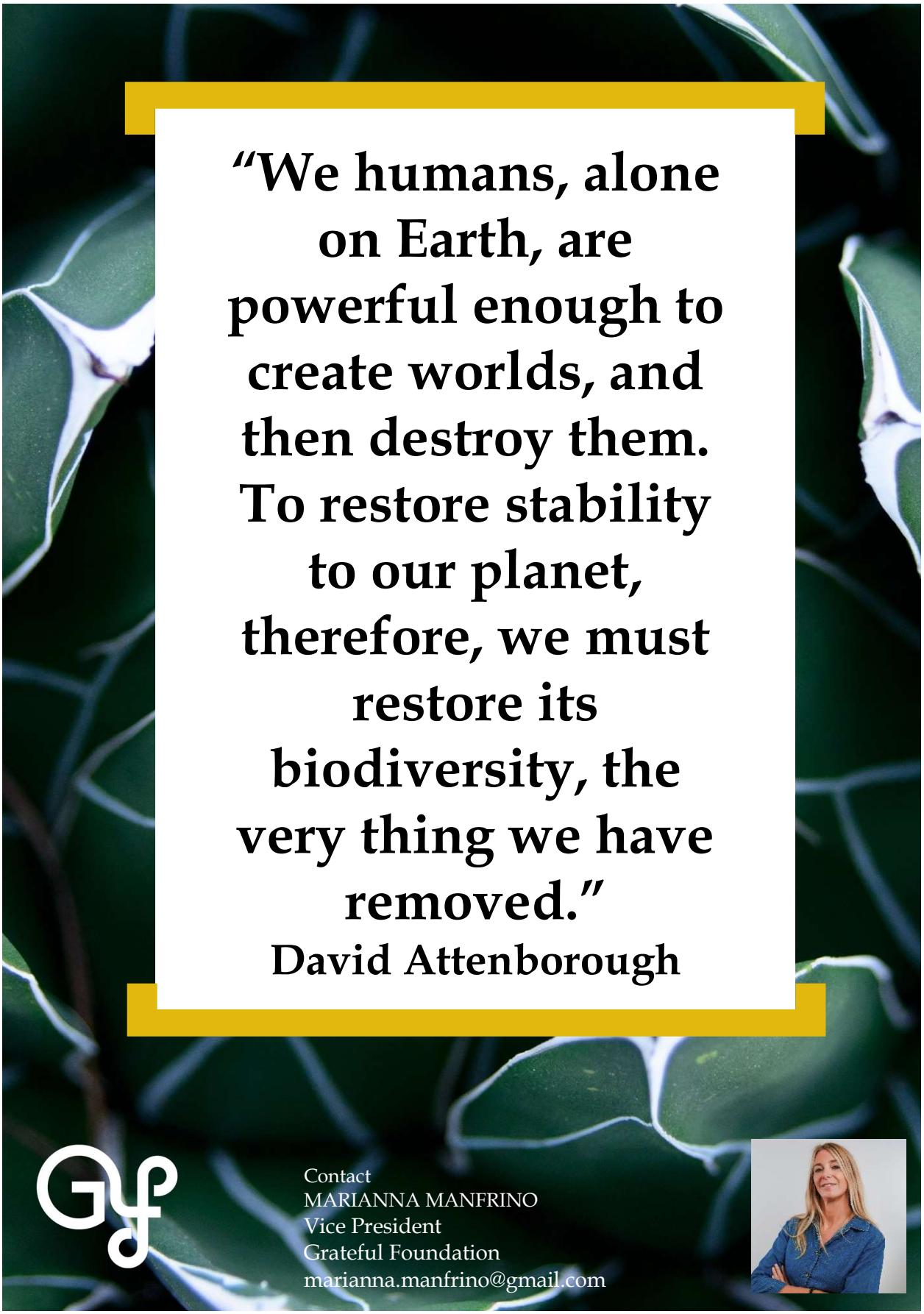
Transactions are the fundamental building block of Solana including purchasing an NFT and making a trade. Solana Foundation Energy use report from 2021 informs that a transaction on Solana takes less energy than two google searches, and 24 times less energy than charging your phone. The energy consumption per transaction with Solana is a mere fraction of that of Bitcoin, being 10 million times smaller.

Project Identification and Verification: InvestConservation® invests in conservation areas that protect at-risk tropical forests. Tropical forests are assessed to meet criteria of including high biodiversity, risk of deforestation, significant sequestered carbon and local capacities for conservation.

Tokenization of Biodiversity Credits: 1 token = 1 hectare linked to a specific hectare of carbon and biodiversity credits ownership. When you buy a tradable token, each token is linked to 1 specific hectare of tropical forest, for the protection of its carbon and biodiversity.

Traceability and Monitoring: More money per dollar (85%) invested than industry averages goes to forest owners to protect nature. Streamlined set-up and blockchain transacting means that up to 85% of every dollar goes directly to landowners, funding conservation. Landowners also earn a 10% royalty every time tokens are traded.

Verification of Impact: Every hectare is monitored via satellite auditing by Orbify®, confirming the forest is intact. Audio scape recorders monitor & quantify external threats (chain saws, hunters) and biodiversity using AI models, building record keeping for species identification.



"We humans, alone on Earth, are powerful enough to create worlds, and then destroy them. To restore stability to our planet, therefore, we must restore its biodiversity, the very thing we have removed."

David Attenborough

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