

Earth Stack: Global Climate Action Infrastructure

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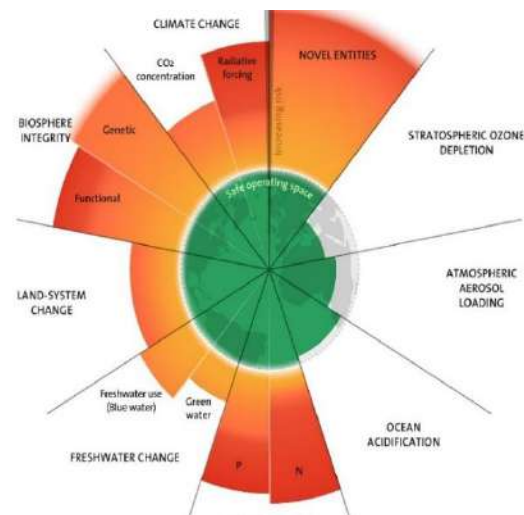
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Abstract

The Earth Stack initiative presents a Digital Public Infrastructure (DPI) [1] approach to addressing global climate action by integrating natural capital into the global economy through a decentralized financial framework known as Finternet [2]. As environmental degradation and biodiversity loss increasingly threaten global economic stability, Earth Stack uses Earth Biometrics—an innovative blend of satellite imaging, eDNA analysis, and AI—to assign measurable value to ecosystems. These values are recorded as digitally verifiable credentials on Finternet, creating a trusted data layer that supports transparency in climate action and enables stakeholders to validate ecological benefits. Furthermore, Earth Stack tokenizes ecosystem services into Nature Tokens, embedding diverse property rights that communities derive from natural resources, such as water purification and carbon sequestration. Governed by regulatory frameworks, these tokens facilitate sustainable financial transactions, unlocking new pathways for green finance and ESG investments. This decentralized, transparent system not only incentivizes ecological preservation but also supports marginalized communities that rely on natural capital. Earth Stack's vision is to build a new economy that values and rewards sustainable practices, setting a foundation for global economic resilience in the face of environmental challenges.

Introduction

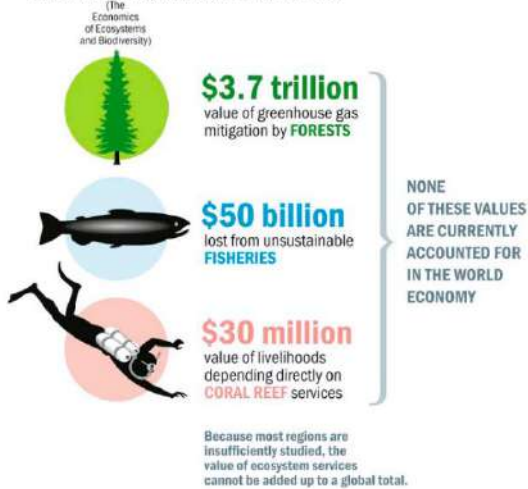
The 20th century borrowed from the future to fuel economic growth—leaving behind climate change, biodiversity loss, and ecosystems on the brink. As of 2023, six of nine planetary boundaries have already been exceeded [3].



As countries like India and China industrialize and as the population of the earth grows to the expected 10+ billion, the planetary impact of humanity will continue to grow. This erosion of Earth's natural capital due to environmental degradation and biodiversity loss poses severe risks to agriculture, water security & public health.

This is not just an environmental issue but also a financial one. Central banks and financial institutions are increasingly recognizing that unchecked environmental degradation can destabilize economies. For example, the collapse of pollination services, essential to agriculture, risks economic losses exceeding \$400 billion annually [4].

The 2010 TEEB report includes these numbers:



Ecosystems such as wetlands, which provide flood protection, help avoid billions in damages annually, further demonstrating their economic significance.

GDP of the Poor: estimates for ecosystem-service dependence

Share of agriculture, forestry, and fisheries in classical GDP



Ecosystem services as a percentage of "GDP of the Poor"



Rural poor population considered in GDP of the Poor
Millions



Source: TEEB for National Policy, 2010; CIA: The World Factbook.

The socioeconomic risks associated with excluding natural assets from economic calculations are now well established. For instance, the degradation of natural capital contributes to increased social and economic inequality, as many rural communities rely on ecosystems for their livelihoods.

When these resources are depleted or undervalued, communities face heightened poverty and vulnerability. Undervaluation of Earth's natural capital also results in insufficient investment in Nature-based Solutions (NbS) and encourages economic activities that harm ecosystems, exacerbating climate change and biodiversity loss.

Preserving Natural Capital is an inherently global challenge since climate, ecosystems and biodiversity do not recognize geopolitical and economic boundaries.

And yet, Natural Capital is highly concentrated in ecological hotspots—regions such as tropical rainforests, wetlands, and coral reefs—that play an outsized role in maintaining global environmental balance. Similarly, coastal ecosystems like mangroves and wetlands not only support biodiversity but also provide natural flood defences, protecting coastal populations and infrastructure from extreme weather events, which are increasing due to climate change.

The Problem

Despite being geographically localized, the degradation of natural ecosystems has global ripple effects, affecting climate stability, food security, and public health across the planet.

The World Bank estimates that biodiversity loss could lead to a global GDP reduction of 2.3% annually, or \$2.7 trillion, by 2030, disproportionately impacting lower-income countries that rely heavily on natural resources [4].

Climate action is thus inherently a coordination challenge. The ecological services provided by these hotspots transcend

national borders, making it imperative that countries and institutions cooperate to safeguard them.

This complex, interdependent system underscores the need for collaborative frameworks that can align environmental conservation with economic activities.

Earth Stack: Building on Finternet

As an interconnected financial infrastructure, Finternet facilitates seamless collaboration between individuals, businesses, and authorities, enabling the efficient exchange of financial instruments tied to natural capital, such as biodiversity credits and nature tokens. The decentralized design of Finternet ensures that these transactions are transparent, traceable, and compliant with regional regulations—critical for addressing the global coordination problem posed by climate action.

By embedding nature into the global economy, Earth Stack leverages Finternet's infrastructure to unlock new channels for green finance, empowering diverse stakeholders to participate in sustainability efforts.

Earth Stack brings together cutting-edge technologies to quantify and integrate natural capital into the financial system.

Earth Biometrics

At its core are Earth Biometrics, which utilize a combination of satellite imaging, eDNA analysis, and artificial intelligence (AI) to create detailed ecological profiles of ecosystems. Satellite imagery provides high-resolution data on land use, vegetation cover, and water quality, enabling continuous monitoring of environmental health across vast regions. eDNA technology enhances these insights by identifying species presence and biodiversity levels within ecosystems, offering granular data about the ecological functions they perform. AI algorithms then analyze these datasets, transforming them

into actionable insights by assigning measurable value to ecosystem services such as carbon sequestration, pollination, and flood mitigation.

These quantified values are recorded as digitally verifiable credentials on Finternet, a decentralized financial infrastructure. Verifiable Credentials (VCs) ensure the authenticity of data by embedding cryptographic proofs that can be independently verified. VCs thus create a trusted data layer that provides transparency, enabling stakeholders to measure and validate the ecological benefits of conservation efforts or carbon sequestration projects in real-time. For example, municipalities could monitor water quality improvements, or businesses could verify biodiversity gains linked to their ESG initiatives, helping them meet compliance goals more effectively.

Nature Tokens

The next component of Earth Stack involves Nature Tokens, which represent the property rights associated with nature and ecosystem services. Formalized property rights enable individuals to unlock economic value from their assets by integrating them into formal markets.

Several property rights associated with natural ecosystems are not digitized limiting the potential of economic mechanisms to sustainability maintain nature. For example, the following property rights, even though they exist are hard to allocate, track and trade thus leaving them out of traditional market mechanisms:

- Rights over sustainable yields from a forest
- Rights to withdraw a specific volume of water
- Rights to fishery yield from oceans and freshwater bodies
- Rights to access genetic resources
- Rights to genetic diversity
- Rights to carbon sequestered
- Rights to water purification services provided by wetlands, rivers

With Nature Tokens, Earth Stack embeds property rights into the digital economy, creating new markets for ecosystem services and aligning economic incentives with environmental preservation.

For example, Earth Stack is being piloted in Kodagu region (Southern India) to tokenize access rights of private agricultural land for elephant herds with the objective of reducing human-animal conflict. Organizations purchasing these tokens benefit by receiving green credits and digitally verifiable ESG credentials. This is an example of how Nature Tokens facilitate greater access to CSR capital.

Earth Stack supports non-market mechanisms too wherein Nature Tokens—representing these ecosystem services—can be managed by local communities. In the Kodagu pilot, for example, a certain number of tokens can be claimed without any financial payment by local villagers and tribals in recognition of covering some of the negative externalities these groups may bear to support the elephant corridor.

Future Work: Green Finance

The Earth Stack team is working on creating a programmable framework around Nature Tokens to ensure that public goods are governed inclusively and transparently. As a first step, the team will be developing automated compliance enforcement via smart contracts to manage Nature Tokens efficiently within legal jurisdictions and in compliance with regional and international environmental policies. Future work will expand to cover hybrid market and community models that catalyse the global flow of green finance and ESG-compliant investments, especially for marginalized communities that depend heavily on natural resources.

With Nature Tokens, Earth Stack embeds property rights into the digital economy, creating new markets for ecosystem services and aligning economic incentives with environmental preservation.

Together, Verifiable Credentials and Nature Tokens establish a financial infrastructure where natural capital is seamlessly integrated into economic transactions, enabling the global financial system to recognize and reward sustainable practices. This integrated approach not only promotes ecological preservation but also enhances economic resilience in the face of environmental challenges.

Call To Action

Earth Stack isn't just a framework—it's a movement to redefine how we value our planet. Join us in building the future, today.

References

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