

Fintech for Biodiversity

A global landscape



Green
Digital Finance
Alliance

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1. Introduction

Fintech for Biodiversity: A Global Landscape explores the new and emerging fintech for biodiversity solutions and new and emerging biodiversity datasets offered by digitisation, and discusses how these are (and could be) leveraged to channel more financing to biodiversity conservation. Prepared by the Green Digital Finance Alliance, or GDFA, the report looks at the ways that born digital biodiversity data could be deployed by fintech-powered environmental, social, and governance (ESG) data providers for use in financial decision-making. The report describes ways that digital technologies generally, and fintech specifically, could be harnessed to empower ordinary citizens to embrace biodiversity conservation finance: whether as retail investors via security token offerings, or (in the case of rainforest inhabitants and other relevant local communities) as duly compensated monitors and guardians of biodiversity. *Fintech for Biodiversity* acknowledges the obstacles for financial institutions and capital markets to channel more investment to biodiversity and suggests ways that creative deployment of fintech might overcome some of those obstacles. Finally, the report lays out three specific pathways for change from the current state of play—where biodiversity finance is an afterthought of an afterthought, getting very little of the already small share of ESG investing’s “e”-focused funds—to a state where biodiversity finance is mainstreamed.

At the moment, the only avenues for most people to invest in biodiversity is via charitable donations (which of course are not “investment” as that word is usually understood) or if one happens to be a policyholder in a pension fund that has forestry in its portfolio, something which may or may not have positive biodiversity impacts. The gap between people and nature in the current engagement model for biodiversity finance no doubt partly explains the corresponding gap in funding: a shortfall of USD 300-400 billion each year¹. It tells a story of people and investors who lack the awareness, inspiration, or instruments to direct enough money to habitat protection. Yet at the same time, outside of biodiversity finance, fintech is transforming the way people learn about and are able to engage with investment opportunities via personalization, automated outcome feedback, and game-like interfaces.

Enabling more biodiversity assets to reach capital markets can both increase capital allocation and open that market up to ordinary citizens as secondary market participants. Fintech is currently re-shaping strategies in other verticals for asset classes to reach capital markets. Biodiversity, also, is in urgent need of a digital reimagining of capital market instruments that can respond to the unique features of this asset class. One of those features is size: most biodiversity assets currently find it difficult to scale beyond the USD 5 million mark. Another feature is spatial distribution. Many habitats cover large geographical areas that require proof-of-impact reporting to use spatially-distributed data collection models.

The data chain from point of creation to where it enters into financial decision-making is different for biodiversity than for many other assets. Native-digital biodiversity data is data observed from space or sensors. Its subjects (non-human animals and other species) are living creatures, to be sure, but they are not economic actors. This makes biodiversity datasets different in degree and in kind from, for example, the data footprints delivered by humans whose every mouse click, app launch, smart-speaker command, fitness-tracking decision, and IoT-linked action creates a new personal datapoint which financial service institutions can track, aggregate, and cross-tabulate in countless ways to innovate new services. In addition, most biodiversity data sets are unstructured and tend to be high in complexity, characteristics which complicate matters in some

¹ (2016) *Conservation Finance, From Niche to Mainstream: The Building of an Institutional Asset Class*. Credit Suisse, IUCN, Gordon and Betty Moore Foundation, the Rockefeller Foundation, McKinsey Center for Business and Environment.

ways but also make ideal use cases for AI and machine learning algorithms to detect changes in biodiversity patterns over time in relation to the development of a specific investment such as an infrastructure asset.

Fintech, in the form of e-commerce platforms and mobile wallets, brings data on consumer behaviors, which holds the potential to be leveraged to deliver positive biodiversity impact. Consumers can be offered real time feedback on their consumption choices in ways that make biodiversity impacts personalized, real-time and with the potential to generate network effects via gamification. This may not constitute a financing avenue in the strict sense of the word but represents a way to leverage the data capabilities of fintech to bring nature into people's everyday choices.

This report first maps the current fintech for biodiversity landscape, then looks at the potential to re-purpose fintech from adjacent verticals to innovate biodiversity finance, and then looks specifically at new and emerging data sets offered by digital technology to drive financial decision-making. Its insights can be used to design avenues to apply these emerging approaches to scale biodiversity finance by addressing the specific investment challenges presented by nature-based assets.

2. How we generated the data

The literature and data is vast on financing mechanisms and strategies for biodiversity conservation in general—but not for fintech-enabled mechanisms specifically. Fintech for biodiversity is not yet an established field of practice, so this report could not rely on a desk review of existing literature. Instead data had to be harvested by picking up signals from the fintech landscape and via primary-source interviews with key informants from sampled segments of the financial ecosystem.

For the global landscaping only the category of ‘Native Conservation Fintechs’ was sampled. These are fintechs with a vision and mission to deliver on conservation finance. The definition of a fintech used in the sampling is a business that has a financial transaction activity as part of the business model design. In addition, this report includes software tools that are aimed at financiers and that offer biodiversity data. Even though such tools may not strictly be categorised as fintech (but rather just as tech-enabled), they nevertheless hold the potential to drive financial decision-making in ways that potentially affect biodiversity and thus made sense to include in this report.

The following four sampling strategies were deployed for the landscaping:

- a Fintech for Biodiversity Challenge administered by GDFA in 2019
- screening accelerators
- screening of AngelList and Twitter
- general web searches

A total of 60 fintechs were identified. This sample does not represent the entire global landscape but is sufficient to identify current major trends.

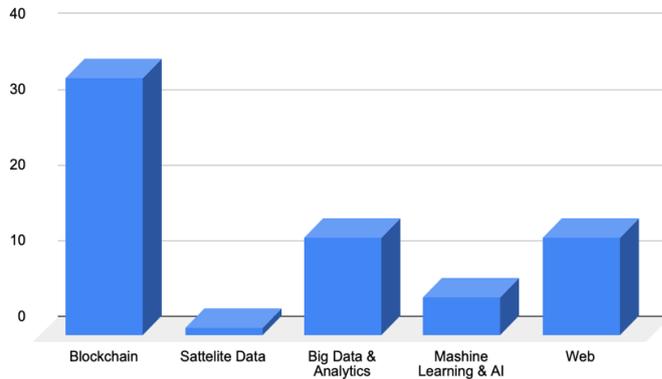
Interviews were conducted with the following categories of financial ecosystem players:

- banks
- development finance institutions
- financial service sector associations
- impact investors
- impact bond market intermediaries
- public policy institutions
- pension funds
- fintechs

3. Fintech for Biodiversity – Product and Enterprise Innovation Landscape

More than half (55 percent) of the fintech for biodiversity solutions are blockchain powered. This is significantly higher than in the countries where the GDFA has mapped out the broader sustainable digital finance space.²

Underlying Technology Powering Fintech for Biodiversity

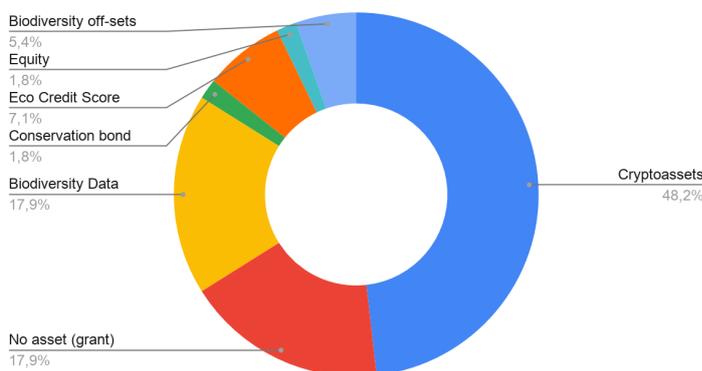


Crypto-assets clearly emerge as a dominant feature of the design of digital biodiversity finance solutions. It is this crypto-conservation community that shows the highest degree of idea generation in terms of the quantity of solutions. This trend reflects that fintechs are responding to a gap in the

market left by incumbent banks whose ties to the fiat economy mean they cannot design new forms of value such as tokenizing the oxygen produced by a tree to make it exchangeable into a digital asset in a game or a product in a store.

The second most prevalent use of fintech is to channel grant funding into biodiversity such as the Dutch digital challenger bank Bunq, which invests in a tree each time a client has spent EUR 100. The trading platform MarketAxess Holdings Inc. uses a similar solution and has committed to plant five trees for every USD 1 million of green bonds traded on the platform.

Assets of fintech for biodiversity solutions



The grant category covers solutions where the user does not get ownership of a tradable asset but where the fintech channels corporate capital into biodiversity with the aim of increasing user loyalty or to appeal to millennials. The use of gamification (such as in the case of Ant Forest and G-Cash Forest) results in increased *platform stickiness*, defined as the number of visits (repeat usage) per month and time spent per visit (session stickiness).

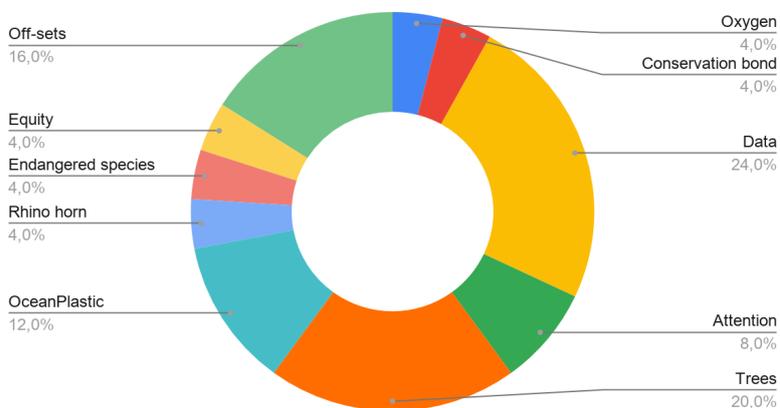
The Eco credit score solution uses biodiversity data to create an Eco credit score that is used to calculate the interest rate payable on the loan. Customers with a high eco credit score undertaking more sustainable projects receive loans funded at more favorable rates.

² See also the link below for more information about the relative distribution of the underlying technologies powering sustainable digital finance in Germany, a country with a significant Ethereum community and with a government that is starting to introduce regulatory clarity on crypto assets, something which otherwise only a few small states have started to do: <https://www.sustainabledigitalfinance.org/initiatives-publications>

3.1 Crypto assets backed by Nature

Looking further into the underlying assets of the crypto solutions reveal a variety of ecological data and traditional financial instruments.

Crypto solutions material assets



The crypto-enabled fintechs that work on data are not in the biodiversity risk management space. Instead they are working to shift nature’s value from extraction-based activity and toward data-gathering instead, or to incentivise biodiversity data passports of commodities. Leveraging blockchain enables them to identify the data providers

and asset owners (who may be rainforest dwellers or other local communities), and to make micro payments that would not otherwise be financially viable due to normal fiat payment transaction fees.

Earth Bank of Codes	Fishcoin
<p>Solution that aims to put all genetic codes of the biodiversity of the Amazon rainforest on the blockchain. Pharmaceutical companies and scientists will then be offered to buy access to the genetic information using a cryptocurrency, which is programmed to be directly paid to the communities taking care of the rainforest. It recognises indigenous bio-IP ownership and shifts how value is extracted from nature.</p> <p><i>Key players: World Economic Forum</i></p>	<p>Seafood supply chain transparency platform that uses a blockchain protocol to incentivise users to share data about seafood from point of catch to plate. Fisherman and processors are paid by the downstream consumers, regulators or environmentalists for the additional data they provide for each catch thereby assigning value to catch and environmental data. By including data about fishing behaviour the fisherman are also incentivised to fish sustainably resulting in a virtuous circle of behavioural reinforcement.</p> <p><i>Key players: The Fishcoin is the main actor read more on www-fishcoin.co</i></p>

The offset category covers both carbon offsets based on tree planting as well as a few biodiversity offset solutions. Proof-of-impact documentation and trading is a new concept that is an alternative to carbon and biodiversity offsets. Successful projects are able to generate value by selling the impact of their work to others who are looking to address impacts or simply to pay for change.

Fintechs have also moved into social media, by enabling users to share their biodiversity messages, commitments and achievements to their social media profiles with the promise of financial reward. Cryptocurrency-enabled platforms allow organisations to buy credit that is then used to incentivise users to share and increase conservation engagement.

Oceans Cam & WWF Selfie

Two applications on the JET8 social media platform incentivise users to share selfies to their social media profiles. Each app comes with a variety of environmentally aligned selfie stickers that can be applied to the social posts to share a message. By sharing posts, users earn points that are redeemable for rewards. NGOs and corporates can launch a branded app and pay to engage with users and social media influencers who can drive up earnings through tracked engagement on the platform.

Key players: World Wildlife Fund

Game tokens representing biodiversity can be invested in and traded, with fees supporting biodiversity projects. Return on investment could be scaled rapidly for the gamification of conservation if corporations were to embrace and market the approach as a fun way to compete with each other on social media to track and show off their sustainability spend. Imagine Microsoft and Google and Facebook bidding up the price of the tokens and holding them to provide ongoing funding streams to their sustainability projects.

Wildcards

Crypto card game that works with conservation organisations to fund endangered species protection projects. A specific animal or project is identified and a card, linked to a crypto token of the animal, is created. The card is then sold to an investor with the proceeds paid to the linked conservation organisation's wallet. The owner is required to list the card for sale on the market so that it is always available to be sold. The owner must also prefund their wallet to cover the monthly Harberg tax that is paid to the conservation project based on listed sale price. (The monthly fee varies per card from 2.5% to 100%.) If no one buys the card before the funds in the wallet run out the card is available for free to the next investor who claims it and funds the account.

Key players: wildcards.world project is the main actor. The idea was born out of the Cape Town2019 Hackathon.

3.2 Fintech for Biodiversity deployment by Incumbents

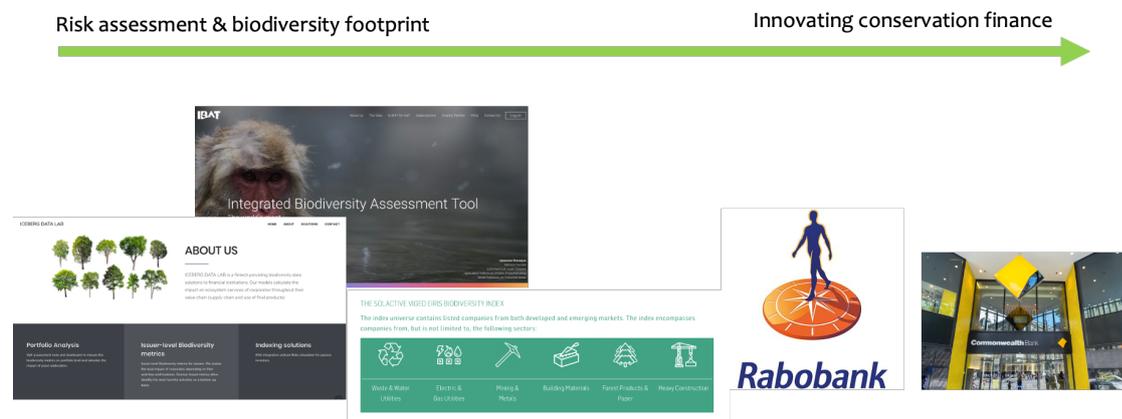
Banks, development finance institutions (DFIs) and asset owners and managers deploy fintech for biodiversity purposes to varying degrees. Most incumbents are in the early stages of exploring how to leverage digital technology for biodiversity data for compliance purposes rather than to deploy fintech to innovate new biodiversity finance products and services.

Deployment of digital data tools to assess biodiversity risks of investment decisions is most mature in project finance, where DFIs tend to use the Integrated Biodiversity Assessment Tool (IBAT)³ as one element of a project risk assessment and risk labelling, which includes biodiversity risks. The risk label of a project determines the steps in the financial decision making process required to progress and determine whether an investment should be dropped or adjusted to mitigate negative biodiversity impacts.

It is still early days for both pension funds and banks to leverage digital tools to measure biodiversity risks. Driven by the taxonomy regulation in the European Union incumbent banks in Europe are starting to realise that the current ESG data screening tools do not allow for the

³ <https://ibat-alliance.org>

capture of biodiversity impacts across their credit and loan portfolios. Five major French banks have therefore put out a tender for a datatool to allow for biodiversity measurements. ASN Bank of the Netherlands has invested significantly in the development of a biodiversity foot printing methodology.⁴ ASN bank used a number of databases for this work, which can be regarded as digital tools.⁵



A few incumbent banks have started to actually design fintech powered biodiversity finance products and services. Two frontrunner examples are Rabobank in the Netherlands and CBA bank in Australia. Rabobank is designing a biodiversity-linked loan product to dairy farmers in the Netherlands, which is only partially a digitised product offering. The cost of capital will be linked to a set of biodiversity performance-based metrics that Rabobank has developed in collaboration with FrieslandCampina and WWF. The data points are based on data sets that the dairy farmers already provide to their dairy cooperatives and which can be found in the Biodiversity Monitor.⁶ CBA in Australia is the only incumbent that has formed a partnership⁷ to test the viability and market readiness of a crypto-conservation solution, in this case a biotoken to trade biodiversity credits.

⁴ (2018) Common Ground on Biodiversity Footprint methodologies for the Financial Sector, ASN Bank, ACTIAM, DCD Biodiversité, and Finance in Motion.

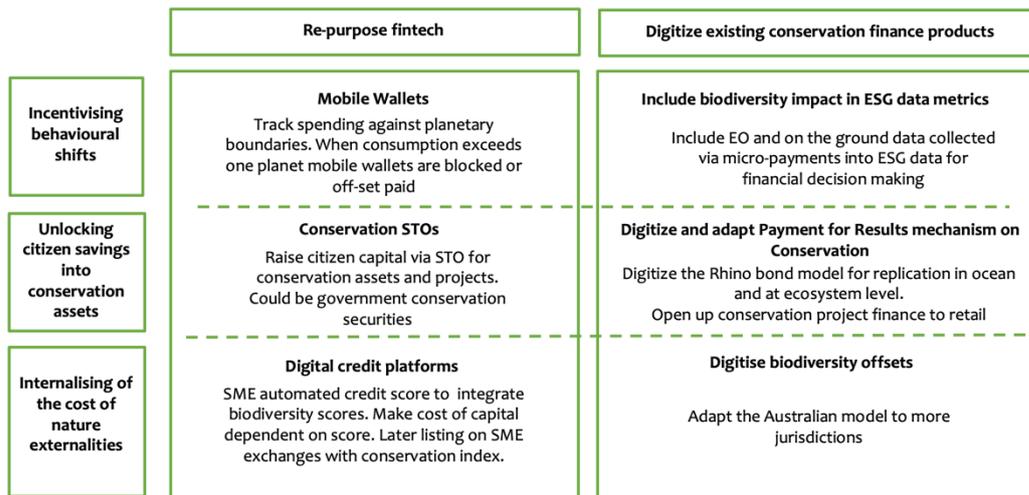
⁵ This include the Exiobase 2.2v. For more on the ASN Bank methodology, please see: *Putting the metrics behind sustainability* at ASN Bank: https://www.pre-sustainability.com/download/Biodiveristy-Footprint-Method-ASN_Bank-A3.pdf

⁶ http://biodiversiteitsmonitormelkveehouderij.nl/docs/Biodiversiteitsmonitor_engels.pdf

⁷ CBA partnered with BioDiversity Solutions Australia; a privately-owned regional business based in Port Macquarie NSW to prove the new blockchain prototype.

4. Citizens and companies as change agents - Harnessing FinTech for Nature

Despite its rapid global growth, fintech has not resulted in any significant digital reshaping or reimagining of biodiversity finance. A different approach is therefore needed to innovate biodiversity finance by harnessing fintech to conservation-finance use cases. This section explores how this harnessing can happen via the following two approaches: 1) Re-purpose to innovate new digital conservation finance avenues and 2) deploy fintech to digitise existing conservation finance avenues to unlock biodiversity funding. The focus is on opportunities with the potential to address the current main barriers to scaling biodiversity finance.



4.1 Re-purpose to innovate new digital conservation finance avenues

The existing fintech landscape reveals a number of opportunities to innovate new digital conservation finance avenues via the re-purposing of fintech from adjacent verticals.

Repurposing fintech # 1: Mobile Wallets - Incentivising Digital Lifestyles for Nature

Customers could opt to allow the algorithms on their mobile wallet to track their spending against planetary boundaries and share that information on social media. Once their consumption exceeds “one planet” limits, they could (a) have their mobile wallet blocked and have to pay a planetary donation to unlock it or (b) incur an ongoing percentage donation applied on any consumption above the one-planet limit but with no interruption of service. The tracking could also potentially be linked to the tax system, with consumption taxes automatically increasing beyond the one-planet limit. Biodiversity offsets with the possibility of real time updates could be an opportunity to further increase customer engagement. By adapting carbon wallets that already exist on payment platforms to include biodiversity footprints also, a new avenue for spending and growing the demands for biodiversity offsets could be created. Mobilising the largest mobile wallet providers to incorporate biodiversity functionality can be an efficient way to reach a large number of people and then to inspire incumbents to copy the approach once proven.

Alipay's Ant Forest is the most scaled example of a mobile payment platform that is increasingly enabling users to shift to greener lifestyles. Ant Forest is an interactive interface embedded in Alipay, the world's largest mobile and online payment platform, where users receive a real-time CO₂ footprint on a number of their everyday behavioural choices. Users gain green energy points as rewards when their CO₂ footprints decrease. These points can be used to plant virtual trees on the platform which are eventually translated into real trees. Ant Forest has more than 500 million users who engage with the platform to accumulate virtual green energy points, which in turn have led to the planting of more than 100 million real trees in northwestern China.



Source: Yuxi Liu 2017, "[Design for social good](#)"

Mobile wallets could begin to include CO₂ footprint calculations on the commodities with the most negative biodiversity impacts, such as beef or soya beans from the Amazonian rainforest. Then behavioural nudges could be used to shift consumption for example for protein consumption from brown to green. This could be undertaken by either mobile and/or e-commerce platforms. It could be done using gamification and personalization with individually defined green protein targets being tracked and reductions in consumption being rewarded. It's important here to remember the scale of the global market for video games: popular ones often reach 50 million or more unique users *each month* showing the enormous addressable market an engaging user experience can generate.

Repurposing fintech # 2: Conservation Security Token Offerings (STOs)

One barrier to allocating more capital to biodiversity assets is the high transaction cost created by these assets' limited size. Only 10 percent of all green-bond proceeds were allocated to nature, a clear indication that biodiversity assets are not sufficient scaled to reach capital markets. On the other hand, the very recent trend towards regulatory clarity around crypto assets⁸ opens the way for regulated Security Token Offerings (STOs) as an avenue to raise capital for those conservation assets currently stuck (as most of them are) in no-man's land, still too small for capital markets but too large for crowdfunding.

Most biodiversity projects are indeed not big enough to be structured as marketable standalone investment products with many not being scalable beyond USD 5 million. New data shows that 577 conservation projects have crowdfunded USD 4,790,634 since 2009⁹ across 72 platforms for implementation across 80 countries. The STO market is still young but is advancing rapidly,

⁸ Countries include but are not limited to Germany, Japan, Luxemburg, Philippines, Singapore, and Switzerland. For more see "Blockchain - Gateway for sustainability linked bonds, widening access to finance block by block" by HSBC and SDFA (2019).

⁹ (2018) Conservation Biology: *Crowdfunding biodiversity conservation*, Eduardo Gallo-Cajiao Carla Archibald Rachel Friedman Rochelle Steven Richard A. Fuller Edward T. Game Tiffany H. Morrison Euan G. Ritchie. Volume 32, issue 6 pages 1426 - 1435.

growing from 5 STOs in 2017 raising USD 65.59 million to, just two years later, 55 projects in 2019 collecting USD 452.95 million. The largest STO to date raised USD 134 million,¹⁰ and predictions are that the security token market will grow to USD 2 trillion by 2030.¹¹ There have been, however, no biodiversity-focused STOs to date. It is still a very nascent market but evolving rapidly with name-brand players such as Morningstar entering via the first rating of an STO in the past year.

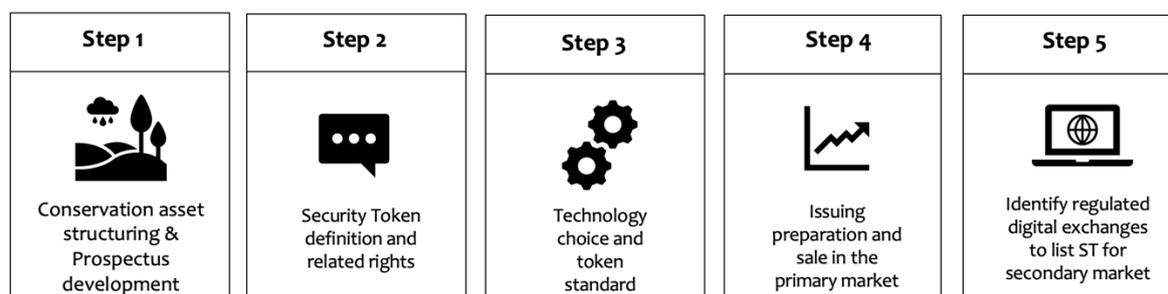


Illustration: Conservation STO structuring process

A pilot biodiversity STO could restrict token offering to pre-vetted investors who want to test the waters for crypto-assets in a controlled trial environment. After a predefined set of milestones the token could be listed on a regulated exchange for secondary market trading to open up the asset to a larger investor base (provided the jurisdiction allows for non-accredited investors to invest in tokens). This could enable biodiversity finance to tap into the global base of investors in the crypto economy whose size is not trivial: crypto derivatives trading on exchanges in 2019 topped USD 3 trillion.¹²

Developing a biodiversity STO with reputable financial institutions could enable the instrument to receive faster uptake via higher credibility of STOs as an instrument for biodiversity finance projects too large for crowdfunding and too small for capital markets. The choice of jurisdiction is crucial as it can severely hamper the process if issued where there is low support from regulators. In Europe, Germany is emerging as an STO leader with BAFIN approving the first regulated STO in Europe last year and having recently approved the first cross-border STO open to investors from 21 countries. Switzerland is another option as regulators recognize tokens as representation of the value of an asset.

Repurposing # 3 integration of biodiversity into automated credit scoring

Automated credit scoring is using increased computing power and new sources of data (e.g., mobile phone use patterns, customer reviews and feedback on e-commerce platforms, real time financial information, bill payment history etc.) to reduce the need for collateral in lending to micro, small and medium enterprises, or MSMEs. Automated credit scoring is a low-touch (and thus low-cost) way to make lending decisions, opening up more (and more affordable) MSME finance by tackling the problem of high transaction costs on small and under-collateralized loans. Ant Financial Services Group and the IFC have started a partnership to introduce the market's first greenness rating standard for MSMEs with the goal of making cost of capital dependent on

¹⁰ (2020) 6 Crypto Experts predict that STOs will bounce back in 2020, Hackernoon <https://hackernoon.com/6-crypto-experts-predict-that-stos-will-bounce-back-in-2020-ya85362f>

¹¹ (2019) Security Token Analysis, Chain Partners: <https://www.finyear.com/attachment/1338789/>

¹² (2020) Cryptocurrency Derivatives Exchange Industry Annual Report January 2020, Token Insight: <https://tokeninsight.oss-accelerate.aliyuncs.com/levelPdf/1579602179554qVp1EivCoWo63YxE852e2.pdf>

the green performance. Biodiversity metrics could be added to the other greenness indicators to calculate the automated credit rating. Although the individual environmental footprint of any individual MSME may be low, collectively they constitute a vast majority of businesses, and their aggregate impact is considerable.¹³ The global digital lending platform market size is expected to grow from USD 5.1 billion in 2018 to USD 12.1 billion by 2023, at a Compound Annual Growth Rate (CAGR) of 18.7% during the forecast period.¹⁴

4.2 Adapt fintech to digitise existing conservation finance avenues to increase capital allocation to biodiversity

A number of opportunities exist to use fintech to digitise existing biodiversity funding instruments both to unlock more capital via efficiency gains and also via the follow-on innovations for which some digitisation processes can pave the way.

Include biodiversity impact into ESG data metrics

For an analysis of this change path, please see Section 5 of this report.

Digitize and adapt Conservation Impact Bonds

Most of the 176 impact bonds issued to date have focused on projects in the social sector¹⁵ as part of the social innovation discourse. Last year the world's first conservation impact bond was launched – a USD 50 million Rhino Impact Bond. In an impact bond, a performance-based contract that deploys private capital covers the upfront cost of project delivery. Upon successful delivery of outcomes, the investor is reimbursed the principal plus a return. At present, the upfront capital for impact bonds ranges from an estimated USD 110,000 to 26.3 million.¹⁶

One challenge with the impact bond model is management costs since impact bonds are mainly structured as public-private partnerships, with the public sector paying for demonstrated outcomes. The first decade of the impact bond's evolution focused on proving the concept and understanding when it is appropriate to use or not. Now the model is being refined to create structures involving debt issuance to actually reach capital markets. Even though this introduces additional costs and requires more time, the goal is to establish bonds that can be marketed to institutional investors.

Remarkably little attention to date has been paid on how to harness fintech to pursue the necessary structural refinements, and this is an oversight ripe for correction. Biodiversity at present is a sector dominated by scarce public finance, service providers often deemed un-credit worthy, and projects too small to reach capital markets as stand-alones. The confluence of these factors makes an impact bond model a potential avenue to unlock more capital. It is also, however, a type of asset which would require more sophisticated datapoints related to outcomes than would an impact bond focused on a social programme (e.g., education, for which improved test scores could serve as metrics). Hence, technology to automate the proof-of-outcome reporting is one way digitisation could increase efficiency and contribute to market-making for conservation-focused impact bonds.

¹³ Environmental Policy Toolkit for Greening SMEs – the EU Eastern Partnership Countries.

<https://www.oecd.org/environment/outreach/Greening-SMEs-policy-manual-eng.pdf>

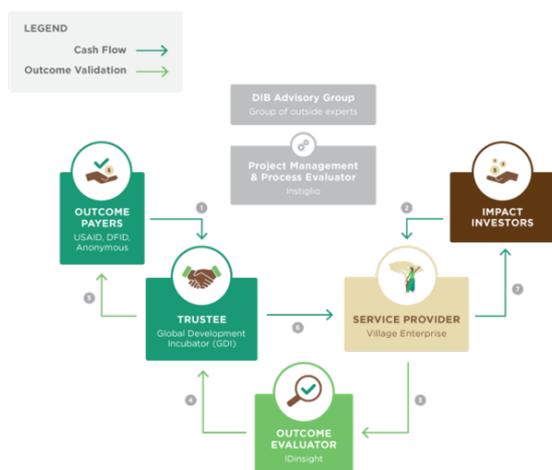
¹⁴ Digital lending platform market by solution, service, deployment mode, vertical, and region – global forecast to 2023: https://www.researchandmarkets.com/research/qk2ks/global_digital?w=5

¹⁵ (2020) The global impact bond market in 2019: A year in review, Emily Gustafsson-Wright, Izzy Boggild-Jones, Onyeka Nwabunnia, Brookings.

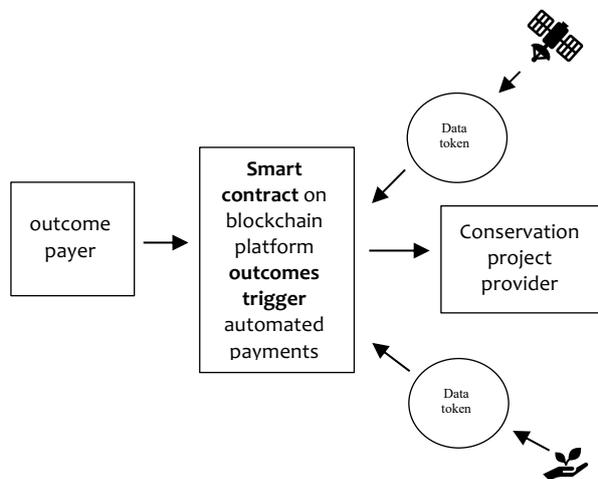
¹⁶ https://www.gprba.org/sites/gpoba/files/publication/downloads/2019-06/Impact%20Bonds%20and%20Considerations%20for%20Investment-6-25-2019_o.pdf

Blockchain-powered bond platforms can be used to structure the actual governance of a biodiversity impact bond with smart contracts deployed for coupon payment, impact verification and automated accounting. Impact bond models like the Rhino Impact Bond's could be adapted to any biodiversity investment where impacts are quantifiable and measurable. Once the bond is digitised it is more cost efficient to open it up for secondary market trading to offer new ways for citizens to engage with biodiversity finance.

Current structure of an outcome bond



Fully digitised outcome bond model



In today's world, automated reporting from the asset via data tokens would still need some degree of human verification and analytics, so a fully digitised conservation impact bond is still a future scenario. But the outcome payer could be a private philanthropic player, a public sector (e.g. bilateral aid agencies), a corporate, or a blend of all three. Digitisation could be a stepwise process, starting with using blockchain for governance of the structure and for automated accounting, and then with the automated outcomes monitoring being built out over time.

By deploying tranches of grant funding or subsidies through cryptocurrencies and smart contracts linked to crowdsourced performance data, the cost of administration could be reduced and speed of fund disbursement increased through automation. That same automation could also increase transparency about how the funds are actually being used and what impact they are having. Smart contracts, whose creation requires upfront setting of clear and measurable indicators, would collectively, over time, have the effect of focusing funding where impact can be measured.

Digitize Biodiversity off-sets

In the fintech for biodiversity landscape 5.4 percent of the solutions offer marketplaces for trading of externalities either for carbon or nature. Policies for offsetting biodiversity losses are used in at least 33 countries around the world, cumulatively restoring and protecting 8.3 million

hectares of land.¹⁷ Compensatory measures should only be considered after the previous steps in the mitigation hierarchy—avoidance and minimization—have been exhausted. Digitized governance of a biodiversity offset scheme cannot correct all the risks and adverse outcomes of a weak policy framework, but it can bring efficiency, transparency in pricing, and traceability in credit trading, thereby allowing biodiversity offsets to mature by addressing current identified barriers to implementation.¹⁸

Tokenisation of biodiversity off-sets leveraging AI and satellite imagery can enable automated creation and trading of the offset credits via smart contracts. This is the biotoken model used by CBA in Australia which can be further refined and adapted to other markets. It is a digital marketplace built to manage credits generated by the New South Wales government's biodiversity offset scheme. The platform is at the proof of concept stage and is able to create biotokens, which are transferable digital tokens, representing unique biodiversity assets. Biodiversity offset schemes are complex to manage for government and property developers because of the sheer number and types of credits. In the case of NSW there are 6000 types of credits relating to biodiversity.

The biodiversity management and trading services platform cost about AUD 600,000 to build. The federal government contributed AUD 300,000 under its regional jobs and investment plan. CBA spent AUD 200,000 as part of efforts to promote environmental sustainability, while BDS spent AUD 100,000.

These complex rules can be embedded into the digital biotoken to automate the process of matching developers with credits and trading. Robo advisory can be included onto the platform to offer automated advice to ensure like-for-like, or even like-for-more, trading. The vision of CBA is eventually to open up the biotoken platform to retail investors so that citizens can allocate their savings to an appreciating asset - nature.

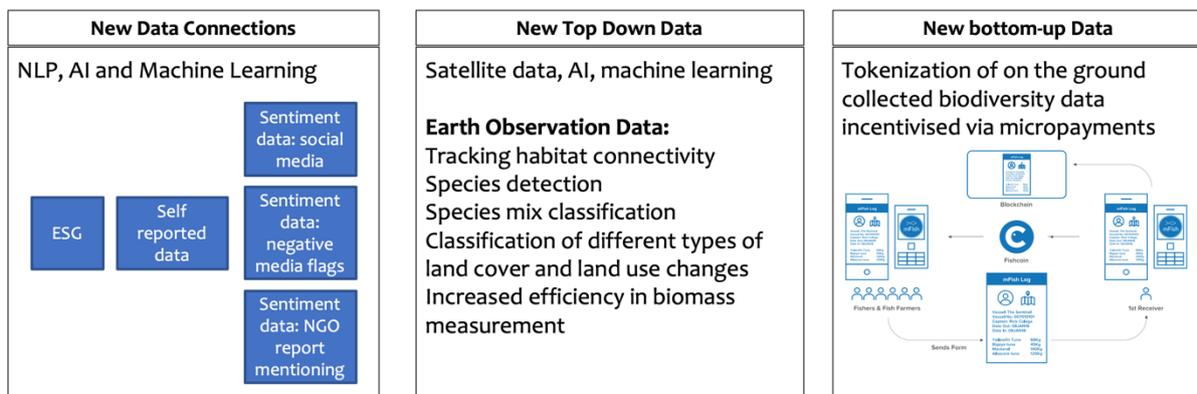
¹⁷ (2019) Niak Sian Koh, Thomas Hahn, Wiebren J. Boonstra: “How much of a market is involved in a biodiversity offset? A typology of biodiversity offset policies.” *Journal of Environmental Management*, Volume 232, 15 February 2019, Pages 679-691.

¹⁸ Biodiversity offsets: from current challenges to harmonized metrics, Bárbara Gonçalves, Alexandra Marques, Amadeu Mortêgua Velho Da Maia Soares, Henrique Miguel Pereira, *Current Opinion in Environmental Sustainability* Volume 14, June 2015, Pages 61-67

5. Current and emerging data sets

Nature is digitising slower than urban areas and human behaviors, which means nature leaves a lighter digital footprint for algorithms to analyze and to influence financial decision-making. A number of tech companies, public institutions and NGOs are working to bridge the data gap. These include, but are not limited to, Microsoft’s AI for Earth, Global Biodiversity Information Facility (GEF) database, the World Bank’s Terrestrial biodiversity database, Forest Watch’s various data bases on forest cover and forest fires, and UNEP’s ENCORE open source database on environmental risks, opportunities and exposures. Types of data in these open or semi-open databases vary significantly. Microsoft’s, for example, is unstructured biodiversity data. The Forest Watch data is near real-time satellite data and the GEF database is species data. None of the databases directly links company value chains to the biodiversity impact data sets, a critical missing data piece identified by most of the key informants interviewed for this report.

Digital technologies, and in some cases fintech, enable three new tools: 1) new data connections; 2) new top-down data; and 3) new bottom-up data. Only the latter is fintech-enabled—the first two are digital technologies that offer data for financial decision-making.



New Data Connections – Linking Sentiment and Self-Reported data

At present, ESG data providers mainly leverage the increased analytical capabilities of AI to deliver insights derived from making new connections between existing self-reported datasets and sentiment data acquired via web-scraping of social media, customer feedback from e-commerce platforms, press mentionings and NGO reports. Hence, currently the tech-enabled ESG data tools do not use earth observation (EO) data to move from scope one and two to actual biodiversity impact data. There is currently a low degree of EO and IoT integration into these solutions, and open source satellite data is hardly integrated into the data sets. As a result, biodiversity data focuses on resource efficiency in production and whether a company has an environmental policy and strategy. The main barrier to incorporating EO data to move into delivering impact data is the costs associated with accessing these data sets¹⁹ as they are behind paywalls.

Behavioural digital data is already being used for automated credit scoring as well as automated KYC. Behavioural analysis can also be used to include exposure to wildlife trafficking in KYC and AML processes. Research shows that social media is used to globalise illegal wildlife trafficking and that it does therefore not require highly trained and complex algorithms to identify

¹⁹ (2018) Launching into Space: Using Satellite Imagery in Financial Services - Case study on Apollo Agriculture and Harvesting Inc. MasterCard Foundation Partnership Finance in a Digital Africa, July 12, 2018.

traffickers.²⁰ The current attention to the web as a marketplace for wildlife trafficking does present the risk that it will shift to the dark web. That will require more sophisticated algorithms to analyze anonymized behavioural data.

New Data Top-Down – Earth Observation Data

Satellite data coupled with machine learning and AI offers a number of new datasets. Individual tree species or animals can be imaged, for a fee, in extreme detail (31-centimetre resolution) by private earth-observation satellites. New datasets also include tree distribution and species mix in forests. An increase in the accuracy of biomass measurement as well as tracking of habitat connectivity and changes in land-use patterns are also metrics emerging from space. Larger animals (e.g. rhinos) can also be tracked however, smaller species such as butterflies are difficult to track by satellites. Rainforests metrics are also difficult to track from the sky because satellites cannot penetrate very far below the top canopy.²¹ Providers of satellite metrics currently include, but are not limited to, RsMetrics, Rezatec and Orbit.

EO Data Platforms		
Open Data Platform	Description	Deployment
Google Earth Engine (GEE)	The Google Earth Engine (GEE) is a cloud computing platform designed to store and process huge data sets (at petabyte-scale) for analysis and ultimate decision-making. Earth Engine stores, more than thirty years of historical imagery and scientific datasets, updated and expanded daily.	GEE is mainly for non-commercial use by researchers. GEE requires user capacity to analyze the geospatial and GIS data available on the platform.
Forest Watch	Developed in partnership between GEE and World Resources Institute. The strength is speed of data updates which is almost real time. It provides observation data on deforestation incl. forest fires. The platform offers a number of APIs for developers and users to build their own applications. Not all countries and area have high quality data, however, the platform has a list of prioritized countries.	Forest Watch Pro is a subscription-based service where investors can upload geolocation of production facilities of investee companies to receive deforestation data and risk analysis. It requires that the investor know the geo location of all the intermediaries in a value chain.
Microsoft AI for Earth	Unstructured biodiversity datasets including images from photo traps, sound recordings and satellite images. It hosts key geospatial and conservation datasets, so that anyone can apply technology to conservation – can use the cloud to operate on global-scale environmental data.	Mainly targeted at innovation to apply AI and cloud computing to environmental challenges. It has distributed 484 grants.
UN Biodiversity Lab	Allows policymakers and other partners to access global data layers, upload and manipulate their own datasets, and query multiple datasets to provide key information on the Aichi Biodiversity Targets and nature-based Sustainable Development Goals. It is powered by XMap, which is the only UN-backed geospatial mapping software which collects and verifies scientific data	The core mission of the UN Biodiversity Lab is three-fold: to build spatial literacy to enable better decisions, to use spatial data as a vehicle for improved transparency and accountability, and to apply insights from spatial data across sectors to deliver on the Convention on Biological Diversity and the 2030 Agenda for Sustainable Development.
Spatial Finance	The Spatial Finance Initiative (SFI) is a multi-disciplinary and multi-stakeholder programme, established by four leading institutions – the Alan Turing Institute, City of London Green Finance Initiative (now the Green Finance Institute), Satellite Applications Catapult, and the University	Bringing together the supply side of EO data and the demand side from the financial sector to shape development of data sets for increased usability in financial decision-making.

²⁰ (2019) “Use of Machine Learning to Detect Wildlife Product Promotion and Sales on Twitter.” Qing Xu, Jiawei Li, Mingxiang Cai, Tim K. Mackey. Department of Computer Science, Department of Computational Science, Department of Health Research and Policy, Global Health Policy Institute, Division of Infectious Disease and Global Public Health. University of California, San Diego, CA United States.

²¹ Interview with Razotec

	of Oxford – with a mission to mainstream the geospatial capabilities enabled by space technology and data science into financial decision-making globally.	
Fee-based services	Rezatec, RS Metrics, Orbit, UP42 and others. Uses satellite imagery and machine learning to provide a landscape observed metrics on e.g. quantify and map the spatial distribution and proportions of discrete tree species within a target area based on their unique spectral signatures. It can also be observations of production sites or value chains.	Investors can receive analysed EO data on specific areas or companies. These can be impact data on land use changes resulting from an investment in e.g. infrastructure.

Large fintechs have the financial capacity to launch satellites or buy access to earth observation data sets. New regulation in China requires listed companies to report on their environmental impact which is leading major Chinese fintechs to acquire their own micro satellite fleet to provide environmental impact data to local banks.

New data set bottom-up

Data collected on the ground by local communities on specific conservation metrics is not new. What is new is fintech’s ability to incentivise such data collection via micropayments as blockchain enabled transfers, something that can be done at little cost even to people without bank accounts. Community-based, on-the-ground efforts can validate data collected from space or fill in the satellite technology’s gaps such as data from beneath the tree canopy where satellite imagery cannot penetrate.

Micropayments can help provide local populations income while at the same time increasing awareness and shifting biodiversity’s value for those populations from what can be extracted to what can be observed and reported. A few early players in the market are trying to develop exchanges for these tokenized data sets. One of these is “Proof of Impact” which is an impact marketplace platform that brings together the suppliers with the demanders of impact data. Impact sellers provide multiple data points across different data layers that are verified by the platform to generate impact tokens that prove impact.

Financial sector deployment of new datasets for biodiversity

A majority of the financial service institutions deploy the first category of data which leverages artificial intelligence and machine learning to make new connections between sentiment data and companies’ self-disclosed data as their main source of biodiversity data. But these do not capture biodiversity impacts of a company and therefore cannot capture the biodiversity footprint of an investment. The increasing number of open source biodiversity databases require that the financial service institution have geolocation data of all the participants of a financed value chain before requesting tailored biodiversity impact data (e.g., the deforestation footprint of an investment). Use of open source databases also requires that a financial service institution have in-house capacity to understand this data and then to translate it into financial decision-making. Financiers can opt to buy tailored and analysed EO data from a provider to track an asset’s impacts. But that option is costly and, again, it requires knowledge of geo-localisation of all participants in the financed asset’s value chain.

Enabling biodiversity-relevant EO data to enter into ESG data tools such as Blackrock’s Aladdin risk management tool is one pathway to enable biodiversity data to influence investment of trillions of dollars. In addition, working to structure markets for tokenized bottom-up biodiversity data purchased via micropayments can both influence behavioral change, if a product receives a higher price dependent on the quality of biodiversity data, and over time, it can shift the value of biodiversity from extraction of the physical bio-assets to knowledge-harvesting about them.

6. Current partnerships in fintech for biodiversity – who is really driving change?

Few global initiatives position themselves at the intersection of fintech and biodiversity. The OECD, G20 and G7 all have workstreams, working groups and/or specialized centers that either focus on green finance with biodiversity as a sub-theme and with parallel workstreams on digitisation. The largest number of initiatives and partnerships are in the earth data space, as described in the previous section. Below is a selection of the global partnerships that position themselves exclusively in biodiversity and finance.

	<i>Fintech</i>	<i>Biodiversity finance</i>	<i>Digital technology</i>
Earth Bank of Codes	X	X	X
Biofin		X	
Global Earth Observation systems of systems (GEOSS)			X
MOCUPP		X	X

The outlined global partnerships operate at very different levels and from different designs. Biofin and GEOSS both have a policy focus and are not integrating fintech. Biofin support countries to develop prioritized biodiversity financing instruments. The BIOFIN Handbook identifies the problem as the current direction and scale of investment flows but does not position fintech as a strategic path to re-direct these flows towards nature. BIOFIN has to date helped 36 countries develop biodiversity financing solutions. Review of the countries' identified prioritised finance solutions shows that digitally enabled solutions are only weakly integrated. Crowdfunding is the only digitally enabled tool explicitly included on the list of prioritised financing solutions in Indonesia, Belize and Costa Rica. In all three cases crowdfunding is positioned as a way to unlock donations rather than as a way to engage citizens more actively as micro-investors or co-owners of biodiversity.

The Group on Earth Observations (GEO) is a global partnership consisting of 103 member governments and 95 participating organisations with a mandate to conduct or use Earth observations. Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) that will link Earth observation resources worldwide across a number of Societal Benefit Areas one of which is biodiversity and ecosystem sustainability. It is essentially trying to build a platform of platforms curating all earth observation data into one infrastructure. It is a government led initiative which does not integrate a fintech element.

Earth Bank of Codes and MOCUPP are two initiatives designed to innovate biodiversity finance either with fintech (Earth Bank of Codes) or with EO technology (MOCUPP). Earth Bank of Codes tries to demonstrate how fintech can shift the ways value is defined and extracted from nature and to incentivise that shift by creating biodiversity data markets. It therefore adopts the thinking from the crypto-conservation community (embedded in solutions such as fishcoin) which tries to step beyond the fiat economy and exchange the value of biodiversity data for some other valuable asset. The Earth Bank of Codes is the only internationally-backed initiative that takes a digitally-led disruptive approach to transform how nature is valued. Other approaches also have impact potential but reflect linear extensions of current thinking and approaches.

MOCUPP is at a different scale of operation as a partnership between the UN and Costa Rica, but a leading example for replication by other countries. It is not leveraging fintech but earth observation technologies to annually monitor land use and forest cover changes and overlays these data sets with land tenancy data. It reveals where there are opportunities for payment for environmental services as well as where there are breaches of the forest law and therefore ground for legal proceedings. MOCUPP is currently going through adjustments to open up the data to the public. It is an approach ready for replication by other countries.

More global initiatives are needed to help restructure markets in ways that will enable these fintech approaches to scale up, redefining what constitutes nature's value and how to reward it. The solutions in the mapped landscape that use blockchain and cryptocurrencies to shift value from extraction to different types of biodiversity data sets (genome data, data on sourcing of extracted products etc.) will not scale unless larger players support the market restructuring. Otherwise these innovations will remain exotic pilots. Those solutions that offer people new ways to invest in a micro-bite of a tokenized nature asset require partnerships with financial institutions that have the capacity to help structure instruments that use fintech to design a citizen-investing layer. Regulators, also, must support the restructuring by accelerating the work already underway in a handful of countries to provide regulatory clarity regarding crypto assets. Only with larger players getting involved can fintech to help biodiversity finance to enter into the savings accounts and everyday lives of people. No global partnerships are currently working on this.

7. Opportunity Gaps & Change Paths

In the short term, three main change pathways can be identified from a review of the current state of the supply side, the opportunities to repurpose fintech from adjacent verticals, and the urgent need for biodiversity to access large amounts of capital.

Pathway #1: Democratise Access to Company Biodiversity Impact Data

Tailored analysed EO datasets that monitor an investment's biodiversity impacts over time are currently available. But as noted earlier, such datasets are costly and require geo-localisation of global value chain participants. Those two factors limit the ability to assign responsibility to companies and financiers for natural habitat degradation. They also limit the ability of digitally-enabled ESG data providers to integrate companies' biodiversity impact data into algorithmic designs and automated scoring models. As a consequence, only limited biodiversity data is currently incorporated into ESG ratings used in financial decision-making. Company scoring models only include resource efficiency data such as water use in production as proxies for biodiversity and the availability of company policies. It inhibits financiers from making financial decisions based on ambitions to lower the negative biodiversity footprint of their investment portfolio. Access to earth observation data tied specifically to the activities of each link in a global value chain will enable biodiversity impact data to be factored into decisions about large capital allocations. This will enable ESG data providers to move into the next paradigm of designing algorithmic scoring of companies based on actual impact data rather than on what a company reports, what people talk about, or negative flags as is the case today. Enabling biodiversity-specific EO data to enter into broader-focus ESG data tools such as Blackrock's Aladdin risk management tool is one pathway for biodiversity data to influence investment of trillions of dollars. This could support the development of an ESG data provider certification scheme where only providers living up to impact metrics are certified.

Pathway #2: Trigger Digital Lifestyles for Nature

The world's population is growing, both in absolute numbers and in terms of the share of people moving out of poverty into the middle class. To keep pace with these changes and put food on the world's tables means that landscapes are changing, too. Take meat as just one example. The Amazon basin is paying a high price as its biodiversity is sacrificed to make room for cattle or soya beans. One immediate solution is to nudge consumers to substitute meat with green protein. This can be done by working with large e-commerce platforms to enable them to formulate industry-level commitments to become active players in the promotion of digital lifestyles for nature. It does not require a huge leap of imagination, for example, to envision online food-delivery platforms providing consumers with verified data about the biodiversity implications for choosing beef over plant-based proteins, much as food packaging already includes nutritional data (calories per serving, sodium count, ingredient mix, and so forth) for virtually every packaged-food item. The impact of including biodiversity information as part of online food ordering could be game-changing. Online sales will make up 5-20 percent of the food and beverage industry's overall sales by 2025, which is ten times more than it did in 2016.²² The current corona crisis is accelerating the use of e-commerce platforms for food purchases, and the crisis also demonstrates that wildlife and habitat wellbeing, food choices and human health are all intimately connected. Currently the fintech industry is mainly focused on leveraging users' behavioural data for carbon footprinting and offsetting, whereas e-commerce platforms (food purchase and meal delivery) are not as engaged in shaping their role in the green transition agenda linked to biodiversity. The change path approach could potentially be driven by one leading player inspiring replicators, much as has already happened with tree planting where the

²² <https://www.sana-commerce.com/blog/shorten-time-market-e-commerce-food-beverage-industry/>

model launched by Ant Forest three and one-half years ago is now inspiring action by a broad range of players, from payment providers to security exchanges.

Pathway #3: Digital Channels for Nature to Capital Markets

Designing a digital biodiversity outcome bond model can enable nature to tap into a greater pool of investment capital. It also paves the way for nature to become a more frequently encountered asset class on capital markets. One option is to digitise the biodiversity outcome bond to make it attractive to more philanthropic and corporate investors; another is to issue a biodiversity bond as a security token offering on an exchange.

The regulatory and public pressures on companies to go biodiversity net neutral or net positive is only going to increase over the coming years. This opens the way for more corporate finance into biodiversity bond structures. To attract these new types of outcome payers, technology can be deployed to bring down the costs of monitoring a spatially distributed asset and to take out other high friction points on the outcome bond structure. Instead of manual auditing of outcomes by a consultancy company, an automated approach to data harvesting can be deployed. Biodiversity data harvesting can happen via earth operations, via on-the-ground data collection, or both. Local communities can be compensated for gathering outcome data via blockchain deployment of micropayments. Such an approach holds the potential to influence behaviours, as biodiversity data, rather than biodiversity extraction, will become the thing that pays. In addition, the income generated for the communities living close to (and gathering data about) the biodiversity asset can of course have beneficial impact, particularly if that income is invested back into that community's priority needs for health, education, and other welfare enhancements. The model thus potentially opens the door to blending philanthropic capital from social impact investors into the instrument. At a bond governance level, the relation between outcome bond participants can also migrate onto a digital platform granting investors direct access to the digital bond ledger book via a web-based interface. This will reduce the degrees of separation between the investors and the biodiversity asset. Digitization will allow for issuance of larger biodiversity bonds using digital technology, which also prepares for secondary market trading in these instruments, bringing them to a larger number of investors.

Digital technology can help nature travel to capital markets by making it cost-efficient to issue smaller biodiversity bonds as security tokens. Digitization is essentially a means to structure capital-raising instruments that correspond to the current size of most biodiversity assets and projects. It is an avenue to tap into new types of investors: those who hold wealth in crypto assets (or who would like to) and those interested in exposure to another of the most important asset classes of the future: nature.

About this Report

The report was commissioned by the MAVA Foundation. The GDFA research team was Africa Manager Gavin Erasmus and Executive Director Marianne Haahr. The report is not a full mapping of the entire global landscape of fintech and incumbent deployment of digital technology for biodiversity in financial decision-making. Any potential mistakes are the responsibility of the GDFA.

A NOTE ON THIS REPORT'S TIMING AND CONTEXT

When work began on *Fintech for Biodiversity* in January 2020, reports had just started to trickle out from one Chinese province about a novel coronavirus that was sickening local people there. By the time this report was completed some three months later, COVID 19 had become a global pandemic, with more than 700,000 confirmed cases and more than 32,000 deaths. At press time, the IMF is predicting that the economic effects of COVID 19 will be even more consequential than those of the 2007-2008 Global Financial Crisis. Despite multi-trillion-dollar relief and stimulus packages, interventions by central banks, and emergency measures by the Bretton Woods institutions, it is impossible to predict whether or how the economic fallout can be minimized. It is also impossible to predict how high a priority environmental issues will be in a world with likely hundreds of millions of newly unemployed. This report does assume that post-crisis, the basic contours of capitalism, and the functioning of capital markets, will resemble the *status quo ante*. We recognize that this is not the only possible outcome.

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