Global Nature Markets Landscaping Study

December 2022

Taskforce on Nature Markets

KNOWLEDGE PRODUCT

About Taskforce on Nature Markets

The Taskforce on Nature Markets' core objective is to shape a new generation of purposeful nature markets that deliver nature positive and equitable outcomes. It seeks to achieve this by:

- Landscaping, analysing, and socialising **existing and emerging approaches**
- Building awareness of **opportunities and risks** across policy, business, and civil society
- Building the basis for a **community of practitioners** with a shared vision and narrative
- Encouraging synergies between **innovations and innovative people/platforms**
- Recommending and advancing **standards of practices** and enabling principles and supportive governance arrangements
- Initiating and supporting **pathfinder initiatives** to scale the implementation of recommended approaches and actions.

The Taskforce is an initiative of, and hosted by, NatureFinance (previously the Finance for Biodiversity Initiative - F4B). It benefits from the broader portfolio of NatureFinance's work and the extensive knowledge of its partners and networks. The Taskforce is supported by the MAVA Foundation.

Find out more about the Taskforce on Nature Markets, its members, partners, work programme and how to get involved at www.naturemarkets.net

About this report

The Taskforce on Nature Markets was established in March 2022 in response to a rise in markets that explicitly monetise and trade nature ('nature markets'). The broad contours of this development were set out in the Taskforce's formative white paper, 'The Future of Nature Markets'.[a] Departing from the white paper, this landscaping study is part of the Taskforce's first phase of foundation building work, in which developing a technical definition, taxonomy with analysed trends of what we understand as Nature Markets is a fundamental and critical task. The outcomes of this study continue to have profound impacts on the studies, research, partnerships, prototypes, and recommendations that follow. This landscaping study is a keystone piece for the work of the Taskforce on Nature Markets.

This knowledge product is part of the Taskforce's knowledge ecosystem which aims to support the Taskforce in delivering its mandate: ensuring the global economy interfaces with nature in ways that deliver nature positive, equitable and net zero outcomes.

This report was produced and authored by the Taskforce on Nature Markets, with Vivid Economics by McKinsey as its knowledge partner, including Jason Eis, Caroline Vexler and Marc Kennedy.

Comments on the paper can be sent to:
Monique Atouguia: monique.atouguia@naturefinance.net

In collaboration with

Vivid Economics
by McKinsey

Vivid Economics by McKinsey is a strategic economics consultancy firm with broad sustainability and macroeconomic capabilities. The firm helps clients in all sectors around the world successfully navigate the risks and opportunities presented by the economy-wide transition to a more sustainable future. It has a global footprint, delivering projects in over 60 countries, and employing more than 250 consultants, data scientists, and solution developers. Vivid Economics was acquired by the global management consulting firm, McKinsey & Company, in 2021.
https://www.vivideconomics.com/

Acknowledgements

This paper has benefited from contributions from the entire NatureFinance (previously Finance for Biodiversity) team, and many others including contributions from members of the Taskforce and its Knowledge Partners.

This report was produced by the Taskforce on Nature Markets with Vivid Economics by McKinsey as its knowledge partner. This work is independent, reflects the views of the authors, and has not been influenced by any business, government, or other institution.

The authors would like to thank those who dedicated time to speak with them throughout its development, read and review various iterations and provide invaluable feedback. Thanks to the Taskforce on Nature Market's Members and Knowledge Partners for consistent feedback. Specific thanks to Joshua Katz, Robin Smale, Margaret Kuhlow, Maritta Koch-Weser, Nathan Sussman, Dominic Waughray, for very helpful exchanges in the process of writing the paper and/or feedback on an earlier draft.

The views expressed in this paper are those of the authors alone. Any errors are our own.

Global Nature Markets Landscaping Study

FINAL REPORT

Executive Summary

Nature markets are an important part of the global economy, and understanding their size and characteristics is critical to understanding how to achieve global sustainability goals like addressing climate change, protecting and restoring natural ecosystems and reducing inequality.[2] As per the Taskforce on Nature Markets' white paper definition, nature markets exist where nature-specific revenues are generated as an integral part of a trade in goods or services (Taskforce on Nature Markets, 2022). As such, they can directly affect the state of nature. They include large and mature markets, such as agricultural commodities, as well as emerging markets that reflect an increasing recognition of the value of nature, like biodiversity credit markets. Nature markets also intersect with emerging climate change related markets, like nature-based solutions for carbon sequestration. Nevertheless, as highlighted in this report, most nature markets are not specifically designed to achieve nature-positive and equitable outcomes. Achieving sustainability goals by halting, or even reversing, continued nature loss will therefore depend on fuller alignment of these goals within nature markets.

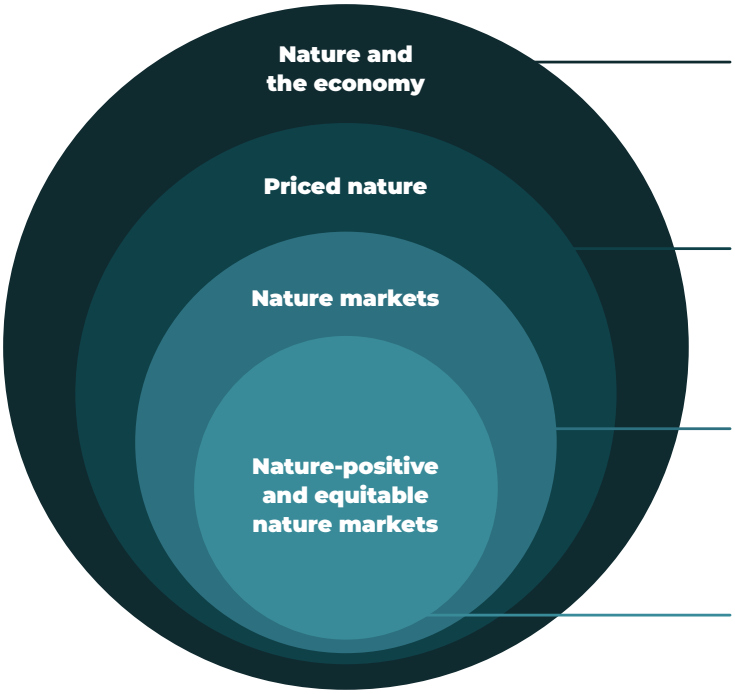
Nature has historically been under-valued and over-exploited through markets due to a well-known set of 'market failures'.[3] When markets fail to value certain outcomes, resources will likely be used inefficiently and under-allocated to some areas. Nature underpins all economic activity, but its true value is often unpriced or underpriced, which has led to significant negative externalities (Bierkens, Reinhard, de Bruijn, Veninga, & Wada, 2019). In many instances, nature markets themselves may actually be drivers of nature loss (UNCTAD, 2017). (Figure 1)

Table 1 The nature markets taxonomy includes four types of nature-specific trade

Type	Description	Category	Traded element	Segments
Asset Markets	Markets in which the right to use ecosystem assets witlh long-lived value are traded	**Real assets**	Rights to use an entire ecosystem asset and resulting services	Agricultural land, timberland, water rights, *biodiversity IP, additional ecosystems assets*
Intrinsic Markets	Markets in which provisioning, regulating, or cultural ecosystem services are traded	**Products**	Use of provisioning services	Hard and soft commodities, legal and illegal wildlife, genetic materials, water rights leases
		Conservation	Conservation of nature for direct economic benefit or altruistic value	Payments for ecosystem services, overseas development aid, philanthropic grants, sustainability-linked debt
		Access	Access to/use of cultural services	Wildlife tourism
Credit Markets	Markets in which credits that reflect efforts to enhance or conserve ecosystem assets or services are traded	**Nature-specific credits**	Credits that reflect the value of ecosystem services	Mitigation banks, water quality credits, *voluntary biodiversity credits*
		Nature-related carbon credits	Credits that reflect the value or carbon sequestration or storage	Nature-related voluntary carbon credits, AFOLU sector compliance carbon allowances
Derivative Markets	Markets for financial products which directly reflect ecosystem values or ecosystem risks	**Financial products**	Financial products directly tied to ecosystem assets or services	Commodity derivatives, nature-related insurance, wildlife NFTs, *biodiversity loss insurance, securitization of ecosystem assets, water futures*

Note: The nature markets in italics have not been sized due to their nascency but they may grow and play a role in creating nature-positive and equitable nature markets in future.

Figure 1 Nature markets in the economy



100% of the economy is 100% dependent on nature, but not all of nature's value is recognized in economic activity

Some of nature is priced in the economy via policies and markets, although not necessarily correctly[1]

Nature markets are where nature-specific revenuesare generated as an integral part of the trade[1]

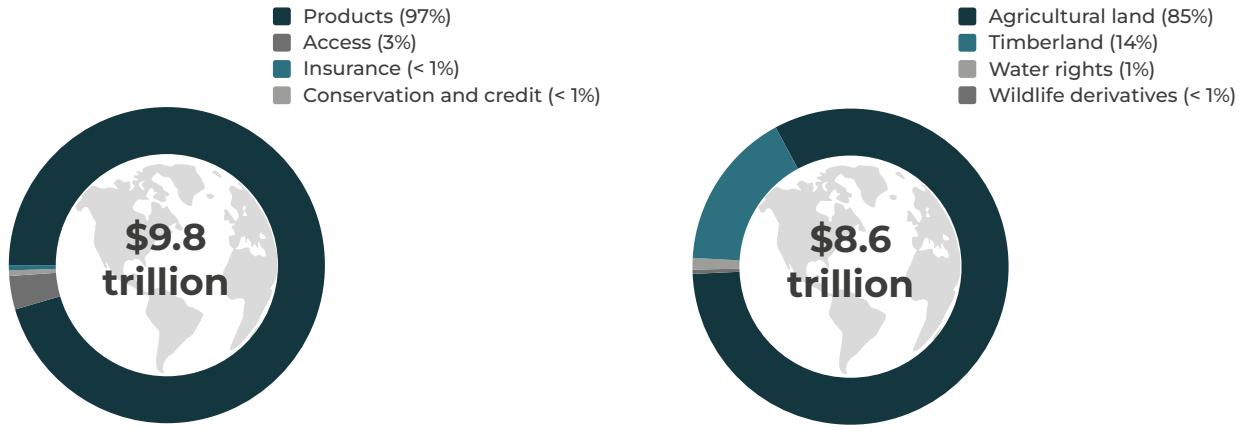
Some, but not all nature markets are currently designed to achieve nature positive and equitable outcomes

The current and potential impact of nature markets may provide opportunities to better align the economy with nature-positive principles. Market governance (e.g., rules of trade, taxes and subsidies) and market infrastructure (e.g., systems of exchange, block-chain ledgers) can affect how well markets function and grow. For nature markets, market governance and infrastructure can determine some of the incentives for how nature is used, and the extent to which these markets can achieve impact at scale. Although markets are not the only, nor necessarily the most appropriate, way to reduce negative impacts on nature, whether nature markets function well will have a large impact on the economic incentives for conservation. To gauge how to best foster effective nature markets, an understanding of the extent, size and distribution of current nature markets globally is needed.

Building on the definition of a nature market laid out in the Taskforce for Nature Markets white paper, the analysis identified and sized at least 24 current nature markets. In technical terms, a nature market is a system composed of transactions between separate buyers and sellers, in which the transacted good or service specifically reflects a stock of ecosystem assets or a flow of ecosystem services from terrestrial or aquatic ecosystems. Using this technical definition, nature markets can be categorized into four types, reflecting the key motivations for exchange of nature-specific products and services (Table 1).

Currently, intrinsic and credit markets related to nature are dominated by commodity products (Figure 2), where the incorporation of nature value could be transformative. The analysis finds that nature markets produce and trade almost US$10 trillion worth of goods and services each year, equivalent to 11% of global GDP. More than 40% of this value comes from agricultural products alone. Any alignment of markets with nature-positive outcomes would to a large extent need to be driven through commodity markets, where the systematic pricing of nature's value would represent a major transformation of how those markets function today.

Figure 2 Overview of nature market size and distribution



Note: Vivid Economics analysis. See appendix for details.
Figures exclude commodity derivatives, as market size is measured using non-comparable metrics.

Although smaller than commodities markets, markets for wildlife tourism and products are sizeable with significant nature impacts. These two wildlife related markets represent roughly US$280 billion in economic value annually. Access to wildlife tourism – the much larger market – can support conservation efforts and some protected areas rely heavily on these revenues. However, the extent to which the nature-related tourism industry adequately prices in the value of nature, and whether it has a nature-positive impact remains uncertain (INTOSAI, 2014). At the same time, illegal wildlife trade – a much smaller market – has an outsized negative impact on biodiversity given its size (further discussed in Box 2).

There are other large nature asset markets also based primarily on commodity products. (Figure 2) There are an estimated 1.2 billion hectares of privately owned and market accessible ecosystem assets worth a combined US$8.6 trillion. This value is also primarily driven by agricultural and soft commodities production, with 85% of the value attributed to agricultural land. Although large, the extent to which nature (or ecosystem) assets are traded in markets is much smaller than in products and services, with a large proportion of such assets either held by the public sector or untraded owing to restrictions on private property markets. Nature-positive outcomes must ultimately manifest in the stock of natural capital, highlighting the importance of how agricultural land markets function and develop going forward.

Hard and soft commodities also underpin large derivative markets for nature (not figured) which are important risk management tools for buyers and sellers of commodities, and their evolution will further shape the pace of scale up for nature markets more broadly. There are roughly US$2 trillion in outstanding notional value of over-the-counter (OTC) derivatives contracts, which play an important role in mature, well-functioning markets, reducing price volatility and enabling investment at scale. Therefore, whether derivative markets can capture nature value could greatly influence if and how nature-positive outcomes will be more fully aligned into product and asset markets.

Emerging nature markets – designed to promote nature-positive outcomes – have a potentially catalytic role in correctly pricing nature but remain small. Emerging nature markets designed to incorporate the value of nature exist across intrinsic, credit, asset and derivative markets. Conservation (intrinsic) and credit markets are more explicitly designed to achieve nature-positive outcomes, and are often directly incorporated into the larger scale, commodity driven product and asset markets to better align then with the appropriate valuation of nature. For example, carbon and biodiversity credits can provide a new product revenue stream to ecosystem asset owners, can drive the certification of sustainable commodities (which might garner a price premium), and can increase the value of the natural asset creating the credits.

While emerging markets are growing, their explicitly traded value currently represents less than 1% of the value of annual goods and services traded in nature markets. Moreover, while some incorporation of sustainability certification exists, its incorporation in the larger commodity-driven markets remains sporadic.[4] Similarly, asset and derivative markets related to the explicit valuation of nature remains very small. Various attempts at innovation exist. These include creating property rights on eco-system assets, assigning intellectual property related to biodiversity and designing various insurance and other derivative products based on the value of nature. Whether and how quickly these emerging nature markets can scale remains a critical question for whether markets can be transformed to deliver nature-positive outcomes.

There are reasons to believe that the future of nature markets may look different than the present. As shown in the heat map below, historical trends do not provide a clear pattern of growth; however, climate change and consumer preferences may be key drivers of demand, and new technologies may facilitate supply by creating a greater number and lower cost of transactions (Figure 3). See Table 5 in Appendix for more details and sources.

- Multiple nature markets are already seeing increased demand for ecosystem services that support climate change mitigation (e.g., carbon credits) and climate change adaptation (e.g., crop insurance). In this way, climate related markets are driving nature markets, and their close interconnection will be critical to the development of the latter

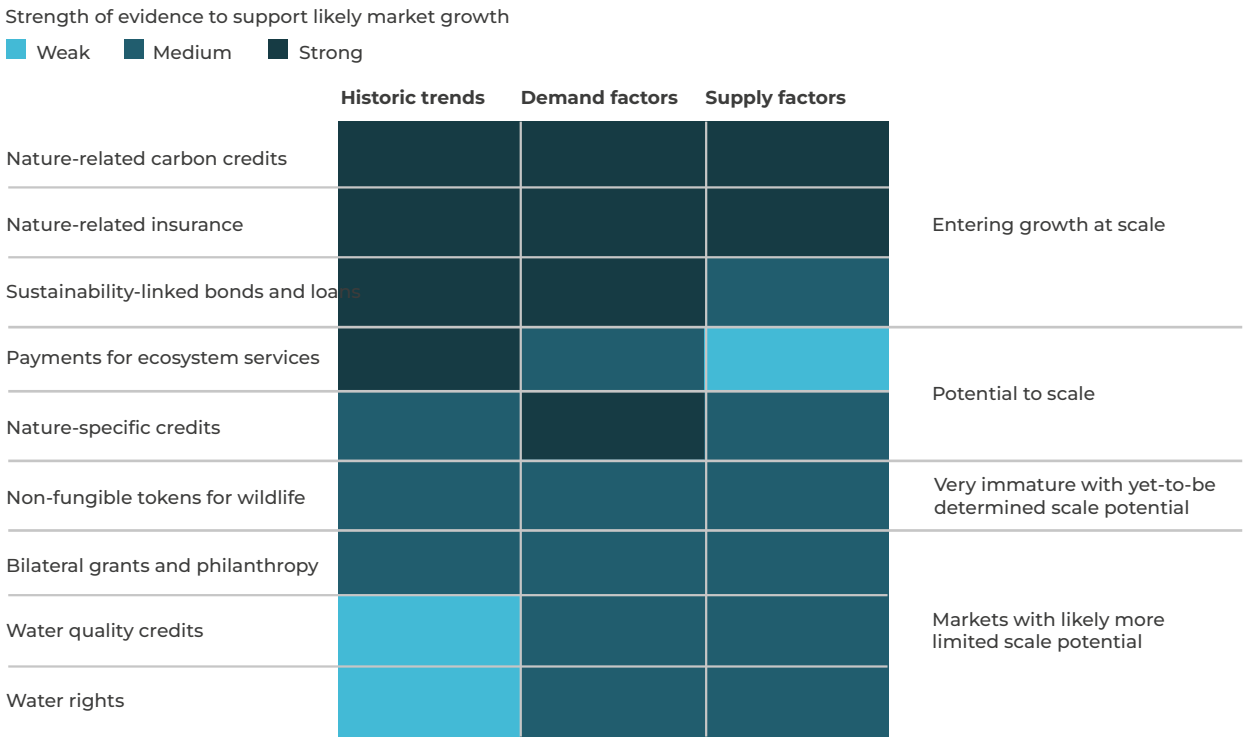
- Consumer preferences have begun to drive change in nature product markets, with increasing volumes for sustainably certified food products (see Box 1), and the increasing association of brand value with sustainability commitments

- Investor preferences are also driving demand for financial products linked to sustainability outcomes (e.g., sustainability-linked debt), and potentially steering capital toward those assets that have demonstrably preserved nature value

- New technologies are also supporting the supply of new products and facilitating transactions in markets like nature-related carbon credits.

- Nevertheless, many markets, particularly those that rely on monitoring and verification, like payments for ecosystem services and biodiversity credits, still face challenges in credibly delivering outcomes and building consumer confidence (IUCN, 2022).

Figure 3 Qualitative review of trends in less mature nature markets[5]



Although smaller than commodities markets, markets for wildlife tourism and products are sizeable with significant nature impacts. These two wildlife related markets represent roughly US$280 billion in economic value annually. Access to wildlife tourism – the much larger market – can support conservation efforts and some protected areas rely heavily on these revenues. However, the extent to which the nature-related tourism industry adequately prices in the value of nature, and whether it has a nature-positive impact remains uncertain (INTOSAI, 2014). At the same time, illegal wildlife trade – a much smaller market – has an outsized negative impact on biodiversity given its size (further discussed in Box 2).

There are other large nature asset markets also based primarily on commodity products. (Figure 2) There are an estimated 1.2 billion hectares of privately owned and market accessible ecosystem assets worth a combined US$8.6 trillion. This value is also primarily driven by agricultural and soft commodities production, with 85% of the value attributed to agricultural land. Although large, the extent to which nature (or ecosystem) assets are traded in markets is much smaller than in products and services, with a large proportion of such assets either held by the public sector or untraded owing to restrictions on private property markets. Nature-positive outcomes must ultimately manifest in the stock of natural capital, highlighting the importance of how agricultural land markets function and develop going forward.

Contents

Introduction

Nature is often underpriced in the economy, which has led to negative externalities and inequalities (Figure 4). Markets are an important part of the global economy, facilitating exchange between buyers and sellers. Prices in well-functioning markets signal the value of goods and services, helping allocate resources efficiently to the areas where people value them most. However, when markets fail to function properly or fail to value certain outcomes (for a variety of reasons), resources will likely be used inefficiently, and under-allocated to some areas. Nature has historically been under-valued and over-exploited through markets (Dasgupta, 2021). For example, the annual negative externalities of the global food system are estimated at US$12 trillion per year (Food and Land Use Coalition, 2019). Such negative externalities and their destructive impact on nature sometimes also deliver inequitable outcomes, negatively impacting nature's stewards, especially indigenous groups and rural communities (UN, 2021).

Figure 4 The explicit value of nature in markets represents a fraction of nature's true value

Seen - The explicit price of nature in nature markets

The explicit price of nature in markets is just the 'tip of the iceberg' in terms of nature's value to people and the economy

Unseen - The true value of nature in the economy

1 **Implicit value**

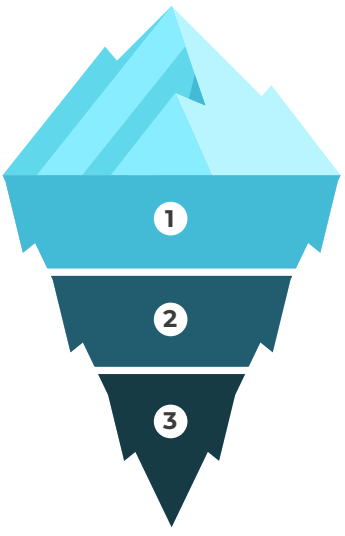
Dependencies on ecosystem services are implicitly valued in markets, but the contribution is not always recognized or properly valued

2 **Missing revenue**

Some parts of nature are completely excluded from markets, without generating revenue for ecosystems and their stewards

3 **Externalities**

Impacts on nature are often un-priced in nature markets and the wider economy creating negative externalities



At the same time, there is a growing set of nature markets that explicitly price and trade nature. For nature markets to arise, there need to be nature-specific revenues generated as an integral part of the trade (Taskforce on Nature Markets, 2022). This includes large and mature markets, such as agricultural commodities, as well as emerging markets that reflect an increasing recognition of the value of nature, like biodiversity credit markets. Nature markets also intersect with emerging climate change related markets, like nature-based solutions for carbon sequestration. The way nature markets function affects the incentives for conservation and sustainable resource management. Although markets are not the only, nor necessarily the most appropriate, way to account for nature's true value, whether nature markets function well or exist at all will likely have a large impact on the economic incentives for conservation.

Nature markets are already an important part of the global economy but are not primarily designed to achieve nature-positive outcomes. Figure 5 shows how nature markets relate to the ways nature is priced and used in the wider economy:

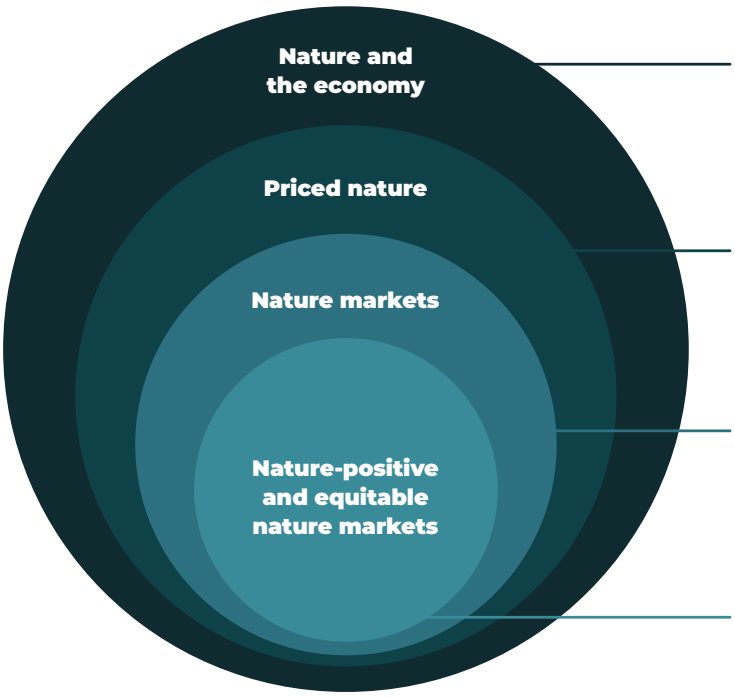
Nature and the economy: All of the economy is dependent on nature, but many parts of the economy are somewhat removed from their nature dependencies. Nature is therefore implicitly traded in all products and services but is often under-valued or not valued at all. For example, many goods are dependent on clean water for production. Since the price paid for by water users is often lower than the true value of water, the trade of these goods does not reflect the full cost of nature dependencies.

Priced nature: Some of nature is priced in the economy, although often incorrectly and without full consideration of nature-related externalities (Dasgupta, 2021). Nature can be priced through regulatory mechanisms (e.g., taxes, permits, fines), certification schemes, or in market transactions.

Nature markets: Nature markets are one way that nature is priced, in transactions where nature is specifically traded and valued. This includes large markets that are already important to the global economy, such as agricultural commodities, as well as emerging markets that reflect an increasing recognition of the value of nature, such as nature-based solutions for carbon sequestration.

Nature-positive nature markets: Most nature markets are not specifically designed to achieve nature-positive and equitable outcomes and may actually be drivers of biodiversity and nature loss. For example, agricultural production is the largest user of land and water and driver of deforestation (Ritchie & Roser, 2021). At the same time, there is an increasing diversity of products and services that aim to deliver nature conservation and restoration, such as nature-related credits.

Figure 5 Only some of nature's value is traded in markets, and not all markets are nature-positive



100% of the economy is 100% dependent on nature, but not all of nature's value is recognized in economic activity

Some of nature is priced in the economy via policies and markets, although not necessarily correctly[1]

Nature markets are where nature-specific revenuesare generated as an integral part of the trade[1]

Some, but not all nature markets are currently designed to achieve nature positive and equitable outcomes

The current impact and scale of nature markets likely point to the need for greater consideration of market governance and infrastructure mechanisms. Market governance (e.g., rules of trade, taxes) and infrastructure (e.g., systems of exchange, blockchain technology) can affect how well markets function and grow. For nature markets, these features could determine some of the incentives for how nature is used, and the extent to which these markets can achieve impact at scale. An improved understanding of nature markets clarifies how nature markets are currently functioning and identifies what might be required for such markets to achieve nature-positive and equitable outcomes.

To gauge how to best foster effective nature markets, an understanding of the extent, size and distribution of current nature markets globally is needed. The objective of the landscaping analysis in this report is to assess the state of and trends in nature markets by defining nature markets, identifying current and emerging nature markets and estimating their size and distribution based on the way in which markets are explicitly priced in the economy. This analysis focuses on the current state of nature markets, laying the groundwork for the Taskforce to assess how to best shape nature markets going forward.

The rest of this report is structured as follows:

- Section 1 unpacks the definition and taxonomy of nature markets, and how nature markets relate to other key nature-related terms
- Section 2 discusses the findings from the landscaping analysis, including the size and distribution of current nature markets
- Section 3 identifies trends in nature markets and discusses emerging market segments
- Section 4 concludes with discussion of key implications for governance of nature markets

Global Nature Markets Landscaping Study

1

Definition and taxonomy of nature markets

Taskforce on Nature Markets

1 Definition and taxonomy of nature markets

To understand how nature markets function, an explicitly definition of nature markets is needed, which has not yet been done systematically. As discussed in the Taskforce on Nature Markets white paper, there is a broad literature that offers a diverse set of concepts related to nature and the economy (Taskforce on Nature Markets, 2022). However, there is no widely agreed definition of nature markets, which precludes a systematic analysis of the current state and trends.[6]

The technical definition used in this report builds on these definitions and unpacks the concept developed in the white paper to systematically identify and size current nature markets. The white paper outlines the concept of a nature market as a trade with a specific price on nature and that generates nature-specific revenues. To apply this definition in practice and identify current nature markets, this analysis uses the following technical definition (Figure 6).

Figure 6 Technical definition of nature markets applied in analysis

WHITE PAPER DEFINITION

A nature market is trade where there is a specific price on nature and that generates nature-specific revenues

TECHNICAL DEFINITION

A nature market is a **system** composed of **transactions** between **separate buyers and sellers**, in which the transacted good or service **specifically** reflects a stock of ecosystem assets **or a flow** of ecosystem services from **terrestrial or aquatic ecosystems**

NATURE MARKET TAXONOMY

Intrinsic

Markets in which provisioning, regulating or cultural ecosystem services are traded

Credit

Markets in which credits that reflect efforts to enhance or conserve ecosystem assets or services are traded

Asset

Markets in which the right to use ecosystem assets with long-lived value are traded

Derivative

Markets for financial products which directly reflect ecosystem service values

System – Nature markets are made up of set of participants engaging in trade. In order to qualify as a nature market, there must be multiple transactions occurring, facilitated by formal or informal market infrastructure. One-off transactions do not qualify.

Transactions – The market necessitates the exchange of currency for products or services, legally or illegally. This means that markets only include exchanges where there is an explicit price on nature. There are many forms of natural capital and ecosystem services that underpin production but are often un-priced or underpriced, like water. The market sizing does not estimate the value of the implicit price of nature in these transactions. In addition, nature markets exclude finance for nature. While finance for nature does involve nature-specific payments, the capital is intended to be repaid and therefore does not constitute a nature-specific exchange.

Separate buyers and sellers – The buyer and the seller in each transaction must be separate entities. This means that self-investment in enhancing natural capital (e.g. domestic conservation funding) and "insetting"[7] are not considered nature markets.

Specifically – Nature markets are limited to the exchange of ecosystem assets, services or derived values. Downstream markets that rely on nature are not considered nature markets (e.g., the market for cotton t-shirts). Financial products where nature is not the primary driver of value (e.g., a sovereign bond where nature risk is considered in the valuation) are excluded.

A stock or a flow – Nature markets can include markets that are intrinsically linked, including markets that reflect both the stocks of ecosystem assets and flows of ecosystem services. This means that the market sizing may include some 'double counting' of ecosystem values, and that market categories should be considered separately.

Terrestrial or aquatic ecosystems – Nature markets do not include markets that reflect the quality of air, or trade on air pollutant values.

Nature is complex, multifaceted, and intersects with markets in many different forms. As a result, the application of the technical definition to determine which markets are included or excluded will involve subjective judgement (Table 2). The market definition should be interpreted as a driving principle of the market-sizing analysis rather than a strict boundary.[8]

The analysis of this paper does not focus on extractive nature markets, such as fossil fuels, mining metals and minerals, as these have been studied and economically valued extensively. The trade of fossil fuels, metals, and minerals are the largest nature markets in terms of economic value. Likewise, the usually destructive impact of these markets on nature and the ways in which they can be reshaped to reduce nature impacts is well documented. The analysis herein instead focuses on markets which trade other provisioning ecosystem services, such as plants, animals and water, as well as cultural and regulating services, their impact and potential for reform less well documented.

This report defines four types of nature markets which reflect the key motivations for exchange of nature-specific products and services between buyers and sellers and underpin how nature is valued in the wider economy and financial systems.

Intrinsic markets are markets in which provisioning, regulating or cultural ecosystem services are traded. These markets have often developed naturally based on the value placed on some ecosystem services and represent an annual production value, comparable to gross domestic product (GDP). Intrinsic markets are the furthest upstream markets for ecosystem services. This includes commodity markets, which meet the definition of nature markets as they involve the direct trade of provisioning services but excludes downstream markets which embed commodities. For example, soy is a direct product of nature; tofu is nature-dependent but does not specifically trade nature and is excluded because there is a market further upstream.

Credit markets are markets in which credits that reflect efforts to enhance or conserve ecosystem assets or services are traded. These markets have primarily arisen in response to climate or nature-related policies. Credit markets represent an annual flow of value.

Asset markets are markets in which the right to use ecosystem assets and their resulting services are traded. These markets require enforceable property rights and reflect demand for stable and long-lived value streams. Asset markets represent a stock of value which may generate revenues over different time periods.

Derivative markets are markets for financial products which directly reflect the value of ecosystem services or assets. Demand drivers vary substantially among products, but these markets reflect increasing recognition of nature's values and the risks posed by nature loss. Derivative markets represent both stock and flow values, depending on the underlying product or asset.

Table 2 The nature markets taxonomy includes four types of nature-specific trade

Type	Description	Category	Traded element	Segments
Asset Markets	Markets in which the right to use ecosystem assets witlh long-lived value are traded	**Real assets**	Rights to use an entire ecosystem asset and resulting services	Agricultural land, timberland, water rights, *biodiversity IP, additional ecosystems assets*
Intrinsic Markets	Markets in which provisioning, regulating, or cultural ecosystem services are traded	**Products**	Use of provisioning services	Hard and soft commodities, legal and illegal wildlife, genetic materials, water rights leases
		Conservation	Conservation of nature for direct economic benefit or altruistic value	Payments for ecosystem services, overseas development aid, philanthropic grants, sustainability-linked debt
		Access	Access to/use of cultural services	Wildlife tourism
Credit Markets	Markets in which credits that reflect efforts to enhance or conserve ecosystem assets or services are traded	**Nature-specific credits**	Credits that reflect the value of ecosystem services	Mitigation banks, water quality credits, *voluntary biodiversity credits*
		Nature-related carbon credits	Credits that reflect the value or carbon sequestration or storage	Nature-related voluntary carbon credits, AFOLU sector compliance carbon allowances
Derivative Markets	Markets for financial products which directly reflect ecosystem values or ecosystem risks	**Financial products**	Financial products directly tied to ecosystem assets or services	Commodity derivatives, nature-related insurance, wildlife NFTs, *biodiversity loss insurance, securitization of ecosystem assets, water futures*

Note: Segments in italics are not included in the current market sizing analysis but are further discussed in the nascent market segments section of the report.

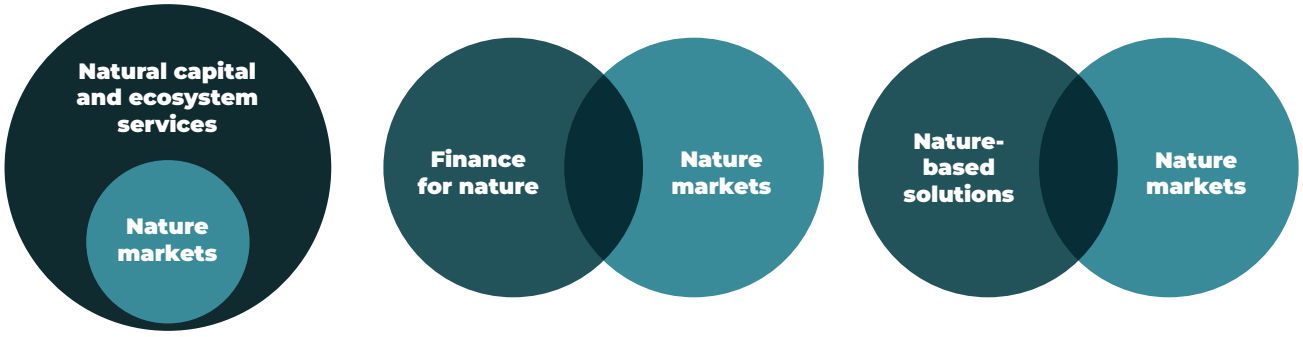
Nature markets are related to, but distinct from, other key nature-related concepts. Some aspects of nature markets overlap with natural capital, nature-based solutions and nature finance. However, there are nature markets that are not captured by any of these terms, necessitating a different definition (Figure 7). Key distinctions between these related terms are:

- **Nature markets vs natural capital:** Ecosystem services reflect the value of benefits that natural capital provides to people. Some ecosystem services (e.g., food) are traded in markets, while other services (e.g., pollination) are not often traded or valued. There are also some nature markets (e.g., non-fungible tokens [NFTs]) that are linked to ecosystem service values but do not directly stem from a natural capital framing.

- **Nature markets vs nature-based solutions (NBS):** NBS are actions to protect and restore ecosystems while addressing social and economic challenges.[9] Only a subset of nature markets is designed specifically to deliver nature-positive outcomes (e.g., water quality credits), and there are also investments in NBS outside of markets (e.g., domestic conservation funding).

- **Nature markets vs finance for nature:** There is increasing interest in the amount of investment directed towards nature. Nature markets necessitate the trade of nature-specific products and services. Therefore, finance for nature (e.g., loans) where there is an expectation of repayment are not considered within the scope of nature markets. Some forms of finance (e.g., sustainability-linked bonds) can be considered effective nature markets because the reduced cost of finance implies a payment for nature.

Figure 7 The nature markets definition and taxonomy is linked to and complements existing nature-related frameworks



Global Nature Markets Landscaping Study

2

Current state of nature markets

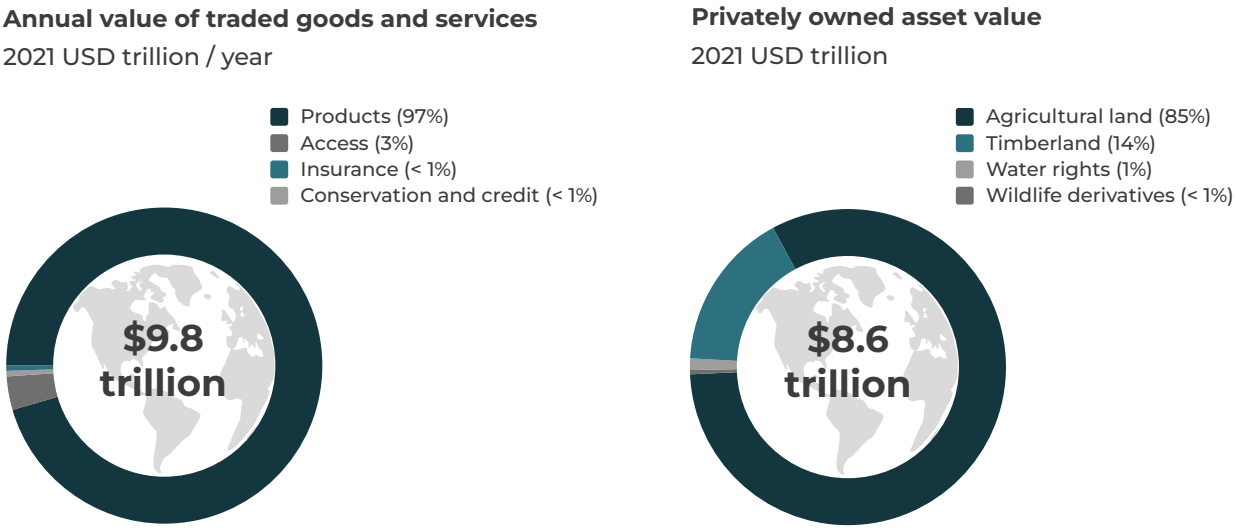
Taskforce on Nature Markets

2 Current state of nature markets

Nature markets are already a major part of the global economy (Figure 8). While nature markets may be perceived as small markets for conservation, some of the largest markets in the economy and financial system are nature markets. Key findings from an analysis of 24 current nature markets includes:[10]

- Nature markets produce and trade almost **US$10 trillion** worth of goods and services, equivalent to around **11 % of global GDP** (Figure 8).
- Privately owned and market-accessible ecosystem assets are worth over **US$8 trillion** (Figure 8) but represent only a fraction of natural capital and other privately traded assets. Privately owned ecosystem assets are worth **26% of the value of commercial real estate assets**.[11]
- Nature underpins **US$2 trillion of outstanding over the counter commodity derivative contracts**. Commodities represent around **20% of the trade volume of all derivatives** (Hong Kong Exchanges and Clearing Limited, 2020).

Figure 8 Summary of current nature markets annual production and asset values



Note: Figures exclude commodity derivatives, as market size is measured using non-comparable metrics. See appendix for methodology details

The following sections provide an overview of the size and key features of 24 current nature markets (Table 3). The focus of the analysis is on the current size of nature markets, with reflection on market features for key market segments. Additional discussion of trends and potential implications for market governance needs is discussed later in this report. The methodology used is detailed in the appendix.

Table 3 Overview of market sizing metrics and estimated values

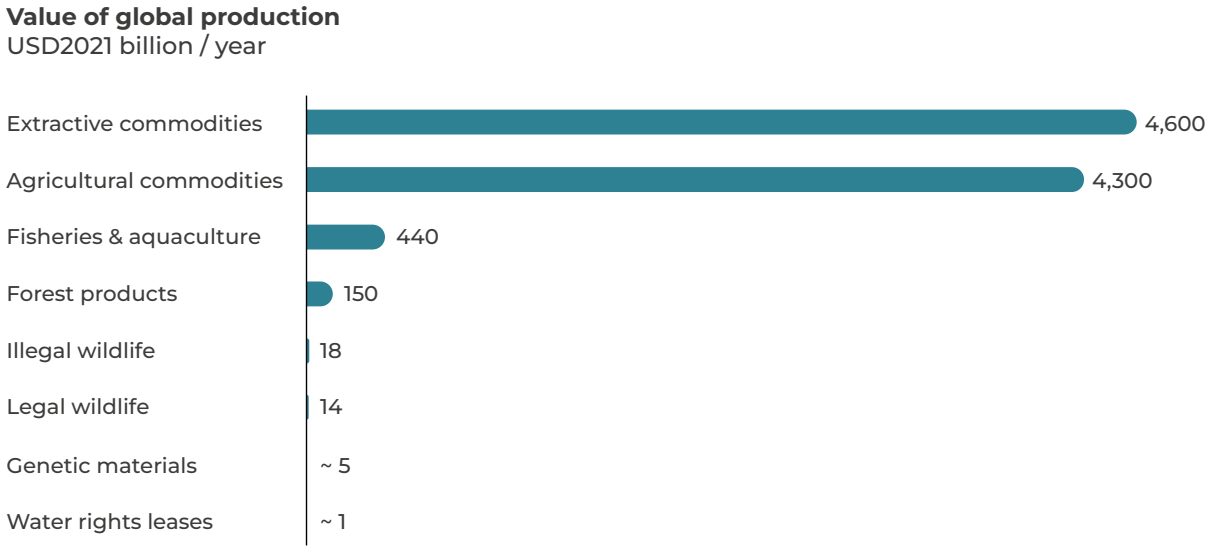
Type	Category	Segment	Market size metric	Value (USD2021 billions)
Intrinsic	**Product**	Extractive commodities	Annual production value	4,600
		Agricultural commodities	Annual production value	4,300
		Fisheries and aquaculture	Annual production value	440
		Forest products	Annual production value	150
		Illegal wildlife	Annual trade value	8-27
		Legal wildlife	Annual production value of largest segments	14
		Genetic materials	Annual production value	5.3
		Water rights leases	Annual value of sold leases	1.2
	Access	Wildlife tourism	Annual expenditure on wildlife tourism	260
	Conservation	Payments for ecosystem servicess	Annual value of payments	9.8
		Overseas development aid	Annual aid value	0.55
		Sustainability-linked bonds and loans	Estimated yield reduction for achieving KPIs from annual debt issuance	0.43
		Debt-for-nature swaps	Average annual value of conservation payments generated in recent swaps	0.19
		Philanthropic grants	Annual grant value	0.12
Credits	**Nature-specific credits**	Mitigation banks	Annual value of credits purchased at point of first sale	4.1
		Water quality credits	Annual value of credits purchased at point of first sale	0.04
	Nature-related carbon credits	Voluntary carbon credits	Annual value of credits purchased at point of first sale	1.3
		Compliance carbon allowances	Annual value of allowances issued based on market price	0.16
Asset	**Real assets**	Agricultural land	Stock value of market-accessible assets at current market prices	7,300
		Timberland	Stock value of market-accessible assets at current market prices	1,200
		Water rights	Stock value of market-accessible assets at current market prices	94
Derivative		Commodity options and futures	Notional value of outstanding OTC contracts as of year end	2,200
		Nature-related insurance	Annual premium payments	36-44
		Wildlife NFTs	Value of recently-issued tokens	<.001

Source: Taskforce on Nature Markets and Vivid Economics

PRODUCT MARKETS

Product markets are the largest nature markets and produce over US$9 trillion in annual value, primarily driven by extractive and agricultural commodities.[12]

Figure 9 Agricultural commodities are the second largest product market



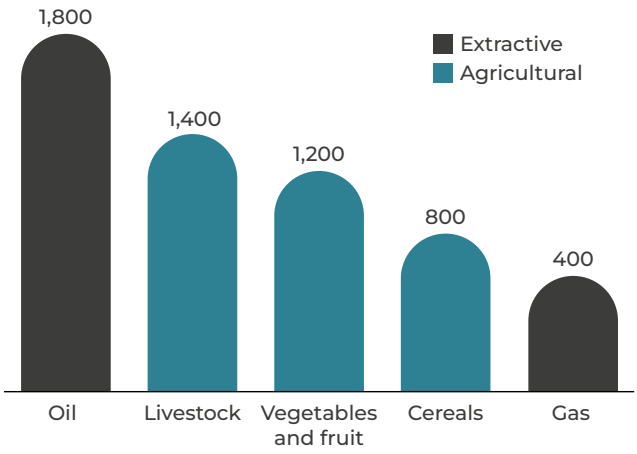
Note: Extractive commodities includes mining of coal, metals and minerals as well as oil and gas. Oil & gas revenues based on average from 2017-2021 due to annual variation. If expected 2022 revenues were used the extractives segment would be worth over US$6 trillion

Agricultural and extractive commodities account for over 90% of the product market size (Figure 9). Production is concentrated in large economies with China, India and the United States accounting for more than half of production value. The value of the market is driven by the five commodities displayed in Figure 10 which account for 60% of production value; livestock alone accounts for 15% of production value. These markets have seen consistent growth in the past few decades in line with GDP growth. For instance, since 2010, the value of agricultural production has increased 2.8% each year compared to 3.4% annual GDP growth (World Bank, 2022).

As noted earlier, this study finds that extractive commodity markets are well understood and so this analysis focuses on soft commodities and other nascent product and service markets. The way in which other nature markets can be shaped to support nature positive and equitable outcomes is less clear than for extractive commodity markets. As such, this study's analysis of product and service markets is centered around the trade of soft commodities and other small but growing product markets.

Figure 10 Livestock is the largest soft commodity produced by value

Top global commodities by value
USD2021 billion / year

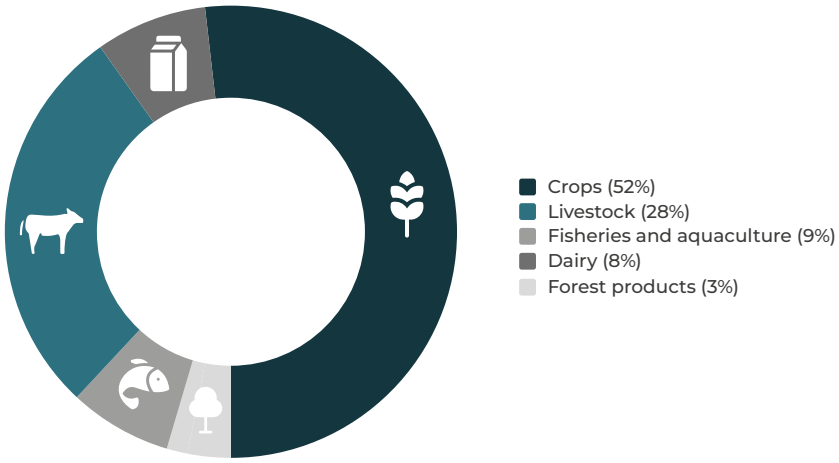


Note: Extractive commodities includes mining of coal, metals and minerals as well as oil and gas. Oil & gas revenues based on average from 2017-2021 due to annual variation. If expected 2022 revenues were used the extractives segment would be worth over US$6 trillion

Soft commodities value is concentrated in livestock and dairy production. As shown in Figure 11, animal-based production is worth US$2 trillion and makes up 44% of the soft commodities market value. On top of this, a large proportion of crop production is used as an input to animal-based agriculture, particularly in developed countries. Globally, more than 40% of cereals are used for animal feed with large regional variation. Only 11% of cereals grown in the United States are used for human consumption compared to 95% in Kenya (Ritchie, 2022). Additional details on the soft commodities market are discussed in Box 1.

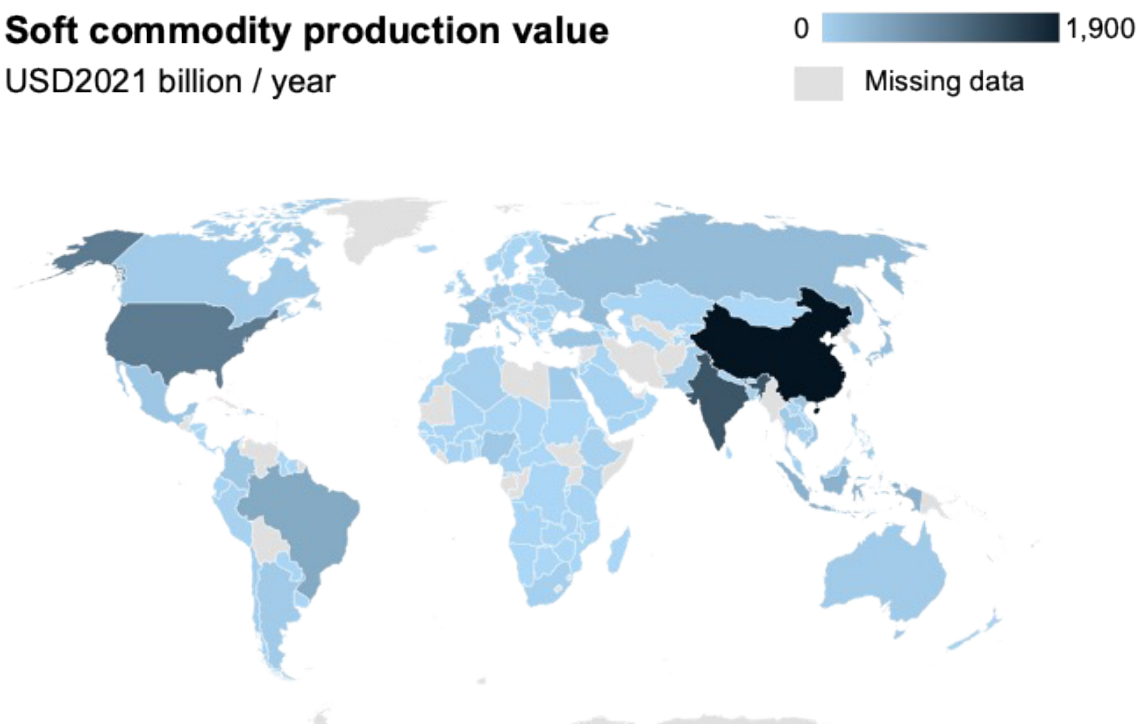
Figure 11 Animal-based production accounts for nearly half of the soft commodities market value

Soft commodity production value
Based on USD2021 billion / year



Fisheries, aquaculture and forest products are smaller but growing commodity segments, worth a combined US$530 billion per year. While fish consumption is growing, the value of fisheries and aquaculture production is one-tenth of the value of agricultural commodities. Aquaculture has recently grown to outstrip capture fisheries in production value. Driven by China, aquaculture production has doubled since 2000. In comparison, production volumes from capture fisheries have remained stagnant since 2000 due to degraded fish stocks and increasingly stringent fishing regulations. Forest products are the smallest soft commodity segment by value. Sawlogs used for timber production account for 70% of market value and major producers include the United States (US), Canada and Russia. Despite being the smallest soft commodity segment, forestry crime has been identified as the most significant source of nature crimes, with up to US$50-152 billion in illicit gains livelihoods (Financial Action Task Force, 2021). It is unknown precisely how much of these gains are reflected in legal markets; the upper bound of illicit gains is similar to the estimated market size, underscoring the scale of illegal activity which has significant impacts on nature outcomes and livelihoods (Financial Action Task Force, 2021).

Figure 12 39% of soft commodities value is produced in China



BOX 1 - Soft commodity markets deep dive

The market for soft commodities plays a critical role in food security and is facing increasing pressures. Soft commodities include crops, livestock, fisheries, aquaculture and forest products. The sector faces at least four pressing challenges that signal a need to scale up and improve the efficiency of markets:

Population growth: The global population is expected to reach over 9 billion by 2050. Meat consumption is also increasing in developing nations due to rising incomes. Combined, these impacts could increase food demand by up to 56% in 2050 compared to 2010 (van Dijk, Morley, Luise Rau, & Saghai, 2021).

Climate change: Climate change can reduce the productivity of livestock, fisheries and aquaculture (IPCC, 2022). Climate-related extreme weather events like droughts and floods can also affect crop yields. These impacts are expected to worsen as water availability decreases and the frequency and magnitude of extreme weather events increases.

Food security needs: As shown in Figure 12, production value is driven by China, India and the United States. Some regions rely heavily on food imports, creating large disparities in self-sufficiency. For example, in Europe, the entire population could be fed with crops produced within 2,500km. By comparison, only 40% of the population in Africa could be fed with production in this radius, creating risks of food shortages if international trade becomes limited or there are production shocks (Kinnunen, et al., 2020). Evolving self-sufficiency needs may have implications for production patterns and pressures on land use.

Nature crimes: The Financial Action Task Force highlights forestry crime from illegal logging and illegal land clearing as the most significant source of value generated by environmental crime (Financial Action Task Force, 2021). These illegal activities may undermine the functioning of legal markets and increase the scale of mispricing.

US$1.3 trillion of soft commodities are traded internationally each year. International imports and exports are a key component of soft commodity markets, with around one-quarter exchanged globally. Moreover, soft commodities represent nearly 5% of annual global trade (UNCTAD, 2022). Even major exporters with secure food supplies are often major importers because they can benefit from lower production costs in other countries and consume seasonal goods year-round (Fader, Gerten, Krause, Lucht, & Cramer, 2013). For instance, in 2020, the United States exported US$120 billion of agricultural commodities and also imported US$100 billion (Chatham House, 2021).

The soft commodities market creates multiple nature-related externalities that are unpriced and largely driven by livestock production. Agricultural production is one of the primary consumers of natural resources. The sector uses 70% of annual freshwater abstractions (World Bank, 2017), has driven nearly 90% of global deforestation since 2000 (FAO, 2020), produces 23% of annual GHG emissions (IPCC, 2019) and is one of the leading causes of nitrogen pollution (Kanter, et al., 2019). Most of these impacts are driven by livestock production which uses nearly 40% of global habitable land area but provides only 18% of calories (Ritchie & Roser, Environmental Impacts of Food Production, 2021). These environmental externalities are often underpriced or not priced at all in production. For example, there are no emissions trading systems that currently cover the agricultural sector and producers in most countries do not pay for the full cost of water abstractions. The lack of price signals may reduce incentives for more sustainable management and efficient production.

Sustainable market segments represent only a fraction of soft commodities production. Currently, the primary incentive structure for sustainable agricultural production is through sustainability certification premiums. For example, organic-certified goods are estimated to garner a 10-80% price markup compared to comparable uncertified goods. (USDA, 2016). Across soft commodity market categories, the sustainability segment is nascent, but growing. Examples of key sustainability certifications in soft commodities include:

Agriculture: Only 1.5% of global farmland is currently certified organic (FiBL & IFOAM, 2021). However, the size of the segment varies by agricultural product. For cocoa, only 7% of production is Rainforest Alliance certified (Rainforest Alliance, 2022). By contrast, the production of Rainforest Alliance certified tea has grown 30% since 2017 to account for 22% of global tea production (Rainforest Alliance, 2022).

Wood products: The share of roundwood production certified by the Forest Stewardship Council (FSC) has more than doubled since 2015 to 17% (FSC, 2015) (FSC, 2018).

Fisheries: 14% of wild marine catch by weight, or around 6% of total fisheries and aquaculture production, is certified by the marine stewardship council (MSC) (MSC, 2022).

Developing linked markets could create additional incentives for more sustainable soft commodities production that better accounts for nature-related externalities. While trends in consumer preferences indicate increasing demand for sustainable production (The Economist Intelligence Unit, 2021), sustainability certification could be more likely to shift production towards more nature-positive outcomes in combination with other mechanisms. However, such certification schemes should adhere to rigorous guidelines on quality assurance of nature impacts. In addition to regulatory mechanisms that can affect production standards or incentives for resource use (e.g., water pricing), linked markets could affect the incentives for sustainable commodities production. For example, accessible and well-developed nature-related credit markets could create incentives for sustainable production systems. In addition, commodity derivative market governance could influence commodity production, and there is already an emerging movement to embed sustainability criteria in derivatives trade.

The largest markets for legal wildlife trade produce US$14 billion per year, with some segments facing increased scrutiny for potential disproportionate impacts on biodiversity. The value of the market for legal wildlife products[13] is primarily driven by inputs to Traditional Chinese Medicine (TCM) and fur production. Demand for TCM products is growing, with the trade of wildlife products supporting a more than US$20-25 billion per year industry. China is the largest producer of inputs, primarily through production of ginseng.[14] Demand from outside of China is growing, although internationalization of TCM faces some regulatory barriers (Lin, et al., 2018). Industry reports estimate the market size within the next few years could reach as much as US$30-35 billion implying significant need to scale up production. Wildlife product trade can have varying impacts on biodiversity with increasing restrictions on products like fur. Luxury fashion businesses are increasingly avoiding use of pelts and the price of mink skins has fallen significantly in recent years. Nonetheless, in 2019 more than 50 million raw mink pelts were produced, supporting around US$25 billion in fur retail value (Hansen, Global fur retail value, 2021).

BOX 2 - Nature crimes and nature markets

Illegal use of nature is large, profitable, destructive and may underpin many nature markets. Nature crimes constitute illegal activity tied to the environment and generate up to US$280 billion per year in criminal proceeds (Financial Action Task Force, 2021). The most prominent crimes include illegal deforestation, mining, fishing, waste and wildlife trafficking. Nature crimes are often connected to entirely legal business activity and associated investments (Global Witness, 2021). For example, investments into soft commodity market segments, such as beef or palm oil, can be major direct or indirect drivers of illegal deforestation. Nature crimes can also be disruptive to legal nature markets. The sale of illegally harvested timber and mined minerals can undermine the commodities markets by lowering the price of legal production. As a result, legal and illegal nature markets are intimately connected and often inter-dependent (Finance For Biodiversity , 2022). Moreover, such illegal trading of nature and related ecosystem services is closely related to other forms of criminal activity, often involving drugs, violence and other drivers of societal disruption (INTERPOL, 2020).

Estimates of the value of illegal wildlife trade indicate that US$8-27 billion[15] of live and dead wildlife and plant specimens are trafficked each year. Widely trafficked mammals include pangolins from China, African and Asian elephants, and African rhinos (United Nations Environment Programme, 2016). While illegal wildlife trade is relatively small in value compared to other nature market segments, it can have an outsized impact on biodiversity by threatening species extinction, introducing non-native species to new areas and supporting the spread of zoonotic diseases. (Cardoso, et al., 2021).

The genetic materials market, worth US$5 billion per year, is primarily driven by the trade of live animals and animal products for breeding and may fail to capture revenues from key genetic values. Live animals generate US$3 billion of revenue each year, primarily from poultry and pigs, compared to US$2.3 billion for animal products such as embryos and semen. The United States is the largest market, making up 27% of global value. In addition to these genetic products, there is wider genetic value from nature that does not currently generate revenue in markets when treated as a public good. For example, the chemical properties of plants play a key role in the production of some pharmaceutical products but, because the intellectual property is often freely accessible, the value is not fully priced in drug production (Convention on Biological Diversity , 2005). As noted in negotiations of the Convention on Biological Diversity, these issues have raised concerns of equity between the users of genetic materials and their unrecognized owners, which can include indigenous communities (ibid). This may also mean that there are reduced incentives for conservation for owners of ecosystem assets. The Convention on Biological Diversity (CBD) has been exploring options to ensure the use of genetic materials can deliver revenues for nature conservation, discussed further in the nascent nature markets section of this report (The United Nations Confrence on Trade and Development , 2014).

Relative to the amount of water used globally, only a small amount of the value of water as a provisioning service is traded in markets (US$1 billion per year). Active markets for water are primarily in Australia and in the western United States. Around 3,000 GL of water rights are leased for annual abstractions, primarily by agricultural producers. This represents just 0.3% of annual groundwater abstractions globally (UNESCO World Water Assessment Programme, 2022). Most countries and regions use non-traded mechanisms for controlling water abstractions, including licensing and tariffs. Water as a provisioning service is embedded in many primary products, including agricultural commodities, which may not adequately price the cost of abstraction. For example, a recent study on the shadow price of water in agriculture found that in most regions of the world, farmers do not pay for the full value of water and in many cases do not even pay for the full costs of water delivery due to subsidies. As a result, water may be used inefficiently both within agriculture and across sectors (D'Odorico, Chiarelli, Rosa, & Rulli, 2020). In addition to irrigation uses, downstream markets for household water use are large, with markets for water and sanitation services worth around US$300 billion in 2021 according to multiple industry reports. However, the market price of these downstream products is primarily driven by added value of infrastructure, sanitation services and transportation.

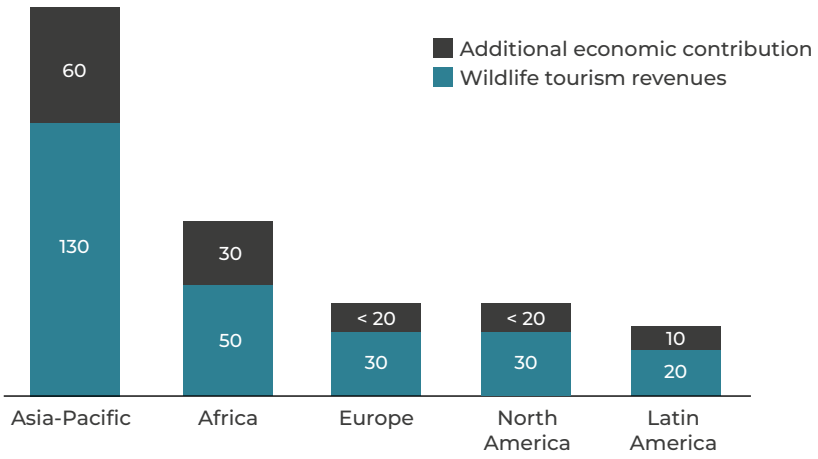
ACCESS MARKETS

Wildlife and nature-based tourism is a growing market that could have significant economic benefits for conservation fundraising and local communities.

Wildlife tourism generates more than US$260 billion in nature-specific revenue per year, nearly 70% of which occurs in Asia Pacific and Africa (Figure 13). There are several types of tourism that are linked to nature, including nature-based recreation (visits to nature sites and protected areas for the purposes of recreation), wildlife tourism (tourism that involves the observation or interaction with local and animal plant life in their natural habitats) and eco-tourism (typically defined as environmentally and socially responsible travel).[16] Not all nature-related tourism generates nature-specific revenues, but it can benefit local economies from the tourism draw, infrastructure development, and employment opportunities. For example, in 2015, it was estimated that nature-based recreation and tourism led to US$600 billion spent locally but did not necessarily generate nature-specific revenues (Balmford, et al., 2015).[17] Nature-specific revenues generated through wildlife tourism can support conservation efforts and some protected areas rely heavily on fees paid by tourism operators to fund conservation budgets. However, the extent to which the nature-related tourism industry is nature-positive is uncertain. While there are many guidelines and policies on sustainable tourism practices, data availability limits reliable assessment on the extent to which these practices are followed (Luc Hoffmann Institute, 2021).

Figure 13 Asia-Pacific is the largest region for wildlife tourism by value

Wildlife tourism by region
USD2021 billion / year

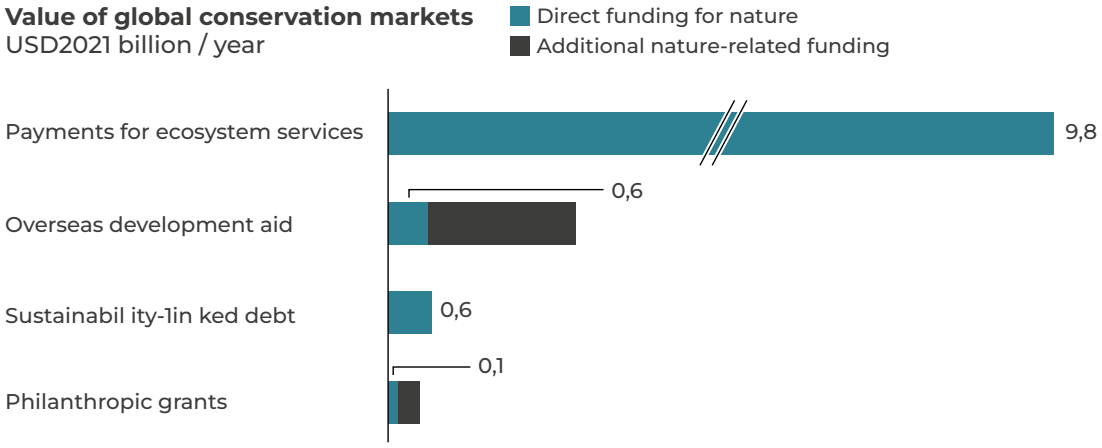


Source: Luc Hoffmann Institute, 2021

CONSERVATION MARKETS

The most traditional market mechanism for regulating services is through payments for ecosystem services (PES) schemes, but there are an increasing number of vehicles through which conservation and enhancement is paid for by both public and private actors.

Figure 14 Payments for ecosystem services make up 88% conservation market value



PES is the largest market for regulating services (nearly US$10 billion per year) but remains a fraction of domestic public spending on biodiversity protection. Regulating ecosystem services (e.g., pollination, water quality regulation) are public goods. As a result, these services are often not valued or are significantly undervalued, and there are limited markets for maintaining regulating services. For example, the Organisation for Economic Co-operation and Development (OECD) estimates that public domestic expenditure on conservation and sustainable use of biodiversity is nearly US$70 billion per year, compared to the estimated US$10 billion per year in market-based conservation payments estimated in this analysis (OECD, 2020). While PES is still the largest market-based mechanism for conservation (Figure 14), there are an increasing number of additional financial mechanisms that reflect willingness to pay for conservation outcomes through results-based financing and philanthropy.

Philanthropic funding for conservation is a small and established nature market driven by the public sector. Overseas Development Aid (ODA) and private philanthropy are considered a nature market, as they provide non-domestic payments for nature-specific outcomes, primarily for biodiversity protection (68%) and soil and water conservation (20%). Nature-specific funding is primarily directed towards biodiversity-rich areas: Africa receives almost half of funding followed by South America and Asia. These conservation markets are worth US$500 million and US$100 million respectively per year and have remained at a consistent level over the last decade. Other nature-related funding (e.g., capacity building for implementation environmental policies) provides an additional to US$2-3 billion, but nonetheless represents a fraction of total annual ODA funding, estimated at over US$70 billion per year.

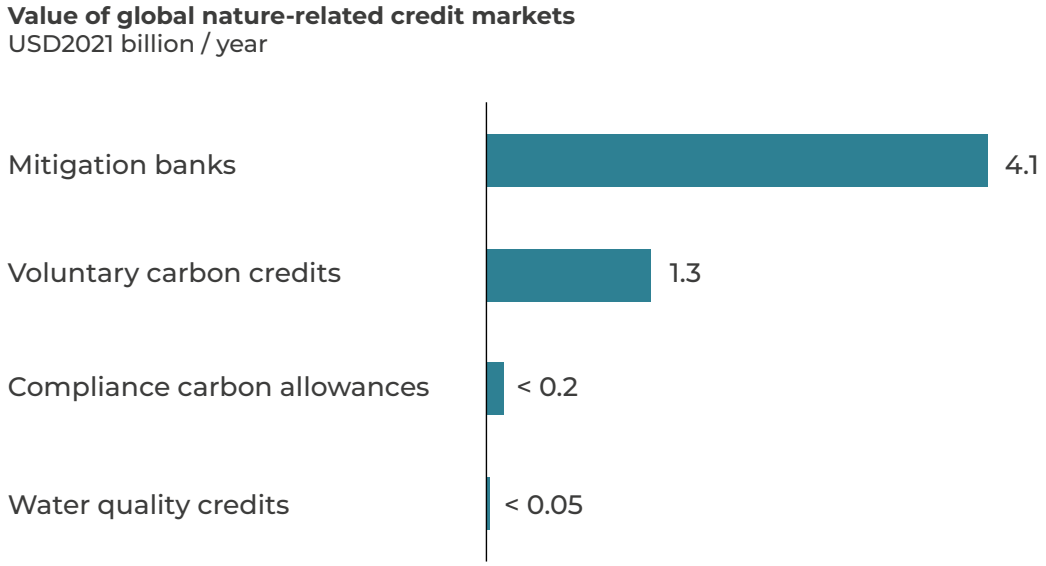
There is an increasing volume of performance-linked financing that is used to fund nature outcomes, representing another effective market for conservation and enhancement. Debt-for-nature swaps and sustainability-linked bonds and loans are important nature markets because although the full value of the debt financing is not itself a nature market, these instruments reflect willingness-to-pay for sustainability outcomes and present an opportunity for greater investor involvement in funding nature.[18] Debt-for-nature swaps are a smaller market than performance-linked debt, with US$2.6 billion in debt restructured between 1987 and 2015, but generate relatively more funding for nature as a proportion of the debt finance (Nedopil, Yue, & Hughes, 2022). Based on recent debt-for-nature swaps, an average of US$250 million in debt is restructured per year, generating an average of US$160 million in conservation payments. By contrast, in 2021 nearly US$150 billion in bonds and loans in nature-related sectors were issued, generating an estimated US$430 million in yield foregone in these transactions.

CREDIT MARKETS

The market for voluntary carbon credits has grown more than six times in value since 2019 but currently remains small compared to compliance driven nature-specific credit markets.

Nature-related credit markets are currently valued at over US$5 billion per year, 73% of which comes from compliance-driven mitigation banks (Figure 15). There is increasing interest in using crediting mechanisms to achieve nature and net-zero objectives. Currently, the largest nature-related credit market is for credits issued from mitigation banks, worth over US$4 billion per year. Mitigation banks are restoration projects that issue credits approved by government agencies. Infrastructure projects that affect nature could then purchase these credits to ensure they comply with policies such as 'no-net loss' biodiversity regulations. Mitigation banks are concentrated in wetlands and streams in the United States. In addition to mitigation banks, there are nature-specific credits for water quality, although they are worth just an estimated US$36 million per year. These credits arise from projects which enhance water quality, usually focusing on nitrogen pollution, and are purchased to offset wastewater discharges. Nature-related carbon credits are growing, due to growth in voluntary carbon markets, increasing market share of nature-based solutions within voluntary carbon markets, and there are indications that compliance markets may increasingly cover the AFOLU sector (discussed further in Box 3).

Figure 15 Nature-specific credits are still larger that nature-related credits in carbon markets, despite recent trends



Note: Only considers credits from Agriculture, Forestry and Other Land Use (AFOLU) projects and forestry allowances in the New Zealand Emissions Trading System (ETS)

BOX 3 - Carbon credit markets deep dive

Climate action is driving growth in voluntary carbon credits, the majority of which are now nature-based. The market for voluntary carbon credits is worth almost US$2 billion, US$1.3 billion of which are nature-based. Nature-based projects generate Agriculture, Forestry and Other Land Use (AFOLU) carbon credits by either avoiding greenhouse gas (GHG) emissions or by sequestering carbon dioxide. Most credits are generated by reducing emissions from deforestation and forest degradation (REDD+); other examples include agroforestry or grassland management. Demand for carbon credits is expected to increase 10 times by 2030 as corporations and financial institutions make progress towards climate targets (McKinsey & Company, 2021). If the proportion of nature-based carbon credits were to remain constant, this would lead to US$13 billion per year of nature-based solutions purchased (UNEP, 2021). The need for nature-based solutions is much higher than this (Ibid).

Carbon credits linked to nature tend to have a price premium and may be preferred to other types of carbon credits by buyers. The share of nature-based credits among voluntary carbon credits increased by almost 20 percentage points in 2021 due to increasingly established markets and potential consumer preferences. Demand for credits with explicitly labeled co-benefits, such as biodiversity, has increased and such credits face a clear price premium (Ecosystem Marketplace , 2022). For example, the volume of credits certified by the Climate, Community and Biodiversity Standard (CCB) grew 280% in 2021 (Ecosystem Marketplace , 2022). This may be because such credits address other dimensions of corporate social responsibility and are easier to market to consumers. While nature-based credits are more than twice as expensive as other credit types, they currently remain the cheapest option for removing emissions (compared to technology-based removals). These have gained market share as demand for removals, which are critical to meeting net-zero targets, increases.

In addition to voluntary carbon market growth, nature may be increasingly managed under compliance carbon markets. There may be increasing interest in creating dedicated markets for AFOLU emissions, as the sector contributes around a quarter of annual anthropogenic emissions (Smith & Bustamante, 2018)..Currently, only the New Zealand emissions trading system (ETS) includes AFOLU emissions by covering the forestry sector. In the 2021 reporting period, GHG removals from forestry generated 6.3 million allowances, 15% of the total, worth over US$150 million (International Carbon Action Partnership , 2022). Other ETS are currently exploring options to include the AFOLU sector; a link between existing compliance carbon markets and the AFOLU sector is being considered in the European Union's (EU) farm to fork strategy (Verschurren, 2022) and the development of the United Kingdom (UK) ETS (Department for Business, Energy & Industrial Strategy, 2022). The inclusion of AFOLU in ETS could create incentives to protect nature and would likely increase investment in nature-based solutions. For example, in the EU, the AFOLU sector absorbs an estimated 230MtCO2e each year (Climate Watch, 2022). Based on 2021 EU ETS allowance prices this sequestration would be worth around US$15 billion (International Carbon Action Partnership, 2022).

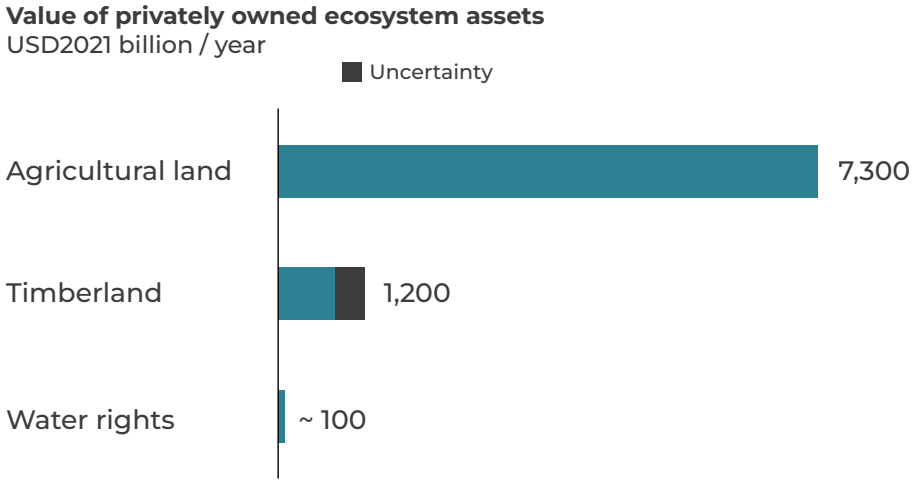
Despite their increasing prominence in carbon markets, there are concerns that nature-based carbon credits may not adequately account for nature outcomes. Voluntary carbon markets have raised questions around additionality, permanence and unintended impacts in slowing aspects of the transition to a low carbon economy (Hale, 2022). Nature-based credits (and potentially future compliance allowances) have raised an additional set of concerns that there may be trade-offs between nature and climate outcomes. For instance, projects may opt to afforest an area using fast-growing monocultures that provide quick and efficient sequestration outcomes but reduce biodiversity and soil quality. These issues could be exacerbated if biodiversity-rich ecosystem assets, such as grasslands, were replaced to generate credits (Overbeck, et al., 2015). As these markets develop and grow, additional governance supports may be required to ensure that nature outcomes are not discounted at the expense of achieving net zero objectives.

ASSET MARKETS

There is around US$8 trillion in privately owned and market-accessible ecosystem assets, with value concentrated in the US and Brazil.

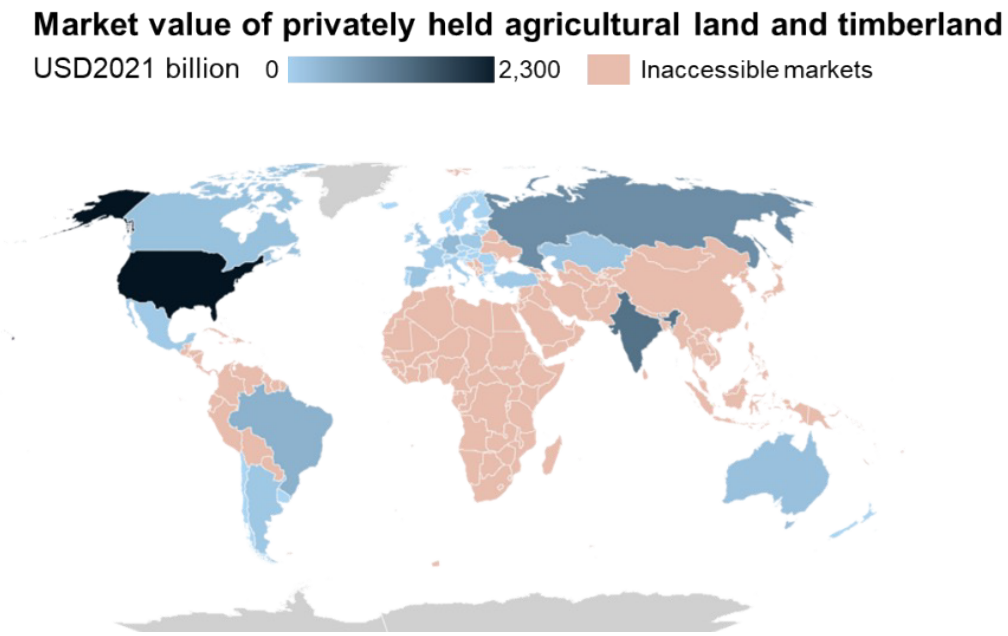
There are 1.2 billion hectares of privately owned and market-accessible ecosystem assets. While there is a large stock of natural capital in many countries, there is more limited private ownership and systematic exchange of ecosystem assets beyond farmland and timberland. For example, mineral reserves are estimated to be worth 20% of the global value of real assets (Mckinsey & Company , 2021). However, the market for mineral rights is excluded from the market size estimate in this report because in many countries underground minerals are controlled by the state. Even in countries like the US where there is greater private ownership and sale of mineral rights, property rights vary by jurisdiction and the value of individual mineral rights depends on a wide variety of factors (Lawshelf, 2022) (US Mineral Exchange , 2021). There is approximately US$7.3 trillion in privately owned and market-accessible agricultural land and US$0.8-1.2 trillion in timberland (Figure 16).[19] In addition to agricultural land and timberland, the stock value of permanent water rights traded in the US and Australia is at least US$94 billion.[20] Across these assets, the market size is largest in the US where there is both a large stock of farmland and timberland assets, high proportions of private ownership, and well-established markets for private households, corporations, and institutional investors (Figure 17). The market infrastructure and regional variability in markets for ecosystem assets is discussed further in Box 4.

Figure 16 Agricultural land accounts for over 80% of privately owned and market accessible ecosystem asset value



Note: Cropland and cultivated pastureland is used as a proxy for private land

Figure 17 Market value for agricultural land and timberland is concentrated in The United States



Note: Inaccessible markets are excluded from the market sizing.
See methodology appendix for further details

BOX 4 - Ecosystem asset markets deep dive

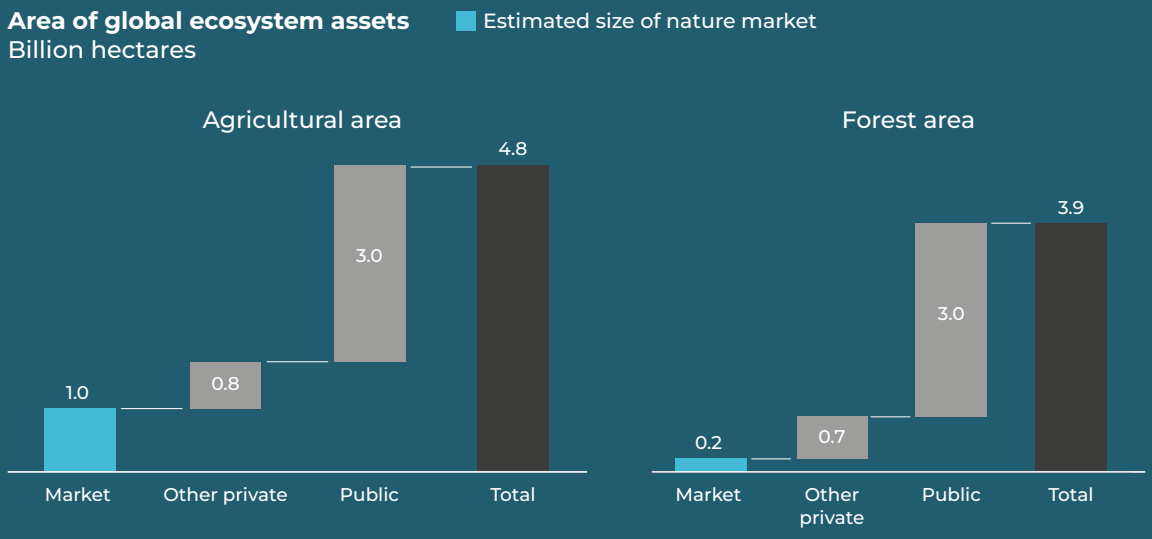
Market infrastructure and ownership structures are highly variable between countries and ecosystem asset types. Most ecosystem assets are owned or managed by the public sector (Figure 18). For ecosystem assets to be systematically traded, would-be buyers need to have confidence in the regulatory environment (e.g., that the exchange of assets is permissible and protected by property rights) and that the asset will deliver value. There is significant variation in the market infrastructure that facilitates these exchanges, particularly for institutional investors that may be interested in foreign asset investments. There is also significant variation in private ownership of ecosystem assets, both between countries and asset types:

Cropland: Half of all habitable land on earth is used for agriculture, predominantly for livestock production. Of this, only an estimated 20% is available in markets. The other 80% is either publicly owned, such as unmanaged grassland, or concentrated in markets with lower market accessibility, market infrastructure and property rights enforcement. The estimated market for cropland is concentrated in the USA, Europe and India, with a combined area of 450 million hectares.

Timberland: There are around four billion hectares of forests globally, more than 70% of which is publicly owned or managed. There is extensive private ownership of forests (more than 800 million hectares) but forests that are not managed for production are not as systematically priced and traded. The estimated market size for timberland is around 200 million hectares (based on private ownership data, reports from institutional investors, and evidence on land tenure) and is concentrated in the US, Europe and South America.

Water: There are only three countries with tradeable and long-lived rights to water: the US, Australia and Chile. However, in Chile, permanent rights to water were sold in the 1980s and are rarely traded today; therefore, the stock value of water assets in Chile are not included in the market size (Donoso & Hearne, 2014).

Figure 18 Market value for agricultural land and timberland is concentrated in The United States



Note: Cropland and cultivated pasture land is used as a proxy for private land, see methodology appendix for further details

There are several key regions with a significant stock of ecosystem assets, some of which are privately owned, that may have limited access to markets. These regions are excluded because ecosystem assets cannot easily be traded, often due to a lack of enforceable property rights. Exclusion from the estimated asset market size does not imply more or less sustainable production systems or fewer opportunities for achieving nature-positive outcomes, but may mean that market shaping efforts have limited implications in these regions. Notable exclusions from this report's estimate of easily accessible markets include:

Russia: Russia has more than 123 million hectares of cropland and 800 million hectares of forests, including 20 million hectares of plantation forest, but less than 1% of forests are privately owned. Russia is not typically considered part of the timberland market due to state ownership, property rights enforcement, and foreign investment restrictions (Barsukova, Radchevskiy, Saifetdinova, Bershitskiy, & Paramonov, 2016).

Indonesia: Indonesia has more than 50 million hectares of cropland. Agricultural land markets in Indonesia are largely informal, with land transactions often lacking proper documentation and registration (Krishna, Kubtiza, Pascual, & Qaim, 2017).

Pakistan: Pakistan has more than 30 million hectares of cropland. However, a lack of a formal land market and insufficient data means it is difficult to identify the determinants of value for land in Pakistan (Rashid & Sheikh, 2015).

China: China has 140 million hectares of cropland, but rural agricultural land ownership is mainly through cooperatives and the transfer of private land is sometimes legally restricted (Li, Tan, & Wu, 2020). China also is typically excluded from estimates of privately owned or exchanged timberland, despite having 70 million hectares of plantation forest, due to state ownership and complex land tenure situations (Timber Trade Portal, 2022) Like agriculture, forestland is primarily owned by the state or collectives (Timber Trade Portal, 2022).

Africa: While some land in Africa may be accessible in markets, in most countries, land has no formal documentation of ownership and cannot be traded (Toulmin, 2009). For example, Nigeria has more than 40 million hectares of cropland but land in the country is publicly controlled, owned by state governors (Agrifarming , 2021). Similarly, Sudan, which has around 20 million hectares of cropland, faces challenges around legal rights over land tenure (Land Portal, 2014).

Institutional investors are increasingly interested in ecosystem assets, with as much as US$145 billion currently invested. Both farmland and timberland are becoming increasingly attractive real assets. Farmland provides a stable long-term investment with regular returns from agricultural production. Since 2011, average farmland prices in major markets have increased almost 40% (Savills, 2020). One of the most significant drivers of global farmland values over the last decade has been the developing presence of new institutional capital. The annual capital raised by dedicated farmland funds doubled in 2019 to reach US$3.6 billion (Savills, 2020). There is limited comprehensive data on total institutional investment in cropland, but it is estimated that up to US$45 billion may be under institutional management in the US alone (Chong, 2019). Timberland assets are also seeing increasing demand due to multiple value stream opportunities and low volatility asset values (Johnson, 2021). Institutional investment in timberland has risen from an estimated US$1 to US$100 billion over the past 30 years (Timberland Investment Resources, 2021). Concerns have been raised that institutional investors may increase the market price of these assets and make it more difficult for farmers to access land (Klebanou, 2022). The UN Principles for Responsible Investment has put out technical guidance for investors on responsible farmland investment, due to the potential nature and equity-related challenges that may arise from increasing institutional investment (Principles for Responsible Investment, 2015).

The price and management of ecosystem assets may depend on the structure of linked markets. The value of an ecosystem asset primarily depends on the income the owner can derive from the asset over time. For timberland and farmland, income is primarily derived from two linked markets: direct soft commodities production or through leasing land to tenants for production. The structures of these secondary markets and their income generation potential may affect the incentives for how land is used. For example, farmland tenure security may affect the incentives for leaseholders to adopt sustainable production techniques, particularly those that may require capital investments. (Adenuga, Jack, & McCarry, 2021). In addition, increasing access to well-developed markets for carbon credits or payments for ecosystem services could improve the incentives for conservation. Currently, landowners may not have full access to these markets or may view these income options as higher risk (Zukunft Des Kohlenstoffmarkets, 2021).

DERIVATIVE MARKETS

Nature-related derivative markets are growing and becoming increasingly important tools for managing nature-related risks and capitalizing on nature-related opportunities.

There is a well-established market for commodity derivatives which may have feedback impacts on the underlying products. Commodity derivatives are contracts, such as options, futures or forwards, that allow buyers to purchase commodities for a certain price at an agreed-upon future date. There are typically two types of investors, producers and consumers of commodities who use derivatives to help manage price risks and those who attempt to profit by trading based on commodity price fluctuations. Markets for commodity derivatives are well established in the financial system and can be traded as standardized contracts on exchanges or in negotiated bilateral trades over the counter (OTC). Both types of exchange are useful to understand how commodities underpin different types of transactions:

Over the counter: There is currently US$2.2 trillion in outstanding notional value of OTC contracts. Most contracts are sold to commodity users in wholesale markets and forwards account for over 75% of value. OTC trades provide a better indication of the nature market size as up to 95% of the physical underlying commodities are traded via derivatives (European Comission, 2012).

Exchange: Exchange traded derivatives are much more standardized and fungible than OTC derivatives. These derivatives are often used for price speculation and only a minority of contracts result in physical delivery of a commodity (UK HMRC, 2022). This leads to large trading volumes that are multiples of the underlying ecosystem services values. In 2021, over five billion commodity derivatives were traded worth a combined US$79 trillion in notional contract value.

The commodity derivatives market can have feedback impacts on the underlying commodities production in several ways. Firstly, derivatives are an important risk management tool for both buyers and sellers of ecosystem services. For example, a beverage manufacturer may wish to purchase a barley derivative to avoid facing uncertain price increases in future. Secondly, derivatives can encourage trade and provide liquidity, facilitating greater and more efficient exchange. Thirdly, regulation of derivatives can affect standards for the underlying products.

Nature-related insurance products accrue US$36 to US$44 billion in premiums per year, and demand is growing as climate risks increase (Figure 19). These insurance products are an important way for asset owners and producers to manage risk exposures. Across most ecosystem assets, insurance penetration is relatively low but may increase as climate change poses increasing damage costs and business interruption risks to ecosystem services. There are currently four main types of nature-related insurance: [21]

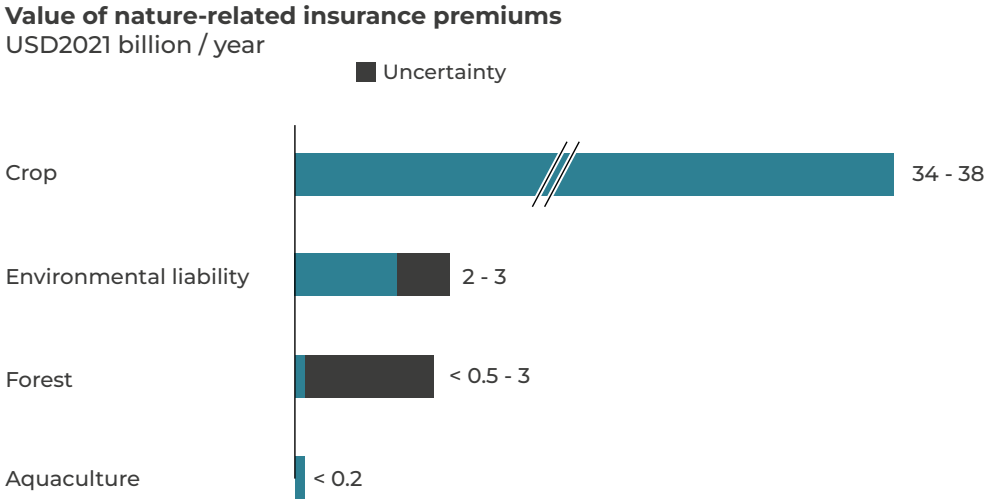
Crop insurance: The crop insurance market is the largest nature-related insurance segment, with estimates of total annual premiums ranging from US$34-US$38 billion per year. Multiple industry reports estimate significant increases in premium revenues over the next five years, with estimates as high as US$55 billion by 2027. Although crop insurance is the largest nature-related insurance market, penetration rates are variable (Mahul & Stutley, 2010). Insurance penetration is particularly low among smallholder farmers, who may be the most vulnerable and least resilient to climate-related risks (GSMA, 2020).

Environmental liability insurance: Environmental liability insurance, which protects against environmental damages and risks, is also increasing as environmental legislation matures and there are increasing restrictions on environmental contaminants in North America, the EU, Australia and Japan. This insurance market generates US$2-3 billion in premiums each year (AON, 2021) (Allianz, 2022).

Forestry insurance: The size of the forestry insurance market is more uncertain than other segments and major insurance providers have signaled opportunities for growth due to increasing risks from climate change like wildfire and currently low levels of insurance penetration. There are more mature markets for insurance in Chile, France, South Africa and Sweden, but even these countries have low levels of insured areas relative to the size of forest assets. China has relatively high forest insurance coverage, with more than 90 of 210 million forested hectares insured and generating around US$600 million per year in premiums (Swiss Re, 2015).

Aquaculture insurance: Aquaculture insurance is a nascent market, with the top ten largest aquaculture producing countries generating just over US$130 million in premiums per year compared to a global market size of US$440 billion in global aquaculture production. However, the market size is estimated to have the potential to increase to more than US$1.4 billion in premiums per year given current low penetration rates. Aquaculture insurance may be increasingly important as climate change increasingly affects abiotic production conditions (Gloabl Index Insurance Facility, 2021).

Figure 19 The crop insurance market is the largest nature-related insurance segment



The market for NFTs related to nature is currently small but growing. NFTs are tradeable tokens stored on a blockchain that represent physical assets (Sharma R. , 2022). Wildlife NFTs are digital representations of nature, often with revenues dedicated to nature conservation. These products are part of the derivative nature markets because their value is dependent on the underlying value of the ecosystem asset or service that they represent. For instance, NFTs related to nature often represent endangered species (NFA, 2022). To date, the largest issuer of NFTs related to nature has been the World Wildlife Fund's (WWF) non-fungible animals, worth around US$300,000 (NFA, 2022). Other initiatives are emerging such as the NFTs issued by WildEarth and Australia Zoo (WildEarth, 2022), (Australia Zoo Wildlife Warriors , 2022). In addition, NFT-related products are also emerging which provide an animated digital representation of nature in exchange for conservation funding. For example, Untamed Planet is creating a gaming experience in which players will be able to explore digital versions of existing ecosystems (Sharma R. , 2022).

Global Nature Markets Landscaping Study

3

Trends in nature markets

Taskforce on Nature Markets

3 Trends in nature markets

TRENDS AND OPPORTUNITIES IN CURRENT NATURE MARKETS

There are opportunities in both established and emerging segments to better align nature markets with nature-positive principles. As with the analysis throughout this study, these trends focus on small but growing product and service markets, focusing on markets which trade provisioning ecosystem services, such as plants, animals and water, as well as cultural and regulating services.

The 24 current nature market segments discussed in the previous section are heterogeneous in size, distribution, governance and impact on nature. Most (although not all) of these markets can be classified into one of two categories: large mature nature markets or small immature nature markets. With appropriate governance supports, both types of markets could be part of efforts to achieve nature-positive outcomes.

Mature markets – Mature nature markets include agricultural commodities and commodity derivatives, which are already a major part of the global economy and financial system. These markets are not typically designed to achieve nature-positive outcomes. Established markets may be an opportunity to align a significant portion of the economy with nature-positive principles.

Immature markets – Immature nature markets typically trade smaller volumes and many of these segments are designed to achieve nature-positive outcomes through voluntary or compliance mechanisms. This includes nascent products such as NFTs for wildlife, established but small markets such as water quality credits trading, and growing markets such as sustainability-linked debt. Emerging markets may provide opportunities to both shape and scale nature markets to better achieve nature-positive principles.

There are some trends in efforts to align mature markets with nature-positive principles, but this is still limited to a small portion of the market. As discussed in the previous section, commodity markets can have significant impacts on nature, but the sustainably certified segments remain a small share of the market, albeit growing strongly in some commodities. There have been recent efforts to shape public and private governance and to create economic incentives for more sustainable production, particularly through linked markets. Examples include:

Deforestation regulation: The EU is implementing a due-diligence legislation to minimize EU-driven deforestation and forest degradation. Under the legislation, operators which place specific commodities, such as soy or beef, on the EU market will have to ensure these are "deforestation free" (European Commission, 2021).

Forestry insurance criteria: Insurer Swiss Re has developed a Sustainability Risk Framework to minimize the environmental impact of business activities. This framework contains specific policy for the forestry, pulp and paper and oil palm sectors. This specifies that, as part of their due diligence process, they will not provide business support for clients that are not fully covered by relevant sustainability certificates (Swiss Re, 2016). Requiring sustainability certifications could create additional incentives for the sector, particularly if insurance is increasingly needed to manage climate-related risks to forests like wildfire (Swiss Re, 2015).

Commodity derivatives regulations: The Sustainable Stock Exchanges has put out guidance on opportunities and challenges in integrating sustainability criteria into derivatives market regulations or within contracts that specify certification requirements. Some derivatives exchanges have rolled out sustainability requirements already; for example, Bursa Malaysia requires traders of oil palm futures to submit a traceability document on sourcing (Sustainable Stock Exchanges, 2021).

Agricultural commodities financing: Several UK grocery store chains are trialing a system of financial incentives for deforestation- and conversation-free soy production through the Responsible Commodities Facility (RCF). The facility will initially provide low-interest finance to 36 farms in Brazil, with the goal of scaling up to support more production that conserves biodiversity and carbon storage (Tesco, 2022).

Historical trends do not suggest significant growth in most immature market segments; however, supply and demand drivers may influence market size in the future. Demand factors include changes in policy, preferences and risks that may affect willingness to pay for nature-related products and services. Supply factors reflect the market's willingness and ability to supply these products and services.

Key demand-side factors

Policy and regulatory: A changing policy or regulatory environment (or anticipated changes) could influence business needs to manage compliance. Climate transition policies may be particularly relevant for nature markets.

Consumer and business preferences: Increasing consumer preferences for 'green' or 'ESG'-related products and services may increase demand for nature-linked products and services in nature markets (Jain & Hagenbeek, 2022). This may include increasing interest in owning nature-related products (e.g., NFTs for wildlife). In addition, businesses looking to capitalize on greening consumer preferences by making nature-positive and net-zero commitments may also increase demand for nature-related products that help them achieve those commitments.

Risks: As climate change and nature loss risks increase, governments, businesses and households may increase demand for derivative products that help them manage those risks. (Australian Government Department of Agriculture and Water Resources, 2019)
Key supply-side factors

Market saturation: Market growth could be limited by the extent to which the volume of products and services provided is already maximized. For nature markets, market saturation may be affected by the size of needs for nature-related products and services or biophysical limits.

Market infrastructure: Market size may also be limited (or supported) by the quality of systems that connects buyers and sellers. Limiting factors could include high transaction costs, high information costs, lack of rules or standardization, lack of property rights, or structural issues (e.g., monopolies) that prevent competition.

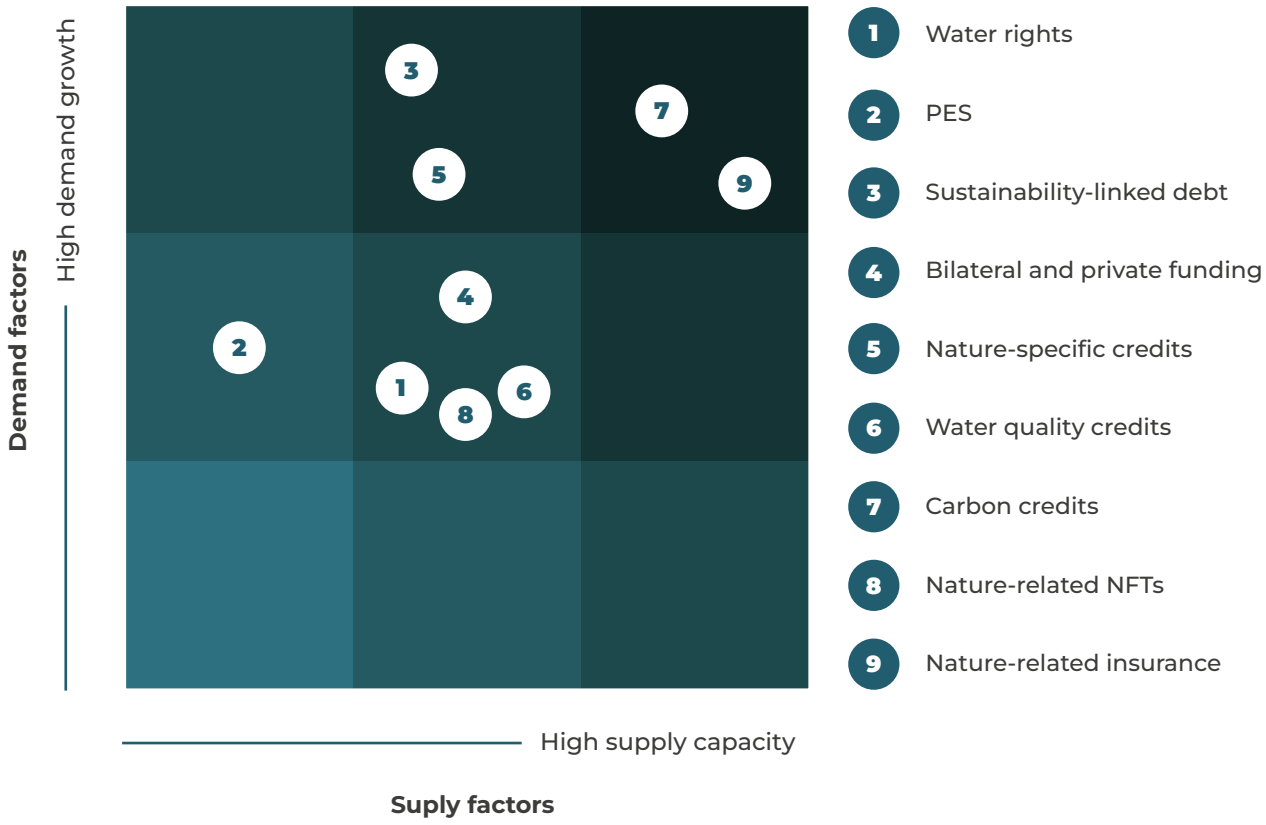
Quality and credibility: Nature markets, particularly markets specifically designed to achieve nature-positive outcomes, require mechanisms that monitor, verify, or certify. The ability of suppliers to credibly produce nature outcomes may be limited by technology, the complexity of measuring the nature-related outcome, the existence of monitoring, reporting and verification (MRV) tools, or concerns around additionality. Some market segments may be limited if comparable products can demonstrate outcomes in a more credible way.

Unit cost: Market segments may be limited if there are comparable vehicles that can deliver nature outcomes at lower unit cost.

Based on the qualitative analysis of trends and market factors, several key findings emerge. Table 4 provides an overview of evidence on some of the key supply- and demand-side factors that may affect immature market growth in the future; a more detailed description of the trends and evidence can be found in Appendix I. Findings include:

- **Climate change risks may be a significant indicator of demand in nature markets.** Multiple markets may see increased demand as a result of both physical and transition risks.
- **Several segments face technical challenges in measuring and verifying nature impacts, which could limit supply.** This is particularly the case for markets designed to achieve nature-positive outcomes, where ability to measure outcomes and achieve consumer confidence may be critical in market growth.
- **New technology may help connect buyers and sellers.** New technologies are improving nature-related modelling, monitoring, and facilitating transactions. However, due to the localized benefits of some ecosystem services, some nature markets may still be unable to scale.
- **Demand may outpace supply (Figure 20).** Trends indicate that there may be greater growth in factors that influence demand for nature markets than capacity to supply. This may require additional governance supports by market regulators to 1) ensure well-designed nature markets can scale and/or 2) ensure that nature markets do not scale at the expense of nature-positive outcomes.

Figure 20 Qualitative assessment of trends in supply and demand factors for less mature nature markets



Note: See Table 4 and Appendix I for description of factors and rationale for qualitative assessment.

Table 4 Qualitative assessment of trends and growth factors in less mature markets

Segment	Historical trends	Demand-side drivers	Supply-side factors
Water rights	There have been no significant developments in new markets for water rights trading, and mixed evidence on growth in existing markets	Given the increasing pressures on water resources from climate and socioeconomic change, additional policies to manage water scarcity will likely be required in some jurisdictions.	Water scarcity is likely to increase regulation on water resources, but whether water rights markets play a significant role will depend on how feasible it is to manage their technical requirements and potential socioeconomic implications
Payments for eco-system services	Most forms of PES have increased in both number of programmes and value of markets over the past decade	The potential demand for PES is uncertain and will likely depend on the evolution of climate risks and future policy trends. Increasing climate risks could increase the demand for PES, while nature regulations could decrease the need for PES as a solution	The supply of small-scale and localized ecosystem services may increase particularly as technologies facilitate exchange, but it may be challenging for this market to scale due to monitoring and verification challenges
Sustainability-linked bonds and loans	Sustainability-linked bond issuance is expected to more than double in 2022; the market grew nine times in 2021	There is increasing consumer interest in ESG-related products	There are opportunities for aligning a greater proportion of bond issuance with sustainability KPIs, but the market may be limited by greenwashing concerns and verification challenges
Bilateral and private funding	Bilateral and private funding for conservation and nature-related outcomes has remained relatively stable over the past decade	There have been some calls for increasing the environment-related share of development aid, although climate remains a more prominent focus than biodiversity and nature among donors	There are no significant barriers to scaling funding beyond donor focus and some perceived concerns surrounding the efficiency of development aid
Nature-specific credits	Wetland and stream mitigation banks have increased in recent years, but conservation banks have decreased	Demand based on compliance is unlikely to significantly increase, but voluntary credit demand may increase due to increasing private sector interest in nature	While the market infrastructure for biodiversity credits does not yet exist, there are several nascent efforts towards creating systematic biodiversity credits

Segment	Historical trends	Demand-side drivers	Supply-side factors
Water quality credits	There have been limited recent developments in water quality trading programs and data on trading is sparse	Demand for water quality credits may increase in some locales in the US but transaction costs for participants may be high	Policymakers may face multiple technical, institutional barriers in developing credible water quality credit trading schemes
Nature-related carbon credits	Nature-related carbon credits have seen significant growth in recent years, both in aggregate market size and as a share of voluntary carbon credits	There is expected to be large growth in demand in voluntary carbon markets, with estimates as high as a 15-fold increase in demand by 2030 and 100-fold increase in demand by 2050	Carbon markets have historically faced challenges in scaling, but growth in recent years indicates that these issues may not necessarily restrict supply; however, growth in nature-related carbon credits does not guarantee nature-positive outcomes
NFTs for wildlife	The market for nature-related NFTs is growing, with several organizations developing the first products in 2022	Consumer and investor trends indicate that NFTs are an increasingly popular product but it is unclear if these trends could indicate the potential demand for nature-related NFTs	The infrastructure for buying and selling NFTs is well-developed and could support growth in the wildlife NFT segment, but there may be concerns of quality and credibility, and the ability to supply low-carbon NFTs
Nature-related insurance products	The market for nature-related insurance is growing across most segments and industry reports estimate further growth in premium volumes	Markets for nature-related insurance may grow as there is an increased need for nature-related risk management tools	Market penetration is low across most nature-related insurance, but there may be technical barriers in modelling risks that underpin insurance products

Note: Darker cells indicate a greater strength of evidence on future market growth. For historical trends, this is based on evidence of whether the market has recently been growing, stagnant or shrinking. For demand-side drivers, this is based on evidence of growth in factors linked to demand; lighter cells reflect a weaker evidence base or mixed demand factors. For supply-side drivers, this is based on evidence of factors showing ability to support market growth; lighter cells reflect mixed supply factors or evidence that supply factors may limit growth.

As with the analysis throughout this study, these trends focus on small but growing product and service markets, focusing on markets which trade provisioning ecosystem services, such as plants, animals and water, as well as cultural and regulating services.

NASCENT NATURE MARKET SEGMENTS

Nascent markets are attempting to capture nature's value in exchange. In addition to the 24 current nature market segments discussed in this report, there are a growing set of transactions that involve revenues generated from payments for nature and its derived values. Some of these nascent markets already have example transactions while others are emerging concepts. Examples of nascent market segments include:

Biodiversity loss insurance (Derivative market)

Opportunities: Increasing recognition of the critical role of ecosystems in the economy and livelihoods has generated interest in developing biodiversity-specific insurance (AXA, 2022). While the market for biodiversity insurance is nascent, several recently developed risk transfer products could provide a blueprint. For example, Swiss Re has launched a product to protect coral reefs in Mexico in tandem with The Nature Conservancy (TNC) and the Mexican government – the product utilises the concept of parametric insurance where rapid disbursements of funds triggered automatically when wind speeds reach a minimum of 100 knots, to enable trained community members to deal with reef damage. TNC has expressed interest in applying the same principles to other natural ecosystems (AXA, 2022).

Challenges: There are several key technical challenges in designing biodiversity insurance products. Firstly, pricing biodiversity risk may not be amenable to current insurance models, which typically use catastrophe risk models (CAT models) that rely on historical data. Given the sensitivity of biodiversity to climatic conditions and increasing climate change risks, a different modelling approach may be needed. Secondly, the magnitude of physical and transition risks linked to biodiversity loss can be more difficult to assess than for other assets. Biodiversity risks can have non-linear impacts and tipping points, making it more challenging to develop models to underpin insurance products (World Bank, 2022).

Voluntary biodiversity credits (Credit market)

Opportunities: The premise of a voluntary biodiversity credit (VBC) is akin to that of a carbon credit; it is an economic instrument that represents biodiversity-enhancing actions (such as protecting or restoring natural habitats, ecosystems or species), through the creation and sale of biodiversity units (Porras & Steele, 2020). While currently there is no unified definition for VBC, there are multiple public and private initiatives underway and several companies have already started providing credits (South Pole, 2022). For example, VBC can be purchased from El Globo Habitat Bank through ClimateTrade, the first block-chain based climate marketplace. Each credit corresponds to 30 years of conservation and/or restoration of 10m2 of the Bosque de Neibla, a high-priority ecosystem (ClimateTrade, 2022). The Australian Government recently announced a new biodiversity certificate scheme which grants tradeable certificates to landholders who restore and manage local habitats (Australian Government, 2022).

Challenges: Much like carbon credits, biodiversity credits are likely to face challenges in ensuring additionality and in MRV (Porras & Steele, 2020). Unlike carbon however, biodiversity credits do not have a simple and accepted unit of account (e.g., tCO2e) which can create confusion in the marketplace (The Biodiversity Consultancy, 2022). This also runs the risk, if not properly designed or governed, of allowing companies to compensate for negative biodiversity impacts in inequitable ways.

Water futures (Derivative market)

Opportunities: As a result of increasing pressure on water resources from abstractions and climate change, the Chicago Mercantile Exchange started issuing the first water derivatives in California in 2020. This product allows farmers, investors, and municipalities to lock in prices for water resources via futures contracts. The futures contract was launched in December 2020 with limited trading. Proponents of the derivative market suggest that it could make water markets more efficient by better aligning supply and demand (Tobin, 2021).

Challenges: Critics argue that the complexity of water rights, water price volatility and the riskiness of scarcity depending on the weather could deter farmers from using the product to hedge risks (Bruno & Schweizer, 2021). Moreover, some critics argue that the existence of the future itself is inequitable, allowing investors who may have contributed to environmental challenges to potentially profit from the derivative market (ibid).

Ecosystem derivatives (Derivative market)

Opportunities: There are a variety of products emerging that capitalize on new technologies and financial products to exchange ecosystem values. For example, securitization of ecosystems has emerged as a nascent derivative product. These securities can include arrangements in which either the collateral on the loans are on ecosystem assets, or proceeds from a pool of assets earmarked to finance ecosystem assets. Currently, the Intrinsic Exchange Group (IEG) is pioneering a new asset class based on ecosystem assets and resulting services (e.g., carbon capture, soil fertility and water purification) (IEG, 2022). The new asset class will be the basis for a new corporation called 'Natural Asset Company (NAC)', the main purpose of which will be to maximize ecological performance and the production of ecosystem services. Other related products such as ClimateTrade utilize blockchain technology to assist companies in offsetting their carbon emissions to verified environmental projects (ClimateTrade, 2022).

Challenges: Ecosystem derivatives may face similar challenges that PES schemes face in the complexity of measuring and verifying nature outcomes. These products may also face challenges in scaling as nascent products with which consumers and investors are likely to be unfamiliar.

Biodiversity intellectual property (IP) (Asset market)

Opportunities: There is growing public and private interest in assigning and potentially monetizing and trading IP rights for elements of biodiversity, such as genetic diversity or raw materials with specific qualities. For instance, the Earth BioGenome Project intends to systematically sequence and catalogue the genomes of species (Lewin, Robinson, Kress, & Zhang, 2018). According to the World Rainforest Movement, a buyer (e.g. pharmaceutical company) could use the platform to obtain IP rights over a biological resource and compensate the seller (e.g., local government) (WRM, 2020).

Challenges: Trading IP rights may face challenges in ensuring that stewards of biodiversity are equitably and appropriately assigned property rights and/or compensated. For example, "biopiracy" can occur from the unauthorized appropriation of genetic resources and knowledge without compensation to their owners, including indigenous communities. Patents have been revoked for pesticides derived from trees used by indigenous populations for their chemical properties (FPS Public Health, 2016). Governing biodiversity IP rights policies is still a work in progress, both at a national and international level. The Convention on Biological Diversity (CBD) introduced the Nagoya Protocol in 2014 which provides policy guidance on sharing the benefits arising from the utilization of genetic resources in a fair and equitable way (UNCTAD, 2014) and the World Intellectual Property Organization (WIPO) has also committed to ensuring that IP systems play a positive role in safeguarding biodiversity (WIPO, 2010). Most countries are still developing national implementation strategies under the Nagoya Protocol and there is uncertainty over the final form of these legal requirements (Lewin, Robinson, Kress, & Zhang, 2018).

As nature-related values and risks are increasingly made explicit and there are new nature-related needs in the economy it is likely that additional nature market segments will emerge. The taxonomy laid out in this report may need to be built upon and expanded to accommodate these nascent markets. In addition, these growing and diverse market segments highlight that governance will likely need to be adaptable to new markets that may have diverse participants and impacts on nature.

Global Nature Markets Landscaping Study

4

Implications and areas for development

Taskforce on Nature Markets

4 Implications and areas for development

Nature markets are already an important part of the economy and there is a growing set of nature markets that explicitly price and trade nature. Nature markets involve trade with a specific price on nature, generate nature-specific revenues, but are not necessarily nature-positive. This includes mature markets, such as agricultural production, and nascent markets, such biodiversity insurance. Although markets are not the only nor necessarily the most appropriate way to valorize nature, whether nature markets function well or exist at all will likely have a large impact on the economic incentives for conservation.

The current and potential impact of nature markets may provide opportunities to better align the economy with nature-positive principles. Market governance (e.g., rules of trade, taxes) and market infrastructure (e.g., systems of exchange, blockchain) can affect how well markets function and grow. For nature markets, these features can determine some of the incentives for how nature is used, and the extent to which these markets can achieve impact at scale. To gauge how to best foster effective nature markets, an understanding of the extent, size and distribution of current nature markets globally is needed.

This report lays the foundation for ongoing Taskforce work by assessing the state of and trends in nature markets. The definition and taxonomy developed in this report allow the Taskforce for the first time to systematically identify current and developing nature markets. The quantitative analysis estimates the size and distribution of current nature markets based on the way in which markets are explicitly priced in the economy. Together, the taxonomy and market sizing provide a baseline for assessing where nature markets are headed and how they can be effectively shaped.

KEY IMPLICATIONS FOR GOVERNANCE OF NATURE MARKETS

The landscaping analysis highlights that while nature markets already influence the global economy, the future of nature markets may look different from the present.

Currently, nature markets are driven by the value and scale of commodities production. Soft commodities production is worth more than US$4 trillion per year and is the primary driver of value in the estimated 1.2 billion hectares of market accessible ecosystem assets. Hard and soft commodities also underpin US$2 trillion in outstanding notional value of OTC derivatives contracts. While credit and conservation markets are growing and are explicitly designed to achieve nature-positive outcomes, these markets currently represent less than 1% of the annual value of goods and services produced in nature markets.

Climate change is both driving growth in and putting pressure on nature markets. Climate risk, climate action and nature outcomes are interdependent. Climate-related risks put pressure on natural resources, such as water, agricultural land, and coral reefs. Simultaneously, ecosystem services are an important tool for both climate change mitigation (e.g., forest carbon sinks) and climate change adaptation (e.g., green infrastructure for flood defense). These interdependencies are already driving growth in some nature markets and increase the need to appropriately price nature in markets. For example, the analysis indicates that the net zero transition is already driving demand for nature-related carbon credits and physical climate risks are increasing demand for nature-related insurance products. Risk management tools in commodity markets are well developed and are emerging in carbon markets (ISDA, 2021), but comparable products are not yet accessible for other types of ecosystem services which could limit development.

Nature markets are highly linked but may not consistently price nature. In theory, nature should be priced consistently across markets, particularly those that are directly linked. For example, the prices in product markets (e.g., agricultural commodities) should be mirrored in the value of ecosystem assets (e.g., agricultural land). However, nature may be priced differently across markets due to differing policy regimes, market access, trade rules and other market distortions that can create mispricing. In addition, the existence or development stage of some nature markets can affect prices and outcomes in linked markets. For example, improving access to markets for PES or nature-related credits could improve incentives for conservation, as land managers may have more reliable access to revenues opportunities. The scale of mispricing across nature markets may be an important factor in shaping nature markets but is currently unknown.

Nature markets are at different maturity levels and may require different types of governance supports to align with nature-positive principles. As highlighted through the analysis, nature markets are at varying stages of development which are linked to varying governance challenges and market shaping opportunities. For example, markets at earlier stages of development like nature-related carbon credits may be subject to market-scaling challenges such as monopolization, rent-seeking behavior, and problems related to informational gaps and asymmetries (Taskforce on Nature Markets, 2022). Well-established markets like soft commodities may be more transparently priced and exchanged but may face different challenges in shaping outcomes.

This report lays the foundation for the Taskforce to start addressing how nature markets can ensure outcomes that improve biodiversity, preserve and build natural capital, and foster an equitable distribution of benefits. Building on the nature markets definition and sizing, there are critical questions that need to be addressed, including:

- What is the extent of mispricing and illegal activity across nature markets?
- To what extent do nature-related benefits and risks get priced into nature-related assets and downstream markets?
- What are the impacts of current nature markets on nature outcomes, and the scale of negative impacts in particular?
- What types of governance structures at the local and global level can most effectively shape nature markets and the use of nature in the wider economy?
- What market standards – e.g., for measuring and reporting – can best enable efficient, nature-positive and equitable nature markets?
- What market infrastructure is required to support nature markets to scale and with sufficient transparency and safeguard mechanisms?

Table 5 Qualitative assessment of trends and growth factors in emerging markets

Segment	Historical trends	Demand-side drivers	Supply-side factors
Water rights	At a global level there have not been significant developments in creating new markets for water rights trading, although there has been recent debate on the transferability of water rights in South Africa (Mashigo, 2022). Within existing water rights trading markets, trends are mixed. As discussed in the previous section, trade in Chile's water rights market is very limited. In Australia, the volume of water traded (both allocations and entitlements) has been increasing since the 1980s but prices have been more variable. (Australian Government Department of Agriculture and Water Resources, 2019)	Global water demand is expected to increase as a result of population growth, economic growth, and urbanization. Climate change may also exacerbate water scarcity, and crops may increasingly require irrigation over rain-fed agriculture. Recent estimates indicate that global demand for water could increase by 20-30% by 2050, as water availability simultaneously becomes more irregular (Boretti & Rosa, 2019).	Given the increasing pressures on water resources from climate and socioeconomic change, enhanced policies to manage water will almost certainly be required. Economic pricing tools can be an important complement to regulatory tools, depending on the context (Zetland, 2021). However, developing new and well-functioning markets for water rights requires significant technical and institutional capacity (Wheeler, Loch, Crase, Young, & Grafton, 2017). In addition, there may be other barriers to developing markets, such as political pressure from industries that currently face low abstraction costs. As a result, and considering the potential equity socioeconomic implications of water rights trade (Camacho, 2016), this type of pricing instrument may not be feasible or appropriate in many jurisdictions. Despite these barriers, some of the successes and challenges of water rights trade could provide lessons learned (Bauer, 2008), and a replicable model in other jurisdictions, lowering some of the potential institutional barriers.

Segment	Historical trends	Demand-side drivers	Supply-side factors
Payments for eco-system services	Most forms of PES have increased in both number of programmes and value of markets over the past decade (Salzman, Bennett, Carroll, Goldstein, & Jenkins, 2018). For example, bilateral watershed PES increased from a market size of 19 mechanisms worth US$13 million in 2009 to a market size of 111 mechanisms worth US$93 million in 2015.	Policy trends and climate risks indicate mixed potential in demand for PES. For example, increasing environmental and biodiversity protection regulations could reduce the need for payments if actions become regulated. Conversely, increasing pressure on nature from climate change and biodiversity risks could make ecosystem services scarcer, increasing demand. For example, bilateral watershed payments to preserve water quality have well-established PES mechanisms in some locales (Salzman, Bennett, Carroll, Goldstein, & Jenkins, 2018). These efforts may be increasingly demanded if climate change exacerbates water scarcity, reducing water quality. Demand for PES linked to wildlife tourism may also increase as tourism potential grows. For example, the Olare Orok Conservancy land lease PES scheme in Kenya pays landowners to relocate settlements and prevent livestock grazing in conservation areas, which are used to create wildlife migratory corridors and for wildlife tourism (United Nations Multi-Partner Trust Fund Office , 2022).	The supply of small-scale and localized ecosystem services may increase as landowners and stewards become increasingly aware of opportunities to generate revenues from conservation and access to technologies facilitates payments and monitoring at lower cost (e.g., smartphones used for wildlife sightings). However, existing PES mechanisms indicate that it may be challenging for this market to scale for several reasons. • Firstly, the private market may be saturated. Since regulating services are often public goods, most of the highest value PES mechanisms are either publicly financed or compliance driven. Where incentives for private actors exist, markets may already be set up. • Secondly, PES may not be the most cost-effective mechanism to enhance or protect ecosystem services. Large PES mechanisms require institutions that connect buyers and sellers at low cost and in a way that allows outcomes to be measured. This may be technically challenging and face institutional barriers, particularly if the mechanism requires multiple government agencies. New technologies are creating opportunities for scaling up PES. For example, the Lion's Share Fund channels advertising that uses the likeness of wildlife into remuneration for conservation (United Nations Multi-Partner Trust Fund Office , 2022). These initiatives may help create new revenue streams for targeted PES but are unlikely to develop into a fully competitive market. • Thirdly, PES may not be perceived as a cost-effective way to achieve outcomes. Research on the effectiveness of PES schemes at achieving conservation outcomes has indicated mixed results, and mixed data quality precludes systematic evaluation (Salzman, Bennett, Carroll, Goldstein, & Jenkins, 2018).

Segment	Historical trends	Demand-side drivers	Supply-side factors
Sustainability-linked bonds and loans	Sustainability-linked bond issuance is expected to more than double in 2022. The market grew nine times in 2021 (Environmental Finance , 2022).	There is increasing consumer interest in ESG-related products generally. The Institution of International Finance estimates that the sustainable debt issuance market could reach up to US$3.8-7.2 trillion by 2025, with sustainability linked loans expected to dominate the market (Azizuddin, 2022). This is currently driven by net zero commitments but could eventually reflect greater demand for nature-related outcomes.	Despite growth, sustainability-linked bonds represent only 10% of the sustainable bond issuance market, indicating opportunities for aligning a greater proportion of bond issuance with specific sustainability outcomes (Nordea, 2022). However, there is varying quality in sustainability-linked debt and there are concerns that market may be subject to greenwashing through insufficiently rigorous KPIs (Principles for Responsible Investment, 2022). There may also be challenges in verifying KPI attainment. The International Swaps and Derivatives Association has put out guidance on KPI development to enhance the credibility of sustainability-linked derivatives (International Swaps and Derivatives Association, 2021).
Bilateral and private funding	Bilateral and private funding for conservation and nature-related outcomes has remained relatively stable over the past decade, with a CAGR of 0.06% from 2010-2019. In aggregate, ODA has been increasing since the late 1990s with a steeper increase from 2020 to 2021 as a result of COVID-19 (OECD, 2021).	There have been some calls for increasing the environment-related share of development aid, although climate remains a more prominent focus than biodiversity and nature among donors (Rijsberman, 2021). Even still, there has been limited growth in the share of ODA with climate-related objectives (OECD, 2019). Some donors have biodiversity specific policies and strategies within their development programs, including the US, the EU, and Germany (OECD, 2017). For example, the European Commission has recently pledged to double international funding for biodiversity in vulnerable countries (European Commission, 2022). As the EU is the leading provider of development finance, this may signal a significant scale-up in funding flows. There may be additional demand for bilateral and philanthropic aid as part of blended finance for conservation and biodiversity. Grants and concessional finance have recently played a key role in unlocking private finance (Convergence, 2019).	There do not appear to be any significant barriers to scaling bilateral and private funding for nature-specific outcomes, beyond technical capacity limitations to meet funding requirements and limited donor focus on biodiversity and nature (OECD, 2017). However, there may be real or perceived concerns surrounding the efficacy and efficiency of development aid more generally that could limit funding for nature through these channels.

Segment	Historical trends	Demand-side drivers	Supply-side factors
Nature-specific credits	Historical trends in nature-specific credits are mixed; wetland and stream mitigation banks have increased in recent years, but conservation banks have decreased (Porras & Steele, Making the market work for nature, 2020). There are no major initiatives for voluntary nature-specific or biodiversity credits yet.	Historical trends and policy developments suggest that demand based on compliance is unlikely to significantly increase. However, there are two trends that suggest demand for voluntary credits may increase. Firstly, an increasing number of private sector companies are making nature-positive commitments, which may require a nature-related credit or offset to achieve (Tridimas, 2021). Secondly, as discussed in the previous section, there is growing demand for nature-related carbon credits which could be an indicator of demand for nature-specific outcomes above and beyond carbon sequestration.	While the market infrastructure for biodiversity credits does not yet exist, there are several nascent efforts towards creating systematic biodiversity credits (discussed in the next section), suggesting an interest and capacity to supply to a largely untapped market. There is an opportunity to build on the models developed and lessons learned from compliance schemes, PES mechanisms, and voluntary carbon crediting (Porras & Steele, Making the market work for nature, 2020).
Water quality credits	There have been limited recent developments in water quality trading programs, with most programs initiated in the 1990s and 2000s. Many programs initiated in the US in the late 1990s and early 2000s have since completed or become inactive. Data on trading volumes and prices in current and historical programs is sparse (Liu & Brouwer, 2022).	A recent review in the US found that demand for water quality credit trading can be affected by biophysical drivers, economic drivers, and policy drivers (Bennett & Gallant, 2018). The analysis found that based on these drivers, there could be demand for both storm water trading and agricultural water quality credit trading in both regions where trading is already active and where trading programs do not yet exist. Demand potential is particularly high in watersheds in eastern States (ibid). Another review suggests that US trading programs have faced challenges in meeting environmental objectives, due to transaction costs that limit participation and trading (Heberling, Thurston, & Nietch, 2018). The National Network on Water Quality Trading has put out guidance and is advancing solutions for policymakers to address demand barriers (National Network on Water Quality Trading , 2018) (Walker, 2019).	Policymakers may face multiple barriers in developing credible water quality credit trading schemes. Recent reviews of water quality trading programs indicated that regulatory complexity and uncertainty in water quality problems have been key factors in program success or failure, which could limit development in data-poor environments or institutions with low technical capacity (Bennett & Gallant, 2018; (Heberling, Thurston, & Nietch, 2018). Another potential barrier is that the agriculture sector is one of the largest sources of water pollution, but is not always regulated within water quality trading which can limit the effectiveness of these schemes. Nonetheless, the review concludes that there is still potential for these programs to develop efficiently, building on the lessons learned from previous and existing mechanisms. In addition to these challenges, policymakers may also face concerns or criticisms that these schemes could exacerbate environmental inequities (Food & Water Watch, 2017). While market design features can limit some of these impacts, these concerns may reduce government support. Due to the high institutional and technical needs, it is unclear the extent to which there is capacity to set up trading programs outside of the US where there is existing market infrastructure.

Segment	Historical trends	Demand-side drivers	Supply-side factors
Nature-related carbon credits	As discussed in the previous section, nature-related carbon credits have seen significant growth in recent years, both in aggregate market size and as a share of voluntary carbon credits. Between 2020 and 2021, the market for nature-related credits more than quadrupled in value.	There is expected to be large growth in demand in voluntary carbon markets, with estimates as high as a 15-fold increase in demand by 2030 and 100-fold increase in demand by 2050 (McKinsey & Company, 2021). As discussed in the previous section, there may be consumer preferences for carbon credits that also generate nature-specific outcomes.	Carbon markets have historically faced challenges in scaling. In particular, carbon credit markets face challenges in verification and transparent accounting (Voluntary Carbon Markets Integrity Initative, 2021). These markets have nonetheless grown significantly in recent years, indicating that these issues may not necessarily restrict supply. Recent initiatives to address these challenges include the Task Force for Scaling Voluntary Carbon Markets (Taskforce on Scaling Voluntary Carbon Markets , 2022) and the Voluntary Carbon Markets Integrity Initiative (Voluntary Carbon Markets Integrity Intiative, 2022). However, growth in nature-related carbon credits does not guarantee nature-positive outcomes. For nature-related carbon credits, there are secondary challenges in ensuring that nature-based solutions do not develop at the expense of local biodiversity or local and indigenous communities. For example, plantation forests which have high carbon sequestration rates can involve non-native species and less diverse ecosystems (Seddon, et al., 2020) (Porras & Steele, Making the market work for nature, 2020).
NFTs for wildlife	The market for nature-related NFTs is growing, with World Wildlife Fund, WildEarth and the Australian Zoo developing the first nature-related NFT products in 2022.	Consumer and investor trends indicate that NFTs are an increasingly popular product. Market reports indicate that the total value of the NFT market could reach more than US$120 billion by 2028. Since wildlife NFTs are a nascent segment, it is unclear if these trends could indicate the potential demand for nature-related NFTs. Nature risks could increase the value of nature-related NFTs in the future. NFTs derive value from scarcity; as endangered species and other forms of biodiversity are increasing at risk the value of and demand for wildlife NFTs could increase.	As a more than US$15 billion market in 2021, the infrastructure for buying and selling NFTs is well-developed and could support growth in the wildlife NFT segment. Since the blockchain technology for exchanging NFTs is well-established, supply side limitations are more likely to come from concerns of quality and credibility, and the ability to supply low-carbon NFTs. For example, WWF received criticism after releasing its wildlife tokens due to the carbon emissions associated with blockchain (Frost, 2022). There are ongoing efforts to develop more energy-efficient networks, which may resolve some of these challenges (Matthews, 2022).

Segment	Historical trends	Demand-side drivers	Supply-side factors
Nature-related insurance products	The market for nature-related insurance is growing across most segments and industry reports estimate further growth in premium volumes. For example, the market for agricultural insurance is growing approximately 5% each year (Krauer, 2019) and environmental liability insurance has also shown increases in recent years (AON, 2021),	Markets for nature-related insurance may grow as there is an increased need for nature-related risk management tools. These needs may arise due to increasing climate and biodiversity risks, increasing private ownership of ecosystem assets, and potential compulsory insurance requirements. For example, there is some evidence that crop insurance may be increasingly used to adapt to climate-related risks. (Falco, Adinolfi, Bozzola, & Capitanio, 2014) (Akter, Krupnik, & Khanam, 2017).	As discussed in the previous section, market penetration is low across most nature-related insurance products, indicating an opportunity for market growth. In addition, improved models and innovative insurance structures like parametric insurance are increasingly providing efficient risk management options. However, there may be several supply-side barriers. Firstly, the complexity of developing insurance products varies by segment and can limit supply. For example, while crop insurance is well-established it can be more challenging to model risks and losses for aquaculture (World Bank Group, 2021). In addition, as climate-related risks increase, some assets or losses could become un-insurable or prohibitively expensive. Premium subsidies already play a large role in agricultural insurance (Global Index Insurance Facility , 2017).

Note: Darker cells indicate a greater strength of evidence on future market growth. For historical trends, this is based on evidence of whether the market has recently been growing, stagnant or shrinking. For demand-side drivers, this is based on evidence of growth in factors linked to demand; lighter cells reflect a weaker evidence base or mixed demand factors. For supply-side drivers, this is based on evidence of factors showing ability to support market growth; lighter cells reflect mixed supply factors or evidence that supply factors may limit growth

Appendix II
NATURE MARKETS DEFINITIONS

The definition of nature markets in this report builds on the definitions laid out in existing literature. Several leading reports have developed definitions of nature markets focused on markets that trade biodiversity or conservation outcomes. Previously used definitions include:

Aligning Market's with Biodiversity (The Swedish Foundation for Strategic Environmental Research, 2021) defines biodiversity markets as "exchanges which create a revenue stream explicitly associated with biodiversity or biodiversity-related transactions." This report also considers a broader definition which includes exchanges where biodiversity is implicitly or explicitly priced.

Markets for Natural Capital (Global Nature Fund, 2021) defines natural capital markets as "market-based instruments for the conservation of biodiversity and ecosystem services." Examples covered include biodiversity offsets and payments for ecosystem services.

A Market Review of Nature-Based Solutions (Finance Earth, 2021), defines NBS markets as "transactions where repayable investment was used to meet some or all of funding need." Examples include sustainable commodities and carbon credits.

Appendix III
METHODOLOGY APPENDIX

This appendix details the approaches used to approximate the market size for the 24 current nature market segments. Figure 21 shows how approaches were prioritized, depending on data availability the various approaches used. Top-down approaches were prioritized over bottom-up and approximated approaches. For consistency, the following assumptions were applied to all methods:

- The market sizing aims to use the most recent possible data, with 2021 data the ideal. However, considering that data from 2020 may be significantly influenced by the COVID-19 pandemic, values from 2019 are prioritized over 2020, then 2020 and then earlier years. Only four market segments rely on data before 2018.
- All estimated values are converted 2021 USD approximations using GDP deflator from World Bank's World Development Indicators.
- Where required, currency conversions were estimated based on an average exchange rate in a relevant year.

Because the quality of the data sources vary between market segments and significant assumptions are built into many of the approaches, the market sizing should be considered an approximation of magnitude but will inherently be imprecise. For that reason, all estimates reported are rounded to two significant figures and ranges are used where needed.

Figure 21 Top-down approaches were prioritized over approximated and bottom-up approaches

	Top-down	Bottom-up	Aproximated
When used	A credible, robust, and sufficiently granular estimate of the market size has already been developed either internally or externally	The market is made up of a small number of players or sub-segments, such that the total size can be estimated by summing the production or sale values	The market size can be approximated based on robust information supplemented with assumptions or extrapolation
Example	Data on commodity production value is widely available	Legal wildlife is used in a select number of end-products	Ecosystem asset values are based on credible private ownership data and estimated market prices

Annual production values

Annual production values represent the revenues generated from the sale of goods and services at their most upstream point. Downstream markets that rely on nature are not included in the analysis (e.g., the market for cotton production is included, but the market for cotton t-shirts which uses multiple nature inputs is excluded). Table 6 displays the approaches used.

Table 6 Market sizing approaches – annual production values

Segment	Approach	Assumption(s)	Source(s)
Agricultural commodities	Top-down		Value of agricultural production from FAOSTAT (2022)
Extractive commodities	Top-down	Oil and gas revenues based on average price from 2017-2021 due to variability in commodity price and market size	Multiple sources, including public data, market research reports, and Vivid Economics analysis
Fisheries and aquaculture	Top-down	Uses "first-sale" revenue	The State of World Fisheries and Aquaculture 2022 (FAO, 2022)
Forest products	Approximated using country-level prices multiplied by production volumes for sawlogs, pulpwood and other industrial roundwood	Excludes fuelwood Prices (2021USD/m3) for countries without data, based on expert opinion: • Sawlogs: 100 • Pulpwood: 50 • Other industrial roundwood: 75	Prices from Wood Resources International (WRI, 2022) Volumes from FAOSTAT Forestry Production (FAO, 2022)
Illegal wildlife	Top-down Source does not capture developments since 2012 in illegal wildlife trafficking which may have altered market value	Assumes no market developments since 2012	OECD (2012)
Legal wildlife	Bottom-up Key legal wildlife segments are identified based on 2016 analysis of legal wildlife trade (Andersson, et al., 2021). Fisheries and are excluded from the valuation since they are estimated in other market segments. The market sizing includes the next largest segments (raw fur trade and the production of key plant products that are inputs to TCM products). Liquorice root market size is based on export values rather than production value, so the market size is an underestimate. Coca leaf production value in key countries is extrapolated based on market share and the value of production in Bolivia.	Price per mink skin in 2019 was approximately $25 (Hansen, Global fur retail value, 2021) Mink skin represents 89% of the fur production market (Hansen, Global fur retail value, 2017)	Mink raw pelt production (Hansen, Global fur retail value, 2021) Ginseng production (Baeg, 2022) Liquorice root exports (Tridge, 2021) Coca leaf production shares (EMCDDA and Europol, 2022) Coca leaf production value Bolivia (UNODC, 2020)

Segment	Approach	Assumption(s)	Source(s)
Genetic materials	Top-down		(Markets and Markets, 2021)
Water rights leases	Top-down	Excludes Chilean water rights market for which trading activity is negligible (Donoso & Hearne, 2014) Australia allocations assumed to be similar to US leases	(Australian Government, 2021) (Schwabe, Nemati, Landry, & Zimmerman, 2020)
Wildlife tourism	Top-down		Wildlife tourism revenues (Luc Hoffmann Institute, 2021)
Payments for ecosystem services	Top-down	Excludes share of PES allocated to carbon markets to avoid double counting with carbon credit market	(OECD, 2021)
Sustainability-linked bonds and loans	Approximated The estimated willingness to pay for nature outcomes is approximated based on the size of debt and a yield reduction parameter assumption. Only debt issued in nature-relevant sectors are included.	Assumes sustainability linked bonds and loans have a 0.29% yield differential (Kölbel & Lambillon, 2022)	Sustainability linked bonds and loans issuance (Environmental Finance , 2022)
Debt-for-nature swaps	Approximated The estimated payment for nature is based on average annual conservation funds generated in debt-for-nature swaps developed between 2010 and 2015.		Debt for nature swaps (Nedopil, Yue, & Hughes, 2022)
Overseas development aid	Bottom up The overall value is the sum of financial flows detailed in the OECD's Creditor Reporting System (CRS) which are allocated to the following CRS sectors: water resources conservation; biosphere protection; biodiversity; site preservation; agricultural land resources	Excludes loans	(OECD.stat, 2022)
Philanthropic grants			
Mitigation banks	Top-down	Assumes no markets developments since 2017	(Bennett, Gallant, & ten Kate, State of Biodiversity Mitigation 2017, 2017)

Segment	Approach	Assumption(s)	Source(s)
Water quality credits	Top-down	Assumes no markets developments since 2016	(Bennett & Ruef, State of Watershed Investments 2016, 2016)
Voluntary carbon credits	Top-down Figure limited to nature-related carbon credits: forestry and land use, and agriculture		(Donofrio, Maguire, Daley, Calderon, & Lin, 2022)
Compliance carbon allowances	Approximated Multiplied the estimated volume of allowances issued by the forestry sector in the New Zealand ETS by the average price in 2021. The New Zealand ETS is the only ETS to cover a nature-related sector		Volume and price from (ICAP, 2022)
Nature-related insurance	Bottom-up and approximated An upper and lower bound is estimated for each of the four nature-related insurance segments using top down estimates of annual premium revenues In absence of top-down estimates, the range for forest insurance is approximated based on a combination of estimates from a market report and a range of assumptions on insured values, premium rates and penetration rates.	$1000 assumed insured value per hectare of forest 0.15-0.8% insurance premium for forest 2-10% forest insurance penetration rate	Crop insurance – Multiple market reports Forest insurance (Swiss Re, 2015) Aquaculture insurance (World Bank Group, 2021) Environmental liability insurance (AON, 2021) (NAIC, 2022)

Asset values (real and derivative)

Privately owned asset value is the estimated stock value of ecosystem assets which can be easily accessed in markets using current market prices. This estimate is not a natural capital account, does not reflect the annual value of assets traded (since assets are much less liquid and exchange is less frequent) and excludes ecosystem assets in countries which are not found to be market-accessible based on qualitative evidence. Table 7 displays the approaches used.

Table 7 Market sizing approaches – asset values

Segment	Approach	Assumption(s)	Source(s)
Agricultural land	Approximated Countries included in the analysis were selected. All "key" markets as defined by Savills and all European markets are included. Additionally, the market infrastructure of the top 30 countries with the most agricultural land, covering 77% of global agricultural land was assessed. Countries deemed to have weak property rights for land or no trading infrastructure were deemed inaccessible, as were countries outside the top 30. As such, the estimate may exclude some small accessible markets. Then the area (ha) of cropland and cultivated grazing land for those countries from the FAO is used. Cropland price data (USD/ha) for 15 countries is obtained from Savills. For countries with missing data cropland prices are extrapolated based on average cropland prices in the region. The price of pastureland is based on the price of cropland multiplied by a constant scaling factor based on US market prices. Market value is estimated by multiplying price and area across the selected countries	· Sizing restricted to countries with sufficient market infrastructure (see Box 4) · Private land assumed to be cropland and cultivated grazing land · Average cropland price weighted by area in a region used to estimate price in markets with missing data · Ratio of cropland to pastureland prices in the US applies globally: pastureland is 3x less expensive per ha from (USDA, 2021)	(FAO, 2022) (Savills, 2020)
Timberland	Approximated The estimated area of privately owned and market-accessible forest is based on a combination of sources. For regions that are considered institutionally 'investable' by investor reports, government and NGO sources were identified for more precise estimates of market size. For European countries, this is based on a single source on timber area per country and assumptions on market ownership.	Assumptions on representation of market size for institutionally investable markets, based on best available evidence US – Corporate and non-corporate timberland forest ownership Canada – Forest land owned by pension funds, investors and forest product companies New Zealand – Productive plantation forest Australia – Commercial plantation forests Brazil – Planted forests Uruguay - All forest is privately owned Chile – Plantation forests Europe – Assume market access is only available in EU/EEA/Switzerland, and that 60% of area is privately owned (European Forest Institute, 2022)	Forest ownership by region (FAO, 2020) EU forest ownership (Schmithuse & Hirsch, 2010) US area (US Congressional Research Service, 2021) Canada area (Rotherham, 2017) New Zealand area (New Zealand Forest Service, 2022) Australia area (Australia Department of Agriculture, Fisheries and Forestry, 2022) Brazil area (World Resources Institute, 2014) Uruguay area (Mongabay, 2011) Chile area (World Resources Institute, 2014)

Segment	Approach	Assumption(s)	Source(s)
Water rights	Approximated Australian data is top-down US will be an underestimate because the source does not include estimates of the stock value of permanent rights. The stock volume in the USA is assumed to the be the volume of leases (at the minimum the volume of available permanent water rights will be equal to the volume leased). The volume is then multiplied by average trading price of permanent rights to estimate market size The Chilean water market is excluded from the analysis because permanent rights to water were sold in the 1980s and are rarely traded today (Donoso & Hearne, 2014)	• Volume of permanent water rights in the US is assumed to equal the volume of water rights leases. This is an underes-timate	(Australian Government, 2021) (Schwabe, Nemati, Landry, & Zimmerman, 2020)
NFTs for Wildlife	Bottom up The value of NFTs sold by the largest provider to date is used to approximate market size: WWF's Non-fungible animals (NFAs)		(NFA, 2022)

Commodity derivatives

Market sizes of commodity derivatives are based on top-down estimates but are not comparable to other market sizes. Table 8 displays the approaches used. There are multiple metrics which can be used to under the size and level of activity in derivatives markets. These metrics are not comparable to annual production values or asset values because:

> Over the counter notional value does not capture the contracts expired or closed in the previous year so cannot be compared to annual production values. It cannot be compared to asset values because, unlike for ecosystem assets, the stock of contracts at the end of a given year can change significantly based on activity in the previous year

> Exchange-traded notional value is the value of all transactions each year. This is different to annual production because contracts which are opened and subsequently closed count as two transactions, despite representing the same underlying commodity. In annual production values the sale of a good or service is only counted once.

Table 8 Market sizing approaches – commodity derivatives

Segment	Approach	Key assumption(s)	Source(s)
Over the counter	Top-down	Market value is based on the notional value of outstanding derivatives contracts at the end of 2021. Does not capture expired or close contracts	(BIS, 2022)
Exchange-traded	Top-down	Market value is the notional value of all contracts traded in 2021. Captures expired or close contracts	(WFE, 2022)

ENDNOTES

[1] For example, environmental taxes are below the level required to halt the destruction of nature (Dasgupta, 2021)

[2] These goals are articulated in more detail according to the United Nation's Sustainable Development Goals: https://sdgs.un.org/goals

[3] See: "Dasgupta, P. (2021), The Economics of Biodiversity: The Dasgupta Review. (London: HM Treasury" for a detailed account of the interactions between nature and the economy, the challenge of market failures and the broad array of potential mechanisms to address these failures.

[4] See Box 1 for a discussion on sustainably certified agricultural commodities

[5] See Table 5 in appendix for further details

[6] See Appendix for previously developed definitions of nature markets

[7] Insetting, as opposed to offsetting, refers to an organization reducing environmental impacts (e.g., emissions) within its own value chain, rather than through the purchase of external offsets.

[8] See the methodology appendix at the end of the report for a full description of the sizing approaches and rationale for including/excluding specific market segments

[9] As defined by the UNEP resolution on nature-based solutions for supporting sustainable development (United Nations Environment Assumbly of the United Nations Environment Programme, 2022)

[10] All figures in this section of the report are in 2021 United States dollars (USD) unless otherwise specified

[11] Based on multiple market reports, the approximate value of commercial real estate assets globally was around $33 trillion

[12] Oil and gas are excluded from the analysis. If they were included, the product market size would be around $10 trillion in annual value.

[13] See methodology appendix for details on included and excluded wildlife product segments

[14] The TCM segment analysis focuses on three plant products, ginseng, liquorice root and coca leaf. The analysis does not include poppy straws, due to limited data availability.

[15] The most widely cited estimates of the global value of illegal wildlife trade is the $7-23 billion estimate from a 2012 OECD report on global trade in environmentally sensitive goods. Since 2012, there have been significant developments in illegal wildlife trafficking. It is unclear if increasing wildlife seizures mean that these figures are actually reduced or increased since then. This report makes use of these figures as an estimate, scaled to 2021 USD.

[16] The nature market sizing focuses on wildlife tourism due to data availability on nature-specific revenues.

[17] This estimate includes both nature-specific revenues (e.g., fees) and non-nature-specific revenues (travel fares, accommodation and other travel-related expenditures). Therefore, the market-sizing approach relies on a different source to estimate nature-specific revenues.

[18] Sizing these markets is indicative of the amount of funding channeled to conservation through these vehicles, but imprecise because the payment for nature will be different in each transaction. For debt-for-nature swaps, the payment for nature depends on the way the debt is restructured. For sustainability-linked bonds and loans, the payment (or the amount in interest investors are willing to forgo in exchange for achieving the nature-related KPI) depends on the structure of the debt agreement. The full methodology used to approximate nature payments in these markets is detailed in the methodology appendix.

[19] The agricultural land estimates are based on a qualitative assessment of market accessibility in different countries. Countries accounting for most agricultural land were assessed but the estimate may exclude countries with less agricultural land. See methodology appendix for a full description of how the market size for privately owned and market accessible ecosystem assets is estimated

[20] See methodology appendix for a full description of methodology, assumptions and caveats

[21] See methodology appendix for list of included/excluded product segments. Biodiversity insurance is discussed in the emerging markets section of the report.

---

[a] Taskforce on Nature Markets (2022) The Future of Nature Markets: https://www.naturemarkets.net/publications/the-future-of-nature-markets

REFERENCES

Adenuga, A. H., Jack, C., & McCarry, R. (2021). The case for long-term land leasing: A review of the empirical literature. Retrieved from https://doi.org/10.3390/land10030238

Agrifarming . (2021). How to buy agriculture land in Nigeria . Retrieved from https://www.agrifarming.in/how-to-buy-agricultural-land-in-nigeria

Akter, S., Krupnik, T., & Khanam, F. (2017). Climate change skepticism and index versus standard crop insurance demand in costal Bangladesh. Retrieved from https://link.springer.com/article/10.1007/s10113-017-1174-9

Allianz. (2022). Environmental liability Insurance. Retrieved from https://www.agcs.allianz.com/solutions/liability-insurance/environmental-liability-insurance.html

Andersson, A. A., Tilley, H. B., Lau, W., Dudgeon, D., Bonebrake, T. C., & Dingle, C. (2021, April). CITES and beyond: Illuminating 20 years of global, legal wildlife trade. Global Ecology and Conservation, 21. Retrieved from https://www.sciencedirect.com/science/article/pii/S2351989421000056

AON. (2021). Environment market status Q1 2022. Retrieved from https://www.aon.com/getmedia/9337eb54-3e93-4098-8b4b-8e3bbf412368/Environmental-Market-Status-Q1-2021_Final.aspx

Australia Department of Agriculture, Fisheries and Forestry. (2022, August 2). Australia's forests. Retrieved from Forests Australia: https://www.agriculture.gov.au/abares/forestsaustralia/australias-forests

Australia Zoo Wildlife Warriors . (2022). We're wildlife warriors . Retrieved from https://australiazoonfts.com/

Australian Government. (2021). Australian Water Markets Report. Retrieved from http://www.bom.gov.au/water/market/documents/The_Australian_Water_Markets_Report_2020-21.pdf

Australian Government. (2022). Biodiversity Certificates to Increase Native Habitat and Support Australian Landholders. Retrieved from https://www.pm.gov.au/media/biodiversity-certificates-increase-native-habitat-and-support-australian-landholders

Australian Government Department of Agriculture and Water Resources. (2019). Abares Insights. Retrieved from https://www.agriculture.gov.au/sites/default/files/abares/documents/SnapshotOfAustralianWaterMarkets_v1.0.0.pdf

AXA. (2022). Corporate View: Biodiversity and insurance. Retrieved from https://axa.foleon.com/biodiversity-guide/biodiversity-at-risk/biodiversity-and-insurance/

Azizuddin, K. (2022, February 2). Sustainable debt issuances could grow fivefold to $7trn in 2025, says finance trade body. Retrieved from Responsible Investor: https://www.responsible-investor.com/sustainable-debt-issuances-could-grow-fivefold-to-usd7trn-in-2025-says-finance-trade-body/

Baeg, I.-H. (2022). The Global Ginseng Market and Korean Ginseng. Journal of Ginseng Culture, 4, 1-12. Retrieved from https://doi.org/10.23076/jgc.2022.4.001

Balmford, A., Green, J. M., Anderson, M., Beresford, J., Huang, C., Naidoo, R., . . . Manica, A. (2015). Walk on the Wild Side: Estimating the Global Magnitude of Visits to Protected Areas. PLOS Biology, 13(2). Retrieved from https://doi.org/10.1371/journal.pbio.1002074

Barsukova, G., Radchevskiy, N., Saifetdinova, N., Bershitskiy, Y., & Paramonov, P. (2016). Problems and Prospects of the Land Market Development in Russia. 6(4), 1981-1997.

Bauer, C. (2008). The experience of Chilean water markets. Retrieved from https://www.zaragoza.es/contenidos/medioambiente/cajaAzul/18S6-P3-Carl%20J.%20BauerACC.pdf

Bennett, G., & Gallant, M. (2018). Mapping potential demand for water quality trading in the United States. Retrieved from https://www.forest-trends.org/publications/mapping-potential-demand-for-water-quality-trading-in-the-united-states/

Bennett, G., & Ruef, F. (2016). State of Watershed Investments 2016. Retrieved from https://www.forest-trends.org/wp-content/uploads/2017/03/2016SOWIReport121416.pdf

Bennett, G., Gallant, M., & ten Kate, K. (2017). State of Biodiversity Mitigation 2017. Retrieved from https://www.forest-trends.org/wp-content/uploads/2018/01/doc_5707.pdf

Bierkens, M., Reinhard, S., de Bruijn, J., Veninga, W., & Wada, Y. (2019). The Shadow Price of Irrigation Water in Major Groundwater-Depleting Countries. Water Resources Research, 55(5), 4266-4287. Retrieved from https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018WR023086

BIS. (2022). Global OTC derivatives market, Statistic Explorer: Table D5.2. Bank for International Settlemens. Retrieved from https://stats.bis.org/statx/srs/table/d5.2?f=pdf

Boretti, A., & Rosa, L. (2019). Reassessing the projections of the World Water Development Report . Retrieved from https://www.nature.com/articles/s41545-019-0039-9#:~:text=Global%20water%20demand%20for%20all,6%2C000%20km3%20per%20year.&text=Global%20water%20demand%20for%20agriculture%20will%20increase%20by%2060%25%20by%202025.&text=By%202050%20the%20global%20populat

Bruno, E., & Schweizer, H. (2021, April 15). Why Wall Street investors' trading California water futures is nothing to fear – and unlikely to work anyway. Retrieved from The Conversation: https://theconversation.com/why--wall-street-investors-trading--california-water-futures-is-nothing-to-fear-and-unlikely-to-work-anyway-155620

Camacho, F. M. (2016). Chile's free market water scheme brings scarcity and conflict for indigenous people . Retrieved from https://theconversation.com/chiles-free-market-water-scheme--brings-scarcity-and-conflict-for-indigenous-people-65499

Cardoso, P., Mensah, K., Barreiros, J., Bouhuys, J., Cheung, H., Davies, A., & Kumschi, S. (2021). Scientists' warning to humanity on illegal or unsustainable wildlife trade. Retrieved from https://www.sciencedirect.-com/science/article/pii/S0006320721003931

Chatham House. (2021). resourcetrade.earth. Retrieved from https://resourcetrade.earth/

Chaudhuri, S. (2003). The impact of IPR on biodiversity . Retrieved from https://www.researchgate.net/publication/28805051_The_impact_of_IPR_on_biodiversity.

Chong, F. (2019). Agriculture: Germ of an asset class. Retrieved from https://realassets.ipe.com/agriculture-germ-of-an-asset-class/10032037.article#:~:text=The%20level%20of%20institutional%20investment,entire%20US%242.5trn%20market.

Climate Watch. (2022). What climate commitments has European Union (27) submitted? Retrieved from https://www.climatewatchdata.org/countries/EUU?end_year=2019&filter=1723&start_year=1990

ClimateTrade. (2022). ClimateTrade and Terrasos jointly promote Voluntary Biodiversity Credits to support biodiversity conservation. Retrieved from https://www.southpole.com/sustainability-solutions/investments-in-biodiversity

Convention on Biological Diversity . (2005). Biodiversity and access to genetic resources . Retrieved from https://www.wipo.int/edocs/mdocs/mdocs/en/isipd_05/isipd_05_www_103974.pdf

Convergence. (2019, October). Data Brief: Blending in Conservation Finance. Retrieved from https://www.thk-forum.org/wp-content/uploads/2022/02/Convergence-Data-Brief-ConservationBrief-2019-1.pdf

Dasgupta, P. (2021). The Economics of Biodiversity: The Dasgupta Review. HM Treasury.

Department for Business, Energy & Industrial Strategy. (2022). Developing the UK emissions trading scheme (UK ETS). Retrieved from https://www.daera-ni.gov.uk/sites/default/files/consultations/daera/developing-the-uk-ets-english.pdf

Diaz, C. (2005). Intellectual property rights and biological resources. Retrieved from https://epub.wupperinst.org/frontdoor/deliver/index/docId/2082/file/WP151.pdf

D'Odorico, P., Chiarelli, D. D., Rosa, L., & Rulli, M. C. (2020). The global value of water in agriculture. Retrieved from https://www.pnas.org/doi/10.1073/pnas.2005835117

Donofrio, S., Maguire, P., Daley, C., Calderon, C., & Lin, K. (2022). State of the Voluntary Carbon Market 2022 Q3. Ecosystem Marketplace. Retrieved from https://www.ecosystemmarketplace.com/publications/state-of--the-voluntary-carbon-markets-2022/

Donoso, G., & Hearne, R. (2014). Water markets in chile: Are they meeting needs? Retrieved from https://link.springer.com/chapter/10.1007/978-94-017-9081-9_6

Ecosystem Marketplace . (2022). The art of integrity: Ecosystem Marketplace's state of the voluntary carbon markets 2022 Q3 . Retrieved from https://www.ecosystemmarketplace.com/publications/state-of--the-voluntary-carbon-markets-2022/

EMCDDA and Europol. (2022, May 6). Coca and cocaine production. Retrieved from European Monitoring Centre for Drugs and Drug Additction: https://www.emcdda.europa.eu/publications/eu-drug-markets/cocaine/production_en#:~:text=In%202020%2C%20Colombia%20continued%20to,pandemic%20(UNODC%2C%202021a).

Environmental Finance . (2022). Sustainable bonds insight 2022. Retrieved from https://www.environmental--finance.com/assets/files/research/sustainable-bond-insight-2022.pdf

European Comission. (2012). Regulation on over-the-counter derivatives and market infrastructures - frequently asked questions. Retrieved from https://ec.europa.eu/commission/presscorner/detail/fr/MEMO_12_232

European Commission. (2021). Questions and Answers on new rules for deforestation-free products. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_5919

European Commission. (2022). Biodiversity financing . Retrieved from https://ec.europa.eu/environment/nature/biodiversity/financing_en.htm#:~:text=The%20EU%20is%20also%20working,10%25%20in%202026%20and%202027.

European Forest Institute. (2022). Who owns the forests and how are they managed? Retrieved from https://efi.int/forestquestions/q2

Fader, M., Gerten, D., Krause, M., Lucht, W., & Cramer, W. (2013). Spatial decoupling of agricultural production and consumption: quantifying dependences of countries on food imports due to domestic land and water constraints. Environmental Research Letters, 8(1), 014046. Retrieved from https://iopscience.iop.org/article/10.1088/1748-9326/8/1/014046

Falco, S. D., Adinolfi, F., Bozzola, M., & Capitanio, F. (2014). Crop insurance as a stratgey for adpating to climate change. Retrieved from https://onlinelibrary.wiley.com/doi/10.1111/1477-9552.12053

FAO. (2020). FAO Remote Sensing Survey. Retrieved from https://www.fao.org/3/cb7449en/cb7449en.pdf

FAO. (2020). Global Forest Resources Assessment 2020. Retrieved from Price per hectare is assumed to range between

FAO. (2022). FAOSTAT. Retrieved from https://www.fao.org/faostat/en/#data/QV

FAO. (2022). The State of World Fisheries and Aquaculture (SOFIA) 2022. Retrieved from https://www.fao.org/publications/sofia/2022/en/

FiBL & IFOAM. (2021). The World of Organic Agriculture. Retrieved from https://www.fibl.org/fileadmin/documents/shop/1150-organic-world-2021.pdf

Finance Earth. (2021). A market review of nature-based solutions. Retrieved from https://finance.earth/wp--content/uploads/2021/05/Finance-Earth-GPC-Market-Review-of-NbS-Report-May-2021.pdf

Finance For Biodiversity . (2022). Breaking the connection between environmental crimes and finance . Retrieved from https://www.f4b-initiative.net/post/breaking-the-connection--between-environmental-crimes-and-finance

Financial Action Task Force. (2021, July). Money Laundering From Environmental Crime. Retrieved from https://www.fatf-gafi.org/publications/environmentalcrime/environmental-crime.html?hf=10&b=0&s=desc(fatf_releasedate)

Food & Water Watch. (2017, November). Paying to Pollute: The Environmental Injustice of Pollution Trading. Retrieved from https://foodandwaterwatch.org/wp-content/uploads/2021/03/ibsp_1711_ejpaytopollute-webfin2_0.pdf

Food and Land Use Coalition. (2019). Growing Better: Ten Critical Transitions to Transform Food and Land Use. Food and Land Use Coalition.

FPS Public Health. (2016). Biopiracy: the example of the Neem tree. Retrieved from https://www.health.belgium.be/en/biopiracy-example-neem-tree

Frost, R. (2022, March 2). WWF decision to sell NFTs labelled 'astonishingly stupid' by environmentalists. Retrieved from euronews.green: https://www.euronews.com/green/2022/02/03/wwf-decision-to--sell-nfts-labelled-astonishingly-stupid-by-environmentalists

FSC. (2015). The global volume and market share of FSC-certified timber. Forest Stewardship Council. Retrieved from https://fsc.org/en/newsfeed/the-global-volume-and-market-share-of-fsc-certified-timber#:~:text=By%20comparing%20this%20figure%20to,fuelwood%20and%20industrial%20roundwood%20market.

FSC. (2018). The Share of Sustainable Wood: Data on FSC's Presence in Global Wood Production. Forest Stewardship Council. Retrieved from https://fsc.org/en/newsfeed/the-share-of-sustainable-wood-data-on-fscs-presence-in-global-wood-production

Gloabl Index Insurance Facility. (2021). A review of aquaculture insurance' summary . Retrieved from https://www.indexinsuranceforum.org/publication/review-aquaculture-insurance-summary

Global Index Insurance Facility . (2017). When and how should agriculture insurance be subsidized? Retrieved from https://documents1.worldbank.org/curated/en/330501498850168402/pdf/When-and-How-Should-Agricultural-Insurance-be-Subsidized-Issues-and-Good-Practices.pdf

Global Nature Fund. (2021). Markets for natural capital. Retrieved from https://www.globalnature.org/bausteine.net/f/8088/MarketsforNaturalCapital-StatusQuoandProspects.pdf?fd=0

Global Witness. (2021, October 22). Deforestation Dividends. Retrieved from https://www.globalwitness.org/en/campaigns/forests/deforestation-dividends/

GSMA. (2020). Agricultural insurance for smallholder farmers. Retrieved from https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/05/Agricultural_Insurance_for_Smallholder_Farmers_Digital_Innovations_for_Scale.pdf

Hale, T. (2022). The carbon offset market is falling short. Here's how to fix it . Retrieved from https://www.ft.com/content/32b1a051-7de6-4594-b31b-753e78aefde1

Hansen, H. O. (2017, July 31). Global fur retail value. Retrieved from https://fur.ca/wp-content/uploads/2017/09/-Global_Fur_Retail_July_20172.pdf

Hansen, H. O. (2021, May 27). Global fur retail value. Retrieved from https://www.wearefur.com/wp-content/uploads/2021/06/Global-fur-retail-value-May-2021-Henning-study.pdf

Heberling, M., Thurston, H., & Nietch, C. (2018). Exploring non-traditional participation as an approach to make watrer quality trading markets more effective. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6662201/

Hong Kong Exchanges and Clearing Limited. (2020). An overview of the global commodity derivatives market. Retrieved from https://www.hkex.com.hk/-/media/HKEX-Market/News/Research-Reports/HKEx-Research-Papers/2020/CCEO_CommDeriv_e_202005.pdf?la=en

ICAP. (2022). New Zealand Emissions Trading Scheme. Retrieved from https://icapcarbonaction.com/en/ets/new-zealand-emissions-trading-scheme#:~:text=The%20NZ%20ETS%20was%20launched,earn%20units%20for%20emissions%20removals

IEG. (2022). Be Invested. Retrieved from https://www.intrinsicexchange.com/

International Carbon Action Partnership . (2022). New Zealand emission trading scheme . Retrieved from https://icapcarbonaction.com/system/files/ets_pdfs/icap-etsmap-factsheet-48.pdf

International Carbon Action Partnership. (2022). ICAP allowance price explorer . Retrieved from https://icapcarbonaction.com/en/ets-prices

International Swaps and Derivatives Association. (2021). Sustainability-linked derivatives: KPI guidelines. Retrieved from https://www.unpri.org/pri-blog/sustainability-linked-loans-a--strong-esg-commitment-or-a-vehicle-for-greenwashing/10243.article

INTERPOL. (2020, November 23). INTERPOL marks a decade of tackling serious organized environmental crime. Retrieved from https://www.interpol.int/News-and-Events/News/2020/INTERPOL--marks-a-decade-of-tackling-serious-organized-environmental-crime

INTOSAI. (2014). Impact of Tourism on Wildlife Conservation. INTOSAI Working Group on Environmental Auditing (WGEA). Retrieved from http://iced.cag.gov.in/wp-content/uploads/2014/02/2013_wge-a_Wild-Life_view.pdf

IPCC. (2019). Special Report on Climate Change and Land.

IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. IPCC. Retrieved from https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

ISDA. (2021, October). Role of Derivatives in Carbon Markets. Retrieved from https://www.isda.org/a/soigE/Role-of-Derivatives-in-Carbon-Markets.pdf

Johnson, T. (2021). Natural Capital: Timberland's evolving value porposition. Retrieved from https://www.tireurope.com/wp-content/uploads/2021/04/Timberlands-Evolving-Value-Proposition-041321.pdf

Kanter, D., Bartolini, F., Kugelberg, A., Leip, A., Oenema, O., & Uwizeye, A. (2019). Nitrogen pollution policy beyond the farm. Nature Food, 1, 27-32. Retrieved from https://www.nature.com/articles/s43016-019-0001-5

Keya, K. (2021). Biodiversity and intellectual property rights - can the two exist. Retrieved from https://blog.ipleaders.in/biodiversity-intellectual-property-rights-can-two-exist/

Kinnunen, P., Guillaume, J., Taka, M., D'Odorico, P., Siebert, S., Puma, M., . . . Kummu, M. (2020). Local food crop production can fulfil demand for less than one-third of the population. Nature Food, 1, 229-237. Retrieved from https://www.nature.com/articles/s43016-020-0060-7

Klebanou, S. (2022). Investors are getting back to the land - U.S. farmland, that is. Retrieved from https://www.businessofbusiness.com/articles/investors-are-getting-back-to-the-land-us-farmland-that-is/

Kölbel, J., & Lambillon, A.-P. (2022). Who Pays for Sustainability? An Analysis of Sustainability-Linked Bonds. SSRN. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4007629#:~:text=Adrien%2DPaul%20Lambillon,-University%20of%20Zurich&text=Our%20results%20show%20that%20in,up%20and%20for%20callable%20bonds.

Krauer, B. (2019). Agriculture insurance: Happiness is in the field. Retrieved from https://axaxl.com/fast-fast-forward/articles/agricultural-insurance-happiness-is-in-the-field

Krishna, V., Kubtiza, C., Pascual, U., & Qaim, M. (2017). Land markets, property rights and deforestation: Insights from Indonesia. Retrieved from https://www.sciencedirect.com/science/article/pii-/S0305750X17301808

Land Portal. (2014). Land and Natural Resources Rights and Reforms in Sudan. Retrieved 2022, from https://www.landportal.org/news/2014/04/land-and-natural-resources-rights-and-reforms-sudan

Lawshelf. (2022). Fundamental issues in mineral rights ownership. Retrieved from https://lawshelf.com/videocoursesmoduleview/fundamental-issues-in-mineral-rights-ownership-module-1-of-5

Lewin, H., Robinson, G., Kress, W., & Zhang, G. (2018). Earth BioGenome Project: Sequencing life for the future of life. Biological Sciences, 115(17), 4325-4333. Retrieved from https://www.pnas.org/doi/10.1073/pnas.1720115115#sec-5

Li, l., Tan, R., & Wu, C. (2020). Reconstruction of China's farmland rights system based on the 'Trifurcation of Land Right' reform . Retrieved from https://www.mdpi.com/2073-445X/9/2/51/pdf

Lin, A. X., Chan, G., Hu, Y., Ouyang, D., Ung, C. O., Shi, L., & Hu, H. (2018). Internationalization of tradtional chinese medicine: Current international market, internationalization challenges and prospective suggestions. Retrieved from https://cmjournal.biomedcentral.com/articles/10.1186/s13020-018-0167-z

Liu, H., & Brouwer, R. (2022). What is the future of water quality trading? Retrieved from https://onlinelibrary.wiley.com/doi/epdf/10.1111/coep.12583

Luc Hoffmann Institute. (2021). The future of nature-based tourism: impact of Covid-19 and paths to sustainability . Retrieved from https://luchoffmanninstitute.org/wp-content/uploads/2021/04/luchoffmanninstitute-future-nature-based-tourism-report-2021.pdf

Mahul, O., & Stutley, C. (2010). Government support to agricultural insurance: Challenges and options for developing countries. Retrieved from https://www.ipcc.ch/apps/njlite/ar5wg2/njlite_download2.php?id=8222

Markets and Markets. (2021). Animal Genetics Market by Products & Services. Retrieved from https://www.marketsandmarkets.com/Market-Reports/animal-genetic-market-12462093.html?gclid=CjwKCAjwsMGYBhAEEiwAGUXJabFvV4Ofori0E9-5FRuBe4XJVCkI0V3oQdYZq9G9kGOfVneKQRIG8BoC9XYQAvD_BwE

Mashigo, L. (2022). Agri SA pursues battle for trading of water rights. Retrieved from https://www.iol.co.za/the-star/news/agri-sa-pursues-battle-for-trading-of-water-rights-54f245c2-6d78-4186-a0cc-16d1f754c7e7

Matthews, L. (2022, April 18). How Some NFTs are Becoming More Sustainable. Retrieved from LeafScore: https://www.leafscore.com/blog/how-some-nfts-are-becoming-more-sustainable/#:~:text=much%20higher%20price.-,Other%20sustainable%20NFT%20marketplaces,minting%20and%20zero%20gas%20fees.

Mckinsey & Company . (2021). The rise and rise of the global balance sheet: How productively are we using our wealth? Retrieved from https://www.mckinsey.com/industries/financial-services/our-insights/the-rise-and-rise-of-the-global-balance-sheet-how-productively-are-we-using-our-wealth

McKinsey & Company. (2021). A blueprint for scaling voluntary carbon markets to meet the climate challenge. Retrieved from https://www.mckinsey.com/business-functions/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge

Mongabay. (2011). Uruguay Forest Information and Data. Retrieved from https://rainforests.mongabay.com/deforestation/2000/Uruguay.htm

MSC. (2022). The Marine Stewardship Council Annual Report 2020-2021. Marine Stewardship Council. Retrieved from https://www.msc.org/docs/default-source/default-document-library/about-the-msc/msc-annual-report-2020-2021.pdf

NAIC. (2022, June 23). Environmental Insurance. Retrieved from https://content.naic.org/cipr-topics/environmental-insurance

Name, T. (n.d.). Retrieved from Vivid: www.vivideconomics.com

National Geographic. (n.d.). A five step plan to feed the world. National Geographic. Retrieved from https://www.nationalgeographic.com/foodfeatures/feeding-9-billion/

National Network on Water Quality Trading . (2018). Breaking down barriers: Priority actions for advancing water quality trading . Retrieved from http://nnwqt.org/wp-content/uploads/2018/10/Breaking-Down-Barriers_Priority-Actions-for-Advancing-WQT.pdf

Nedopil, C., Yue, M., & Hughes, A. (2022). Scaling debt for nature swaps - which nature, how much debt and who pays? Retrieved from https://assets.researchsquare.com/files/rs-1358929/v1_covered.pdf?c=1646160426

New Zealand Forest Service. (2022). About New Zealand's forests. Retrieved from https://www.mpi.govt.nz/forestry/new-zealand-forests-forest-industry/about-new-zealands-forests/

NFA. (2022). Non-fungible animals. Retrieved from https://www.wwf-nfa.com/

Nordea. (2022). Sustainability-linked bonds: A status check . Retrieved from https://www.nordea.com/en/news/sustainability-linked-bonds-a-status-check#:~:text=In%20just%20a%20few%20years,for%20the%20year%20to%20date.

OECD. (2012). Illegal Trade in Environmentally Sensitive Goods. Retrieved from https://www.oecd.org/env/illegal-trade-in-environmentally-sensitive-goods-9789264174238-en.htm

OECD. (2017). Biodiversity: OECD DAC external development finance statistics. Retrieved from Organisation for Economic Cooperation and Development: https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/biodiversity.htm

OECD. (2019). Climate change: OECD DAC external development finance statistics. Retrieved from Organisation for Economic Cooperation and Development: https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm

OECD. (2020). A comprehensive overview of global biodiversity finance.

OECD. (2021). Official Development Assistance (ODA). Retrieved from Organisation for Economic Cooperation and Development : https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/official-development-assistance.htm

OECD. (2021). Tracking Economic Instruments and Finance for Biodiversity. Retrieved from https://www.oecd.org/environment/resources/biodiversity/tracking-economic-instruments-and-finance-for-biodiversity-2021.pdf

OECD.stat. (2022). Creditor Reporting System (CRS). Retrieved from https://stats.oecd.org/Index.aspx?DataSetCode=crs1

Overbeck, G. E., Veldman, J. W., Negreiros, D., Mahy, G., Stradic, L. S., Fernandes, G., . . . J. Bond, W. (2015). Where tree planing and forest expansion are bad for biodiversity and ecosystem services. Retrieved from https://academic.oup.com/bioscience/article/65/10/1011/245863

Porras, I., & Steele, P. (2020). Making the market work for nature. Retrieved from https://pubs.iied.org/sites/default/files/pdfs/migrate/16664IIED.pdf

Porras, I., & Steele, P. (2020). Making the market work for nature: How biocredits can protect biodiversity and reduce poverty. Retrieved from https://pubs.iied.org/sites/default/files/pdfs/migrate/16664IIED.pdf

Principles for Responsible Investment. (2015). Responsible investment in farmland. Retrieved from https://www.unpri.org/farmland/responsible-investment-in-farmland/716.article#:~:text=Farmland%20offers%20a%20stable%20long,biodiversity%2C%20toxics%20and%20land%20rights.

Principles for Responsible Investment. (2022). Sustainability-linked loans: A strong ESG commitment or a vehicle for greenwashing? Retrieved from https://www.unpri.org/pri-blog/sustainability-linked-loans-a--strong-esg-commitment-or-a-vehicle-for-greenwashing/10243.article

Rainforest Alliance. (2022). Coffee Certification Data Report 2021. Retrieved from https://www.rainforest-alliance.org/resource-item/coffee-certification-data-report-2021/

Rainforest Alliance. (2022). Tea Certification Data Report 2021. Retrieved from https://www.rainforest-alliance.org/resource-item/tea-certification-data-report-2021/

Rashid, S., & Sheikh, A. T. (2015). Farmers' perceptions of agircultural land values in rural pakistan . Retrieved from https://pide.org.pk/psde/pdf/AGM30/papers/Farmers Perceptions of Agricultural Land Values in Rural Pakistan.pdf

Rijsberman, F. (2021). Greening ODA: 50% of development aid should support environment and climate action. Retrieved from https://www.eco-business.com/opinion/greening-oda-50-of-development-aid-should-support-environment-and-climate-action/

Ritchie, H. (2022). Land use diets. Our World in Data. Retrieved from https://ourworldindata.org/land-use-diets

Ritchie, H., & Roser, M. (2021). Environmental Impacts of Food Production. Our World in Data. Retrieved from https://ourworldindata.org/environmental-impacts-of-food

Rotherham, T. (2017). The taxation of privately owned forest land in Canada: A review of the taxation systems in all ten provinces. The Forestry Chronicle, 93(2). Retrieved from https://pubs.cif-ifc.org/doi/pdf/10.5558/tfc2017-016

Salzman, J., Bennett, G., Carroll, N., Goldstein, A., & Jenkins, M. (2018). The global status and trends of payments for ecosystem services. Retrieved from https://www.nature.com/articles/s41893-018-0033-0

Savills. (2020). Global Farmland Index. Retrieved from https://pdf.euro.savills.co.uk/uk/rural---other/spotlight--global-farmland-index---sep-2020.pdf

Savills. (2020). Global Farmland Index. Retrieved from https://pdf.euro.savills.co.uk/uk/rural---other/spotlight--global-farmland-index---sep-2020.pdf

Schmithuse, F., & Hirsch, F. (2010). Private Forest Ownership in Europe. Retrieved from https://unece.org/fileadmin/DAM/timber/publications/SP-26.pdf

Schwabe, K., Nemati, M., Landry, C., & Zimmerman, G. (2020). Water Markets in the Western United States: Trends and Opportunities. 12(1), 233. Retrieved from https://www.mdpi.com/2073-4441/12/1/233/htm

Seddon, N., Chausson, A., Berry, P., Girardin, C., Smith, A., & Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. Retrieved from https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0120

Sharma, R. (2022). Animoca and untamed planet collaborates for nature metaverse . Retrieved from https://www.cryptotimes.io/animoca-and-untamed-planet-collaborates-for-nature-metaverse/

Sharma, R. (2022). Non-fungible token (NFT). Retrieved from https://www.investopedia.com/non-fungible--tokens-nft-5115211

Smith, P., & Bustamante, M. (2018). Agriculture, forestry and other land use (AFOLU). Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter11.pdf

South Pole. (2022). Investments in Biodiversity. Retrieved from https://www.southpole.com/sustainability-solutions/investments-in-biodiversity

Sustainable Stock Exchanges. (2021). How derivatives exchanges can promote sustainable development: an action menu. Retrieved from https://sseinitiative.org/wp-content/uploads/2021/04/SSE-WFE--Derivatives-Exchanges-Guidance.pdf

Swiss Re. (2015). Forestry insurance: A largely untapped potential. Retrieved from http://www.biztositasiszemle.hu/files/201512/pub_forestry_insurance.pdf

Swiss Re. (2016). Sustainability Risk Framework. Retrieved from https://www.swissre.com/dam/jcr:f402aa58--4108-473c-b5a7-36fb50f05e88/Sustainability_Risk_Framework_Brochure_en.pdf

Taskforce on Nature Markets. (2022, April). The Future of Nature Markets. Retrieved from https://uploads-ssl.webflow.com/623a362e6b1a3e2eb749839c/6242510f80c173df031c4d79_TNM_WhitePaper.pdf

Taskforce on Scaling Voluntary Carbon Markets . (2022). Final announcment on the recommendation for the new governance body composition. Retrieved from https://www.iif.com/tsvcm

Tesco. (2022, August 2). Zero-deforestation soy initiative underway with major UK supermarket backing. Retrieved from https://www.tescoplc.com/news/2022/zero-deforestation-soy-initiative-underway-with-major-uk-supermarket-backing/

The Biodiversity Consultancy. (2022). Biodiversity credits: Risks and opportunties. Retrieved from https://www.thebiodiversityconsultancy.com/knowledge-and-resources/biodiversity-credits-risks-and-opportunities-143/

The Economist Intelligence Unit. (2021). An Eco-wakening. The Economist Intelligence Unit. Retrieved from https://files.worldwildlife.org/wwfcmsprod/files/Publication/-file/93ts5bhvyq_An_EcoWakening_Measuring_awareness__engagement_and_action_for_nature_FINAL_MAY_2021.pdf?_ga=2.12775991.1673164269.1662123201-2065062413.1660572885

The Landbanking Group . (2022). Nature needs a better bank. Retrieved from https://thelandbankinggroup.com/

The Swedish Foundation for Strategic Environmental Research. (2021). Aligning markets with biodiversity. Retrieved from https://www.mistra.org/wp-content/uploads/2021/06/mistra-bp-aligning-markets-with-biodiversity-2021.pdf

The United Nations Confrence on Trade and Development . (2014). The convention on biodiversity and the Nagoya protocol: Intellectual property implications . Retrieved from https://unctad.org/webflyer/convention--biodiversity-and-nagoya-protocol-intellectual-property-implications

Timber Trade Portal. (2022). Retrieved from Forest resources and context of China : https://www.timbertrade-portal.com/en/china/28/country-context

Timberland Investment Resources. (2021). Timber investments: A primer. Retrieved from https://tirllc.-com/wp-content/uploads/2021/07/Timberland-Investments-A-Primer-2021-07-07.pdf

Tobin, A. (2021, May 18). Could trading water on the stock market actually be good for the environment? Retrieved from euronews.green: https://www.euronews.com/green/2021/05/17/could-trading-water--on-the-stock-market-actually-be-good-for-the-environment

Toulmin, C. (2009). Securing land and property rights in sub-Saharan Africa: The role of local institutions. Land Use Policy, 26(1), 10-19. Retrieved from https://www.sciencedirect.com/science/article/abs/pii-/S0264837708000811

Tridge. (2021). Licorice Root. Retrieved from https://www.tridge.com/intelligences/licorice-root2/export

Tridimas, B. (2021, November 6). 'Get Nature Positive': 95 businesses join forces in pledge to end nature loss. Retrieved from Business Green: https://www.businessgreen.com/news/4039872/nature-positive-businesses-join-forces-pledge-end-nature-loss

UK HMRC. (2022). Understanding corporate finance: derivatives: settlement. Retrieved from GOV.UK: https://www.gov.uk/hmrc-internal-manuals/corporate-finance-manual/cfm13040

UNCTAD. (2014). The convention on biodiversity and the Nagoya protocol: Intellectual property implications. Retrieved from https://unctad.org/webflyer/convention-biodiversity-and-nagoya-protocol-intellectual-property-implications

UNCTAD. (2017). Commodity dependence and the Sustainable. United Nations Conference on Trade and Development. Retrieved from https://unctad.org/system/files/official-document/cimem2d37_en.pdf

UNCTAD. (2022, February 17). Global trade hits record high of $28.5 trillion in 2021, but likely to be subdued in 2022. Retrieved from https://unctad.org/news/global-trade-hits-record-high-285--trillion-2021-likely-be-subdued-2022#:~:text=%E2%80%9COverall%2C%20the%20value%20of%20global,the%20COVID%2D19%20pandemic%20struck.

UNEP. (2021). State of Finance for Nature. UNEP. Retrieved from https://www.unep.org/resources/state-finance-nature

UNESCO World Water Assessment Programme. (2022). The United Nations World Water Development Report 2022: groundwater: making the invisible visible; facts and figures . Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000380733

United Nations Environment Assumbly of the United Nations Environment Programme. (2022, March 2). Nature-based solutions for supporting sustainable development. Retrieved from https://wedocs.unep.org/-bitstream/handle/20.500.11822/39864/-NATURE-BASED%20SOLUTIONS%20FOR%20SUPPORTING%20SUSTAINABLE%20DEVELOPMENT.%20English.pdf?sequence=1&isAllowed=y

United Nations Environment Programme. (2016). The rise of environmental crime: A growing threat to natureal resources, peace, development and security. Retrieved from https://wedocs.unep.org/handle/20.500.11822/7662

United Nations Multi-Partner Trust Fund Office . (2022). The lion's share fund. Retrieved from https://mptf.undp.org/fund/lns00

UNODC. (2020). Fact Sheet – Bolivia Coca Cultivation Monitoring Report, 2020. Retrieved from https://www.unodc.org/documents/crop-monitoring/Bolivia/Bolivia_Coca_Survey_Fact_sheet_Executive_Summary_2020.pdf

US Congressional Research Service. (2021, November 24). U.S. Forest Ownership and Management: Background and Issues for Congress. Retrieved from https://unece.org/fileadmin/DAM/timber/publications/SP-26.pdf

US Mineral Exchange . (2021). How to calculate mineral rights value in 2022. Retrieved from https://www.usmineralexchange.com/blog/mineral-rights-value/-calculate-mineral-rights-value/#:~:text=The%20average%20price%20per%20acre%20for%20mineral%20rights%20that%20are,between%20%240%20and%20%24250%2Facre.

USDA. (2016). Investigating Retail Price Premiums for Organic Foods. USDA. Retrieved from https://www.usda.gov/media/blog/2016/06/14/investigating-retail-price-premiums-organic-foods

USDA. (2021). Land Values 2021 Summary. Retrieved from https://www.nass.usda.gov/Publications/Todays_Reports/reports/land0821.pdf

van Dijk, M., Morley, T., Luise Rau, M., & Saghai, Y. (2021). A meta-analysis of projected global food demand and population at risk of hunger for the period 2010–2050. Nature Food, 2, 494-501. Retrieved from https://doi.org/10.1038/s43016-021-00322-9

Verschurren, J. (2022). Towards EU carbon farming legislation: what is the role of ETS? Retrieved from https://www.lawandglobalisation.nl/towards-eu-carbon-farming-legislation-what-is-the-role-of-the-ets/

Voluntary Carbon Markets Integrity Initative. (2021). Aligning voluntary carbon markets with the 1.5C Paris Agreement ambition. Retrieved from https://vcmintegrity.org/wp-content/uploads/2021/07/VCMI-Consultation-Report.pdf

Voluntary Carbon Markets Integrity Intiative. (2022). VCMI claims code of practice consultation. Retrieved from https://vcmintegrity.org/

Walker, S. (2019). After 15 years, EPA updates water quality trading policy. It could do more. Retrieved from https://www.wri.org/insights/after-15-years-epa-updates-water-quality-trading-policy-it-could-do-more

WEF. (2016, September 28). Wildlife crime: a $23 billion trade that's destorying our planet. Retrieved from https://www.weforum.org/agenda/2016/09/fighting-illegal-wildlife-and-forest-trade/#:~:text=With%20a%20value%20of%20between,%24200%20million%20in%20annual%20revenue

WFE. (2022). WFE Derivatives Report 2021. World Federation of Exchanges. Retrieved from https://www.world-exchanges.org/storage/app/media/2021%20Annual%20Derivatives%20Report.pdf

Wheeler, S. A., Loch, A., Crase, L., Young, M., & Grafton, Q. (2017). Developing a water market readiness assessment framework. Retrieved from https://www.sciencedirect.com/science/article/pii/S0022169417304614

WildEarth. (2022). Wildlife conservation NFTs. Retrieved from https://wildearth.tv/nft/

WIPO. (2010). IP can support biodiversity . Retrieved from https://www.wipo.int/pressroom/en/articles/2010/article_0016.html

World Bank. (2017). Annual freshwater withdrawalsl. Retrieved from https://data.worldbank.org/indicator/er.h2o.fwag.zs

World Bank. (2022). Insuring Nature's Survival : The Role of Insurance in Meeting the Financial Need to Preserve Biodiversity. Retrieved from https://openknowledge.worldbank.org/handle/10986/37437

World Bank. (2022). World development indicators . Retrieved from https://databank.worldbank.org/source/world-development-indicators

World Bank Group. (2021). A review of aquaculture insurance. Retrieved from https://www.indexinsuranceforum.org/publication/review-aquaculture-insurance-summary

World Resources Institute. (2014). Brazil. Retrieved from Forest Legality Initiative: https://forestlegality.org/risk-tool/country/brazil

World Resources Institute. (2014). Chile. Retrieved from Forest Legality Initiative: https://forestlegality.org/risk-tool/country/chile#:~:text=Only%20a%20quarter%20of%20Chile's,protection%20of%20soil%20and%20water.

WRI. (2022). Wood Resources International. Retrieved from https://woodprices.com/

WRM. (2020). Blockchain and Smart Contracts: Capital's Latest Attempts to Seize Life on Earth. World Rainforest Movement. Retrieved from https://www.wrm.org.uy/bulletin-articles/blockchain-and-smart-contracts-capitals-latest-attempts-to-seize-life-on-earth

Zetland, D. (2021). The role of prices in managing water scarcity . Retrieved from https://www.sciencedirect.com/science/article/pii/S2468312420300237

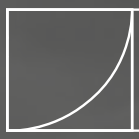
Zukunft Des Kohlenstoffmarkets. (2021). Nature-based solutions in carbon markets . Retrieved from http://www.carbonmarket-foundation.org/userfiles/zdk/file/NbS%20Carbon%20Markets%202021_04_29_final.pdf

About NATURE FINANCE

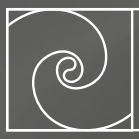
NatureFinance is committed to aligning global finance with nature positive, equitable outcomes.

The core mission of NatureFinance is to accelerate the alignment of global finance with equitable, nature positive outcomes. We do this by shaping the many dimensions, actors and change pathways at the nature-finance nexus.

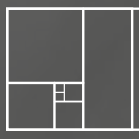
How we make change:



Nature Markets: shaping principles-based nature markets by increasing awareness, innovations and better governance of nature-linked markets including nature credits and soft commodity markets.



Nature Liability: extending the liabilities of financial institutions for nature outcomes, including the application of anti-money laundering rules to break the links between investment and nature crimes.



Nature Data & Disclosure: Increasing the quality and quantity of nature data, risk assessment and transparency across financial markets to enable integrated assessments of nature-climate risks and impacts.

Sovereign Debt: Engaging market actors, and governing institutions in efforts to place nature in the world's sovereign debt markets, including scaling the issuance of sustainability performance-linked sovereign bonds.

Nature Investment: Creating new nature focused investment opportunities that address climate, food security, equity and broader sustainable development goals.

For more information and publications, visit www.naturefinance.net

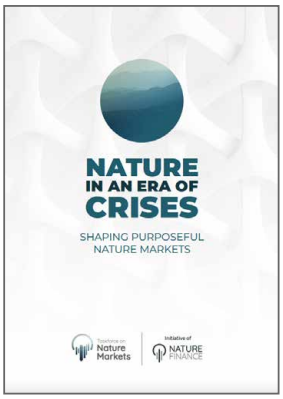
NatureFinance is the next phase of impact of the Finance for Biodiversity Initiative (F4B), established with support from the MAVA Foundation. The work also benefits from partnerships with, and support from, the Children's Investment Fund Foundation (CIFF) and the Finance Hub of the Gordon and Betty Moore Foundation.

Our use of Fibonacci sequence imagery is inspired by the association of this unique ratio with the maintenance of balance, and its appearance everywhere in nature- from the arrangement of leaves on a stem to atoms, uncurling ferns, hurricanes and celestial bodies.

Related Publications

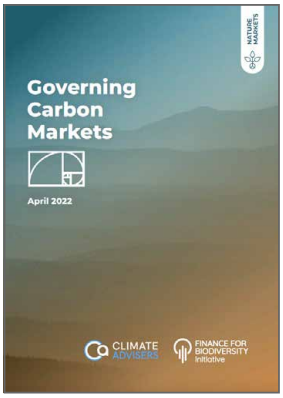
The Future of Nature Markets

Click to access publication >



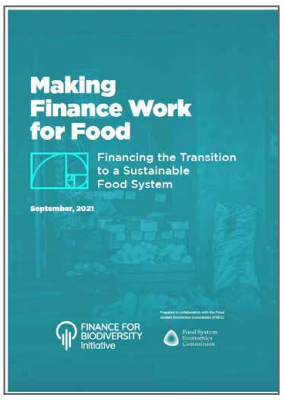
Nature in an Era of Crises

Click to access publication >



Governing Carbon Markets

Click to access publication >

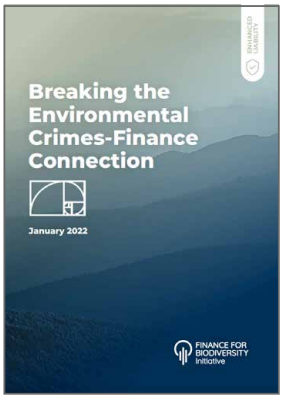


Making Finance Work for Food

Click to access publication >

Nature Loss And Sovereign Credit Ratings

Click to access publication >



Breaking the Environmental Crimes-Finance Connection

Click to access publication >

Taskforce on Nature Markets