Earth Observation for Environmental, Social, and Governance Schemes

GDA M&E Topical Overview

December 2023

Contents

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Caribou Space supports organisations to bridge the space and sustainable development worlds by working with governments, space agencies, development agencies, and private sector space companies. Caribou Space provides:

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- Economic evaluation: Quantification of the economic causes and impacts of space technology.

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Glossary

ABCD	ADM, Bunge, Cargill, and Louis Drefus
ADB	Asian Development Bank
AI	Artificial Intelligence
AID	Agile Earth Observation Information Development
APP	Analytics Processing Platform
CAGR	Compound Annual Growth Rate
CO^2	Carbon Dioxide
EM	Emerging Markets
EO	Earth Observation
ESA	European Space Agency
ESG	Environmental, Social, and Governance
ETF	Exchange-traded Fund
GDA	Global Development Assistance
GDA APP	GDA Analytics Processing Platform
GDA CCC	GDA Communicate Connect Cooperate
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GNI	Gross National Income
GPS	Global Program on Sustainability
GSS	Green, Social and Sustainability
IFC	International Finance Corporation
IFI	International Financial Institution
ILO	International Labour Organization
JESG	J.P. Morgan ESG
ML	Machine Learning
NASA	National Aeronautics and Space Administration
NCA	Natural Capital Accounting
NRT	Near Real Time

OECD	Organisation for Economic Co-operation and Development
PM2.5	Fine Particulate Matter
PPP	Purchasing Power Parity
SME	Small and Medium Enterprises
SPI	Standardised Precipitation Indicator
SLBs	Sustainably Linked Bonds
TA	Technical Assistance
UN SDG	United Nations Sustainable Development Goal
WB	World Bank
WBG	World Bank Group
WWF	World Wide Fund for Nature

Key points

This report defines ESG as *"an approach that seeks to incorporate environmental, social and governance factors into asset allocation and risk decisions, so as to generate sustainable, long-term financial returns"*[1] and earth observation (EO)/geospatial ESG as "*the use of geospatial data* [including EO] *to generate ESG relevant insights into a specific commercial asset, company, portfolio or geographic area.*"[2]

Based on insights from the World Bank Group (WB), the Asian Development Bank (ADB), the Inter-American Development Bank (IDB) and the International Fund for Agricultural Development (IFAD) the main ESG-related tasks undertaken by IFIs are data provision, advisory services, and standard setting. The WBG looks at three key ESG-related topics: sustainable finance, corporate ESG and sovereign ESG.

The key benefits of the use of EO data for ESG are:

- Affordability: satellites can reduce the money spent on in-person visits to understand ESG issues.
- Coverage: satellites can obtain data from anywhere in the world and harmonise them across countries.
- Frequency: EO data can be generated at very high temporal frequencies.
- Speed: EO-enabled ESG enables near real-time insights.
- Objectivity: satellites can facilitate a more objective evaluation of ESG.
- Continuity: EO data can be acquired over extended periods of time, offering a time series of images.

The WBG is already leveraging the value of EO/geospatial data for ESG, particularly in the acquisition of environmental data sets in its ESG data portal.

There are some limitations and barriers to greater uptake of EO for M&E which need to be addressed and/or overcome by IFIs:

- Limitations in monitoring the 'S' (social) and the 'G' (governance) in ESG
- Data interdependencies & limited availability of asset and supply chain data
- Translating environmental data into economic data

The information gathered in this report gives rise to two key implications /recommendations:

- Continue to develop EO for ESG as a use case scenario in the GDA Analytics Processing Platform (GDA APP)
- Draw attention to EO for ESG via the GDA Communicate Connect Cooperate (GDA CCC)

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[1] OECD, *ESG Investing: Practices, Progress and Challenges*, 2020, https://www.oecd.org/finance/esg-investing.htm
[2] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

Introduction

This report is a topical overview analysis carried out by the M&E activity, under the European Space Agency (ESA)'s Global Development Assistance (GDA) programme - a global partnership to mainstream the use of Earth Observation (EO) into development operations, implemented in cooperation with major International Financial Institutions (IFIs).

"Broadly speaking ESG investing is an approach that seeks to incorporate environmental, social and governance factors into asset allocation and risk decisions, so as to generate sustainable, long-term financial returns."[3]

In recent years, Environmental, Social, and Governance (ESG) investment has gained global momentum driven by client demand and external pressures, and is now the largest sustainable investment strategy for assets globally, with a value of US$25.2 trillion.[4] Policymakers have recognised that integrating ESG data into financial markets is key to achieving the Paris Agreement, the United Nations Sustainable Development Goals (UN SDGs), and other key global objectives.[5] ESG investment is critical for achieving inclusive growth and reducing the detrimental impact of the pandemic on income inequality. An ongoing challenge with ESG investing is access to robust data that allows for an affordable, comparable, and scalable way to assess sustainability issues attached to investments.[6]

This report draws insights from the WBG and World Wide Fund for Nature (WWF) publication, 'Geospatial ESG', including the definition of EO/geospatial ESG, "*the use of geospatial data* [including EO] *to generate ESG relevant insights into a specific commercial asset, company, portfolio or geographic area*"[7]. We recognise that geospatial data, the term used in the WWF report, refers to a combination of data beyond solely that derived from EO satellites. Instead, this report will focus on the value that data derived from EO satellites brings to ESG. Satellite-enabled data can provide additional insights into all three of the ESG pillars, but is particularly valuable in understanding environmental factors, and hence this will be the area this report focuses mainly on.

There are six sections of this report split as follows:
- **Background:** a definition of ESG, trends and challenges and the ESG financial ecosystem.
- **ESG in IFIs:** an overview of ESG processes in IFIs, focusing on the WB, the ADB, the ADB, and the IFAD.
- **The value of EO data for ESG:** an explanation as to how EO contributes to ESG as well as the main key characteristics of EO that make it useful for ESG.
- **Case studies:** a list of all case studies referred to throughout.
- **EO data for ESG in IFIs:** an overview of how IFIs use EO data for ESG, as well as potential limitations and barriers to the increased adoption of EO in ESG.
- **Implications & avenues for better integration:** a list of key recommendations and considerations to be made to better integrate EO data into ESG insights.

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[3] OECD, *ESG Investing: Practices, Progress and Challenges*, 2020, https://www.oecd.org/finance/esg-investing.htm
[4] Global Sustainable Investment Alliance (GSIA), *Global Sustainable Investment Review*, 2021, https://www.gsi-alliance.org/trends-report-2020/
[5] World Bank Group (WBG), 'Global Program on Sustainability Pillars', 2022, https://www.worldbank.org/en/programs/global-program-on-sustainability/priority-themes#3
[6] Patterson D. et al., *Geospatial ESG*, World Wide Fund (WWF) UK, 2022, https://wwf-sight.org/geospatial-esg/
[7] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

Background

Defining Environmental, Social, and Governance (ESG)

Corporate ESG

The International Financial Corporation (IFC), the private sector arm of the World Bank Group (WBG) defines ESG as "*a set of environmental, social, and governance factors considered by companies when managing their operations, and investors when making investments, in respect of the risks, impacts, and opportunities relating to but not limited to:*

- *Environmental issues: potential or actual changes to the physical or natural environment (e.g., pollution, biodiversity impacts, carbon emissions, climate change, and natural resource use);*
- *Social issues: potential or actual changes on surrounding community and workers (e.g., health and safety, supply chain, diversity, and inclusion); and*
- *Governance: corporate governance structures and processes by which companies are directed and controlled (e.g., board structure and diversity, ethical conduct, risk management, disclosure, and transparency), including the governance of key environmental and social policies and procedures.*" [8]

Sovereign ESG

Whilst ESG has traditionally applied to companies, it is increasingly applied to sovereign debt, which is the debt owed by the government of a country to a lending institution. The WBG report 'Demystifying ESG' defines sovereign ESG as the integration of environmental, social and governance factors in assessing the performance and sustainability of sovereign entities such as national governments.[9] The consideration of these factors helps provide a comprehensive understanding of a country's overall risk profile and long-term sustainability and may influence decisions to invest in sovereign bonds. As the report 'Credit Worthy: ESG Factors and Sovereign Credit Ratings' argues, sovereign ESG scores complement traditional sovereign credit ratings.[10]

The sovereign context is what has been researched the least and is a key focus area for IFIs given that their primary clients are so-called Client States (emerging market governments), with whom they collaborate on sovereign-level interventions. However, Sovereign ESG scores are not without controversy. On one hand, ESG providers decide on what constitutes a good sovereign performance for Governance and Social issues, but this is often driven by ingrained income biases at the national level. 90% of sovereign ESG scores can be explained by a country's national income.[11] ESG scores in higher income countries tend to be higher given that they have stronger institutions and less inequality. This means that ESG-tilted investments, where countries with higher ESG scores receive a higher weight, will inevitably send more funds to developed countries, which can drive funding

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[8] IFC, 'Environmental, Social, and Governance', 2023, https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/environmental_social_and_governance
[9] Gratcheva E. M. et al., *Demystifying Sovereign ESG*, 2020, https://openknowledge.worldbank.org/entities/publication/86767582-9a12-595d-be47-71db162dca82
[10] Gratcheva E. M. et al., *Credit Worthy: ESG Factors and Sovereign Credit Ratings*, 2022, https://openknowledge.worldbank.org/entities/publication/289eb58b-4c13-53ca-bdfd-0e6d778927c0
[11] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

away from low-income countries. This raises the question of how developing countries can compete with developed ones when it comes to ESG. On the other hand, there is less agreement on how to determine a good environmental score. This is largely due to what "good" performance is, data gaps, out-of-date statistics and reporting standards that are not comparable. Comparability across countries relies heavily on the capabilities of national statistical offices.[12]
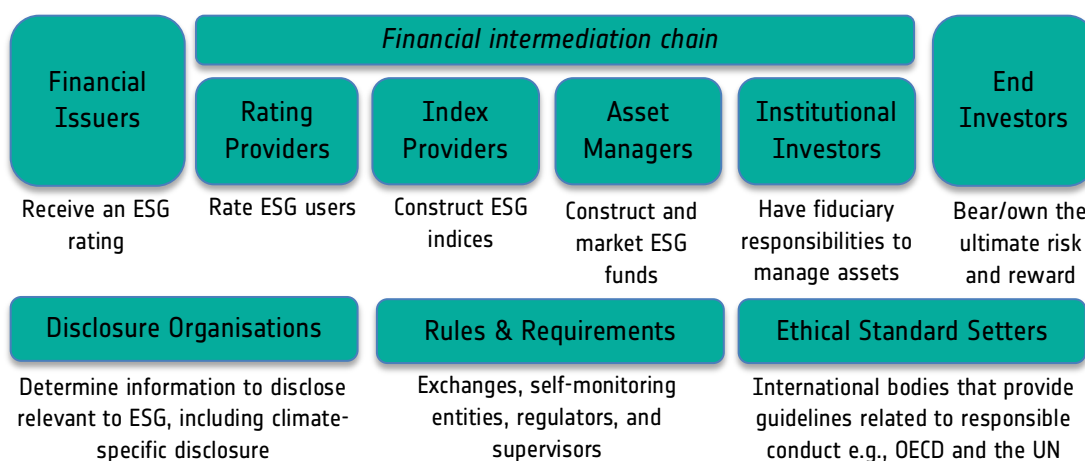
As stated in the flagship report "*The Changing Wealth of Nations 2021: Managing Assets for the Future*"[13], a key challenge with sovereign ESG has been translating environmental materiality into economic materiality, which in turn influences financial materiality. For example, forest loss does not directly translate into economic output. This makes it more difficult to assess the impact forest loss has on e.g., the sovereign bond market. Understanding these links is vital for financial market participants and policy makers alike.

The ESG financial ecosystem

According to the Organisation for Economic Co-operation and Development (OECD), there are various key players in the ESG ecosystem (see figure 1)

- **Financial issuers**: they supply equity or debt to the financial market e.g., sovereign bond issuers, and small and medium enterprises (SME) equity issuers.
- **Rating and index providers**: they offer metrics and information that help calculate ESG scores, they rate ESG issuers and convert ratings into market *indices.*
- **ESG users:** they invest in private and public entities e.g., *asset managers*, *institutional investors* and public authorities including central banks.
- **ESG framing, guidance, and oversights actors**: they help define ESG reporting to help ensure long-term sustainability e.g., disclosure bodies and standard setters.

Figure 1: Structure of ESG Financial Ecosystem[14]

Financial Issuers	Financial intermediation chain				End Investors
	Rating Providers	Index Providers	Asset Managers	Institutional Investors	
Receive an ESG rating	Rate ESG users	Construct ESG indices	Construct and market ESG funds	Have fiduciary responsibilities to manage assets	Bear/own the ultimate risk and reward

Disclosure Organisations	Rules & Requirements	Ethical Standard Setters
Determine information to disclose relevant to ESG, including climate-specific disclosure	Exchanges, self-monitoring entities, regulators, and supervisors	International bodies that provide guidelines related to responsible conduct e.g., OECD and the UN

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[12] Dang H-A. H. et al., *Statistical Performance Indicators and Index: A New Tool to Measure Country Statistical Capacity*, 2021, https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-9570

[13] Gratcheva, E. and Wang, D. (2021) 'Natural Allies: Wealth and Sovereign ESG', in *The Changing Wealth of Nations 2021: Managing Assets for the Future.* Washington, D.C.: World Bank Group.

[14] OECD, *OECD Business and Finance Outlook 2020*, 2020, https://doi.org/10.1787/ba682899-en

ESG in International Financial Institutions (IFIs)

Most IFIs, besides the WB, do not have an explicit ESG strategy. Instead, they may use different terminologies related to ESG, such as sustainable finance or sustainability and safeguards. Based on insights from the WB, the ADB, the IDB and the IFAD we have summarised some of the main ESG-related tasks IFIs undertake, as follows:

- **Data provision**: curate and maintain a wide range of ESG data to be available to ESG rating agencies, policy makers, financial market participants, and academic researchers.
- **Advisory services**: raise awareness, guide, and increase capacity of ESG issues among companies and investors in developing markets, as well as governments for sovereign debt, and Green, Social and Sustainability (GSS) Bonds.
- **Standard setting**: develop and standardise ESG principles.

World Bank Group (WBG)

The WBG's long-term finance unit has been a key protagonist in promoting Sustainable Finance globally, by providing and analysing data, designing instruments, and offering technical assistance (TA) to support investors and regulators in its client countries to "*'green' their financial systems*". According to the WB, sustainable finance is defined as "*the process of taking due account of…ESG… considerations when making investment decisions in the financial sector, leading to increased longer-term investments into sustainable economic activities and projects.*"[15]

The WBG engages in corporate ESG and sovereign ESG in different ways as explained below.

Corporate ESG

The IFC is the institution within the WBG that engages with corporate ESG. It provides ESG policies, guidelines and tools that are widely adopted as market standards and included in operational policies by investors, corporations, stock exchanges, financial intermediaries, regulators, and countries, helping EM raise their ESG standards.[16] The IFC has eight performance standards which establish the requirements that clients are to meet throughout the life of an investment[17]:

1. *Assessment and Management of Environmental and Social Risks and Impacts*
2. *Labour and Working Conditions*
3. *Resource Efficiency and Pollution Prevention*
4. *Community Health, Safety, and Security*
5. *Land Acquisition and Involuntary Resettlement*
6. *Biodiversity Conservation and Sustainable Management of Living Natural Resources*
7. *Indigenous Peoples*
8. *Cultural Heritage*

Moreover, 35 Development Finance Institutions (DFIs) have based their Corporate Governance Development Framework on the IFC's Corporate Governance Methodology.

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[15] WBG, 'Sustainable Finance', 2021, https://www.worldbank.org/en/topic/financialsector/brief/sustainable-finance
[16] IFC, 'Sustainability Overview', 2023, https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/
[17] IFC, *Performance Standards on Environmental and Social Sustainability,* 2012, https://www.ifc.org/content/dam/ifc/doc/2010/2012-ifc-performance-standards-en.pdf

Sovereign ESG

The WB's Global Program on Sustainability encourages the use of high-quality data analysis on sustainability to improve decision-making by governments and the private sector. It helps countries integrate sustainability considerations into decision-making by (1) providing global information on natural capital and sustainability, (2) facilitating country-level support to integrate natural capital approaches into decision-making and (3) promoting sustainability in the financial sector.[18] A key output of pillar 3 has been the sovereign ESG data portal.

Sovereign ESG Data Portal

The WB's Sovereign ESG Data Portal[19] is a free online platform that was launched in 2019 to allow policymakers, the financial sector and academic researchers access to country-level ESG data. It aims to provide information and tools for better understanding of ESG, to bring people from the investment community together and to guide users to external sources as well as facilitate data access. According to Dieter Wang from the WBG's Finance, Competitiveness & Innovation Global Practice (GP), the main two users of the data portal are investors looking for country-level data to assist them with investment or risk management. The data is also used by policymakers, for which ESG presents a way to profile a country, in addition to traditional credit ratings.[20]

The data portal includes 131 indicators, of which 71 fall within the three ESG components:[21]

- **Environment**: *measures the sustainability of a country's economic performance given its natural resource endowment, management, its risk or resilience to climate change and other natural hazards.*
- **Social**: *quantifies the sustainability of a country's economic performance with regard to its efficacy in meeting the basic needs of its population, reducing poverty, managing of social and equity issues and investing in human capital and productivity.*
- **Governance**: *describes the sustainability of a country's economic performance in the context of its institutional capacity to support long-term stability, growth, and poverty reduction.*

The Data Portal includes a tool called Score Builder to help calculate ESG scores that summarise a country's ESG performance under one composite score. The tool allows users to build their own custom ESG score by 1) determining which of the 131 indicators to include, 2) choosing which countries are relevant to the use case, and 3) deciding on how the indicators should be aggregated.

Asian Development Bank (ADB)

The ADB has no explicit strategy for ESG. However, there are several related areas to this that the ADB engages in.

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[18] Cervigni R., *The Global Program on Sustainability Brochure*, 2019, https://thedocs.worldbank.org/en/doc/607021572911236975-0120022019/original/GPSBrochure2019.pdf
[19] WBG, 'Sovereign ESG Data Portal', 2023, https://esgdata.worldbank.org/?lang=en
[20] Gratcheva E. M. et al., *Credit Worthy: ESG Factors and Sovereign Credit Ratings*, 2022, https://openknowledge.worldbank.org/entities/publication/289eb58b-4c13-53ca-bdfd-0e6d778927c0
[21] WBG, 'Sovereign ESG Data Framework', 2023, https://esgdata.worldbank.org/data/framework?lang=en

Sustainable Finance

According to Roberta Casali, the Vice President (VP) of Finance and Risk Management, the ADB, has been supporting developing members in Asia scale up sustainable finance in a variety of ways: [22]

1. Launching ESG-themed bonds: ADB was one of the first IFIs to launch ESG-themed bonds, starting with water bonds in 2010, and extending to green, blue, gender, health, and education bonds. As of mid-April 2023, the principal outstanding of its themed bonds reached close to $19.5bn, setting framework practices to expand the ESG market in Asia.
2. Developing partnerships with standard-setting and regulatory agencies: The ADB provides confidence in ESG investments by establishing guidelines and taxonomies in the region, and addressing concerns over greenwashing, enabling the ESG bond market to thrive.
3. Leveraging its capital, de-risking projects and improving project bankability to attract private capital.

Additionally, the ADB writes reports on ESG transferring in-house knowledge on ESG investing to governments, private investors, and other relevant stakeholders. For example, the ADB Institute (ADBI), a think tank within the ADB, published the book 'ESG Investment: Opportunities and Risks for Asia'[23], which provides a current state of ESG investment and assesses the risks and benefits of ESG in an evidence-based approach.

Environment Safeguards

ADB's environmental safeguards ensure that its projects are environmentally sound and sustainable. The Safeguard Policy Statement (SPS) ensures to measure project impacts and assess significance, to examine alternatives and to develop, implement and monitor environmental management plans.

International Fund for Agricultural Development (IFAD)

In March 2023, IFAD became a voting member of the International Capital Markets Association (ICMA) principles, ensuring that IFAD as an ESG bond issuer, actively contributes to influencing and securing transparency in issuing and managing ESG bonds. Additionally, ESG is a key component of both IFAD's Investment Policy Statement (2022)[24] and Private Sector Engagement Strategy (2019-2024)[25].

Investment Policy Statement

As a responsible investor, IFAD adheres to the Ten Principles of the United Nations Global Compact (UNGC), including fundamental principles on labour, human rights, anti-corruption, and the environment.[26] IFAD also aims to invest in green bonds and other thematic ESG securities.

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[22] Casali R., 'Financing climate transition in Asia Pacific', https://www.omfif.org/2023/07/financing-climate-transition-in-asia-pacific/
[23] ADB
[24] IFAD, IFAD's Investment Policy Statement 2022, 2021 https://webapps.ifad.org/members/eb/134/docs/EB-2021-134-R-52.pdf
[25] IFAD, IFAD Private Sector Engagement Strategy 2019-2024, 2019, https://www.ifad.org/en/-/document/private-sector-strategy
[26] United Nations Global Impact, The Ten Principles of the UN Global Compact, 2023, https://unglobalcompact.org/what-is-gc/mission/principles

Private Sector Engagement Strategy

The review process for any private sector interventions relies on various principles, including the alignment with rigorous ESG standards. Direct financial investment provided by IFAD provides confidence to investors regarding ESG considerations and aims to build the capacity of private sector partners to improve ESG standards.

Inter-American Development Bank (IDB)

Corporate ESG

The IDB and its private sector arm, IDB Invest, created IndexAmericas, a corporate sustainability index which aims to incentivise responsible corporate citizenship in Latin America and the Caribbean.[27] The Index uses 188 indicators to evaluate companies, which fall under the four dimensions seen in figure 2. Whilst ESG criteria accounts for 80% of a company's score, the rest is taken from IDB-IDB Invest development criteria.

Figure 2: The Four Dimensions of Sustainability Captured by IndexAmericas: ESGD[28]

Sovereign ESG

The IDB has published several sources that provide investors and governments with information on sovereign ESG. For example, the report titled 'The Business Case for ESG Investing for Pension and Sovereign Wealth Funds'[29], which uses a case study on Chile's sovereign wealth funds and pensions funds shows that ESG investments can deliver better performance on environmental, social and governance factors without sacrificing financial returns. The report also points to the particular importance of ESG investments in sovereign wealth funds and pension funds given the large share in global assets and long-term investment horizon.

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[27] IDB, 'The IDB Group Corporate Sustainability Index for Latin America and the Caribbean', 2023, https://indexamericas.iadb.org/en
[28] IDB, 'About IndexAmericas', 2023, https://indexamericas.iadb.org/en/Aboutus
[29] Hoffmann B. et al., *The Business Case for ESG Investing for Pension and Sovereign Wealth Funds*, 2020, https://publications.iadb.org/en/the-business-case-for-esg-investing-for-pension-and-sovereign-wealth-funds

The value of Earth Observation (EO) data for ESG

Measuring environmental variables on the ground in-situ may be effective, but it is also expensive and difficult to scale. To provide up to date comparable insights, ESG analysts need results at both the company and country level that can be assessed at a high frequency and are consistent in their methodology. This has sparked the search for alternative solutions.
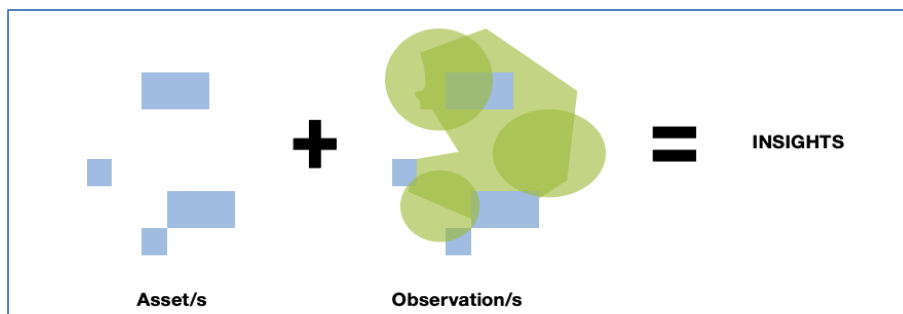
How EO and geospatial ESG works

"*The rapidly growing availability of geospatial data* [which includes EO data] *paves the way for better evaluation of Environmental, Social and Governance (ESG) performance and ultimately, better informed ESG investing.*"[30]

To understand how EO brings value to ESG, it is important to understand how geospatial ESG works and how EO contributes to it. According to the WWF report, geospatial ESG uses *asset* and *observational data* to provide ESG-related insights (see figure 3):[31]

- **Asset data** – *Datasets, often grouped by sector, defining the location and ideally the property boundaries (as a point, linear or polygon feature) of commercial assets (e.g., a factory, farm, mine, road, etc.), their ownership, and frequently key attributes of the asset class (e.g., type of power plant, production, date of construction, etc.).*
- **Observational data** – *Any data applied, often geospatially defined, to generate insight into assets. For ecosystem impact, variables such as methane emissions, habitat clearance, biomass loss, deforestation, habitat fragmentation, endangered species proximity, habitat connectivity, etc.*

Figure 3: Diagram Illustrating the Basics of a Geospatial ESG Approach[32]

At its most basic level, geospatial ESG starts with the accurate location and definition of ownership of a commercial asset (asset data). Using both EO and Geographical Information Systems (GIS) the asset can be assessed against observational data, such as environmental, governance and social variables. Sub-asset monitoring, or voluntary reporting, such as ESG company reports, can be integrated to asset data for more in-depth insights. Merging the insights of multiple assets at the company, national or sector level in turn provides insights at various scales that are relevant to a variety of financial applications ranging from project finance to sovereign debt.

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[30] Gratcheva, E. M. et al., *A New Dawn: Rethinking Sovereign ESG*, 2021, https://openknowledge.worldbank.org/entities/publication/3d620ef9-27db-55b0-b2c3-d2d1bb4a83ea
[31] Patterson D. et al., *The Biodiversity Data Puzzle*, WWF-UK, 2022, https://www.wwf.org.uk/our-reports/biodiversity-data-puzzle
[32] Patterson D. et al., *The Biodiversity Data Puzzle*, WWF-UK, 2022, https://www.wwf.org.uk/our-reports/biodiversity-data-puzzle

Key characteristics

Even though, as we have seen, EO data is usually combined with other datasets to provide useful insights, it is increasingly able to provide environmental insights at different scales that are independent, consistent, and repeatable at a high temporal frequency. This makes EO data ideal for the creation of consistent ESG insights at a global scale for millions of assets. It will increasingly become possible to understand the impact of assets, corporations, and nations on the environment without them disclosing this information themselves, as this information will be available independently from them via satellite data.

The value of EO data derived from satellites can be seen through its key characteristics: affordability, coverage, frequency and speed, objectivity, anonymity, comparability, and consistency.

Affordability

ESG reporting can be costly and so factoring these assessments into financial decisions may not always be possible or desirable for many actors in lower-income countries. Obtaining data related to the environment often requires on-site visits which take up a lot of time and resources. Conversely, by obtaining data remotely, EO data derived from satellites can make ESG data provision more affordable. There is an abundance of free and open EO data, which can be fed into ESG insights, from for example the ESA and the National Aeronautics and Space Administration (NASA) (see case Study 1, 2 and 3). At the same time commercial EO data sets are becoming increasingly more affordable, meaning that geospatial ESG reporting is within reach even for developing countries.

IFIs could benefit from the use of EO data particularly when trying to get a broad sense of some of the ESG risks before sending someone on the ground. There are certain measurements that would not be possible without satellites because the costs associated with collecting this data through "on the ground" teams would be prohibitive. Satellites contribute to more than half of the 55 essential climate variables.[33] The WBG has committed to align all its financing operations with the goals of the Paris Agreement by July 2025[34], making the use of satellites increasingly vital.

Coverage

Traditional ESG data collection, such as through face-to-face interviews, may require travel and physical contact, and may often be limited to a specific area. Satellites have global coverage, making it possible to monitor vast, remote, and even conflict regions across countries and continents. ESG monitoring using satellites can be harmonised for global consistency, which is key for comparability. The WWF's "Geospatial ESG" report shows that even with limited resources, and only open data, it is possible to generate robust geospatial ESG insights, which use EO data, that can be scaled globally, allowing financial institutions to better differentiate between impacts at different scales and across different applications.[35] The availability of data at different scales allows IFIs to provide ESG-related financial insights at a variety of levels, at asset level (see case study 1), at company level (see case study 2), at regional level (see case study 4), or at national level or

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33 Committee on Earth Observation Satellites (CEOS), 'The Earth Observation Handbook', 2018, http://eohandbook.com/sdg/part1_3.html
34 WBG, 'The World Bank Group and Paris Alignment', 2023, https://www.worldbank.org/en/publication/paris-alignment/overview
35 Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

even at a global level (see case study 3). By being able to look at global risk factors, satellites can help provide a contextual risk that falls beyond the project boundary to sovereign or corporate ESG investments.

Frequency

Compared to traditional modelling approaches that rely on data that is disclosed annually, data from satellites can be generated at a very high temporal frequency. This means that the use of EO can allow for high frequency data on the ESG performance of assets to be collected, on up to a daily, weekly, and/or monthly basis.[36] Case study 3 shows how useful satellite data is in providing insights at a higher frequency than once year. The effects observed around droughts and the labour market in this case study would have not been possible to identify with annual country data only. Additionally, the increased frequency by which satellite data is collected in Case Study 5 allows for more accurate assessments of land conversion activities and deforestation, enabling a clearer understanding of the effectiveness of initiatives that are aiming to reduce deforestation.[37]

Speed

Most companies only publish an ESG report once a year, and often with a large time lag. The speed at which data can be obtained from satellites reduces their time lag and increases company-level ESG oversights. The same is true for project financing and sovereign debt. Satellites can provide sustainability insights in near real time (NRT), at a much faster rate than many traditional data collection methods. For example, EO data can become available within hours after it is acquired by the satellite. With the Sentinel-1 satellite, access to data is made available within one hour of observations over NRT areas for those who have a subscription, or within 24 hours of observation without a subscription.[38]

Objectivity

ESG currently depends on voluntary company reporting, which can be highly subjective. Using EO data allows us to move away from assessing companies at their word to assessing them by their actions. The move away from self-reporting in ESG, reduces risk of positivity biases and companies omitting critical negative details.[39] For example, satellite data can help monitor greenhouse gas emissions and make sure regulatory standards are met, preventing companies from being able to tweak such data for their own benefit. According to the 'Geospatial ESG' report EO/geospatial data is "*objective in nature*".[40]

However, an objective data measurement alone is not sufficient. EO data must be converted into economically meaningful numbers, and these statistics then have to be interpreted, which gives room for potential human bias. There may be bias for instance when field observational data is introduced, or even when interpreting satellite imagery itself.

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[36] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/
[37] Albergel C., Domenech A., 2023, 'Satellite Data and Sustainability-Linked Bonds: Monitoring Land Use in Peruvian Amazon, https://gda.esa.int/story/satellite-data-and-sustainability-linked-bonds-monitoring-land-use-in-peruvian-amazon/
[38] ESA, 'Data Distribution Schedule', https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/data-distribution-schedule
[39] https://www.wwf.org.uk/sites/default/files/2020-12/Spatial%20Finance_%20Challenges%20and%20Opportunities_Final.pdf
[40] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

Anonymity

The nature of traditional face-to-face data collection methods means the subjects of ESG-assessment activities cannot be fully anonymous and therefore these processes can be invasive into a person's life. However, by deriving data from satellites, IFIs can make observations on the ground unnoticed, whilst also limiting privacy risks associated with traditional data collection methods. Essentially, ESG can occur without disturbance to both human and wildlife populations.

However, data gathered from satellites do carry concerns of potential espionage for national governments. As the resolution of imagery improves, individuals are increasingly identifiable from satellites.

Continuity

Traditional data collection methods are often only able to provide data specific to the time it is recorded. When it comes to satellite data, some data series date back to the 1970s and have been acquired continuously, providing IFIs with unique evidence over time that helps them drive incorporating ESG considerations in developing countries. Time-lapse satellite imagery on demand provides an ESG analyst with a rapid way of placing the project spatially and temporally, by playing a short ten-second video on how the site has changed from say the 1970s.

Table 1: How EO-Enabled ESG Can Solve the Problems Encountered in Traditional ESG Modelling

	Traditional ESG	EO-enabled ESG	Case study
Affordability	Visits and in-situ machinery, such as sensors, can be costly and deter ESG considerations.	Doesn't require in-person visits which can be costly, and some EO data can be obtained freely.	1, 2, 3
Coverage	Often limited to a specific area and lack of standards prevents comparability.	Obtained remotely from anywhere on the planet and can be harmonised to allow for comparability.	1, 2, 3, 4
Frequency	Rely on data that is disclosed annually.	Can be generated at a very high temporal frequency (daily, weekly, monthly etc.)	3, 5
Speed	Obtaining data is time consuming.	Provides ESG-relevant insights near-real time, at a much faster rate.	NA
Objectivity	Self-reporting leads to positivity biases.	Allows objective ESG evaluation of companies and countries.	NA
Anonymity	Some ESG assessments may gather information from individuals who cannot remain fully anonymous to the enumerator.	Satellites can gather imagery remotely and may be able to replace or at least complement information gathered from people on the ground.	NA
Continuity	Usually provides only limited access to historical data.	Continuously acquired and larger access to historical data.	1, 4

Case studies

Case study 1: Asset level assessment – mines in Brazil with the World Wide Fund (WWF)

To illustrate the value of EO for ESG reporting at the asset level, the WWF's Conservation Intelligence team, compared 763 commercial mines in Brazil against environmentally relevant observational datasets. Access to time lapse satellite imagery allows an ESG analyst to place the project in a temporal and spatial context very quickly. Each mine site was scored against a number of variables, using the following EO data layers: Biodiversity Intactness Index, Ground Carbon, Forest Loss, Forest Structural Condition Index and Forest Structural Integrity Index (see three example mines in table 2).

The insights from the mining assets in Brazil could be applied globally and used to (1) define the high-level impact of mines on habitats, conservation areas and freshwater exposure etc, (2) monitor land degradation, emissions, dam growth and expansion of mines and (3) define environmental ratio efficiency of mines[41], or aggregating this to the company level, comparing them against other local or global mines. The results per variable at the asset level could then be integrated alongside other traditional methods for assessing ESG.

Table 2: Example Results for Three Mines (EO Data in **Bold**)[42]

Mine Name	Aurizona	Capanema	Northern System
Ecoregions	Mangroves	Tropical & Subtropical Grasslands, Savannas & Shrublands	Tropical & Subtropical Moist Broadleaf Forests
Biodiversity Intactness Index (Mean Score)	**0.94**	**0.66**	**0.73**
Ground Carbon (Mean Score)	**9650**	**8700**	**0**
Forest Loss 2019 (km²)	**0.99**	**0.0026**	**0.0215**
Forest Structural Condition Index (FSCI) (Mean Score)	**No Data**	**No Data**	**1.26**
Forest Structural Integrity Index (FSII) (Mean Score)	**No Data**	**No Data**	**0.12**
Protected Areas (Area Overlap – km²)	6.2857	3.13	3.14
Key Biodiversity Areas (Area Overlap – km²)	3.14	3.14	3.14

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[41] Where environmental costs are considered against any positive values e.g., the extent of habitat destruction against mining production per year.
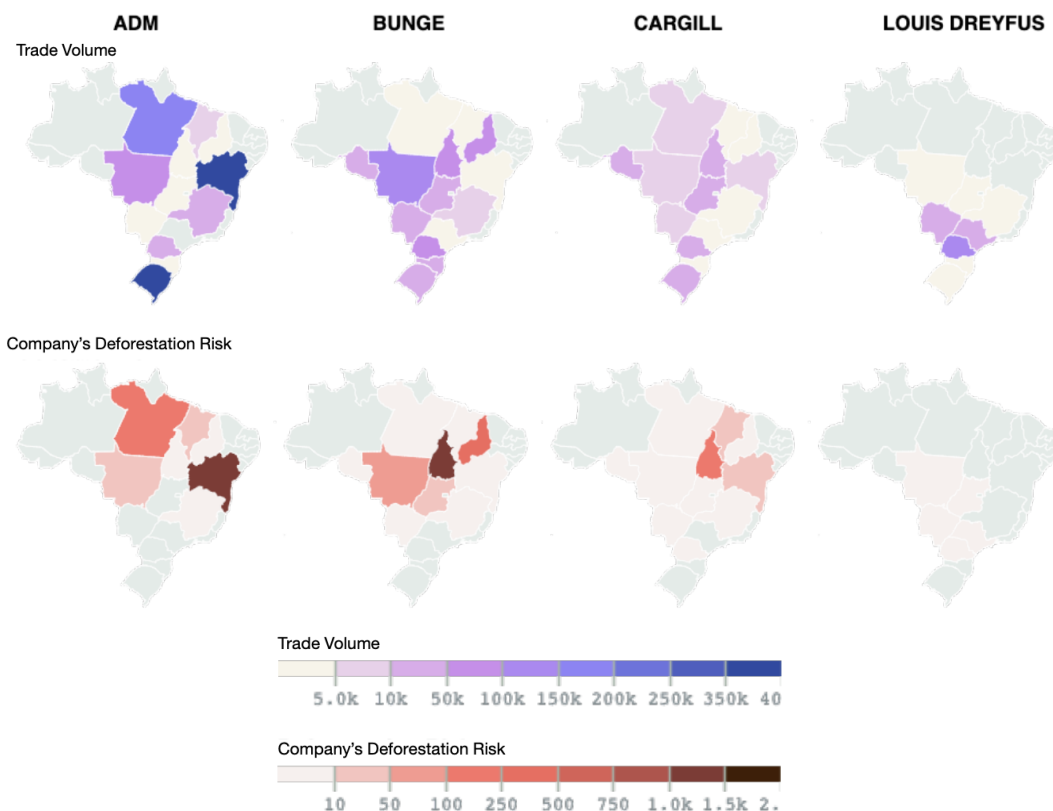[42] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

Case study 2: Company level assessment – soft commodities in Brazil

This case study demonstrates a method developed by Trase to connect per shipment trade data to subnational sourcing regions by mapping soft commodity supply chains at scale using publicly available data. It provides insights into the risk of deforestation within soft commodity[43] supply chains. The production and trade of soft commodities is associated with deforestation. Trase maps soy supply chains and translate these into ESG metrics for parent companies in five key steps: (1) Mapping soy supply chains, (2) assessing soy deforestation, (3) assessing soy deforestation risk to the trade, (4) aggregating soy deforestation risk to parent companies, and (5) translating data into ESG metrics

The four soy traders in Brazil that dominate the trade are ADM, Bunge, Cargill and Louis Drefus (ABCD). They handle 50% of exports and are associated with 43% of soy deforestation risk. Depending on their sourcing patterns, they each have different exposures to deforestation risks e.g., Louis Drefus accounts for 10% of exports and only 1% of deforestation risk, because it obtains most of its soy from the south of Brazil where forests were cleared many years ago (see figure 4). 50% of soy deforestation risk associated with Brazil's soy exports are from 1% of municipalities that produce soy.

Figure 4: Map of Soy Exports and Associated Soy Deforestation Risks of the ABCD Traders[44]

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43 Soft commodities are commodities that are grown rather than mined and include coffee, palm oil, soya, sugar, corn, livestock, fruit etc.
44 Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

Case study 3: Sovereign level assessment – the use of EO on droughts and employment in Brazil with the WBG
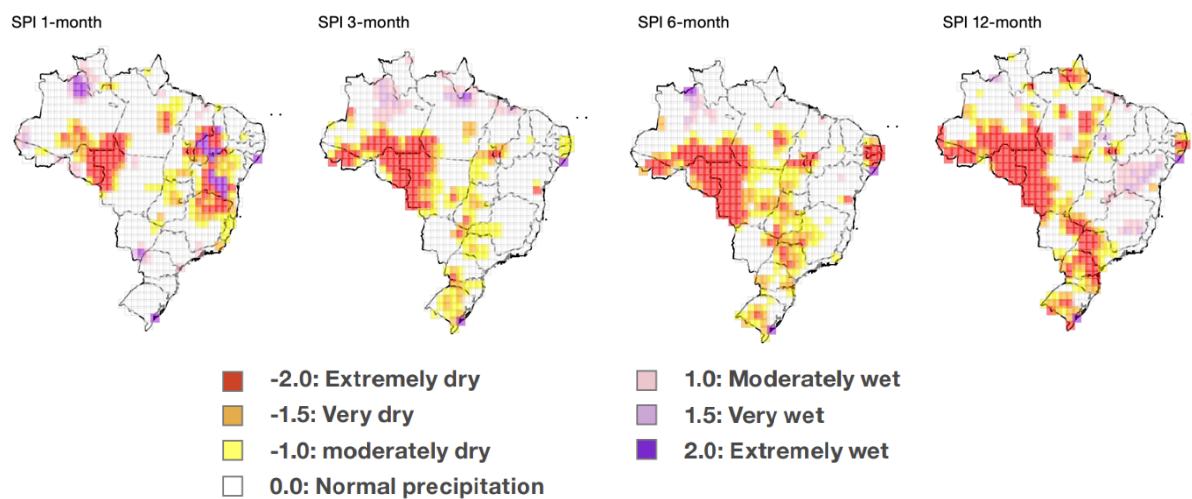
This case study estimates the strength of the link between environmental and economic factors for the case of precipitation anomalies in Brazil. This involves firstly showing how EO data can help better quantify the environmental materiality of droughts and then estimating its link with the economy.

The study calculated the monthly standardised precipitation indicator (SPI), which is used by the Copernicus European Drought Observatory, to measure precipitation anomalies (see figure 5). A high SPI-1 value in January would indicate a strong deviation from rainfall values compared to in January of previous years. SPI-1 looks at one month, SPI-3 three months etc. SPI-1 to SPI-3 is a short-term measure that helps detect reduced soil moisture. SPI-3 to SPI-6 encompass an entire harvesting season where a lower number would indicate a seasonal drought. SPI-12 represents an extended period, where a low value could indicate a reduction in stream flows.

The EO data on SPI needs to be connected with economic factors. The SPI data was translated from a geospatial format into a tabular format which collects observations at the state level, paving the way for statistical models that can be used to assess how unusually dry or wet weather can affect Brazil's employment patterns. The case study found that dry periods were usually followed by lower employment in subsequent months. However, this was only the case for dry periods up to six months and not for longer periods, which may be because the local economy adjusts to the conditions.

Ultimately, establishing the link between the environment and the economy is key to building a better sovereign ESG framework.

Figure 5: SPI over 1-, 3-, 6- and 12-Month Horizons[45]

Legend:
- ■ -2.0: Extremely dry
- ■ -1.5: Very dry
- ■ -1.0: moderately dry
- □ 0.0: Normal precipitation
- ■ 1.0: Moderately wet
- ■ 1.5: Very wet
- ■ 2.0: Extremely wet

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[45] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

Case study 4: Uncovering the impact of rural investments on climate resilience using GIS

In order to understand whether IFAD investments make the rural poor more climate-resilient, IFAD undergoes various impact assessments at the end of projects. Besides surveying households to gather information on their wellbeing and incomes, IFAD also captures the geo-location of these households, allowing IFAD to superimpose climatic variables such as rainfall and temperature for a specific variable. This data is fed into econometric models to assess the impact the project had on adapting to climate change. Figure 6 shows the market and household locations of an impact assessment of the Coastal Climate Resilience Infrastructure Project in Bangladesh.

Figure 6: Market and Household Locations of the Impact Assessment of the Coastal Climate Resilient Infrastructure Project in Bangladesh[46]


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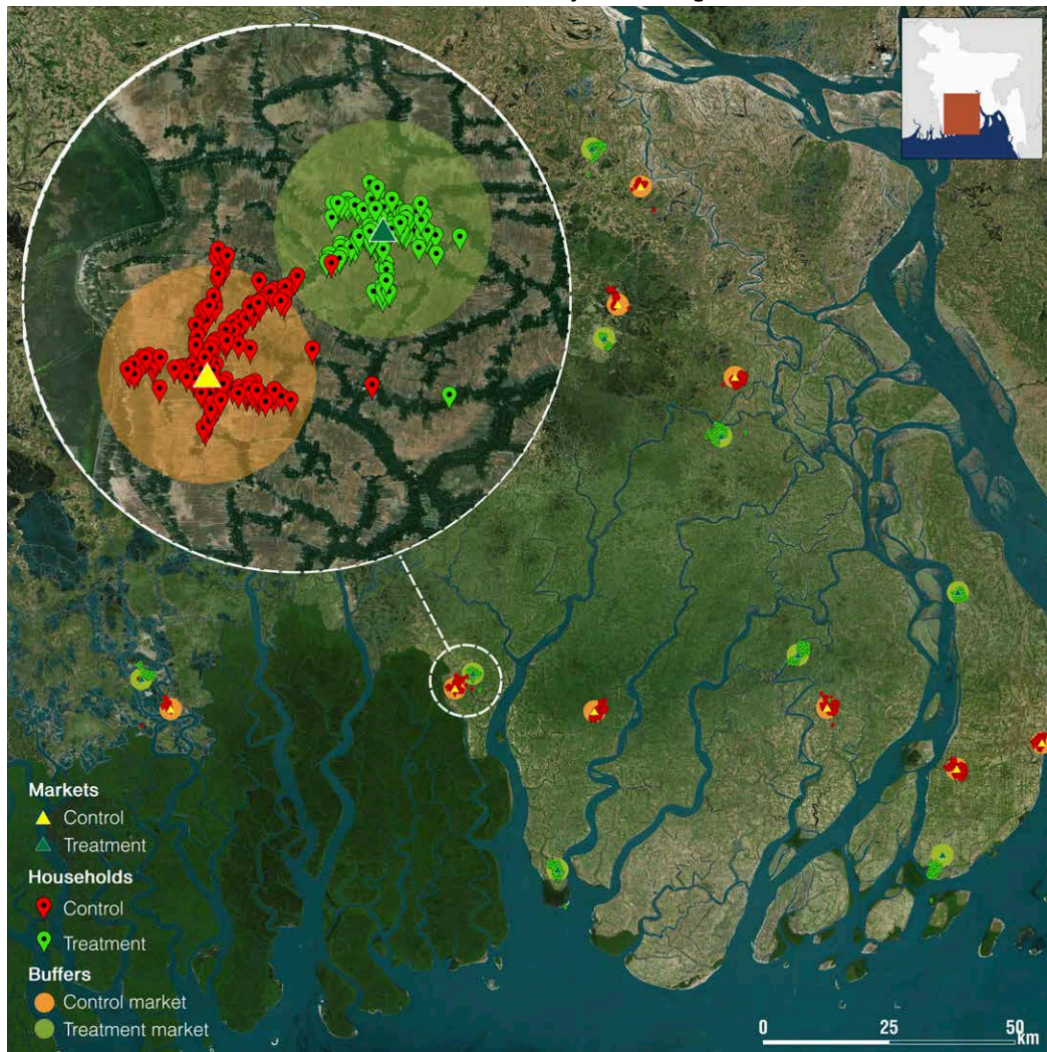
[46] IFAD, *Mapping Rural Development: How to use GIS to monitor and evaluate projects*, 2022
https://www.ifad.org/documents/38714170/45948858/GeoMapManual-Final_WEB.pdf/05a555cc-65d8-2367-c7ce-3775f52d3101?t=1658502655336

Case study 5: Satellite data and sustainability-linked bonds: monitoring land use in the Peruvian Amazon

ESA's GDA AID Climate Resilience Consortium, in collaboration with the WBG's Global Program on Sustainability (GPS), has conducted an in-depth study on deforestation in the Peruvian Amazon rainforest. This study can guide further investments in Sustainably Linked Bonds (SLBs) and other innovative financial tools that encourage sustainable investment and bridges the gap between countries looking for conservation financing and investors wanting a transparent view of a project's progress prior to investing.

High-resolution optical and radar satellite data from Landsat and Sentinel-1 was used to develop a model that offered periodic (every three months) insights into deforestation activities spanning from 1985 to 2021. The image on the lower left shows the average cloud cover in the region from June 2020 to December 2020. This is a key challenge when monitoring land changes in rainforests using satellites.

Figure 7: Land Cover Alterations Using Landsat and Sentinel-1 Satellite Imagery[47]
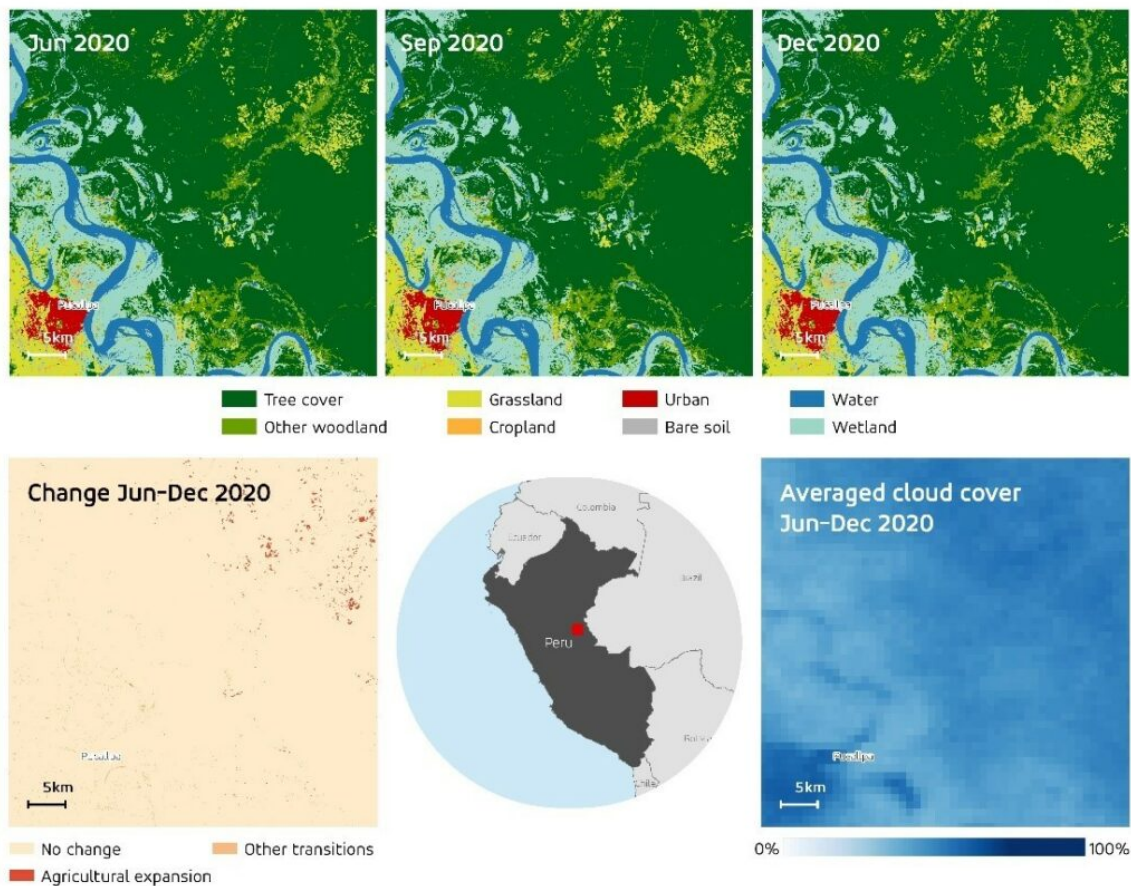
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[47] Albergel C., Domenech A., 2023, 'Satellite Data and Sustainability-Linked Bonds: Monitoring Land Use in Peruvian Amazon, https://gda.esa.int/story/satellite-data-and-sustainability-linked-bonds-monitoring-land-use-in-peruvian-amazon/

Current use of EO in ESG in IFIs

According to the report by the WWF and the WBG, IFIs are experiencing increased pressures relating to ESG on three main fronts:[48]

- Increased calls for voluntary and mandatory disclosure and regulation for ESG reporting.
- The need to address "*double materiality*"[49].
- The general growing importance of the topic of the environment.

This has resulted in some IFIs to begin to increase their inhouse capacities for the use of EO data, particularly for environment-related data.

The use of EO data for ESG schemes in IFIs

This report found no concrete information on the use of EO data for ESG schemes at the IDB and the ADB, unlike the WBG and the IFAD as seen below.

WBG

Sovereign ESG

A key objective of the Global Program on Sustainability is the development and dissemination of policy recommendations on integrating sovereign ESG for investors, Emerging Market (EM) bond issuers, ESG data and ratings providers and credit rating agencies. According to the WBG "*Geospatial data serves an indispensable role to realise this agenda.*"[50]

To improve ESG data availability and quality the WBG is leveraging geospatial and EO data, expanding it to new currently underrepresented indicators such as marine life, biodiversity loss etc. The WBG deepened its collaboration on sovereign ESG data with ESA, which had already been helping the WBG to monitor development projects and disaster-risk financing programmes.

The WBG recently relaunched its sovereign ESG data portal, which in collaboration with ESA now uses EO/geospatial sources. Firstly, there is an improvement in the environmental indicators enhanced by EO/geospatial data. Secondly, a new land cover composition tool has been added, which uses data from ESA's Climate Change Initiative Land Cover project (see case study 4).

Corporate ESG

Currently, IFC has an internal GIS tool where most of its real sector projects are mapped out against IFC's Performance Standards, but more could be done in the space of GIS analysis, particularly when it comes to climate-related projects and mapping projects across a region. According to Min Batstone, at the IFC, "*Without mapping projects, you are flying blind.*"

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[48] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

[49] This refers to the idea that a company has to report both on how its business is affected by sustainability factors and how its activities impact society and the environment. For example, a company may be reporting on the financial cost of the energy it uses, and how that impacts financial performance. Applying double materiality would mean also reporting on the impact the company's energy consumption has on its environment and society. Source: Täger M., '"Double materiality": what is it and why does it matter?', 2021, https://www.lse.ac.uk/granthaminstitute/news/double-materiality-what-is-it-and-why-does-it-matter/.

[50] WBG & WWF, 2020, *Spatial Finance: Challenges and Opportunities in a Changing World,* https://www.wwf.org.uk/sites/default/files/2020-12/Spatial%20Finance_%20Challenges%20and%20Opportunities_Final.pdf

IFAD

In 2022, IFAD published a Catalogue of Geospatial Tools and Applications for Climate Investments, which features innovative geospatial tools including EO, and real-life case studies from IFAD's operations, to give a flavour of how and where IFAD uses such technology.[51] There are various ways that IFAD uses these technologies to optimise climate investment.[52]

1. Targeting areas most in need: IFAD uses data to identify which areas are most vulnerable to climate change, by assessing:
   a. Sensitivity to climate change e.g., whether a community is in a flood-prone area.
   b. Vulnerability to climate change impacts e.g., whether an area is expected to flood more often due to climate change.
   c. Adaptation capacity e.g., whether a community finds it harder to identify alternative sources of income, so it has a lower capacity to adapt.
2. Mapping climate investments: IFAD projects often use geotagging to show where activities have taken place so that maps can be drawn to understand where work is being done and whether it is successful. In Kyrgyzstan, projects funded by IFAD geotagged more than 2,000 places investments had been made in the livestock sector.
3. Assessing impacts of climate investments: After the completion of a project, IFAD staff often survey households about their livelihood and well-being, tag their geo-locations and collect other location-specific information, such as their climate histories, to understand if climate investments are having an impact at the project level (see case study 4)

Potential limitations and barriers to the increased adoption of EO for ESG

This report draws on limitations gathered through user interviews with ESG experts at the WBG as well as those found from desk research.

Limitations in monitoring the 'S' and the 'G' in ESG

The nature of data collection from satellites lends itself most to tracking changes in the physical environment, such as forestry mapping. This makes EO data particularly useful in the 'E' part of ESG: Environment. However, satellites struggle to monitor the other two variables of ESG: Social and Governance. This means that EO data may not provide sufficient information to make complete ESG considerations. It must be combined with different types of data such as national statistics on demographic changes.

Translating environmental data into economic data

Even though EO data helps better assess environmental materiality, such as better measurement of deforestation and droughts, better data coverage alone is not enough to improve sovereign ESG. As mentioned, establishing a link between environmental and economic materiality is key to improving the sovereign ESG framework. Case study 3 represents one way in which the environmental-economic materiality link can be made by using a "*flexible modelling approach*", which allows for quantifying meteorological events for economic decision makers. Figure 9 shows the responses of

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[51] IFAD, Catalogue of Geospatial Tools and Applications for Climate Investments, 2022, https://www.ifad.org/en/web/knowledge/-/geospatial-tools-and-applications-for-climate-investments
[52] IFAD, Seeing the bigger picture: 6 ways IFAD uses GIS to optimise climate investment, 2022, https://www.ifad.org/en/web/latest/-/seeing-the-bigger-picture-6-ways-ifad-uses-gis-to-optimize-climate-investment

employment to rainfall anomalies over various accumulation periods. Shorter droughts, between one and three months, have a significant impact on subsequent employment during harvesting seasons, whilst the effect of longer-term droughts can be alleviated due to adjustment efforts. In fact, according to the WWF's 'Geospatial ESG' report, this approach can also be applied to study other EO/geospatial data sources, beyond precipitation anomalies. [53] For example, land cover transition data can be used to better assess which regions are most sensitive to precipitation anomalies. Combined with employment figures or production data, EO data can help assess the effect of these physical risks on the larger economy.

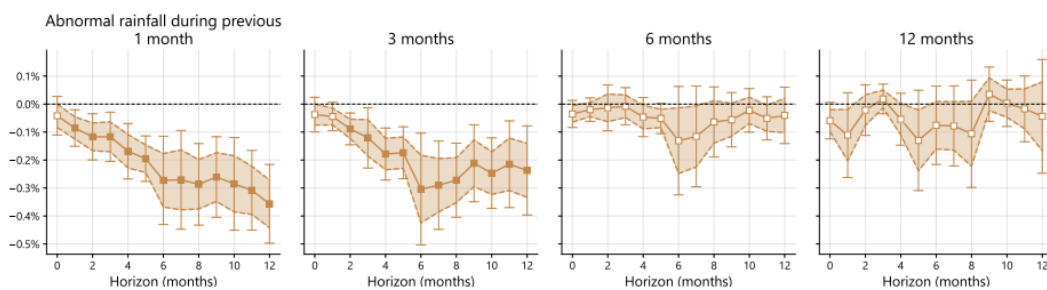Figure 9: Employment Responses to Unusual Rainfall: Predominant Farm Use Land Use and Land Cover Units[54]

(a) Very wet or extremely wet
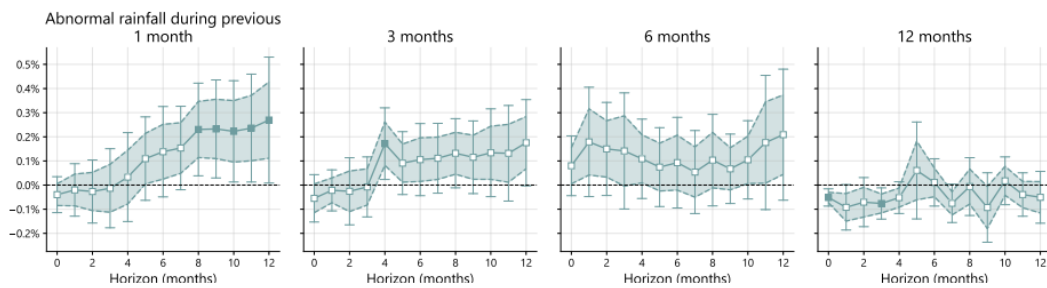
(b) Very dry or extremely dry
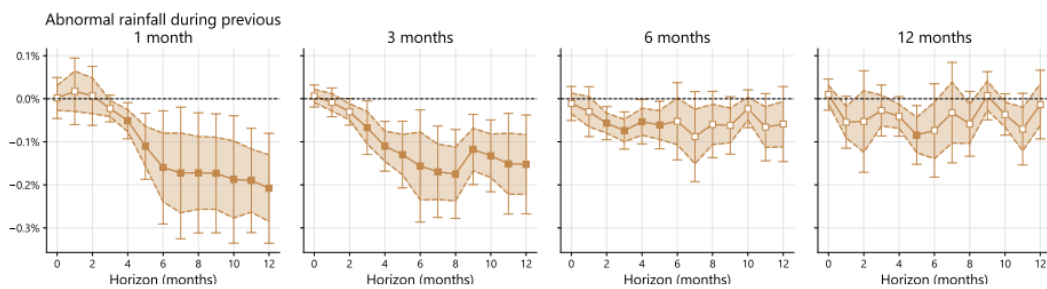
(c) Very dry or extremely dry during harvest months (soybeans, corn and rice)

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[53] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/
[54] Patterson D. et al., *Geospatial ESG*, WWF-UK, 2022, https://wwf-sight.org/geospatial-esg/

Data interdependencies & limited availability of asset and supply chain data

The value of EO ESG is only as valuable as the extent to which supply chain and asset data is available. Combining complex global supply chains which each have different impacts and dependencies is difficult. In many cases no disclosure is required, and data may simply not exist, resulting in a lack of availability of highly granular data at the sub-national level. There is a need for greater transparency around supply chains, and until this happens EO-enabled ESG insights and applicability will remain constrained.

Limited use cases available

According to Dieter Wang from the WBG's long-term finance team, a key barrier to the increased use of EO and geospatial data at the WBG and the uptake of developing countries in using such data for ESG is the lack of use cases around ESG currently available and uncertainties around the costs to (a) research and develop EO and geospatial capabilities as well as (b) operationalising EO and geospatial enabled solutions. GDA's support has helped de-risk these use cases – however, for more countries to adopt the use of EO data in ESG investing more use cases are needed to showcase the impact that EO data can have. Despite the challenges, he sees EO data as a keystone technology for mainstreaming sustainable finance instruments, for example, sustainability-linked bonds that target deforestation.[55] Remote sensing data used for monitoring, reporting and verification (MRV) can significantly lower the reporting delay while also Increasing transparency for both Issuers and Investors of such Instruments.

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[55] Wang, D. et al., *Could Sustainability-Linked Bonds Incentivise Lower Deforestation in Brazil's Legal Amazon?*, 2023, https://esgdata.worldbank.org/pub/could-slbs-lower-amazon-deforestation

Implications & avenues for better integration

Continue to develop EO for ESG as a use case scenario in the GDA Analytics Processing Platform (GDA APP)

In January 2023, ESA issued a tender for the design and implementation of a flexible and versatile analytical environment within the GDA programme. Powered by European public cloud resources, this environment aims at targeting the specific requirements, information needs and working practices of IFIs and their clients and end users in the context of international development activities.

Inside the GDA APP, there will be the cardinal use scenario "*Environment, Social and Governance schemes (R-14)*"[56]. This will allow IFIs to explore the value of EO in ESG further than they have to date, helping to close the awareness gap about the value of EO for ESG amongst client state and development stakeholders.

This report suggests that the ESG use case in the GDA APP could focus on the following key areas:

- Sovereign ESG, that is the integration of ESG factors in assessing the performance and sustainability of sovereign entities such as national governments, as this is what may be most applicable to IFIs.
- Translating environmental data into economic data.

Draw attention to EO for ESG via the GDA Communicate Connect Cooperate (GDA CCC)

Geospatial ESG is a complicated concept, as it requires a combination of technical and financial understanding. There is both a lack of understanding of what it entails as well as an awareness gap. ESA should draw attention to it via the GDA CCC, for example by highlighting work completed for the ESG use case in the GDA APP (as above).

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[56] ESA, Statement of Work GDA - Analytics & Processing Platform (APP), 2023