Using Earth Observation for Monitoring & Evaluation

GDA M&E Topical Overview

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Contents

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The following authors wrote this report: Carlotta Maucher (primary author) and Nicki McGoh (secondary author).

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- Christoph Aubrecht (ESA)
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- Elise Montano (Caribou Digital)

- David Taverner (Caribou Space)

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Glossary

ADB	Asian Development Bank
AfDB	African Development Bank
APP	Analytics Processing Platform
CCRIP	Coastal Climate-Resilient Infrastructure Project
DIME	Development Impact Evaluation
EO	Earth Observation
EO4SD	Earth Observation for Sustainable Development
EO4Poverty	Earth Observation for Poverty
ESA	European Space Agency
ESG	Environmental, Social, and Governance
GDA	Global Development Assistance
GEMS	Geo-Enabling initiative for Monitoring and Supervision
GIS	Geographic Information Systems
GOST	Geospatial Operations Support Team
FCV	Fragility, Conflict and Violence
IED	Independent Evaluation Department
IEF	Independent Evaluation Function
IEG	Independent Evaluation Group
IFAD	International Fund for Agricultural Development
IFI	International Financial Institution
IOE	Independent Office of Evaluation
ITS	Information and Technology Solutions
KfW	Kreditanstalt für Wiederaufbau
M&E	Monitoring & Evaluation
MFF	Multi-tranche financing facility
NDVI	Normalised Difference Vegetation Index
NO_2	Nitrogen dioxide
NRT	Near Real Time

SAR	Synthetic Aperture Radar
SAWAP	Sahel and West Africa Programme
SDG	Sustainable Development Goal
SO_2	Sulphur dioxide
TPM	Third-party monitoring
UNDP	United Nations Development Programme
WB	World Bank

Introduction

This report is a topical overview analysis carried out by the GDA Monitoring & Evaluation (M&E) and Impact Assessment 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).

Recent investment in data acquisition via satellites, open and free access to data and advances in data science and data processing speeds have meant that satellite imagery is more readily available, at a lower cost and higher quality. IFIs are increasingly realising the potential use of EO for sustainable development purposes. However, there is growing recognition of the value in the use of EO data for M&E.

There are important limitations to EO that limit its value for the M&E of all interventions, in particular limitations relating to resolution, issues related to cloud cover and availability of images and its inability to look inside buildings, which would make it less useful to evaluate e.g., the restocking of malaria medicine. Nonetheless, EO can bring great value to the M&E of a variety of development interventions across expansive areas, such as those related to agriculture and forestry, and can also monitor physical features as a proxy for socioeconomic factors. Therefore, this report will focus on these key areas exploring the use of EO across the different forms of M&E, each of which are undertaken for a different purpose.

This report will look at the use of EO data in the M&E process of development interventions, **focusing primarily on the World Bank (WB) and the Asian Development Bank (ADB)**, ESA's primary IFI partners under the Space for IDA collaboration framework.

Key points

- The WB and the ADB conduct both self-evaluations and independent evaluations in order to better understand the progress made and results achieved through their interventions. Evaluations are undertaken by the Independent Evaluation Group (IEG) in the WB and the Independent Evaluation Department (IED) in the ADB.
- There are key differences and similarities in the IEG's and IED's budget and Work Programme (WP):
    - Differences: the IEG's WP is structured by work streams whilst the IED's WP is structured by evaluation products.
    - Similarities: both the IEG and IED follow the principle of independence to achieve accountability and learnings from their products. Both departments receive less than 2% of the overall budget allocated to the organisational administrative costs.
- The key benefits of the use of EO for M&E are its affordability, coverage, frequency, speed, objectivity, anonymity, and continuity.
- EO data benefits M&E throughout the project cycle and the three M&E stages; from establishing baselines and setting targets (M&E framework design), to assessing the progress of the intervention (progress M&E) to evaluating the outcome of the project/programme (post-programme evaluation).
- Whilst the WB and the ADB both point to the value of EO in short blogs, this has yet not translated into significant changes being made in their WP activities.
- There are some limitations and barriers to greater uptake of EO for M&E which need to be addressed and/or overcome by IFIs; decentralised/ non-strategic data procurement, lack of complementary skill sets, wider IFI processes need to be adapted to allow for EO-enabled M&E, and not all projects will be suited to EO-enabled M&E
- The information gathered in this report gives rise to four key implications /recommendations:
    - Continue to develop the EO for M&E as use case scenario in the upcoming GDA Analytics Processing Platform (APP)
    - Continue to support and learn from the WB Geo-Enabling initiative for Monitoring and Supervision (GEMS)
    - Support IFIs to establish technical requirements related to M&E at a strategic level
    - Share value and learnings of using EO for M&E

Background

Defining 'monitoring' and 'evaluation'

This report uses the WB's Evaluation Principles to define monitoring and evaluation. Monitoring is an ongoing process of observing, collecting, and analysing information to gain a better understanding into whether a process, programme, project, theme, strategy, or policy is achieving the expected outcomes.[1] Evaluation is an objective assessment of the effectiveness of a process, programme, project, theme, strategy, or policy and helps to determine whether it meets its objectives, to estimate its impact and/or to assess whether the benefits outweigh the costs.

Monitoring and evaluation enhance and feed into each other. Monitoring enables collection of important data, and the availability of good data is needed for good evaluation.

Forms of Monitoring & Evaluation (M&E)

In IFIs, M&E can be seen as a two-layered approach. On one hand, the borrower, which oversees the implementation of a project, will undertake the M&E activities that are designed for the project. On the other hand, the IFI that provided funding supervises the project ensuring that the borrower complies with the financing agreement and the environmental and social standards.

There are many forms of M&E including environmental, social, and governance (ESG) compliance and monitoring progress against global-level targets [e.g., the Sustainable Development Goals (SDGs), Net Zero Emissions targets, etc.]. This report will essentially focus on two dimensions of M&E:

- **Supervision and third-party monitoring (TPM)**; overseeing an intervention to ensure that everything is running on time and on schedule and that the right things are being done (by the right people). TPM exists in two key ways in IFIs. Firstly, as an approach to smart supervision whereby the IFI contracts an independent agent to verify that project implementation by the borrower complies with the provision of the financing agreement and that the environmental and social performance of the project meets the agreed standards. Secondly, as an approach to project implementation whereby the borrower contracts third parties to strengthen monitoring and evaluation systems and obtain additional data on the achievement of progress development. IFIs allocate a large proportion of their time and resources to support and supervise project financing provided to clients, however, ensuring that the right people have the appropriate and timely information to inform risk management and resource allocation is difficult. To ensure effective implementation of programmes and accountability in the use of resources, IFIs ideally need high quality project data that helps them identify risks in real time and respond appropriately.
- **Assessment of programme impacts or results**; overseeing an intervention to ensure that the activities being carried out are producing the intended outputs and that everything is on track to deliver the desired results/impact. Evaluations assess the extent to which the desired objectives, results and impacts were achieved. This type of M&E is conducted by the client governments themselves or by the implementing agencies. Development

[1] WB, International Finance Corporation, Multilateral Investment Guarantee Agency, *World Bank Evaluation Principles*, 2019, https://ieg.worldbankgroup.org/sites/default/files/Data/reports/WorldBankEvaluationPrinciples.pdf

interventions have often relied on qualitative data collection methods including structured literature reviews, interviews, focus groups and surveys. Though these continue to be essential methods for M&E, they may not paint the full picture. The emergence of new data sources and data-based methods gives practitioners the ability to look at a broader evidence base.

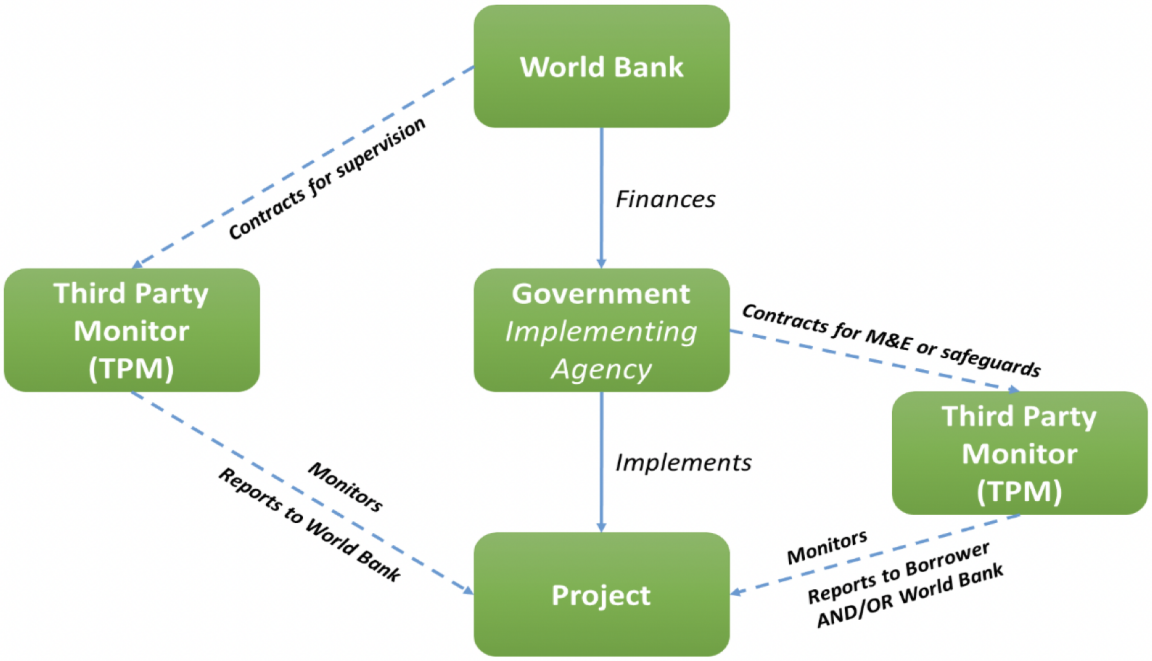
M&E in International Financial Institutions (IFIs)

According to KPMG's Monitoring and Evaluation Survey, M&E is becoming increasingly important in a time of growing public scrutiny of development programmes and an increased demand for measuring results and impact by current and potential donors.[2] Current and potential donors to development interventions want to know how funds are being used, whether they are being used effectively, and whether projects and programmes being implemented are successful in achieving intended goals.

Third-party Monitoring (TPM) at the World Bank (WB)

TPM is an inherent part of project supervision at the WB, and one internal good practice note states that "*the goal of using third parties to assess the status and performance of a project through a specialised party is to provide an unbiased perspective on the issue and status, and to make recommendations for improvement, where relevant.*"[3]

Figure 1: Forms of TPM in Relation to IFI, Borrower, and Project[4]



[2] KPMG, *Monitoring and Evaluation in the Development Sector*, 2014, https://assets.kpmg/content/dam/kpmg/pdf/2014/09/2014-survey-monitoring-evaluation-v4.pdf

[3] Khawaja A., Arnold A-K., *Third Party Monitoring, Good Practice Note*, 2018, https://documents1.worldbank.org/curated/en/578001530208566471/Environment-and-Social-Framework-ESF-Good-Practice-Note-on-Third-Party-Monitoring-English.pdf

[4] Khawaja A., Arnold A-K., *Third Party Monitoring, Good Practice Note*, 2018, https://documents1.worldbank.org/curated/en/578001530208566471/Environment-and-Social-Framework-ESF-Good-Practice-Note-on-Third-Party-Monitoring-English.pdf

The WB choosing to engage with TPM directly is designed to complement project monitoring in areas that are difficult to access or to carry out supervision duties, but where the duty of care lies with the WB. Contracts for a TPM are likely to fall under one or more of the following three objectives:

1. Perform fiduciary oversight
2. Control infrastructure quality
3. Monitor social and environmental risks, especially gender-based violence.

This form of TPM is different from the requirement for the client entity to use TPM to verify activities against the WB's Environmental and Social Framework. When TPM is conducted by the WB, funding cannot come from recipient-executed project funds due to potential conflict of interest. In Fragility, Conflict and Violence (FCV) contexts, TPM takes a lot of time and is particularly resource intensive, costing as much as US$2 million for a three-year contract.[5]

In 2022, the WB has beta launched its Project360 platform that is designed to support operational teams to work with clients to manage projects virtually. The platform integrates geospatial data including high resolution satellite and drone imagery to provide project leaders with up-to-date information and news in their project locations. This provides an ideal structure to facilitate the use of satellite imagery and the integration of other data sources. Given P360 is a system that has been created by the WB and is hosted behind its firewall, the data hosted on it is owned by the WB and thus adequate for supervision on the WB-side, rather than client M&E as part of their project implementation.

Evaluation at the WB and the Asian Development Bank (ADB)

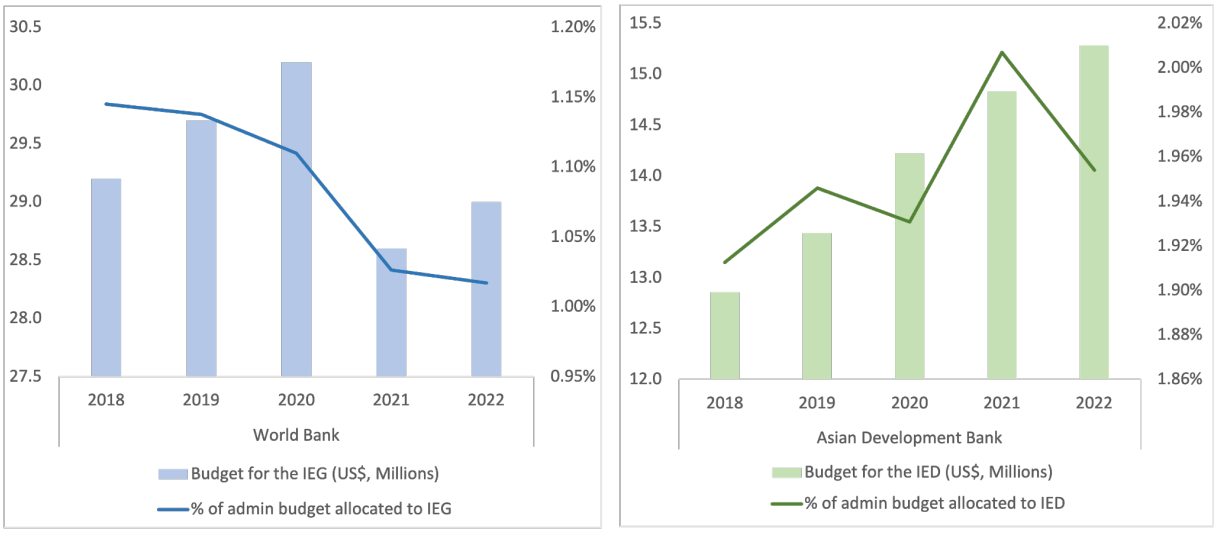
There are two main evaluation modalities: self-evaluation and independent evaluation. Self-evaluation is conducted by those responsible for designing and implementing a country strategy, programme, or project. They are not structurally or functionally independent, but they are both reviewed and validated by an Independent Evaluation Function (IEF) on a sample basis.

Budget allocated to IEG and IEF

The WB and ADB offer useful indications of whether IFIs in general have increased their budgets directed towards M&E. Both the WB and the ADB provide public information on the proportion of their budgets allocated to their IEFs, which allows us to get an insight into trends in the level of spending (as seen in Figure 2).

[5] WB, 'World Bank Group Strategy for Fragility, Conflict, and Violence 2020–2025', 2020, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/844591582815510521/world-bank-group-strategy-for-fragility-conflict-and-violence-2020-2025

Figure 2: Comparing the Total and % of Administrative Budget (in US$m) Allocated to the WB's and the ADBs IEFs[6]



An insight into the IEG and the IED

When comparing the WPs of IEG and IED, we can see that they differ in terms of structure (as seen in Table 1). The former's is structured against six thematic strategic priority areas, whilst the latter's WP is structured according to its evaluation products. Nonetheless, overall, the IEG and the IED both operate in a similar manner. This may be because they have similar objectives and principles that drive their evaluations. Both entities prioritise accountability and independence in their evaluations, each reporting to the Board of Directors with no involvement from management.

Table 1: M&E at the WB and ADB[7]

	WB's IEG	ADB's IED
Objectives	Accountability and learning	Accountability and evaluation knowledge
Principles	Utility, Credibility, and Independence	Independence, Impartiality and Objectivity
How is the Work Programme (WP) structured?	Structured by six work streams: Gender; FCV; Climate Change and Environmental Stability; Human Capital; Growth & Shared Prosperity; Mobilising Finance for Development - since the fiscal year 2020.	Since WP 2020-2023, structured by evaluation products; High-Level Evaluations, All Other Evaluations and Contingency Resources for Unprogrammed Evaluations and Other Works

[6] WB, 'Bank Budget - Trend', 2022, https://finances.worldbank.org/Budget/WB-Bank-Budget-BB-Trend/7ubh-fzdj; ADB, 'Budget of the Asian Development Bank Series', 2022, https://www.adb.org/documents/series/budget-asian-development-bank

[7] WB, 'Work Plan & Budget and Indicative Plan', 2022, https://ieg.worldbankgroup.org/sites/default/files/Data/reports/iegworkprogramfy23-25.pdf; ADB, 'Work Program and Budget Framework', https://www.adb.org/documents/work-program-and-budget-framework-2022-2024

The value of Earth Observation (EO) for M&E

This section provides a deeper analysis of the shortfalls of traditional data collection in M&E and the way in which EO overcomes these gaps.

Key characteristics

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

Affordability

Both the assessment of programme impacts and TPM and supervision often require on-site visits which take up a lot of time and resources. By obtaining data remotely, EO data could make these two forms of M&E more affordable. Case study 1 is an example of how IFIs used freely available EO data for M&E. More importantly, however, 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. Advancements in satellite technology and science have resulted in an increasing array of EO satellite missions, and in-turn dozens of geophysical parameters being measured daily from a range of different satellite orbits. In the domain of climate change alone, of the 55 essential climate variables more than half have a major contribution from satellites or simply would not be possible without satellites, such as global sea level.[8]

Coverage

Traditional data collection methods, such as face-to-face interviews and in-field testing, require travel and physical contact, and are often limited to a specific area. Satellites have global coverage, making it possible to monitor vast, remote, and even conflict regions across countries and continents. Moreover, EO has given rise to new ways of measuring impacts of interventions such as economic development. In Case study 2, the ADB used geospatial data to assess the economic impact of a newly-built road in Armenia by looking at night-time radiance in the affected areas. Another example (shown in case study 3) details a WB activity using EO data to estimate a proxy for current or past informal trade.

Range of scales

A key benefit of using EO for M&E purposes is the range of scales at which this data can be collected and then analysed. The availability of data at different scales allows IFIs to evaluate spatially explicit interventions and enables programme activities to be monitored at the local, national, or global level. For example, data for a specific region may be pinpointed to assess the impact of a local policy initiative, as has been done with the Restoration Activities in the Murat River Watershed Rehabilitation Project (from 2013 to 2022) in Türkiye funded by the International Fund for Agricultural Development (IFAD). The project is one example of several within IFAD, which has published its own manual offering guidance on the use of Geographic Information Systems

[8] Committee on Earth Observation Satellites (CEOS), 'The Earth Observation Handbook', 2018, http://eohandbook.com/sdg/part1_3.html

(GIS) in the monitoring and evaluation of rural development projects.[9] EO can be used in certain sectors to assess the impacts of large-scale policies over expansive areas. The WB-funded EO for Sustainable Development (EO4SD) Agriculture and Rural Development cluster has helped provide the Sahel and West Africa Programme (SAWAP) teams with tools and indicators to better monitor and evaluate objectives and execution of achievements.[10] They are now using EO to consistently monitor land cover and status and productivity, erosion potential and agricultural production across multiple countries.

Access to remote and conflict areas

Given that IFIs often invest in regions that are difficult to reach or dangerous to be in, it can be beneficial for M&E to function remotely. In response to this challenge, the WB launched the GEMS, with the aim of bringing "*eyes on the ground, where we cannot always have feet on the ground*".[11] As of February 2023, GEMS had expanded on a global scale and supported about 1,000 projects in over 100 countries world-wide with digital real-time monitoring tools and skills. Given its focus on capacity-building, GEMS was listed by the UN Innovation Network among the best Innovations in 2020 and received the Geospatial World Forum's Geospatial World Excellence Award in 2021.[12]

With the remote nature of EO data, auditors may be able to identify what areas carry risks without having to conduct an in-field visit. It may also strengthen fiduciary oversight. Covid-19 has also challenged traditional data collection methods that need travel and physical contact, such as face-to-face interviews. The WB's IEG states that "*the use of geospatial data on project variables has become an attractive solution to fill the void of field missions during the Covid-19 pandemic*".[13]

However, even though EO data expands the variety and volume of data and allows development actors to monitor and evaluate interventions remotely, it should not be seen as a silver bullet. There is a danger of misinterpreting such data. For instance, even though synthetic aperture radar (SAR) images from satellites can be extremely useful for oil detection in the sea, there are other ocean surface phenomena which also produce regions of low radar backscatter thereby reducing the accuracy of results.[14] Thus, in-situ data is often needed to understand and verify EO data, even in remote contexts. Ideally, EO data should not replace traditional data collection methods, but rather complement them, as seen in case study 1.

Novel uses of EO data

[9] IFAD, Mapping Rural Development, 2022, https://www.ifad.org/documents/38714170/45948858/GeoMapManual-Final_WEB.pdf/05a555cc-65d8-2367-c7ce-3775f52d3101?t=1658502655336

[10] ESA, 'TRAINING: EO FOR M&E IN THE SAHEL AND WEST AFRICA', 2017, https://eo4sd.esa.int/2017/10/30/training-space-data-for-me-activities-in-the-sahel-and-west-africa-regions/

[11] WB, 'Geo-Enabling initiative for Monitoring and Supervision (GEMS)', 2020, https://www.worldbank.org/en/topic/fragilityconflictviolence/brief/geo-enabling-initiative-for-monitoring-and-supervision-gems

[12] Geospatial World, 'GWF 2021 Awards acknowledge outstanding contributions to the geospatial domain', 2021, https://www.geospatialworld.net/news/gwf-2021-awards-acknowledge-outstanding-contributions-to-the-geospatial-domain/

[13] Yokoi H., Vaessen J., Vandercasteelen J., 'Why evaluators should embrace the use of geospatial data during Covid-19 (Coronavirus) and beyond', 2020, https://ieg.worldbankgroup.org/blog/why-evaluators-should-embrace-use-geospatial-data-during-covid-19-coronavirus-and-beyond

[14] Mendoza A., Pellon de Miranda F., Bannerman K., Pedroso E., *Satellite Environmental Monitoring of Oil Spills in the South Gulf Mexico*, 2004, https://www.researchgate.net/publication/254518601_Satellite_Environmental_Monitoring_of_Oil_Spills_in_the_South_Gulf_Of_Mexico

Remote sensing has opened up new measurements that have previously not existed. The aforementioned EO Clinic case (see case study 3) on informal trade assessment is a novel application of EO data. The EO for poverty (EO4Poverty) project which launched in 2020, uses both EO data, as well as non-EO data from social media and publicly available household surveys, to generate national spatial poverty maps.[15] In essence, EO has shown what is available and applied a novel way of using it, in other words to find a proxy for poverty. These novel uses of EO data could open new ways to monitor and evaluate interventions.

Comparability

Traditional data collection methods may lack standardisation in measurements or methods, which inhibits the possibility to make meaningful comparisons or provide regional/global statistics. Monitoring using satellites can be harmonised allowing policymakers to compare interventions. For example, in 2016 the Permanent Interstate Committee for drought control in the Sahel, published an atlas showing a time series analysis of land use and land cover trends based on an analysis of satellite imagery from 1975 to 2014 in 17 West African countries. Despite a variety of different programme interventions, standardised EO data enabled development actors to easily compare countries by their annual rate of agricultural expansion.[16]

Satellite data can also help identify regions that are comparable to each other. As illustrated in case study 4, geospatial data helped improve the control group selection through matched sampling rather than a random control group in a post-hoc quasi-experimental setting. The selection of a control group will also strengthen fiduciary oversight and auditing. However, satellite data often requires further refinement and analysis before being used in decision contexts. This means that a high level of geospatial technical capacity is needed, which may not always be the case for those in charge of M&E.

Frequency

EO allows IFIs to adjust the data collection cycles to whatever works best for the M&E objectives. From a technological perspective, the smaller the period between capturing two consecutive images at the same location the higher the frequency/temporal resolution.[17] The Copernicus Sentinel satellites, which provide free and open access data, provide new images every five days, whereas commercial EO data, such as Airbus Pleiades constellation and Planet Lab's PlanetScope DOVEs, might update multiple times a day. The ability to capture imagery at different frequencies of the same area is particularly crucial in time-sensitive events like irrigation or planting timings. Additionally, if auditors had access to satellite data, they would be able to perform TPM and supervision at different temporal frequencies.

Speed

[15] ESA, 'EO4Poverty', 2020, https://sdg.esa.int/activity/eo4poverty-4409

[16] Winterbottom B., Reij C., Stirrett G. H., *Sustainable Land Management in the Sahel*, 2021, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/343311608752196338/sustainable-land-management-in-the-sahel-lessons-from-the-sahel-and-west-africa-program-in-support-of-the-great-green-wall-sawap

[17] Shah Z., 'What is temporal resolution?', https://www.atlasai.co/learn/what-is-temporal-resolution

Operating environments are becoming increasingly complex, making it difficult for the right people to access the right information at the right time. This affects programme assessment, project implementation and risk management. Satellites can improve risk identification in Near Real Time (NRT) by providing EO data for the exact same location at a much faster rate than traditional data collection methods. 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.[18] Quick and easy access to data is useful in use cases that require sudden and unpredictable changes to be detected and continually monitored. This allows IFIs to react quickly to the data and immediately correct if needed. This is particularly helpful in interventions in disaster resilience and FCV, where events on the ground change rapidly, often with life-threatening implications.

Objectivity

Traditional data collection methods such as focus groups or surveys require interpretation by experts who may have unconscious biases or who may be influenced by political or other factors when carrying out an evaluation of an intervention. Conversely, EO is derived from satellite instrument measurements, which have a known and controlled range of error and are thus less susceptible to biases that may occur with human observations. The ability to be data-driven and objective can enable IFIs to be fully accountable to donors and not biased by political factors. Furthermore, the Ukraine conflict emphasises the value of EO in bringing clarity to the misinformation surrounding conflict zones. The objective nature of EO could help contribute to the WB's fiduciary assurance objective ensuring that "*funds are used for the intended purpose*".[19]

Anonymity

M&E for a development intervention may involve entering a group's or individual's lives and exploring how effective the programme/project has been for them. The nature of face-to-face traditional data collection methods means the subjects of monitoring or evaluation activities cannot be anonymous and therefore these processes can often be invasive. Using EO data, however, IFIs can make observations on the ground unnoticed, whilst also limiting privacy risks associated with traditional data collection methods. Essentially, M&E can occur without disturbance to both human and wildlife populations. Anonymity becomes most valuable in interventions related to demographic domains, such as in FCV or health. However, EO from satellites do carry a "Big Brother" perception of being monitored, and concerns of potential espionage for national governments. Additionally, though the spatial resolution "cap" may prevent us from inferring individuals from commercially available satellite imagery, imaging capabilities for defence purposes are way ahead. Finally, informed consent is not possible when using satellite data sources. Those involved may not be aware of their invasion of privacy, and if they are aware they are unlikely to be able to contest it in real time or retrospectively.

[18] ESA, 'Data Distribution Schedule', https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/data-distribution-schedule

[19] Jabbour J., Koteiche R., 'Independent third-party monitoring: A risk management tool for fiduciary assurance in Lebanon', 2021, https://blogs.worldbank.org/arabvoices/independent-third-party-monitoring-risk-management-tool-fiduciary-assurance-lebanon

Continuity

Traditional data collection methods are often only able to provide quality data in the moment of programme implementation. As Tala Hussein, a quality specialist at the United Nations Development Programme (UNDP), puts it "*in the field, you cannot see the past*."[20] Some EO data series date back to the 1970s and have been acquired continuously, providing IFIs with unique evidence that helps provide immediate feedback on project performance and risk management in light of long-term trends. In case study 4, the IFAD Independent Office of Evaluation (IOE) used satellite data on irrigation in the region from 2003, seven years before project implementation to understand long-term trends in the region. However, IFIs should not rely on EO's ability to look into the past to replace ongoing project measurement. Instead, they should embed M&E throughout the project/programme as will be illustrated next.

The value of EO for M&E in the project cycle

The WB's project cycle (see figure 3) illustrates the six stages of project design, implementation and evaluation used at the Bank. M&E should be integrated at each stage, and EO has the potential to contribute to M&E throughout.

Figure 3: Framework Used by the WB to Design, Implement and Supervise Projects[21]

M&E activities can be embedded throughout the programme lifecycle as follows:

[20] United Nations Institute for Training and Research, 'Using earth observation and GIS for the monitoring and evaluation of development projects', https://unitar.org/about/news-stories/news/using-earth-observation-and-gis-monitoring-and-evaluation-development-projects

[21] WB, 'World Bank Project Cycle', https://projects.worldbank.org/en/projects-operations/products-and-services/brief/projectcycle

1. **Design of monitoring activities**; during the Identification, Preparation and Appraisal Stages of a project cycle, it is necessary to plan what exactly will be monitored and how the required information will be gathered. This allows IFIs to define project objectives and set criteria for measuring success from the beginning, as well as allowing the project to establish a baseline and set targets. The preparatory stages also enable IFIs to assess any potential risks in the project to understand what activities could be monitored by way of mitigation.
2. **Monitoring progress**; during the Implementation and Support Stage. This involves the ongoing collection of data to ensure the project is going in the right direction. This information is often presented in progress reports, dashboards, mid-term evaluations or quarterly reviews. IFIs should modify the programme design and activities in response to evidence generated at this stage.
3. **Post-Programme Evaluation**; at the end of the project cycle in the Completion/Validation and Evaluation Stage. The aim of M&E here is to assess whether the intervention's impact falls in line with the objectives of the project. Learnings should then be used to guide future projects.

Table 2 looks at how each of the characteristics of EO explained in the previous section contribute to each of the three stages of M&E in the project cycle. EO data provides evaluators with valuable insights from the start of the project, getting a better assessment of the initial situation of a region and assessing the project throughout, to the end, enabling a more robust evidence base for post-programme evaluation.

Table 2: How EO's Characteristics Contribute to the Three M&E Stages

	Design of monitoring activities	Monitoring progress	Post-Programme Evaluation
Affordability	The affordability of EO data helps when budgeting for M&E, which can often be very costly.	Affordable data collection methods are particularly needed when monitoring is conducted on a regular basis.	Evaluation after an intervention is sometimes neglected especially when the budget has been exceeded.
Coverage	Set criteria to measure success by providing access to different scaled regions, to remote and conflict areas, to a larger catalogue of measurements as well as novel uses of EO data. Allows IFIs to identify control areas and compare regions to each other.	Ongoing collection of EO data for novel uses to ensure the project is going in the right direction by providing access to remote and conflict areas at different scales (less need for interim field visits). Allows evaluators to compare between regions and adjust according to findings.	Assess impacts of interventions at different scales, in conflict and remote areas (access to dangerous, restricted, or difficult to reach areas) and in novel ways of using EO data. Allows evaluators to compare the impacts of different interventions to guide future projects.
Frequency	Gives IFIs the possibility to set M&E objectives in which data is collected at various frequencies. IFIs identify the frequency at which EO data needs to be collected at the start of the project.	Evaluators will receive data at the frequency of which the EO data is selected. A high frequency will be particularly beneficial in time-sensitive events, so IFIs can quickly adjust the project accordingly.	A frequent access to EO data, means that IFIs are able to see the continuous effect of a programme, which helps evaluate the overall impact of the project and provide learnings for future projects.

Speed	IFIs should define at which speed EO data needs to be collected at the beginning of the project, and this will depend on whether sudden and unpredictable changes need to be detected and continually monitored.	The speed of EO data allows IFIs to provide immediate findings on how a project is going. This is particularly helpful in FCV interventions where events on the ground change rapidly, often with life-threatening implications.	Fast access to EO data, means that IFIs are able to see the immediate effect of a programme, which helps evaluate the overall impact of the project and provide learnings for future projects.
Objectivity	The objective nature of EO, allows evaluators to identify baselines and set targets that are not influenced by e.g., political factors.	Objectivity in data collection ensures that external changes do not affect evaluation and makes sure that the project is going in the right direction.	Post-programme evaluation must be objective for IFIs to be fully accountable to donors, and to ensure trust between parties.
Anonymity	IFIs need to ensure that anonymity concerns with EO data are addressed at the beginning of an intervention.	EO data is often considered less invasive, which is particularly useful when collecting data continuously.	Evaluating the impact of a project should not disturb human or wildlife populations.
Continuity	Help establish baselines and trends which together with objectives help define the targets used to assess progress of a project.	The continuous acquisition of data ensures the project is going in the right direction, allowing IFIs to quickly modify the programme in response to this data.	Allows IFIs to access baseline data if it wasn't collected ex ante.

Case studies

Case study 1: Project performance evaluation of the Coastal Climate-Resilient Infrastructure Project in Bangladesh (CCRIP)

CCRIP was implemented in 12 coastal districts from 2013 to 2019, by the Local Government Engineering Department of the Government of Bangladesh and was co-financed by IFAD, African Development Bank (AfDB) and Kreditanstalt für Wiederaufbau (KfW). By building or rehabilitating climate-resilient roads and markets in economically disadvantaged rural areas or places that are highly vulnerable to natural disasters and climate change, the project aimed to improve the livelihoods of poor households.

Travel restrictions and social distancing requirements during the Covid-19 pandemic meant that field visits and in-person meetings were often not possible. GIS data and visual imagery from freely available sources was used to compensate for this absence. A cyclone in 2020 provided an opportunity to use a "natural experiment" to evaluate how well the infrastructure built could withstand it (Figure 4). Local stakeholders were asked to take photographs and videos of the project infrastructure to complement the sometimes-poor quality of the satellite images.

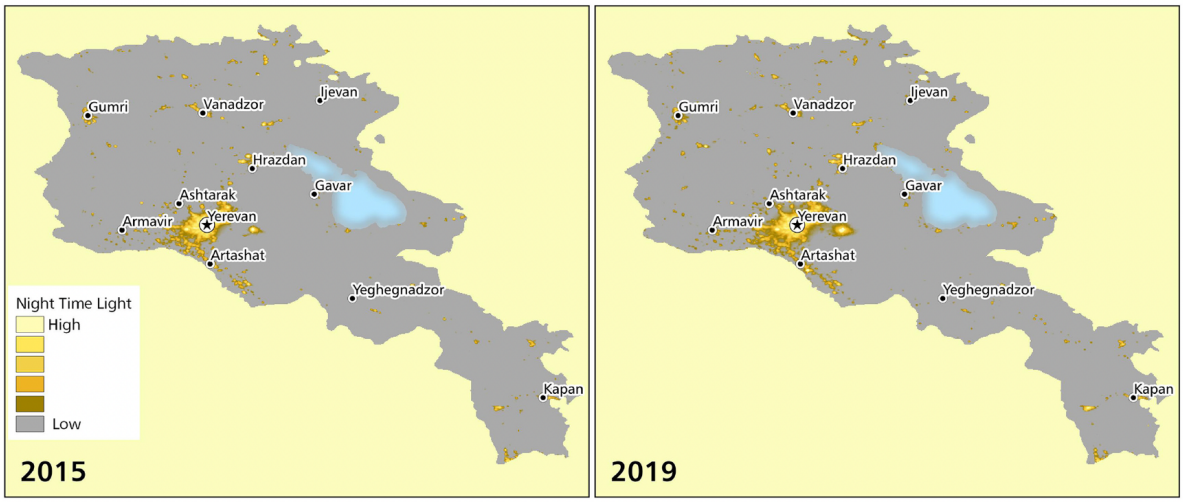
Figure 4: Using Satellite Imagery to Assess Infrastructure Quality and Performance Before (Left) and After (Right) CCRIP[22]

[22] IFAD Independent Evaluation Office, *Lessons Learned from Conducting a Remote Evaluation during the Covid-19 Pandemic*, 2020, https://www.ifad.org/documents/38714182/39733087/IFAD-IOE-BRIEF-LEARNING-CCRIP-01-03.pdf/ca92cf88-2aec-f22b-c6f7-48bc3967611c

Case study 2: North-south Road Corridor Investment Programme in Armenia

ADB provided a multi-tranche financing facility (MFF) investment loan to support the Armenian government's program to reconstruct the north-south road corridor in Armenia, complementing the East-West Highway between Georgia and Azerbaijan. Figure 5 shows the night-time light status of the whole country in 2015, before the road was finished being built in 2016, and in 2019, about three years after completion. The night-time light analysis showed that economic activities near the road had grown faster than in other areas. The results of the impact evaluation using GIS were consistent with feedback from residents along the improved road sections, confirming that travel times had improved and that they had benefited from better access to socioeconomic facilities.

Figure 5: Night-time light in Armenia in 2015 compared to 2019[23]



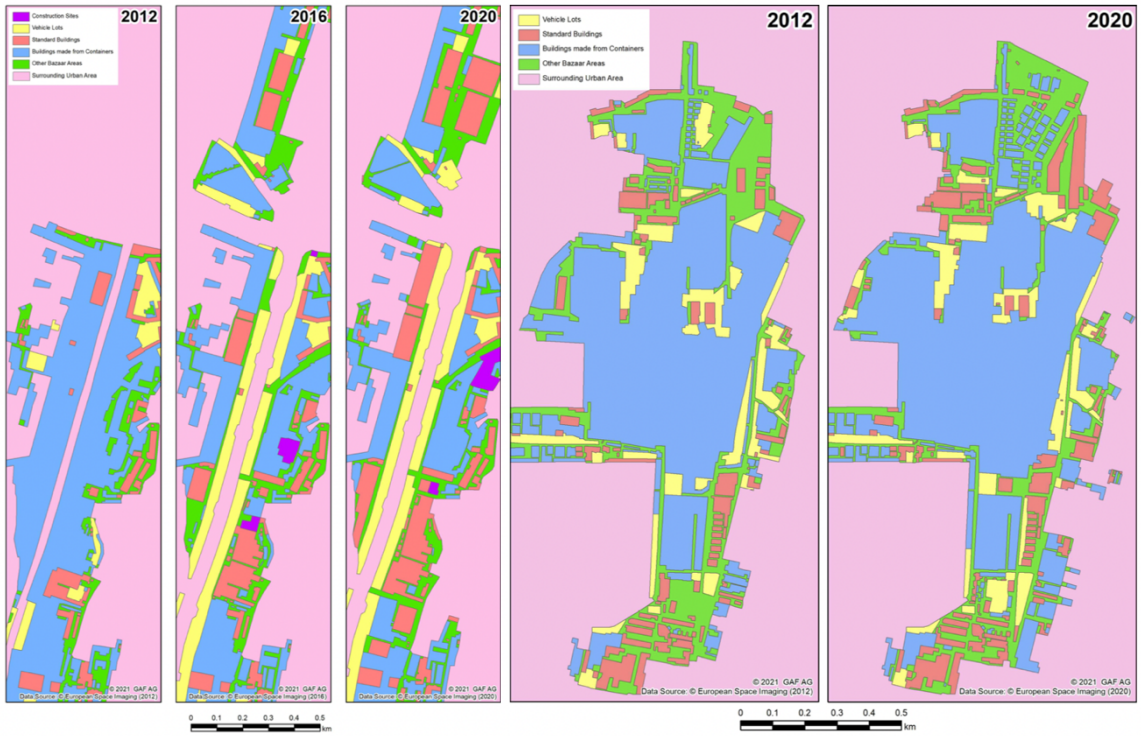
[23] Yokota et al., *Application of Geographic Information Systems in Impact Evaluation and Geospatial Portfolio Analysis of Transport Projects*, 2022, https://journals.sagepub.com/doi/abs/10.1177/03611981221092007?journalCode=trra

Case study 3: EO Clinic - estimating the magnitude and spatial distribution of informal trade in Central Asia

The WB is supporting Central Asian countries to enhance regional trade, investment, and connectivity. However, in these areas informal trade forms a large proportion of regional trade and provides a large amount of employment in these geographies. However, this economic activity is often not recorded in official statistics, and its omission can be detrimental to policy design and recommendations, it undermines tax collection and hurts law-abiding local firms trying to compete with undeclared goods. Ad hoc surveys are sometimes conducted; however, these are not done regularly and are prone to underreporting.

The WB has identified EO's potential in filling the gaps to some of this data required. In fact, growth in informal cross-border trade often leads to densification of man-made structures in the local hinterland, as well as an increase in vehicle presence and pedestrians shopping in these markets. EO methods can be used to observe the peri-urban landscape of inland markets as a proxy to estimate current or past informal trade (see figure 6).

Figure 6: Centre of Barakholka Bazaar in 2012, 2016 and 2020 (Left) and Dordoi Bazaar in 2012 and 2020 (Right)[24]

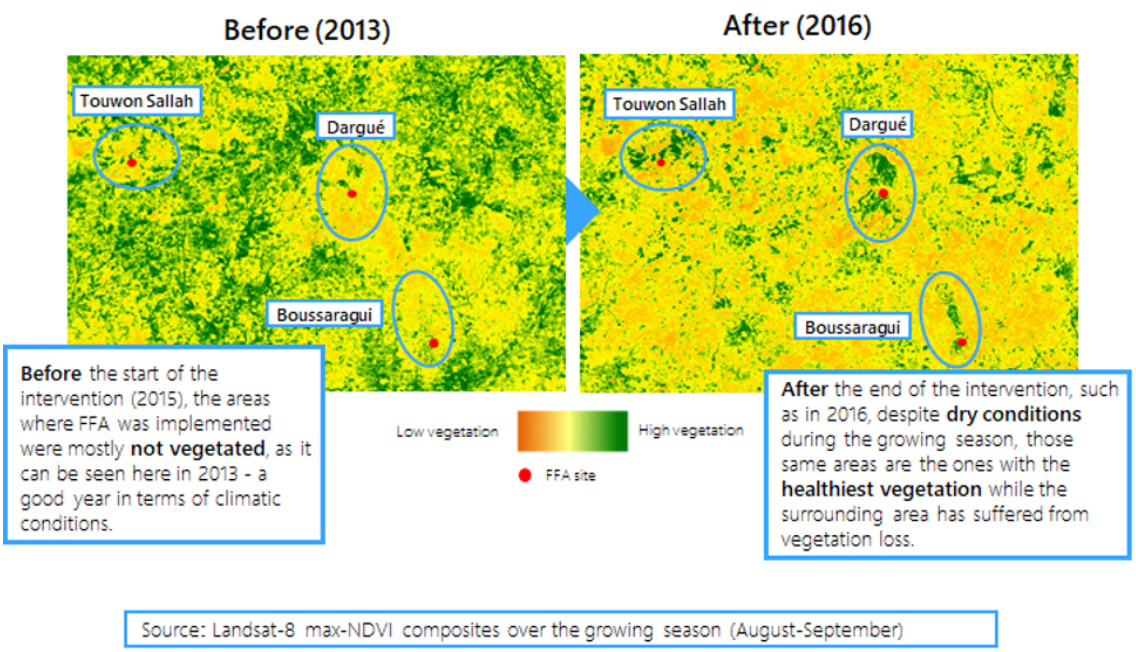


[24] ESA, *EO Clinic - Rapid-Response Satellite Earth Observation Solutions for International Development Projects*, 2021, https://eo4society.esa.int/wp-content/uploads/2022/02/EOC0014_WOR_v01.pdf

Case study 4: Evaluation of International Fund for Agricultural Development's (IFAD) Agricultural Support Project in Georgia

For the evaluation of the IFAD's Agricultural Support Project in Georgia, the IOE combined the use of freely available satellite data with traditional evaluation. Five irrigation schemes were rehabilitated as part of the project intervention. They focused on the difference in vegetation development (NDVI) between 2013 and 2016. NDVI variations may be due to the intervention itself, but may also be because of seasonal weather conditions, the stage of development of the vegetation or changes of agricultural practices. Therefore, they matched clusters with demographic and geo-spatial characteristics prior to the intervention. Non-treated sites with similar characteristics were identified and compared to treated sites. This enabled IFAD to be able to get a much more accurate comparison of sites because of a data-driven matching process and ability to compare NDVIs.

Figure 7: Using Satellite Imagery to Compare NDVI Prior To and After Agricultural Support Project in Georgia[25]



[25] Evaluation Support Service Team, 'Combining satellite imagery with traditional evaluation techniques', 2020, https://europa.eu/capacity4dev/devco-ess/wiki/1-combining-satellite-imagery-traditional-evaluation-techniques

Current use of EO for M&E in IFIs

Use of EO for M&E in the WB Independent Evaluation Group (IEG) and the ADB Independent Evaluation Department (IED)

EO's characteristics of being more objective and anonymous than many traditional data collection methods, makes it particularly useful to fulfil IEG's and IED's principles of objectivity and anonymity. This raises the question as to whether the WB and the ADB has fully embraced the value of EO for M&E.

According to the WB blog article titled 'Geospatial Analysis in Evaluation', the IEG "*has been exploring the use of new techniques of geospatial analysis - including the use of satellite and digital images … to help answer questions on relevance and effectiveness of development interventions*".[26] Similarly, in the ADB blog article called 'Let's Scale Up Remote Sensing Technology to Better Evaluate Projects' the IED states that the results it received from the measurement of outcomes in two case studies on natural resources and irrigation "*offer strong evidence to justify wider uptake and application of remote sensing for outcome monitoring and evaluation*."[27]

Though these blogs show an increasing understanding of the value of EO for M&E by both the IEG and IED, it does not feature heavily in either Work Programme (WP). In IEG's WP for the Fiscal Year 2022, a paragraph is dedicated to the IEG Academy's new focus on innovative technologies such as those that enable remote observation within the context of COVID-19. However, this brief mention of remote observation and the lack of any mention of EO in the IED's WP suggest that EO has not yet become an integral part of the strategies and roadmaps created by these two IEFs. It is fair to conclude that there is at least a base level of awareness of the value of EO in M&E, but that this has not yet become a standard practice or systematised in the way that the IEFs conduct their work. Additionally, when it comes to TPM, neither the WB nor the ADB have implemented EO into their TPM. This is an area largely under-exploited for EO service providers so far.

Potential limitations and barriers to the increased adoption of EO for M&E

Not all projects will be suited to EO-enabled M&E

Certain development projects may not benefit from the use of EO for M&E. "Environmental" domain areas, such as Forestry, Agriculture and Food Security, Disaster Resilience and Climate Change are the domain areas that are particularly suited to EO. This is because satellites monitor the status of the natural and manmade environment, they can leave questions of economic and financial materiality unanswered. Though it may be true that satellites provide information on socio-economic factors, the nature of remote sensing means that it may be less useful in addressing demographic questions.[28]

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[26] Ziulu V., 'Geospatial Analysis in Evaluation', 2022, https://ieg.worldbankgroup.org/blog/geospatial-analysis-evaluation

[27] Kilroy G., Brubaker A., Vijayaraghavan M., 'Let's Scale Up Remote Sensing Technology to Better Evaluate Projects', 2019, https://blogs.adb.org/blog/let-s-scale-remote-sensing-technology-better-evaluate-projects

[28] O'Connor B., Moul K., Pollini B., de Lamo X., Simonson W. (UNEP-WCMC), *Compendium of Earth Observation Contributions to the SDG Targets and Indicators*, 2020, https://eo4society.esa.int/wp-content/uploads/2021/01/EO_Compendium-for-SDGs.pdf

For instance, in the case of the CCRIP project highlighted in Case study 1, EO data was useful in exploring questions of infrastructure quality and performance and due to the pandemic, the reliance on this data was necessarily high. However, the M&E also called for other forms of data to assess institutional, social relations or empowerment issues. Not being able to interact face-to-face with people made it difficult to assess power relationships and gender dynamics between groups. Additionally, the need to conduct interviews remotely meant that most of the interviews ended up being with informants at the government level and there was less diversity in community level informants introducing selection bias. Though this was partially offset by involving a local consultant who had worked on the project and had expertise in social and gender inclusion, it did not remove the problem entirely.

Ultimately, developmental projects must acknowledge challenges of social inclusion, gender equality or other demographic related issues that underpin the wider challenges they aim to address. These challenges may not be as well suited for the use of EO for M&E however they need to be taken into consideration, and complementary methods employed.

Wider IFI processes need to be adapted to allow for EO-enabled M&E

If geospatial data is to be integrated into IFI project processes such as ongoing monitoring and evaluation, it will be necessary for improved information management on projects to enable this. For example, in many instances, projects that are being implemented are not properly geolocated and so the IFIs, and often even the client itself, do not have the exact geodata corresponding to the location of that project. For example, an infrastructural development project may be recorded as taking place in the capital city or HQ of the WB's presence in a particular country, rather than in the precise location of the activities. The GEMS team, within the WB, recognises that this need for localised data collection is valuable and has invested in building capacity "from the ground up", on client-side and among WB staff, partners, and other local stakeholders. These efforts by the GEMS team are playing an important role in ensuring that data collection at a local level is improved and that those data can be integrated with and complemented by other sources of data, such as satellite EO data over the longer term. Therefore, there could be opportunities to collaborate with the GEMS team to leverage their local data collection teams and the capacity building efforts that they are making.

Lack of complementary skillsets

A further limitation for further uptake of EO data within the M&E processes of IFIs is the presence of M&E professionals with the relevant skills and experience to use geospatial data effectively within their work. Within the Development Impact Evaluation (DIME) team, in the Research Group of the WB, there are M&E experts with data science backgrounds who are aware of and familiar with applications for EO data and exploring cutting edge techniques to incorporate new forms of data into their M&E processes. However, this skillset is by no means widespread, and it will require a conscious effort to be taken to recruit professionals with the relevant experience.

Decentralised/ non-strategic Data Procurement

Given the organisational structure of many IFIs (and donor agencies), and the largely decentralised budget allocation, IFI-side procurement of all types is fragmented, and many parts of the same

organisation will often be purchasing the same or similar services and products. In the case of the WB, although there is a “centralised” Geospatial Operations Support Team (GOST), there is no obligation for teams to procure geospatial data through this team which means that there is still a risk that several teams procure similar data and that there is a lack of knowledge sharing and cross-learning about how data can be used for M&E purposes. As a result, the procurement or even, repeated (and duplicative) procurement of value-adding services for M&E purposes throughout the organisation may not be optimised and considered in a sufficiently strategic fashion, leading to the data itself being (or even just perceived as being) less cost-effective. Client States may face similar procurement challenges in terms of duplicative spending on similar data across their various government agencies. Addressing this challenge requires centralised action to look into licensing terms in order to negotiate data sharing mechanisms at an appropriate organisational level. National-level legislation around data sharing and data storage are highly heterogeneous meaning that there is not be a one-size-fits-all blueprint that can be adopted for all relevant parties.

Implications & avenues for better integration

Continue to develop the EO for M&E as a use case scenario in the upcoming 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.

Having EO for M&E (specifically "Remote Monitoring & Supervision (R-11)")[29] as a cardinal use scenario in the upcoming GDA APP, will allow IFIs to explore the value of EO in M&E further than they have to date. The cross-cutting nature of M&E fits in well with the cross-cutting user-oriented software tools GDA APP will provide. Additionally, it would help closing the awareness gap about the value of EO for M&E amongst client state and development stakeholders.

Finally, the GDA might envision further support actions, such as the possible initiation of a dedicated activity to EO for M&E.

Continue to support and learn from the WB Geo-Enabling initiative for Monitoring and Supervision (GEMS)

As well as enhancing real-time risk management in FCV settings, GEMS aims to systematically enhance M&E by building capacity in digital data collection and analysis. As of July 2021, GEMS had expanded on a global scale providing real time monitoring for over 650 projects in 70+ countries world-wide. Given its focus on capacity-building, it was listed by the UN Innovation Network among the best Innovations in 2020. A partnership with the ESA has allowed GEMS to build capacity in the use of EO through satellite imagery for development monitoring, however, the actual level of use of EO is still limited.

The GEMS initiative has built up an impressive level of awareness across the WB with a number of project teams mentioning it in their official project documentation. This has largely been put down to a strong champion for digital technologies and data who has been very proactive in engaging others around the WB and promoting the initiative with relevant groups. There are no doubt lessons from this experience that can be taken on board and adopted elsewhere.

Furthermore, there could be ways in which to leverage and expand the GEMS data collection activities to further promote and enable the use of satellite EO data. This could help to generate the complementary information that will be required to ensure that WB projects are well set-up for using EO data in their M&E activities.

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

Support IFIs to establish technical requirements related to M&E at a strategic level

If the IFIs want to embrace the use of EO more proactively in their M&E function, it would be valuable for them to consider their needs centrally and then to translate those needs into their specific requirements for EO products. There needs to be a more strategic and organisation-wide approach to procuring data and a more in-depth consideration of how to do this to ensure that the use of EO data is cost-effective. If ESA were to support this, it could indeed be part of the GDA-related activities.

Share value and learnings of using EO for M&E

As seen, IFIs that do use EO for M&E of development interventions often do not publicise their reasons for doing so, nor share any learnings. This evidently excludes Case study 1, where IFAD evaluators shared their experience of using EO for evaluation during the pandemic.[30] Such information proves useful for future projects that encounter some of the same challenges. The learnings on how to overcome selection bias should be shared amongst projects to pre-empt certain risks that may influence the success of a development intervention. In fact, to maximise the impact of big data analytics, IFIs should identify and create synergies across operations. The team should look to key players (champions) within the IFIs to facilitate knowledge sharing and learning and to promote success stories. In the WB, teams such as GOST, GEMS, and Information and Technology Solutions (ITS) would be a good place to start.

[30] IFAD Independent Evaluation Office, *Lessons Learned from Conducting a Remote Evaluation during the Covid-19 Pandemic,* 2020, https://www.ifad.org/documents/38714182/39733087/IFAD-IOE-BRIEF-LEARNING-CCRIP-01-03.pdf/ca92cf88-2aec-f22b-c6f7-48bc3967611c

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Contact us via gda@esa.int