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A study on the environmental and socio-economic co-benefits of GEF Interventions

Evaluation Approach and Concept Note
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Contents

1. Introduction & Objectives

Since the Rio Earth Summit in 1992, the Global Environment Facility (GEF) has been one of the largest actors in the environmental sector, providing approximately $24 billion in grants, and marshaling an additional $107 billion in co-financing for more than 4,700 projects in 170 countries. With the explicit goal of supporting international environmental conventions and agreements, a number of these projects have been subjected to evaluation by the GEF Independent Evaluation Office (IEO) to assess their effectiveness in terms of environmental outcomes. However, relatively little research has been conducted to examine the socioeconomic co-benefits that may accrue due to environmental interventions. This is reflective of a broader shortage of impact evaluations of development projects, as the primary environmental impacts of development projects and programs are rarely assessed and quantified conclusively (Alpizar et al. 2020). Indicators to capture socio economic co benefits were included in the GEF-6 results architecture.

Recognizing this gap in the broader literature and the limited tracking and analysis of these co-benefits in GEF interventions, this proposal builds on the GEFO IEO pilot study on Uganda, which measured income benefits alongside environmental outcomes. This study will provide one of the first systematic, global-scope explorations of the environmental and the associated socioeconomic co-benefits of GEF activities.

The approach detailed in this proposal would build substantially on the availability of geospatial data and other surveys available from country or other sources. The wealth of open and freely available geospatial data - from sources such as satellites and surveys - has enabled new geospatial modalities of impact evaluation [GEF/ME/C.51/Inf.2]. These Geospatial Impact Evaluation (GIE) methods fill in a “missing middle” between (1) costly randomized control trials, and (2) terminal evaluation reports conducted by implementing partners, which lack independence and (frequently) statistical rigor. Further, by leveraging long-term satellite records, GIE approaches enable historic, quasi-observational analyses of past project implementations. In addition to impact evaluations, Geospatial Data has also been shown to help improve targeting, coordination, and monitoring activities.

Another benefit of geospatial methods is that they enable testing a broad range of hypotheses. For example, data on land cover can be used to explore if GEF projects have resulted in decreases in deforestation, or increases in reforestation; similarly, data on night-time lights may be able to illustrate if efforts have slowed human encroachment. Recent efforts (Runfola et al., 2020) have highlighted that geospatial data can also be used to explore the impacts of GEF projects on socioeconomic conditions in and around GEF projects. This allows for novel questions about socioeconomic co-benefits to be asked and answered, even during periods when travel is limited due to pandemic conditions.

When combined with other data and methods, geospatial analysis provides a comprehensive overview of environmental and socio-economic benefits. This concept note describes the three components of the study to systematically assess the environmental and the associated socioeconomic co-benefits of GEF activities: 1. **Geospatial analysis**, 2. **In-depth case studies, and** 3. **Portfolio analyses.**

1.1. Geospatial analysis

Geospatial analysis using satellite data together with socio-economic, health, and demographic survey data. This will include an analysis of the primary benefits (environmental) and socioeconomic co-benefits (human) attributable to GEF projects using satellite and other geospatial information. The analysis will consist of two main tasks. **Task 1** will focus on the geocoding of projects in 5 regions across the globe, **Task 2** will focus on quantifying the primary productivity of these projects along multiple objective environmental measures of the GEF, as well as the socioeconomic co-benefits of projects across each region.

Task 1. Geocoding: To leverage geospatial data for these purposes, precise information on the geographic location of project activities must first be generated. Further, this information must be computer-readable: i.e., it is insufficient to know the name of the place a project was implemented; rather, the latitude and longitude information representing the boundary of each intervention must be known. As a part of previous evaluation efforts, the geocoding of a large subset of projects has been completed, inclusive of those in the Land Degradation, Biodiversity, Sustainable Forest Management, Programmatic, and Multi-Focal Area portfolios. The proposed activities would build on those efforts, geocoding additional GEF projects in five regions across the globe (see table 1). Projects to be geocoded in each region would include those that contain - in project documentation - sufficiently granular descriptions of geospatial activities that can be mapped to regions representative of where GEF activities occurred.

Table 1: Synopsis of Regions to be studied and available data for a subset of countries. The exact countries to be studied within each region may vary depending on the availability of additional socioeconomic information.

Region	Countries & Socioeconomic Survey Data
LAC	Mexico - IPUMS; 2015 Costa Rica - IPUMS; 2011
South America	Peru - LSMS; 1994 | DHS 2009 w/ GPS | DHS 2012 w/o GPS | IPUMS 2007 Ecuador - LSMS; 1998 | IPUMS 2010
South Asia	Nepal - LSMS; 2011 | DHS 2011, 2016 w/ GPS | IPUMS 2011 India - DHS 2016 w/GPS Bangladesh - DHS 2011, 2014, 2017 w/ GPS | IPUMS 2011
Southeast Asia	Vietnam - LSMS 2006; DHS 1997, 2002, 2005 w/o GPS | IPUMS 2009 Cambodia - LSMS+ 2020; DHS 2005, 2010, 2014 w/ GPS | IPUMS 2013 Laos - IPUMS 2005

Central Africa	Chad - DHS 2014 w/ GPS Botswana - IPUMS 2011

This georeferencing would follow the methodology previously developed for GEF projects, ensuring technical compatibility with previously geocoded GEF datasets. Leveraging a team of trained geocoders, the methodology relies on a coding system where two experts employ a defined hierarchy of geographic terms and independently assign geographic boundaries (i.e., WDPA sites) to each identified project activity. This approach can be used to capture geographic information at several levels—coordinate, city, and administrative divisions—for each location, thereby allowing the data to be visualized and analyzed in different ways depending upon the geographic unit of interest.

Procedures to ensure data quality will include the de-duplication of projects and locations, correcting logical inconsistencies (e.g., making sure project start and end dates are in proper order), finding and correcting field and data type mismatches, validating place names and correcting gazetteer inconsistencies, strict version control of intermediate and draft data products, semantic versioning to delineate major and minor versions of various geocoded datasets, and final review by an interdisciplinary group of trained geocoders.

To facilitate the measurement of impact on both environmental and socioeconomic outcomes, we will merge the location of GEF projects with a variety of ancillary variables (i.e., precipitation, distance to urban areas). Proposed environmental and SEB indicators align with the United Nations resolution A/RES/71/313, which includes a total of 232 indicators to assist in the measurement of progress towards the SDGs; we specifically focus on indicators for SDG 1 5.1 and 15.3 for environmental outcomes, and SDG 1, 7 and 11 for socioeconomic outcomes. Based on guidance from the UNCDD for SDG 15.1[1] and 15.3[2], Environmental Indicators will include (Where G denotes data used for the globally consistent analyses, and L denotes data for local-scope analyses):

- (G) Forest area as a proportion of total land area
- (G) NDVI as a proxy for NPP (MODIS and AVHRR-based)

A variety of indicators will be used to directly measure socioeconomic benefits across a number of SDG focus areas, including SDG 1.1[3], 7.1[4], 11.6[5],

[1] By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

[2] By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation neutral world.

[3] By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than 1.25 a day

[4] By 2030, ensure universal access to affordable, reliable and modern energy services

[5] By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

- (G) Annual mean levels of fine particulate matter (OMI/Aura)
- (G) Proportion of population with access to electricity (VIIRS, DMSP)
- (G) Conflict-related deaths per 100,000 population (ICEWS, GDELT, ACLED)
- (L) Annual household consumption (where available; IPUMS, DHS, see Jean et al. 2017)

These variables will be calculated on the basis of both satellite information and survey data, as is appropriate for a given measurement. Other data that may be used in this analysis include road network data (roads), global administrative zones (geoBoundaries), protected areas (WDPA), population (GPW), topography (SRTM), air temperature and precipitation (UDEL), and land cover (ESA, MODIS and/or from Hansen (2013)).

Task 2. Quantifying Global and Local Benefits of GEF interventions: A two-pronged strategy for quantifying both primary environmental impacts and socioeconomic co-benefits will be followed. First - at the global scale - for every project region geocoded, the overall rate of reforestation will be calculated for projects that had an objective related to this outcome. The overall cost (per hectare of reforestation) per region will be calculated and used as a top-line comparison. This data will provide estimates on the efficiency of GEF outcomes.

Second, building on the global results and building on the geospatial impact evaluation procedures in GEF/ME/C.51/Inf.2, we will apply a Quasi-experimental Geospatial Interpolation (QGI) model to explore the impacts of GEF projects in each local region. QGI provides a unique insight into the causal effect of interventions by allowing researchers to examine the spatial distance-decay of impacts (i.e., if a clinic has an effect only on the village it is located in, or also neighboring villages). QGI broadly mitigates two interrelated sources of bias: (1) the arbitrary selection of a distance threshold and (2) the possibility of spillover of interventions from treated to control locations. Unlike other models used to examine causal impacts, QGI explicitly models the distance-decay function of the treatment estimate through an iterative approach of changing the distance thresholds at which controls and treatments are demarcated (similar to the approach adopted by kriging-based spatial interpolation). QGI provided the basis for previously-published peer review studies of the impact of GEF projects on socioeconomic co-benefits in Uganda; full details on the methodological implementation can be found in that report. In this context, QGI will be applied to iteratively model the impact of GEF projects within each region along six different dimensions, as summarized in table 2.

Table 2: *Indicators and measurement strategies to be employed*

Topic	**Indicator**	**Measurement Strategy/Source**
Environmental Benefits (E)	E.1. Total Forest Cover	MODIS MOD44B Vegetation Continuous Fields (VCF) - Percent Tree Cover.

	E.2. Above Ground Vegetative Biomass	MODIS MOD13A3 Vegetation Indices - NDVI and/or EVI.
Socioeconomic Co-benefits (S)	S.1. Electrification	NEDIS DMSP Nighttime Lights
	S.2. Air Pollution	OMI/Aura Aerosol Optical Depth (Near UV; 2004 to Present)
	S.3. Economic Wellbeing	IPUMS, LSMS, LSMS+, DHS (see table 1)
	S.4. Fragility	ACLED

These quantitative analyses will be accompanied by qualitative synopsis of the causal chains apparent in driving observed outcomes and impacts within each region, with a focus on understanding the complexity of causal chains, and how they differ. This work is described below.

1.2. In-depth case studies

The quantitative results from geospatial analysis will be used as a part of a multi-modal triangulation strategy, in which the evaluation team will conduct extensive desk research (including literature review, project document review, and related activities) and on-the-ground interviews and observation through select case studies conducted to complement and triangulate the findings of the quantitative analysis. The case studies would be selected from the regions proposed in this concept note and would help deep dive into the findings of the global analysis. Within each region, one or two projects will be selected with the aim of assessing specific assumptions and cause-effect relationships in the project design to verify and ground-truth findings and to provide detailed context-specific observations for the evaluation analyses. The selection of these projects will be determined from the project portfolio and the findings from the global analysis.

1.3. Portfolio analysis

This analysis will involve the review of GEF project documents, strategy, and indicators of the GEF results framework. The socioeconomic benefits of GEF projects were not systematically monitored prior to GEF-6; socio-economic indicators were included in the GEF 6 results architecture. The study will thus formatively look at result frameworks since GEF-6 to review the use of socio-economic indicators in projects approved after the change in the GEF results framework. For projects included prior to the GEF-6 results framework, the data analysis and the case studies will provide insights into the nature of socio economic benefits achieved.

1.4. Synthesis reports

Overall, the synthesis will follow mixed-methods approach described earlier. The report will include:

1. Literature review with an annotated bibliography focused on existing research on socioeconomic co-benefits of environmental activities.
2. Portfolio review to capture insights into socio-economic benefits tracked in the GEF
3. Contrast hypothesized co-benefits on the basis of theories identified in step 1 with the findings from the quantitative analysis. The case studies would further provide evidence on the casual linkages hypothesized and validated with satellite information.
4. For each region, a report containing the synthesized outputs of the qualitative and quantitative components of this study will be produced, for a total of 5 reports. These reports will finally be synthesized into a single summary with accompanying graphics and tables.

2. Evaluation Timeline

The evaluation timetable is summarised below.

Tasks	Timeline (by)
Inception – finalization of scope and preliminary evaluation design	March 2023
Computer data and map of GEF projects within each region and data integration tasks complete.	March 2023
Global and local models of GEF project benefits are implemented and finalized.	May 2023
Case studies Field data collection survey	November 2023
Data analysis, triangulation, synthesis	December 2023
Evaluation Report (draft)	March 2024
Evaluation Report (final)	April 2024
Presentation to GEF Council	June 2024

3. Evaluation Team

The co-task managers for this exercise are Geeta Batra and Anupam Anand. Peer reviewers for this evaluation will be Anna Viggh (Internal), and Anand Patwardhan (University of Maryland).