Guidance for Monitoring of Ecosystem Services, Socioeconomic Benefits, and Resilience of Food Security for Global Environment Facility Food Security Integrated Approach Pilot (FS-IAP)

March, 2019

1. Summary

Through Component 3 (Monitoring and assessment of global environmental benefits and agro-ecosystem resilience) of the Global Environment Facility Food Security Integrated Approach Pilot (FS-IAP) project, Conservation International (CI), through its Vital Signs program, and in partnership with other members of the umbrella project, is leading the development of a conceptual framework for multi-scale monitoring and assessment of ecosystem services and socio-economic benefits of the project.

Assessing ecosystem services, socio-economic benefits, resilience of food security, and in particular those specific elements expected to be impacted as a result of project activities, requires a range of indicators to be assessed, from the project-scale through the program level.

The hub project will support the development and assessment of indicators of change in ecosystem services, socio-economic benefits and resilience of food security focusing on the program as a whole. In addition, although the hub project as a unit is not directly involved in project activities across each of the country projects of the FS-IAP, it will also play a supporting role in advising country projects on the types of indicators that might be useful within a project to assess ecosystem services, socio-economic benefits, and resilience of food security within each project.

In addition to providing guidance on methods and indicators, the hub project will also assist countries in obtaining the necessary datasets to conduct monitoring and assessment. Monitoring will require data from Earth Observation (EO), social surveys, and modeled products drawing on both EO and social survey data. The integration of data products from a range of sources data ensures the best available information is available to countries and the hub project. Vital Signs and the Technical Advisory Group (TAG) will be supporting the countries in the acquisition of baseline and gender disaggregated measures at multiple scales and will provide an operational framework for measuring changes in these indicators as projects progress.

This document outlines recommendations on indicators and methods for monitoring ecosystem services, socioeconomic benefits, and resilience of food security and provides recommendations on how to access these indicators.

2. Introduction

The GEF IAP program is responsible for tracking two sets of indicators: Global Environmental Benefits (GEBs), and Socio-economic benefits:

Global environmental benefits:

- Land under integrated management
- GHG emissions avoided or reduced
- Conservation of genetic diversity on farm

- Number of sector policies and regulatory frameworks that integrate biodiversity considerations
- Land cover (trends in NDVI)

Socio-economic benefits:

- Direct beneficiaries (number, and disaggregated by gender)
- Food security index

These two sets of indicators will be tracked and reported to the GEF at the program level. The twelve countries in the IAP have included in their project documents targets of the GEBs that they expect to contribute to. The country level contributions to the GEBs will be aggregated and compared with the measurements at the hub level to demonstrate impact at scale.

The assumption of the FS-IAP design is that the program will have an impact larger than that of the aggregated values of the indicators for the country projects alone, due to the expectation that the technical assistance provided by the program will have broad influence on food security policy and climate resilience in the region. Though the program-level indicators will aid in tracking changes in the region, additional indicators are required to assess those changes that are expected to result from the activities of the individual country projects. Assessing the relative impact of project activities in particular will require indicators more closely linked to the actual on-the-ground interventions and policy changes instituted by the projects.

For this reason, the hub project recommends tracking three sets of finer-scale indicators as well as the broad GEB and socioeconomic benefits indicators: 1) ecosystem services, 2) more detailed information on socioeconomic benefits, and 3) resilience of food security.

This document provides general background and guidance on indicators for assessing ecosystem services, socioeconomic benefits, and resilience of food security, as well as information on potential data sources that might be used for monitoring these indicators.

3. Background on indicators for assessing ecosystem services, socioeconomic benefits, and resilience of food security

3.1. Indicators will vary by tier

The data that is available for monitoring ecosystem services, socioeconomic benefits, and resilience of food security will vary by country project as a function of factors including the project activities (and therefore the appropriate indicators necessary to assess impact) and budget, availability of existing data, and the expertise of the project team and partners.

To account for this variability among projects, the hub advocates a tiered monitoring approach, such that projects make of the best-available information for each indicator, consistent with the objectives, expected impacts, and available budget for that project. Tier 1 indicators (which will be applied at the regional level) will in most cases use primarily publicly available datasets broadly available across the region, while Tier 2 indicators will take advantage of more detailed analysis or data collection taking place across a large number of the individual country projects. Tier 3 indicators will also draw on project-specific datasets, but also on more specialized indicators that may not be commonly collected by the country projects. In the tables below the tier at which each indicator applies will be noted. Some indicators apply across multiple tiers.

3.2. Assessing ecosystem services

A key goal of the IAP is to support the mainstreaming of ecosystem services into development planning, and to safeguard the natural capital that supports these services. The IAP targets geographies that have experienced loss of ecosystem services, with resultant impacts on food security and human wellbeing. Sustainable land management and other forms of sustainable agricultural production offer the potential of improving productivity, while also reducing the loss of ecosystem services (such as hydrological and climate regulation, nutrient and carbon cycling, pest and disease control) that are essential for sustainable and resilient agroecosystems.

To assess project impact on ecosystem services, establishing a baseline of ecosystem services prior to the initiation of project activities, and monitoring of these services throughout the project duration is necessary. There are various approaches for monitoring ecosystem services. The most direct approach is to use modelling tools that allow direct modelling and valuation of the ecosystem services provided by an area. While this approach is useful in quantifying services provisioning, it does generally require specialized datasets and modeling experience. Neugarten et al. (2018) provide a recent overview of modeling tools in this area. As an alternative to modeling, indicators can be used. Indicators are values "derived from measures", that can be used to indicate the level of services provisioning in the absence of direct measurement (Egoh et al. 2012). For example forest cover as derived from satellite imagery might be used as an indicator of carbon sequestration (a provisioning service provided by ecosystems).

While projects should consider the potential of using modeling tools to assess ecosystem services, if project's do not have access to expertise in the application of these tools, the hub project recommends that indicators be used. A list of suggested ecosystem services indicators to be monitored at each tier is in Table 1. Given the regional scale monitoring required by the hub-project, the majority of the ecosystem services indicators will be monitored using Earth observation, supplemented with national-level data from country projects where available. At minimum, ecosystem services indicators should be assessed at baseline and in year five for each project.

Service Type	**Service**	**Indicator**	**Scale**	**Source**	**Tier 1**	**Tier 2**	**Tier 3**
Provisioning (products obtained from ecosystems)	Fodder production	Productivity of grassland areas	250 m	Earth observation	X	X	X
	Fodder production	Grassland area	30 m	Earth observation	X	X	X
	Crop production	Productivity of agricultural land	250 m	Earth observation	X	X	X
	Crop production	Agricultural land area	~ 30 m	Earth observation	X	X	X

	Water provision	Surface water availability		Modeling		X	X
	Water provision	Ground water availability		Modeling		X	X
	Water provision	Evapotranspiration		Earth observation	X	X	X
Regulating (benefits from regulation of ecosystem processes)	Climate regulation	Change in soil carbon	300 m	Modeling	X	X	X
	Climate regulation	Aboveground biomass	~ 30 m	Earth observation	X	X	X
	Climate regulation	Belowground biomass		Earth observation	X	X	X
	Erosion prevention	Potential soil erosion		Modeling		X	X
	Water flow regulation	Soil characteristics		Modeling		X	X
	Water flow regulation	Nutrient retention		Modeling		X	X
Cultural (non-material benefits from ecosystems)	Tourism	Visitor numbers to natural features	Per park	Logs, proxies like Flickr		X	X
	Aesthetic value	Area of natural land cover types	~ 30 m	Earth observation	X	X	X
	Tourism	Accessibility of natural areas	~ 30 m	Earth observation	X	X	X

Table 1. Potential ecosystem services indicators to be monitored at each tier. Modified from Egoh et al. (2012) and Brown et al. (2014).

3.3. Assessing socioeconomic benefits

Across all country projects the hub project will assess beneficiary households (number), as well as gender-disaggregated data collected by country projects, and the food security of households using an index to be developed by FAO. In addition to these broad indicators, the hub project recommends that projects collect additional data (disaggregated by gender where applicable), in order to characterize project socioeconomic impacts in more detail.

The information required to assess the socioeconomic benefits of projects generally must be collected using household surveys. Above the project-level (at national-regional scales), publicly available datasets based on census or large sample surveys carried out by international organizations can be useful, however some expertise in data analysis and statistical modeling is required in order to calculate meaningful indicators from these datasets. Additional details on publicly available datasets is provided in section 4.2.

Indicator	Scale	Source	Tier 1	Tier 2	Tier 3
Income*	Individual (household if not available)	Social surveys		X	X
Land area under integrated management	Household	Social surveys		X	X
Membership in co-ops, farmers organizations, and advisory networks*	Individual	Social surveys		X	X
Employment (status, occupation, type, broken down by age and gender)*	Individual	Social surveys	X	X	X
Richness of traditional crop varieties and animal breeds	Household	DATAR		X	X

*Table 2. Potential indicators of socioeconomic benefits to be monitored at each tier. Also see gender integration indicator framework for hub project. *Indicates an indicator that should be disaggregated by gender.*

3.4. Assessing resilience of food security

The program-level indicators are not designed to capture changes in the resilience of food security per se. Given the aims of the program as a whole, it is useful to ensure that indicators relevant to assessing resilience of food security are assessed. While there are varied definitions of "resilience" throughout the literature, the RAPTA Framework (O'Connell et al. 2016), provides a definition that is particularly useful in the context of GEF project design. The RAPTA Framework defines resilience as:

> "the capacity of a social–ecological system to absorb shocks and trends (e. g. like drought) and to reorganise so as to retain the same functions, structure, and feedbacks (i.e. the same identity)"

Borrowing from the RAPTA definition, and from Bullock et al., (2017) resilient food security can be defined:

> A system with resilient food security is able to maintain food access, availability, and utilization in the face of chronic and acute stresses and shocks.

Resilience is generally recognized as arising from the combination of three factors: absorptive capacity (ability to absorb a stressor or shock without loss of function or change in structure), adaptive capacity (ability of to learn and adjust), and transformative capacity (ability to transition to a new system) (Béné et al. 2012, Douxchamps et al. 2017). These three capacities, and their interactions, cannot be assessed directly. Therefore, practitioners must instead monitor indicators associated with these three capacities that can be more directly measured.

There have been a number of alternative frameworks proposed in the literature for assessment of resilience, together with a set of associated indicators, and a number of tools have been developed specifically for the assessment of resilience, such as the Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP) (Choptiany et al. 2015), Resilience Index Measurement and Analysis (RIMA) and RIMA-II (FAO 2016), and Community-based Resilience Analysis (CoBRA) tools. Data from the SHARP survey related to socio-economic and biophysical aspects of resilience have been collected as part of GEF projects in a number of FS-IAP countries (Uganda, Burundi, Burkina Faso, Senegal). The SHARP survey also provides information on priorities to strengthen resilience at household level.

Douxchamps et al. (2017) provide an overview of these and similar tools. In addition to these frameworks focused directly on resilience, social survey and qualitative analysis frameworks designed to assess other aspects of land systems can also provide useful information and guidance on design of questions to capture key indicators associated with resilience. For example, the Multidimensional Poverty Assessment Tool (MPAT) (designed to assess poverty), and Women's Empowerment in Agriculture Index (WEAI) (designed to assess women's empowerment), provide detailed guidance on assessing each of these key areas.

Indicators for assessing resilience can in general be broken down into a number of categories (borrowing from Douxchamps et al. 2017): assets and capacities, stressors and shocks, and contextual factors. Indicators of assets and capacities are related to the unit of analysis (a household, village, or other unit, depending on the project), and include assets, uses of these assets, and capacity to learn. Indicators of stressors and trends assess the magnitude, frequency, and type of thhese influences, while contextual factors are associated with institutions, natural resources, and ecosystem function. Asses, use of assets, and capacities are all associated with the unit of interest itself (for example the household), while indicators of stressors and trends and contextual factors are associated with broader scales.

The tables following in this section list a number of examples of indicators that might be used to assess resilience within these three categories of indicators. Note that the hub project does not expect every country project to assess the full list of indicators contained in the tables within this section. The appropriate indicators for each country project should be chosen with consideration for the type of project that is being implemented. It is recommended, however, that country projects attempt to collect at least several relevant indicators from within each of the categories of indicators listed below, and at minimum that they be collected both at project initiation and completion, such that each category of resilience can be assessed prior to and after project activities.

Guidance on potential indicators for assessing assets, uses of assets, and capacities at the household-level are listed in Table 3. Note that the particular indicators to be assessed will vary by country project, and the choice of indicators should be informed by an analysis of which assets, capacities, and uses of assets are most likely to be effective in building resilience to the particular stressors and shocks that are identified as affecting the site (Constas et al. 2014).

Category	**Example**	**Scale**	**Source**	**Tier 1**	**Tier 2**	**Tier 3**

Assets (resources associated with unit of analysis)	Income*	Individual (household if not available)	Social surveys		X	X
	Food Insecurity Experience Scale (FIES)*	Individual	Social surveys, following FIES			X
	Land area (per household)	Household	Social surveys		X	X
	Household size (number of people)	Household	Social surveys		X	X
	Gender of household members	Individual	Social surveys			X
	Age of household members	Individual	Social surveys			X
	Health (stunting, infant mortality rate, etc.)*	Regional	Social surveys	X	X	X
	Evenness of crop varieties and animal breeds	Household	DATAR		X	X
	Effective population size (animals only)	Household	DATAR		X	X
	Richness of traditional crop varieties and animal breeds	Household	DATAR		X	X
	Access to time and labor saving technologies (min tillage, water pans, irrigation kits, efficient stoves, etc.)*	Household	Social surveys			X
	Time spent in sourcing for resources like firewood or water	Household	Social surveys			X
Uses of assets (how assets support livelihoods)	Access to agricultural advisory or inputs*	Individual	Social surveys		X	X
	Access to small grants, saving, and borrowing services*	Individual	Social surveys		X	X

	Membership in economic organizations (co-ops, farmers organizations, and advisory networks)*	Individual	Social surveys		X	X
	Leadership of economic organizations (co-ops, farmers organizations, and advisory networks)*	Group-level	Social surveys		X	X
	Membership in non-economic organizations (natural resources management, community and social infrastructure)*	Individual	Social surveys		X	X
	Leadership of non-economic organizations (natural resources management, community and social infrastructure)*	Group-level	Social surveys		X	X
	Schooling*	Regional (tier 1) or individual (tiers 2 and 3)	Social surveys	X	X	X
	Land management (crop rotations, soil and water management)	Household	Social surveys		X	X
	Area of traditional crop varieties and number of animal breeds per hectare	Household	DATAR		X	X
	Trends in population size of breeds and of crop varieties	Household	DATAR		X	X
	Knowledge management (sharing between farmers, record keeping, baseline knowledge of agroecosystem, etc.)	Household	Social surveys			X
	Level of mutual decision-making*	Household	Social surveys			X

	Distribution of tasks across members of the family*	Household	Social surveys			X
Capacities (to cope, adapt, and learn)	Coping strategies*	Household	Social surveys			X
	Employment (status, occupation, type, broken down by age and gender)*	Individual	Social surveys	X	X	X
	Adoption of new technologies*	Individual (household if not possible)	Social surveys			X
	Exposure to mass media*	Individual	Social surveys	X	X	X
	Literacy*	Individual	Social surveys	X	X	X

*Table 3. Potential project-level indicators for assessment of assets and capacities at each tier (modified from Cabell and Oelofse, 2012). *Indicates an indicator that should be disaggregated by gender.*

Potential indicators for monitoring stressors and shocks are listed in Table 4. Not all of these indicators will be relevant for each country project. As with the indicators for assets, uses of assets, and capacities, the indicators chosen to assess stressors and shocks will vary by country project depending on the project activities and local context.

Category	**Example**	**Scale**	**Source**	**Tier 1**	**Tier 2**	**Tier 3**
Climate	Trend of number of rainy days per year	1 – 10 km	Earth observation, and/or station data	X	X	X
	Trend of wettest quarter precipitation	1 – 10 km	Earth observation, and/or station data	X	X	X
	Rate of change of maximum daily temperature	1 – 10 km	Earth observation, and/or station data	X	X	X
	Rate of change of minimum temperatures	1 – 10 km	Earth observation,	X	X	X

			and/or station data			
Degradation	Trend of productivity	10 – 100 m	Earth observation	X	X	X
	Change in land cover	10 – 100 m	Earth observation	X	X	X
	Change in soil carbon	10 – 100 m	Earth observation, direct observation	X	X	X
Conflict	Political conflict	Local - regional	Qualitative sources		X	X
Disease	Pest and disease outbreak	Local – regional	Earth observation, direct reports		X	X
Markets	Volatility of food and commodity market pricing	Local – regional	Statistical and survey data		X	X

Table 4. Potential project-level indicators for assessment of stressors and trends at each tier. Adapted from Constas et al. 2014 (2014) and Douxchamps et al. (2017). Note that these indicators will vary greatly among projects depending on the project activities and agroecological system under consideration. Projects should choose indicators relevant to the particular stresses and shocks likely to be encountered by households in the project area.

A number of examples of indicators that might be used by country projects to monitor context are listed in Table 5. These indicators capture those factors that are not determined at the household-scale, but that might shape resilience within project areas, and the capacity of households to respond to stressors and shocks (Constas et al. 2014).

Category	**Example**	**Scale**	**Source**	**Tier 1**	**Tier 2**	**Tier 3**
Social	Infrastructure access	Local - regional	National data, gridded data		X	X
	Market access	Local	National data, gridded data		X	X
	Social networks	Local	Social surveys			X

	Strength of local institutions	Local - national	Social surveys, qualitative data		X	X
Ecological	Climate (annual precipitation, mean temperatures, agroecological variables)	1 – 10 km	Earth observation	X	X	X
	Number of growing seasons	Regional	Earth observation	X	X	X
	Agricultural suitability, agro-climatic potential yields	Regional	Earth observation, modeling	X	X	X

Table 5. Potential project-level indicators for assessment of contextual factors at each tier, adapted from Douxchamps et al. (2017).

4. Datasets and tools to be supported by hub project for assessment of ecosystem services, socioeconomic benefits, and resilience of food security

A range of tools available from the hub partners to support data collection and calculation of indicators by the country projects, as well as by the hub component. CI has developed an operational system, Trends.Earth, for delivery and analysis of spatial datasets, and has integrated datasets from the European Space Agency-supported EO4SDG program and other partners into the system. Trends.Earth leverages Google Earth Engine, a hybrid cloud and desktop-based system for processing spatial datasets, and QGIS, an open-source Geographic Information System (GIS). The Trends.Earth project (http://trends.earth, Figure 1), supported by prior GEF financing, provides a unique system that supports users in acquiring and analyzing large spatial datasets, allowing users with limited Earth observation and GIS experience to access EO-derived information even in areas of low-bandwidth. The system is free, fully open-source, and is already being widely used to assist countries analyzing datasets in support of reporting to the United Nations Convention to Combat Desertification (UNCCD). Representatives from over 140 countries have already been trained on the system (including over 46 in sub-Saharan Africa).

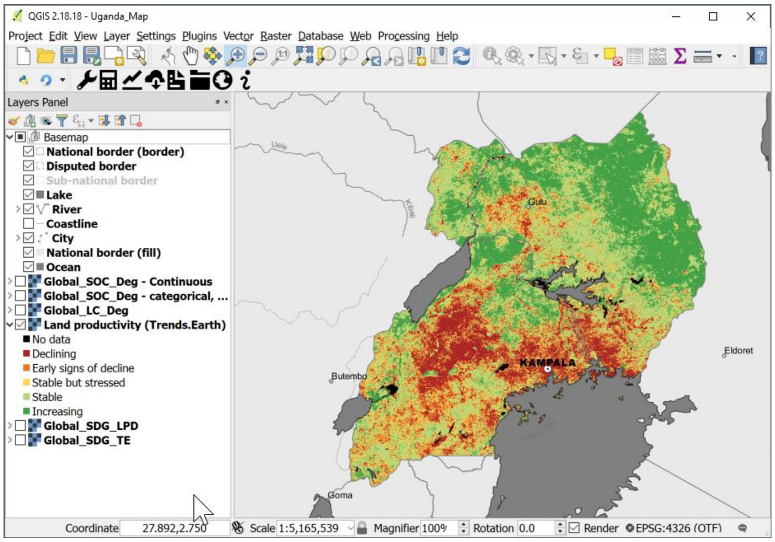

Figure 1. Example analysis within Trends.Earth.

CI also maintains a related tool, the Resilience Atlas (http://www.resilienceatlas.org, Figure 2), for basic access to indicator datasets (including online mapping and visualization of basic analyses) through a web portal. The Resilience Atlas was designed to allow users policymakers and others to derive insights from large survey and climate datasets by visualizing the factors that affect resilience to stressors and shocks like climate change – without the need for expertise on how to download and analyze large datasets.

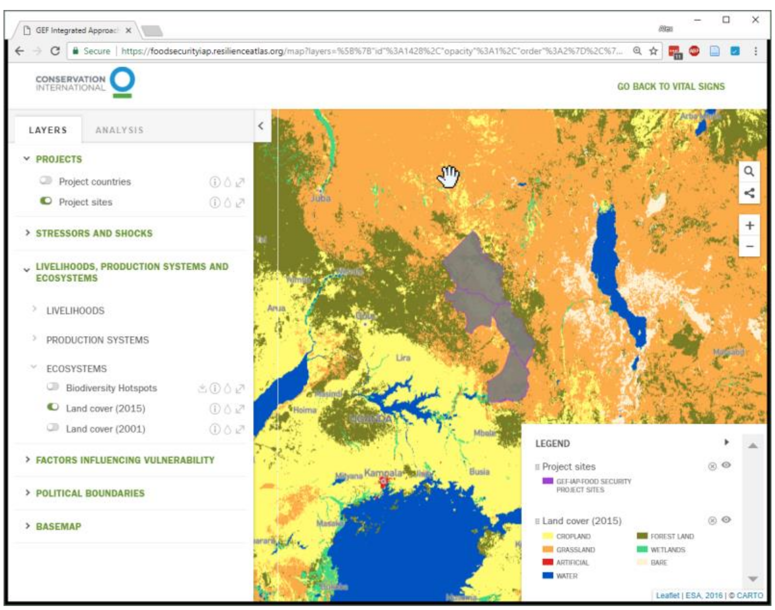

Figure 2. The FS-IAP Resilience Atlas, visualizing the FS-IAP project areas in Uganda overlaid on top of the European Space Agency Climate Change Initiative (ESA-CCI) Land Cover data from 2015.

Data from a range of sources (including the European Space Agency, NASA, World Bank, FAO, and others) has been incorporated into both the Trends.Earth and Resilience Atlas systems for usage by the hub project and IAP countries, and training on both tools was provided in May 2018 at the IAP meeting in Nairobi. The IAP-customized Resilience Atlas is available online at: https://foodsecurityiap.resilienceatlas.org

To support the FS-IAP countries in accessing and analyzing the EO-derived indicator datasets, while simultaneously building Earth observation and GIS capacity, CI will train countries (focusing on monitoring and assessment focal points from each country) on the use of the Trends.Earth and Resilience Atlas tools in collaboration with existing capacity-building efforts in the region, and in conjunction with the annual FS-IAP workshops being organized by the hub project.

4.1. Potential sources of earth observation (EO) data

There are a number of freely available datasets derived from earth observation that can support country projects in the calculation of indicators of ecosystem services, socioeconomic benefits, and resilience of food security. <> lists some of the key data sources. While country projects and the regional hub project are not expected to monitor every indicator on this list, this list provides guidance to potential data sources if a specific indicator is needed for a particular country project. CI will facilitate access to the datasets on this list through the Resilience Atlas and Trends.Earth.

Indicator	**Title**	**Spatial resolution**	**Temporal resolution**	**Coverage**	**Source / Notes**	**License**	**HUB Contact**
Land cover	Land cover	300 m	Annual	All IAP countries, 1992 – 2015	European Space Agency Climate Change Initiative (CCI). Land cover, land surface seasonality products and open water bodies.	Freely available under CC by-SA 3.0 license	EO4SD - GeoVille
Land cover	Land cover (30 m)	30 m (10-20 m, where resolution of Sentinel data is available)	Years 1 and 4 of project	All IAP countries	Produced by CI in collaboration with regional partners. Both annual (two time points) and land cover degradation layers will be provided.	Freely available under CC by-SA International license	CI
Productivity	Above ground biomass production	250 m	Annually (2010-2016)	All IAP countries	FAO WaPOR	Freely available under CC by-SA 3.0 license	EO4SD – eLEAF

Climate	Actual Evapotranspiration	250 m	2010	All IAP countries	FAO WaPOR	Freely available under CC by-SA 3.0 license	EO4SD - eLEAF
Productivity	Gross Biomass Water Productivity	250 m	Annually (2010-2017)	All IAP countries	FAO WaPOR	Freely available under CC by-SA 3.0 license	EO4SD - eLEAF
Productivity	Land productivity	250 m, 8 km	Annual	All IAP countries, 2001 – present at 250 m, 1982 – 2015 at 8 km	Trends.Earth, produced following UNCCD SDG 15.3.1 GPG, and MODIS MOD13Q1-coll6 or AVHRR GIMMS. Broken into five classes consistent with UNCCD SDG 15.3.1 GPG	Freely available under CC by-SA 4.0 license	CI
Soil properties	Soil organic carbon	250 m	Annual	All IAP countries, 1992 – 2015	Trends.Earth, drawing on ESA CCI, SoilGrids, produced following UNCCD SDG 15.3.1 GPG. Both annual and soil organic carbon degradation layers will be provided.	Freely available under CC by-SA 4.0 license	CI
Climate	Precipitation (current and historical)	.05°	5-day, monthly, annual, climatology	All IAP countries, 1981 – present	Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS). Derived change products will also be provided.	Public domain	CI
Climate	Precipitation and temperature (projected future)	.25°	Aggregated into projections	All IAP countries	NASA Earth Exchange Global Daily Downscaled	Public domain	CI

			for 2040-2060, and 2080-2100		Projections, processed by CI into derived products.		
Climate	Carbon emissions due to deforestation	30 m	annual	All IAP countries, 2000 - present	Trends.Earth, drawing on Hansen et al. (2013) Global Forest Change data, ESA CCI, Intact Forest Landscapes, IPCC Climate Zones, and IPCC GPG-LULUCF	Freely available under CC by-SA 4.0 license	CI
Food security	Famine Early Warning System (FEWSnet)	Polygon shapefiles	Quarterly	All IAP countries, except Burundi, Eswatini, Ghana or Senegal	USAID	Freely available under CC by-SA 4.0 license	NA

Table 6. Freely available datasets from earth observarion data, with global or continental coverage. Also see the "Best Practices Guidelines for using Earth observation for Food Security" document for further guidance on these datasets.

4.2. Potential sources of social survey data

While the hub recommends country projects design their own data collection using existing tools to ensure they have relevant indicators collected at the appropriate scale for their projects, there are two broadly available social survey datasets that country projects might find useful for supplementing these datasets with indicators at the regional to sub-national scales: the Living Standards Measurement Study, and the Demographic and Health Surveys. These two programs are the largest multi-national data collection efforts drawing on individual-level survey data, and are available in a majority of the IAP countries (Figure 3).

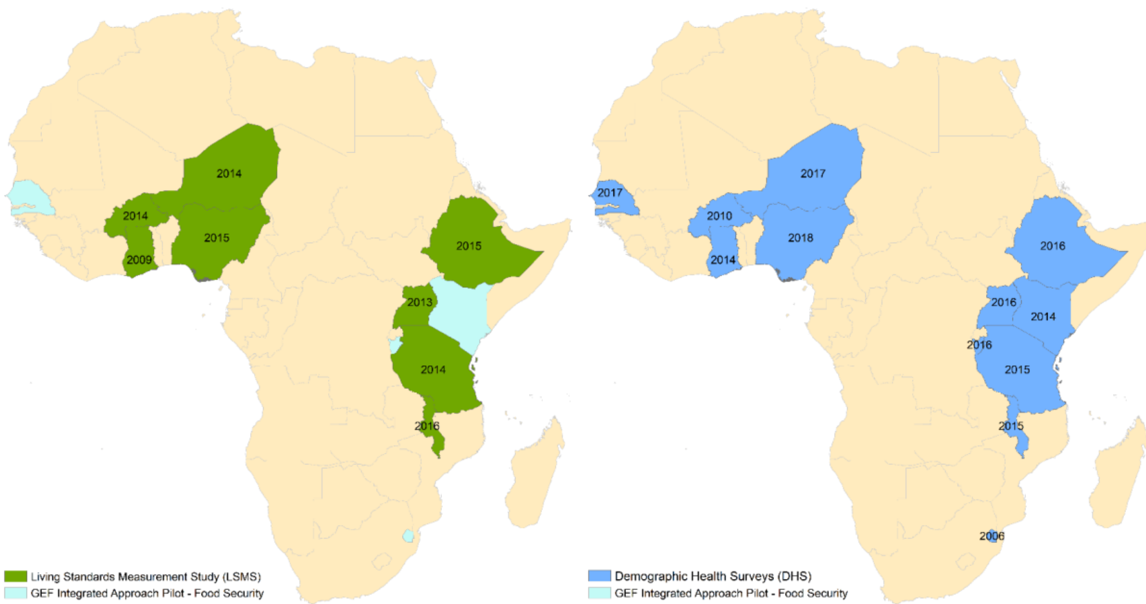

Figure 3. Availability and year of last survey for last LSMS survey (left), and availability and year of last DHS survey (right) for the FS-IAP countries.

A list of some of the primary indicators that can be derived from DHS and LSMS countries is listed below (Table 7). In addition to information from social surveys, which are typically representative at the first sub-national level, data from modeled socioeconomic data products, including from the WorldPop project and Gridded Population of the World (GPW), can be used to calculate population within project areas, which might be useful as an input when assessing the potential beneficiaries of country projects.

Category	**Variable**	**Source**
Population and health	Stunting (percent of children)	DHS
	Total population	WorldPop (100 m resolution)
	Total fertility rate	DHS

	Infant mortality rate (per 1,000 live births)	DHS
	Wasting (percent of children)	DHS, LSMS
	Underweight (percent of children)	DHS, LSMS
Human Capital	Illiteracy rate (women)	DHS
	Illiteracy rate (men)	DHS
	Percentage of people with secondary education (women)	DHS
	Percentage of people with secondary education (men)	DHS
	Percentage of people without access to mass media (women)	DHS
	Percentage of people without access to mass media (men)	DHS
Manufactured Capital	Access to piped water	DHS
	Access to electricity	DHS
	Access to grain storage	DHS
	Access to land line phone	DHS
	Access to cellular phone	DHS
	Road access	DHS
Agriculture	Sensitivity of cereal yields to rainfall variability	Derived product from LSMS using CHIRPS data

Table 7. Social survey-derived indicators available to countries from regional survey datasets (LSMS and DHS).

4.3. National data available from countries

In addition to the EO and multi-country social survey datasets described above, there are national-level data available from the statistics offices of many of the IAP countries. A number of these potential data sources are listed below.

Country	**Source**	**Years Available**
Swaziland	UNICEF, SwaziStats	(1967 to present), 2007, 2017
Malawi	UNICEF, Malawi NSO	(1966-present), 2008
Tanzania	TZA NBS, UNICEF	2002, 2012
Uganda	Uganda Bureau of Statistics, UNICEF	2002, 2014

Kenya	UNICEF, KNBS	2009 (next in 2019)
Burundi	UNICEF, Central Bureau of Census	2008-2009, 1990, 1979
Ethiopia	UNICEF, Central Statistics Agency	2007, 2017
Senegal	UNICEF, Census	1976, 1988, 2013
Nigeria	UNICEF, NBS	1997, 2016
Ghana	UNICEF, Statistical Service	2000, 2010
Niger	UNICEF, Stat-Niger	1977, 1988, 2001, 2012
Burkina Faso	UNICEF, Stats	2006, 2017

5. Regional capacity building for analysis and use of EO and social survey data

CI will harmonize and complement other capacity building efforts that have been adopted by the country projects (including Burundi, Uganda, Ethiopia and Malawi) including the use of tools developed by other organizations including FAO, European Space Agency (ESA), Earth Observation for Sustainable Development (EO4SD) and the Regional Mapping of Resources for Development (RCMRD) in East Africa, and the NASA SERVIR West Africa program (Figure 4), to build capacity in analysis of EO and social survey data.

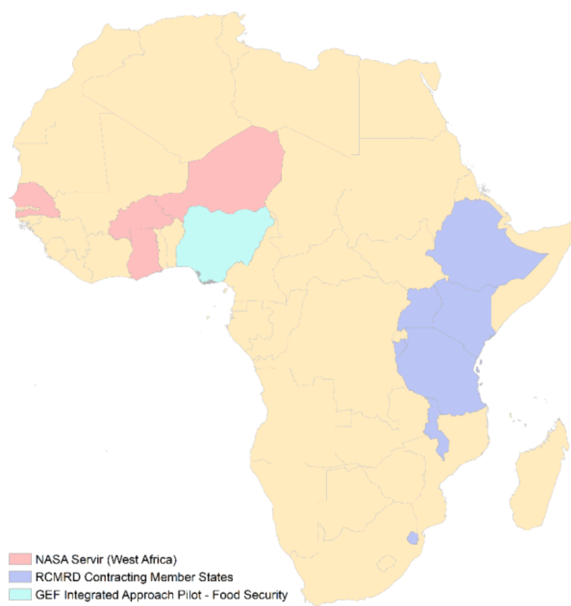

Figure 4. Status of FS-IAP countries within the service area of the Regional Centre of Mapping of Resources for Development (RCMRD) and NASA SERVIR West Africa programs.

6. Data gaps

Earth Observation (EO) data provides the opportunity for wide area mapping of key indicators of ecosystem change. To some extent EO data can also provide contextual socioeconomic information (population distribution and structure, proxies for infrastructure access, crop yields). However, other variables (health related data, for example) are more difficult to assess with EO. Socioeconomic datasets like DHS and LSMS are very useful at broad scale (first sub-national level) and can be used for finer scale mapping and analysis by experts familiar with methods for disaggregating this data. However, these data are not available across all of the IAP countries (Senegal, Kenya, Burundi, and Swaziland do not have LSMS data, for example). Therefore, there is a need for project-level activities particularly around socioeconomic data collection, to ensure that relevant indicators are available at project-scale. See section 3.4 for potential tools that might be used to guide such data collection.

7. References

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