The Hectares Indicator Methods and Guidance

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Contents

Glossary

ESA	European Space Agency
FIP	Forest Investment Program
GFOI	Global Forest Observations Initiative
GIS	Geographic Information Systems
GTAP	Global Trade Analysis Project
ICF	International Climate Fund
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales (Colombia)
IFRI	International Forestry Resources and Institutions (University of Michigan)
INPE	Instituto Nacional de Pequisas Espaciais(National Institute for Space Research, Brazil)
IPCC	Intergovernmental Panel on Climate Change
KPI	Key Performance Indicator
MEL	Monitoring, Evaluation and Learning (recently named "Compass")
ODA	Overseas Development Assistance
OECD	Organisation for Economic Co-operation and Development
PIA	Programme Impact Area
REDD+	Reducing Emissions from Deforestation and Forest Degradation
MSFP	Multi-Stakeholder Forestry Programme (there are MSFP's in Nepal and Indonesia)
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UKSA	UK Space Agency
VPA	Voluntary Partnership Agreement

About the Hectares Indicator

The Hectare Indicator is a consistent, widely applicable, low cost approach to monitoring the effectiveness of interventions that aim to save forests from loss or degradation. It provides fund and programme managers with tools to report and analyse the effects of interventions across the areas where they are applied.

Why is it needed?

- Global forest resources, particularly in the tropics are under pressure from a range of threats, including agricultural expansion, mining, and over extraction of timber and fuelwood.
- Billions of dollars are spent by agencies, governments, NGOs and private sector initiatives to reduce forest loss.
- But the effectiveness of interventions to reduce forest loss and improve forest governance are rarely measured.

Who is it for?

All organisations that fund, invest in or participate in efforts to reduce forest loss and establish sustainable forest use.

Why bother?

Without monitoring the effectiveness of investments in sustainable land use, public finance will be wasted on ineffective interventions, forest loss will continue and lessons about what works in different areas cannot be learned.

Background and Applicability of the Hectares Indicator

The Hectares Indicator Methodology was originally developed to enable investments under the UK's international climate fund (ICF) to report against an agreed Key Performance Indicator (KPI 8) - ***the area of avoided forest loss attributable to UK investments in developing country forestry programmes***. The methodology has now been tested in 7 countries and continues to be used to assess the effectiveness of several UK government ODA programmes.

Box 1. UK's ICF Forest Investments

The International Climate Fund (ICF) is a major part of the UK's commitment under the Copenhagen Accord (UNFCCC, CoP15, 2009), whereby developed countries agreed to jointly mobilise $100 billion per year of climate finance by 2020 from public, private, bilateral and multilateral sources to support developing countries mitigate and adapt to climate change though low carbon growth, reduced deforestation and increased resilience.

Overseas Development Assistance (ODA) funding provided from the ICF between April 2011 to March 2016 was £3.87 billion and a further £5.8 billion has been committed to March 2021, along with an intent to stimulate similar levels of private finance. Investment in forest related programmes is expected to make up approximately 20% of funding - approximately £200 million per year.

To ensure that funds are used effectively and efficiently, and to ensure that lessons are learned from implementation, the programmes applying ICF resources are required to report against relevant Key Performance Indicators (KPIs). The intent is that KPI reporting should not be a "tick box exercise" but should link into processes of monitoring, evaluation and learning at different levels within donor departments, programmes, multilateral partners and recipient country institutions.

During development and testing of the Hectares Indicator several potential applications to private and public-sector interventions have become apparent, including:

- Forest and land use investments by a wide range of donors and multilateral investment institutions, in response to a general growth in the demand for transparency and accountability for results from ODA funding;
- Private sector investments in climate smart agriculture and zero deforestation supply chains;
- Developing country national forest and agriculture agencies, monitoring and reporting on the effectiveness of sub-national policies and programmes to reduce deforestation and forest degradation in line with national commitments under the UNFCCC Paris Agreement;
- Private sector investment instruments such as green bonds that aim to develop agriculture without losing forests and other natural ecosystems.

All these intervention types can benefit from an on-going, spatially explicit measure of forest loss relative to expected levels of land use change.

About this Version and Related documents

This version of the Hectares Indicator Methods and Guidelines replaces a previous consultation version, published in March 2017. This version takes into account the experiences of organisations applying the guidance over the past 2 years and is written in a more generic style, to be accessible to a broader range of interventions.

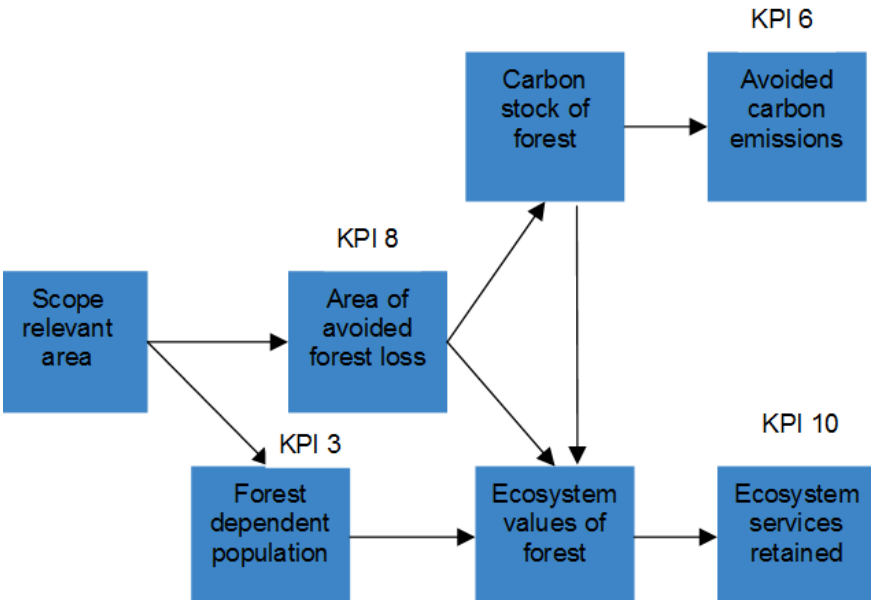
While this document provides an overview and general guidance there are also a number of more detailed training materials and presentations that are available and kept up to date on a more frequent basis.

- End-user manual for applications on the mapping platform (Ecometrica, 2016)
- Mapping platform administrators' manual (Ecometrica, 2016)
- A Review of Earth Observation Methods for Detecting and Measuring Forest Change in the Tropics (Mitchard, 2016)
- The Hectares Indicator - Online Community of Practice (maintained by Ecometrica)

Linkages to Other Performance Measures

The Hectares Indicator is designed to be a building block for other impact measures for forest and land use interventions, as shown in Figure 1. It is important that performance assessments for different components of impact are based on a common view of the geographic and demographic scope of a given intervention. Once the impact area and associated populations of forest dependent people have been identified, these boundaries can be applied to measures of avoided forest loss, avoided greenhouse gas emissions, livelihoods and ecosystem services.

Figure 1. Diagram showing how the ICF's forest related Key Performance Indicators (KPIs) are logically related.



Hectares Indicator Development

Ecometrica and collaborating researchers at the University of Edinburgh and LTS International have been involved in the development of methods, tools and sources of evidence used for reporting the performance of forest and land use projects since 2013.

In 2014, a research team at Ecometrica, University of Edinburgh and LTS International completed a review of potential methods and approaches to quantify avoided forest loss and degradation from projects and programmes.

In 2015, Ecometrica obtained ESA support to test a risk based methodology for the Hectares Indicator in Brazil, Nepal and Ghana.

From 2016 to 2018, DFID funded further development and testing of the methodology in Indonesia, Colombia, Ghana and Brazil. Ecometrica developed Version 1 of the Hectares Indicator Methods and Guidance (published in November 2016).

From 2018 to 2020 the UK Space Agency's Forests 2020 project will be using the Hectares Indicator to monitor progress in six countries.

Development of Data Sets and Mapping Applications

For each country, spatial evidence in the form of map layers (including forest extents from different earth observation initiatives, risk of deforestation maps, historic forest loss maps and relevant administrative boundaries) was made available on interactive mapping applications, developed for each test country on the Ecometrica Mapping Platform EO Labs[1]. This evidence is now in a structure that can be maintained and added to over time. Calculation of avoided loss can also be done by non-GIS experts for specific areas of interest using the spatial data in the system.

[1] An EO Lab is a version of the mapping platform that is under the administration of a local institution or research facility, with Ecometrica providing backup and online support.

General Approach and Guidance

The following points summarise the general approach taken in the design of the Hectares Indicator methodology:

- The methodology is intended to be a light touch, repeatable (preferably annual) quantitative assessment of progress towards the objectives of an investment or intervention, as opposed to a one-off, retrospective study. The results are meant to feed back into programme management in a timescale that can inform decisions on resource allocation and modes of intervention as well as reporting on the impacts.
- Where possible, the Hectares Indicator assessment should use existing forest monitoring assets, particularly data produced by national REDD+ MRV and forest monitoring systems.
- The method combines quantitative steps to estimate the scale and spatial distribution of impacts and qualitative methods to describe context, causality and contribution of the investment.
- The methodology provides a degree of consistency but is non-prescriptive in the selection of data inputs and key assumptions. These should be discussed with stakeholders and experts to understand their limitations and the potential alternatives.
- Use of the mapping platform provided by Ecometrica is recommended, to ensure data and other evidence is transparent, properly curated and can be updated or extended to other areas. The platform also reduces the effort required to calculate and analyse the results. Other mapping software may be used.

Box 2. Why a light touch, annual process?

One-off evaluation studies are often expensive and time consuming. Significant resources are expended in the design, contracting and management of large evaluation assignments. The results of detailed evaluations are rarely delivered in time to be acted upon within the timeframe of a 3 to 5-year project; they tend to inform the future interventions. The advantage of an annual process is that once set up, it can be repeated regularly and can feed into annual budgetary and planning processes. The design of the method means that the outcomes in terms of forest conserved or lost can be viewed in specific locations of the intervention area so that problems and opportunities can be identified. Periodic Hectares Indicator analysis builds up a rich data picture by looking at change over time, so emerging threats can be picked up and acted upon, and the need for specific measures or policy adjustments can be identified.

Use National Data Assets and Definitions, wherever possible

Before starting the assessment of a particular investment on land use change and forest condition it is important to take stock of the forest and land use monitoring systems within the country. Many developing countries are making significant efforts to build national forest monitoring capabilities for REDD+ MRV, FLEGT, land reform, national investment planning and other purposes. Wherever possible, it is recommended to use data and definitions (e.g. the technical definition of forest cover) that are being produced or approved by these national processes. Efforts should be made to engage with relevant forest monitoring institutions to request access to relevant datasets.

At the same time, it should be recognised that few developing countries have yet developed detailed time-series analysis of forest change over the past decade. Furthermore, partner country forest monitoring departments are often overstretched and may find it difficult to devote much time to supporting data requests. There may be practical reasons for not using national datasets, for example where these are still under development or not available for the timescales or geographic areas of the intervention. Ideally, Hectares Indicator assessments should complement national or regional monitoring efforts and can provide useful feedback in terms of usability and accuracy of national data products. If a separate approach is taken then this decision should be justified.

Be Transparent and Evidence-based

The Hectares Indicator methods and guidance are non-prescriptive, with a number of options provided for varying in-country circumstances and intervention types. However, the following practices are recommended for all users:

- Explain choices and assumptions: as there are a number of choices with regard to methodological steps, datasets to be selected as inputs to calculations and assumptions to be made, it is important to explain the choices made when documenting the work.
- Document data and other evidence: as in all scientific and technical work, it is important to keep records of data and other evidence sources, including appropriate references and metadata.
- Curate datasets effectively: many of the data inputs to forest KPIs are in the form of datasets, often spatial data. It is important to curate these effectively, with appropriate version and access controls. The Ecometrica mapping platform provides tools for data curation to ensure results can be reproduced and built upon for future reporting.

Take Care with Interpretation of Results

Estimating the impact of a policy intervention or investment on land use change is not straightforward. Actions for sustainable land use, climate smart agriculture and forestry are not simple cases of fencing off clearly defined areas of forest for protection purposes. They generally involve interactions with a range of stakeholders, from policy makers to civil society organisations and businesses, to address factors underlying deforestation and degradation by promoting changes to existing technical, legal or economic processes.

Box 3. Accountability versus Learning?

The academic literature on evaluation sometimes contrasts quantitative accountability metrics with causal frameworks or systems analysis, with the latter seen as more powerful tools for explaining what happens between programme inputs and observed outcomes (Stern *et al*, 2012). The measurement of physical outcomes is seen by some analysts as less important than understanding the causal relationships between various institutions and stakeholders associated with the intervention.

The approach taken by the Hectares Indicator Methodology asserts that quantitative results are fundamental to understanding the difference between success and failure. When these are mapped and overlain with contextual information on land use, society, and tenure, this provides a rich source of evidence for exploring cause - effect relationships such as the drivers of land use change, the conditions needed for successful interventions and the priorities and opportunities for protecting certain forest ecosystems at risk.

The methodology gives programme managers and M&E teams flexibility in the extent to which they use the results of Hectares Indicator analysis to go beyond basic accountability reporting to explore causal influences and conditions that affect the outcomes and long-term impacts of investments in forests.

While the causes of forest loss and degradation are complex and varied, the question of whether (and crucially where) interventions are succeeding or failing to reverse these losses can be objectively answered, albeit with some degrees of uncertainty, through measurements of forest change relative to the stock of forest at risk. Quantitative results are not an alternative to qualitative analysis but should be used as a foundation of evidence on which to explore causal relationships.

Quantitative results of monitoring can provide information on the extent and condition of forest resources and on the rate of depletion relative to expectations but on their own do not explain the linkages between interventions and outcomes. For example, a successful outcome may arise through local efforts despite a superfluous ODA input. Conversely, the effect of a positive intervention may be masked or overwhelmed by outside events. Analysis of causal linkages will often involve triangulation of evidence from mapping with stakeholder views.

Preparation and Resource Requirements

Wherever possible, Hectares Indicator reporting should be initiated at the planning stage of the investment so that resources are targeted at areas with significant forest at risk. Ideally, several of the methodology steps (scoping and forest risk mapping) can be included within inception phase activities as these are relevant to the allocation of resources. Definition of the forest extent prior to the commencement of the intervention is an essential baseline activity and understanding the risk factors and their spatial distribution should also be considered at that stage.

It is recommended that Hectares Indicator assessments are integrated with the monitoring of other key performance metrics and this is also best planned at the early stages of any intervention.

As previously stated, Hectares Indicator assessments are intended to be light touch, periodic (preferably annual) assessments of progress towards intended outcomes. They are not meant to be in-depth scientific studies, although in some cases more detailed investigations of particular drivers of forest change and how they may be addressed could be undertaken as extensions of the Hectares Indicator work.

Based on experience of countries and programmes assessed during the pilot studies we estimate a time input of 30 to 50 analyst days should be sufficient to conduct an initial Hectares Indicator report for a national or regional scale investment, depending on the scale, complexity of the intervention and the availability of suitable datasets. Annual updates and improvements should be less time intensive, since many of the core datasets covering the impact area and maps of forest at risk should already be established. For subsequent annual updates, 15 to 30 days of analyst input should be sufficient (this includes updating the relevant datasets on the mapping platform, running the new analysis and publishing the results).

Skills

A successful Hectares Indicator assessment requires a combination of skills including Geographic Information System (GIS), forest monitoring using Earth Observation, knowledge of forest policies and the drivers of land use change and forest policy for the programme intervention areas. A two-person analyst team working on a given programme is recommended, with the following skills:

- Moderate to advanced GIS skills, ideally an MSc level in GIS or >2 years post graduate experience, with experience in vegetation classification and use of remote sensing to estimate changes in forest cover and extent. Ideally the GIS analyst should have the support of a team member for conducting quality assurance on data products (it is good practice for GIS products to be quality checked).
- Forest policy or programme consultant with understanding of the theory and practice of interventions in the forest / rural land use sectors, understanding of land dynamics, economic and social drivers and ideally with knowledge of the countries or programmes being assessed.

Data

The datasets required for undertaking a Hectares Indicator assessment are listed in Table 1. As previously mentioned, where nationally recognised datasets are available, these should be preferred, provided they are of appropriate quality (consistency, resolution, accuracy).

Getting access to national datasets necessary for performance assessments is a common issue across many international investment programmes. It is often necessary to get high level sign-off to

data requests, and corresponding time lags for processing and responding to these requests should be factored into the planning of the assessment. It is recommended that programme funding arrangements should include agreements over access to relevant data for monitoring and evaluation purposes. Ideally, the datasets that will be used to monitor progress would be identified as part of the business case and sign-off for project finance.

Table 1. Data Required for Hectares Indicator Analysis

Data Category	Type of dataset	Potential Sources
Programme Impact Area: polygons of farm extents, municipalities, districts, landscapes or other areas that constitute boundaries and subsets of the Programme Impact Area	Vector data in the form of shapefiles, KMZ files or shapefiles/ CSV of points with associated radius or area	Programme implementation organisation and / or local stakeholders
Forest extent: Baseline extent of forest area (may be a simple forest / non-forest dataset or include classifications of forest type or degree of disturbance).	Raster maps in form of geotiff (or vector data in the form of shapefiles that can then be converted to raster files)	National or international forest monitoring organisations
Risk Factors: Maps of factors that influence the risk of forest loss or degradation within and around the impact area: - roads, navigable rivers, existing agriculture, settlements, population density - soil type, slope, rainfall, altitude - land use, ownership type, protection status	Combination of vector and raster datasets used to produce a final risk map	National and sub-national planning agencies, international repositories of soil and climate data, space agencies
Forest Change: time series of forest loss, may be derived from a series of vegetation maps	Time series of raster datasets	National forest monitoring agency or other research centre, e.g. Prodes, 2016 in case of Amazonia University of Maryland or other international source (Hansen et al. 2013) Ecometrica

Tools

The analyst working on the mapping data will likely require a desktop GIS software package, such as QGIS or ArcGIS© for handling and processing data, and for preparing it for upload to the mapping platform.

Raster and vector data layers can be uploaded to the Ecometrica mapping platform which is being used to curate the spatial data used for Hectares Indicator analysis across most of the UK Government's forest investment portfolio. Instructions on how to prepare and upload data onto the mapping platform are provided in the training manual[2]. The mapping platform runs automated queries to deliver results for avoided forest loss as well as the intermediate calculation steps. Details on how to navigate on the relevant applications on the mapping platform are provided in the user instructions[3].

[2] EO Lab training manual for Hectares Indicator Analysis

[3] Ecometrica Mapping Platform user instructions

The Hectares Indicator Methodology

Overview

The Hectares Indicator methodology consists of four steps. While these are sequential some of the tasks may be carried out in parallel:

(1) **Set Scope:** define the impact area, forest and other ecosystem types and timeframe over which the performance is to be estimated, and identify key datasets;

(2) **Set a Reference Level:** determine the reference level of forest loss against which the performance of the intervention will be compared;

(3) **Measure Actual Forest Loss:** use best available data to estimate the actual forest change across the impact area within the reporting period;

(4) **Analyse Results:** calculate the difference between actual change and reference level. Carry out further analysis to examine the contribution and causal linkages between programme inputs and the observed performance.

Each of these steps involves specific tasks and should produce results that feed into the standard report template[4].

To accommodate different programme circumstances, varying data availability and to give programme evaluation teams discretion on the appropriate depth in which to examine causal and contributory factors, some flexibility in the form of *method choices* is provided at each stage.

Prior to starting the assessment, the evaluation team should clarify the needs and expectations of users of the information (e.g. a basic accountability report, or deeper understanding of impacts and processes), they should also ensure that they have adequate resources available to undertake the assessment plus buy-in from relevant programme staff and stakeholders. The methodological choices to be made at each step will be influenced by the availability of data, the needs of users and the resources available. These choices should therefore be considered at an early stage.

As mentioned in the previous section, it is important to consider the resource requirements for Hectares Indicator reporting early within the operational planning and budgeting of the project. Some of the early methodological steps should ideally be undertaken during the inception phase since they can have a significant impact on resource requirements for subsequent reports.

[4] Appendix A

Step 1: Set Scope

The purpose of the scope setting step is to define the impact area and timeframe over which outcomes of an intervention are to be examined and to identify the data sets that will be used or considered.

Main tasks involved in Scoping:

1. Describe the context and how the intervention is expected to affect forest cover and condition within certain areas;
2. Define the geographic extent of the impact area;
3. Review forest extent maps available for the impact area for the start of the project and select most appropriate;
4. Decide whether to use wall-to-wall measurement or representative sample areas;
5. Define potential intermediate outcomes that could indicate progress towards reducing deforestation and degradation.

During the scoping step, it is important to establish relationships with organisations that will input data or information to the Hectares Indicator results and potential users.

S1.1 Describe how and over what timeframe the intervention is expected to impact forest cover and condition

To define the geographic extent of the impact area, it is useful to review the logic of the intervention design to identify types of forest and land use that are likely to be affected by the investment, and over what timescale. Certain forest types (e.g. protected areas, mangroves, or plantation crops) may be excluded from the analysis if they are not likely to be impacted by the intervention. Table 2 gives an example of how inclusion / exclusion criteria might be used to determine which forests to cover within the scope of analysis.

Evidence for this step will include documentation, such as the investment business case, programme log-frames and operational plans, if not already explicit within the project business case, the conditions and constraining factors that are likely to influence the area and types of forest likely to be impacted should be considered.

Table 2. An example of potential decisions on what forest areas to include within scope of a project promoting climate smart agriculture on farms with woodland

Geographic Area Frame	**Forest Categories within Frame**	**Inclusion / Exclusion Decision**
Target Municipalities	Protected Areas	Exclude on basis that climate smart agriculture will not affect forest within PAs
	Forest on hillsides around agriculture	Include on basis that new agricultural practices could have positive or negative impacts on forests outside the farm boundaries (leakage)
	Woodland on farms	Include on basis that these areas will be included in climate smart agriculture plans

	Mangrove	Exclude on basis that this ecosystem is not covered by the intervention and unlikely to be affected by leakage

With reference to the project design and plans, it is recommended to consider the expected timeframes when project outcomes can be expected to result in measurable changes in land use or forest conditions. The timeframe may not be uniform across the project area since there may be pilot areas where interventions are implemented in advance of being rolled out more widely.

It is useful to engage with stakeholders and potential data providers during this step, so that theories of change can be cross-checked and relevant contextual datasets (e.g. forest concession maps and protected areas) can be identified.

The outputs of S1.1 should be:

- Descriptions on what forest / land use types the intervention is expected to impact.
- A description of the causal steps and potential intermediate outcomes.
- A description of the conditions that may alter the intended impact and how these vary in different land use, regional or land tenure contexts.
- A description of the expected timeframe for impacts in different types of land use / areas.

S1.2 Define the geographic extent of the impact area

Forest related investment programmes vary in the extent to which their geographic and forest type boundaries are defined within programme design and operational documents. Where clearly defined political or geographic boundaries are given, then these are readily adopted by the Hectares Indicator analysis. However, this step should also consider whether non-target forest areas could be either positively or negatively affected by activity displacement (also known as leakage). For example, it is possible that extraction of timber could be displaced from officially recognised forest management areas to protected or farm woodlands as a result of tighter regulation. Stakeholder guidance should be sought on whether and to what extent leakage areas beyond the target areas should be included within the boundary of the impact area.

In the case of programmes that operate across an entire country or regions it is helpful to break these down into subdivisions so that comparisons of outcomes in different areas can be made.

Several ICF programmes involve interventions at the level of individual communities or farms that are intended to translate to an impact at the wider landscape level. In these cases, it is important to clarify the assumptions and expectations with donors, implementation agencies and stakeholders with regard to the mechanisms by which farm level interventions are intended to translate into wider landscape impacts. For example, is there an expectation that farm provision of wood for construction and fuel will substitute for extraction from nearby forests? It is useful to map the target farms in relation to forest areas that are thought to be relevant to the programme. Where no clear links between the target farms and the forests in the wider landscape can be made it may be appropriate to constrain the area of impact to the farm level polygons.

Box 4. Application of Boundaries at Farm and Landscape levels for a Silvo-pastoral Programme

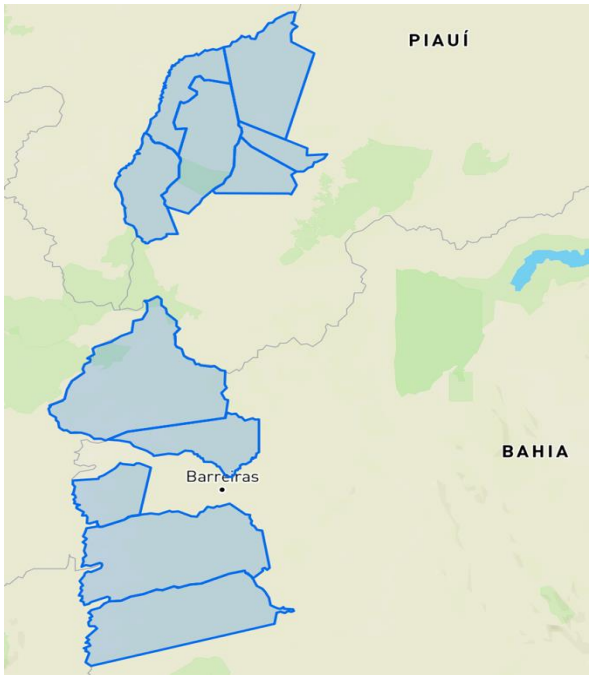
The Nature Conservancy in Colombia carried out a Hectares Indicator analysis of an ICF funded programme to promote low carbon agroforestry systems on cattle farms in Colombia. The analysis was conducted at two levels - (1) farm and co-operative boundaries; (2) landscapes including forested hillsides around those farms. The results showed a successful adoption of zero deforestation commitments within the farmed area and no evidence of increased forest loss in the surrounding areas.

Even where landscape level impacts cannot be directly linked to farm or community level activities it may be relevant to map forests and forest change in the wider landscape to provide contextual or comparative information.

Vector boundary data can be uploaded to the mapping platform as shapefiles and relevant narrative descriptions applied. These areas can be categorised, for example into municipalities or protected areas. Where programmes are being rolled out from initial pilot areas to larger areas it may be useful to differentiate these.

Where a programme operates in more than one country, it is recommended to conduct separate Hectares Indicator analyses for each country.

Figure 2. The municipal boundaries for the first phase of Defra's ICF Cerrado Project (screenshot from icf-cerrado.ourecosystem.com).



The outputs of S1.2 should be:

- A description of the geographic extent of the intervention impact area and how this extent covers both positive and potential negative impact areas;
- Polygons (shapefiles) of the potential impact areas of the programme;

- Descriptions and/or categorisation of programme area polygons.

S1.3 Review Available Forest Maps and Select the Most Appropriate

While ICF forest investment cases frequently estimate areas of forests that could be protected or restored by a given intervention, the forest's defining characteristics (percentage canopy cover, minimum extent and canopy height) and source data are rarely specified. The area quantum is highly dependent on the initial forest map product selected, particularly in the case of fragmented or open canopy woodlands.

The following figures (3a and 3b) show examples of forest extent according to different sources for the municipality of Riachão das Neves in the state of Bahia, Brazil.

Figure 3a: Forest Cover in 2010 according to MODIS (2010)[5]: 76,000 hectares

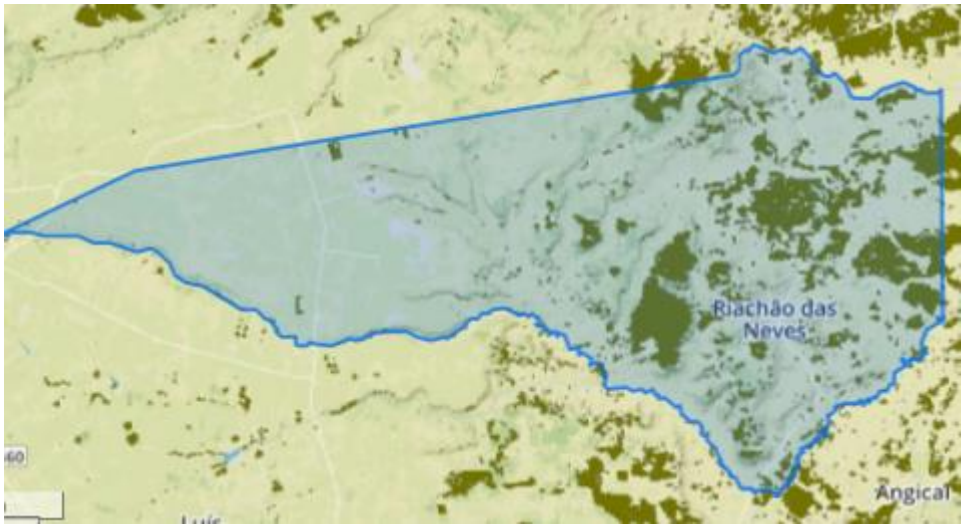


Figure 3b: Forest Cover in 2012 according to Hansen et al (2013): 172,000 hectares

[5] DiMiceli, C.M., M.L. Carroll, R.A. Sohlberg, C. Huang, M.C. Hansen, and J.R.G. Townshend (2011), Annual Global Automated MODIS Vegetation Continuous Fields (MOD44B) at 250 m Spatial Resolution for Data Years Beginning Day 65, 2000 - 2010, Collection 5 Percent Tree Cover, University of Maryland, College Park, MD, USA. Sourced from the Global Land Cover Facility

Having reviewed the available sources of data on forest extent for the impact area, select the most suitable product based on the criteria below, and note the reasons for this selection.

Recommended criteria for selection of most appropriate base map of forest area:

- Recognised by national authorities;
- Available to use;
- Compatible with national forest / non-forest definition;
- Agreement with start date of intervention;
- Adequate resolution (<250 metre pixels).

Forest or land use types found in S1.1 to be irrelevant to the analysis may be masked out of the assessment.

The outputs of S1.3 should be:

- A list of potential forest maps to be used for the starting conditions of the programme;
- A description of the criteria used to select the base map;
- A base map of forest areas uploaded to the mapping platform along with reference data and any adjustments made.

S 1.4 Decide on Sampling Method: Wall-to-wall vs. Representative Sample Areas

Ideally it should be possible to assess land use change processes on a wall-to-wall basis (complete coverage of the impact area), since this avoids extrapolation bias when translating results from sample areas to the wider impact area. However, where there is insufficient available data on forest change or the data available for the area is of insufficient quality then use of samples areas will be necessary.

Figure 4 shows a decision tree in support of the decision on whether to adopt a wall-to-wall or representative sample approach. The key factors in decision making are the accuracy of free or low-cost forest change metrics over the impact area. The University of Maryland (UMD) forest loss dataset is a benchmark set of data on forest loss, since it is produced annually for the whole world and made available on a free and open-source basis. However, the UMD forest loss data is known to vary in its accuracy for detecting forest change and has known limitations in areas of high cloud cover, and in detecting small scale changes due to subsistence agriculture or forest exploitation.

Further information on the suitability of different forest change detection methods is given in Methodology Section - S3 and in the Review of Technologies for Forest Change Detection[6].

When a sample based approach is to be adopted, effort should be made to avoid selection bias[7]. The preferred way to avoid bias is to randomly sample either the whole impact area or stratified sub-sets of the area that have illustrated particular characteristics.

[6] (Mitchard, 2016).

[7] Selection bias is the selection of individuals, groups or data for analysis in such a way that proper randomisation is not achieved, thereby ensuring that the sample obtained is not representative of the population intended to be analysed.

Stratification is a useful way of generating additional information about programme effectiveness within different conditions (forest types, landscapes, socio-political groupings). There are various tools for making random selections of points or polygons within a given area[8] [9].

In some cases, some selection bias may be unavoidable - for example, high levels of cloud cover may make data availability for change detection difficult in certain areas. It may also be the case that certain areas where the programme has piloted work are particularly rich in contextual socio-economic data and are seen as attractive to include within the sample. If specific areas have been chosen for these reasons it is important to note the selection criteria and be duly cautious about extrapolating conclusions to wider areas.

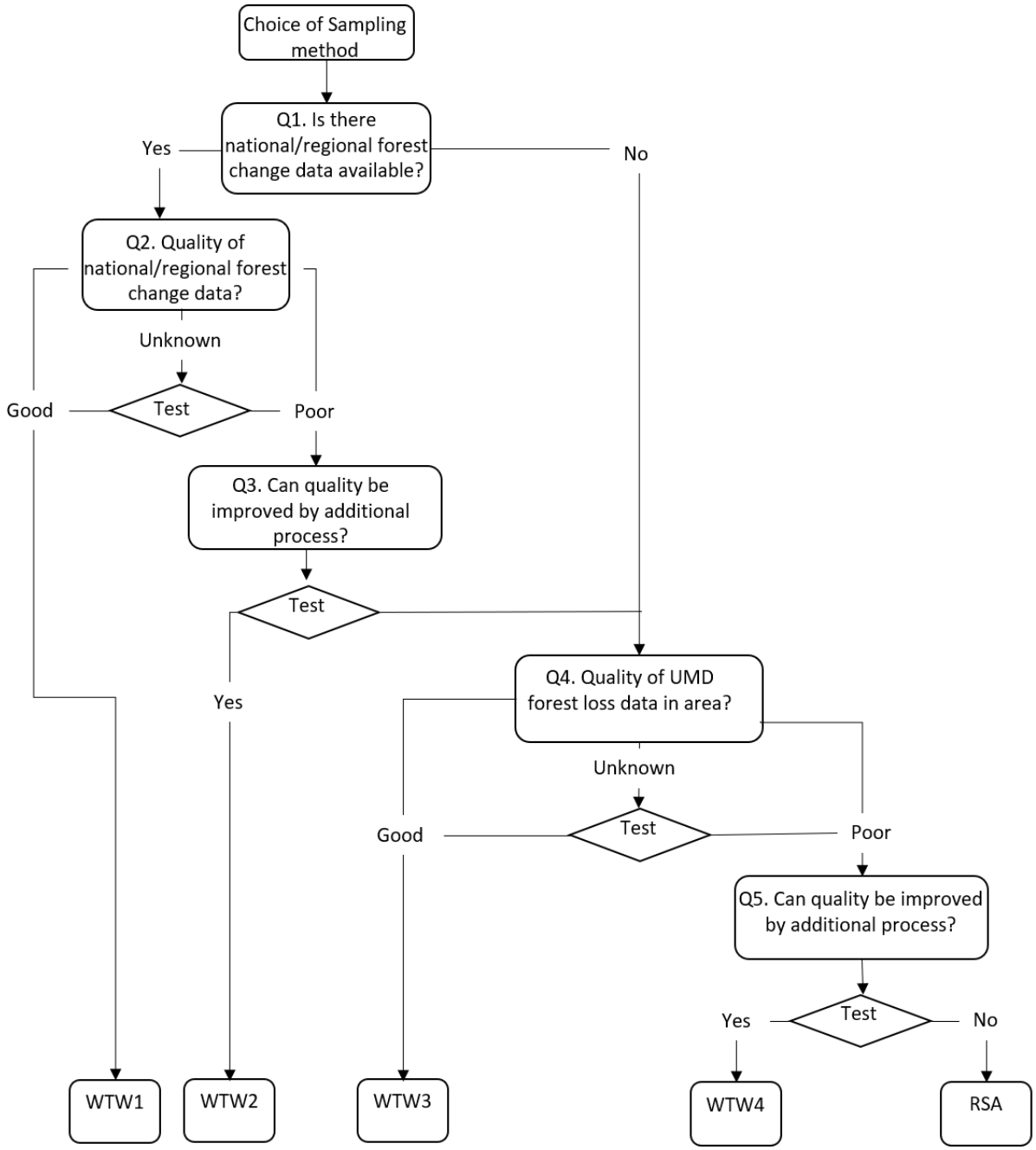
The outputs of S1.4 should be:

- A decision on whether to conduct wall to wall or sample representative based analysis;
- For sample based analysis, a description of the selection and / or stratification methods used.

[8] Buja, K. and C. Menza (2013) Sampling Design Tool for ArcGIS, CCMA, NOA, SIlver Spring, MD

[9] PVANB (2012) https://pvanb.wordpress.com/2012/12/03/stratified-random-sampling-in-qgis/

Figure 4. Decision tree to assist determination of the sampling approach to Hectares Indicator analysis



Outcomes of the decision process:

WTW 1 = Direct use of national/regional forest loss data across whole impact area.

WTW 2 = Use of filtered or processed national/regional forest loss data across whole impact area.

WTW 3 = Direct use of University of Maryland (UMD) forest loss data across whole impact area.

WTW 4 = Use of filtered or processed UMD forest loss data across whole impact area.

RSA = Use of representative sample areas.

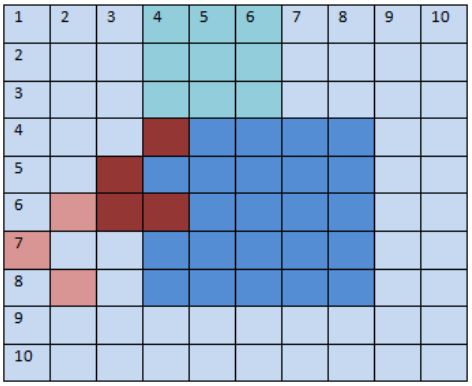
Step 2: Setting a Reference Level

The purpose of setting a reference is to provide a credible and evidence based level of forest loss / gain against which the performance of the intervention can be estimated.

A key source of good practice on setting reference levels for mitigation of deforestation and forest degradation (IPCC Special Report on LULUCF[10]) notes that there is no definitive or foolproof way of setting a reference level (also known as baseline) against which the avoidance of deforestation can be measured. Changes to forests do not follow easily predictable, linear trends and are often a result of social, policy and economic changes.

Figure 5 illustrates the difficulties with using historic rates of forest loss to set reference levels for future land use change activity. The 10x10 grid represents a total forest area of 100 units. Within this total area there are two sub-areas (dark blue, 25 units, and blue-green, 9 units). Deforestation in year 1 occurs in 3 units (pale pink), and 4 units in year 2 (dark pink). The table below shows the rate of forest loss in each area, in each year. It is apparent that the recent national rate of forest loss is not necessarily an appropriate rate for the sub-areas, and that the past rate of loss in the sub-areas themselves may not be indicative of future rates.

Figure 5. Graphical illustration of problems with using historic spatial patterns of forest loss to set baselines or reference levels for future emissions. The question marks in the table below indicate the difficulty of assigning a reference rate to a particular area based on the pattern of loss



Deforestation rate	Year 1	Year 2	Future rate
total forest	3%	4%	?
Sub-area 1	0%	8%	?
Sub-area 2	0%	0%	?

Despite the inherent uncertainty associated with any reference rate of forest loss the reference level step is still an essential step to provide context against which forest loss can be evaluated.

[10] IPCC (2000) Special Report on Land Use, Land Use Change and Forests. Intergovernmental Panel on Climate Change. ISBN: 92-9169-114-3. (para's 70-76).

S2.1 Select Reference Level Method

As mentioned in the introduction to Step 2, there is no perfect solution to setting reference levels for forest change. The following options for Hectares Indicator reporting may be considered:

- **Option 1.** Apply a previously agreed reference level for the national or regional context, based on historic rate of loss. This method is recommended where the country or region has negotiated a reference level for forest loss as a result of a REDD+ programme[11] . This option may be combined with Option 4, whereby a risk map is used to assign areas within the area covered by the national or regional reference level into different risk categories, with the overall level of forest loss aligned with the agreed reference level.
- **Option 2.** Use the rate of loss in a set of comparison areas where the programme is not being implemented. The feasibility of this approach depends on the existence of areas that exhibit similar characteristics where the programme interventions are not being implemented. Finding suitable comparison areas can be challenging.
- **Option 3.** Use previously constructed predictive model of land use change, taking account of economic, infrastructure and spatial variables. This approach is not recommended unless there is a pre-existing model for the project area that meets the following criteria:
    - Works at the scale and over the area required to cover the intervention impact area;
    - Data inputs required to run the model are available;
    - Tested / validated against actual change data;
    - Transparent, ideally published, results and methods in peer-reviewed journal;
    - Recognised by national or local agencies as a reflection of pressures on forests and future scenarios;
    - Updatable - able to update the model to reflect future changes to demand or laws relevant to the context of the programme.
- **Option 4.** Use a risk based approach - whereby each forest pixel within the impact area is assigned a probability of forest loss or degradation based on a number of risk factors. This is the recommended approach for most cases where there is no prior agreed reference level. A risk based approach is less deterministic than a complex model, but allows the differentiation of the intervention impact area into different strata or classes, recognising that the risk of loss is not uniform across all forest areas. Where possible, the risk map should be calibrated using historic forest loss data.

Of these four options, the risk based approach (Option 4) has been used most widely for Hectares Indicator reporting to date, with Option 1+4 used for a large scale UK investment in Indonesia (see Box 5). The risk mapping approach has been found to be cost-effective in a wide range of contexts and has been demonstrated to provide useful information about the drivers of forest change. Figure 6 provides a decision tree to assist the selection of reference level method.

[11] Normally agreed between National REDD+ Focal Point and international agencies such as the World Bank's BioCarbon Fund

Box 5. Combining agreed national reference and risk based approach to set the reference level for the FLAG programme in Indonesia

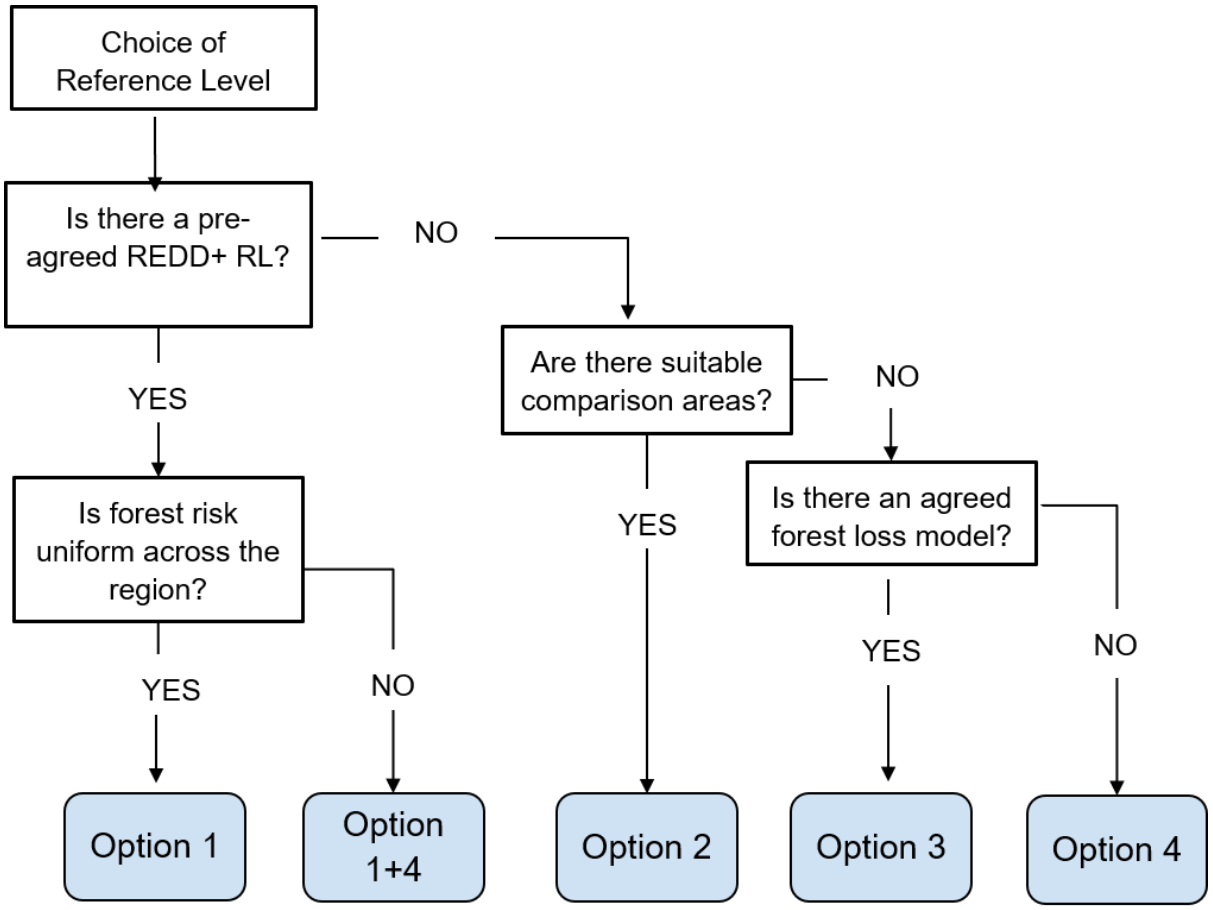
Analysts at Daemeter Consulting (Bogor, Indonesia) implemented the Hectares Indicator analysis to report on the KPI 8 for the Forest, Land and Governance (FLAG) programme, an ICF funded bilateral programme in Indonesia that ran over three years (2015- 2018). FLAG supports action to reduce the rate of deforestation and degradation in Indonesia and contributes to the GHG emission reduction targets set by the Government of Indonesia.

To define baseline emissions from deforestation, Indonesia uses averaged historical deforestation from 1990-2012 for its submission to UNFCCCC for REDD+ implementation (Ministry of Environment and Forestry Indonesia, 2016). However, Indonesia's forest areas vary greatly between provinces, so to establish a reference level for the Hectares Indicator that reflects the different forest and risk drivers across the landscape, Daemeter chose to align their risk map with the national reference level (option 1+4 in Figure 6). The risk map for Indonesia was generated following the ACEU methodology, which included accessibility, slope, elevation, rainfall, distance from previous sites of deforestation and level of protection of the forest. A detailed methodology is available in the Reports section on the ICF Indonesia application (developed and maintained by Daemeter on the Ecometrica Mapping Platform). Based on the current Indonesian forest extent and the national annual deforestation rate, it was assumed that the forest will be gone in 50 years under business as usual scenario. The expected loss period (default of 20 years in the methodology) was therefore adjusted to reflect an overall rate of forest loss that matches the agreed national reference level.

The output of S2.1 should be:

- A decision and explanation on which reference level approach is to be used.

Figure 6. Decision Tree to support Selection of Reference Level Option



Option 1 = Pre-defined reference level based on international REDD+ agreement

Option 1+4 = Risk map aligned with agreed national or regional reference level

Option 2 = Comparison area

Option 3 = Predictive model

Option 4 = Risk map

S2.2a (Option 1) Apply Agreed Reference Rate of Forest Loss

Where a reference level for forest loss for the area has been agreed, the rate can be used directly within the mapping platform to calculate the expected loss for any area of interest. It is important to clarify whether the percentage change refers to a compound or linear rate of loss. It is also important to provide an explanation of the source data for the agreed reference level and how / whether the rate is expected to apply to the intervention impact area.

To apply **Option 1+4**, go to S2.2d and adjust the loss period of the risk map to align the overall level of expected losses to the rate of forest loss in the agreed national or regional reference level.

The outputs of S2.2a should be:

- A percentage rate of loss to be applied as a reference level within the mapping platform, along with explanation of the source data and assumptions.

S2.2b (Option 2) Use Comparison Areas

Where suitable comparison areas exist, they may be used as "non-treatment" reference sites. Forest change should be measured using the same metrics / data sources as used for the rest of the programme intervention area or sample sites. Comparison areas may be stratified according to the same criteria as the intervention areas

The outputs of S2.2b should be:

- A percentage rate of loss (rates of loss in the case for stratified areas) to be applied as a reference level within the mapping platform, along with explanation of the source data and assumptions.

S2.2c (Option 3) Apply Predictive Model

There are few examples of land use change simulation or prediction models that meet the criteria for use within forest Hectares Indicator analysis, however where such models exist they can be powerful tools for setting reference levels and for reflecting complex interactions between causal factors associated with land use change.

To use a predictive model for generating a reference level the following steps are recommended:

- Describe the structure of the model, its main assumptions and processes;
- Discuss and agree the suite of input variables that reflect the economic or social parameters to be adopted in the model (most models can be set up reflect different scenarios such as high or low economic growth, high or low population growth);
- Run the model and collect results (ideally one should conduct multiple runs with different input variables to test the sensitivity of the model to different circumstances). Depending on the structure of the model the output should either be a map of forest change over time or non-spatial rates of forest change. These results can be used as either a (spatially) uniform percentage change or a change map, similar in format to the risk map.

The outputs of S2.2c should either be:

- A raster map showing the percentage change category of all land units (pixels) of forest within the intervention impact area, or a uniform change parameter applied to all forest areas;
- An explanation of the modelling process, the assumptions made and input data used.

S2.2d (Option 4) Construct Risk Map

Likert type risk scales are used in a wide variety of medical[12], insurance and risk-response interventions[13]. They take account of a number of risk factors to assign an individual or other entity into a risk category. Likert scales condense and simplify more complex causal relationships into a number of key points that can be weighted according to context. For example, the risk that forest on cultivable land may be cleared will be lower if the land is difficult to access because of slope or natural barriers. The steps required to complete a risk map are as follows:

- Collect information on the main risks to forests. For example, expansion of agriculture, fuelwood extraction, illegal logging, etc.
- Gather spatial data relating to risk factors (these can be grouped into accessibility, attraction for cultivation or extractable resource and degree of protection).
- Calibrate each risk factor according to local or regional information. For example, in Sofala Province Mozambique, where charcoal extraction is a significant driver of forest loss, informants estimated that gently sloping areas within 6 km from a road were accessible to informal charcoal producers; in the Cerrado region of Bahia, Brazil, agricultural experts stated that 1000mm rainfall was the cut-off for viable arable production. Stakeholder consultation with experts who have local knowledge is highly recommended to calibrate the risk drivers in the risk analysis (see Box 6 as an example of stakeholder meeting to improve a risk map in Ghana).
- Overlay and weight risk factors to produce 5 point Likert scale map. The recommended risk categories are shown in Table 3 and an example risk map is shown in Figure 7:

Table 3. Description of Categories of Forest at Risk of Loss or Severe Degradation.

Risk Category	Brief Description	Expected [tree cover / biomass] loss within 20* years
V. High	At immediate risk of loss - accessible and attractive to convert with no effective protection	90%
High	Accessible and attractive second choice land for cultivation and extraction, limited protection	70%
Med	Some access, moderately attractive for cultivation or extraction or partially protected	50%
Low	Difficult to access and not attractive for cultivation or extraction and/or fairly well protected	30%
V. Low	Very difficult to access, little potential for cultivation or extraction and/or very well protected	10%

*recommended default for consistency between risk factor analysis

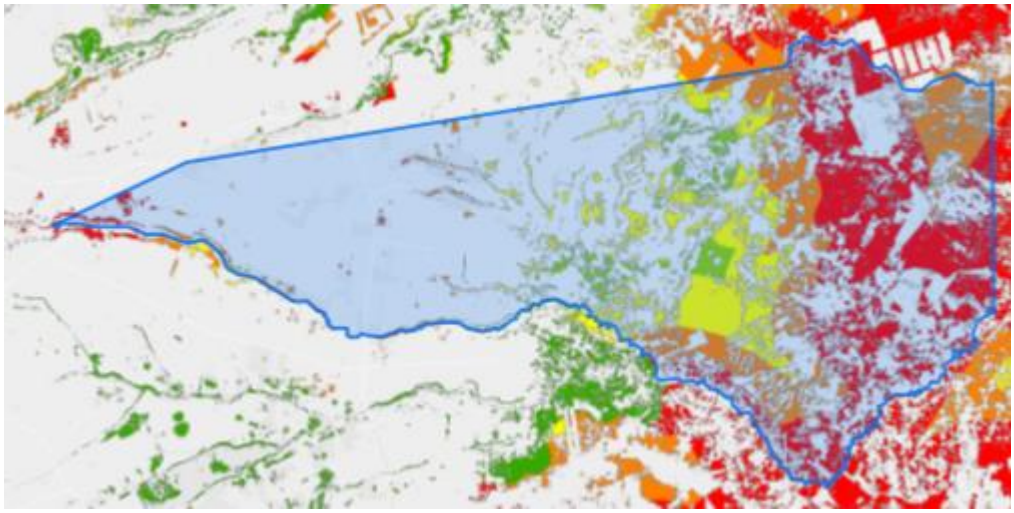
[12] An excellent example of a scale that is used for diagnostic and prognostic purposes is the Glasgow Coma Scale (GCS). The GCS is now widely used by clinicians and researchers to describe the level of neurological impairment in patients. The GCS is also used, in combination with other factors to assess the likelihood of mortality within given periods.

[13] Jay P. Singh, et. al. (2014) International Perspectives on the Practical Application of Violence Risk Assessment: A Global Survey of 44 Countries. International Journal Of Forensic Mental Health Vol. 13.

- If applying Option 1+4 adjust the expected loss period (default 20 years) to give an overall rate of loss that corresponds to the agreed national or regional reference level.
- Upload the risk map to the platform and configure reference level query.

Examples of risk mapping exercises are given in Appendix B, including descriptions on how risk maps can be calibrated and validated.

Figure 7 Example Risk Map in the Cerrado, Brazil



The outputs of S2.2d should be:

- A raster map showing the risk category of all land units (pixels) of forest within the intervention impact area.
- An explanation of the assumptions made for categorising forest into risk classes and details of the input data sets.
- An estimate of the extent of the forest at risk within the impact area.

Box 6. Stakeholder consultation to scale up the Hectares Indicator in Ghana

The Hectares Indicator was applied by the RMSC to report on the KPI 8 for the VPA areas in Ghana (more details can be found on the VPA Ghana mapping application). The KPI 8 report was well received within the RMSC team and the methodology was recognised as a useful tool to standardise reporting on the effectiveness of various projects.

A stakeholder meeting was held to solicit their views on the methodology and to discuss how it can be applied across the forest sector programs in Ghana. During this consultation meeting, new risk drivers to be added to the risk map were highlighted, such as population density. The importance of incorporating policies and other non-spatial data such as forest management system was also discussed. The risk map will also be improved by incorporating plantation areas (as a separate unit from natural forest), as well as wildlife and biodiversity indicators to reflect the overall ecosystem performance. This meeting was also valuable as it allowed to identify and agree on the weight to attribute to each risk factor based on their level of impact on deforestation/ forest degradation.

Step 3 Measure Forest Change

The measurement of actual forest change provides an absolute estimate of the outcome for the forest resource in terms of extent and condition.

It is essential to monitor the outcomes for forests within the intervention impact areas. In the same way that the effectiveness of health interventions must be related to observations of disease and mortality incidence, it is critical to know whether forest loss is continuing, accelerating or reducing.

S3.1 Review available forest change detection data products and select the most appropriate

To select the most appropriate change detection products for Hectares Indicator assessment refer to The Review of Earth Observation Techniques for Forests (Mitchard, 2016), which provides a state-of-the-art reference of the capabilities of different sensors and data products to detect and measure forest loss and degradation in different circumstances.

The available change detection products for the impact area should be reviewed and where possible assessed for accuracy. Detailed accuracy assessments of forest change detection data are normally outside the scope of the Hectares Indicator, given the specialist nature of this task and the time required.

S 3.2 Apply any filters or adjustments to the forest change data products where required and clip the dataset to the extent of the intervention impact area

Depending on the type of forest change data, it may be necessary to filter or mask certain change signals to reduce the errors of commission, for example within existing cropland where harvesting may be included as loss. Details on filtering processes are contained in reference case studies and instruction manuals.

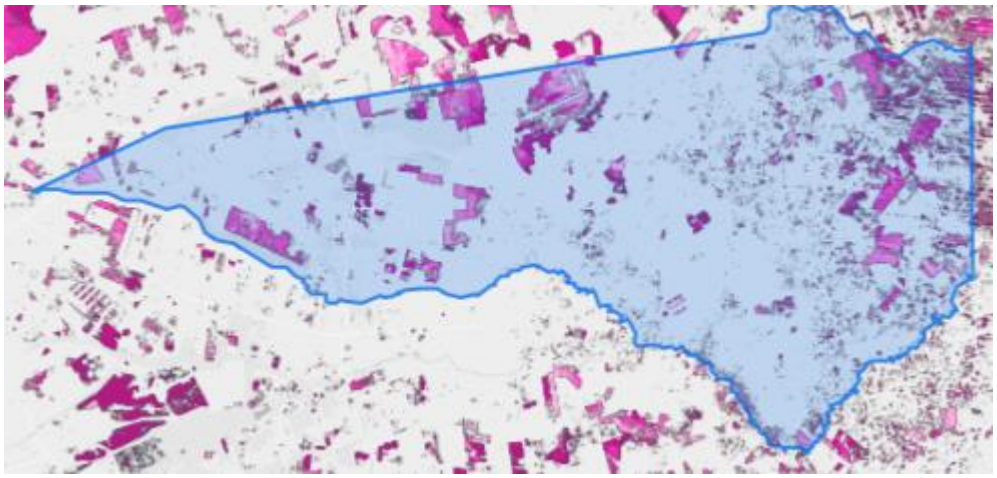
S3.3 Upload the filtered change detection data

Once the change detection data is uploaded to the mapping platform, automated calculations on the forest loss in any given area of interest can be made. The Mapping Platform will also automate the calculation of avoided forest loss by comparison to the reference level at any location.

The outputs of S3 should be:

- A raster map showing the actual forest loss or degradation within the impact area at given timeframes.
- A description of the source data and estimates of uncertainty.

Figure 8 Example forest loss map (data from University of Maryland, 2014)



Step 4 Analysis

The purpose of analysis is to draw conclusions from the data and supporting information for monitoring, evaluation and learning purposes

The level of detail that can be explored within this step of the method can vary, depending on the requirement for more detailed evaluation and learning. S4.1 will be required for completing the basic accountability reporting requirements of the forest investments under the UK's International Climate Fund. S4.2 is guidance intended to support more detailed evaluation at the programme level and S4.3 is guidance for more general thematic learning.

S4.1 Basic estimation of Avoided Forest Loss for Accountability Reporting

The estimation of avoided forest loss across the all impact area will be automatically calculated by summing the avoided forest loss as calculated on the mapping platform once the data has been uploaded and query setup completed. Where large numbers of polygons / impact areas are involved, the use of the Ecometrica Business Intelligence module is recommended to reduce time and support the analysis. A reporting template for Hectares Indicators results is provided in Annex A.

- Hectares Indicator results

The calculations for avoided hectares loss can be run for each area of interest and summed. Figure 9 shows how the results of avoided forest loss are automatically calculated in tabular form for each area of interest within the programme impact area.

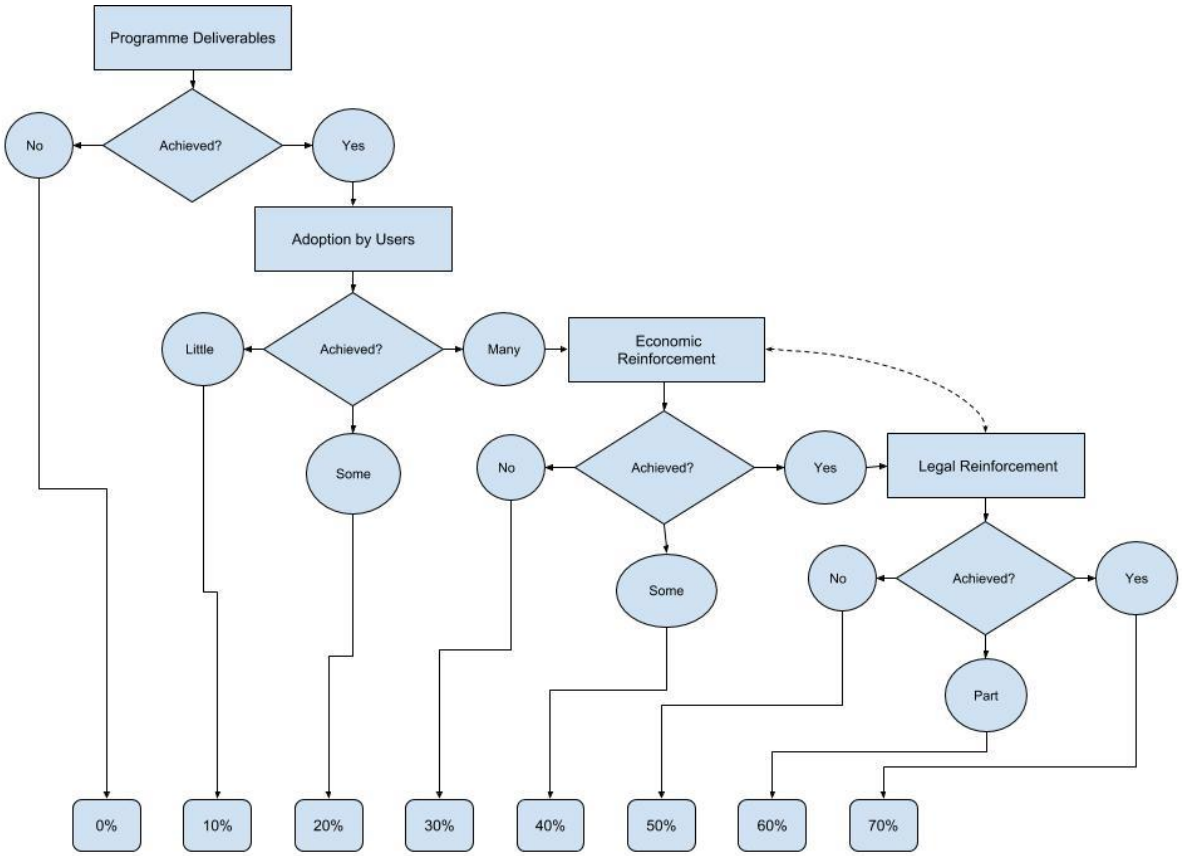
Figure 9. Results of Avoided Loss Calculation on the Ecometrica Mapping Platform

Risk Category	Area [ha]	Forest Loss 2016 [ha]	Expected Loss 2016 [ha]	Avoided Loss 2016 [ha]
Very Low	43 209	1 110	216	-894
Low	13 184	80	198	118
Medium	42 678	729	1 067	338
High	25 169	1 267	881	-386
Very High	31 306	1 201	1 409	208

- Attribution Analysis

The Attribution Process is a structured process used to provide an estimate of the percentage of the total observed impact of avoided forest loss that can be reasonably attributed to the investment or intervention within a particular area. This process is sometimes a requirement of financial reporting for certain funds. The following attribution process (Figure 10) was developed following discussion with UK government departments contributing to the International Climate Fund.

Figure 10. Flow diagram of the default Hectares Indicator Attribution Process agreed with the UK's International Climate Fund.



If programme deliverables are yet to be achieved, for example if the project is still at early phases of development, the percentage attribution will be zero. Once deliverables are achieved, the level of attribution depends on adoption by end users, followed by either economic and/or legal reinforcement that ensures continuity of the forest protection effort. According to this schema 30% or more of the impact is always left to be accounted for by local / in-country actors, although some analysts have suggested that they could claim more than 70% if they are particularly innovative and successful.

During the implementation phase of the programme there may be a time lag for the translation of outputs to outcomes. Even in the absence of measurable impacts at the outcome level the assessment team may be able to identify intermediate outcomes or steps towards the intended benefits that can be included in the report. Appropriate measures of intermediate outcome are likely to be related to the type of investment, for example in the case of a broad policy intervention, intermediate steps may be stages in the legislative process for new forest policy adoption, whereas in the case of a low carbon agriculture programme stages may relate to the adoption and roll-out of new systems by farmers.

The output of S4.1 should be:

- A completed Hectares Indicator report, along with supporting notes and evidence.

S4.2 Analysis of Hectares Indicator results for monitoring and corrective action

More detailed analysis of results can be used by programme teams to monitor progress and propose corrective actions, such as focusing efforts on specific areas where progress is less than expected or where there appears to be greater potential for impact.
Typical monitoring and corrective action type questions could include:

- Is the intervention having an impact in the areas intended?
- Are there early signs that outcomes are not being achieved in certain areas / social groups?
- Does the scope of the project reflect the ambition in terms of area of forest benefiting?

Geographic analysis to compare progress across impact area and suggest corrective or improvement actions can be undertaken.

The output of S4.2 should include:

- A list of questions, answers and supporting analysis.

S4.3 Hectares Indicator Analysis to support Programme Evaluation

Evaluation processes go beyond basic reporting for accountability and internal monitoring to explore the causal factors behind the success or failure of investments. Questions are often grouped according to the OECD - DAC structure:

Relevance:

- Were the areas targeted relevant to the goal of conserving forest at risk?
- Have the interventions addressed the drivers of forest change in these locations?
- Has there been progress in terms of intermediate outcomes (local adoption / progress in pilot areas)?

Effectiveness:

- How effective has the programme been in different types of forest and geographic areas?

Efficiency:

- What is the ratio of resources to results in different areas?

Sustainability:

- Has the improvement of condition, enforcement of protection been maintained (on-going monitoring)?

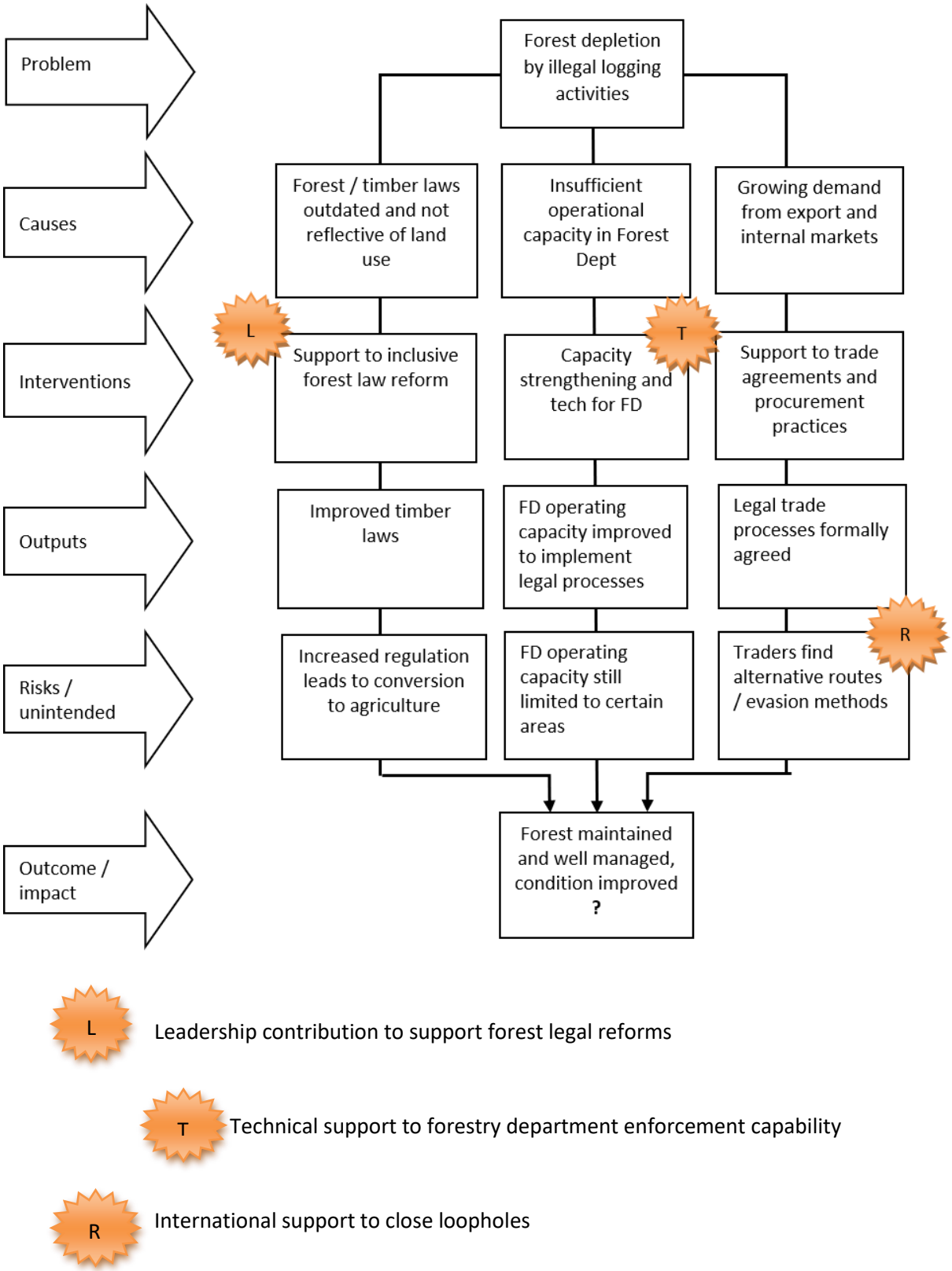
Evaluators should attempt to go beyond documenting what has happened, to understand how and why things have developed as observed and to identify, strengths, weaknesses and areas for improvement.

There is a wide range of literature and tools on evaluative methods for natural resource related interventions. Theory of change analysis is a valuable conceptual tool that can be useful to identify and assess the importance of causal linkages in the chain of events from problems and interventions through to eventual impacts. Figure 11 illustrates a potential combination of contribution analysis within the theory of change, to identify specific areas where interventions had an effect.

The outputs of S4.3 are open ended but expected to include:

- Information regarding effectiveness, efficiency and sustainability of the programme that can feed into evaluative work.
- Information on context, constraints and conditions affecting the translation of outputs to outcomes at the programme level.

Figure 11. The effect of intervention contributions can be explored by reference to a causal chain representing how important contributions were made within the theory of change for the intervention.



S4.4 Hectares Indicator Analysis to support Learning

Learning processes go beyond looking at a single project but involve looking at a range of interventions in different circumstances to develop an understanding of what combinations of factors are needed to produce successful outcomes. It is important to note that learning processes occur at multiple institutional levels (within UK Government Departments, within partner countries, multilaterals and research partners and other donors) and should not be compartmentalised or left to "experts".

The information and data generated by forest KPI monitoring and reporting can be invaluable as evidence into the following types of learning questions:

- What types of interventions work in certain situations?
- How can we mitigate risks relating to translation of outputs to outcomes?
- What are the emerging threats to forests in different parts of the world?
- Where are the gaps in terms of forests at risk without effective interventions?

The outputs of S4.4 are open ended but expected to include:

- Information regarding effectiveness, efficiency and sustainability across various regions and types of intervention that can feed into evaluative and learning processes.
- Information on context, constraints and conditions affecting the translation of outputs to outcomes at the ICF level.

Understanding and Use of Results within Donor Institutions

While monitoring systems such as the Hectares Indicator can provide a rich set of data and insights that have the potential to inform decisions on programme design and management, institutional donors often lack the structures, processes and skills to use the information.

Several points should be considered:

- Hectares Indicator and other KPI monitoring should be factored into programme M&E systems at an early stage;
- Programme managers should consider starting Hectares Indicator analysis at project inception phases, or even at programme design stage to understand the potential avoided forest loss within the areas being targeted;
- Information should be gathered across an investment portfolio to enable comparisons and portfolio lessons to be learned.

Interpretation and Use of Results

One of the concerns of programme staff with regard to KPI reporting is how the results will be interpreted by donor decision makers. There are common concerns expressed by local partners regarding the way in which expectations of impacts (in terms of hectares avoided forest loss) may have been raised, or constraints simplified, during the business case stages of programmes.

Another concern is that the donor may use this type of analysis to claim the achievement of benefits that are first and foremost the result of national initiatives or civil society efforts. Donor representatives should make efforts to communicate that this is not the intent.

It is also recommended that donor institutions invest time in the training of programme managers to understand, interpret and communicate the results from these types of quantitative monitoring systems.

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Appendix A, KPI 8 Reporting Template

The reporting template shown overleaf is intended to summarise on one page the key metrics and supporting information arising from a periodic ICF KPI 8 assessment exercise.

The template is set up for use with the risk mapping option for reference setting as this is the most widely used method to date and as it provides useful information on the forest area that could be most affected by the ICF intervention.

The template is in a tabular form with four columns corresponding to the four methodological steps, and four input rows. The first input row contains the high level results and space for map layers illustrating the distribution of results across the area of impact. The second input row gives some further background and context. The third input row summarises data sources and assumptions and there is a final row where comments on the overall KPI assessment process (e.g. limitations and plans for future work) can be added as a note.

The template should give the reader a rapid overview of the following key questions:

- What is the impact area of the programme, how much and what type of forest is there?
- How much of the forest is at risk of loss and what is the risk distribution?
- What was the rate of forest loss within the reporting period?
- What was the avoided loss (expected - actual) relative to the risk profile?
- What was the contribution of the ICF intervention to the observed impact?

More detailed exploration of the data and methods can be obtained through the Ecometrica mapping applications and their associated documentation.

Programme: **Impact Area Name:** **Reporting Period:** **Link to web app:**

Area of Impact	**Forest Resource At Risk**	**Forest Loss**	**Impact and Contribution**
Forest in impact area (ha): Description of forest types: Map:	Weighted risk index: Map:	Area of forest lost (ha): Types of loss / conversion: Map:	Avoided forest loss: Contribution Score: Percentage Attribution to ICF:
Programme Activities in Period:	Main drivers / risks: Impact area (ha): V. High High Med Low V. Low	Forest losses in period: Forest loss breakdown by risk category: V. High High Med Low V. Low	Intermediate Outcomes
Source of forest extent map: Definition of forest cover:	Assumptions and Data Sources: Conditions for - Access: Cult/Ext: Protection:	Source of forest loss data: Comment on accuracy:	Assumptions and Stakeholder Views:
Comment on KPI analysis:			

Appendix B, Case Study: steps followed to construct a risk map in the Cerrado area in Brazil

The Hectares Indicator was used to report on KPI 8 (ha of avoided deforestation) in the Brazilian Cerrado. The ICF supports the management and restoration of forests in Brazil, and more specifically works towards reducing biodiversity loss by restoring native vegetation and reducing deforestation through the 'Reducing Deforestation in the Cerrado area (Brazil 1)' programme.

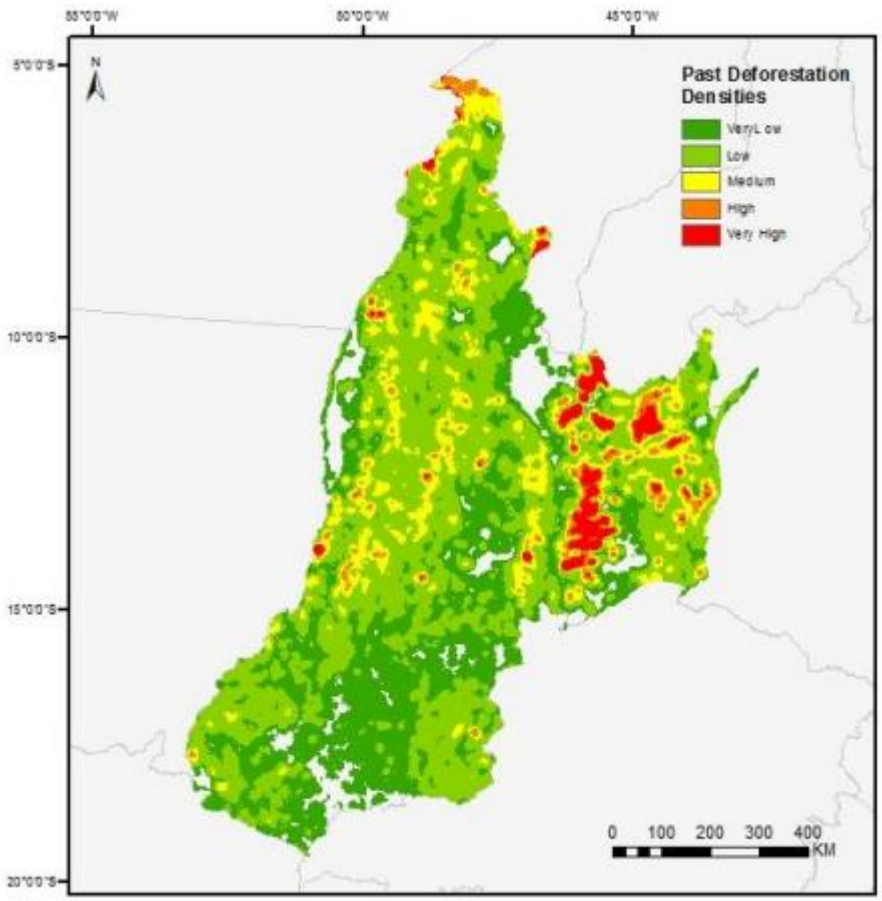
In order to estimate ha of avoided deforestation in the programme areas, the observed annual forest loss was subtracted from the amount of expected forest loss within the area over a 20 year period (these analyses were run on the ICF Cerrado web application developed on the Ecometrica Mapping Platform) . Expected loss was estimated by applying an ACEU type risk model to highlight the risk of deforestation and degradation of the forest in the programme area depending on their accessibility, suitability for cultivation, extractable value and if they are unprotected.

Each of the four ACEU parameters were defined and assigned a level of risk based on assessments of region-specific drivers of forest loss and land use change. Local knowledge was used as much as possible to assign values to the risk factors, but gaps were filled by literature study. The tables and figures below summarise the various risk drivers and their risk score.

Table 1: Accessibility - risk of deforestation associated with access by road

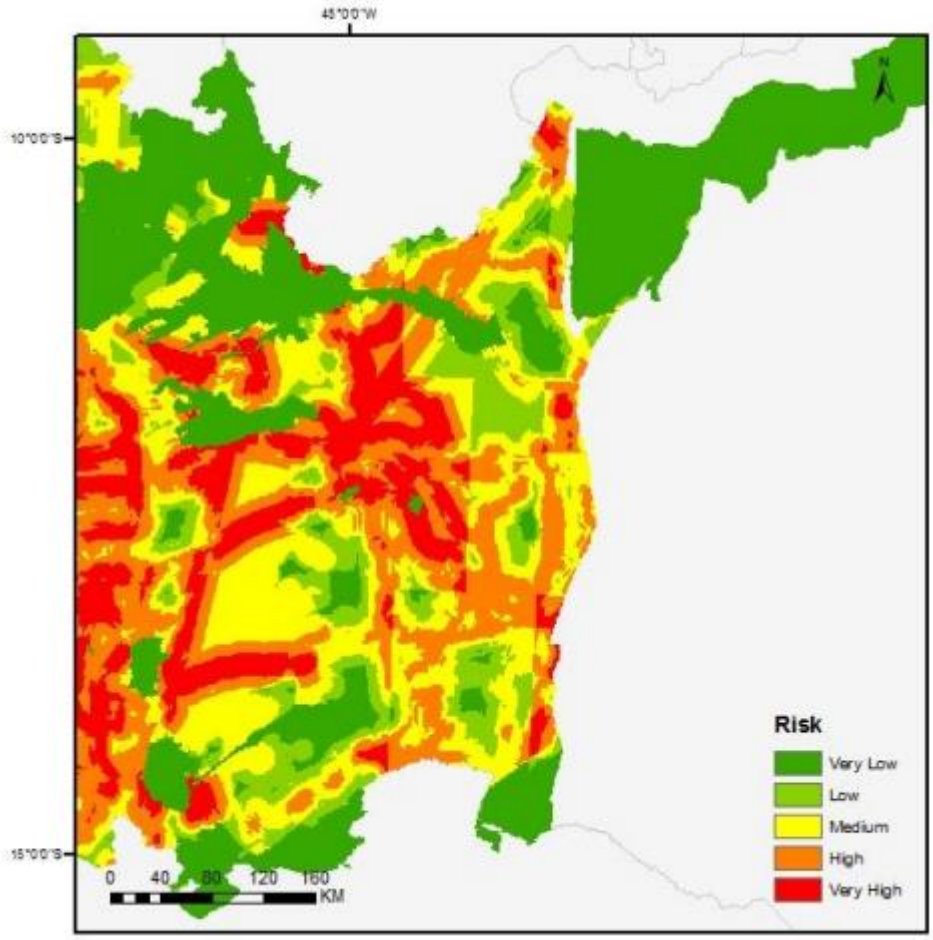
Distance from the road	**Risk level**
4.5 km	5 (very high risk)
9 km	4
13.5 km	3
18 km	2
22 km	1 (very low risk)

Figure 1: Accessibility / Cultivability / Extractability - risk due to proximity to previous sites of deforestation



Historic patterns and rates of deforestation provide an indication of areas at higher risk of deforestation because areas already deforested show easy accessibility, a degree of economic attraction and a lack of, or an ineffective, protection under management schemes. A density map of deforestation events was created, and the density values were divided into 5 classes where highest density values were assigned the highest risk value (5) and the lowest density values were given the lowest risk value (1).

Figure 2: Cultivability: Precipitation - zoomed in subset showing lowered risk due to the very low annual rainfall in Bahia



Consultation with Brazilian partners in the project confirmed that areas with annual precipitation lower than 1,000 mm were unsuitable for cultivation. With the exception of the areas with rainfall below this limit, it was assumed that the land within the Cerrado area had cultivable value for commercial crops or grazing pasture. Therefore, areas with less than 1,000 mm annual precipitation were assigned one risk lower than as previously assigned (due to accessibility by road and past deforestation density).

Table 2: Protected Areas

Protected Areas	**Risk level**
Federal and State protected areas	1 (lowest risk)
Permanent Protected Areas (PPAs)	1 (lowest risk)

After all the risk drivers described above were combined, the resulting risk map was adjusted to take into account the effect of protected areas. Risk values in areas under federal and state protection were reassigned to the lowest risk (1), as well as PPA buffer zones around water bodies and large rivers. This resulted in the final risk of deforestation

map for the Cerrado area, which was then uploaded to the Mapping Platform and queried to return expected loss depending on the risk category the forest area fell into.

Figure 3: Final risk map for the Cerrado area developed following the ACEU methodology (screenshot from icf-cerrado.ourecosystem.com).