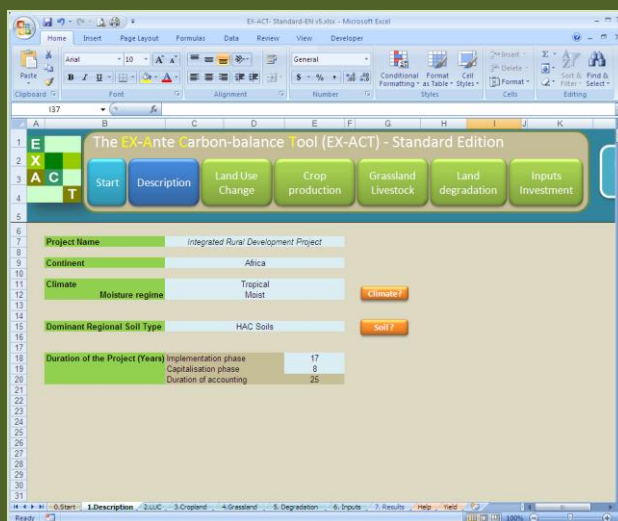
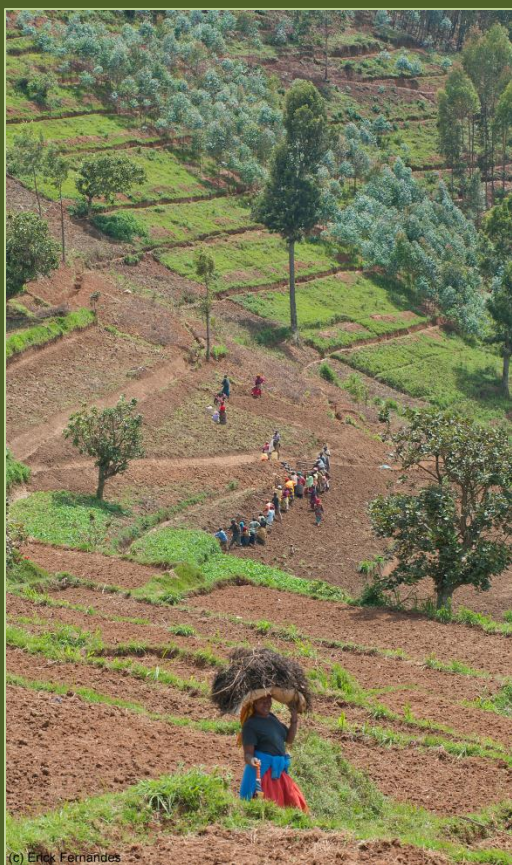


# EX-ACT

## QUICK GUIDANCE FOR USERS



*Estimating and Targeting  
Greenhouse Gas Mitigation in  
Agriculture*



## Abstract

As part of the new World Bank Group Environment Strategy (2012), all World Bank (WB) investment projects must undertake Greenhouse Gas (GHG) emissions accounting ('carbon footprinting') starting in fiscal year FY14 (July 2013). The EX-ACT tool will be the primary tool for GHG emissions accounting in the agriculture sector.

EX-ACT is a land-based accounting system, estimating carbon (C) stock changes (i.e. emissions or sinks of CO<sub>2</sub>) as well as GHG emissions per unit of land, expressed in equivalent tonnes of CO<sub>2</sub> per hectare and year. EX-ACT can be applied to a wide range of development projects from all AFOLU sub-sectors, including projects involving climate change mitigation, livestock, forest management, land use change watershed development, intensification of production systems, and food security. EX-ACT helps project designers to estimate and prioritize project activities with high benefits in economic and climate change mitigation terms.

This *Quick Guidance* on EX-ACT provides an overview and explanation of methodology, results and data needs for the application and final use of the Ex-Ante Carbon-balance Tool (EX-ACT). It complements the more comprehensive EX-ACT *User Manual* and it is targeted at leading World Bank users to proficiency in the independent use of the tool.

- **EX-ACT Website:**  
[www.fao.org/tc/exact](http://www.fao.org/tc/exact)
- **Free Tool Access:**  
[www.fao.org/tc/exact/carbon-balance-tool-ex-act](http://www.fao.org/tc/exact/carbon-balance-tool-ex-act)
- **EX-ACT *User Manual* & EX-ACT *Quick Guidance*:**  
[www.fao.org/tc/exact/user-guidelines](http://www.fao.org/tc/exact/user-guidelines)

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## 1) Overview<sup>1</sup>

In November 2012, a group of international financial institutions, including the World Bank, agreed to a harmonized approach to project-level GHG accounting that follows established methodologies that are consistent with international best practice. The World Bank's Environment Strategy includes GHG accounting as a means to inform the institution with a clearer and more complete understanding of the impacts its lending portfolio have on GHG emissions. The Strategy, which was endorsed by the Board in spring of 2012, prescribed that GHG accounting be introduced beginning during the period from FY14 to FY16. The Ex-Ante Carbon-balance Tool (EX-ACT) will be the primary instrument for GHG emissions accounting in the agriculture sector.

This document provides a how-to-use reference for EX-ACT users. It is divided into 8 sections, including this overview. Section 2 briefly explains the essentials of EX-ACT. Section 3 provides the main results of EX-ACT and shows how to utilize them as part of the project document design process and to prioritize selected investment decisions. Section 4 discusses the advantages of engaging in a carbon-balance appraisal and how using EX-ACT serves this purpose. Section 5 describes the methodological background of EX-ACT. Section 6 describes the Tool's data requirements. Section 7 explains the steps of scenario building. Section 8 is a short guide on data entry for task team leaders.

## 2) The Ex-Ante Carbon-balance Tool

### A. What is EX-ACT?

The Ex-Ante Carbon-balance Tool (EX-ACT) is a land-based accounting system used to measure and to project changes to the carbon balance over time. This carbon balance, or "carbon footprint," refers to the amount of carbon released into the atmosphere through emissions, relative to the amount of carbon stored in the soil and plant material of an area, and relative to the carbon that soil and plant material is actively removing or "sequestering" from the atmosphere. Emissions of GHGs, which differ dramatically in the intensity of their effects on the atmosphere, are measured in terms of carbon dioxide-equivalence. The measurements are expressed in terms of tons of carbon dioxide-equivalent per hectare over a period of one year (a volume that is ordinarily abbreviated to "tCO<sub>2</sub>-e"). In addition to spatial, area-based measurement, EX-ACT can also be used to measure changes to the carbon balance per unit of produce. Ex-ante estimations of how this balance will change as the result of human activities associated with land use change in development projects are particularly valuable in sectors that use a great deal of land, such as agriculture, forestry, pastoral livestock, watershed management, and of course climate change adaptation and mitigation. EX-ACT is cost-effective to use, requires a relatively small amount of data, and offers a variety of resources that users can refer to in finding information they need. While EX-ACT was principally designed for use at the project level, it is readily scalable to program and sector-wide levels, and can be used for policy analysis.

### B. Targeted users

The primary use of EX-ACT is in the area of project design. Development practitioners at the World Bank who need to estimate the GHG-balance of investment proposals in the agriculture, forestry and land use sector are therefore the principal intended audience. The main target users should be involved during the project design stage and pursue the objective of aligning ex-ante programme and project documents in accordance with the results obtained from the EX-ACT appraisal.

### C. Basic structure of EX-ACT

EX-ACT consists of a set of six linked modules, which are Microsoft Excel spreadsheets covering different activity areas of the agriculture, forestry, and other land use sectors. They allow users to specify

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<sup>1</sup> For more detailed information, a glossary of terms and the complete bibliography, please refer to the EX-ACT User Manual.

information concerning a few geographical, climatic, and agro-ecological variables and a wider set of information regarding land-use change activities and agricultural management practices. The modules in EX-ACT are:

1. **General description of the project**  
(geographic area, climate and soil characteristics, duration of the project);
2. **Land use change**  
(deforestation, afforestation/reforestation, non-forest LUC)
3. **Crop production and management**  
(agronomic practices, tillage practices, water & nutrient management, manure application)
4. **Grassland and livestock**  
(grassland management practices, livestock feeding practices)
5. **Land degradation**  
(forest degradation, drainage of organic soils, peat extraction)
6. **Inputs and further investments**  
(fertilizer and agro-chemical use, fuel consumption, electricity use)

The wide coverage of these six topic modules enables EX-ACT to analyse a wide range of agricultural and forestry development projects, such as:

- Livestock development
- Crop production intensification
- Rural development
- Food security
- Climate change mitigation (forestry, etc.)
- Forest protection and management
- Watershed development
- Land rehabilitation
- Bio-energy

Depending on the specific project, data collection and model completion is only necessary in the modules relevant to the project. The main data needs occur only in the focal areas of the project. Rather than choosing modules according to project type, the modules are chosen in regards to project impacts i.e. what is affected by the project.

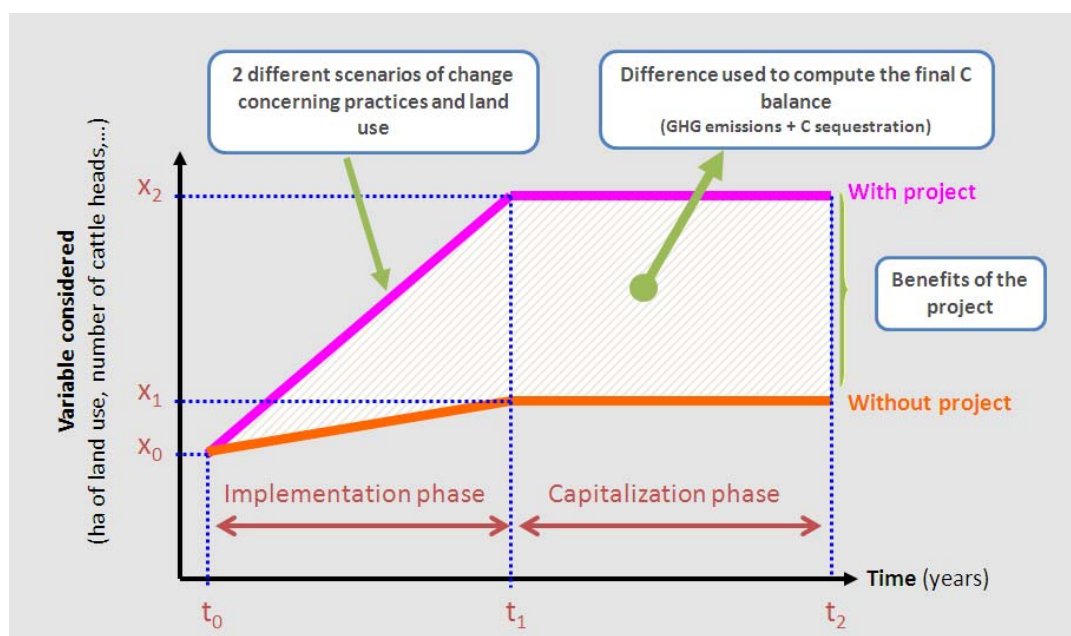
This flexibility allows for the adequate consideration of multi-segment projects and leads the project designer to think of possible indirect impacts on in-directly impacted areas, e.g. increased pressure for deforestation or grassland degradation.

## D. Scenario building

Scenario building enables designers to make projections about the impacts that a prospective project or intervention is most likely to have, and to compare this **With-Project Scenario** to the alternative business-as-usual **Without-Project Scenario** in which the project never took place. This ex-ante evaluation of two alternative theoretical scenarios requires data on a real-world baseline situation – something which is very familiar to ex-ante economic analysis in general.

Baseline scenario building begins with the **Initial Situation** of land use and management practices in the project area, given in the following figure as  $\mathbf{x}_0$ , using the example of a project that is designed to increase the amount of cropland that is cultivated using improved nutrient management. Developing the alternative scenarios over a two year period, the **With-Project Scenario** projects an increase in the improved fertilized area to  $\mathbf{x}_2$  hectares, while the **Without-Project Scenario** forecasts a proportionately smaller increase in area to  $\mathbf{x}_1$  hectares

## Building development scenarios for the use in EX-ACT



EX-ACT differentiates between two time periods. The **implementation phase** defines the time period in which active project activities are carried out and lasts from  $t_0$  until  $t_1$ . Thereby the period covered by the analysis does not necessarily end with the termination of the active project intervention. Even after the point that a new equilibrium in land use and practices is reached in  $t_1$  further changes may occur, for instance changes in soil carbon content or in biomass, that are extended results of the intervention following the lifespan of the intervention itself. This period defines the **capitalization phase** which lasts from  $t_1$  until  $t_2$ .

The difference in activity data between With- and Without-Project scenarios serves then later as the input data for calculating the carbon-balance of the project.

### *Some practical principles for the easy use of EX-ACT*

- Only modules that are directly impacted by project activities have to be filled
- Sophisticated main data needs occur only in the focal areas of the project
- It is normal that many data entry cells will not be used
- Information is entered on changes occurring With-Project vis-a-vis Without-Project situation.

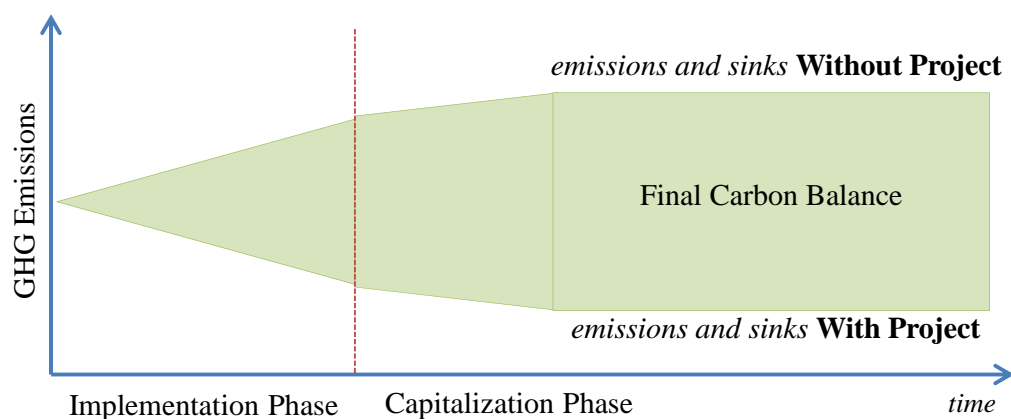
## 3) EX-ACT results

### A. Interpreting results

The specific agro-ecological conditions and activity data in all of the EX-ACT modules lead to the calculation of GHG emissions and carbon stock changes. The comparison of the net emissions from With-Project and Without-Project scenarios constitutes the marginal difference in GHG emissions and carbon sequestration due to project implementation which defines the overall carbon balance.



## The Final Carbon Balance



Drawing from the example of a proposed agroforestry project in an area experiencing deforestation and land degradation. The proposed project is shown to lower the pace of deforestation and other adverse effects of land use change, while establishing agroforestry and increasing productivity by stronger use of fertilizers. The EX-ACT results displayed in the following figure may be interpreted in the following ways:

**1 Overall gross results:** Users will see the overall gross emissions and sequestration results of the without-project scenario (left column) and with-project scenario (middle column). The indications are made in tonnes of CO<sub>2</sub> equivalents as total over the entire period of analysis, but also per hectare and per hectare and year.

In the example, the **Without-Project** scenario leads to net emissions of 4.9 million tons CO<sub>2</sub> equivalent. This translates into 12.3 tons per hectare annually, and 246 tons per hectare over the course of the period covered.

The **With-Project** scenario leads to substantially lower net emissions at just 36 rather than 246 tons owing to the much increased volumes of sequestration achieved through afforestation, agriculture, and grasslands.

**2 Overall carbon-balance:** Comparing the gross results between the **Without-** and **With-Project** scenarios gives the difference achieved through project implementation. This is the project's carbon-balance. It amounts to a total of 4,248,318 tons CO<sub>2</sub> equivalent in avoided emissions or increased carbon sequestration over the full analysis duration of 20 years. This is equivalent to reduced emissions of 210 tons per hectare over the full duration or -10.5 tons per hectare annually.

## Main EX-ACT results

Component of the project	Gross fluxes		Balance
	Without	With	
	All GHG in tCO2eq		
Positive = source / negative = sink			
Land Use Changes			
Deforestation	3,740,693	481,117	-3,259,576
Afforestation	-61,922	-59,994	1,928
Other	398,762	-51,877	-450,640
Agriculture			
Annual	55,507	-27,852	-83,359
Perennial	-7,000	-304,467	-297,467
Rice	44,898	17,973	-26,925
Grassland & Livestocks			
Grassland	121,601	-113,685	-235,286
Livestock	12,563	9,699	-2,864
Degradation	499,722	103,011	-396,711
Inputs & Investments	162,352	664,934	502,581
Total	4,967,178	718,860	-4,248,318
Per hectare	246	36	-210
Per hectare per year	12.3	1.8	-10.5

**Gross results and carbon-balance by module:** Differentiating the gross emissions effects of the With- and Without-Project scenarios identifies the components that lead to the greatest impacts: the most important sources of emissions and the most important sources of sequestration or “sinks.”

In this example, the establishment of perennial crop land and the rehabilitation of degraded grassland are the largest sinks, sequestering 304,467 tons and 113,685 tons carbon equivalent respectively. The leading sources of emissions become the use of fertilizers and other inputs at 664,934 tons carbon equivalent and the still ongoing deforestation at 481,117 tons. The largest impact achieved in this With-Project scenario is attributable to the projected reduction in the rate of deforestation, which in turn reduces the rate of net emissions by 3,259,576 tons carbon equivalent. This component alone accounts for 75 percent of the project’s carbon impact. This is followed by the project’s non-forest land use change activities (-450,640 tCO<sub>2</sub>e), and the rehabilitation of degraded land (-396,711 tCO<sub>2</sub>e).

## B. Utilizing results

EX-ACT is also useful for comparing alternative project designs. The *Irrigation and Watershed Development Project* in Madagascar was appraised differentiating between two scenarios for its watershed component. One entailed a large watershed component covering 65,000 hectares with substantial areas covered by complementary components involving improved pasture, afforestation, and agroforestry as well as reduced deforestation. The other entailed a much smaller watershed management component covering 8,250 hectares, and smaller areas covered by the other components.

### Differential project activities as part of a smaller and up-scaled watershed component

	Smaller watershed component (ha)	Up-scaled watershed component (ha)
Afforested areas	2,250	15,000
Avoided deforestation	2,000	6,000
Improved pasture	2,500	34,000
Agro forestry	1,500	10,000
<b>Total area of watershed component</b>	<b>8,250</b>	<b>65,000</b>

The up-scaled project proposal would increase the necessary total budget by US\$83 million, more than double (+103 percent) the funding required by the smaller watershed project proposal. The question is whether the additional costs are justified, or which additional costs are the most justified by the additional benefits in terms of the project’s impact on the carbon balance. The cost differentials by component are estimated to be US\$1,500 per ha reforested area, US\$300 per ha of avoided deforestation, US\$400 per ha of improved pasture, and US\$ 1000 per ha of agroforestry. The additional watershed components are thus estimated to require funding of US\$47.9 million.

EX-ACT analysis suggests that the benefits in terms of GHG mitigation are far more than proportionate. Over the 20 year life of the project, the impacts do not double, but rather increase by a factor of six. Compared to the 2.4 million tons of CO<sub>2</sub> equivalent projected to result from the smaller watershed project, the up-scaled project is projected to improve the carbon balance by 12.4 million tons.



## Budget and carbon-balance of the two scenarios

	Small watershed component (ha)	Up-scaled watershed component (ha)
Budget (million USD)	40.5	83
Carbon-balance (mio t CO <sub>2</sub> )	2.4	12.4
Carbon-balance per ha (t CO <sub>2</sub> , 20 years)	21	93
Carbon-balance per ha/yr (t CO <sub>2</sub> )	1.05	4.6

Most projects of course have multiple development objectives. Results of EX-ACT analyses should be used alongside other references such as performance and socio-economic indicators when investment decisions are being considered.

In agriculture, forestry, and livestock projects in which the With-Project scenario shows greater emissions than the Without-Project scenario, EX-ACT is useful in identifying priority areas and components in which the greatest and most cost-effective mitigation potential exists.

## 4) EX-ACT data needs

A tier level of analysis represents a level of methodological complexity to estimate greenhouse gas emissions following the definition in NGGI-IPCC-2006. Tier 1 methods rely on default values and require a lower level of detail, while Tier 2 methods require regional specific carbon stock values and emission coefficients, implying higher precision and the need for more sophisticated data. Besides offering the option to use Tier 1 default values, EX-ACT encourages users to substitute default values with more location-specific Tier 2 data that lead to lower uncertainty levels in the estimation. The process through which Tier 2 data can be procured and entered into the tool is presented at a later point of this *Quick Guidance* and in greater detail in the *User Manual*.

### A. Selecting which modules are relevant for a proposed project

EX-ACT is primarily concerned with all land areas that will be altered as a result of a project's processes and activities, and does not necessarily require a full inventory of all land-uses and agricultural practices in the project area.

Data are needed concerning all those areas **in which change is observed between project start and end of the capitalization phase** due to project implementation as well as in those areas **where such alterations are actively prevented as a result of** project implementation, for instance through prevented deforestation. In addition to more generic Tier 1 data, more detailed Tier 2 data can be selectively applied to increase resolution and the confidence level of projected results.

The following checklist should help users determine which modules apply to their projects.

## Checklist for identifying project relevant EX-ACT modules

Carbon-balance Impact		EX-ACT	Project intervention	
Main Impact Area		Module(s) to fill	YES	NO
POSITIVE (SINK)	<b>A Reduced emissions of carbon dioxide</b>			
	A1 Reduction in rate of deforestation	Land use change		
	A2 Reduction in forest degradation	Land degradation		
	A3 Adoption of improved cropland management	Crop production		
	A4 Introduction of renewable energy and energy-saving technologies	Investments		
	<b>B Reduced emissions of methane and nitrous oxide</b>			
	B1 Improved animal production	Livestock		
	B2 Improved management of livestock waste	Livestock		
	B3 More efficient management of irrigation water in rice	Crop production		
	B4 Improved nutrient management	Crop production, Livestock		
	<b>C Carbon sequestration</b>			
	C1 Conservation farming practices	Crop production		
	C2 Improved forest management practices	Land use change		
	C3 Afforestation and reforestation	Land use change		
	C4 Adoption of agroforestry	Crop production		
	C5 Improved grassland management	Grassland		
	C6 Restoration of degraded land	Land use change		
NEGATIVE (SOURCE)	<b>D Increased emissions of methane, nitrous oxide and carbon dioxide</b>			
	D1 Increased livestock production	Livestock		
	D2 Increased irrigated rice production	Crop production		
	D3 Increased fertilizer use and over-fertilization	Inputs		
	D4 Production, transportation, storage and transfer of agricultural chemicals	Inputs		
	D5 Increased electricity consumption	Investments		
	D6 Increased fuel consumption	Investments		
	D7 Installation of irrigation systems	Investments		
	D8 Building of infrastructure	Investments		
	<b>E Decreased carbon stocks</b>			
	E1 Increased deforestation & timber logging	Land use change		
	E2 Increased land degradation (forests, croplands, grassland)	Land degradation, Grassland		
	E3 Cropland expansion	Land use change		
	E4 Residue burning, deep tillage, ...	Crop production		

### B. Overview of data needs

After the identification of the relevant topic modules, users may proceed with data collection. Considering first the more elementary Tier 1 data needs, they are rather easy to procure for project managers and are part of the standard information available by project appraisal documents. They concern few geographical, climatic and agro-ecological variables and a wider set of information regarding land-use change activities and agricultural management practices. The entire tier 1 data needs are comprehensively depicted in the table below.

## Overview of Tier 1 activity data that can be accommodated in EX-ACT

Description module	
Obligatory	<ul style="list-style-type: none"> <li>- Sub-continent</li> <li>- Type of climate</li> <li>- Moisture regime</li> <li>- Dominant regional soil type</li> <li>- Project duration</li> </ul>
Land use change module	
Only if project related	<ul style="list-style-type: none"> <li>• <b>Deforestation</b> <ul style="list-style-type: none"> <li>- Forest type and size</li> <li>- Area deforested</li> <li>- Final land use after conversion</li> <li>- Burning during conversion?</li> </ul> </li> <li>• <b>Afforestation &amp; reforestation</b> <ul style="list-style-type: none"> <li>- Type of current land use</li> <li>- Type of future forest</li> <li>- Burning during conversion?</li> </ul> </li> <li>• <b>Other land use change</b> <ul style="list-style-type: none"> <li>- Type of current land use</li> <li>- Type of future land use</li> <li>- Burning during conversion?</li> </ul> </li> </ul>
	Crop production module
	<ul style="list-style-type: none"> <li>• <b>Annual systems</b> <ul style="list-style-type: none"> <li>- Current and future planted crop area (by type of crop)</li> <li>- Crop management practices</li> <li>- Practices of residue burning?</li> </ul> </li> <li>• <b>Perennial systems</b> <ul style="list-style-type: none"> <li>- Current and future planted crop area (by type of crop)</li> <li>- Practices of residue burning?</li> </ul> </li> <li>• <b>Irrigated rice</b> <ul style="list-style-type: none"> <li>- Specifications of water management practices</li> </ul> </li> </ul>
Grassland and livestock module	
	<ul style="list-style-type: none"> <li>• <b>Grassland</b> <ul style="list-style-type: none"> <li>- Current and future grassland area by state of degradation</li> <li>- Practices of grassland burning?</li> </ul> </li> <li>• <b>Livestock</b> <ul style="list-style-type: none"> <li>- Type and number of livestock</li> <li>- Feeding and breeding practices</li> </ul> </li> </ul>
	Land degradation module
	<ul style="list-style-type: none"> <li>• <b>Forest degradation</b> <ul style="list-style-type: none"> <li>- Dynamic of forest degradation/ rehabilitation by forest type and size</li> <li>- Occurrence of forest fires?</li> </ul> </li> <li>• <b>Degradation of organic soils (peatland)</b> <ul style="list-style-type: none"> <li>- Vegetation type and size concerned by drainage of organic soils</li> <li>- Area affected by peat extraction</li> </ul> </li> </ul>
	Input and investment module
	<ul style="list-style-type: none"> <li>• <b>Agricultural inputs</b> <ul style="list-style-type: none"> <li>- Weight of agricultural inputs by type</li> </ul> </li> <li>• <b>Energy consumption</b> <ul style="list-style-type: none"> <li>- Quantity of electricity, liquid and gaseous fuel, and wood consumed</li> </ul> </li> <li>• <b>Building of infrastructure</b> <ul style="list-style-type: none"> <li>- Size of area with newly established irrigation infrastructure or buildings (by type)</li> </ul> </li> </ul>

Tier 2 data involves location-specific variables that offer specifications on the carbon content and stock changes in all five carbon pools as well as the emission factors for selected practices. While all Tier 2 data needs that can be accommodated in EX-ACT are given in the User Manual, useful examples include the following:

- Above and below ground biomass levels and changes for forestland
- Soil carbon content
- Rates of soil carbon sequestration on various land uses

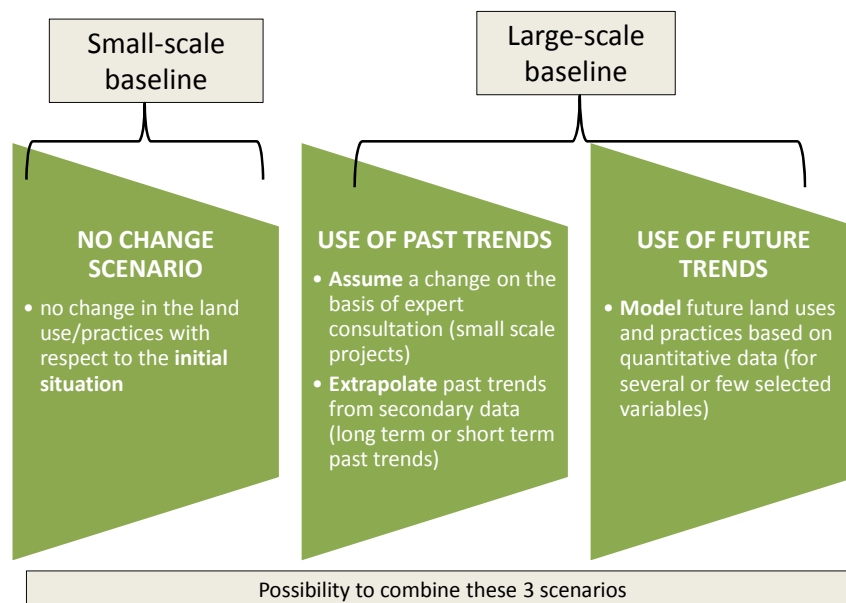
- Amount of biomass burnt during land conversion and crop residue management
- N<sub>2</sub>O and CH<sub>4</sub> emissions from manure management
- Emissions from enteric fermentation
- Emissions associated to the construction of agricultural, road and building infrastructure

The collection of Tier 2 data is especially advised for core project components that are expected to be larger sources or sinks of GHGs. This logic may be understood as a good practice leading to a reasonable combination of Tier 2 and Tier 1 data. Data collection of Tier 2 variables is thereby often difficult and it will for this reason it will never be possible to collect Tier 2 information for all considered variables.

## 5) Building the baseline scenario

Because the EX-ACT carbon-balance of a project is given by the difference of the overall effects of project and baseline scenario, the final results of EX-ACT are determined as strongly by the project as the baseline scenario. The baseline scenario is therefore one of the most important steps in an EX-ACT analysis. Users can choose between three approaches to generate a baseline scenario.

### Three main baseline methodologies



## 6) Brief guide to data entry

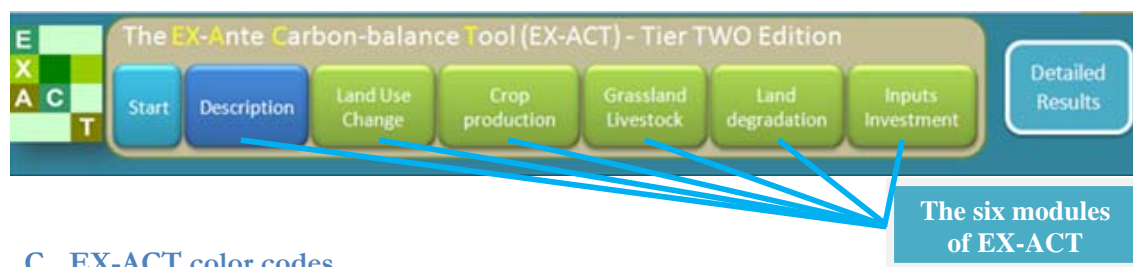
### A. Where to download, how to start

Users can download the Excel file containing EX-ACT for free at [www.fao.org/tc/exact/carbon-balance-tool-ex-act](http://www.fao.org/tc/exact/carbon-balance-tool-ex-act).

### B. Navigation bar

The navigation bar located at the top of the Excel window allows users to move between the six different topic modules. This provides the main overview of the topic and activity areas of relevance to EX-ACT. By clicking on the EX-ACT logo on the top left, users navigate directly to the EX-ACT homepage where they can find additional information.

## EX-ACT navigation bar



### C. EX-ACT color codes

Every EX-ACT module is subdivided into its different components using boxes. EX-ACT thereby uses a repeating colour code throughout all modules. Cells in light blue indicate where users have to specify information, while the background color brown, specifies the variables and units that have to be provided as well as resulting changes in GHG emissions and carbon stock changes.

By clicking on the orange boxes used throughout EX-ACT, users may find additional information and help that facilitates completing the relevant module components. The violet boxes indicating “Tier 2” instead allow users to specify location specific values for carbon pools (e.g. soil carbon content) and GHG emissions.

### EX-ACT color codes

### D. Description module

After leaving the start screen, the user proceeds to the description module, where most of the necessary information for subsequent windows can be selected from series of drop-down menus. Much of this consists of descriptive information about local agro-ecological conditions.

## The Description Module

**The EX-Ante Carbon-balance Tool (EX-ACT) - Tier TWO Edition**

Start Description Land Use Change Crop production Grassland Livestock Land degradation

Project Name: Trial Project

Continent: Africa

Climate: Tropical Moist

Moisture regime: Moist

Dominant Regional Soil Type: HAC Soils

Duration of the Project (Years):

Phase	Duration (Years)
Implementation phase	10
Capitalisation phase	10
Duration of accounting	20

### E. Data entry in the topic modules

The *User Manual* contains a detailed step-by-step guide to data entry. For illustrative purposes, the deforestation sub-section of the land use change module is referenced here.

### Deforestation (land use change module)

**2.1. Deforestation**

Available AEZ? 1. Tropical rain forest - 2. Tropical moist deciduous forest - 3. Tropical dry forest - 4. Tropical shrubland

Type of vegetation that will be deforested	HWP (tDM/ha)	Fire Use (y/n)	Final use after deforestation	Forested area (ha)				
				Start	Without	*	With	*
Forest Zone 1	0	YES	Annual Crop	5000	1000	D	4500	D
Select the vegetation	0	NO	Select Use after deforestation	0	0	D	0	D
Select the vegetation	0	NO	Select Use after deforestation	0	0	D	0	D
Select the vegetation	0	NO	Select Use after deforestation	0	0	D	0	D
Select the vegetation	0	NO	Select Use after deforestation	0	0	D	0	D
Select the vegetation	0	NO	Select Use after deforestation	0	0	D	0	D

\* Note concerning dynamics of change : D correspond to "Default", "I" to Im

Tier 2

When using the deforestation sub-module, the following types of information will be needed:

- Identifying the current forest type:** Based on the climatic information provided in the *Description Module* users are provided with up to four different types of agro-ecological forest categories.
- Users then choose from a drop-down list, which of these four forest categories describes best the area under the project subject to potential deforestation. In the example above this is *Forest Zone 1* standing for *Tropical rainforest*.
- Identifying the final land use after deforestation:** Users select the final land use after conversion from a drop down list. In the above example the forest is converted to annual crop land.
- Surface deforested:** Subsequently, users then specify the size of the area that remains forested for the three EX-ACT scenario points: In the example the initial forest size is 5,000 ha. Without project
-



implementation it will diminish due to deforestation to a final size of 1,000 ha, while with project implementation still 4,500 ha will remain forestland.

**Tier 2 specifications:** While the previous information is sufficient for EX-ACT to calculate a Tier 1 based carbon-balance, further information can be specified after clicking on the Tier 2 button:

## Tier 2 specifications for deforestation

### 2.1. Deforestation

Available AEZ?

1.Tropical rain forest - 2.Tropical moist deciduous forest - 3.Tropical dry forest - 4.Tropical shrubland

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You have indicated that your are using the following types of vegetation: Forest Zone 1 (here below highlighted in blue)

Use this part only if you want to refine analysis with Tier 2 coefficients

All values are in t of carbon per ha (tC/ha)  
(default values are provided for your information only, while EX-ACT will use Tier 2 values automatically wherever specified)

Type of vegetation (that will be deforested)	Above-ground		Below-ground		Litter		Dead wood		Soil C	
	Default	Tier 2	Default	Tier 2	Default	Tier 2	Default	Tier 2	Default	Tier 2
Forest - Zone 1	145.7	168.0	53.9	65.0	3.7	3.9	0.0		65.0	68.3
Forest - Zone 2	122.2		29.3		3.7		0.0		65.0	
Forest - Zone 3	56.4		15.8		3.7		0.0		65.0	
Forest - Zone 4	32.9		13.2		3.7		0.0		65.0	
Plantation - Zone 1	70.5		26.1		3.7		0.0		65.0	
Plantation - Zone 2	56.4		11.3		3.7		0.0		65.0	
Plantation - Zone 3	28.2		7.9		3.7		0.0		65.0	
Plantation - Zone 4	14.1		5.6		3.7		0.0		65.0	

As shown in the screenshot above, users can specify as part of the Tier 2 specifications for forest subject to deforestation the carbon content of above- and below-ground biomass, litter, dead wood and soil organic carbon.

In the example above we only made use of the forest category “Forest – Zone 1/ Tropical rainforest,” which is why it is automatically shaded in blue by EX-ACT. Due to collected Tier 2 data collected by project staff, it is known that the forest subject to deforestation is per hectare characterized by 168 tons of carbon in above ground biomass, 65 tons in below ground biomass and 3.9 tons in litter, while the soil carbon content is 68.3 tons per hectare.

More details on data collection and entry of such Tier 2 data can be found in the *User Manual*.