Estimation of future emissions of GreenHouse Gaz (GHG)

Use of the Ex-Act tool

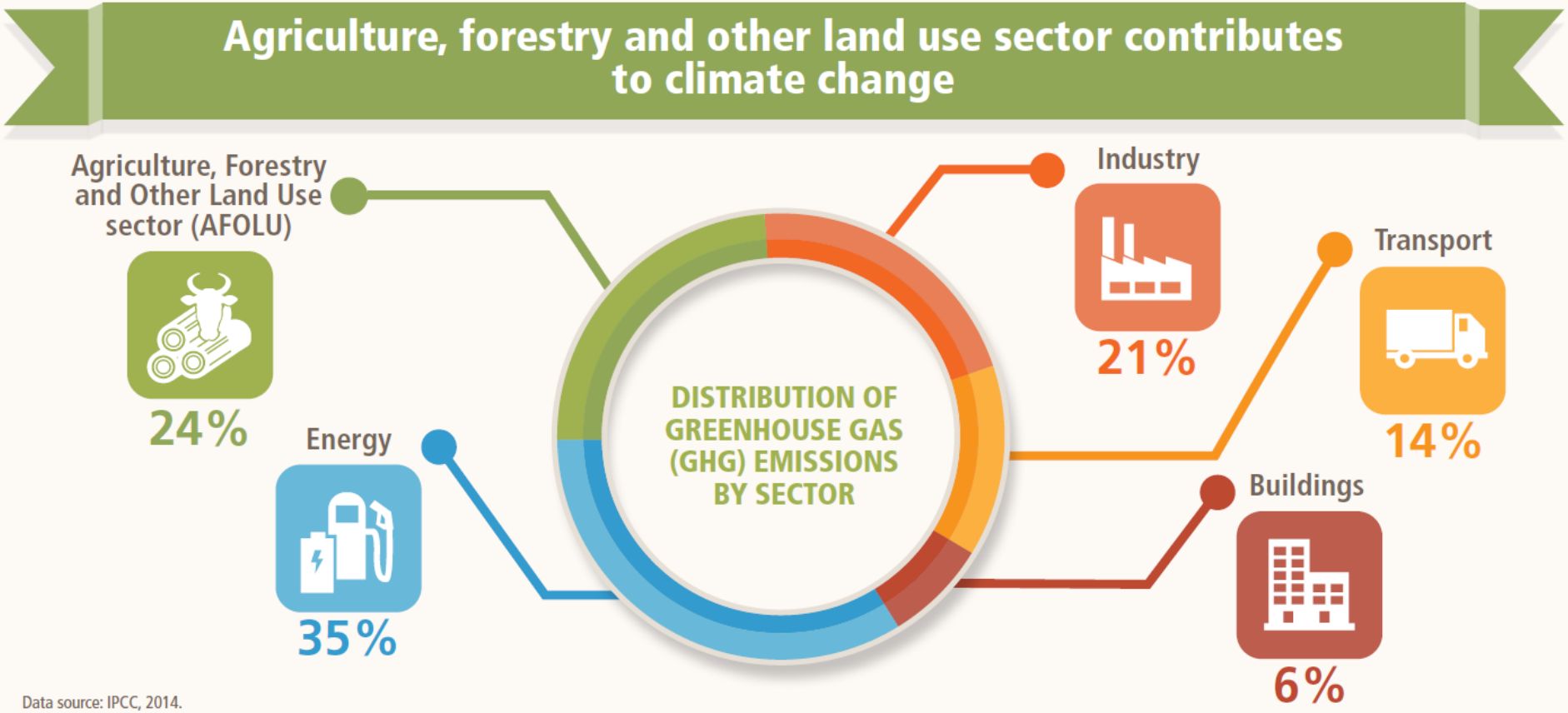
Training from the FORAE Project

Marie Nourtier – 24-07-18

Why accounting for GHG ?

Source: FAO, 2016

Why accounting for GHG ?



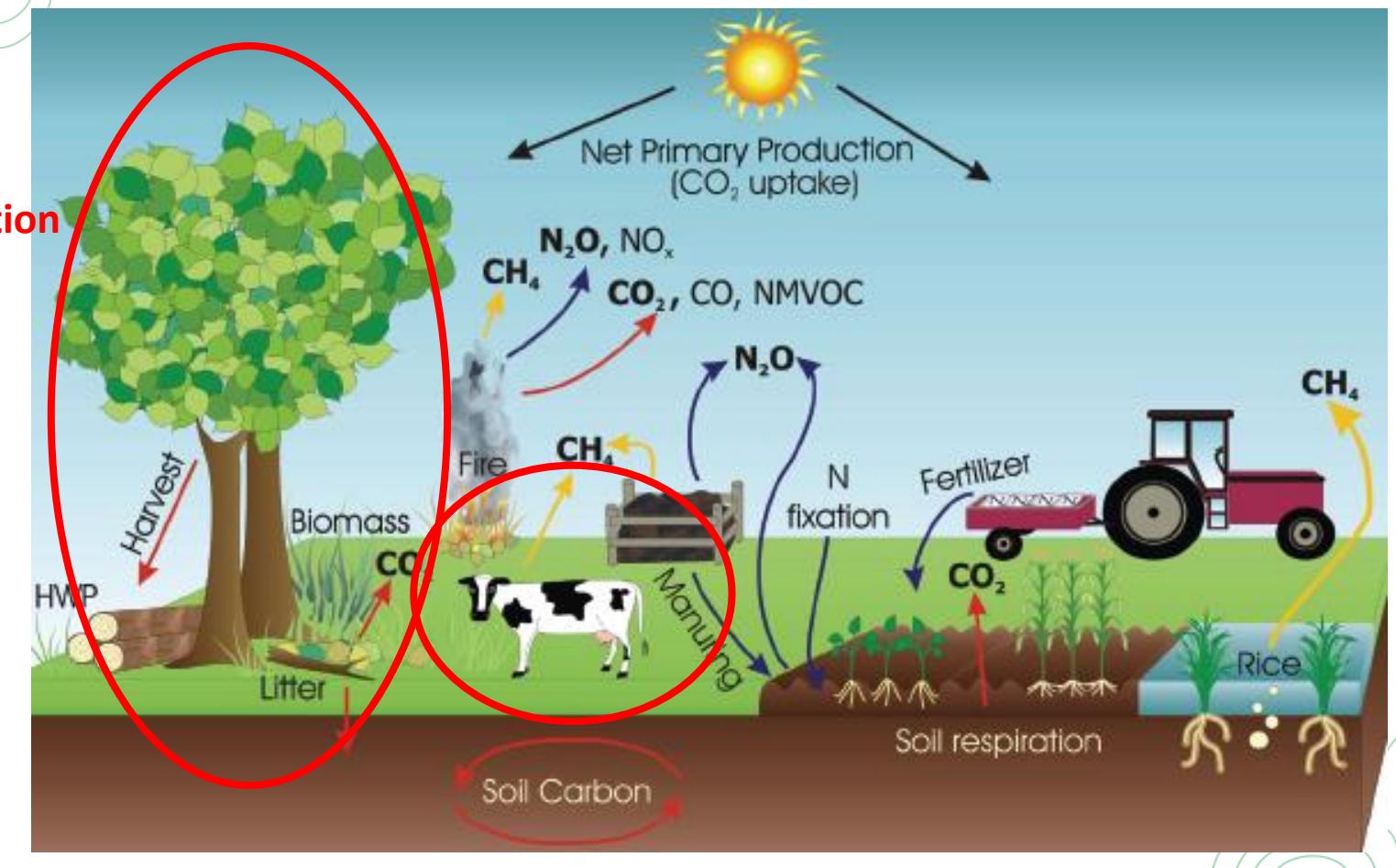
Source: FAO, 2016

Why accounting for GHG ?

CO_2	CH_4	N_2O
1	21	310

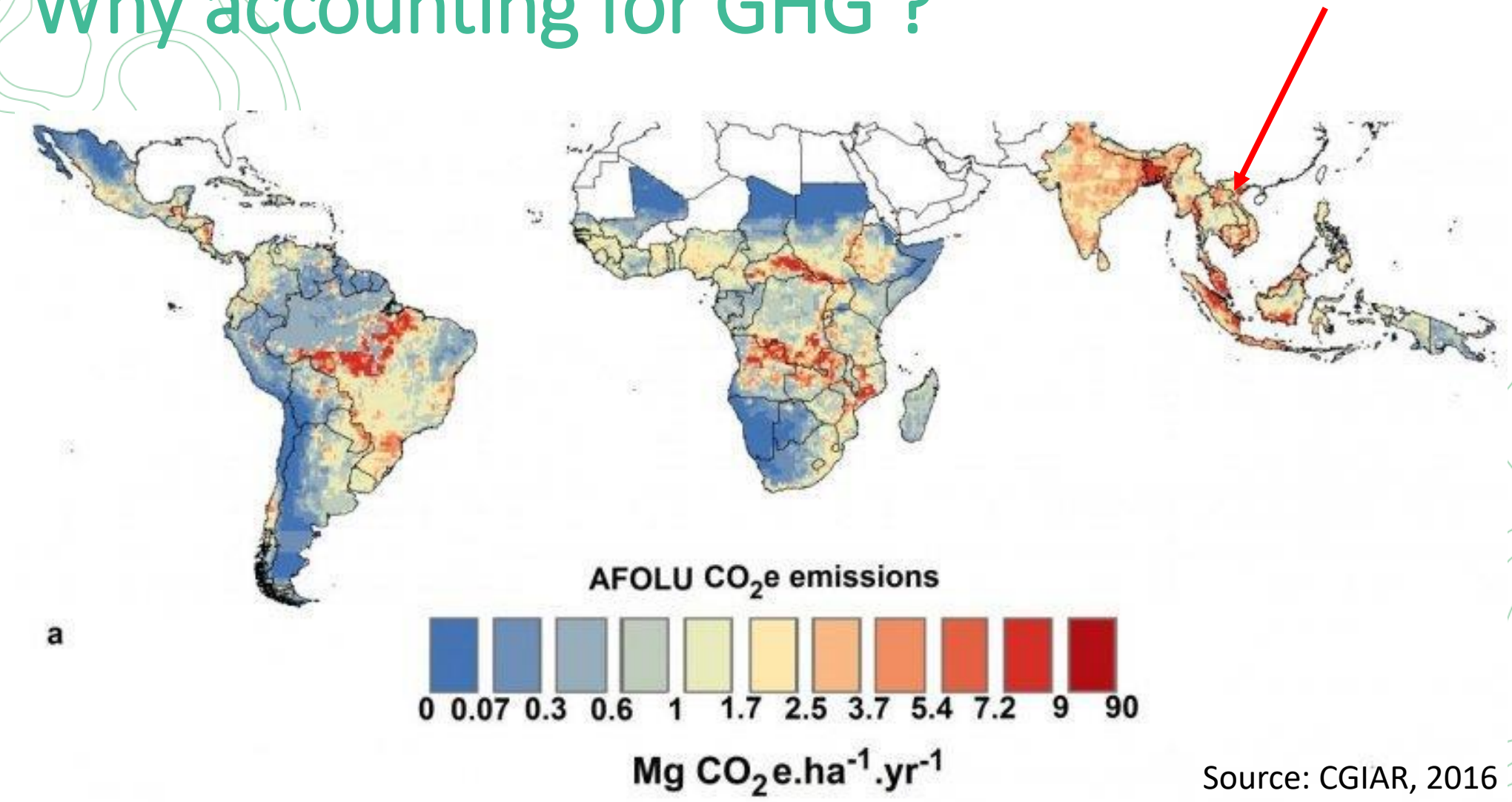
Official Global Warming Potential (GWP-100yr)

Deforestation



Cow breeding

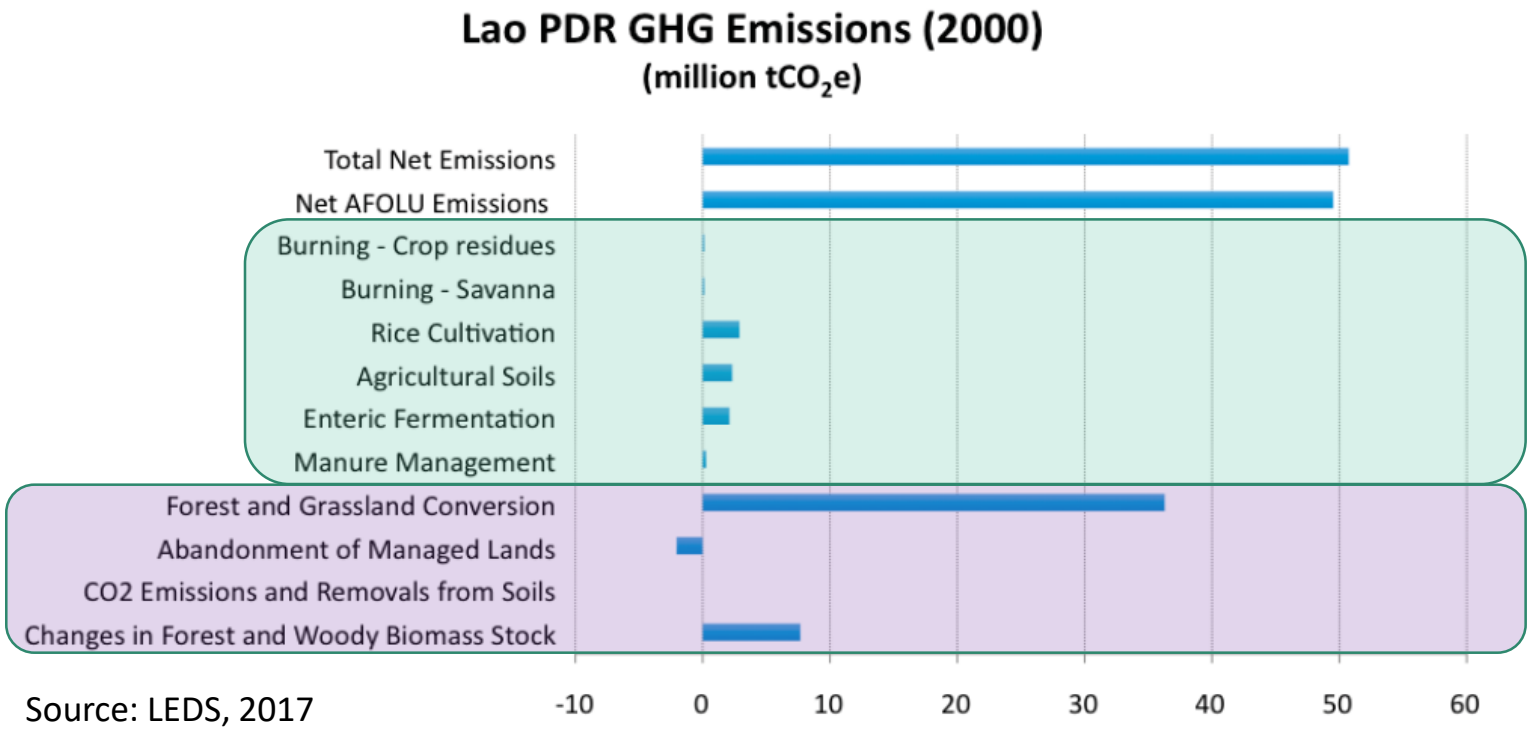
Why accounting for GHG ?



Source: CGIAR, 2016

Why accounting for GHG ?

- Laos is a contributor to CC, mainly because of AFOLU sector



Agriculture

Land use change - deforestation

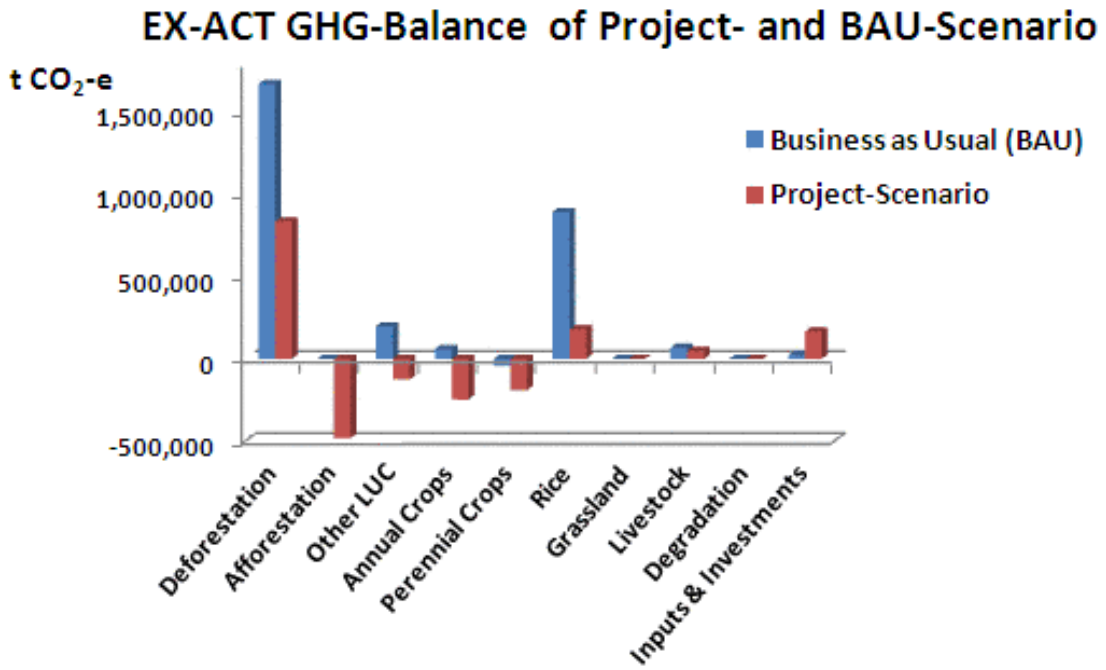
Source: LEDS, 2017

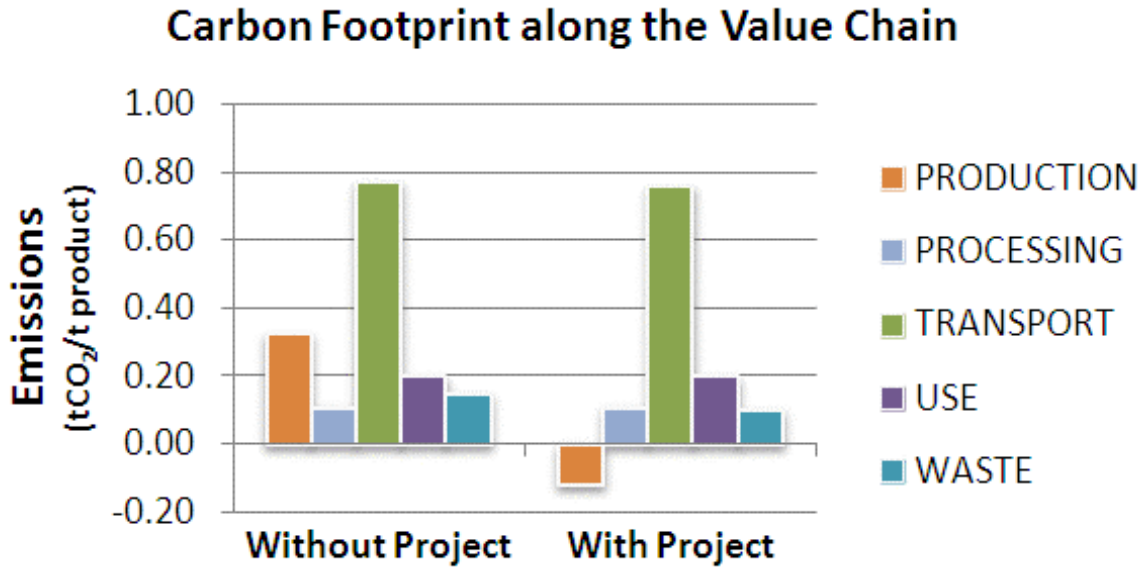
The Ex-Act tool

- Ex-Act is a tool developed by FAO

The Ex-Act tool

- Ex-Act is a tool developed by FAO
- Calculation of the GHG emissions without and with a project
  - Projection in the future, after the project if activities continue





The Ex-Act tool

Emission Estimate = **Activity Data** X **Emission Factor**

Emission Estimates: "Key Categories" (usually~10-15 Sources) account for over95% of a countries emissions, focus resources on these

Official Statistics: Activity Data usually can be found in national or international statistics

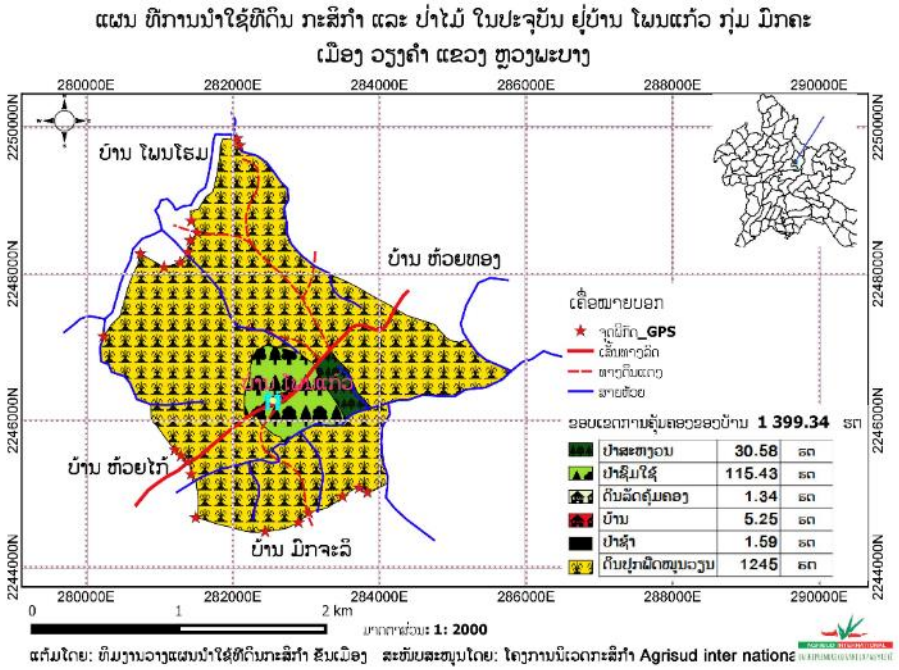
Guidelines: Most sources can use defaults from IPCC Guidelines – Only "Key Categories"(~10-15 Sources) need use more detailed parameters

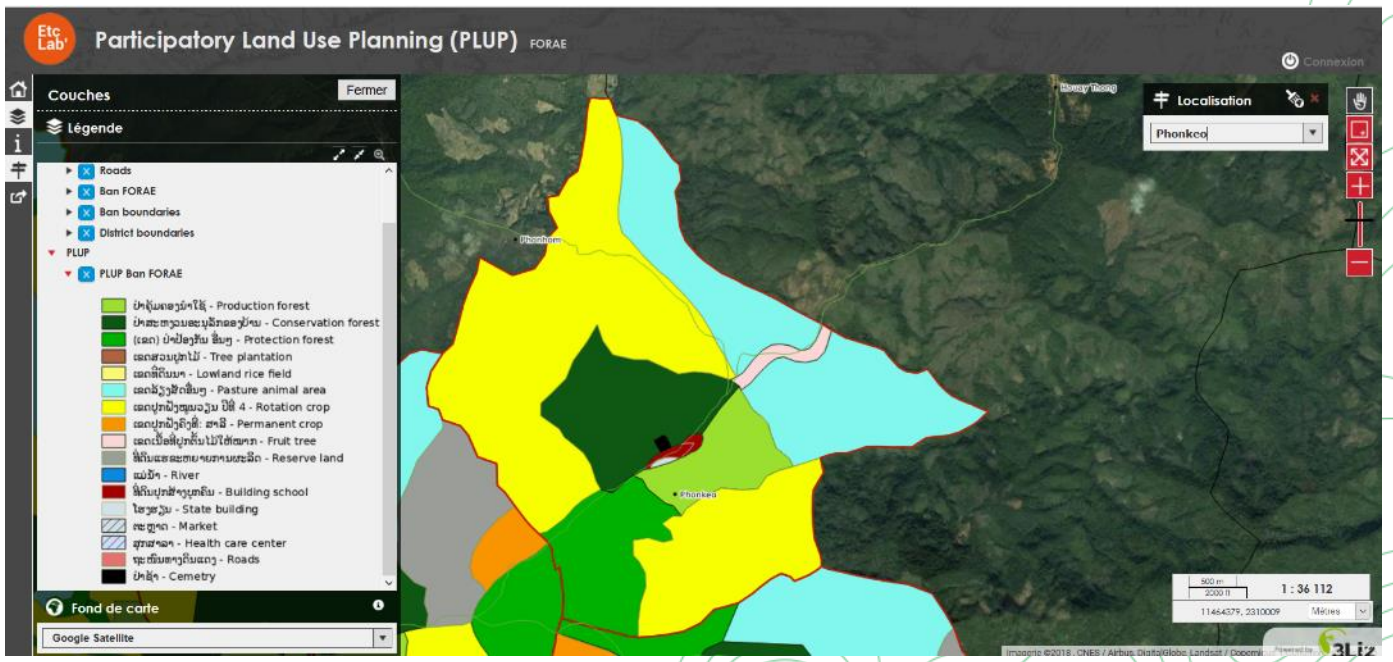
Only direct fluxes

Example from the FORAE Project

Web GIS interface:
www.forae-viengkham.com

- Land use map at the beginning of the project
- Projection of the land use in a management plan – 20 years





Example from the FORAE Project

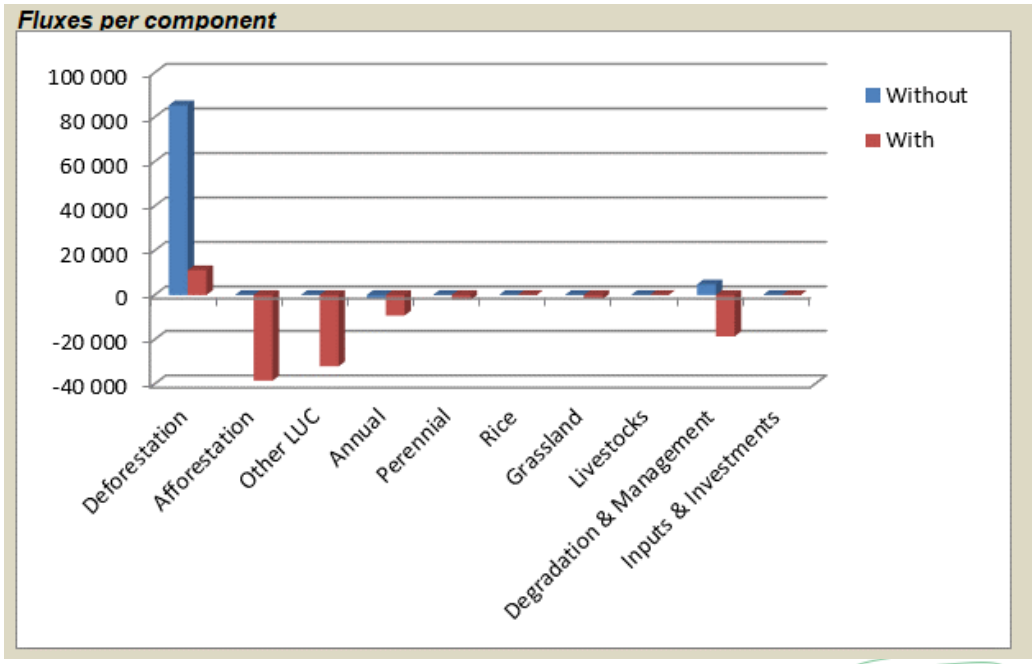
- Hypothesis on land use change – simple changes

Land use	Area in ha without PLUP	Area in ha in PLUP	Land use changes in Ex-Act
Protection Forest		124	annual crop -> forest (moderate degradation)
School		1	-
Buildings village		6	-
Conservation Forest	31	157	forest (moderate degradation) -> forest (low degradation)
Production Forest	115	83	forest (large degradation) -> forest (moderate degradation)
Pasture animal area		336	annual crop -> grassland
Rotation crop	1245	674	annual crop -> annual crop
Fruit Tree		16	annual crop -> perennial/tree crop
Cemetery Forests		2	forest -> forest

Example from the FORAE Project

- Main GHG benefits are linked to forest – reduction of deforestation or forest restauration

Components of the project	Gross fluxes Without	With	Balance
	All GHG in tCO2eq		
	Positive = source / negative = sink		
Land use changes			
Deforestation	85 293	11 125	-74 168
Afforestation	0	-38 460	-38 460
Other LUC	0	-32 070	-32 070
Agriculture			
Annual	-1 208	-9 239	-8 032
Perennial	0	-2 231	-2 231
Rice	0	0	0
Grassland & Livestocks			
Grassland	0	-1 737	-1 737
Livestocks	0	0	0
Degradation & Management	4 730	-18 625	-23 355
Inputs & Investments	0	0	0
Total	88 816	-91 237	**-180 053**
Per hectare	102	-105	-206
Per hectare per year	5.1	-5.2	-10.3



Questions before an exercise on Ex-Act

Exercise

- An imaginary project in Laos

On 10 000 ha and during 10 years

- Forest area is 3000 ha at the beginning
  - 50 % is degraded and will be restored
  - 50 ha/yr are converted for slash and burn agriculture without the project – the project will divide deforestation by 5
- 5000 ha are for agriculture
  - 1000 ha are for pasture and 500 ha will be added for the project from croplands
    - Number of cows is 30 per ha and it will be reduced to 10 per ha
  - 1000 ha are for rice – System of rice intensification (SRI) with water management will be implemented on 200 ha of those 1000 ha
  - 1000 ha will be converted to agroforestry
  - Improved agronomic techniques will be implemented on the rest of the fields
- 1500 ha are abandoned lands
  - 500 ha of forest regeneration
  - 500 ha converted to pasture
- 500 ha are wetlands
  - 100 ha will be converted to rice fields by the project

Exercise

- Step 1 :
  - Summary your land use with and without the project in a table
  - Identify your land use changes

Exercise

Download v7.2:
http://www.fao.org/tc/exact/carbon-balance-tool-ex-act/en/

- Step 1 :
  - Summary your land use with and without the project in a table
  - Identify your land use changes
- Step 2 :
  - Start to complete Ex-Act Excel file
    - First, project description
    - And information on land use, sheet by sheet

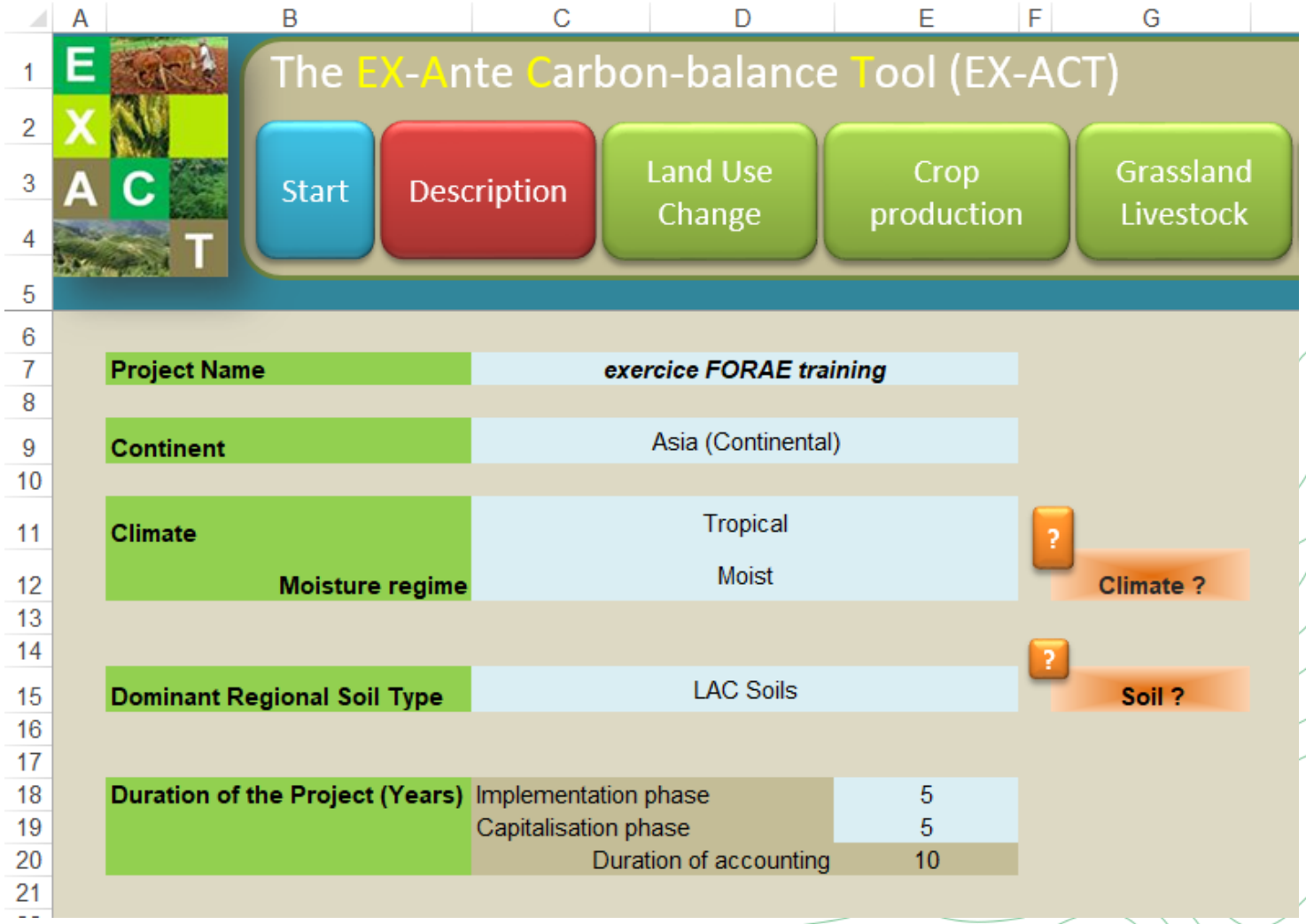
Exercise

- Step 1 :
  - Summary your land use with and without the project in a table
  - Identify your land use changes

LULC	initial area	activity	without project	with project
forest	3000 ha	deforestation will be divided by 5	500 ha	100 ha
		50% are degraded and will be restaured	1500 ha moderatly degraded	1500 ha with low degradation
croplands	5000 ha	increase of pasture land	1000 ha	1500 ha
		decrease of cow cattles	30 cows/ha	10 cows/ha
		irrigated rice -> SRI	0	200 ha
		agroforestry	0	1000 ha
		improved agronomic techniques	0	2000 ha
abandoned lands	1500 ha	converted to pasture	0	500 ha
		converted to forests (forests regeneration)	0	500 ha
wetlands	500 ha	converted to irrigated rice	0	100 ha

Exercise

- Step 2 :
  - Project description



The EX-Ante Carbon-balance Tool (EX-ACT)

Start | Description | Land Use Change | Crop production | Grassland Livestock

Project Name	***exercice FORAE training***
Continent	Asia (Continental)
Climate	Tropical
Moisture regime	Moist
Dominant Regional Soil Type	LAC Soils
Duration of the Project (Years)	Implementation phase: 5
	Capitalisation phase: 5
	Duration of accounting: 10

? Climate ?

? Soil ?

Exercise

- Step 2 : LUC

- Positive impact of reduction of deforestation, forest regeneration and plantation of fruit trees
- Positive impact of grasslands management compared to abandoned lands or annual crops

2.1. Deforestation

AEZ map — Zone 1 = Tropical rain forest — Zone 2 = Tropical moist deciduous forest — Zone 3 = Tropical dry forest — Zone 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	*	Deforested area (ha) Without	With	Total Emissions (tCO2-eq) Without	With	Balance
Forest Zone 2	0	YES	Annual Crop	3000	2500	D	2900	D	500	100	214 281	42 856	-171 425
Select the vegetation	0	NO	Select Use after deforestation	0	0	D	0	D	0	0	0	0	0

2.2. Afforestation and Reforestation

AEZ map — Zone 1 = Tropical rain forest — Zone 2 = Tropical moist deciduous forest — Zone 3 = Tropical dry forest — Zone 4 = Tropical shrubland

Type of vegetation that will be planted	Fire Use? (y/n)	Previous land use	Area that will be afforested/reforested Without	*	With	*	Total Emissions (tCO2-eq) Without	With	Balance
Forest Zone 2	NO	Set Aside	0	D	500	D	0	-73 136	-73 136
Select the vegetation	NO	Select previous use	0	D	0	D	0	0	0

2.3. Other Land Use Changes

Fill with your description	Initial land use		Final land use	Message	Fire Use? (y/n)	Area transformed (ha) Without	*	With	*	Total Emissions (tCO2-eq) Without	With	Balance
agroforestry	Annual Crop	→	Perennial/Tree Crop		NO	0	D	1000	D	0	-24 805	-24 805
conversion to pasture1	Annual Crop	→	Grassland		NO	0	D	500	D	0	-21 509	-21 509
conversion to pasture2	Set Aside	→	Grassland		NO	0	D	500	D	0	-10 522	-10 522

Exercise

- Step 2 : Cropland

Detailed explanation of the meaning of each practice can be found in Smith et al (2007). Note that some practices may present some overlapping. Some descriptions of the options are briefly given below:

- Improved agronomic practices: all practices that may increase yields and thus generate higher residues. Examples of such practices reported by Smith et al. (2007) are, using improved crop varieties, extending crop rotations, and rotations with legumes crops.
- Nutrient management: application of fertilizer, manure, and biosolids, improving either the efficiency (adjusting application rate, improving timing, location…) or diminishing the potential losses (slow release fertilizer form or nitrification inhibitors).
- Tillage/residue management: adoption of practices with less tillage intensity ranging from minimum tillage to no-tillage and with or without residues maintenance on the field.
- Water management: enhanced irrigation measures that can lead to an increase in the productivity (and hence of the residues).
- Manure application: improving nutrient source using manure or Biosolids.

Some of the practices may result in concomitant gain in terms of C sequestration, reduction of N_2O and C sources but also emissions increases, e.g. increase N_2O potential emissions associated with increases on external N inputs. The emissions or reduction of N_2O and CH_4 are

3.1.2. Annual systems remaining annual systems (total area must remain constant)

Fill with your description	Main season crop	Management options (Improved agronomic practices)	Nutrient management	No till & residue retention	Water management	Manure application	Residue management	Yield (t/ha/yr)	Area (ha) Start	Without	*	With	*	Total Emissions (tCO2-eq) Without	With	Balance
		Definitions?					Yield?									
improved agriculture on annual crop	Default	Yes	?	?	?	?	Please select		0	0	D	2000	D	0	-13 200	-13 200
description 2	Default	?	?	?	?	?	Please select		0	0	D	0	D	0	0	0

Exercise

- Step 2 : grassland
  - Positive impact of the reduction of the size of the cattle

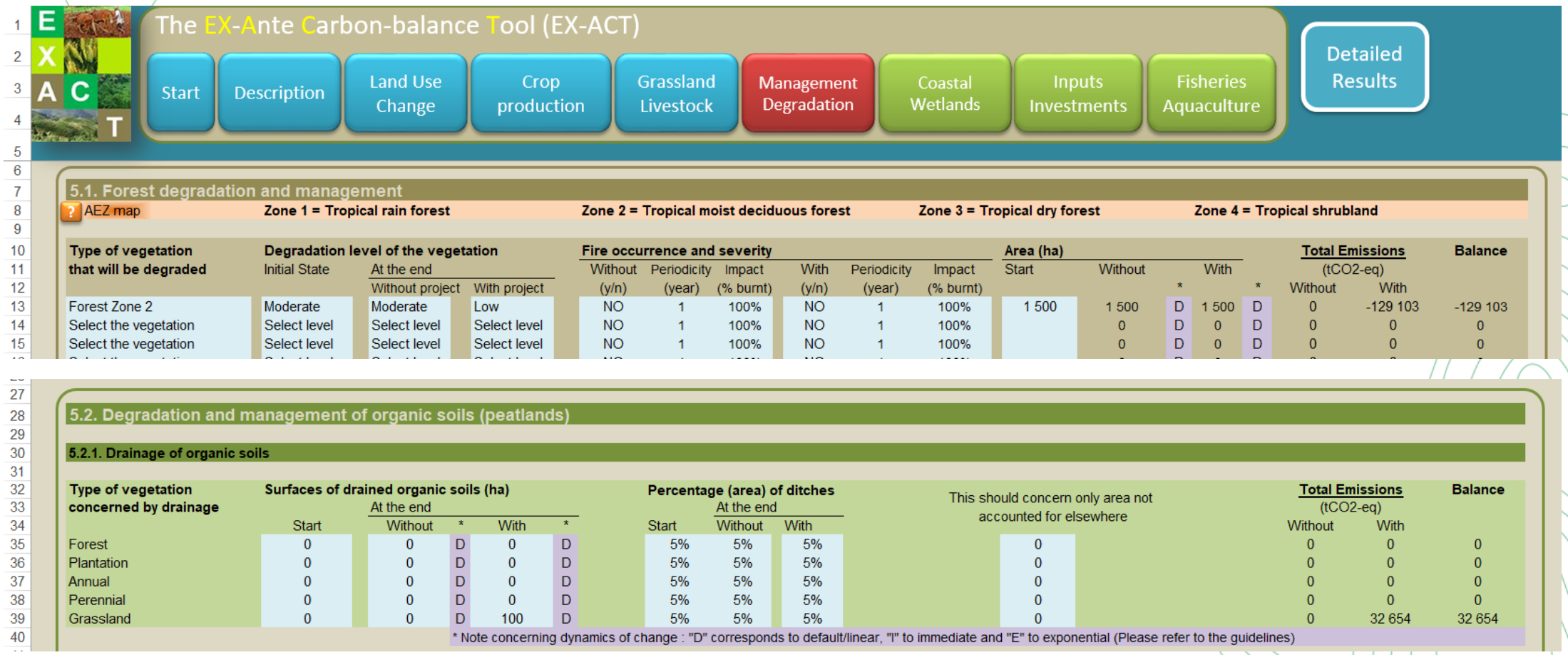
4.2. Livestock (and manure management)

Livestock categories	Head number (mean per year)					Technical mitigation option (%)									Production (meat, milk, etc)			Total Emissions	
	Start	Without project	*	With project	*	Feeding practices*			Specific Agents*			Breeding*			in tonnes of product per year			(tCO2-eq)	
						Start	Without	With	Start	Without	With	Start	Withou	With	Start	Without	With	Without	With
Dairy cattle	0	0	D	0	D	0%	0%	0%	0%	0%	0%	0%	0%	0%				0	0
Other cattle	30	30	D	10	D	0%	0%	0%	0%	0%	0%	0%	0%	0%				443	222
Buffalo	0	0	D	0	D	0%	0%	0%	0%	0%	0%	0%	0%	0%				0	0
Sheep	0	0	D	0	D	0%	0%	0%	0%	0%	0%	0%	0%	0%				0	0
Swine (Market)	0	0	D	0	D	Feeding practices: e.g. more concentrates, adding certain oils or			Specific agents: specific agents and dietary additives to reduces CH4			Breeding: increasing productivity through breeding						0	0
Swine (Breeding)	0	0	D	0	D	oilseeds to the diet, improving			emissions (Ionophores, vaccines			and better management						0	0

Exercise

- Positive impact of forest restauration
- Negative impact of the conversion of peatlands

- Step 2 : degradation



The EX-Ante Carbon-balance Tool (EX-ACT)

Start | Description | Land Use Change | Crop production | Grassland Livestock | Management Degradation | Coastal Wetlands | Inputs Investments | Fisheries Aquaculture | Detailed Results

5.1. Forest degradation and management

AEZ map — Zone 1 = Tropical rain forest — Zone 2 = Tropical moist deciduous forest — Zone 3 = Tropical dry forest — Zone 4 = Tropical shrubland

Type of vegetation that will be degraded	Degradation level of the vegetation: Initial State	At the end: Without project	At the end: With project	Fire occurrence and severity: Without (y/n)	Without: Periodicity (year)	Without: Impact (% burnt)	With (y/n)	With: Periodicity (year)	With: Impact (% burnt)	Area (ha): Start	Area (ha): Without	*	Area (ha): With	*	Total Emissions (tCO2-eq): Without	Total Emissions (tCO2-eq): With	Balance
Forest Zone 2	Moderate	Moderate	Low	NO	1	100%	NO	1	100%	1 500	1 500	D	1 500	D	0	-129 103	-129 103
Select the vegetation	Select level	Select level	Select level	NO	1	100%	NO	1	100%		0	D	0	D	0	0	0
Select the vegetation	Select level	Select level	Select level	NO	1	100%	NO	1	100%		0	D	0	D	0	0	0

5.2. Degradation and management of organic soils (peatlands)

5.2.1. Drainage of organic soils

Type of vegetation concerned by drainage	Surfaces of drained organic soils (ha): Start	At the end: Without	*	At the end: With	*	Percentage (area) of ditches: Start	At the end: Without	At the end: With	This should concern only area not accounted for elsewhere	Total Emissions (tCO2-eq): Without	Total Emissions (tCO2-eq): With	Balance
Forest	0	0	D	0	D	5%	5%	5%	0	0	0	0
Plantation	0	0	D	0	D	5%	5%	5%	0	0	0	0
Annual	0	0	D	0	D	5%	5%	5%	0	0	0	0
Perennial	0	0	D	0	D	5%	5%	5%	0	0	0	0
Grassland	0	0	D	100	D	5%	5%	5%	0	0	32 654	32 654

* Note concerning dynamics of change : "D" corresponds to default/linear, "I" to immediate and "E" to exponential (Please refer to the guidelines)

Exercise

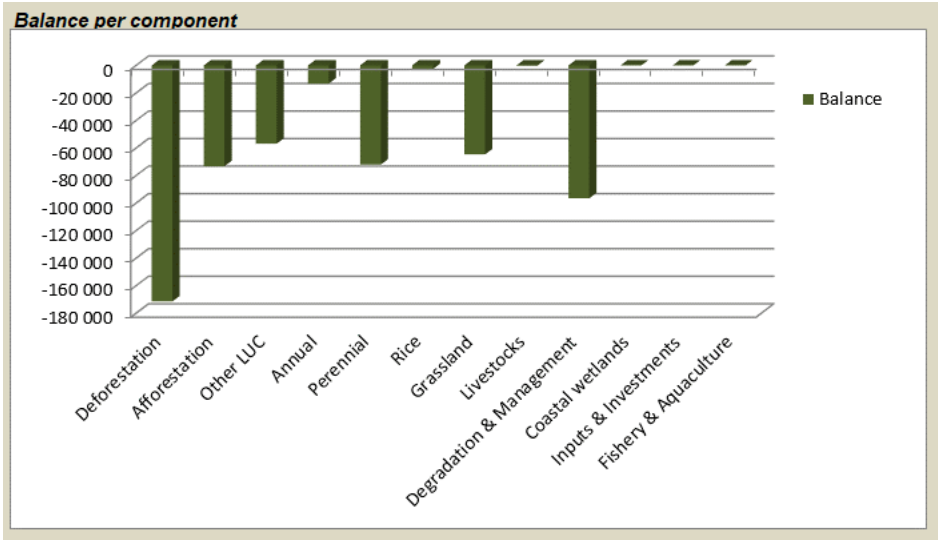
- Step 2 : inputs

Exercise

- Step 1 :
  - Summary your land use with and without the project in a table
  - Identify your land use changes
- Step 2 :
  - Start to complete Ex-Act Excel file
    - First, project description
    - And information on land use, sheet by sheet
- Step 3 :
  - Check results on Ex-Act and identify potential errors
  - Report on results

Exercise

- Step 3 :
  - Check results on Ex-Act and identify potential errors
  - Report on results



- High positive impact of forest restauration & managenement
- Positive impact of management of grassland
- Negative impact of the conversion of peatland

Project Name	exercice FORAE training	Climate	Tropical (Moist)	Duration of the Project (Years)	10
Continent	Asia (Continental)	Dominant Regional Soil Type	LAC Soils	Total area (ha)	8000

Components of the project	Gross fluxes Without	With	Balance	Share per GHG of the Balance All GHG in tCO2eq CO_2 Biomass	Soil	Other	N_2O	CH_4	Result per year Without	With	Balance
	All GHG in tCO2eq Positive = source / negative = sink										
Land use changes											
Deforestation	214 281	42 856	-171 425	-151 879	-13 442		-1 697	-4 406	21 428	4 286	-17 143
Afforestation	0	-73 136	-73 136	-67 320	-5 816		0	0	0	-7 314	-7 314
Other LUC	0	-56 836	-56 836	-612	-56 224		0	0	0	-5 684	-5 684
Agriculture											
Annual	0	-13 200	-13 200	0	-13 200		0	0	0	-1 320	-1 320
Perennial	0	-71 983	-71 983	-66 733	-5 250		0	0	0	-7 198	-7 198
Rice	47 888	45 301	-2 586	0	0		0	-2 586	4 789	4 530	-259
Grassland & Livestocks											
Grassland	0	-64 625	-64 625	0	-64 625		0	0	0	-6 463	-6 463
Livestocks	443	222	-222				-42	-180	44	22	-22
Degradation & Management	0	-96 450	-96 450	-119 409	18 961		1 756	2 243	0	-9 645	-9 645
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	262 613	-287 851	**-550 463**	-405 954	-139 596	0	17	-4 930	26 261	-28 785	-55 046

0.Start | 1.Description | 2.LUC | 3.Cropland | 4.Grassland | 5. Management | 6. Coastal | 7. Inputs | 8. Fish | 9. Results | Help | Yield | Calculations

Thank you for your attention

Questions?

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