Webinar FAO/Agreenium/UN-ESCAP
October 28, 2020

Preventing and Mitigating Land Degradation: Nutrient Turnover and Terrestrial Carbon Sequestration

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A presentation in three parts

- Interrelations between the AFOLU sectors and climate change
- EX-ACT tool: Introduction - examples
- Nutrient turnover strategies for mitigating land degradation

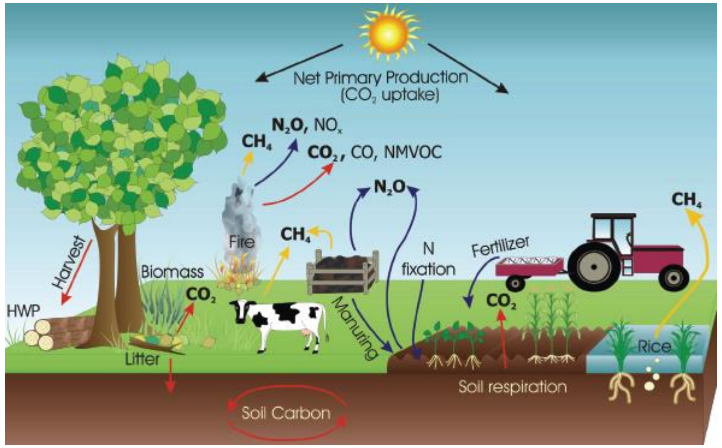
interrelations between the AFOLU sectors and climate change

Agriculture & Climate change

Agriculture forestry And other land use

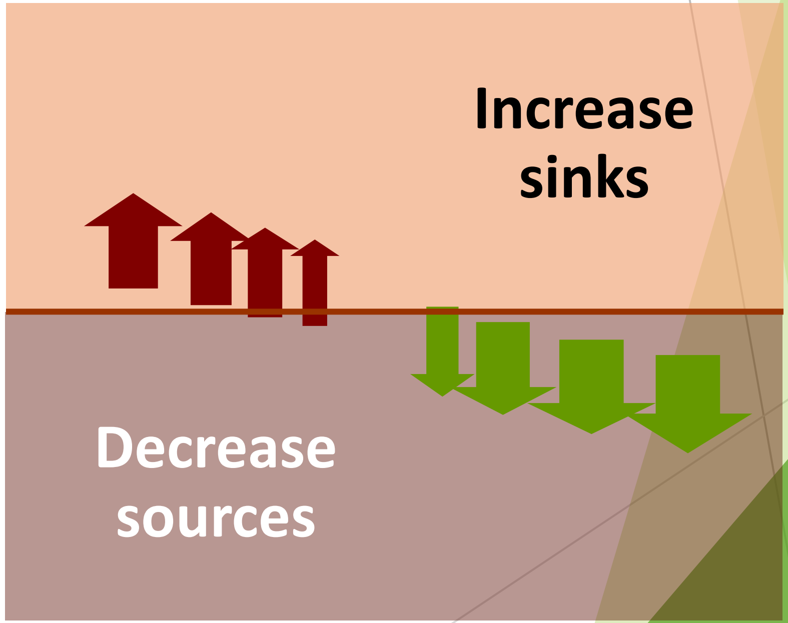
- **Threatened** by climate change
- **Responsible** for 1/4 of total GHG emissions
- **Huge potential** to cost-effectively mitigate

3 accounted GHG : CO_2, CH_4, N_20

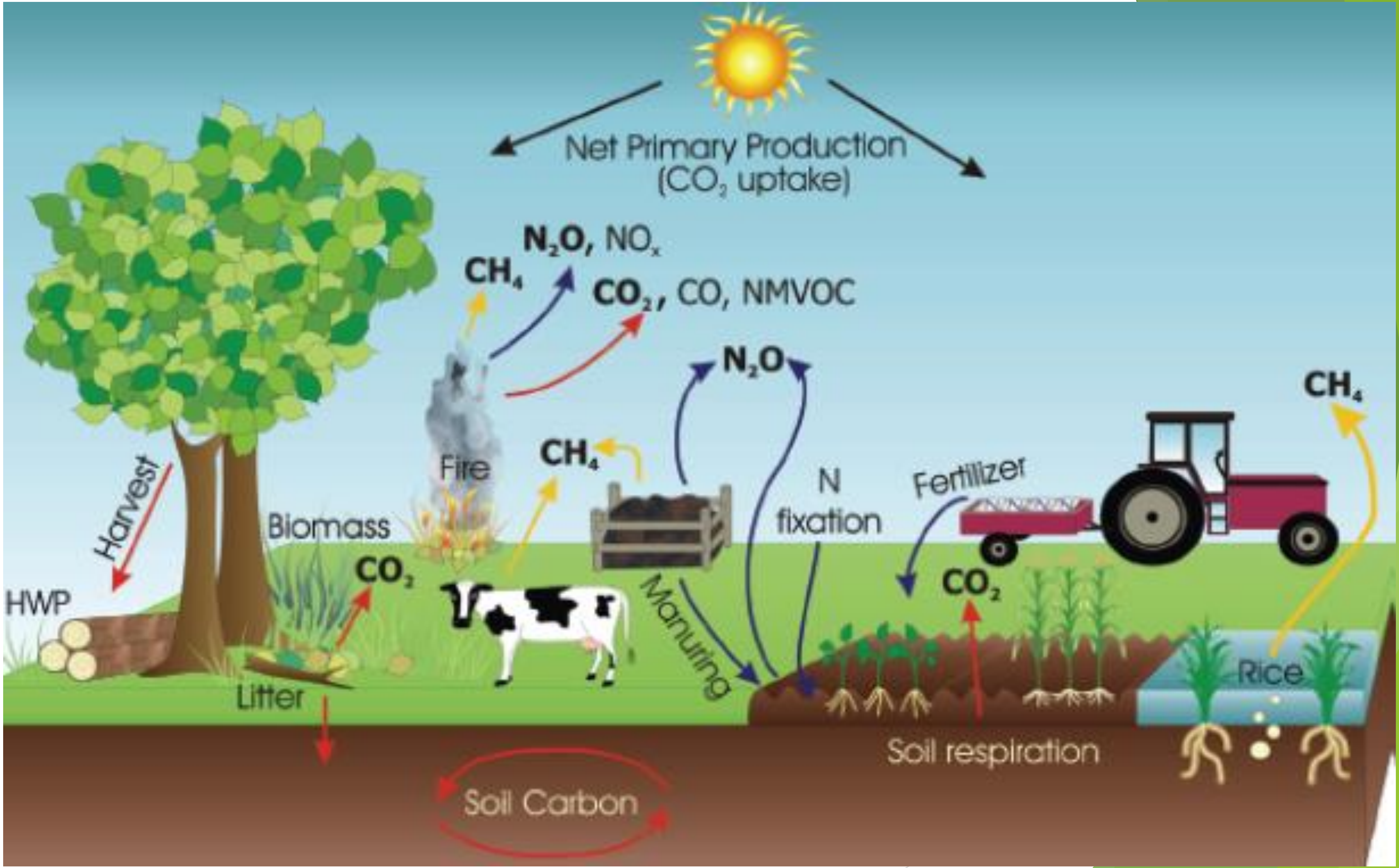


The main GHG emission sources/removals and processes in managed ecosystems
(After IPCC Volume 4 Chapter. 1 Introduction)

Mitigation

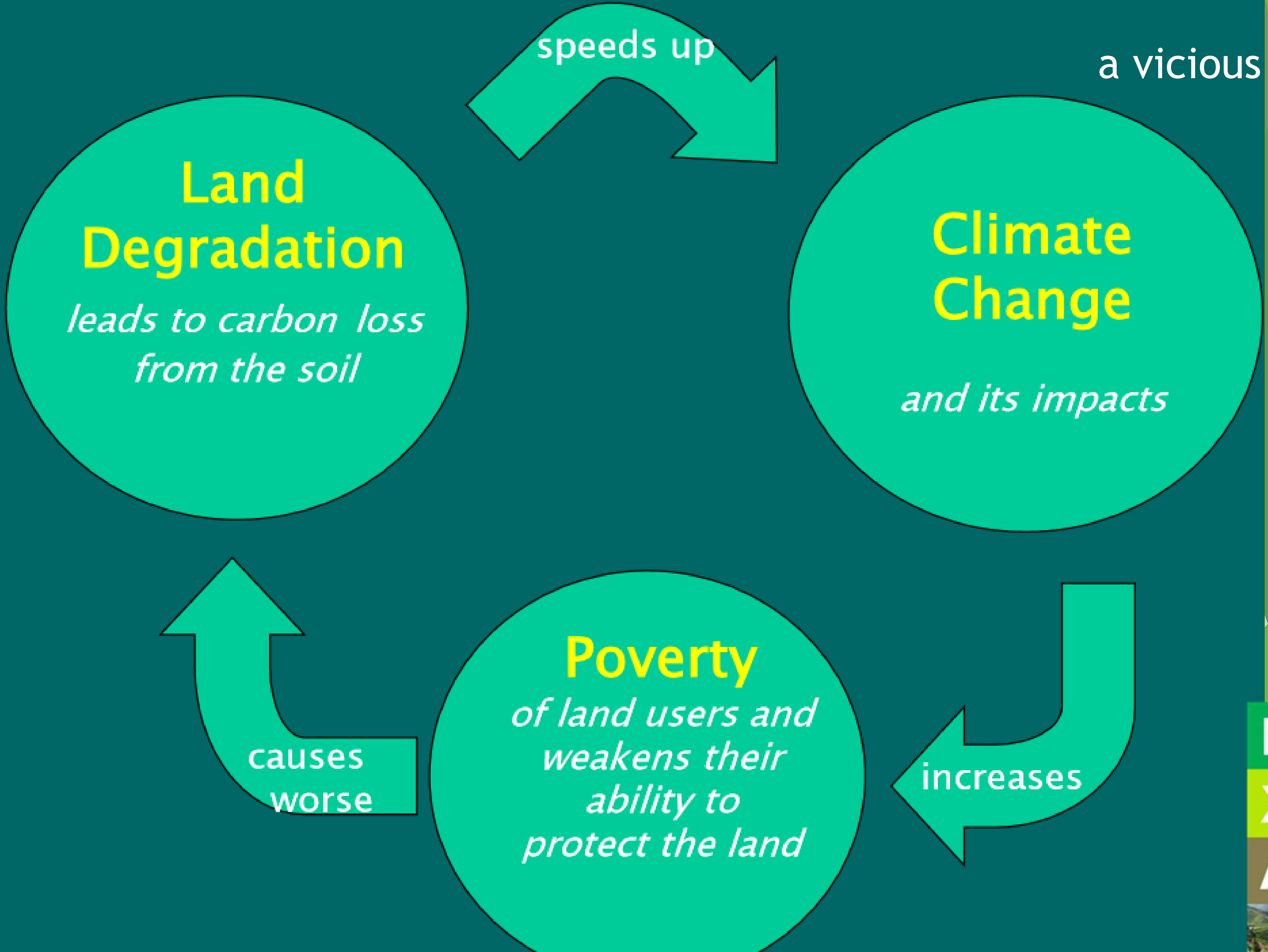


70 % of agriculture mitigation potential → **In developing countries**



Net Primary Production
(CO2 uptake)
CH4
N2O, NOx
CO2, CO, NMVOC
N2O
CH4
CH4
Fire
Harvest
Biomass
CO2
HWP
Litter
Manuring
N
fixation
Fertilizer
CO2
Rice
Soil respiration
Soil Carbon

a vicious circle…



Negative impact of tillage-based agricultural practices

- intensive agriculture has contributed to the loss of between 30% and 50% of soil organic carbon in the last 2 decades of the 20th
- 3% loss in soil organic carbon goes with loss of water storage (432 m3 per hectare), and 400 tons of CO2e per hectare emitted.
- Such loss of soil organic carbon and water holding capacity is due to a range of practices,
  - elimination of perennial groundcover,
  - repetitive cultivation and tillage,
  - continuous grazing,
  - bare fallows,
  - removal of crop residues and grassland burning.

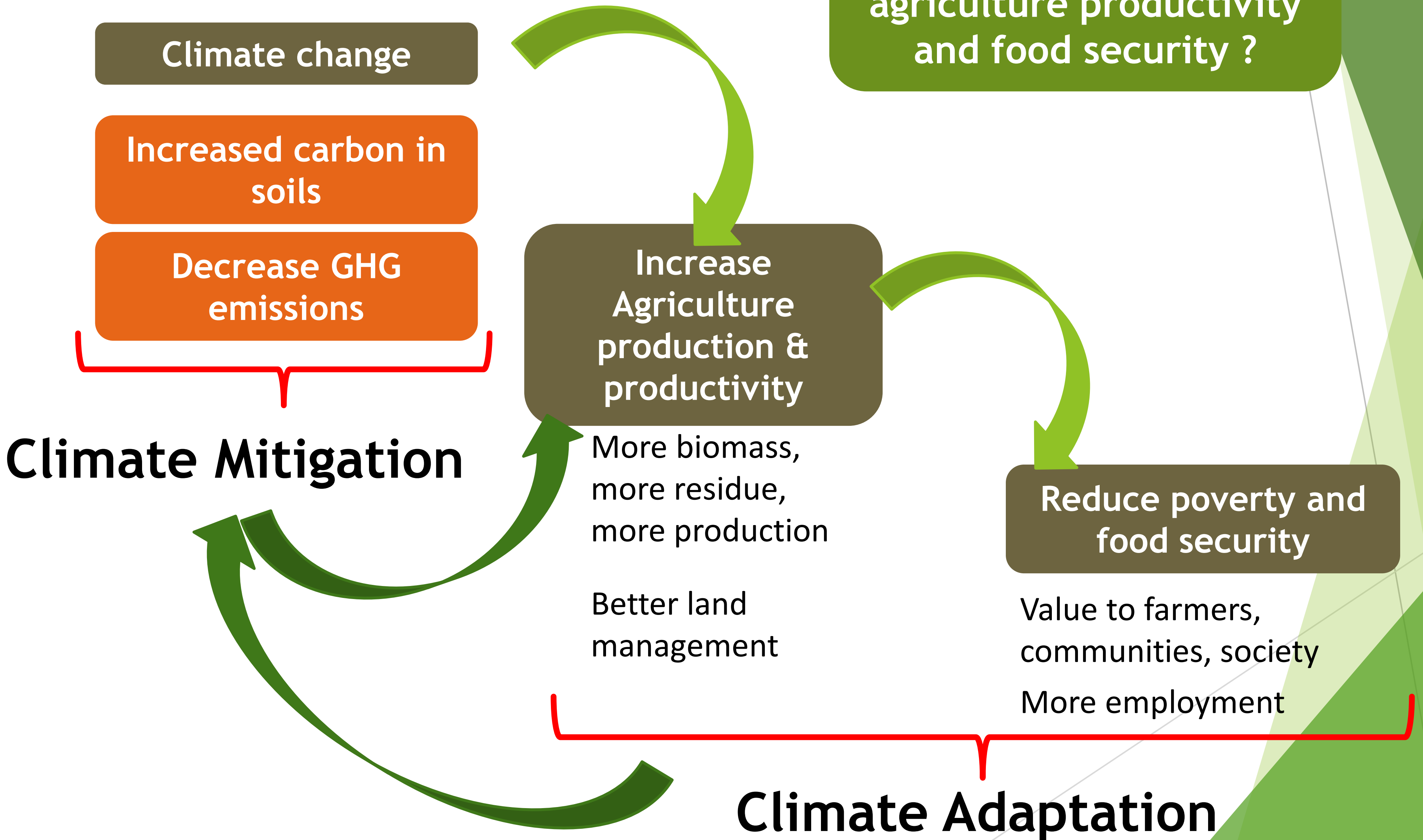
Risks of intensive monoculture

- Intensive monoculture, in combination with the high use of external inputs, has been an approach farmers have adopted to achieve the highest possible yields with minimal labour. However, the **production of energy-intensive mineral fertilizers and pesticides is a major source of greenhouse gas emissions.**

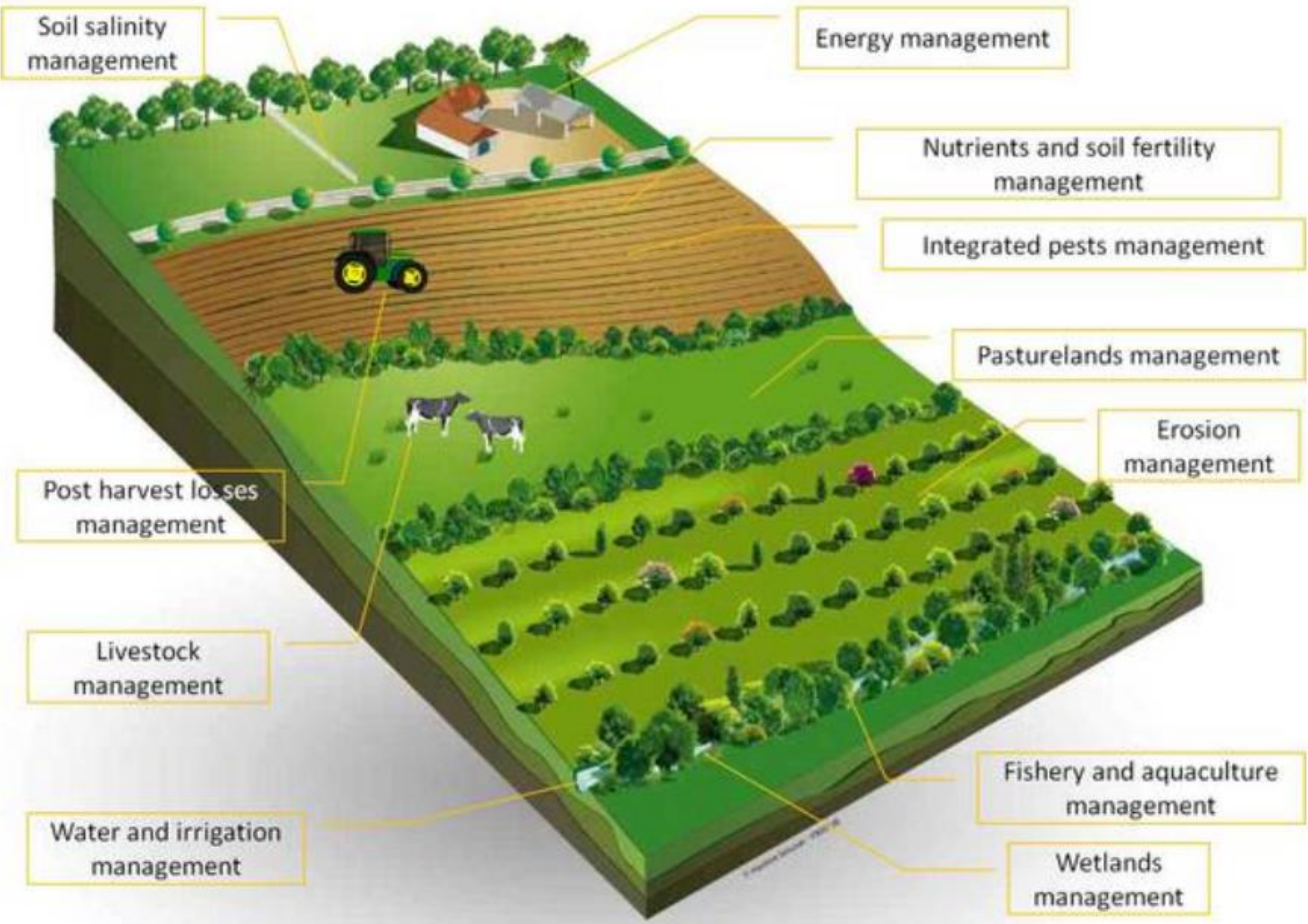
Agriculture & Climate Change

How do low carbon options contribute to agriculture productivity and food security ?

Turn it over...



Sustainable agriculture practices



EX-ACT tool

EX-Ante Carbon-balance Tool

A partnership developed by three FAO division in 2010

Partnership	External partnership
FAO Investment Center TCI Policy Support Service TCS Ag. Economics Division ESA	IRD (French Development Research Institute) World Bank GIZ, IFAD, AFD (France), ADB, SEI (Sweden), ADEME (France)

☞ **EX-ACT** is a FAO tool to estimate the mitigation impact of agricultural and forestry projects

☞ it supports **decision-making** for agriculture and forestry planning, policies and **investment projects**

WHAT IS EXACTLY EX-ACT?

- An Excel based tool to quantify the amount of GHGs released or sequestered from activities in the AFOLU sector
- Requires activity data on agricultural practices, resource use and land use change
- Calculates estimated GHG impacts in tonne of CO_2-e

MAIN LOGIC OF EX-ACT

Takes into account activities

Deforestation, A-Re/forestation, forest degradation, Restoration of grasslands, livestock, cultivation of annual crops, cultivation of perennial crops, fertilization of crops, installation of building, installation of irrigation systems…

that impact GHG fluxes (emissions and sinks)

CO_2, CH_4, N_2O

or stock changes from and to different carbon pools

above-ground biomass, below-ground biomass, soil, litter and dead wood

GHG EMISSIONS

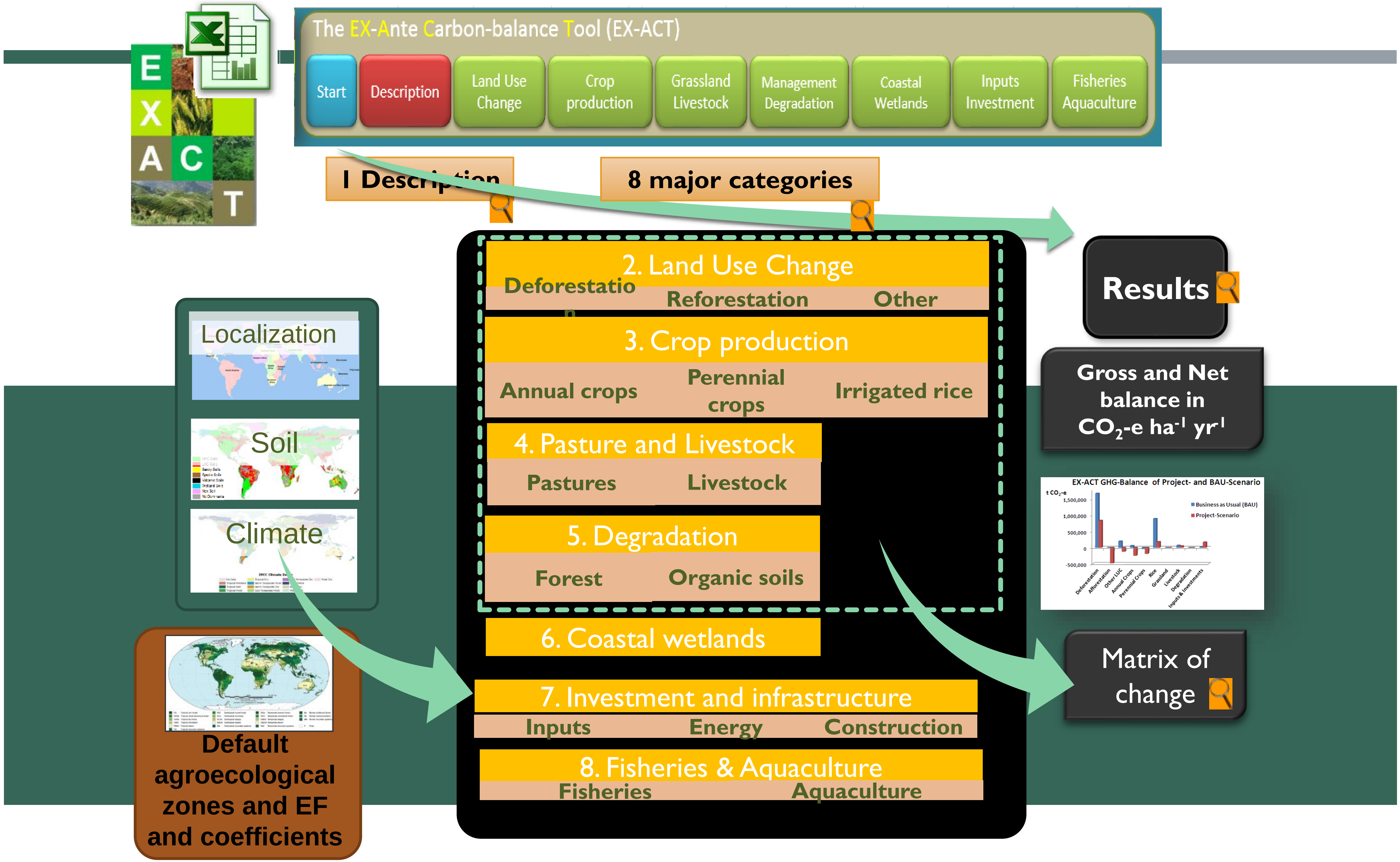
CARBON STOCK CHANGES

Carbon balance in **t of eq-CO_2**

Positive result : There are more emissions ☹

Negative result: There are less emissions ☺

MITIGATION !

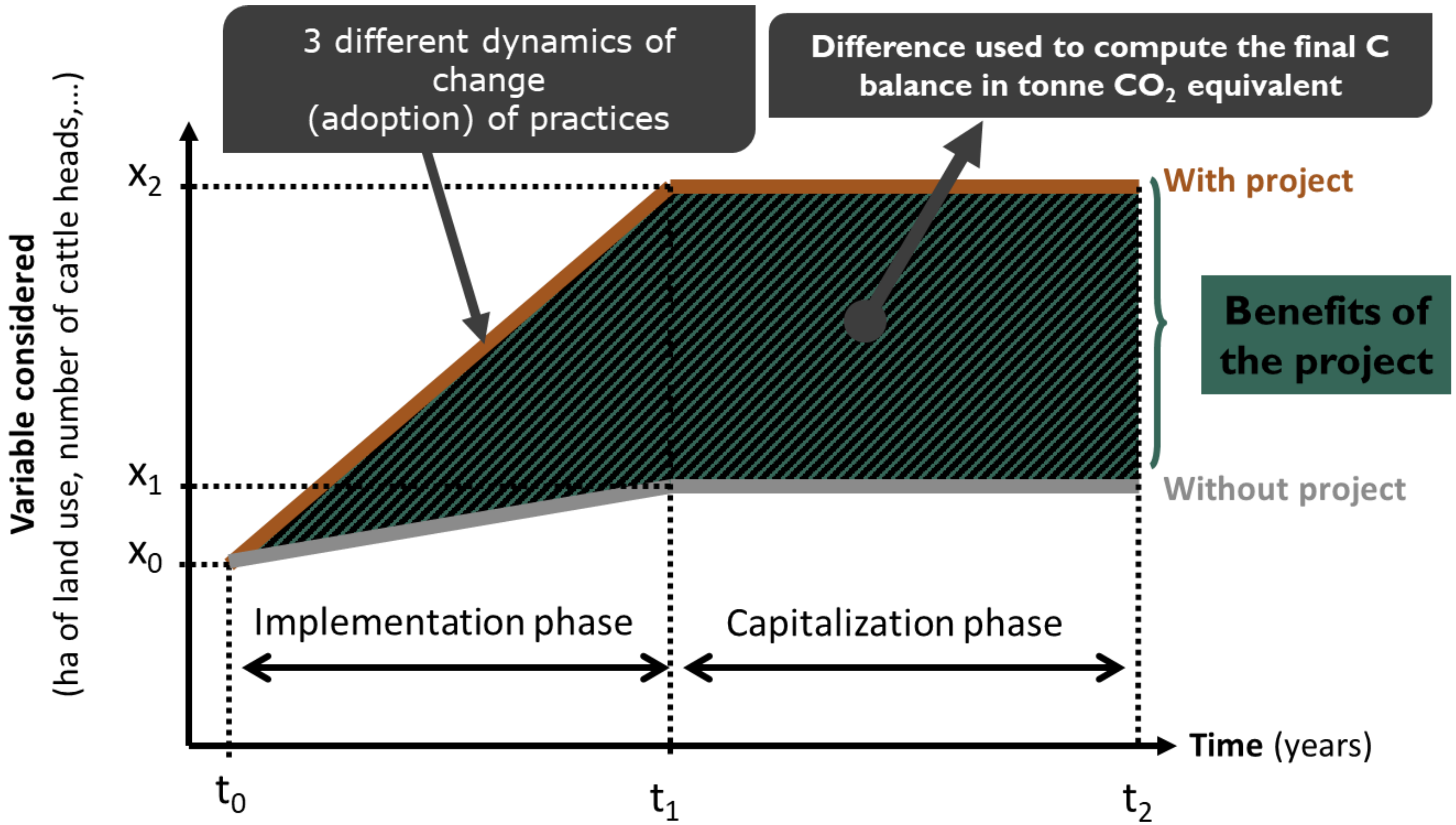


The EX-Ante Carbon-balance Tool (EX-ACT)
Start
Description
Land Use Change
Crop production
Grassland Livestock
Management Degradation
Coastal Wetlands
Inputs Investment
Fisheries Aquaculture
E X A C T
1 Description
8 major categories
Localization
Soil
Climate
Default agroecological zones and EF and coefficients
2. Land Use Change
Deforestation
Reforestation
Other
3. Crop production
Annual crops
Perennial crops
Irrigated rice
4. Pasture and Livestock
Pastures
Livestock
5. Degradation
Forest
Organic soils
6. Coastal wetlands
7. Investment and infrastructure
Inputs
Energy
Construction
8. Fisheries & Aquaculture
Fisheries
Aquaculture
Results
Gross and Net balance in CO_2-e ha^{-1} yr^{-1}
EX-ACT GHG-Balance of Project- and BAU-Scenario
t CO_2-e
1,500,000
1,000,000
500,000
0
-500,000
Business as Usual (BAU)
Project-Scenario
Deforestation
Afforestation
Other LUC
Annual Crops
Perennial Crops
Rice
Grassland
Livestock
Degradation
Inputs & Investments
Matrix of change

BUILDING A WITH AND A WITHOUT PROJECT SCENARIOS

The two alternative scenarios are specified over time

For a set of variables concerning land use, management practices and resource use

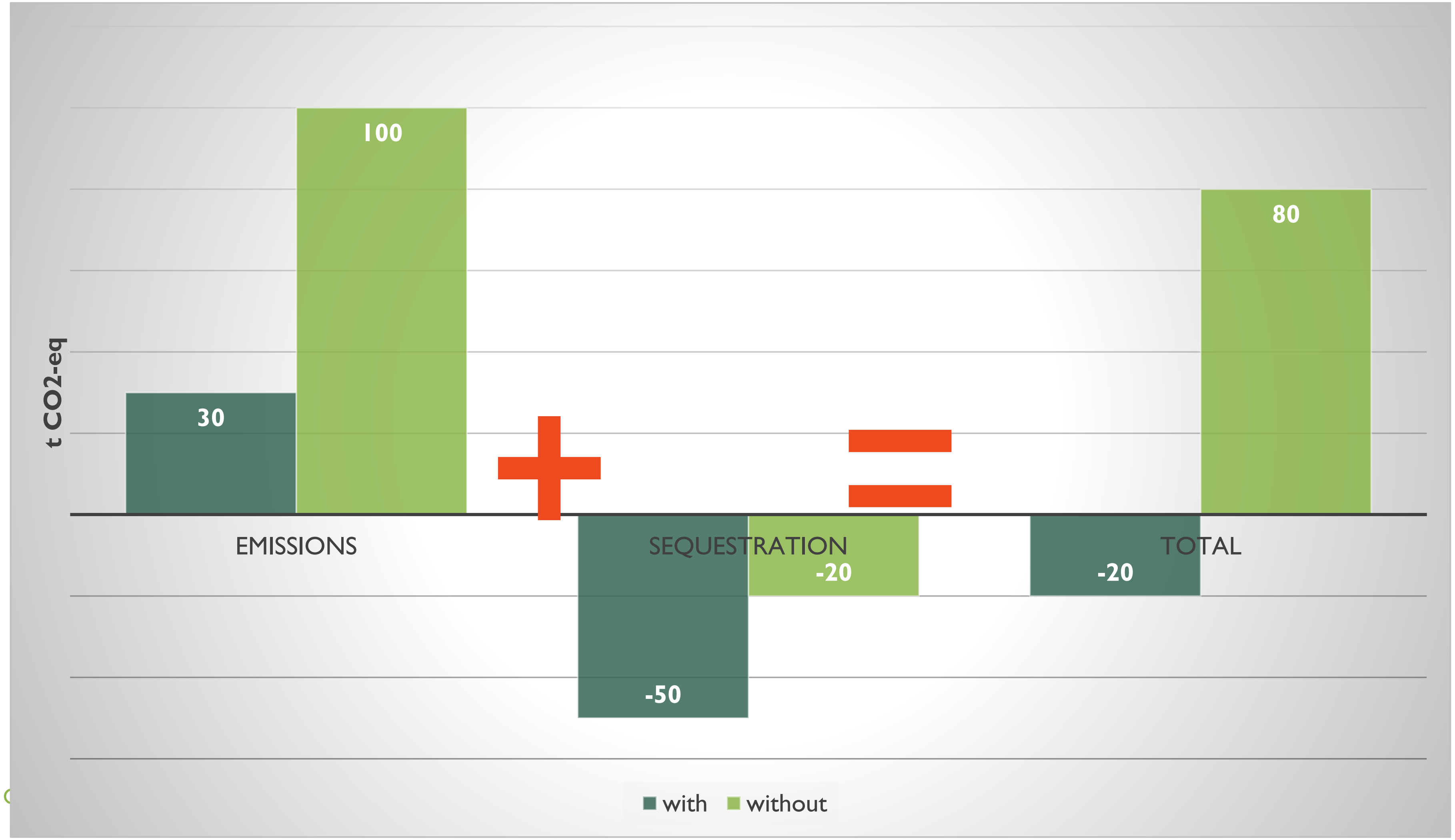


GROSS RESULTS

Component of the project	Gross fluxes Without tCO_2eq	Gross fluxes With tCO_2eq
Land Use Changes		
Deforestation	70,000	25,000
Afforestation	-10,000	-20,000
Other	0	0
Agriculture		
Annual	10,000	-5,000
Perennial	-10,000	-15,000
Rice	0	0
Grassland & Livestocks		
Grassland	0	0
Livestock	15,000	5,000
Degradation	5,000	-10,000
Inputs & Investments	0	0
Total	80,000	-20,000

- Emissions: 100 000 t 30 000 t
- Sequestration: -20 000 t -50 000 t

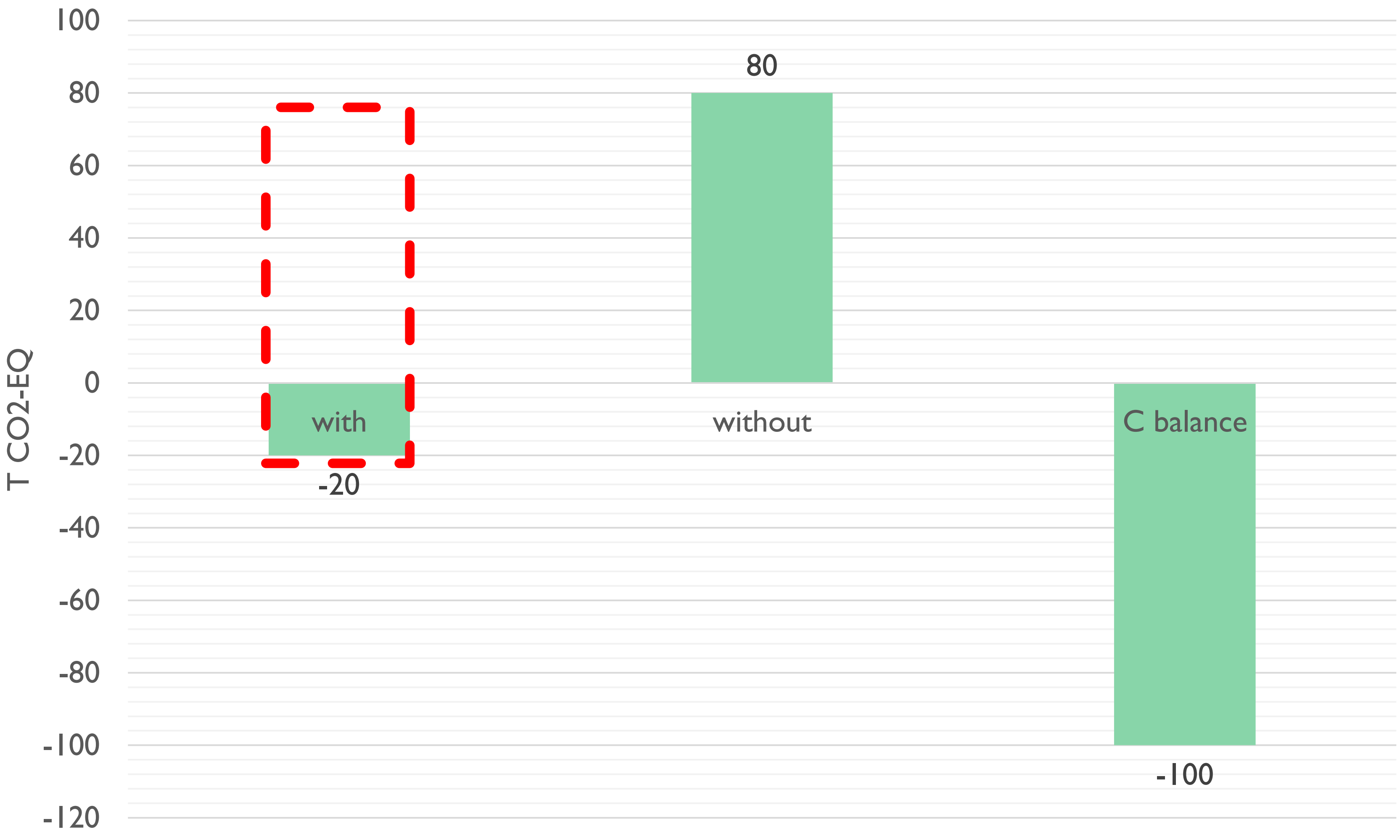
GROSS RESULTS



THE CARBON BALANCE

Component of the project	Gross fluxes Without tCO_2eq	Gross fluxes With tCO_2eq	Balance
Land Use Changes			
Deforestation	70,000	25,000	-45,000
Afforestation	-10,000	-20,000	-10,000
Other	0	0	0
Agriculture			
Annual	10,000	-5,000	-15,000
Perennial	-10,000	-15,000	-5,000
Rice	0	0	0
Grassland & Livestocks			
Grassland	0	0	0
Livestock	15,000	5,000	-10,000
Degradation	5,000	-10,000	-15,000
Inputs & Investments	0	0	0
Total	80,000	-20,000	**-100,000**

THE CARBON BALANCE



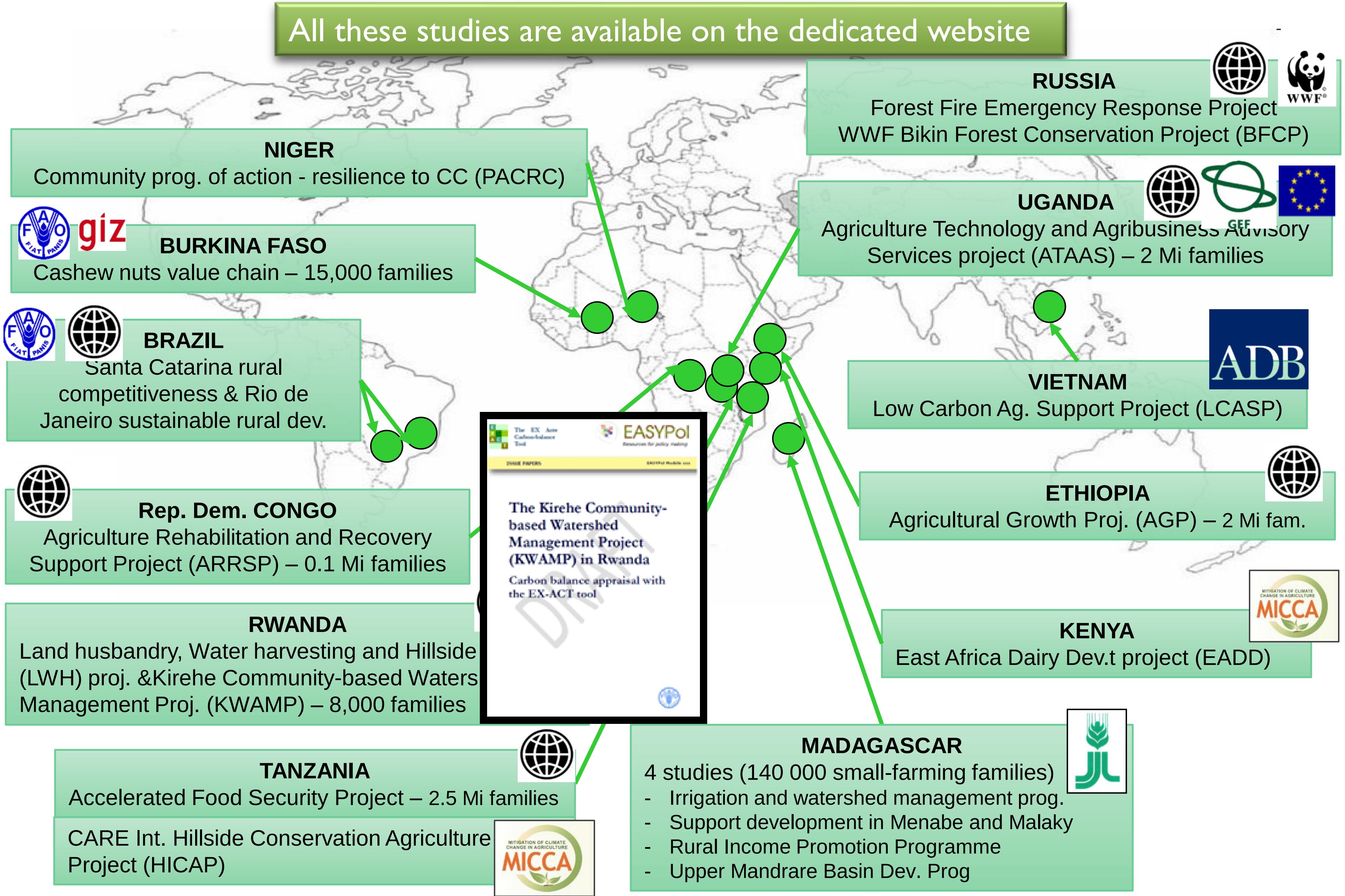
EX-ACT E-learning: 4-5 Hours in English / French/ Spanish

https://elearning.fao.org/course/view.php?id=474

Estimating GHG Emissions and Carbon Sequestration in Agriculture, Forestry and Other Land Use with EX-ACT

JUNE 2019 5 h

EX-Act applied at landscape levels for developing country, smallholder contexts



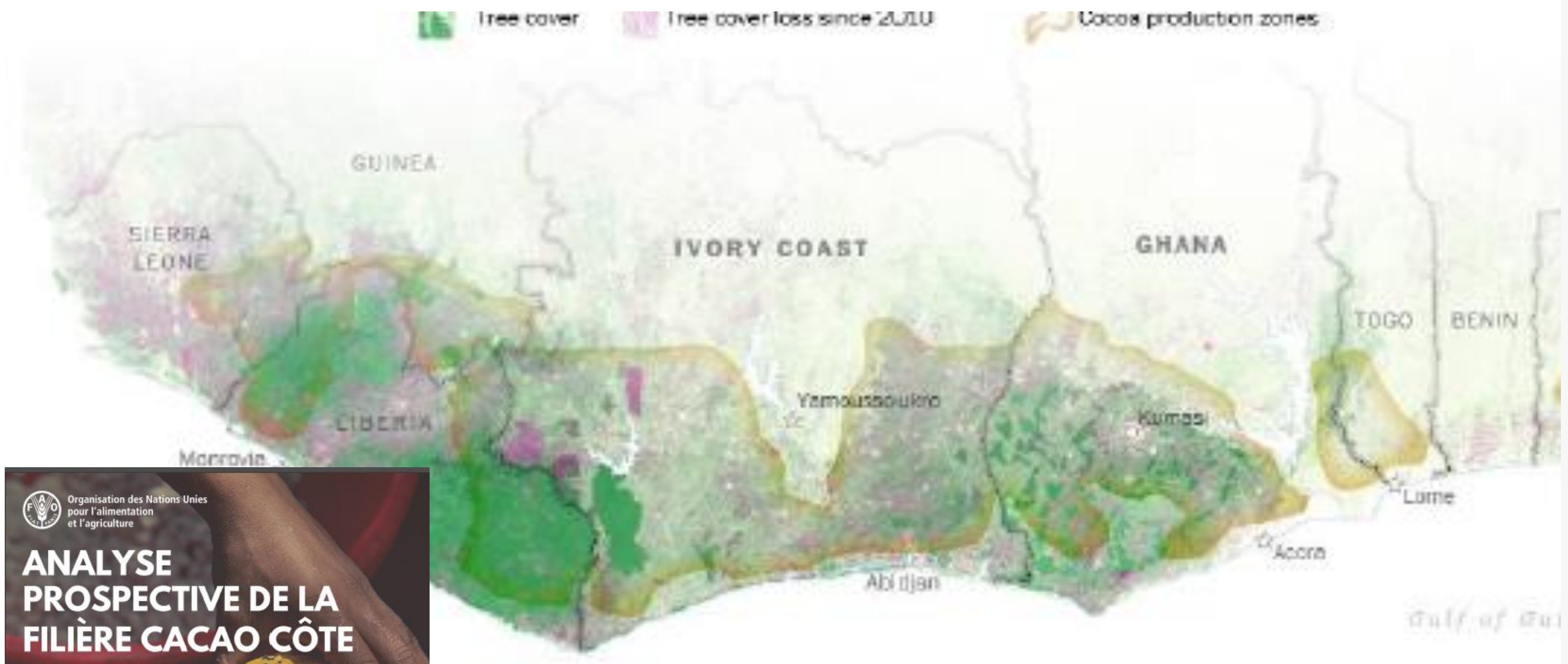
Nutrient Turnover strategies for mitigating land degradation

Nutrient turnover and terrestrial carbon sequestration

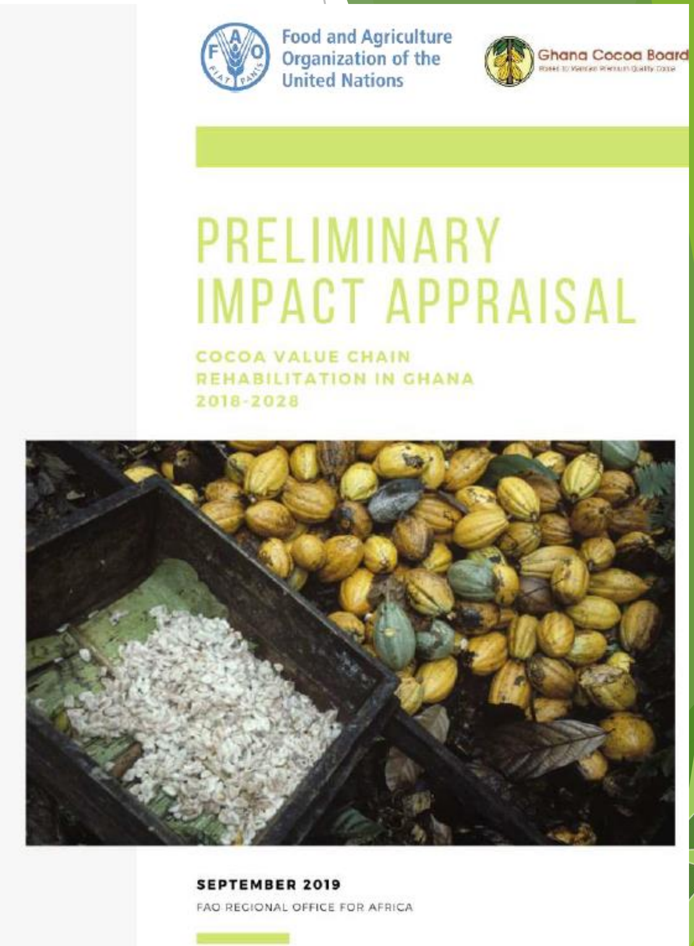
- **Terrestrial carbon sequestration** occurs in standing biomass (e.g. trees), long-term harvested products (e.g. lumber), living biomass in soil (e.g. perennial roots and microorganisms), recalcitrant soil organic matter in soil (e.g. humus)
- **Photosynthesis** represents the largest transfer of carbon (through carbon dioxide) in the carbon cycle. Through photosynthesis, plants draw carbon dioxide out of the air to form plant tissues (carbohydrates).
- **Wide scale Afforestation and expansion of Agroforestry Value chains** are Key strategies for inversing degradation process

Example: Sahel Green Barrier

2020-2030 Rehabilitating cocoa value chain in Ghana and ivory Coast



17 million Tons of COe fixed per year

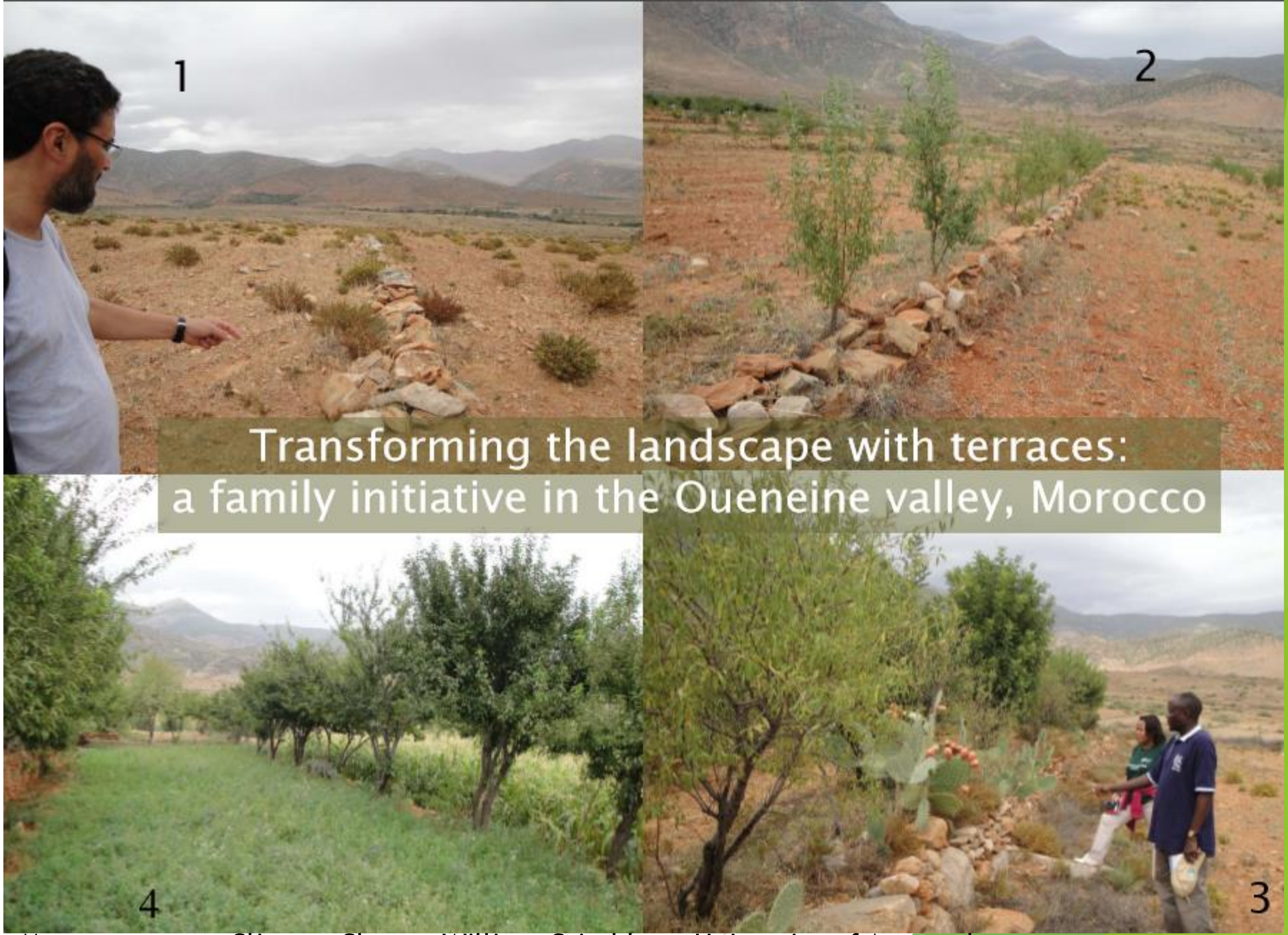


Climate Mitigation dimension of the whole value chain	Current		Upgrading
GHG impact (tCO_2-e per year)	8,042,606.5	-	9,497,515
GHG impact (tCO_2-e per year per hectare) - Production level only	1.4	-	1.9
Carbon footprint of production (tCO_2-e per tonne of product)	4.1	-	3.4
Annual tCO_2-e [emitted (+) / reduced or avoided (-)]		-	**17,540,122**

The solutions are there:

Sustainable practices with co-benefits for adaptation and mitigation ….

Examples: Morocco



Source: Adapting Soil-Water Management to Climate Change William Critchley – University of Amsterdam

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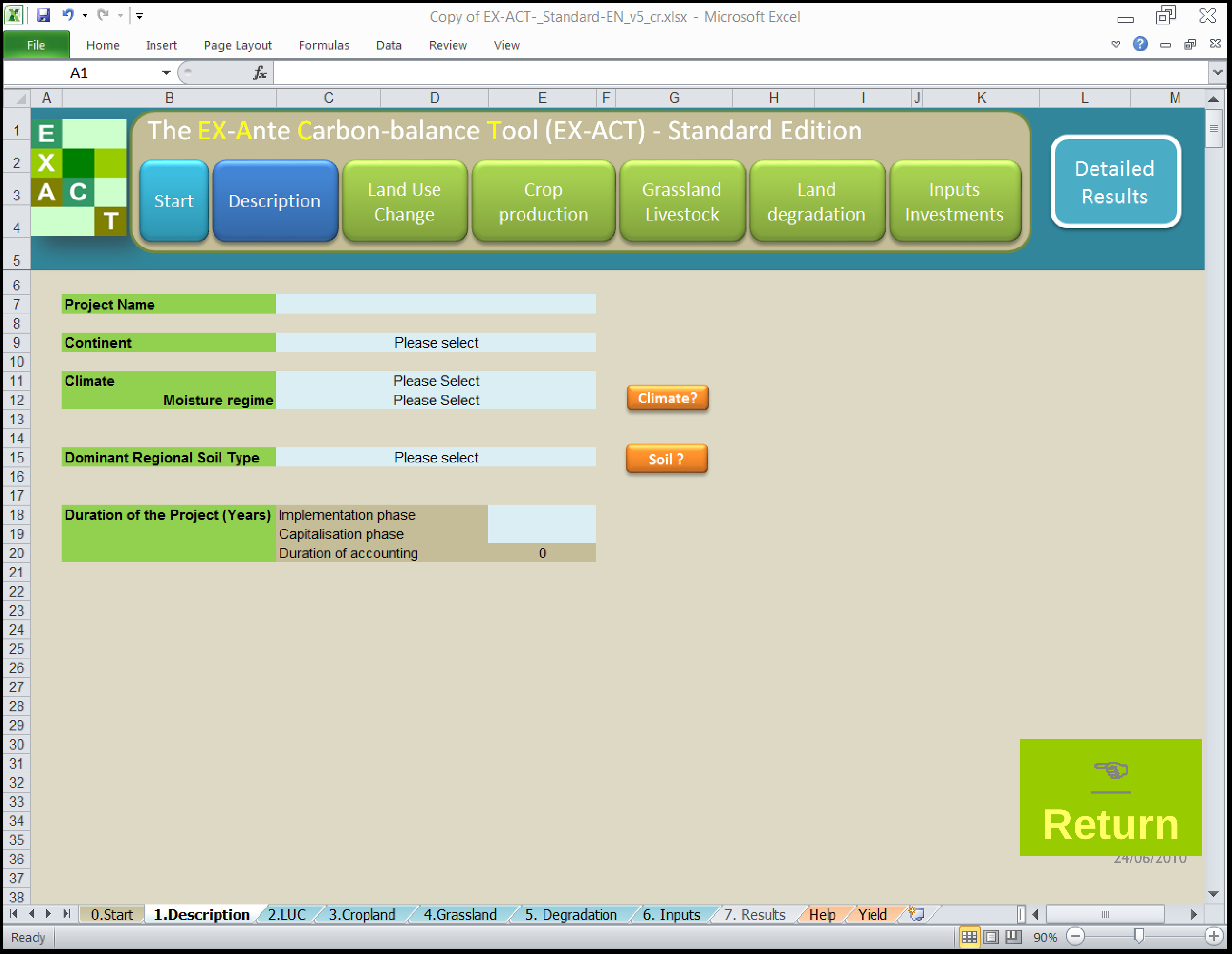
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File
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A1
The EX-Ante Carbon-balance Tool (EX-ACT) - Standard Edition
Start
Description
Land Use Change
Crop production
Grassland Livestock
Land degradation
Inputs Investments
Detailed Results
Project Name
Continent
Please select
Climate
Please Select
Moisture regime
Please Select
Climate?
Dominant Regional Soil Type
Please select
Soil ?
Duration of the Project (Years)
Implementation phase
Capitalisation phase
Duration of accounting
0
Return
0.Start
1.Description
2.LUC
3.Cropland
4.Grassland
5. Degradation
6. Inputs
7. Results
Help
Yield
Ready
90%

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T23 | D

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

Start | Description | Land Use Change | Crop production | Grassland Livestock | Land degradation | Inputs Investments | Detailed Results

3.1. Annual systems (to be used also for pluri-annual systems such as cotton or sugarcane)

3.1.1. Annual systems from other LUC or converted to other LUC *(Please fill step 2.LUC previously)*

Yield?

Description	Improved agro--nomic practices	Nutrient management	NoTill./residues management	Water management	Manure application	Residue/Biomass Burning	Yield (t/ha/yr)	Area (ha) Start	Without	With
Annual after Deforestation	?	?	?	?	?	NO		0	0	0
Converted to A/R	?	?	?	?	?	NO		0	0	0
Annual after non-forest LU	?	?	?	?	?	NO		0	0	0
Converted to OLUC	?	?	?	?	?	NO		0	0	0

3.1.2. Annual systems remaining annual systems *(total area must remains contant)*

Yield?

Fill with you description	Improved agro--nomic practices	Nutrient management	NoTill./residues management	Water management	Manure application	Residue/Biomass Burning	Yield (t/ha/yr)	Area (ha) Start	Without	*	With	*
trad coton	No	?	?	?	No	YES		5000	5000	D	1000	D
improved coton	Yes	?	?	?	Yes	NO		0	0	D	3000	D
rainfed rice	Yes	?	?	?	?	NO			0	D	1000	D
trad cassava	No	?	?	?	?	NO		1000	1000	D	0	D
imp cassava	Yes	?	Yes	?	?	NO		0	0	D	1000	D
description 6	?	?	?	?	?	NO		0	0	D	0	D
description 7	?	?	?	?	?	NO		0	0	D	0	D
description 8	?	?	?	?	?	NO		0	0	D	0	D
description 9	?	?	?	?	?	NO		0	0	D	0	D
description 10	?	?	?	?	?	NO		0	0	D	0	D
							Total	6000	6000		6000	

Tier 2

* Note concerning dynamics of change : **D correspond to "Default"**, "I" to Immediate and "E" to Expo

Total Annual syst.

3.2. Perrenial systems (Agroforestry, Orchards, Tree crops...)

0.Start | 1.Description | 2.LUC | 3.Cropland | 4.Grassland | 5. Degradation | 6. Inputs | 7. Results | Help | Yield

Ready | Average: 750 | Count: 14 | Sum: 6000 | 90%

Return

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Ante Carbon-balance Tool (EX-ACT) - Standard Edition

Description | Land Use Change | Crop production | Grassland Livestock | Land degradation | Inputs Investments

Detailed Results

Select GWP for ca

Official (1st period 2

CO_2	1
CH_4	21
N_2O	310

Without Project

Organic soils

Mineral soils (ha)		FINAL: Forest/ Plantation	Cropland: Annual	Cropland: Perennial	Cropland: Rice	Grassland	Other Land: Degraded	Other Land: Other	Total Initial
INITIAL: Forest/Plantation		0	0	0	0	0	0	0	0
Cropland	Annual	0	6000	0	0	0	0	0	6000
	Perennial	0	0	0	0	0	0	0	0
	Rice	0	0	0	0	0	0	0	0
Grassland		0	0	0	0	0	0	0	0
Other Land	Degraded	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	1000	1000
	Total Final	0	6000	0	0	0	0	1000	7000

With Project

Organic soils

Mineral soils (ha)		FINAL: Forest/ Plantation	Cropland: Annual	Cropland: Perennial	Cropland: Rice	Grassland	Other Land: Degraded	Other Land: Other	Total Initial
INITIAL: Forest/Plantation		0	0	0	0	0	0	0	0
Cropland	Annual	0	6000	0	0	0	0	0	6000
	Perennial	0	0	0	0	0	0	0	0
	Rice	0	0	0	0	0	0	0	0
Grassland		0	0	0	0	0	0	0	0
Other Land	Degraded	0	0	0	0	0	0	0	0
	Other	0	0	1000	0	0	0	0	1000
	Total Final	0	6000	1000	0	0	0	0	7000

Slide 15

Return

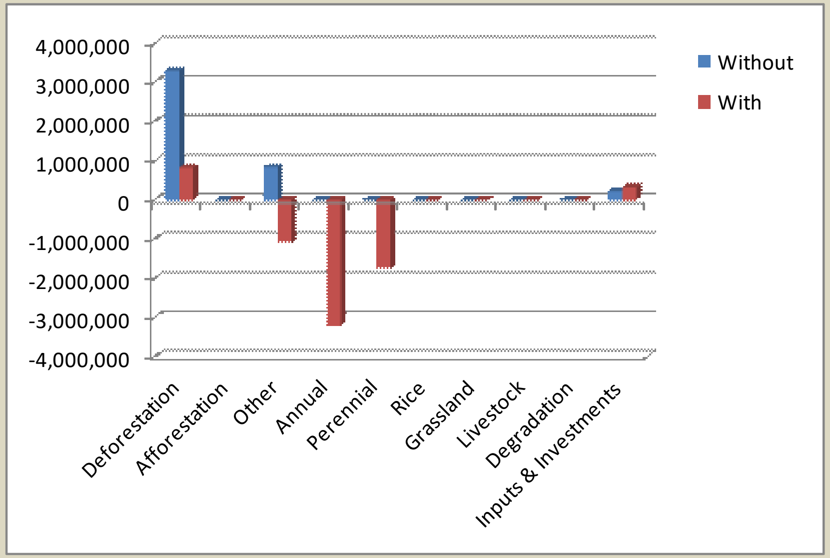
24/06/2010

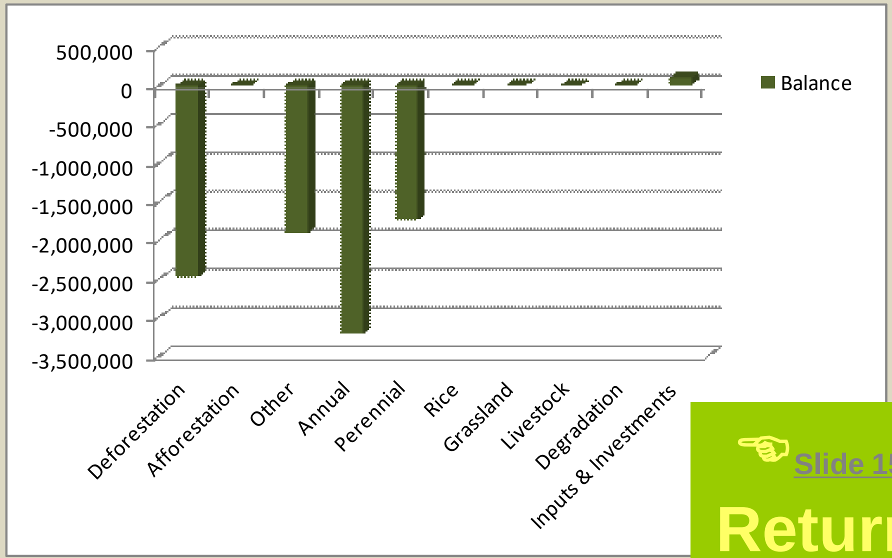
0.Start | 1.Description | 2.LUC | 3.Cropland | 4.Grassland | 5. Degradation | 6. Inputs | 7. Results | Help | Yield

Ready

Name of the project	Land rehabilitation an	Climate	Tropical (Moist)	Duration (yr)	20
Continent	Africa	Soil	LAC Soils	Total area (ha)	130000

Component of the project	Gross fluxes Without	With	Balance	Share per GHG of the Balance, Result per GHG: CO_2 Biomass	CO_2 Soil	CO_2 Other	N_2O	CH_4	Results per year without	with	Balance
	All GHG in tCO_2eq; Positive = source / negative = sink										
Land Use Changes											
Deforestation	3,302,710	825,677	-2,477,032	-2,180,849	-235,235		-18,451	-42,497	165,135	41,284	-123,852
Afforestation	0	0	0	0	0		0	0	0	0	0
Other	836,917	-1,068,971	-1,905,888	-111,467	-1,794,421		0	0	41,846	-53,449	-95,294
Agriculture											
Annual	0	-3,211,250	-3,211,250	0	-3,211,250		0	0	0	-160,563	-160,563
Perennial	0	-1,743,167	-1,743,167	-1,620,667	-122,500		0	0	0	-87,158	-87,158
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	0	0	0	0		0	0	0	0	0
Livestock	0	0	0				0	0	0	0	0
Degradation	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	224,030	322,044	98,013			55,419	42,595		11,202	16,102	4,901
Total	4,363,657	-4,875,666	**-9,239,323**	-3,912,982	-5,363,406	55,419	24,143	-42,497	218,183	-243,783	-461,966
Per hectare	34	-38	-71	-29.7	-41.3	0.4	0.2	-0.3			
Per hectare per year	1.7	-1.9	-3.6	-1.5	-2.1	0.0	0.0	0.0	1.7	-1.9	-3.6





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