Awareness and assessment of ecosystem services of rubber plantations

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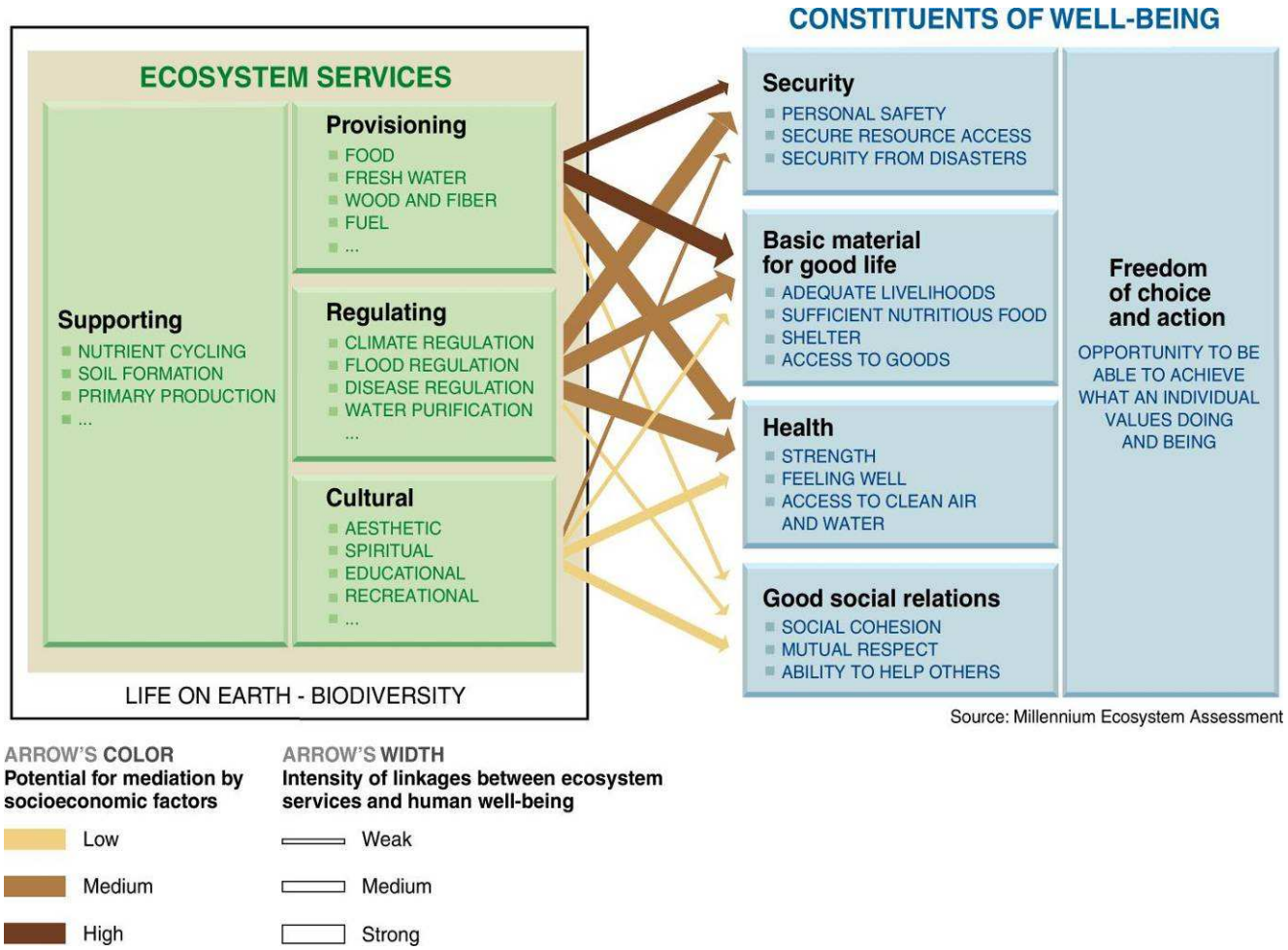
CIRAD
Hevea Research Platform in Partnership

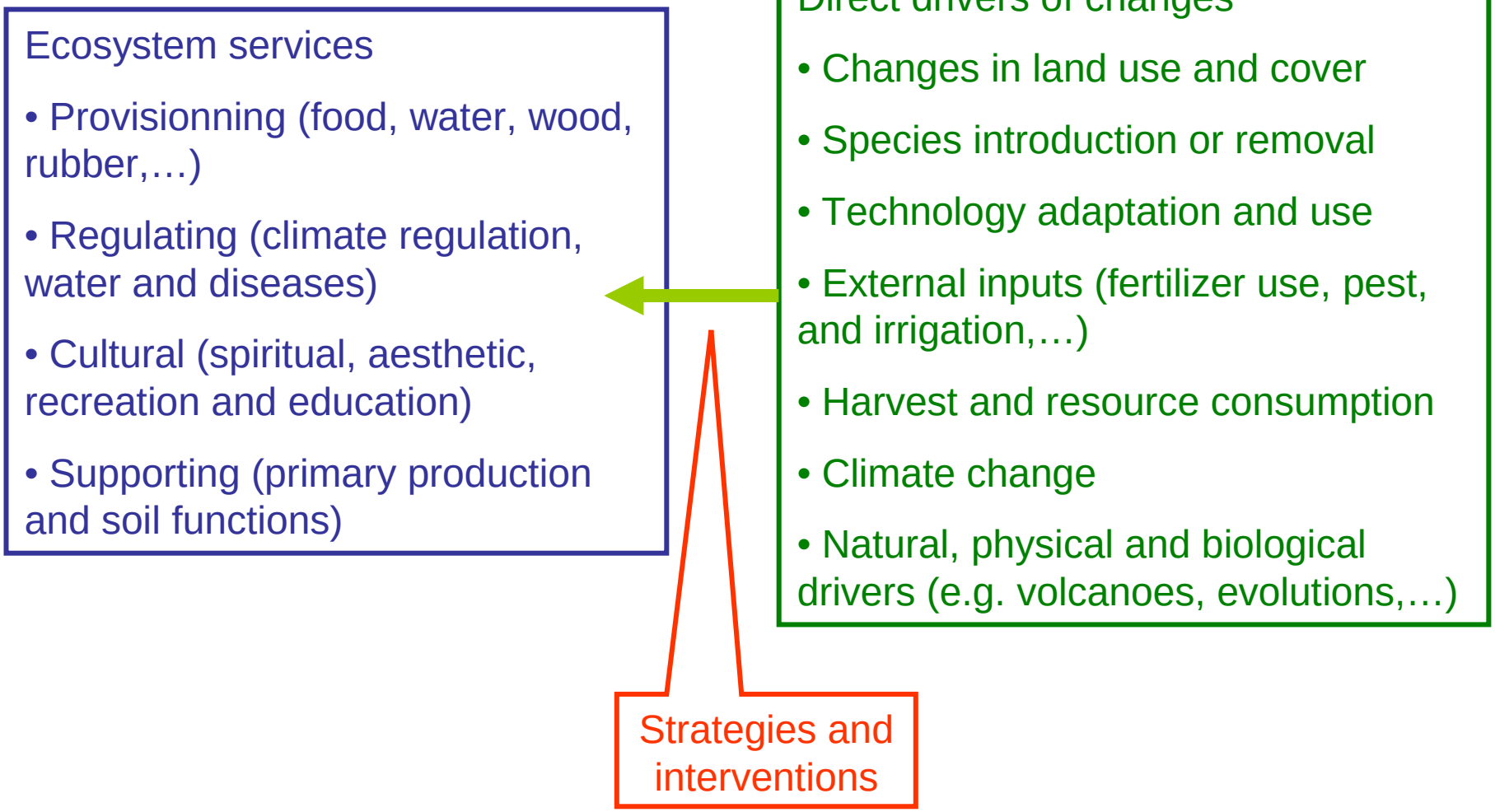
IRRDB Climate Change Seminar on Natural Rubber. November 30, 2009

Ecosystem services in the Millenium Ecosystem Assessment



Source: Millennium Ecosystem Assessment

Drivers of change. What strategy for research?



Ecosystem services

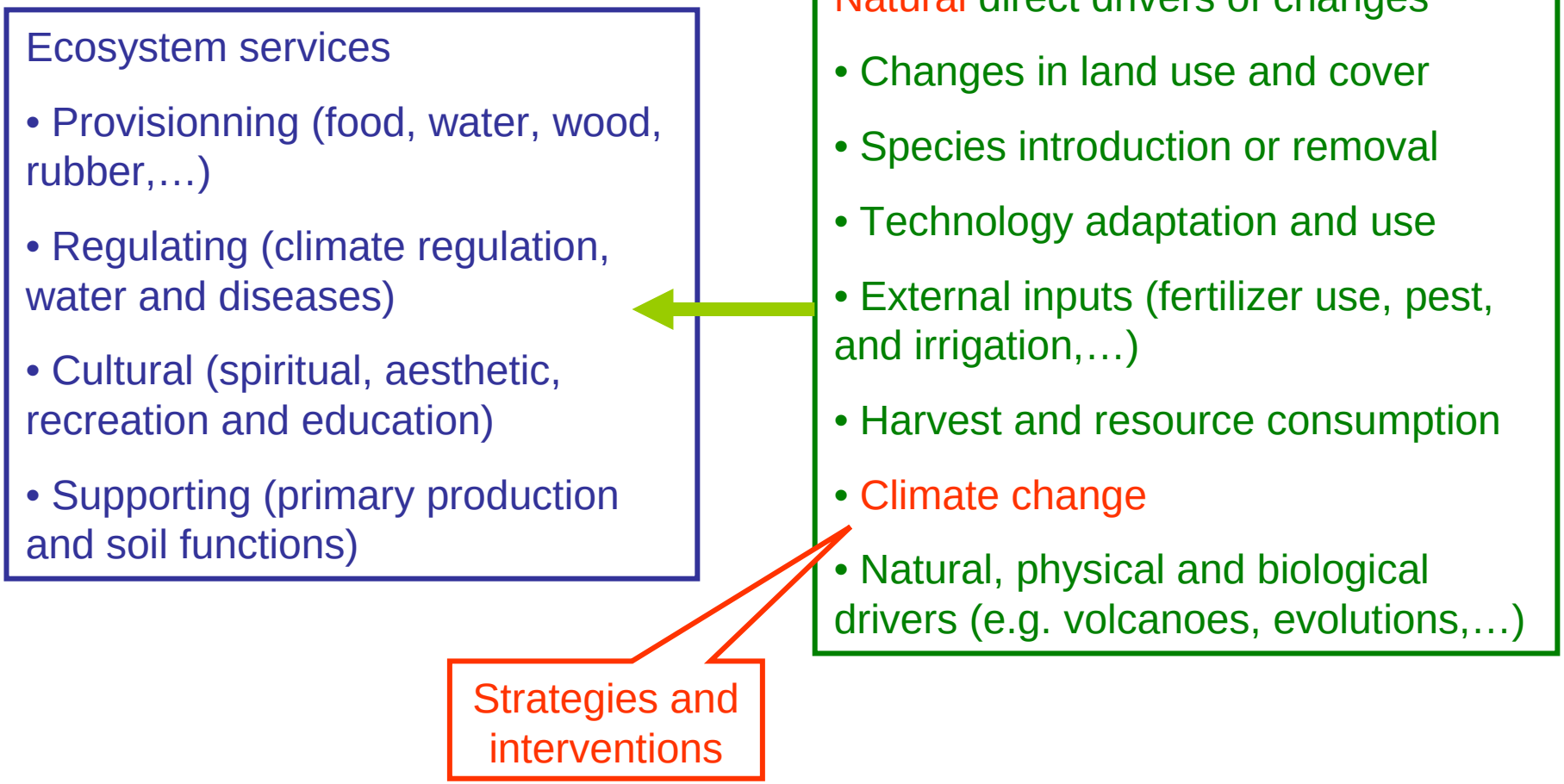
- **Provisionning** (food, water, wood, rubber,…)
- **Regulating** (climate regulation, water and diseases)
- **Cultural** (spiritual, aesthetic, recreation and education)
- **Supporting** (primary production and soil functions)

Which services?

Direct drivers of changes affected by agricultural practices and technology

- Changes in land use and cover
- Species introduction or removal
- Technology adaptation and use
- External inputs (fertilizer use, pest, and irrigation,…)
- Harvest and resource consumption
- Climate change
- Natural, physical and biological drivers (e.g. volcanoes, evolutions,…)

Which drivers?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• Supporting (primary production and soil functions)
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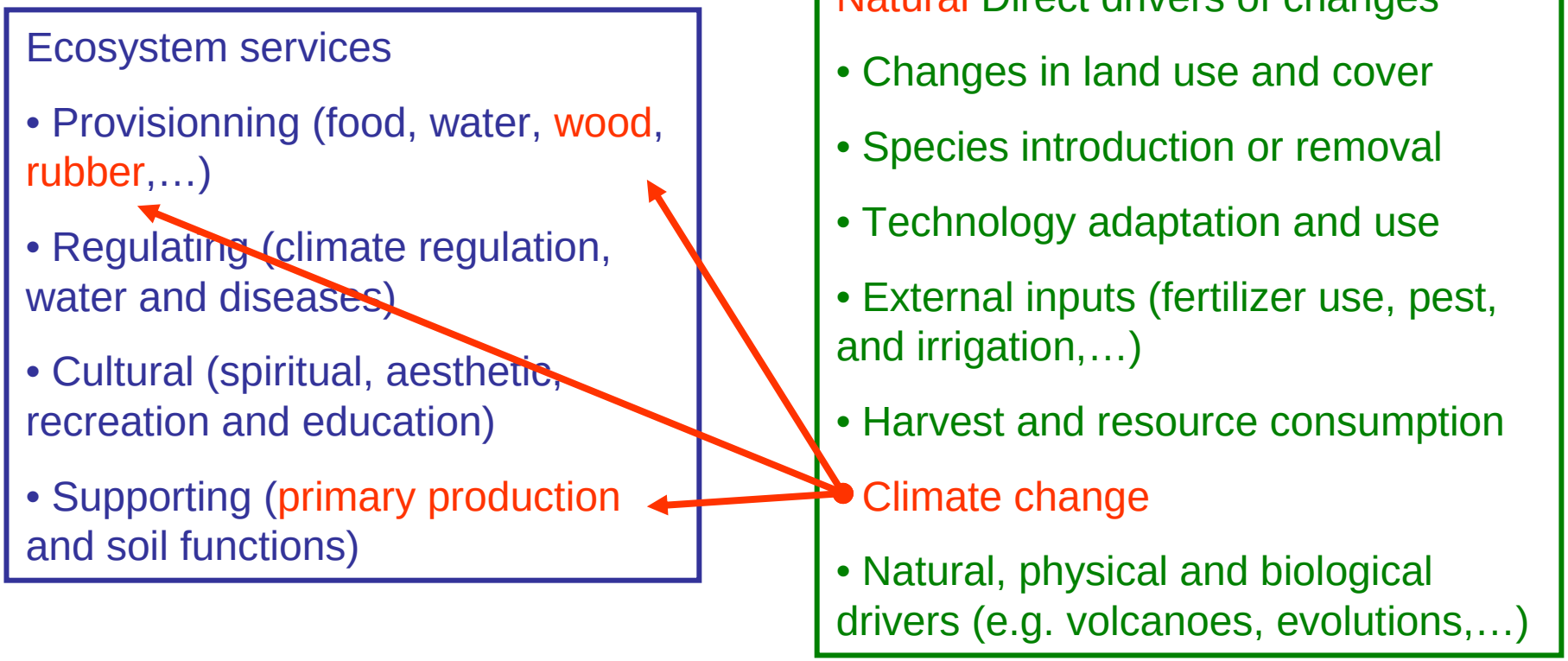
Strategies and interventions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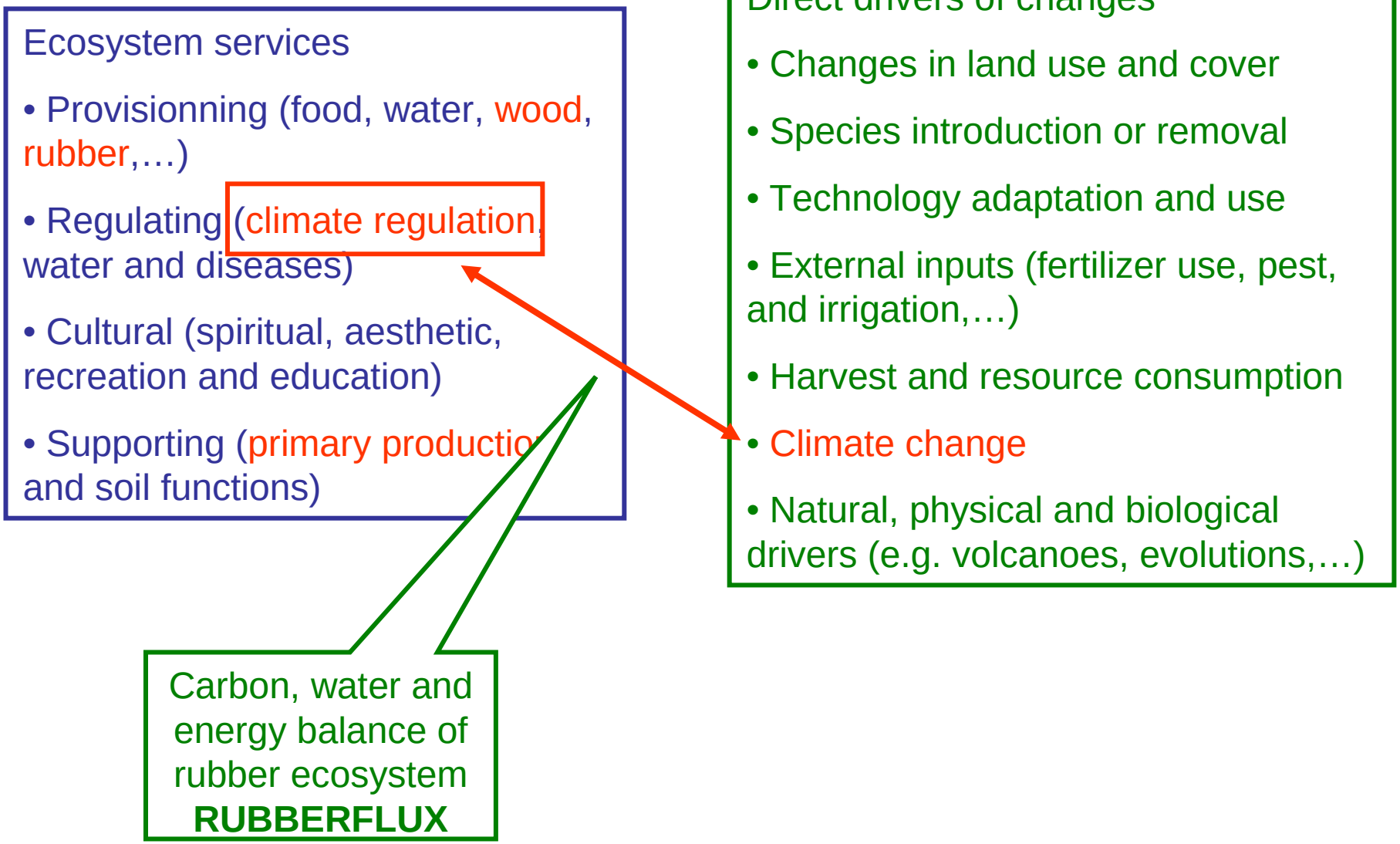
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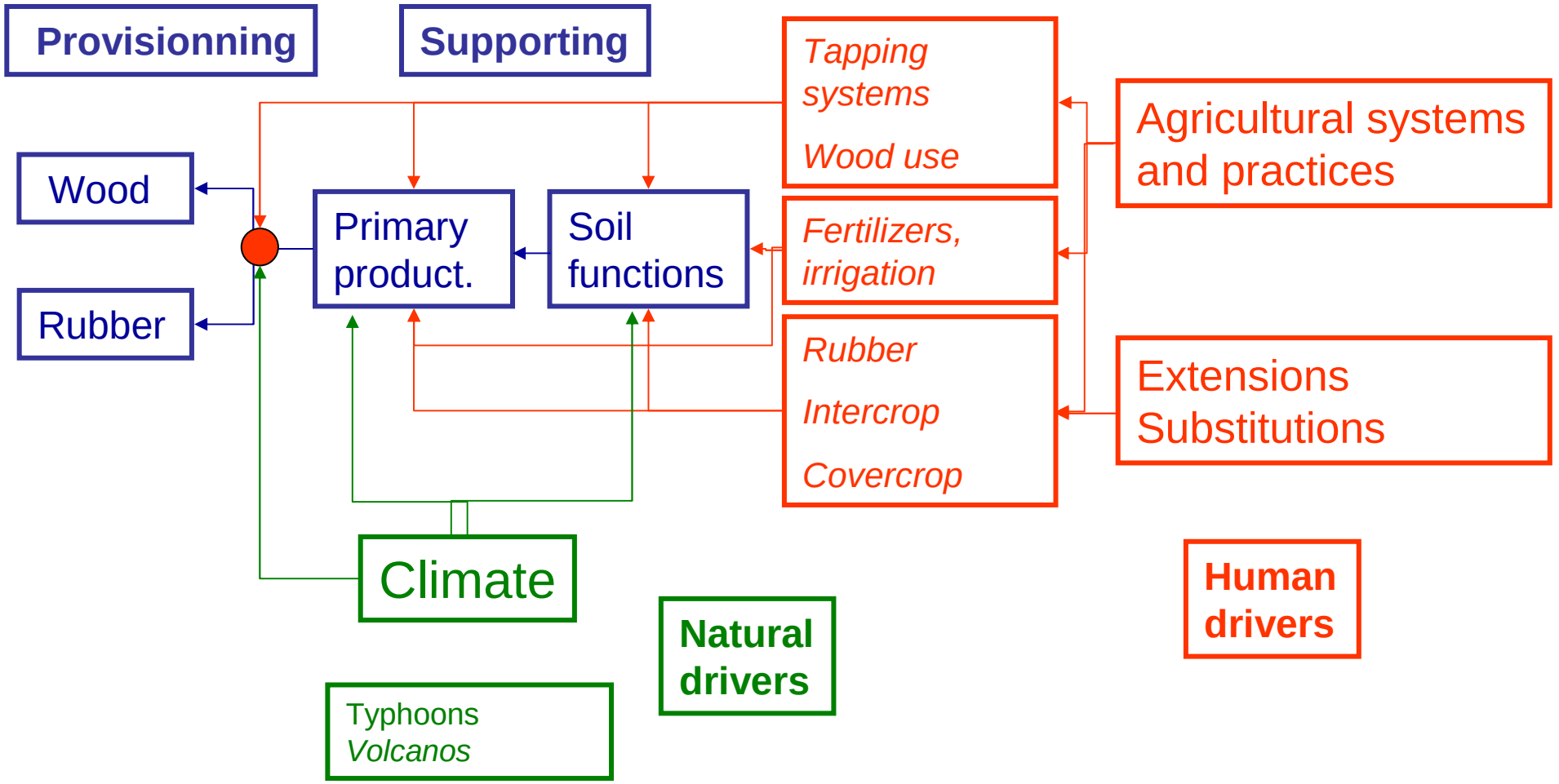
Carbon, water and energy balance of rubber ecosystem
RUBBERFLUX

Functionnal framework in rubber systems



Focus: impact of rubber plantations on regulating and supporting services

Our claim: rubber plantations are forest like, they have a positive impact on environnment.

… needs to be backed by reliable data!

1. Impact on biodiversity
2. Impact on C sequestration
3. Impact on water balance and water run-off (erosion, flooding).
4. Impact on soil functions

And keep realistic…rubber plantations are no rainforest!

Biodiversity is an issue

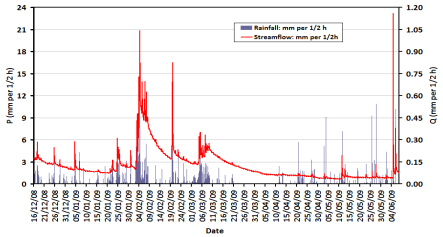
- Mostly mono-specific plantations
- Few clones (80 % of RRIM 600 in Thailand)
- Intensive land cleaning for practical reasons.

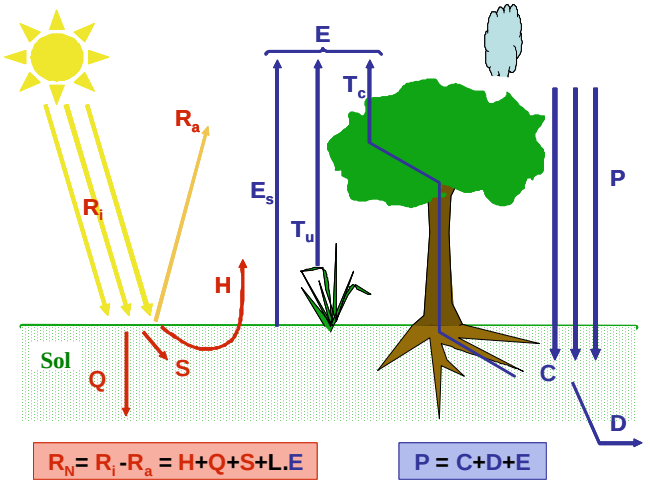
Few actual studies – if any – on functional biodiversity

Crucial for the green image of NR!

Water balance

- Few studies so far
  - Sustainability of plantation, balance in water use
  - Possible positive impact on run-off and erosion, watershed studies
  - Large scale extansions: impact on local climate (water but also energy balance)

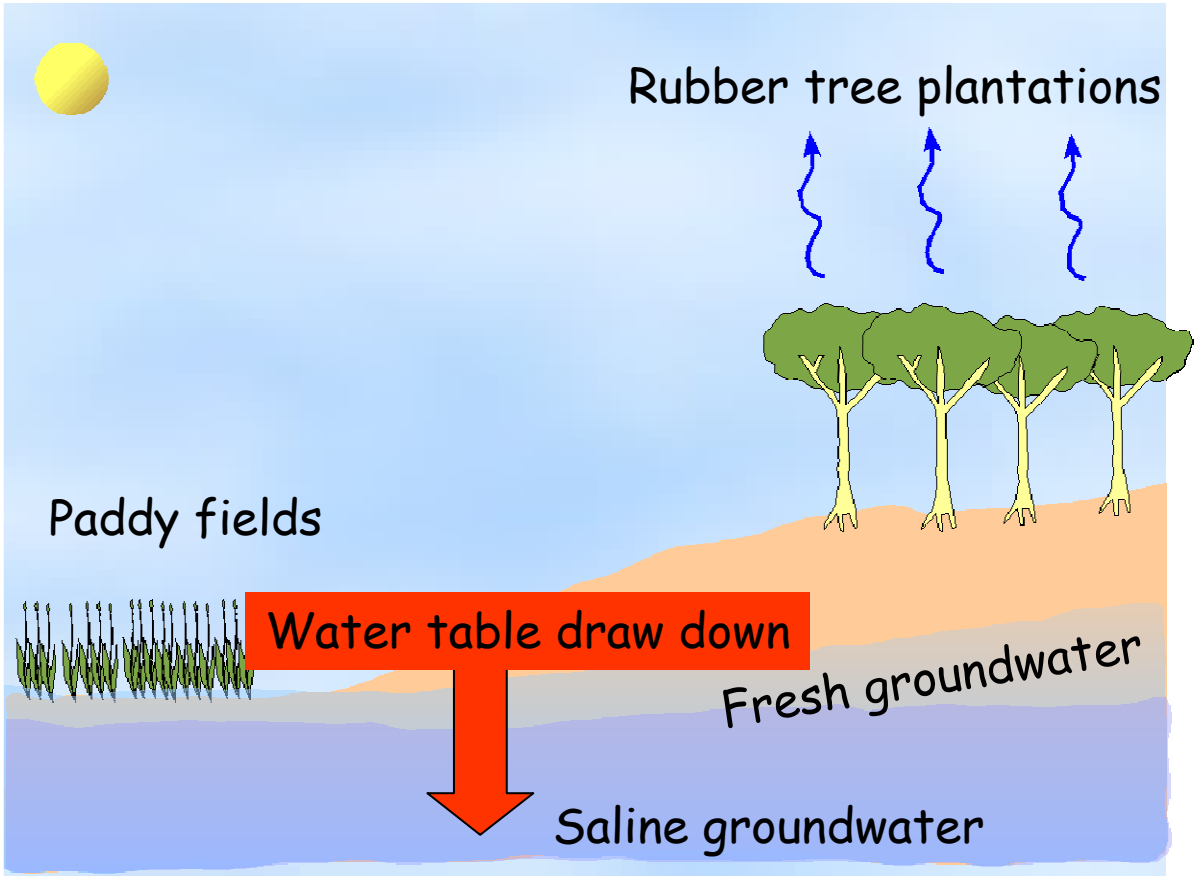




Example: possible remediation of salty soils in NE Thailand by extansion of rubber plantations.

Origin of salinity: forest clearing in the uplands these last 50 years.
Now Many farmers adopt rubber

Can it be the solution to massive soil salinisation ?

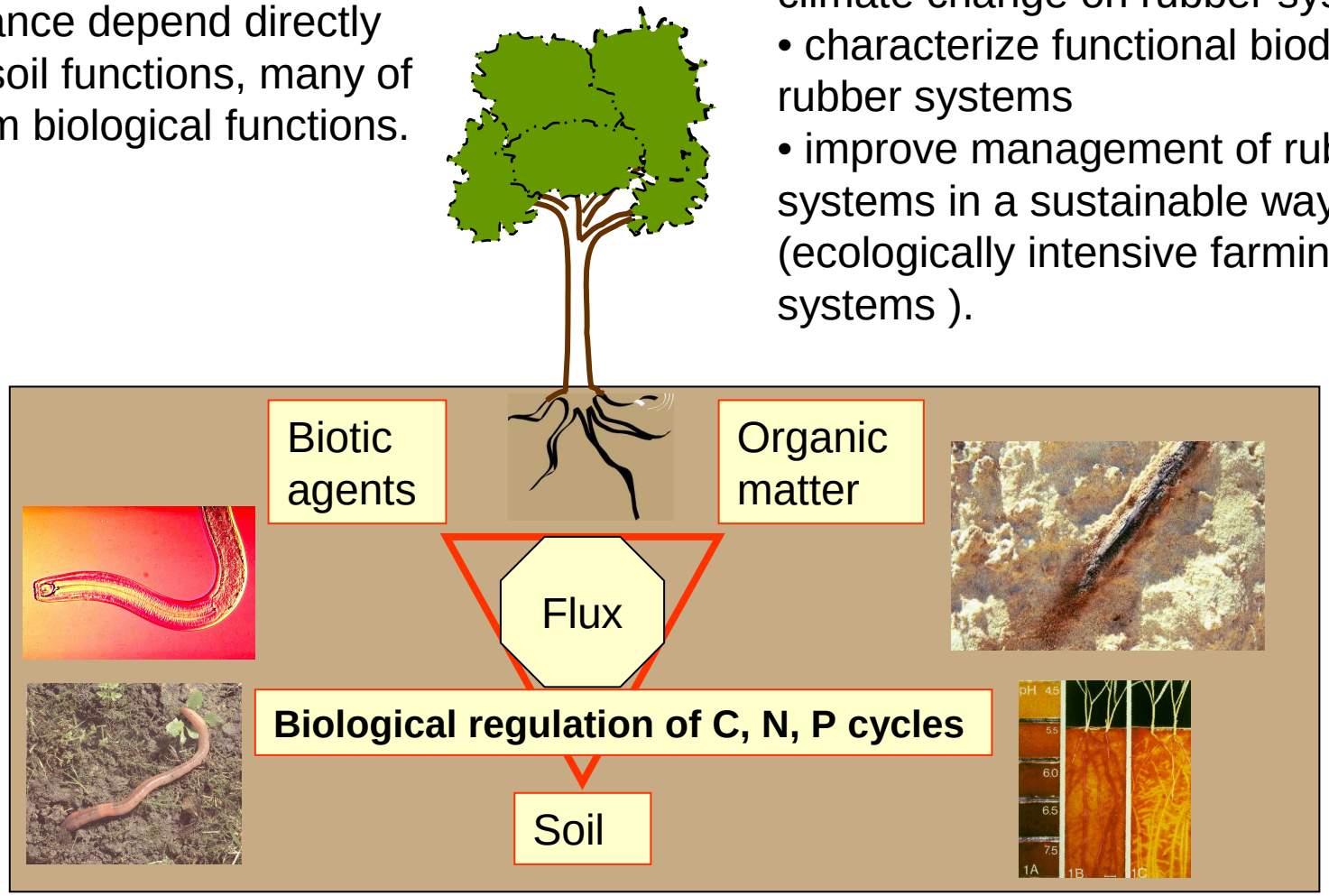


Soil functions

Primary production, C sequestration and water balance depend directly on soil functions, many of them biological functions.

Soil ecology is a key domain to be developped to

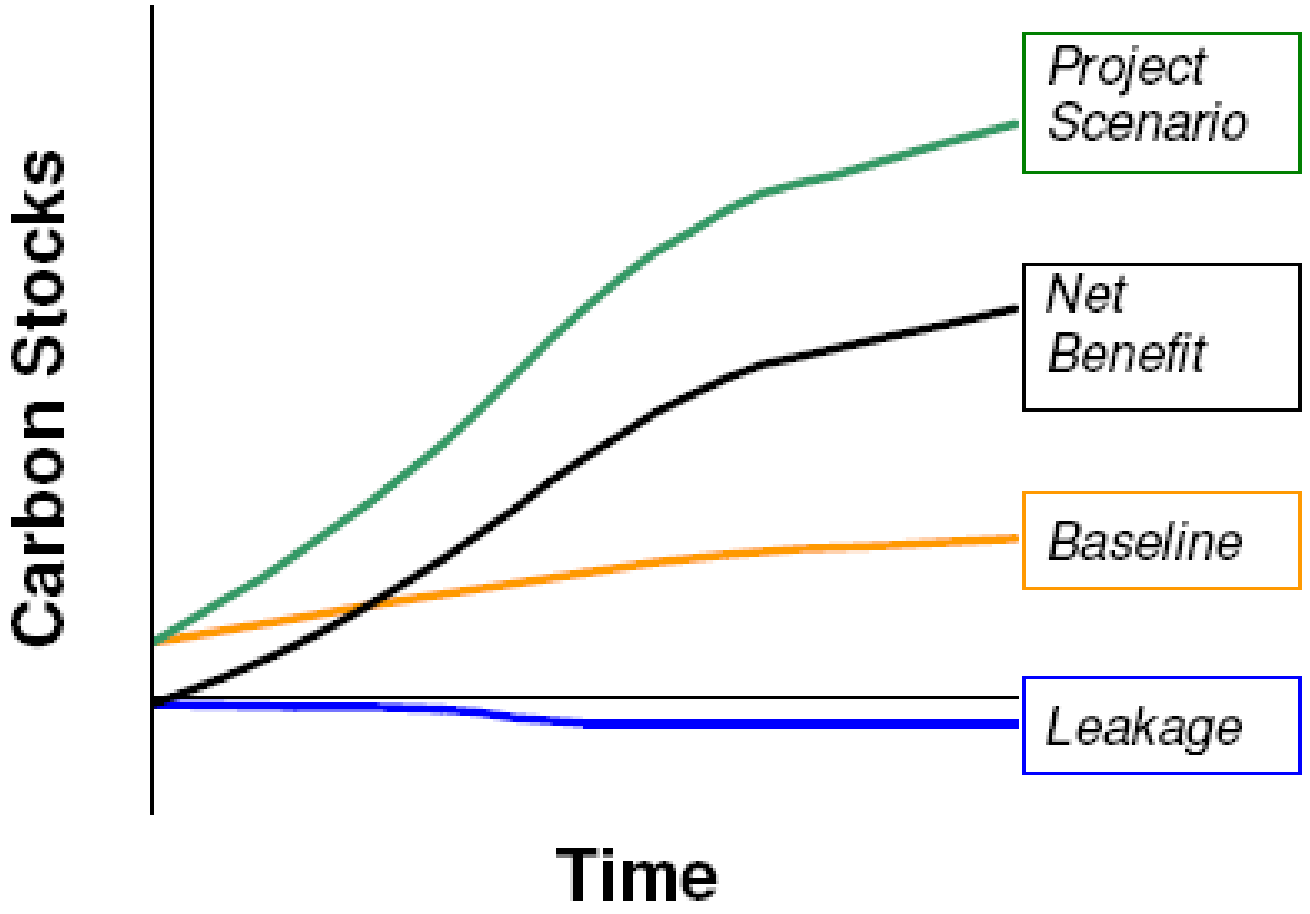
- understand and predict impact of climate change on rubber systems
- characterize functional biodiversity of rubber systems
- improve management of rubber systems in a sustainable way (ecologically intensive farming systems).



C sequestration in rubber plantations
Issues

Agriculture and Carbon trading

The additonality criteria



➔ C subsidies essential to the project achievement

Agriculture and Carbon trading

The “Permanence” criteria

= Assess the risk of releasing C sequestred or stored by a project

A/R projects provide non-permanent CER (short term or long term)

Crediting period : 20 years renew twice (max. 60 years) or 30 years

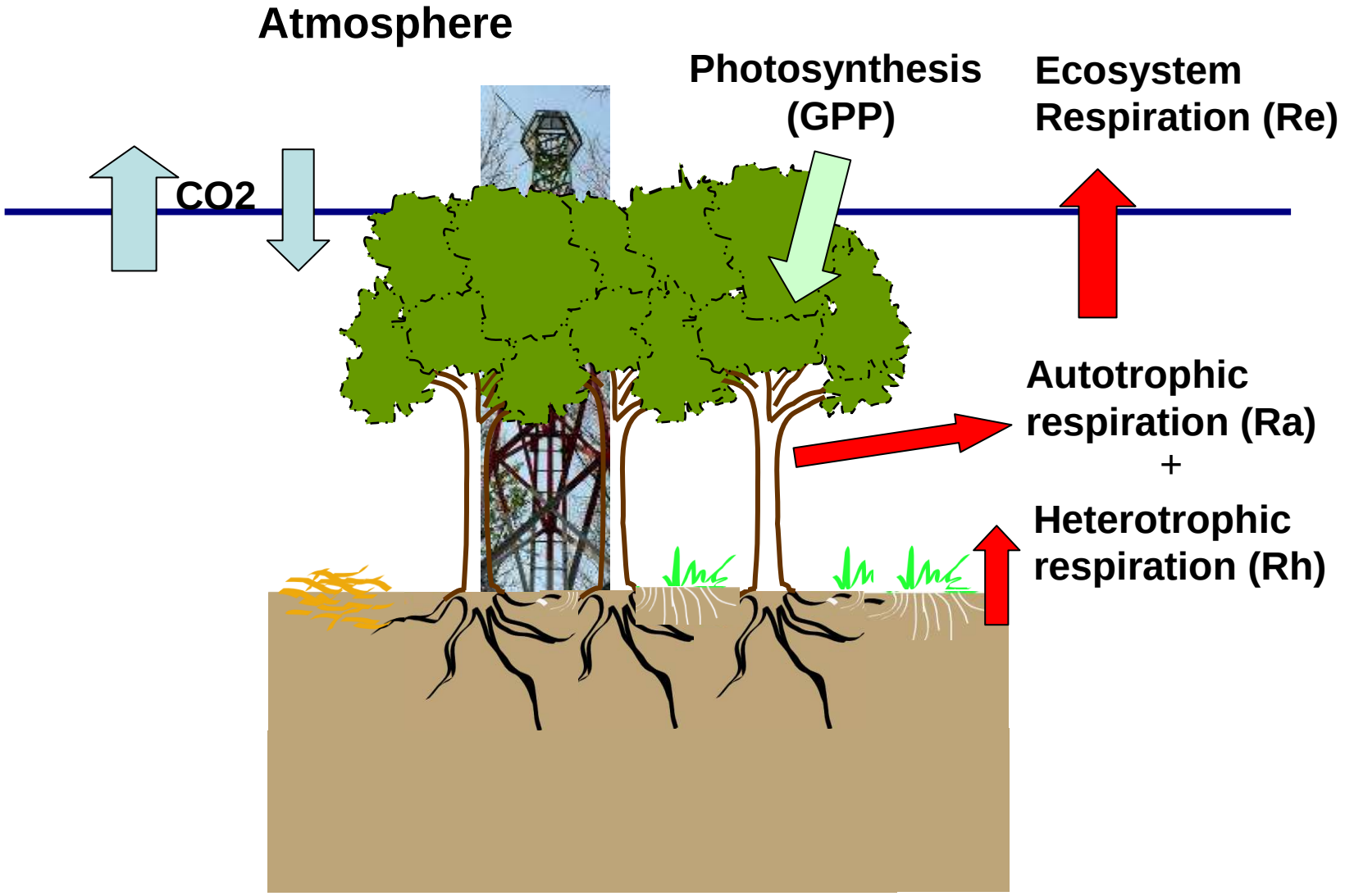
C sequestration in rubber plantations
Methods

The stock method

Net Ecosystem Productivity (NEP) = $\Delta C_T + \Delta C_S + \Delta C_L + C_{exp}$

The flux method or Eddy-correlation method

NEP = ΣNEE (Net Ecosystem Exchange) = GPP - Re




LI-7500
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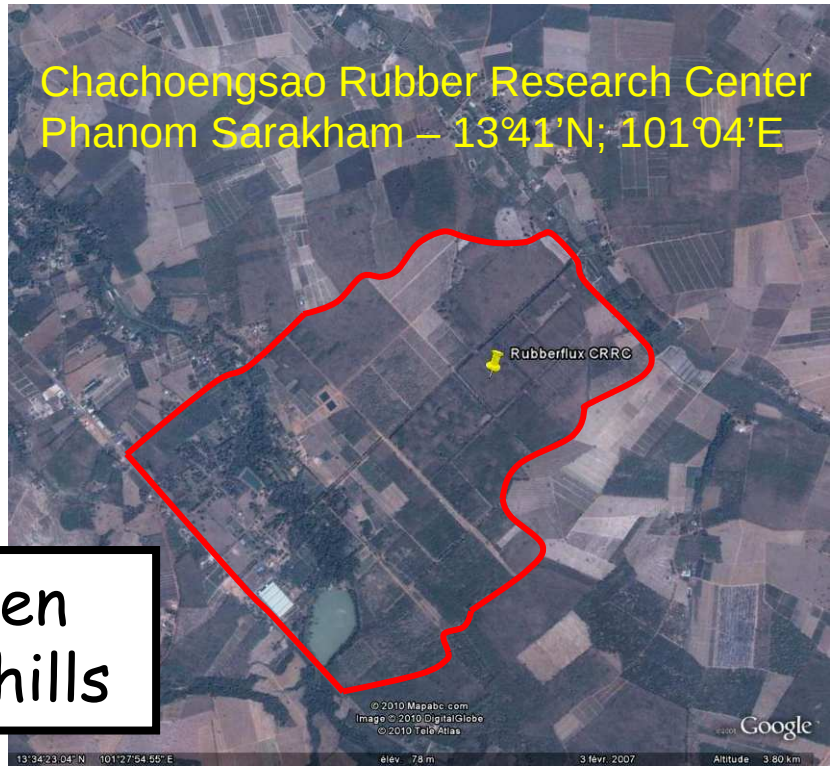
Stock vs Flux method

Method	Time resolution	Spatial resolution	Cost
Stock	Year	Chronosequence	Low
Flux	Hour	Plantation	High

The Rubberflux experiment

Site:
Chachoengsao Rubber Research Centre (DOA/RRIT)



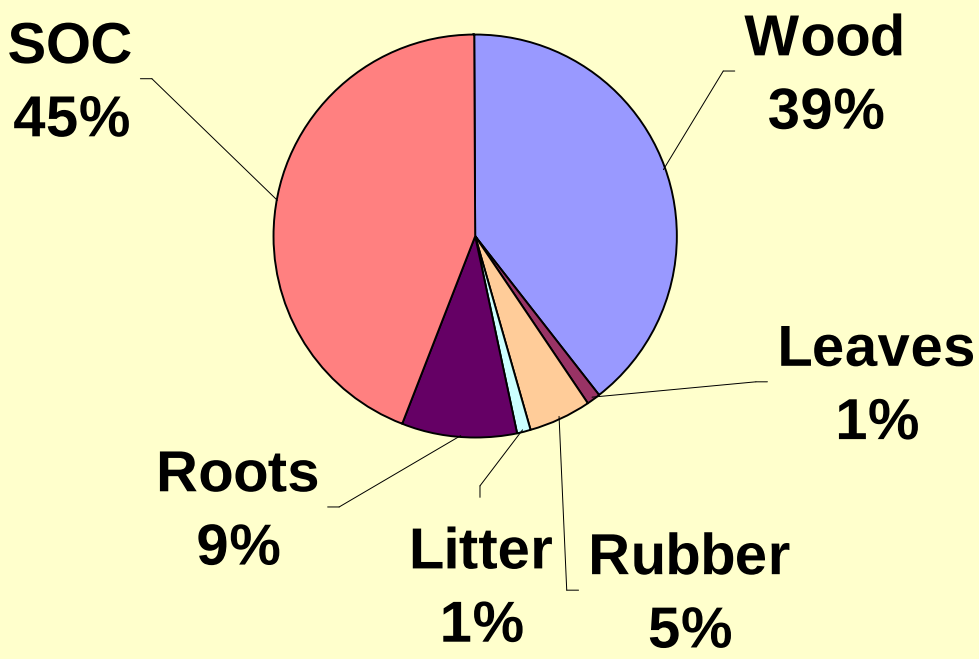
Landscape: transition between central lowlands and eastern hills

C sequestration in rubber plantations
Some results

Stock method

Carbon distribution in a 14 years stand in Chachoengsao province

Total Carbon content of the stand = 187 tC/ha



Stock method

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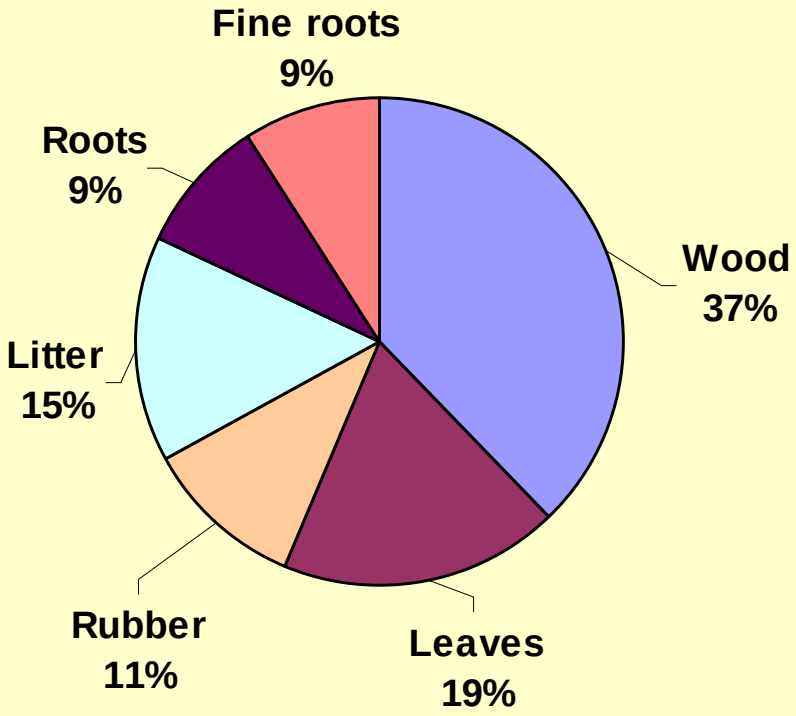
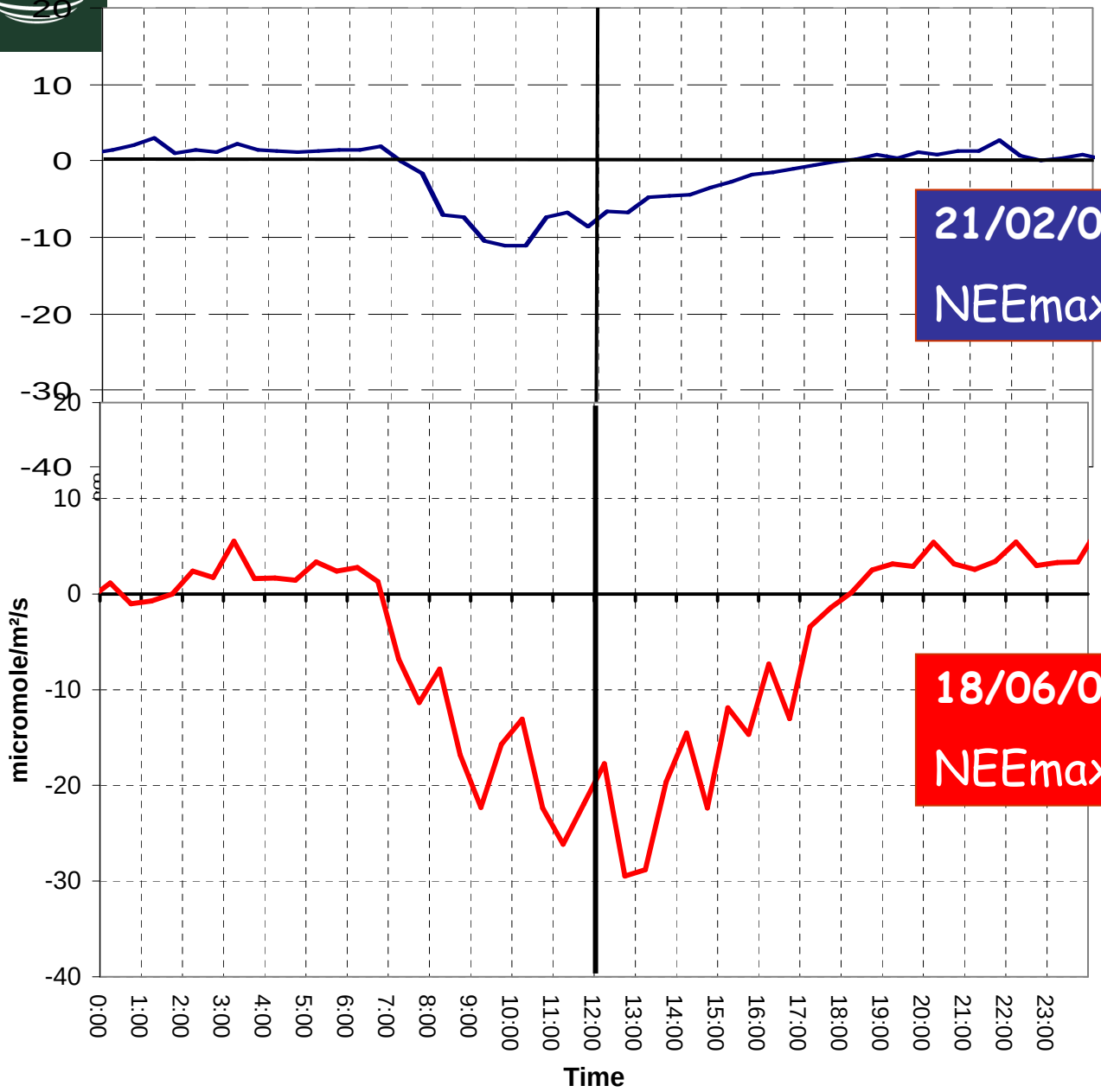


Estimated annual NEP = 14.1 tC/ha

Flux method : daily pattern of NEE



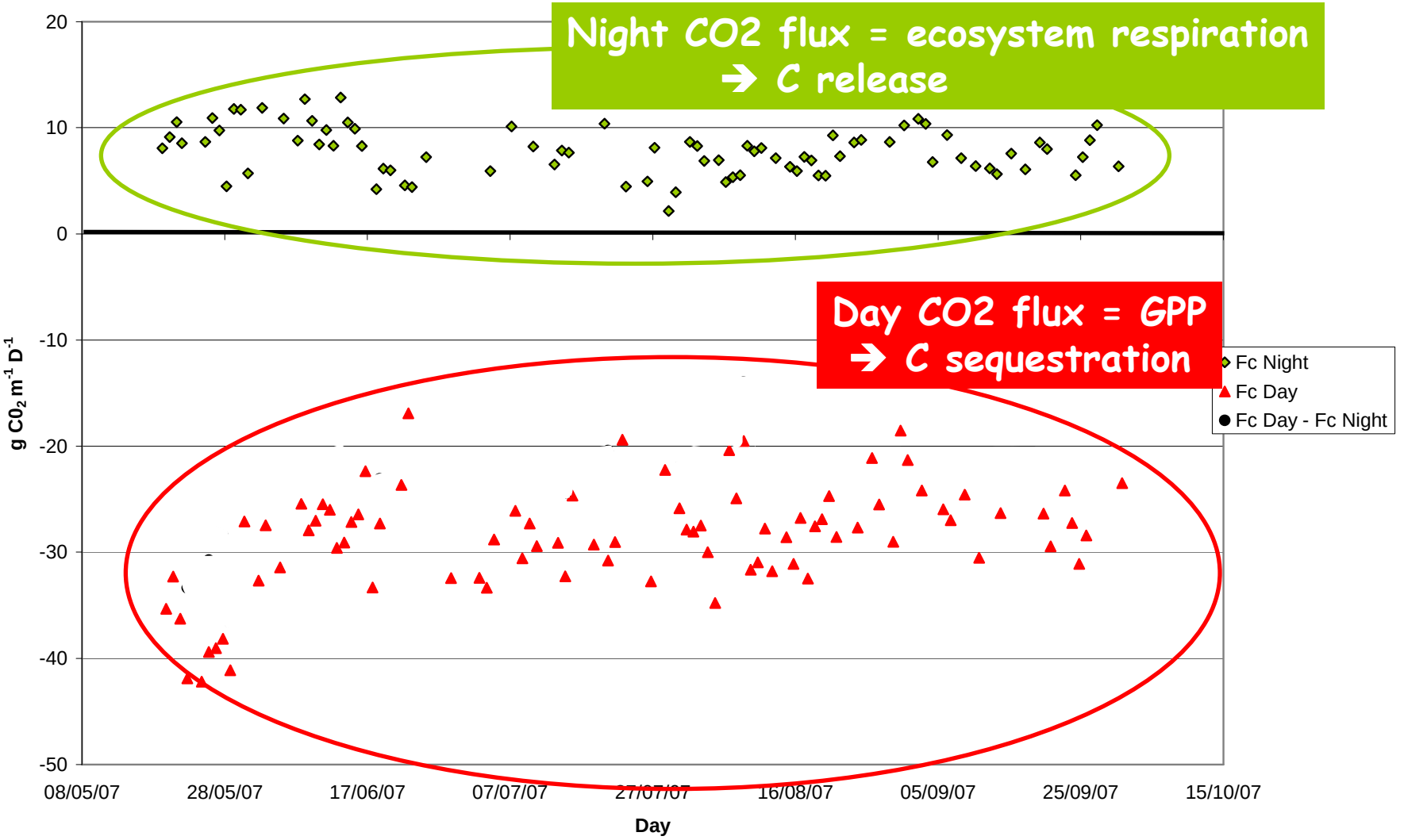
21/02/08 Dry season

NEEmax = 11 µmol $CO2.m^{-2}.s^{-1}$

18/06/07 Rainy season

NEEmax = 30 µmol $CO2.m^{-2}.s^{-1}$

Flux method : CO2 daily flux May to Sept '07



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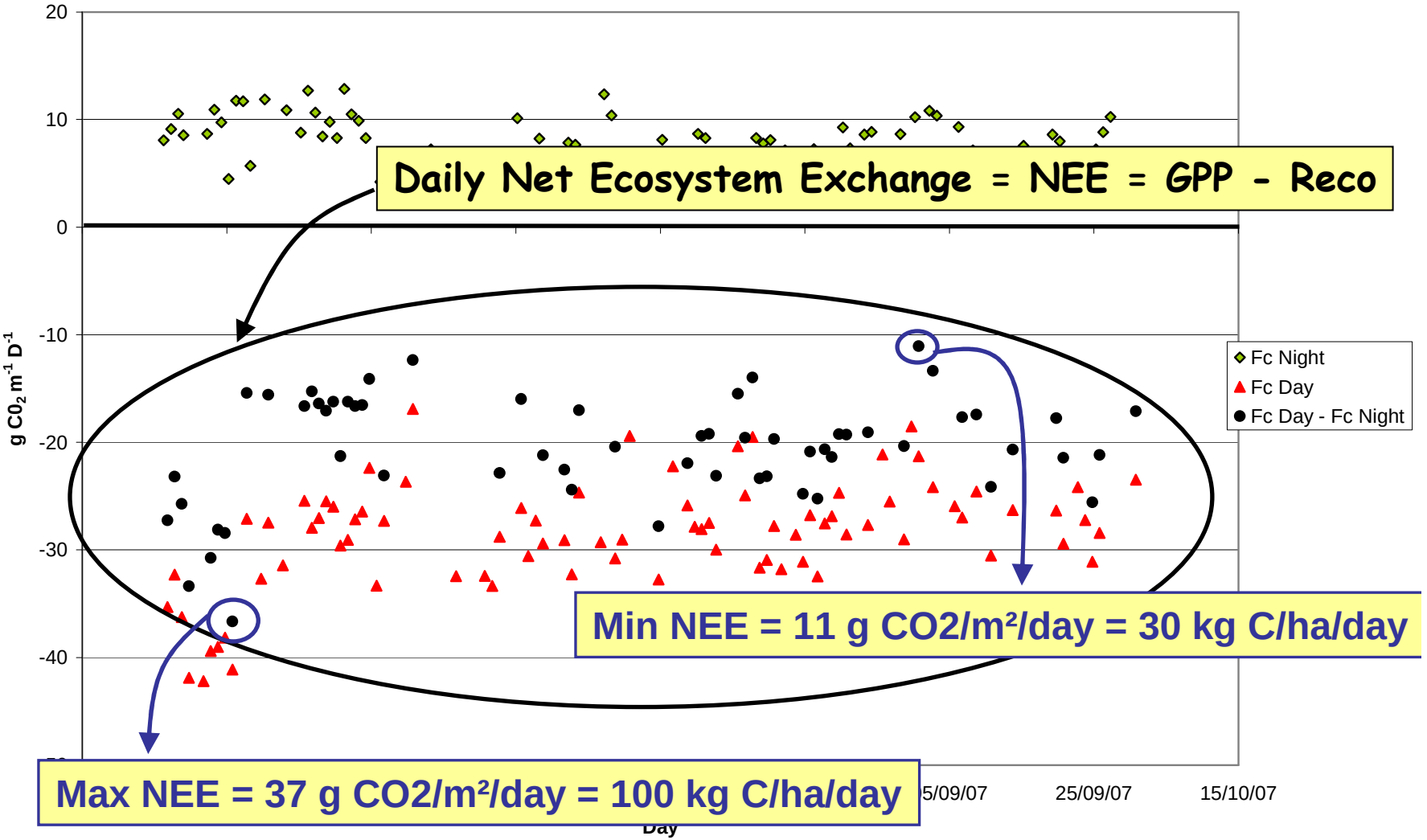

Permanence?

(adapted from Arak Chantuma, 2008)

Wood use 25 years plantations

Location	Wood biomass (t/ha)	Wood sold out (t/ha)	Ratio
SE coast	256	151	59%
SW coast	184	114	62%
Central area	181	112	62%

➔ C leftover : 40% wood residues + roots + SOC

Future opportunities for NR sector to get subsidies from C market

Initial system Baseline	Options for the 2008-2012 period	Options for the future (>2012)
Forest	- A/R : no - Substitution : OK	- Improved management
Crop, pasture, grassland	- A/R : 1st rotation Rubber - Substitution : OK	- A/R : 1st rotation Rubber - Substitution : OK - Improved management
Rubber plantation	- A/R : no - Substitution : OK	- A/R : No - Substitution : OK - Improved management

➔ ADDITIONALITY ?

The additionality issue

- **Rubber planting or replanting is well subsidized in Thailand → A/R projects with rubber not eligible!**

- **Improved management to increase/protect C sequestration**
  - **Agrocecology : soil management to avoid loss of SOC or increase SOC**
  - **Agroforestry : increase NEP, biodiversity…**

- **Prove that NR production system is threaten by more profitable or more environmental harmful commodities (i.e. oil palm)**

Other strategie : Life Cycle Assessment

- GER (Gross Energy Requirement), used as an indicator of th
  primary energy resource consumption: direct + indi
  feedstock (Boustead and Hancock, 1979);
- NRER (Non-Renewable Energy Requirement), used as an
  cator of non-renewable energy use;
- GWP_{100} (Global Warming Potential), used as an indicator
  greenhouse effect;
- ODP (Ozone Depletion Potential), used as an indicator
  stratospheric ozone depletion;
- AP (Acidification Potential), used as an indicator of aci
  phenomenon;
- EP (Eutrophication Potential), used as an indicator of su
  water eutrophication;
- POCP (Photochemical Ozone Creation Potential), used
  indicator of photo-smog creation;
- WU_t (Water Use total), used as an indicator of direc
  indirect fresh water use;
- WU_d (Water Use direct), used as an indicator of the direct
  water for rice irrigation and processing.

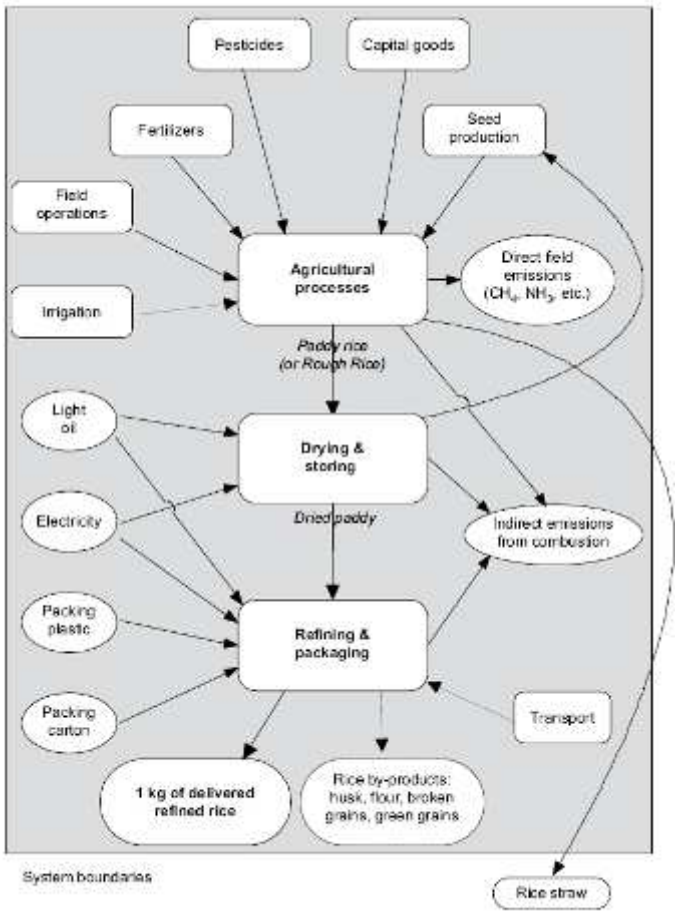

Fig. 1. System boundaries for white milled rice chain.

From Blengini&Busto, 2009

Advantages from scientific approaches of C sequestration

- More C pools are taken into account
- Understanding the fate of C in the ecosystems is important to develop appropriate management techniques
- Development of functional models for predicting impacts of alternative scenario or assess C sequestration at regional/national level

HEVEA RESEARCH PLATFORM IN PARTNERSHIP (HRPP)