WCRP Conference for
Latin America and the Caribbean:
Developing,linking and applying climate knowledge

UNIVERSIDAD DE LA REPÚBLICA URUGUAY

New agricultural models, some old problems.

Agriculture and the integrity of Socio-Ecological Systems

José Paruelo

GEP Grupo de Ecología de Pastizales

BEST-P

IAI Inter-American Institute for Global Change Research

Focus in LA

General scheme of land use and land cover changes

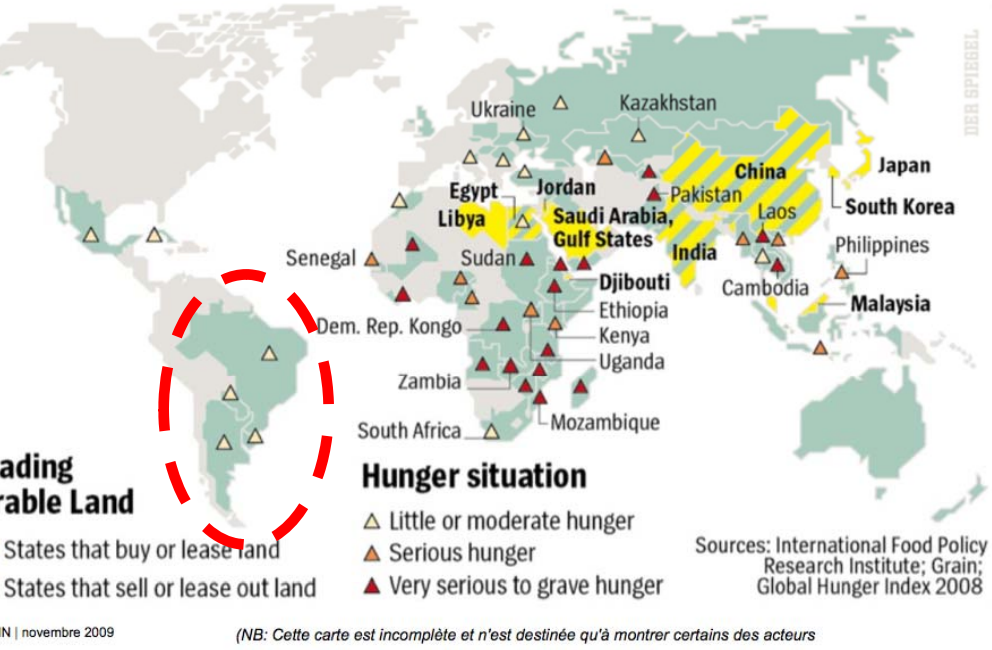
Drivers and consequences. Old and new ones

Feedbacks and Socio-Ecological Systems

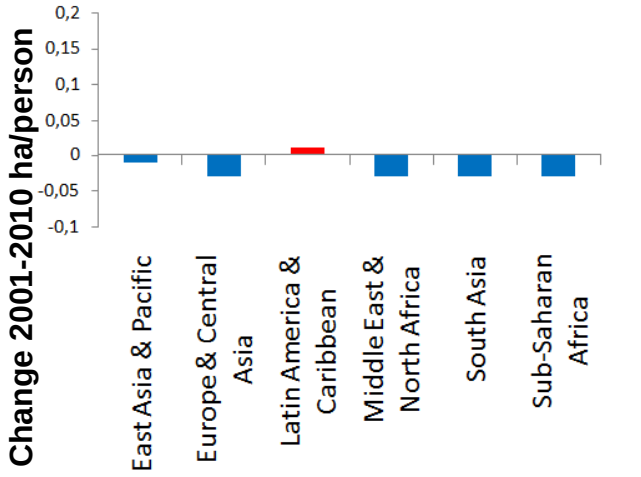
Some common features of historical collapses of SSE

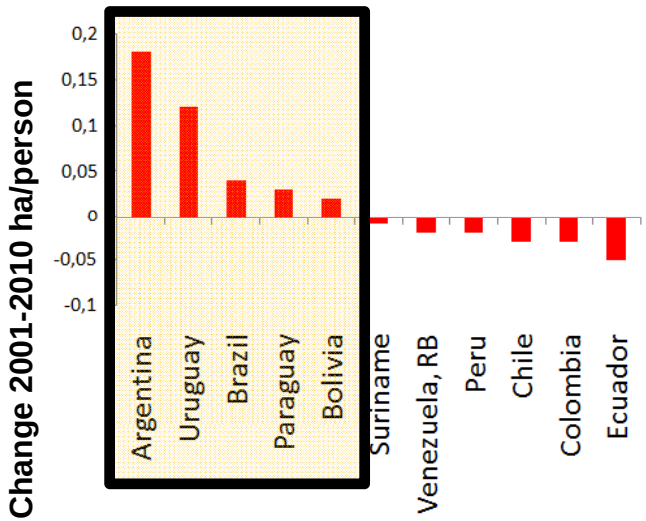
ocus in LA

nd grabbing: the buying or leasing of large ces of land in developing countries, by mestic andtransnational companies, vernments, and individuals.



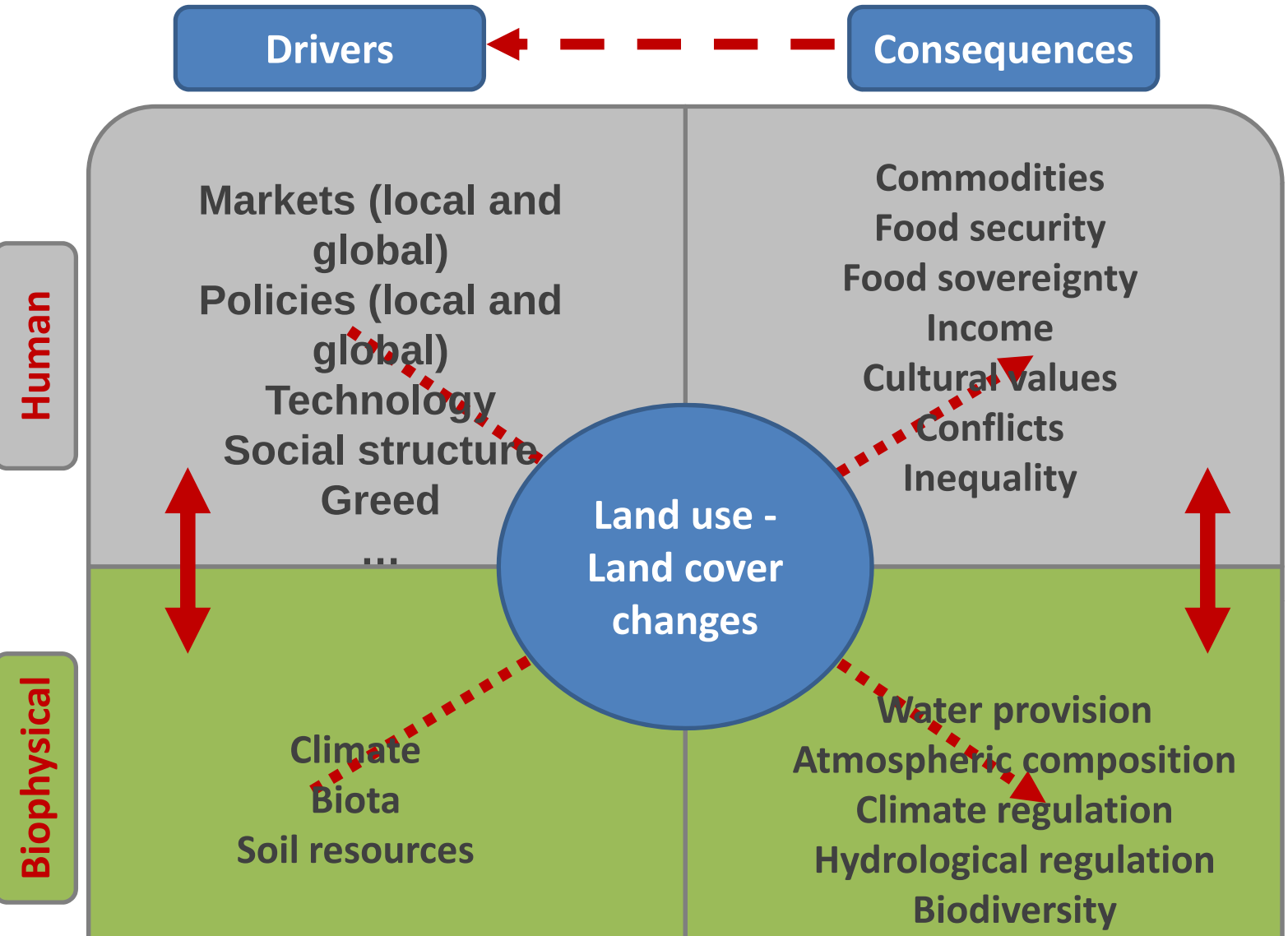
(NB: Cette carte est incomplète et n'est destinée qu'à montrer certains des acteurs





ocus on the subtropical dry forests

Gran Chaco


Drivers
Consequences
Human
Biophysical
Markets (local and global)
Policies (local and global)
Technology
Social structure
Greed
...
Commodities
Food security
Food sovereignty
Income
Cultural values
Conflicts
Inequality
Land use - Land cover changes
Climate
Biota
Soil resources
Water provision
Atmospheric composition
Climate regulation
Hydrological regulation
Biodiversity

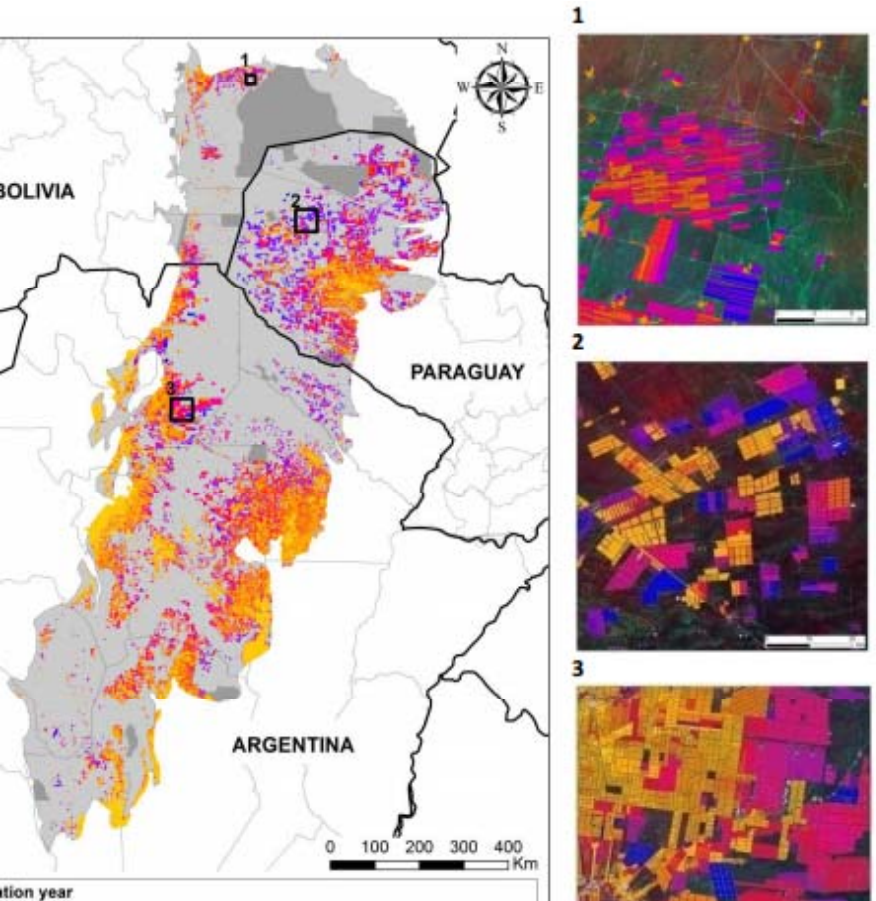
1. Describing the changes

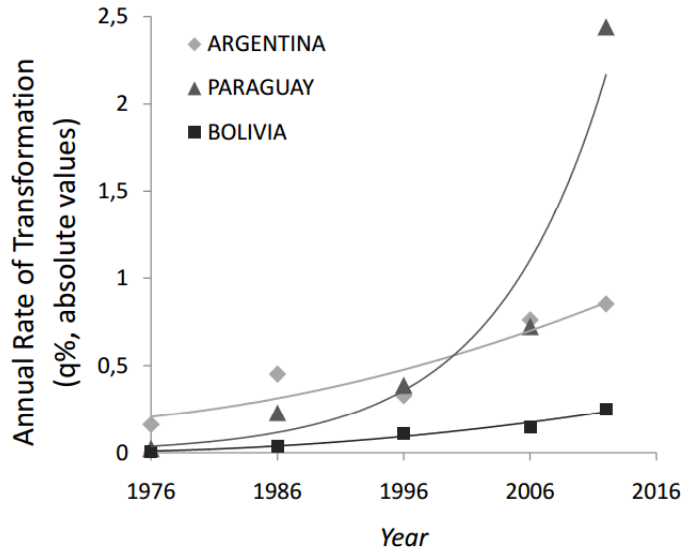
2. Building hypotheses on the drivers of land use/land cover changes

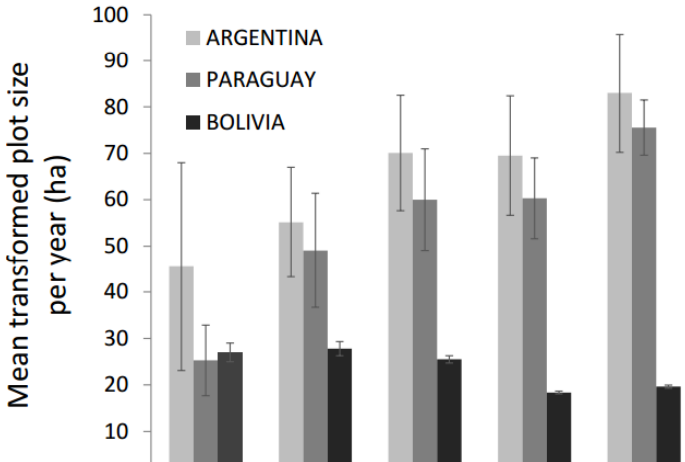
3. Quantifying the consequences

4. Evaluation of the feedbacks

Describing the changes

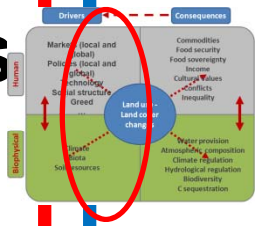






1. Describing the changes

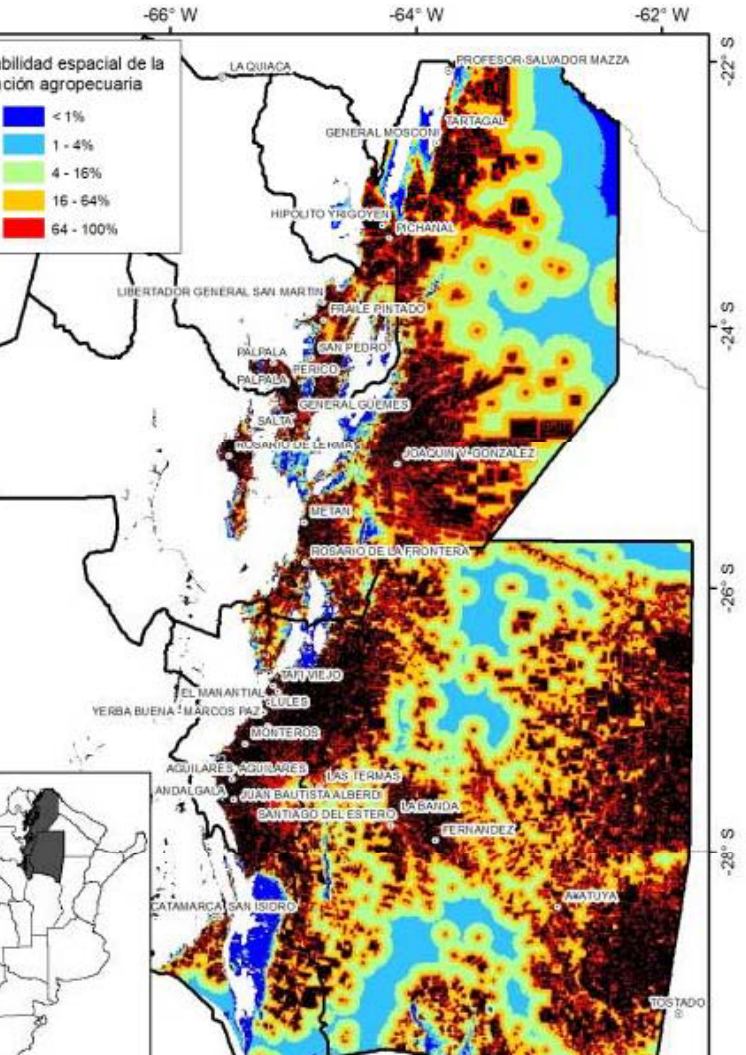
2. Building hypotheses on the drivers of land use/land cover changes



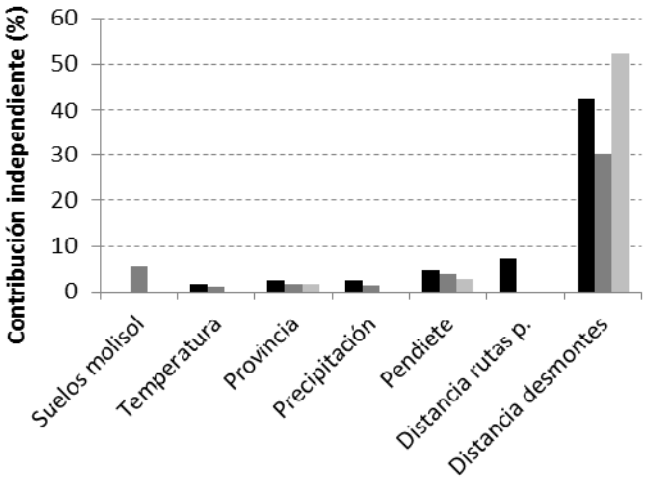
3. Quantifying the consequences

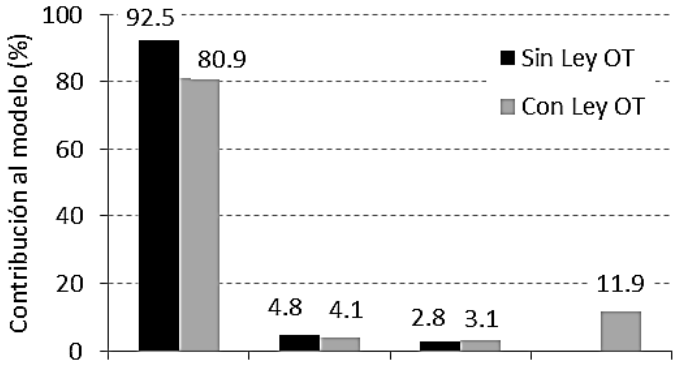
4. Evaluation of the feedbacks

Building hypotheses on the drivers of land use/land cover changes

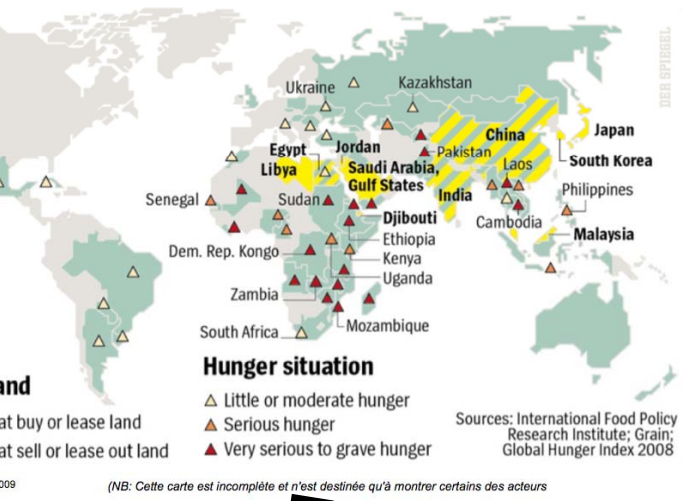


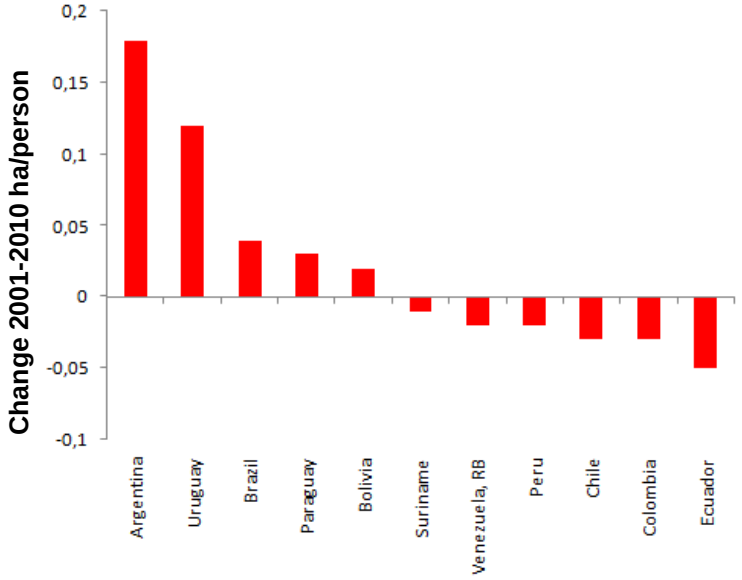
Deforestation





uilding hypotheses on the drivers f land use/land cover changes





Land grabbing as a major driver of land trasnformation

-Larger cleared areas
-Larger crop patches
-Agri-bussiness or Industrial Agriculure syndrome
-Focus in food security or in profit depending on the

1. Describing the changes

2. Building hypotheses on the drivers of land use/land cover changes

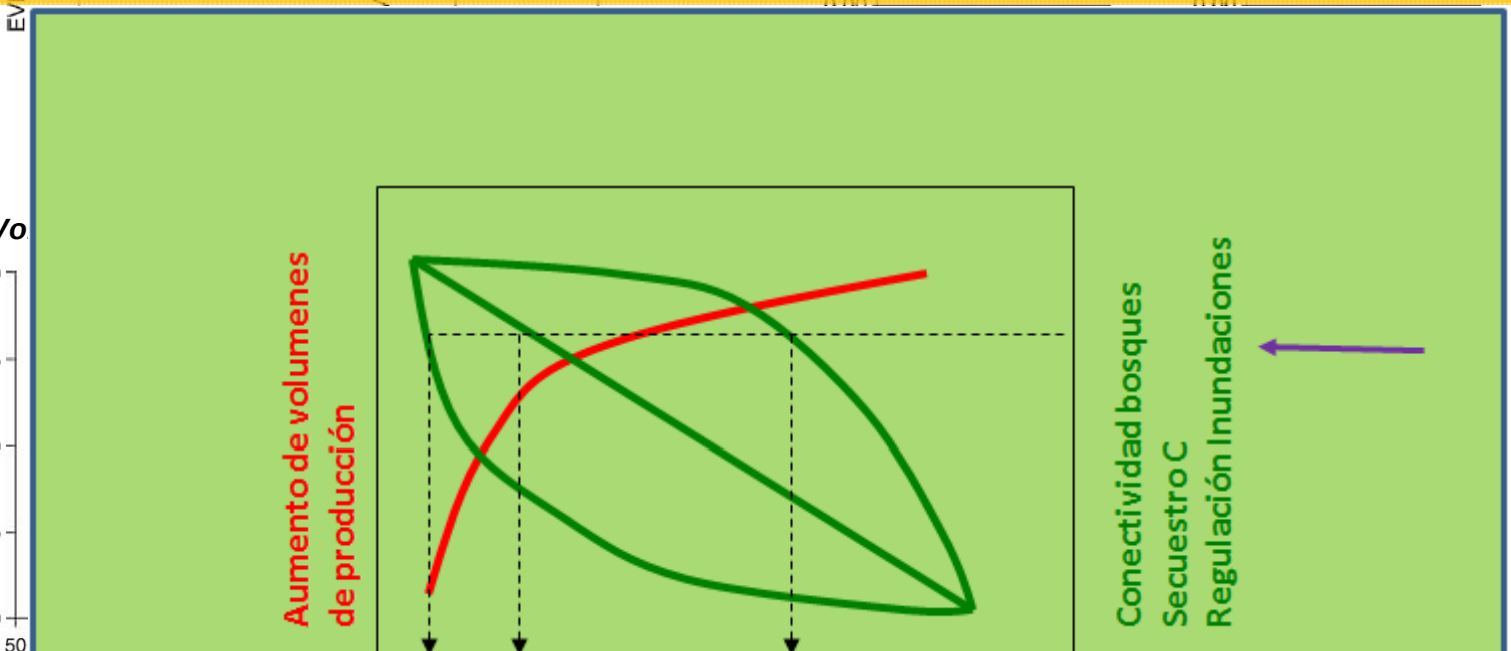
3. Quantifying the consequences

4. Evaluation of the feedbacks

Quantifying the consequences

Change in Ecosystem Services provision

ha transformed

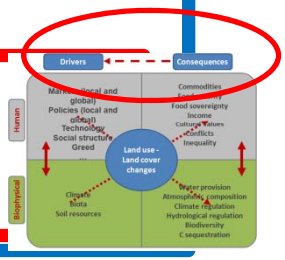


1. **Describing the changes**

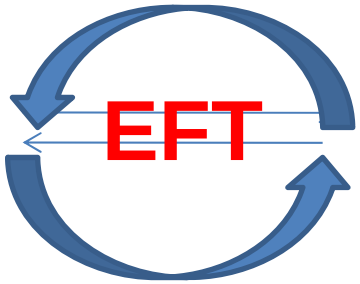
2. **Building hypotheses on the drivers of land use/land cover changes**

3. **Quantifying the consequences**

4. **Evaluation of the feedbacks**



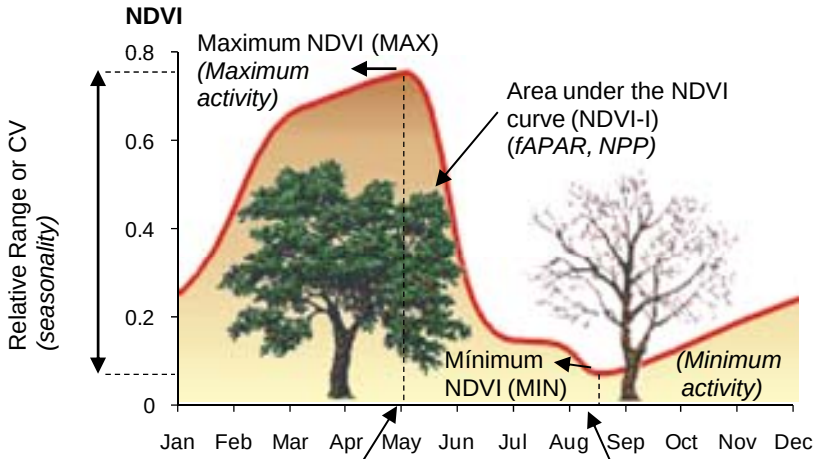
Land Use and Land Cover



Climate

Ecosystem Functional Types (EFT): ***Groups of ecosystems sharing functional characteristics, i.e the exchange of matter and energy between the biota and the physical environment.***

unctional Attributes derived from the seasonal curve of NDVI



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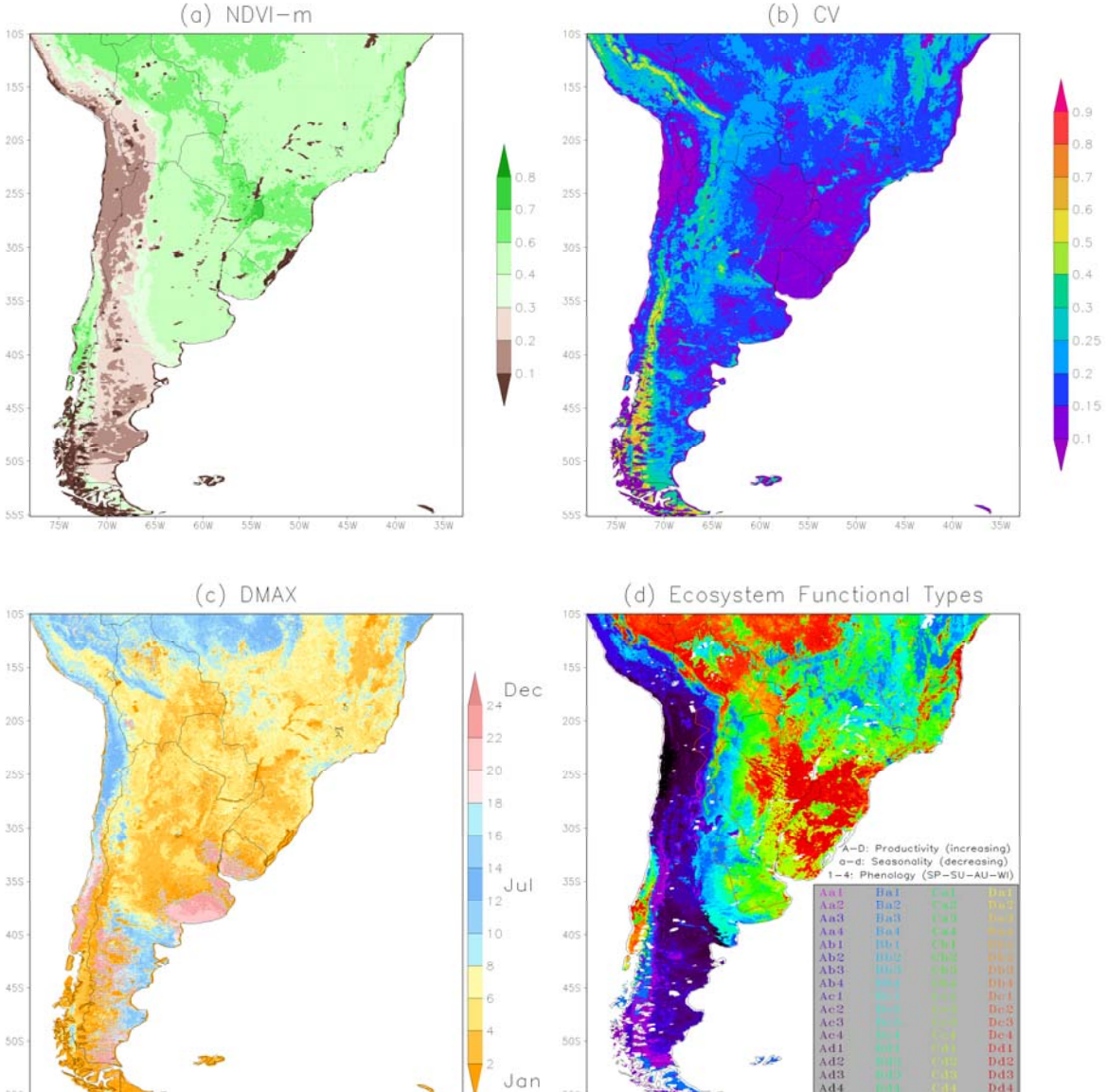
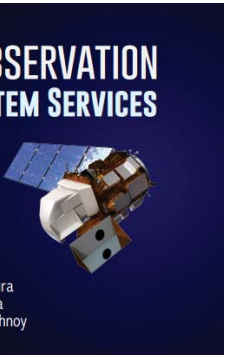
and Human Controls of Ecosystem Functional nperate South America

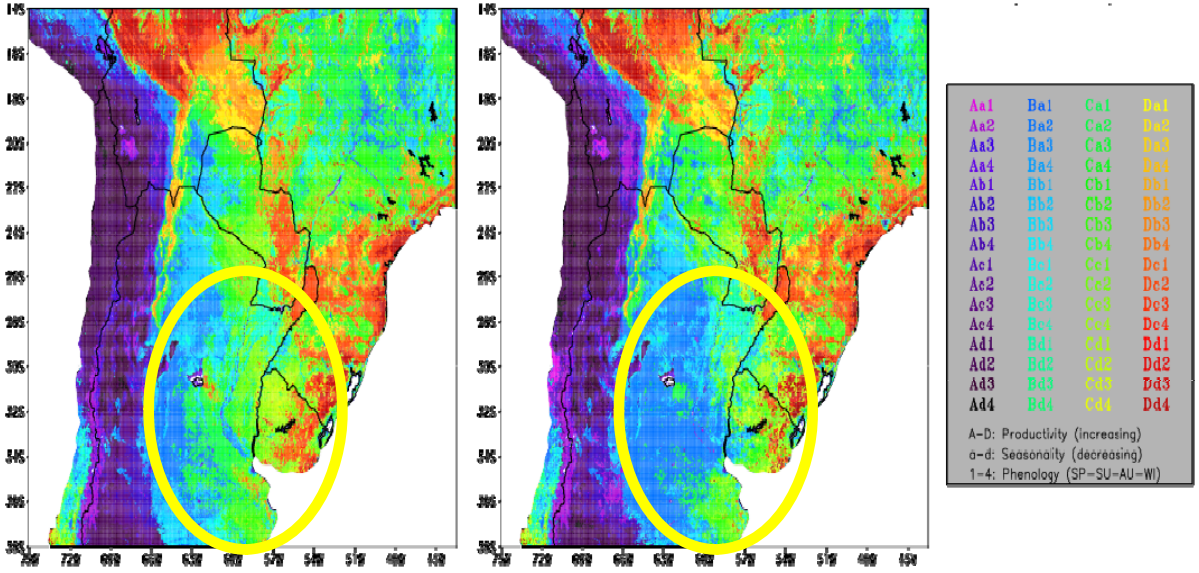
ra [1,*], José M. Paruelo [2], Howard E. Epstein [3] and Javier Cabello [4]



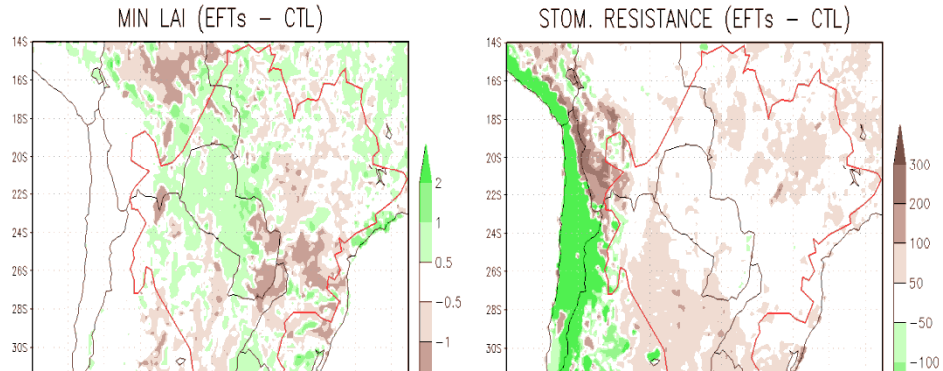


Monitoring
Services

Interannual variability of the biophysical properties

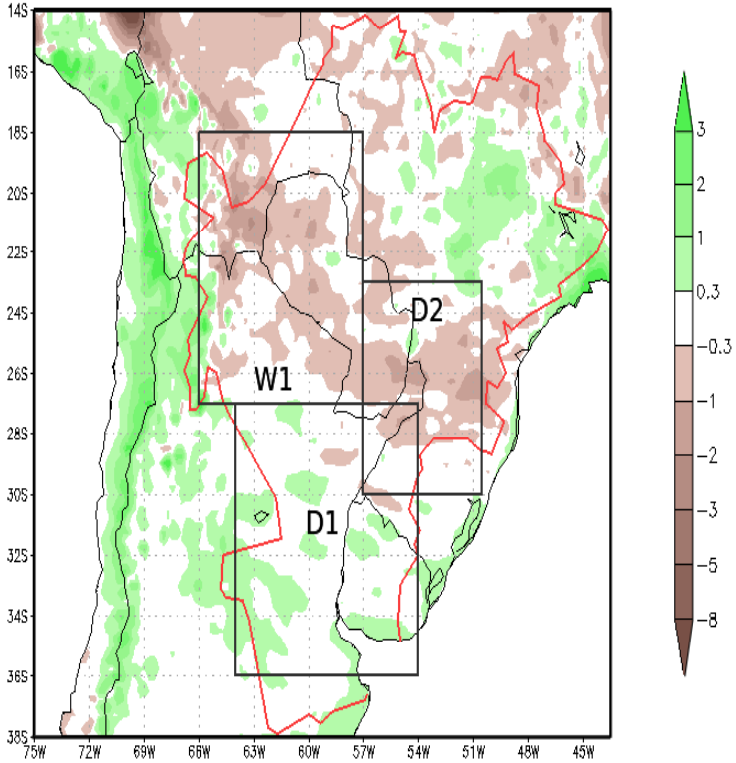


Noah land surface model table of physical properties



eduction in Precipitation Biases when using EFTs

her Research and casting (WRF) model



Peft – Pctl

The brown shades in areas W1 and D2 represent a reduction in the positive bias when using

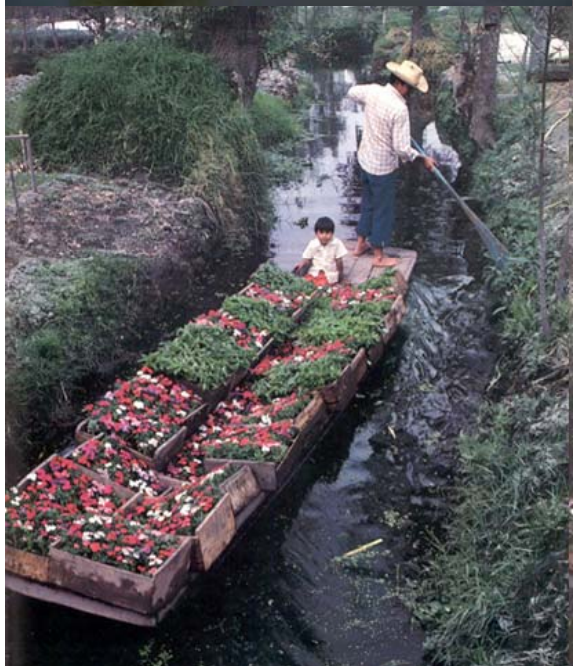
The green shades in area D1 represent a reduction in the negative bias when using EFTs

Everything changes… ***What is going to happen?***

Would the Chaco Socio-Ecological Systems persist, change to something else or collapse?

We may learn something from the past…

ne of the transformations were succesfull
l last for centuries…



Some others not!

e analysis of several cases of SES collapses in very different geographic, vironmental and historic contexts, from Easter Island to the Norwich onization of Greenland, allowed anthropologists and ecologists to ntify some common features.

veral of these factors seems to operate in the Gran Chaco.

e we repeating history with agri-business expansion?

These common features include:

1. The model used for decision making is based on an extrapolation of knowledge acquired in different systems with some similarities but critical differences.

2. The information available is scarce, problems are over-generalized and the description of the temporal and spatial heterogeneity of the structural and functional characteristics of the SSE is insufficient.

3. The observation period is short and the dynamics of the system is poorly characterized and/or trends are not evident. Lagged feedbacks are not perceived.

4. Those who take long term, strategic decisions are not those who actually operate on the agroecosystems.

5. Decision makers may acknowledge the problems but they do not feel responsible for them.

6. The "model of nature" used (explicit or implicitly) as decision framework is not

These common features include:

1. The model used for decision making is based on an extrapolation of knowledge acquired in different systems with some similarities but critical differences.

Agriculture in the argentine Chaco is based (in general terms) on the same technological packages than in the pampas. A subtropical region with summer precipitations is cultivated using a model developed in a temperate area with even distributed precipitation

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The regular distribution of the deforested patches in the territory suggests that the edaphic and geomorphological heterogeneity was not took into account. The expansion of agriculture to areas with historical records of mean annual precipitation under 600 mm during wet periods ignores the temporal variability of rainfalls and/or cyclic behaviors. The regular shape and the increasing size of deforested patches ignores the effects of landscape configuration on vertical and horizontal flows of energy and matter.

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Rainfed agriculture expands into semi-arid zones during wet periods and collapsed during dry cycles promoting desertification processes. The slow but sustained raise of groundwater in areas where croplands replace forests and the salinization problems that may occur are an example of lagged feedbacks in the SEE.

6. The "model of nature" used (explicit or implicitly) as decision framework is not

These common features include:

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Land grabbing located decision makers even in a different continent. As a consequence decision making is disconnected from an eventual degradation dynamics and the responses are lagged. Land grabbing and industrial agriculture connect systems with a very different dynamics: financial markets and agroecosystems. Response times, internal and external controls and feedbacks differ markedly between them.

***4. Those who take long term, strategic decisions are not those who actually operate on the agroecosystems*.**

5. Decision makers may acknowledge the problems but they do not feel responsible for them.

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Not only global environmental problems (biodiversity losses or climatic change) but also more local issues such as contamination, flood regulation, etc, are considered as government or international institutions responsibility. The lack of territorial bounds of the actual decision makers would exacerbate this behavior.

***5. Decision makers may acknowledge the problems but they do not feel responsible for them*.**

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3. The observation period is short and the dynamics of the system is poorly characterized and/or trends are not evident. Lagged feedbacks are not perceived.

A typical case is to assume an equilibrium dynamics to plan and to evaluate impacts. A number of exogenous (from climatic change to biological invasions) and endogenous (the succession dynamics of a forest, the disturbance regime, the land surface-atmosphere interaction) factors are continually changing and modifying the response of the system.

6. The "model of nature" used (explicit or implicitly) as decision framework is not

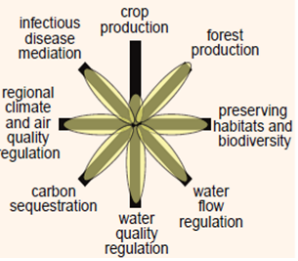
Information and knowledge problems

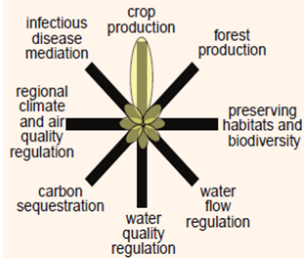
Conceptual framework problems

Political and ideological problems

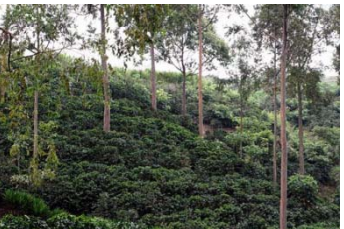
Partially competing conceptual models to understand LULCC in the Gran Chaco

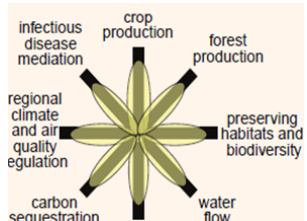
Land sparing/Forest transition





Land sharing





"Tsunami"

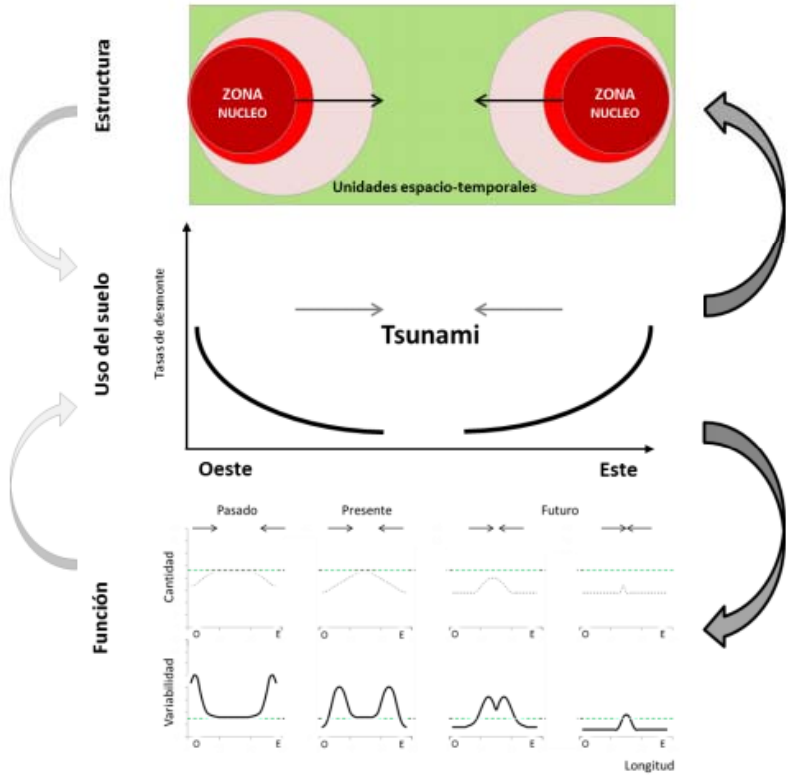


Figura 6.5. Modelo conceptual de cambio de uso de suelo tipo Tsunami", caracterizado por poseer velocidad de cambio diferencial dependiente de la distancia a la zona de avance o frontera agropecuaria. Esta velocidad decrece en

hat is the role of the scientific community?

Pure Scientist

Issue Advocate

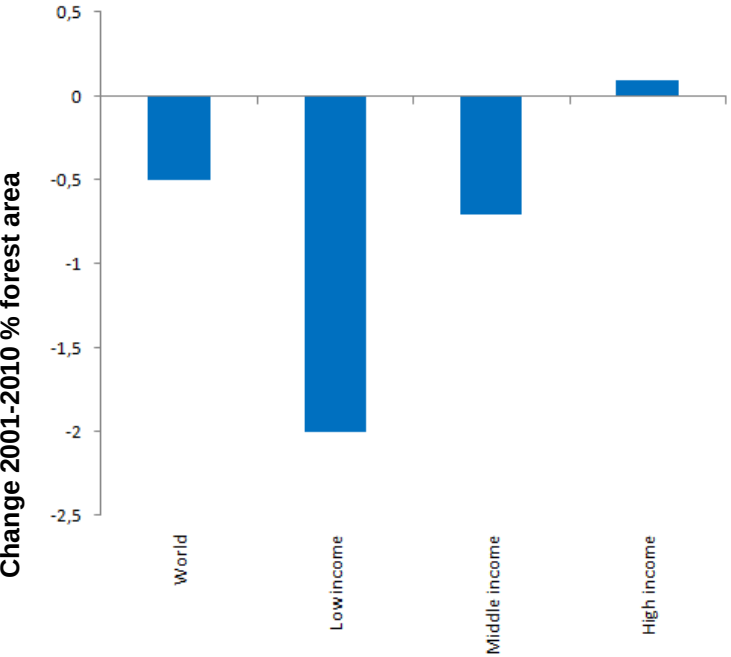
Science Arbiter

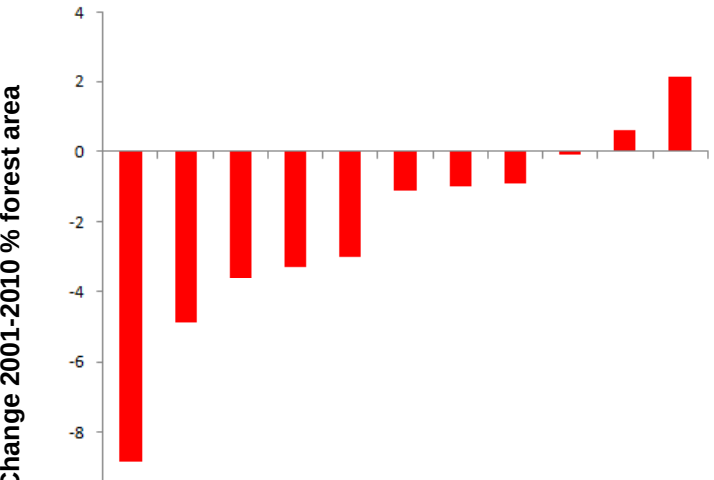
Honest Broker of Policy Alternatives

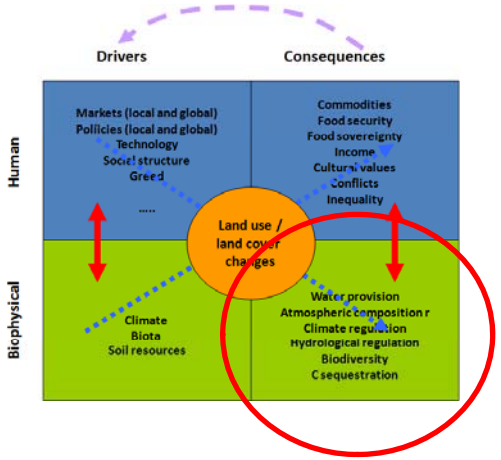
Muchas gracias...

LART

GEP
Grupo de Ecología de Pastizales


Change 2001-2010 % forest area
0,5
0
-0,5
-1
-1,5
-2
-2,5
World
Low income
Middle income
High income


Change 2001-2010 % forest area
4
2
0
-2
-4
-6
-8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Hydrological regulation
Biodiversity
C sequestration

erything changes… What is going to happen?

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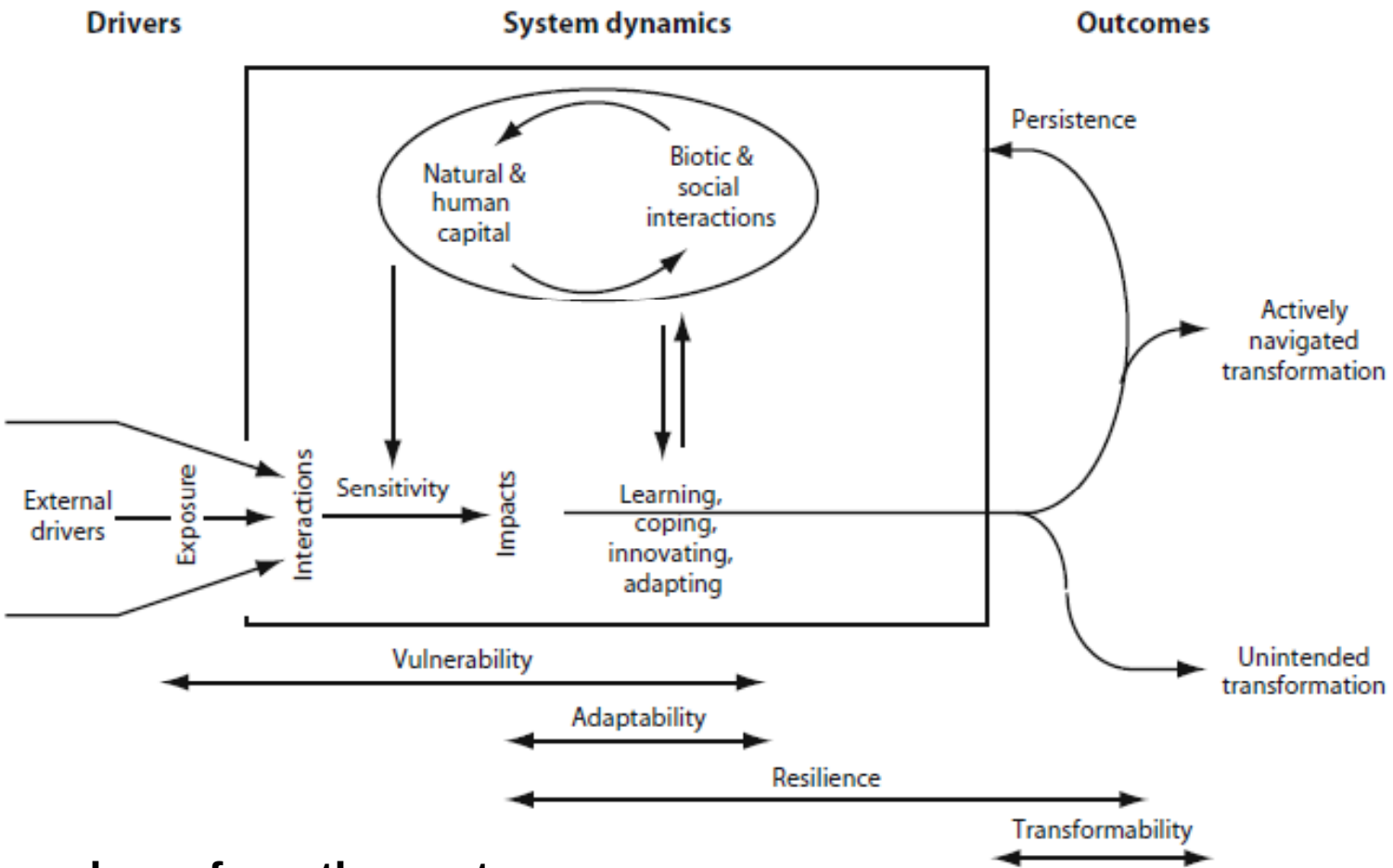

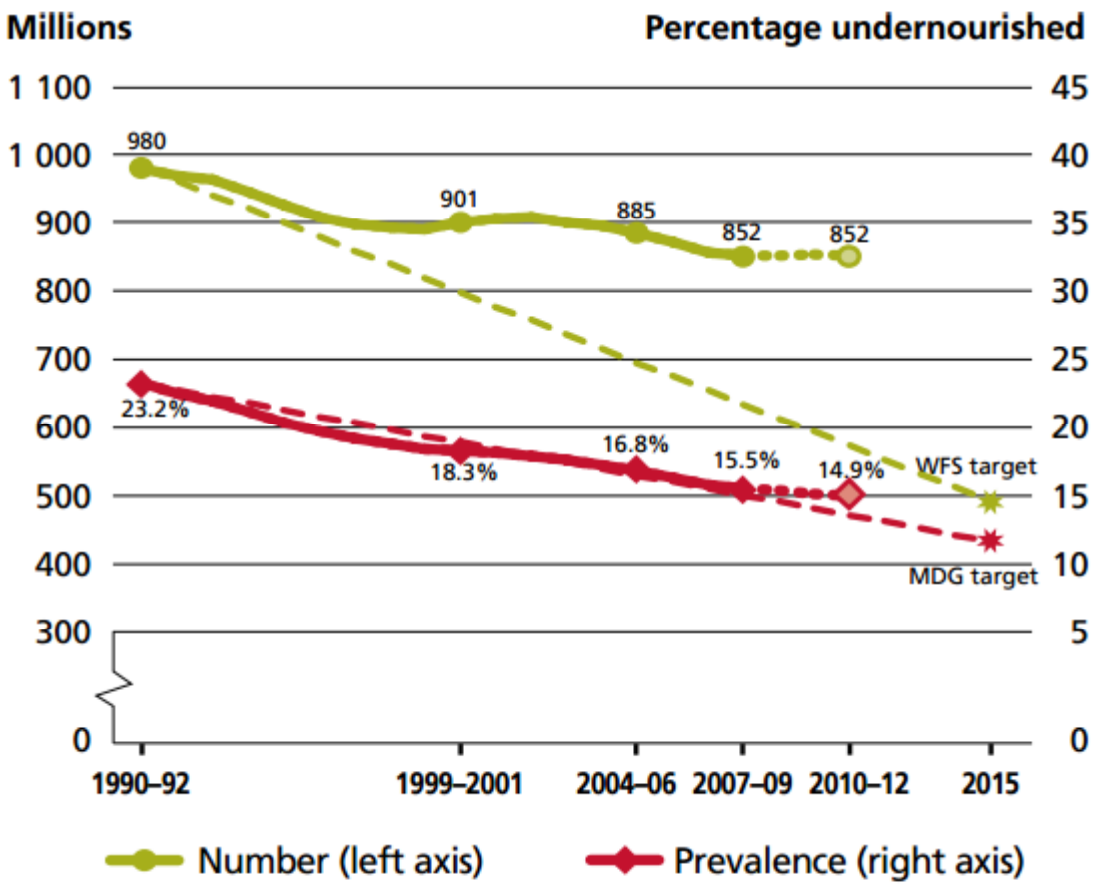

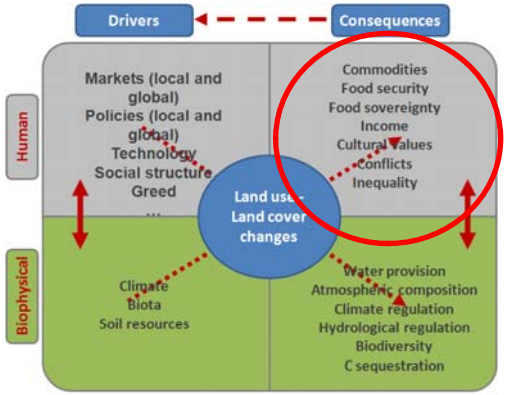

Note: Data for 2010-12 in all graphics refer to provisional estimates.
Source: FAO.

Agricultural land / person
Changes 2001-2010