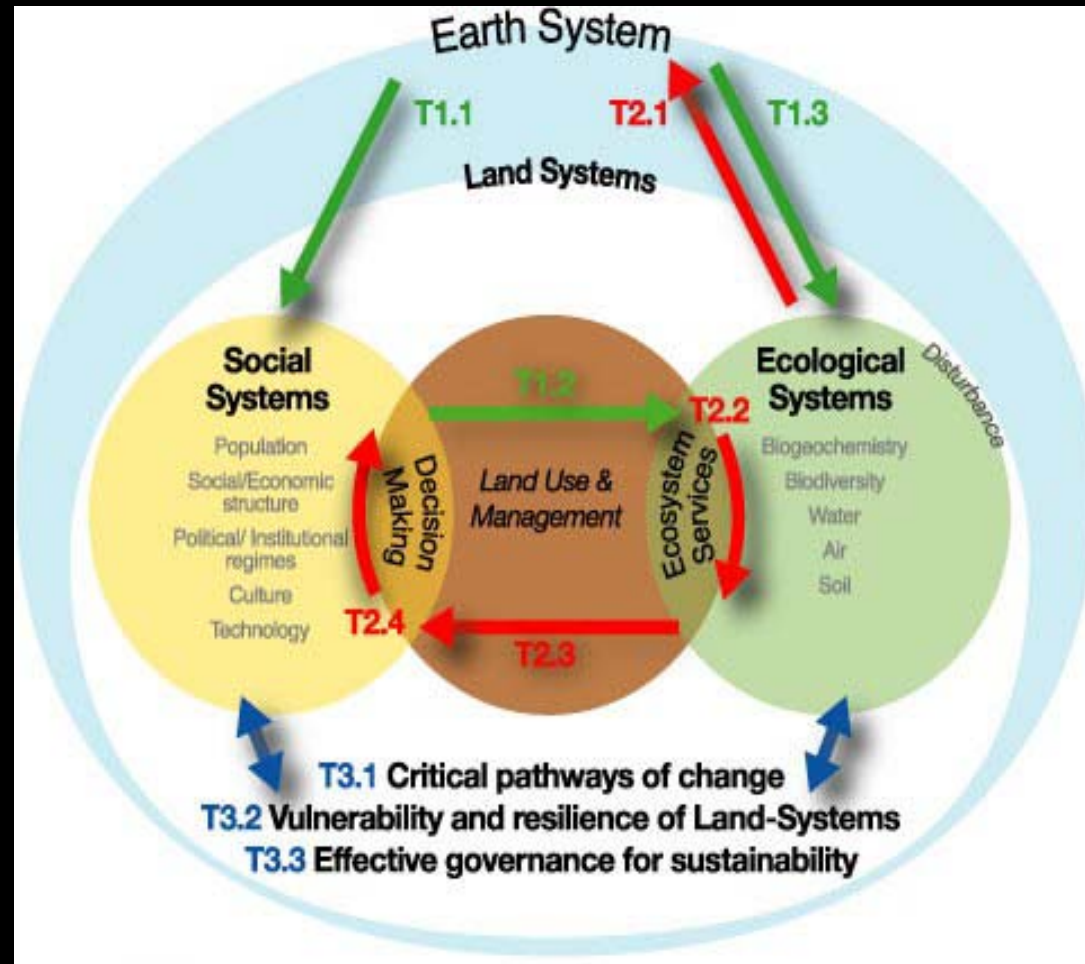


Integration through modelling for the Global Land Project

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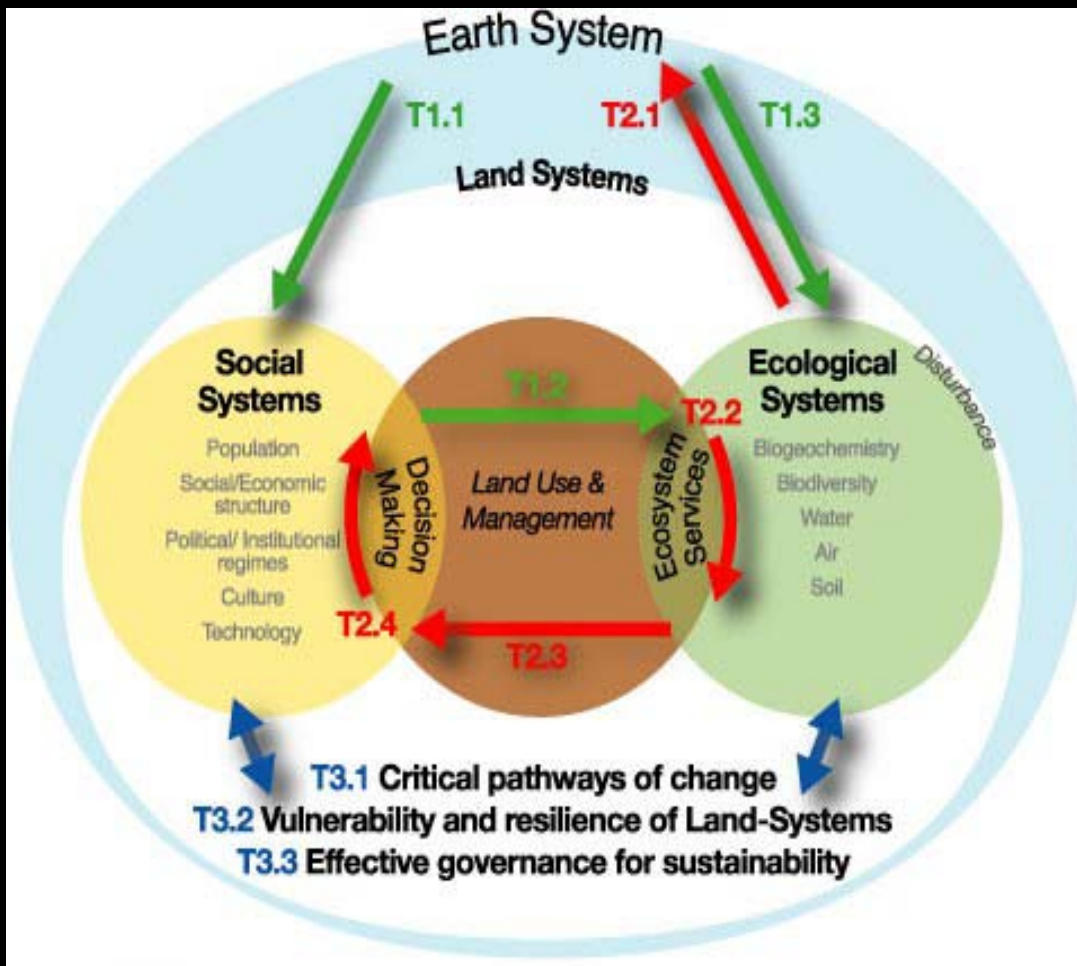
Global Land Project

1. Dynamics of land-systems
2. Consequences of land-system changes
3. Integrating analysis and modelling for land sustainability



Land systems

- The Global Land Project recognises land systems as coupled natural and human systems:
 - Interdependent
 - reciprocal causal relationships
- Complex systems
 - Complex
 - Contingent
 - Hierarchical
 - Irreducible



Integrated models

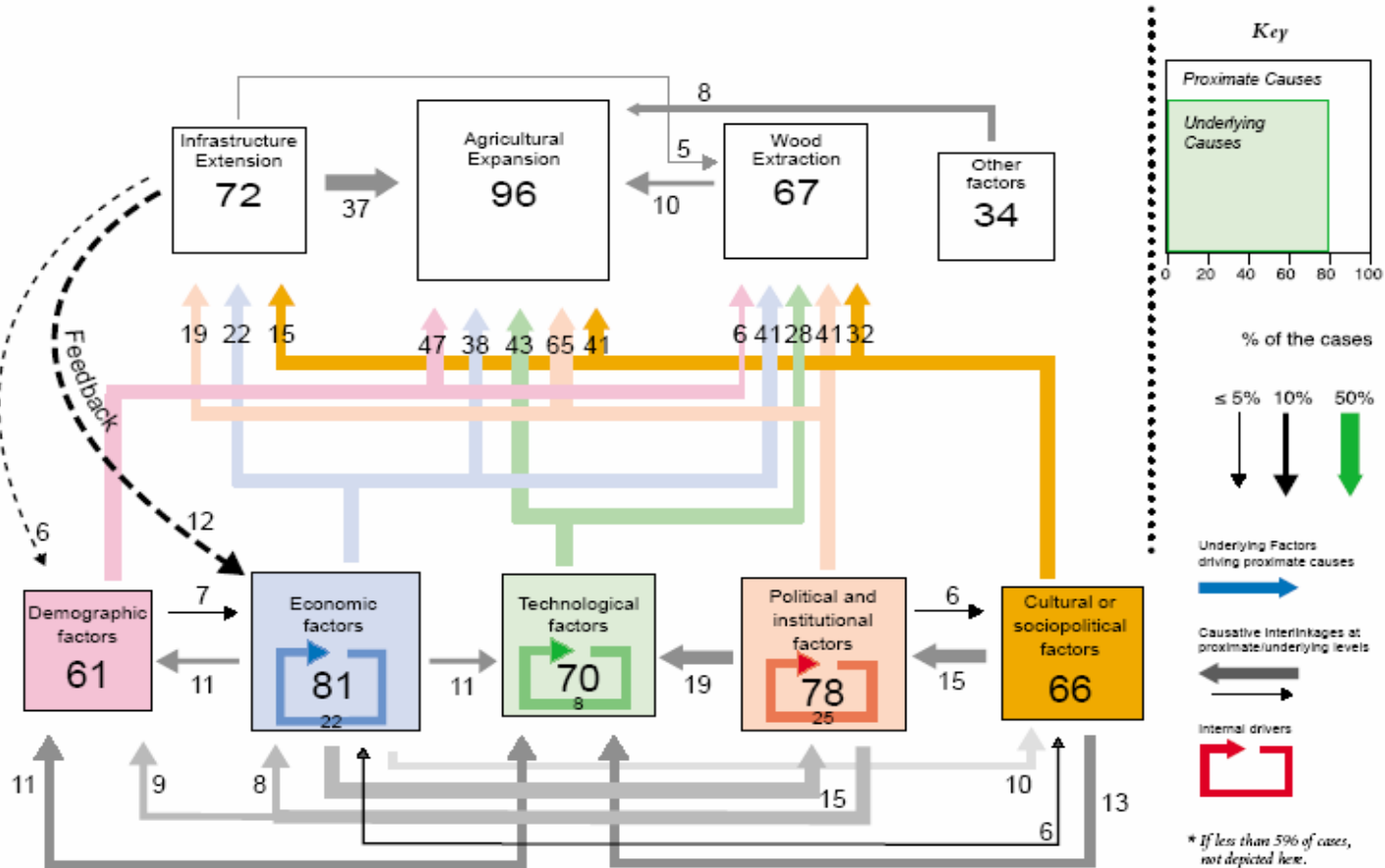
- To develop a design specification for integrated models representing land systems as coupled natural and human systems
 - Address the spatial, temporal and process dynamics of both human and natural systems, and the interaction of these systems
-

From case studies to integrative models

1. Develop case studies that identify sequences and histories of land changes
What happens?
 2. Compare case studies to determine the different states of land systems and driving factors
Are there generalisations?
 3. Develop an understanding of the processes operating and determine the relations that are applicable
What controls land systems and land change?
-

Meta-analysis: comparing case studies

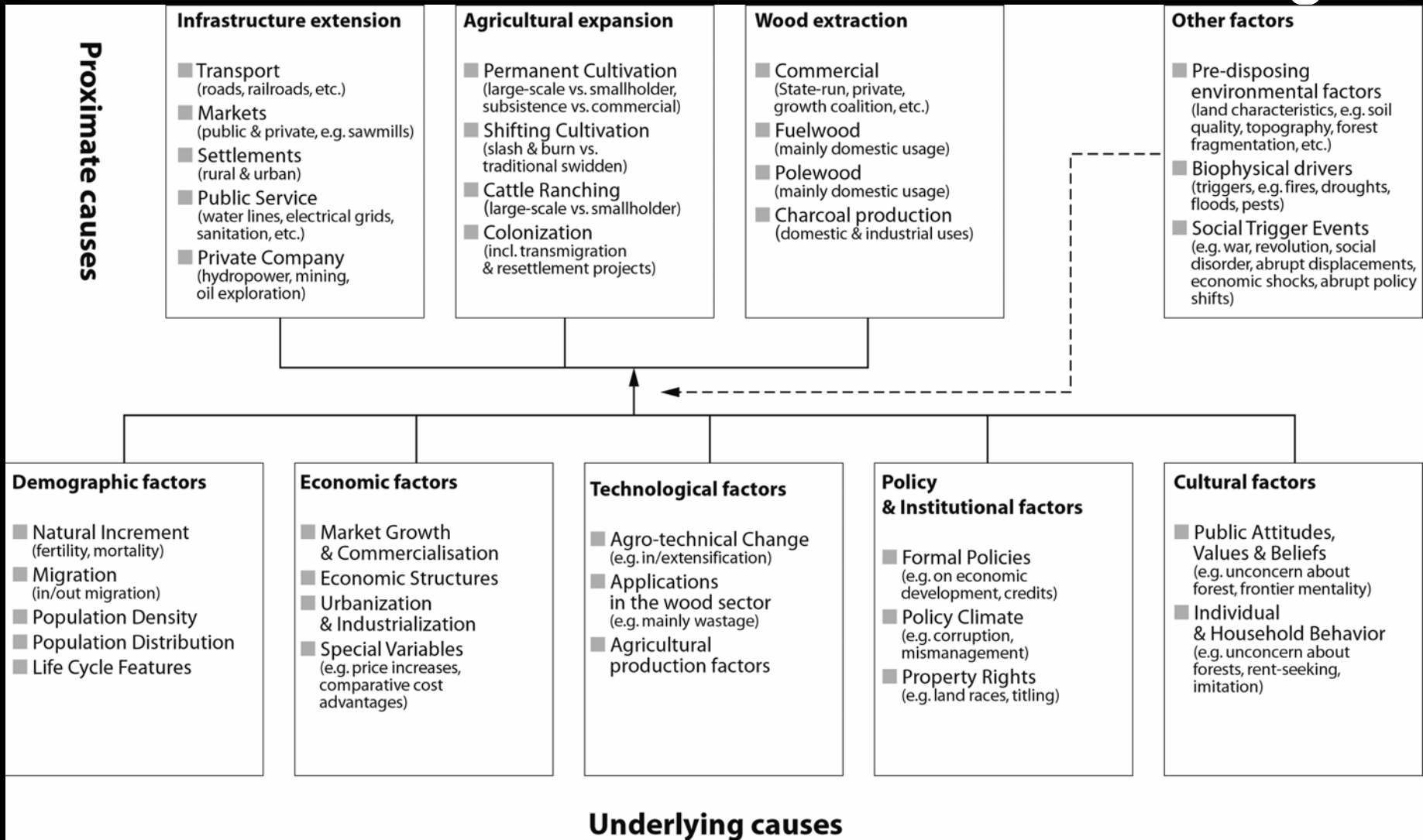
Figure 9 A systemic and generalized view upon the causative pattern of tropical deforestation (N = 152 cases)*



© Geist & Lambin, What drives tropical deforestation? A meta-analysis of proximate and underlying causes of deforestation based on subnational case study evidence. LUCC Report Series n° 4, 2001



Proximate and underlying causes of change



Causes/Drivers of change

UNDERLYING CAUSES	CONSTRAINTS ON CHOICE	PROXIMATE CAUSES	CONSEQUENCES
<ul style="list-style-type: none"> Cultural or socio-political Policy and Institutional Demographic Economic Technological Environmental 	<ul style="list-style-type: none"> Land Quality/Suitability Land Tenure Social Norms Individual Preferences Finance 	<ul style="list-style-type: none"> Agricultural Changes Cultivation techniques Ranching Infrastructure Changes Transportation Markets, Agreements Services Industrial Changes Employment Industry ... 	<ul style="list-style-type: none"> Economic Social Environmental
<p>External Factors/Trigger Events e.g. weather, economic shocks</p>		<p>Modified from: Geist and Lambin (2001, 2002, 2004) Birnie et al., (2002)</p>	

Factors/drivers

- Factors/Drivers

- Cultural or socio-political
- Policy and Institutional
- Demographic
- Economic
- Technological
- Environmental

Political

Economic

Social

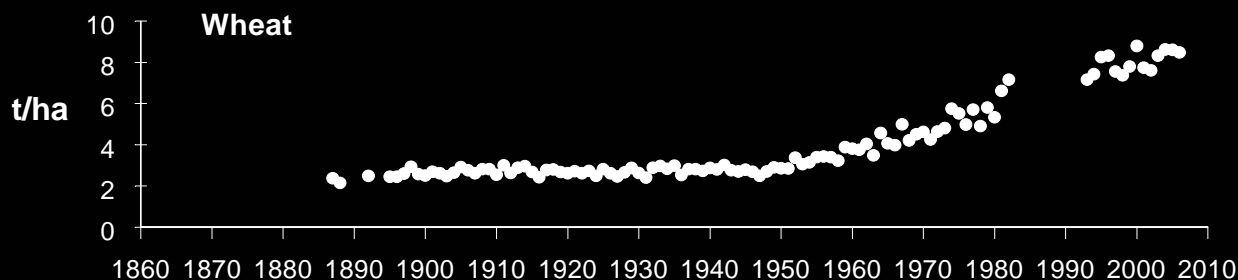
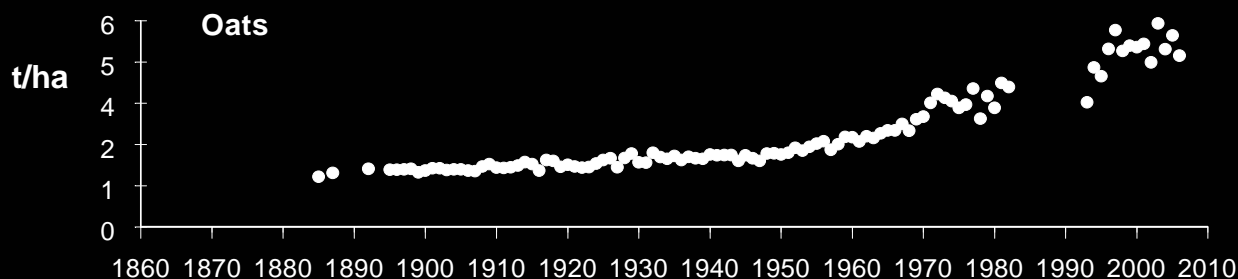
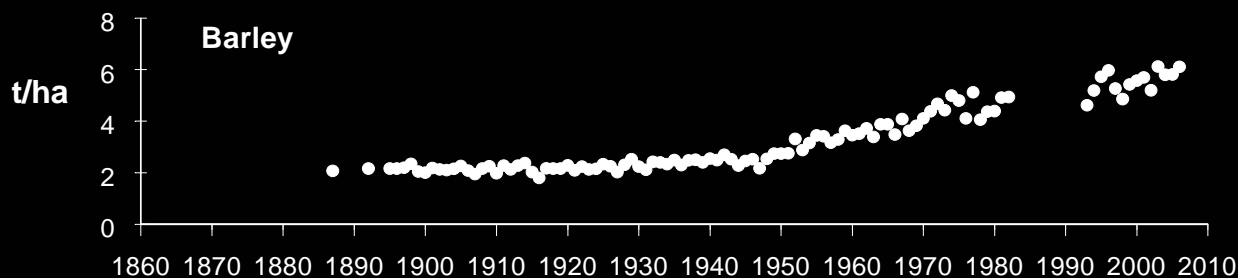
Technological

Legal

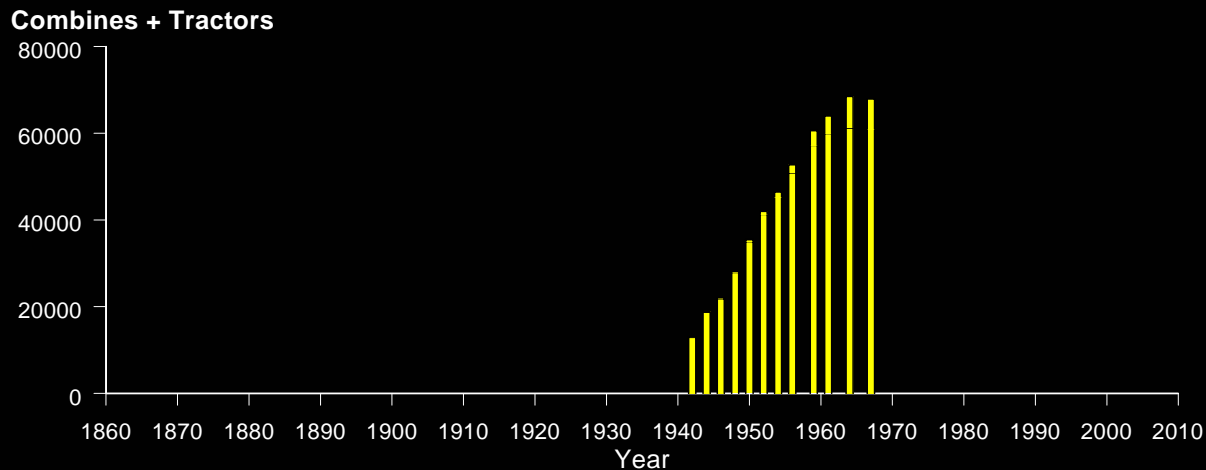
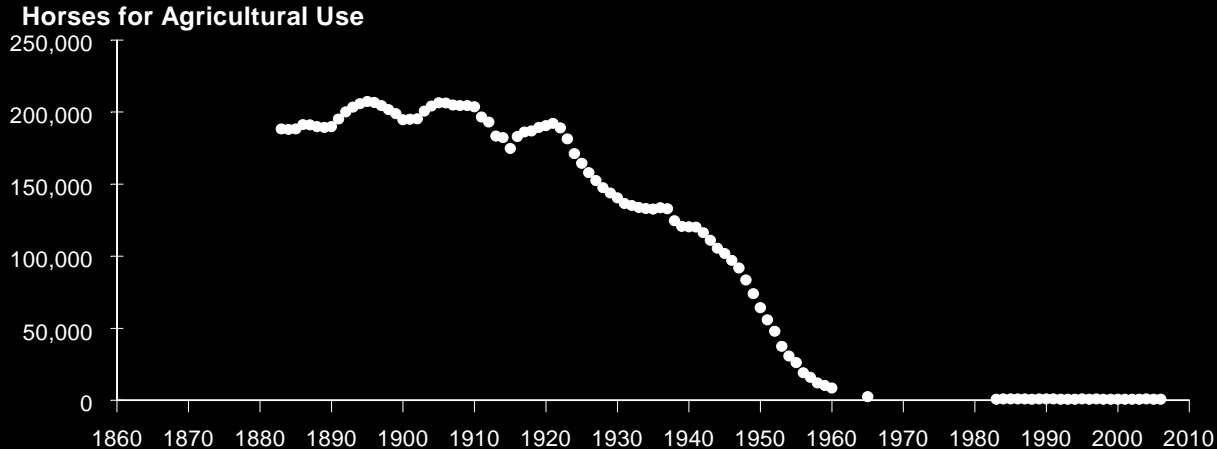
Environmental

... processes?

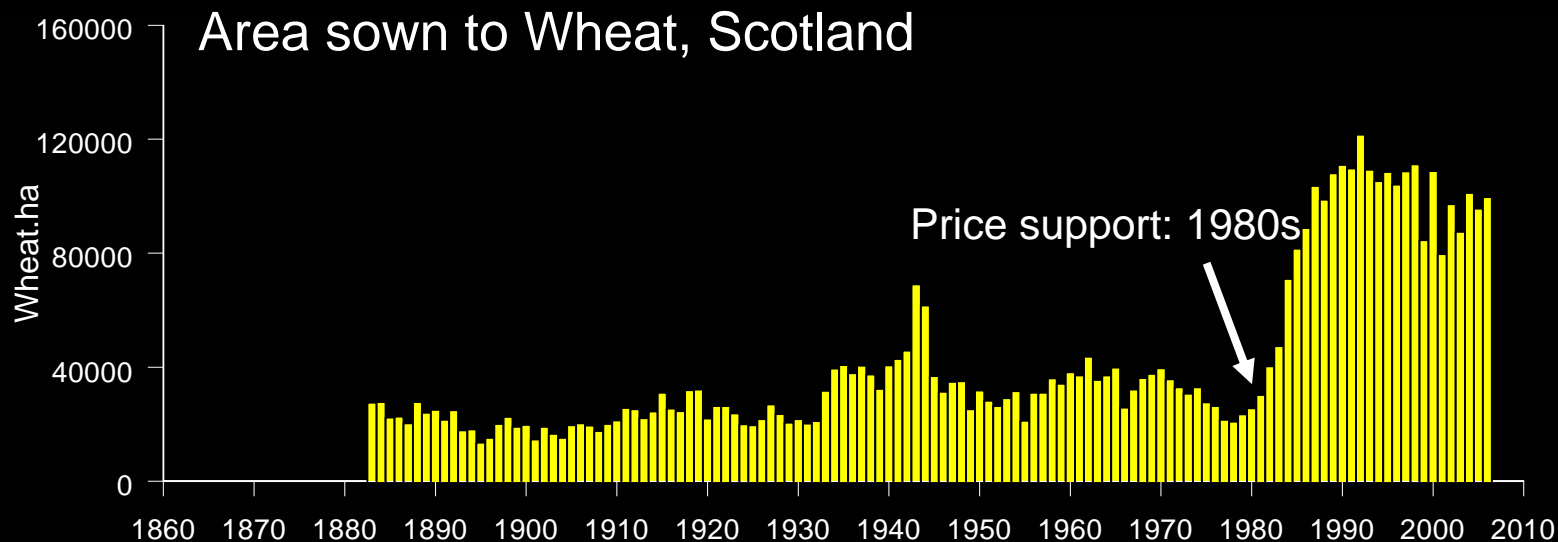
Technological change: Crop breeding: increased yield



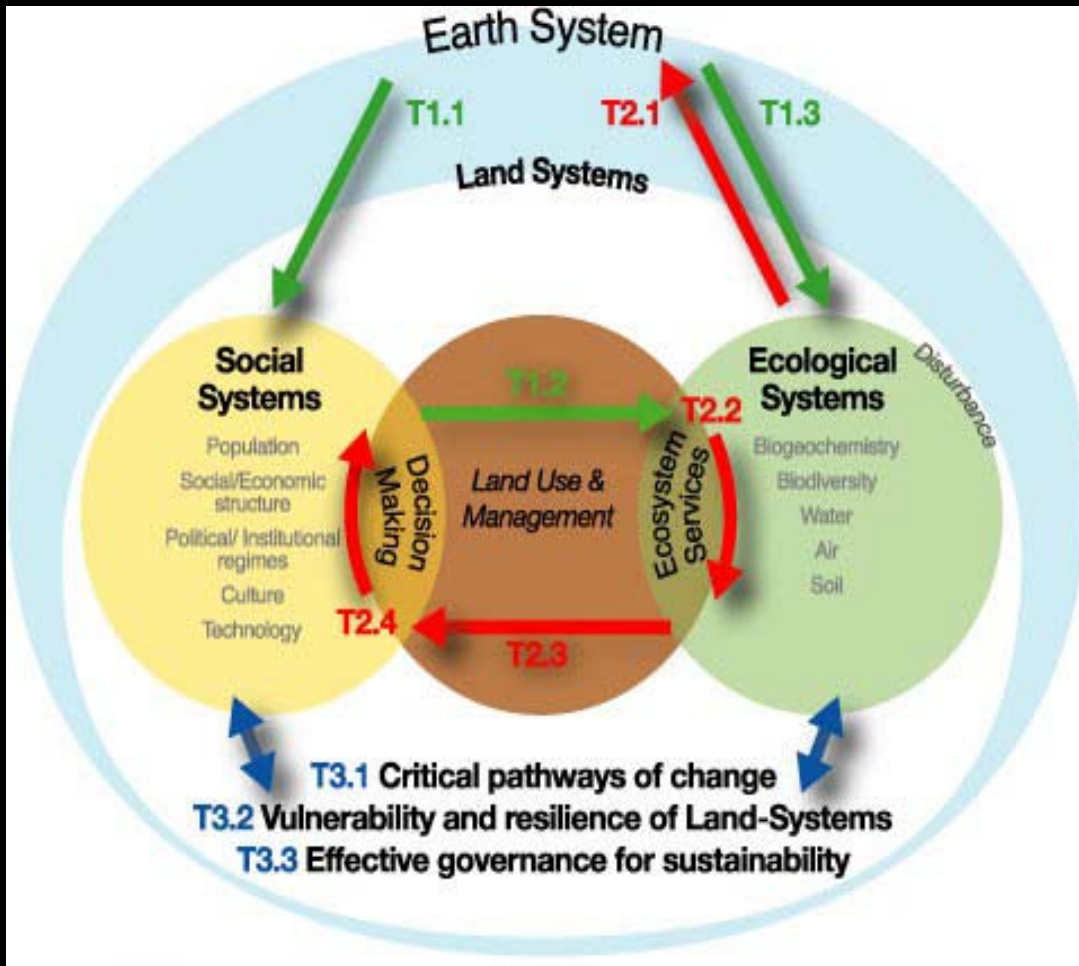
Technological change: Mechanisation of agriculture



Structural/Policy drivers: Common Agricultural Policy

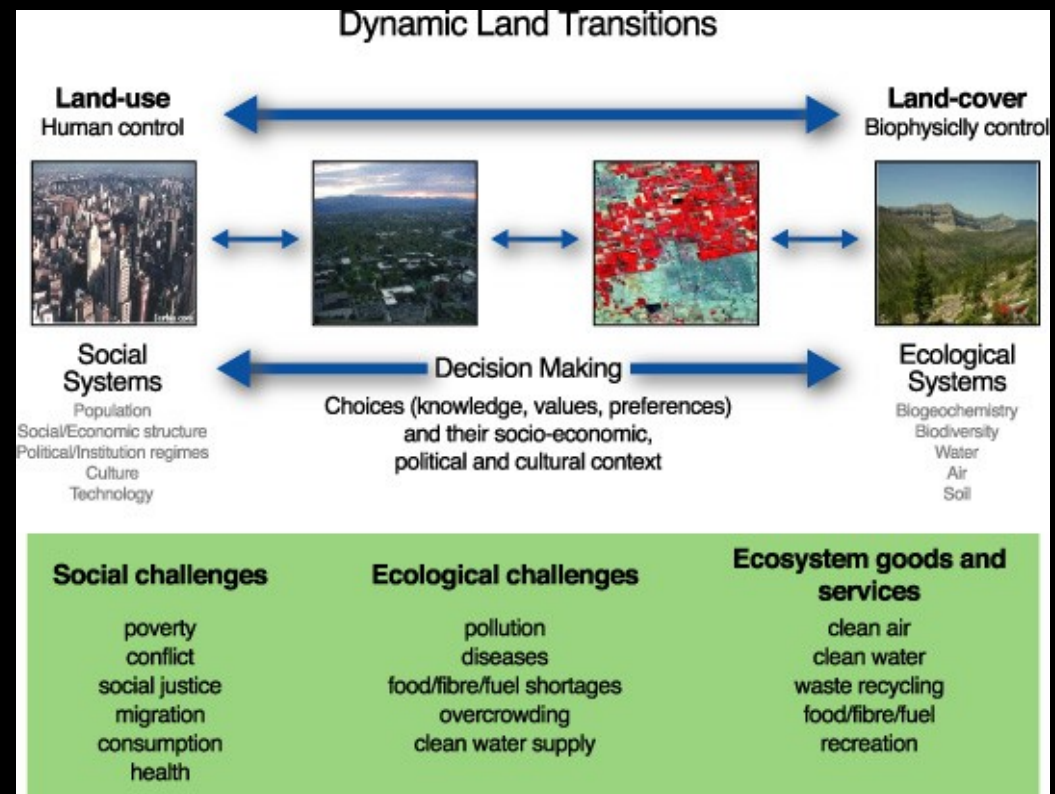


- Innovation
- Diffusion and adoption
- Decision-making



Process dynamics

- Biophysical systems
 - Species dispersal
 - Material cycles
 - Soil formation
 - etc...
- Human systems
 - Innovation
 - Diffusion
 - Decision-making
 - etc...



Additional requirements

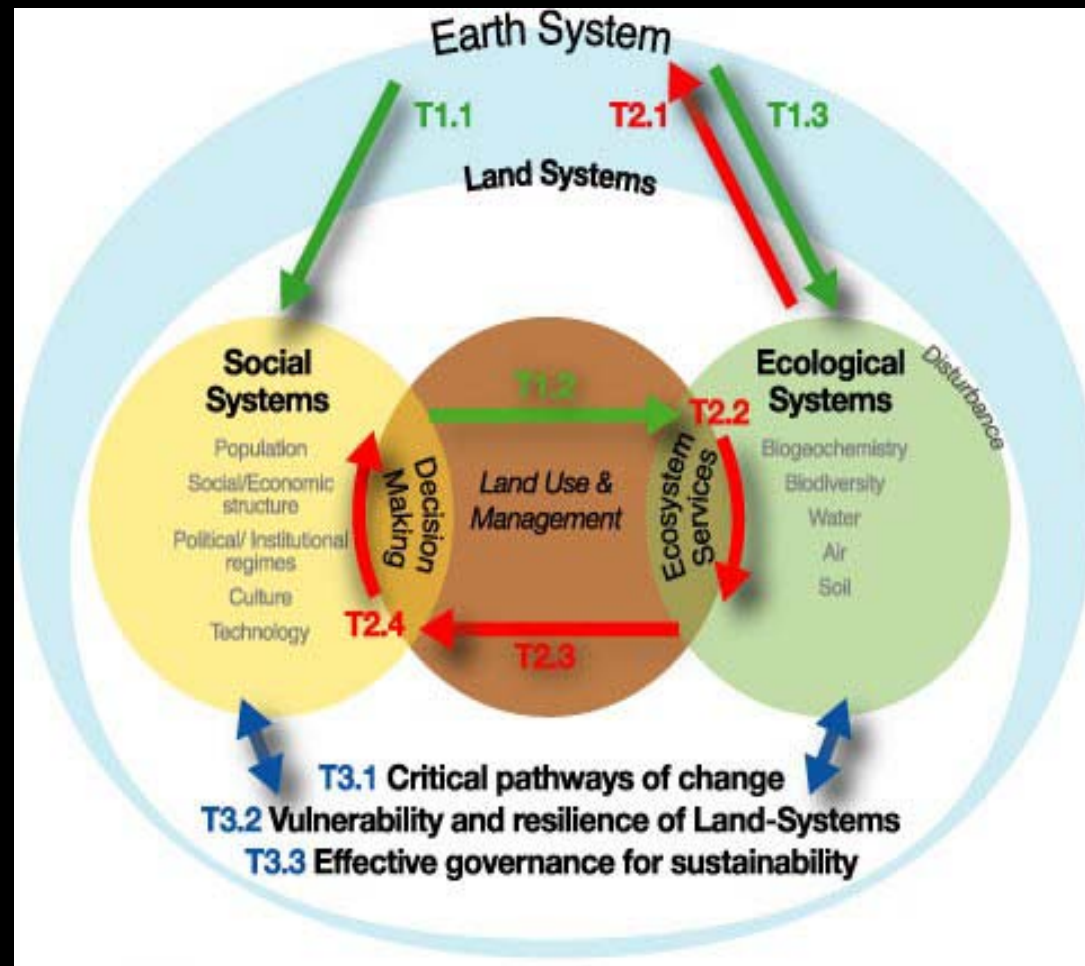
1. Attention to forcing variables
 2. Focus on coupling the subsystems (human and natural)
 3. Efforts directed to modelling coupling variables
-

Forcing variables

- Inputs at the system boundaries
 - Context for change
 - Multi-scale effects (including space, time, organisation, ...)
 - A capacity for adaptation may also be valuable – to represent and detect change in the importance of drivers
-

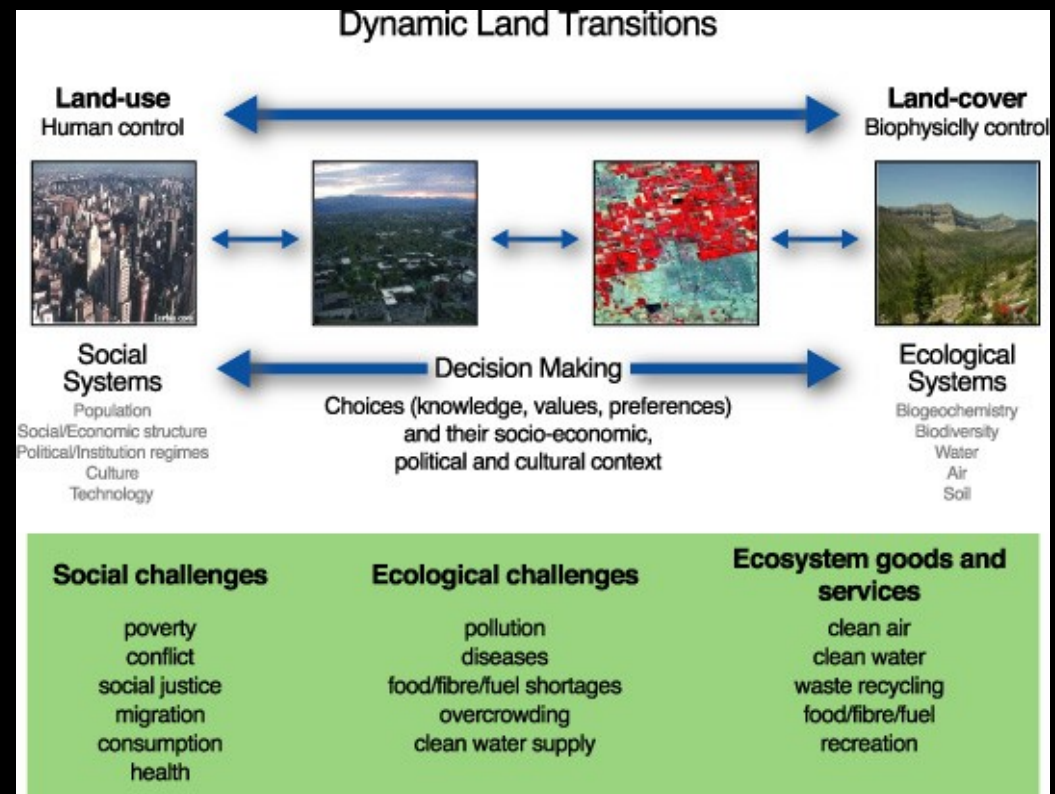
Coupling the subsystems

- Understanding of processes that couple subsystems



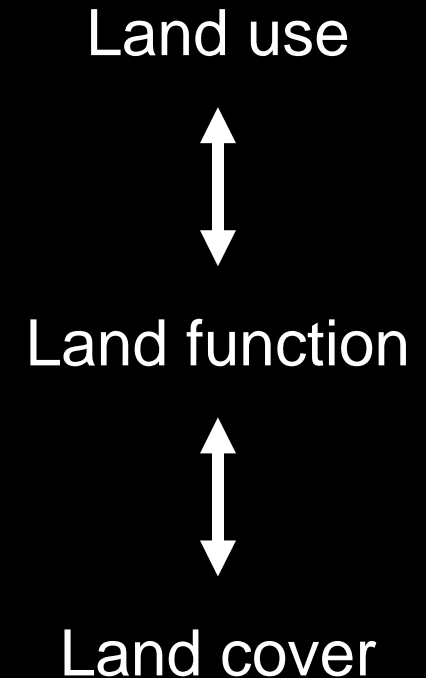
Coupling variables

- Land use
- Land cover
- Ecosystem services
- Land function



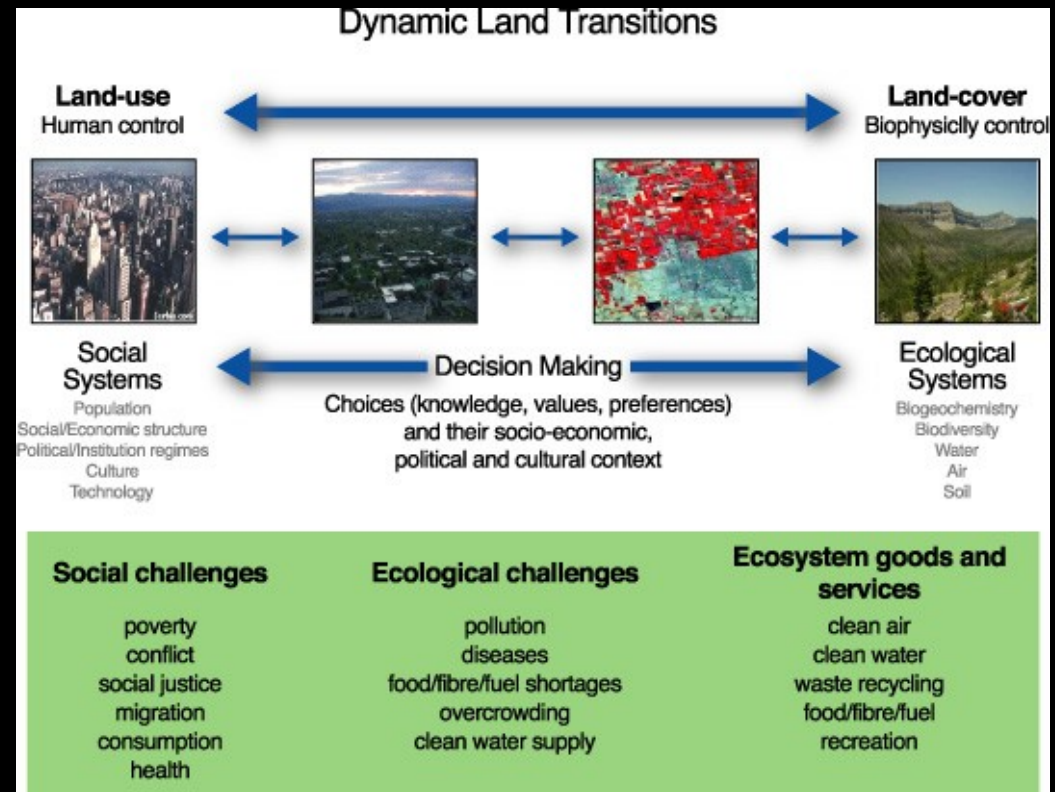
Land functions

- **Economic**
 - Resource and non-land based industries and services
 - Land based production
 - Infrastructure
 - Mobility and transport
 - Housing
 - Places of work
 - ...
- **Social**
 - Provision of work
 - Human health
 - Recreation
 - Cultural-Landscape identity, scenery, cultural heritage
 - Community
 - ...
- **Environmental**
 - Provision of biotic and abiotic resources
 - Support for, and provision, of habitat
 - Maintenance of ecosystem/earth system processes
 - ...



Coupling variables

- Land use
- Land cover
- Ecosystem services
- Land function



Summary

- Develop a process-based approach to human and natural systems
 - Innovation, diffusion, decision-making
 - Hydro-, geo-, atmo-, bio-, litho- sphere processes
 - Focus on
 - Process dynamics
 - Forcing variables
 - Coupling of human and natural subsystems
 - Coupling variables
 - Land use
 - Land cover
 - Land function
 - Ecosystem services
-