

Land Systems, Global Change and Sustainability: Global Land Project  
Open Science Meeting; ASU, Tempe, Arizona, October 17-19, 2010



## Methodology for Adaptation to Climate Change: Future Management of Trade-offs in Agricultural Production vs. Water Quality in Korea

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And Members of the TERRECO Project



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YONSEI UNIVERSITY



HELMHOLTZ  
ZENTRUM FÜR  
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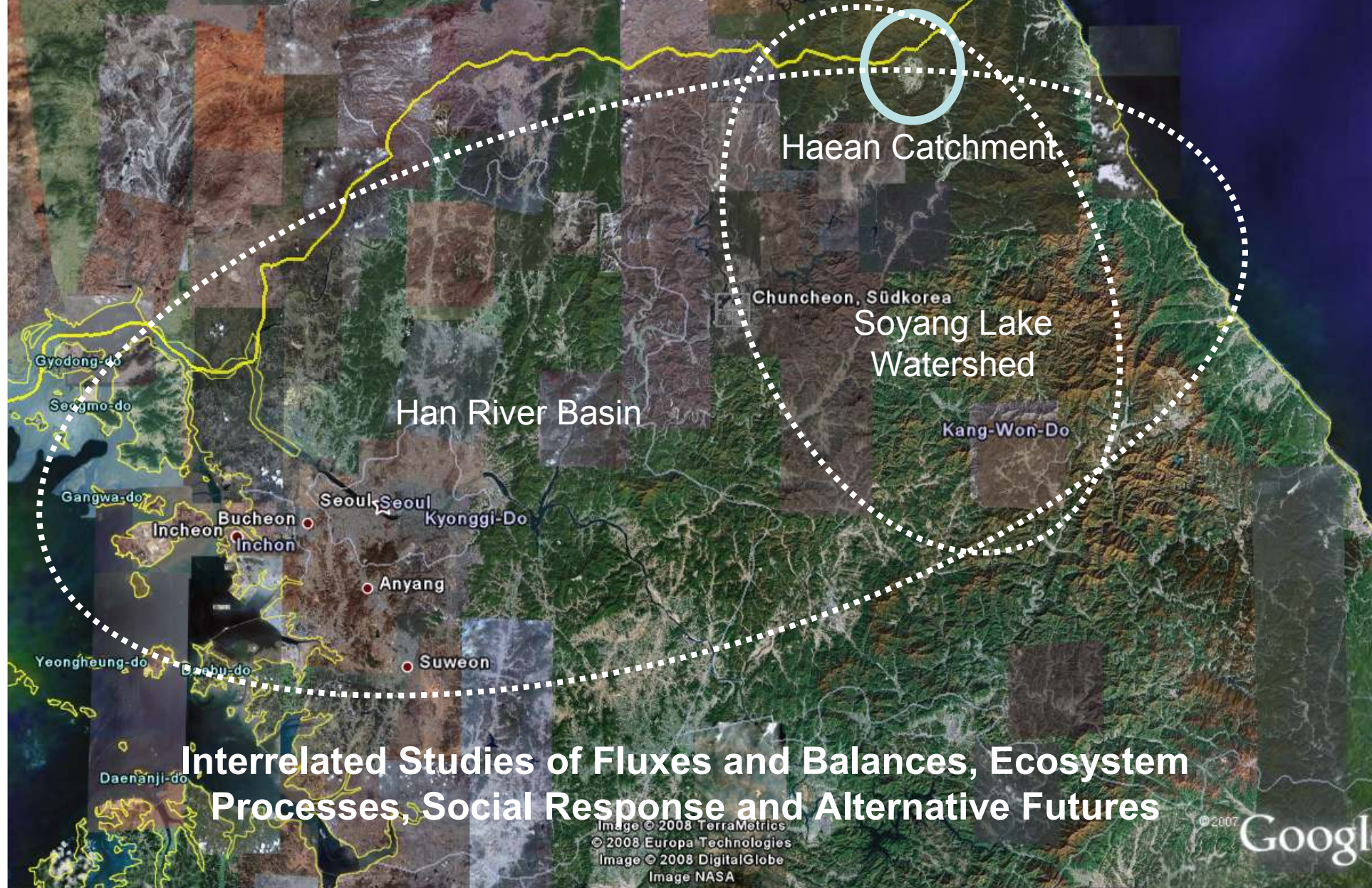


## **TERRECO – A program in:**

### **International education and exchange**

- Phase 1: financed from March 2009 until August 2013
- Phase 2: possible until February 2018
- Participants: ca. 20 scientists in Bayreuth and ca. 20 scientists in Korea plus doctoral students
- **A potential to influence 70 to 80 young scientists capable in resource management under global change**

# Complex Terrain and Ecological Heterogeneity (TERRECO) - A project at landscape to regional scale



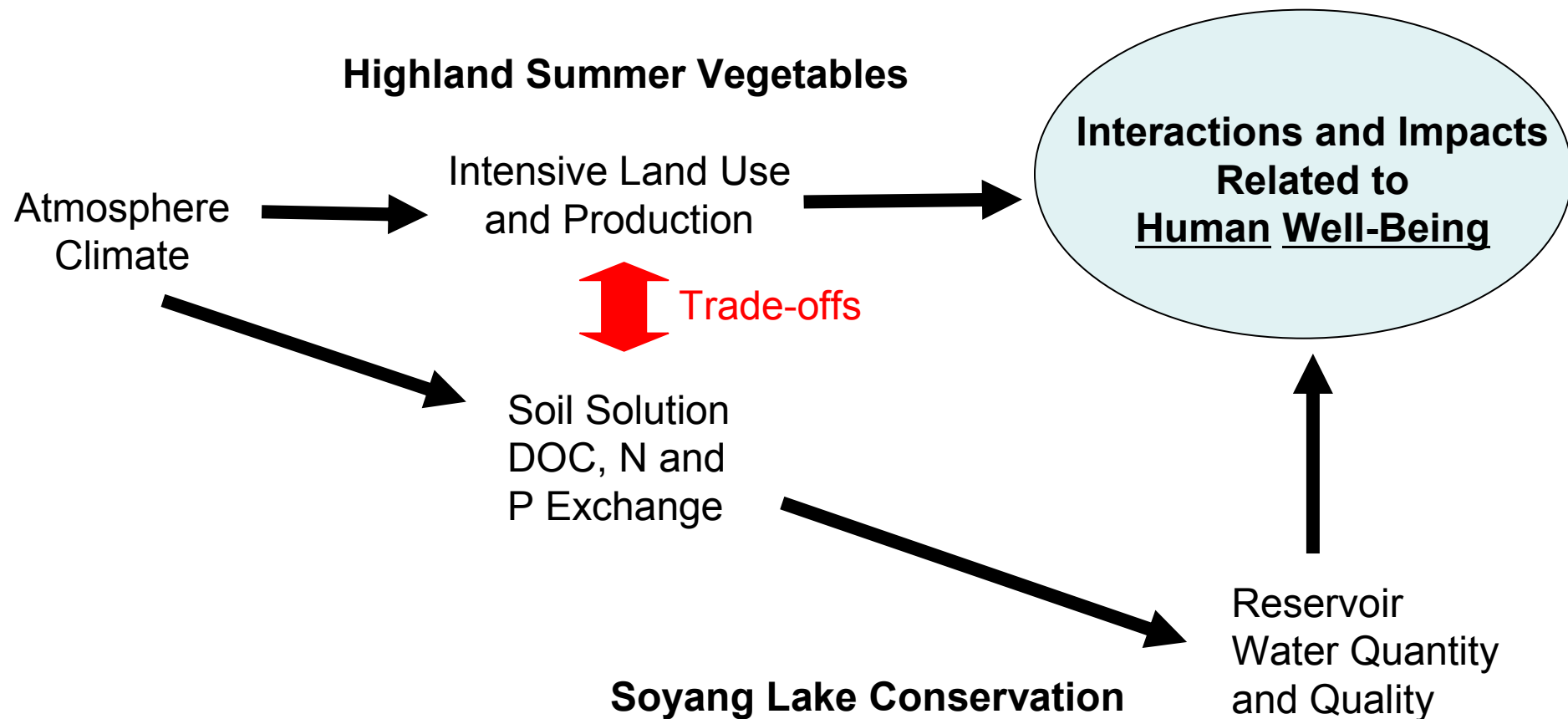
Interrelated Studies of Fluxes and Balances, Ecosystem Processes, Social Response and Alternative Futures

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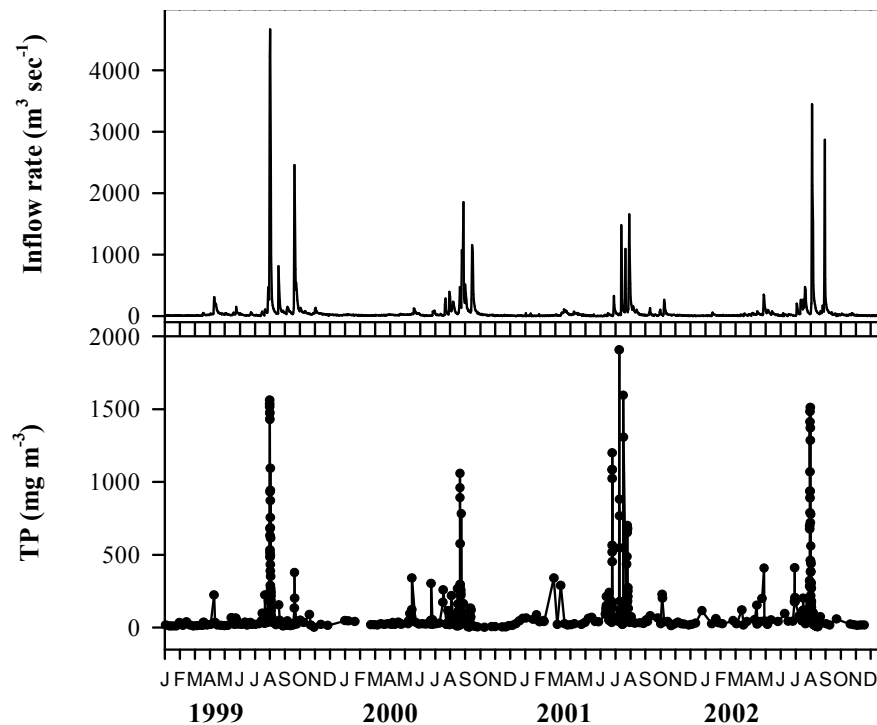
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## TERRECO: A Social-Ecological Analysis of Trade-offs in Ecosystem Services

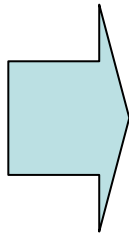


# Complex Terrain and Ecological Heterogeneity (TERRECO) - A question requiring social-ecological analysis

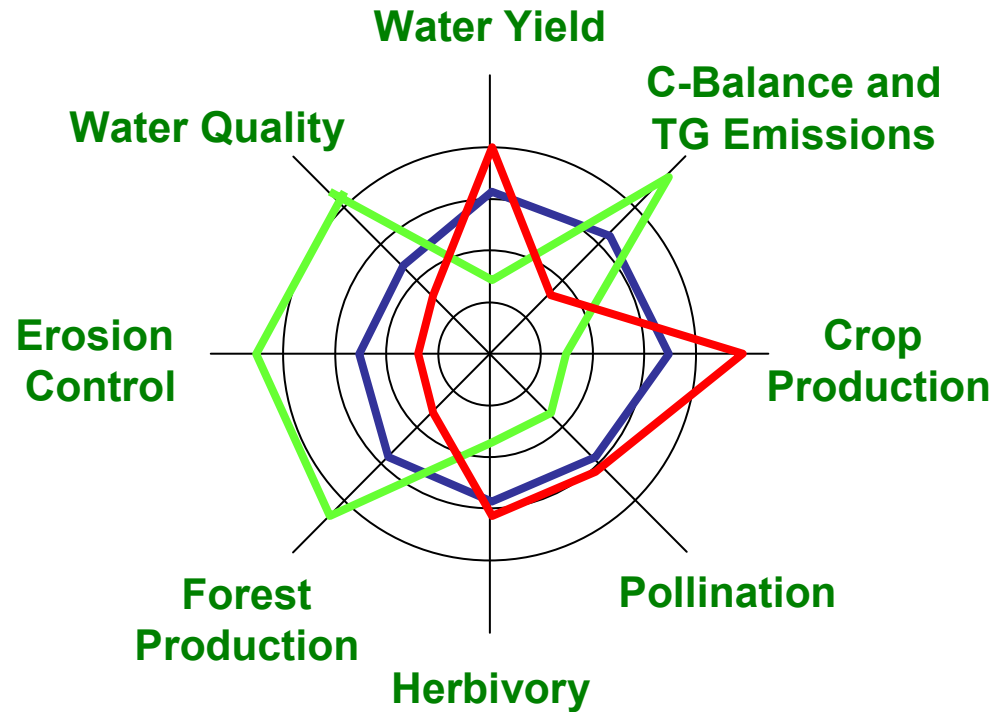


# Evaluation of Ecosystem Services

## Evaluations via models:



Trade-offs in  
Production vs.  
Water Yield and  
Water Quality



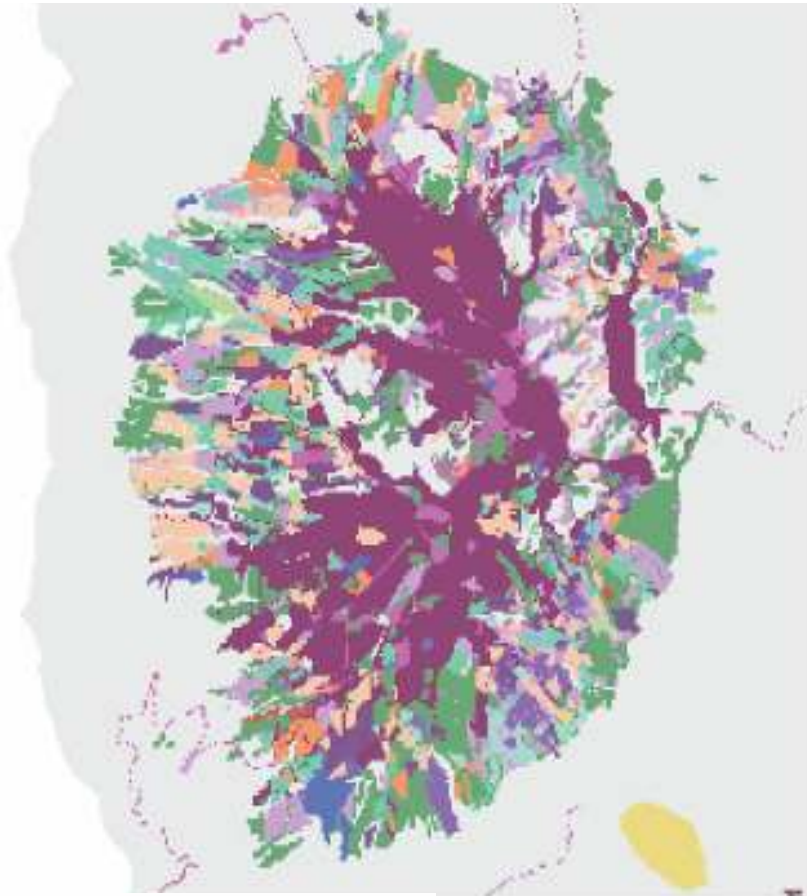
### Performance:

Forested Catchment

Agricultural Catchment

Regional Mean

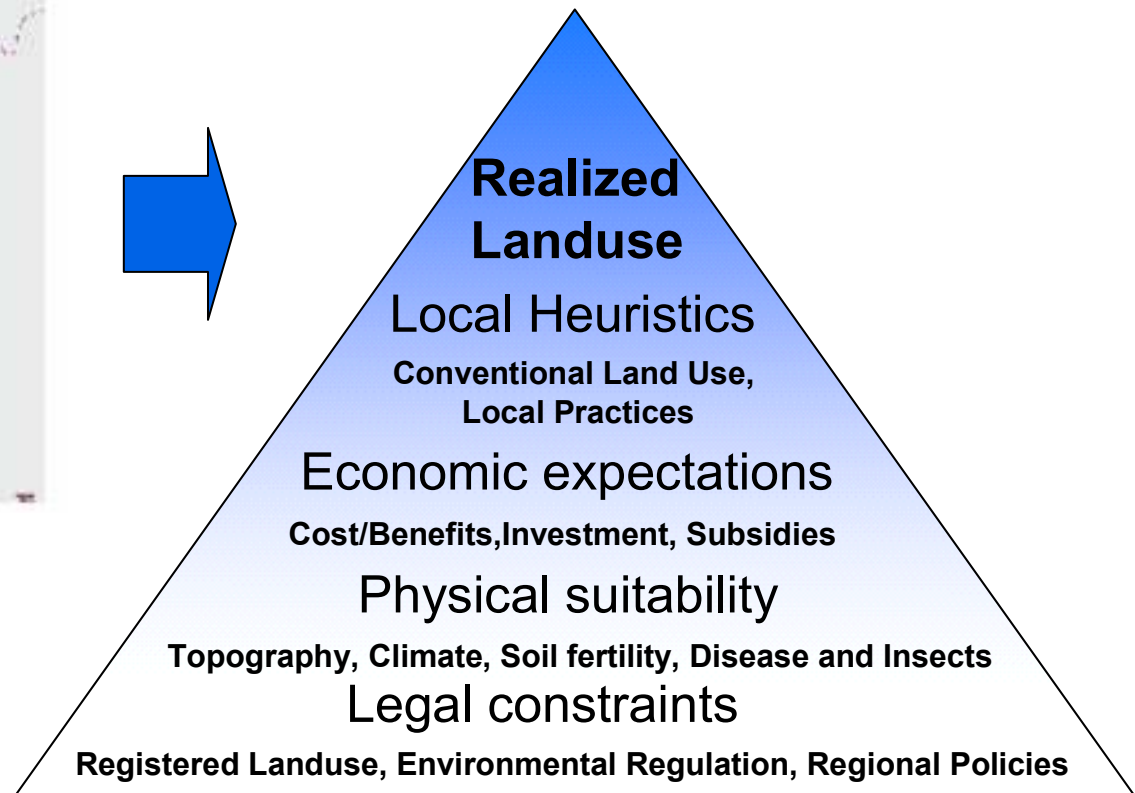
# Haean Abstracted Functional Landuse



- |                   |  |            |
|-------------------|--|------------|
| Feature_          |  |            |
| Inland water      |  | Cabbage    |
| Deciduous Forest  |  | Ocean      |
| Coniferous Forest |  | Orchard    |
| Barren            |  | Radish     |
| Mixed Forest      |  | Potato     |
| Urban             |  | Bean       |
| C3 grasses        |  | Maize      |
| Rice paddy        |  | Codonopsis |
| Inland wetland    |  | Ginseng    |
|                   |  | Pepper     |

## Ongoing Development of a Probabilistic LULC Extrapolation Tool

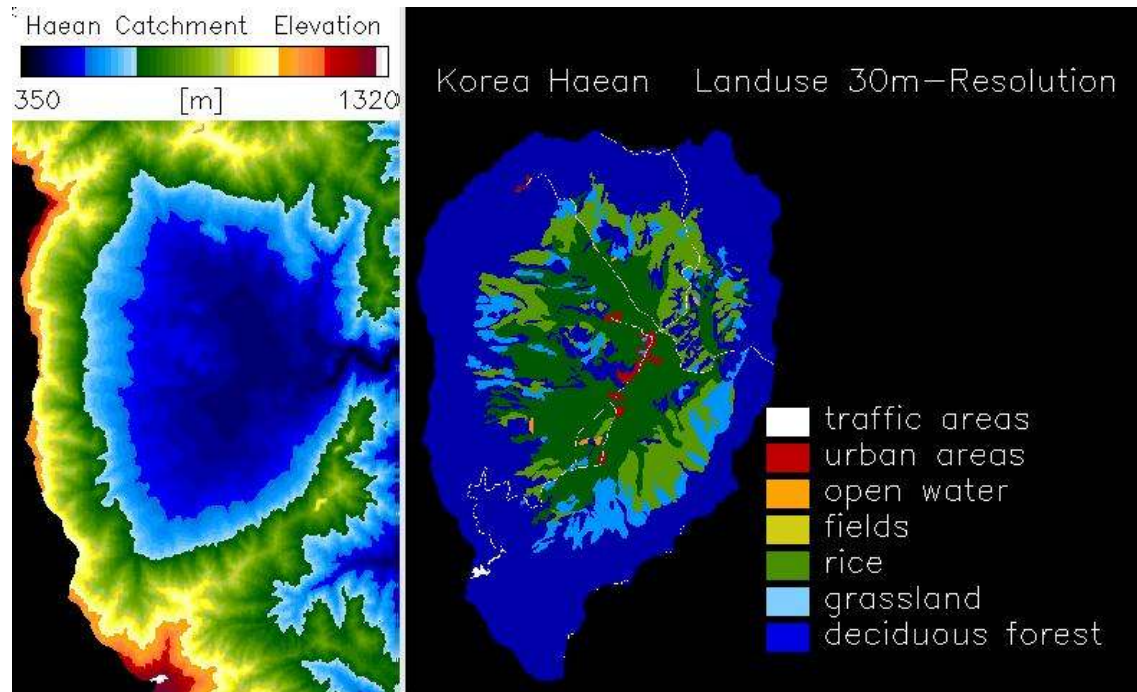
Seo et al.



# Initial Scales of Study

Haean Catchment - field studies and model testing

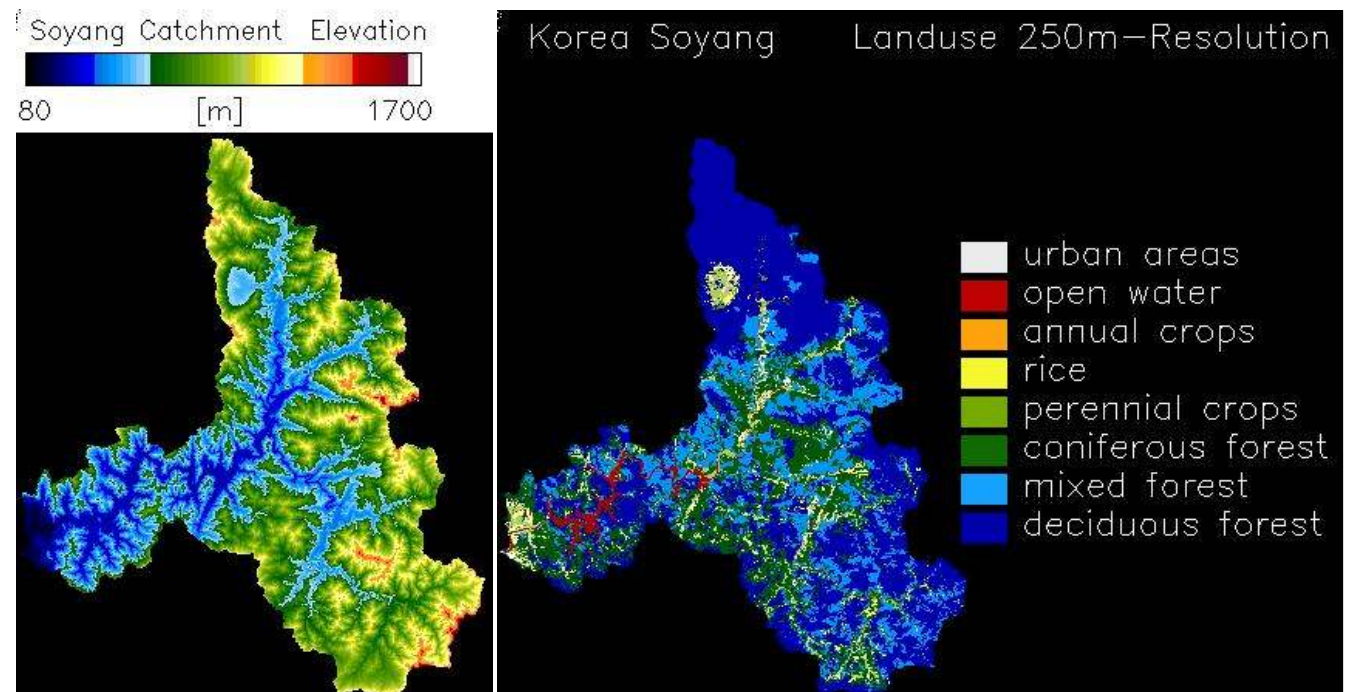
60 km<sup>2</sup>  
30 m resolution



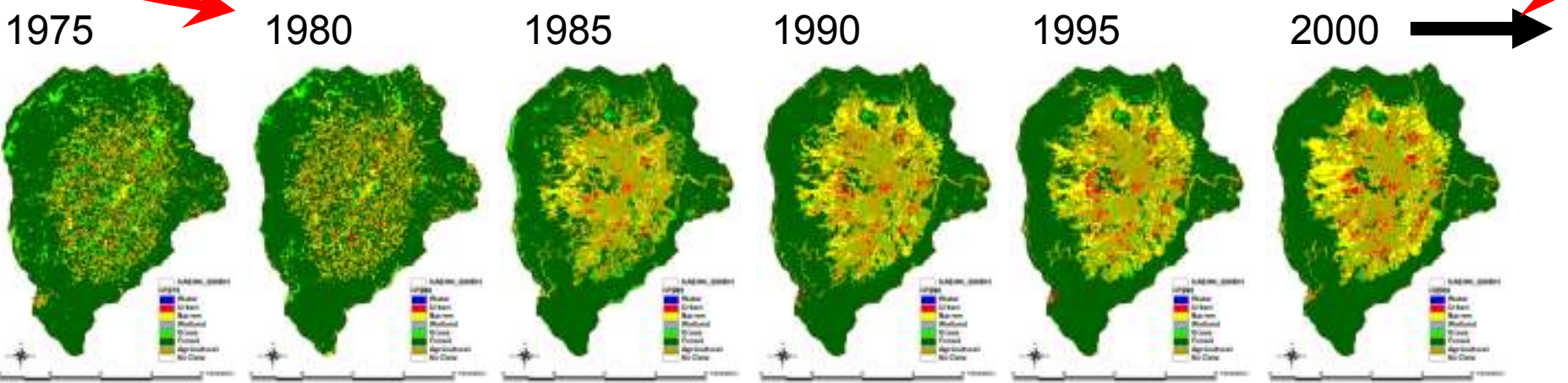
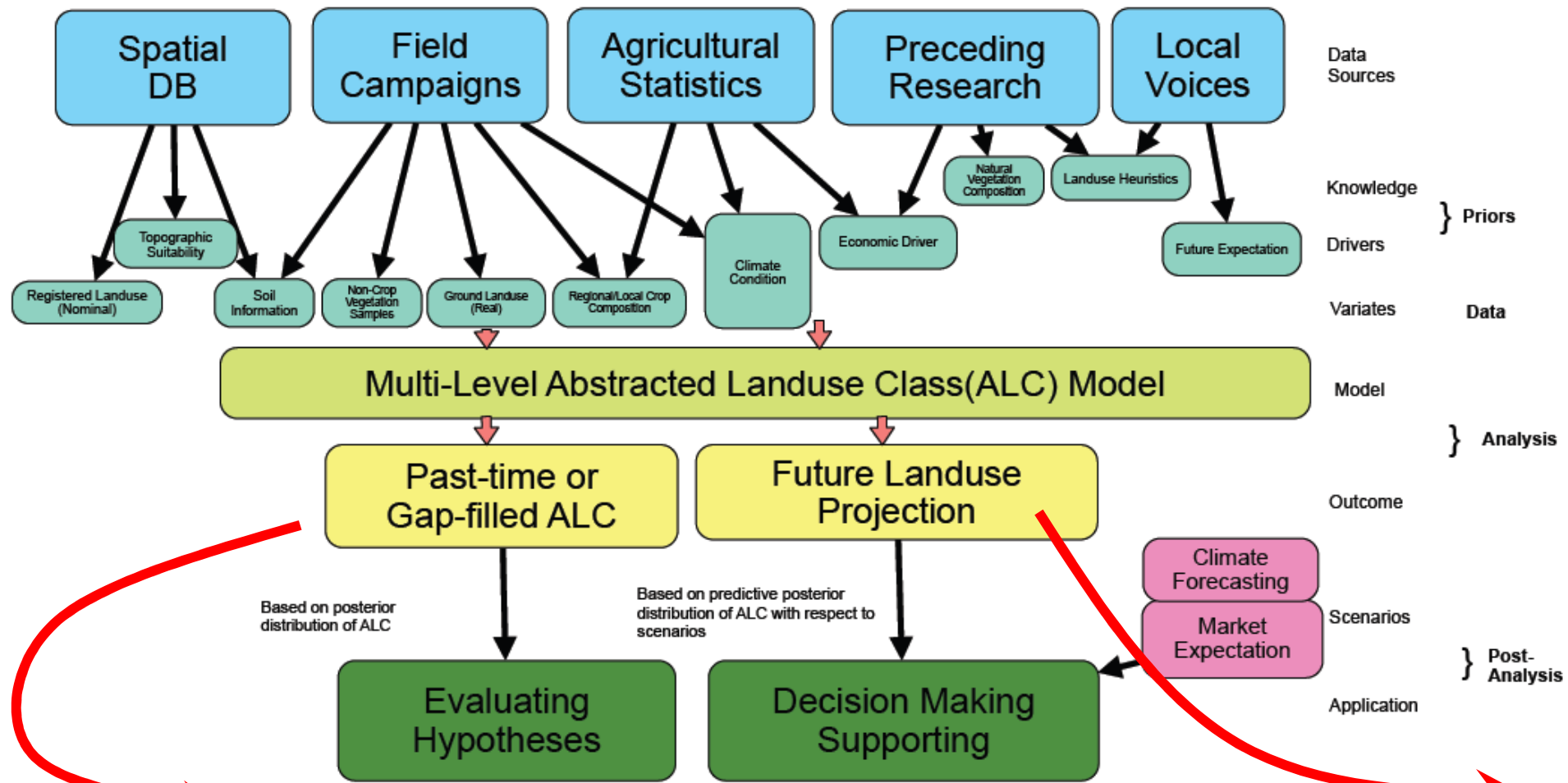
## Soyang Lake Watershed

integrated unit for water resource, economic, and policy evaluations

2800 km<sup>2</sup>  
250 m resolution





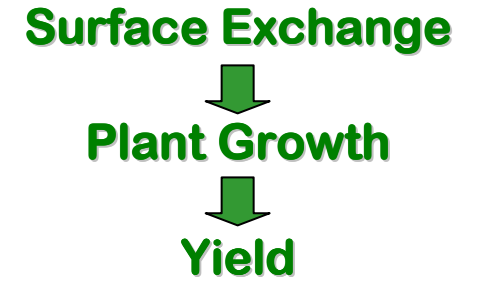
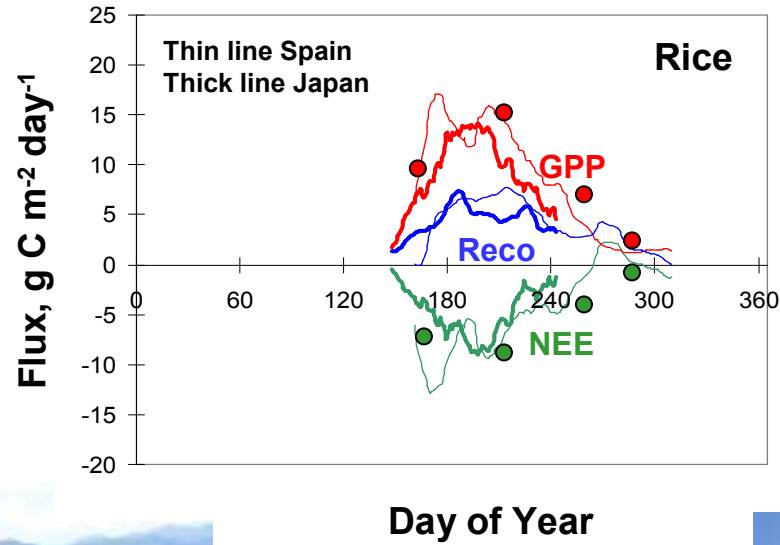




## Local Field Studies to Support Modelling

1. Land use from year to year – and local decision making
2. Climate controls on carbon uptake and crop growth and yields
3. Fertilizer inputs and agricultural efficiencies
4. Insect pests and new ways for biological control
5. Occurrence and preservation of valued bird populations
6. Understanding water flows in the Haean landscape
7. Water use, hydrology and transport of materials with respect to preservation of Soyang Lake
8. Understanding local stakeholder thinking and interests

[www.bayceer.uni-bayreuth.de/terreco](http://www.bayceer.uni-bayreuth.de/terreco)



## Monsoon Runoff Monitoring



## Infiltration and Preferential Flow Paths



[www.bayceer.uni-bayreuth.de/terreco](http://www.bayceer.uni-bayreuth.de/terreco)



## Flows and biogeochemistry in Haean catchment

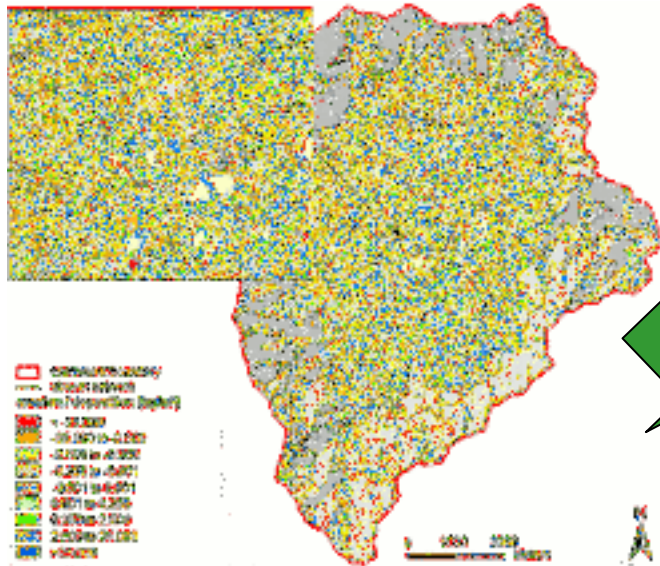


**Establishment of piezometer transects**

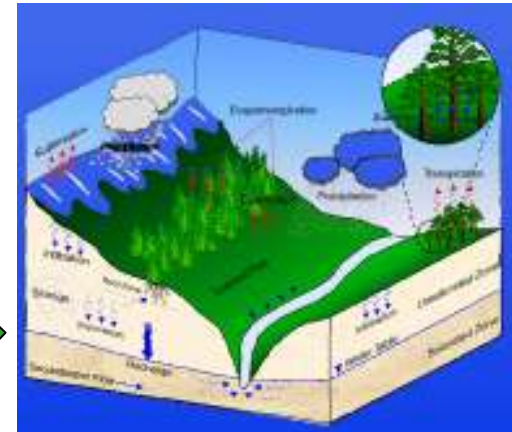


# Production/Hydrological Framework:

**EROSION-3D**

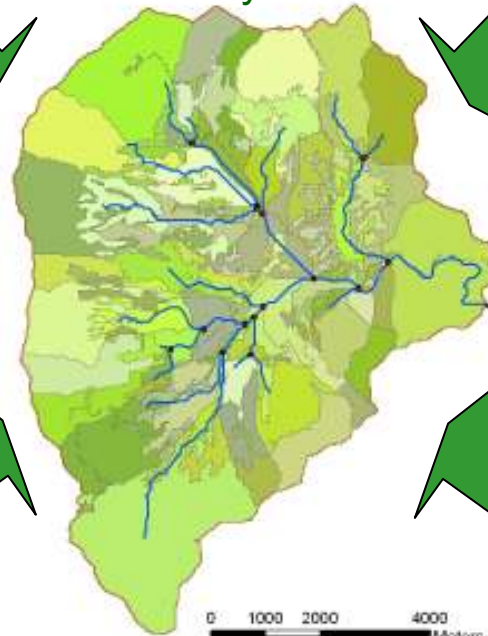


**HydroGeoSphere**

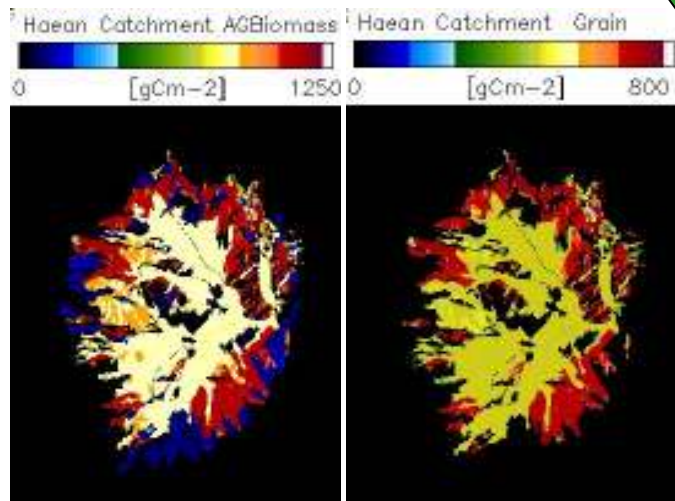


**SWAT<sub>2005</sub>**

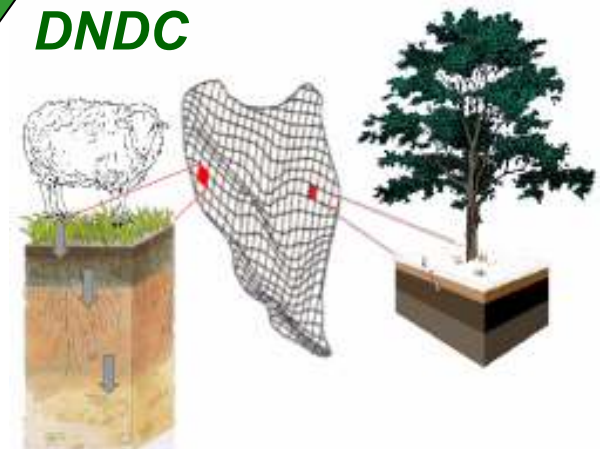
Production, HRU response,  
River System



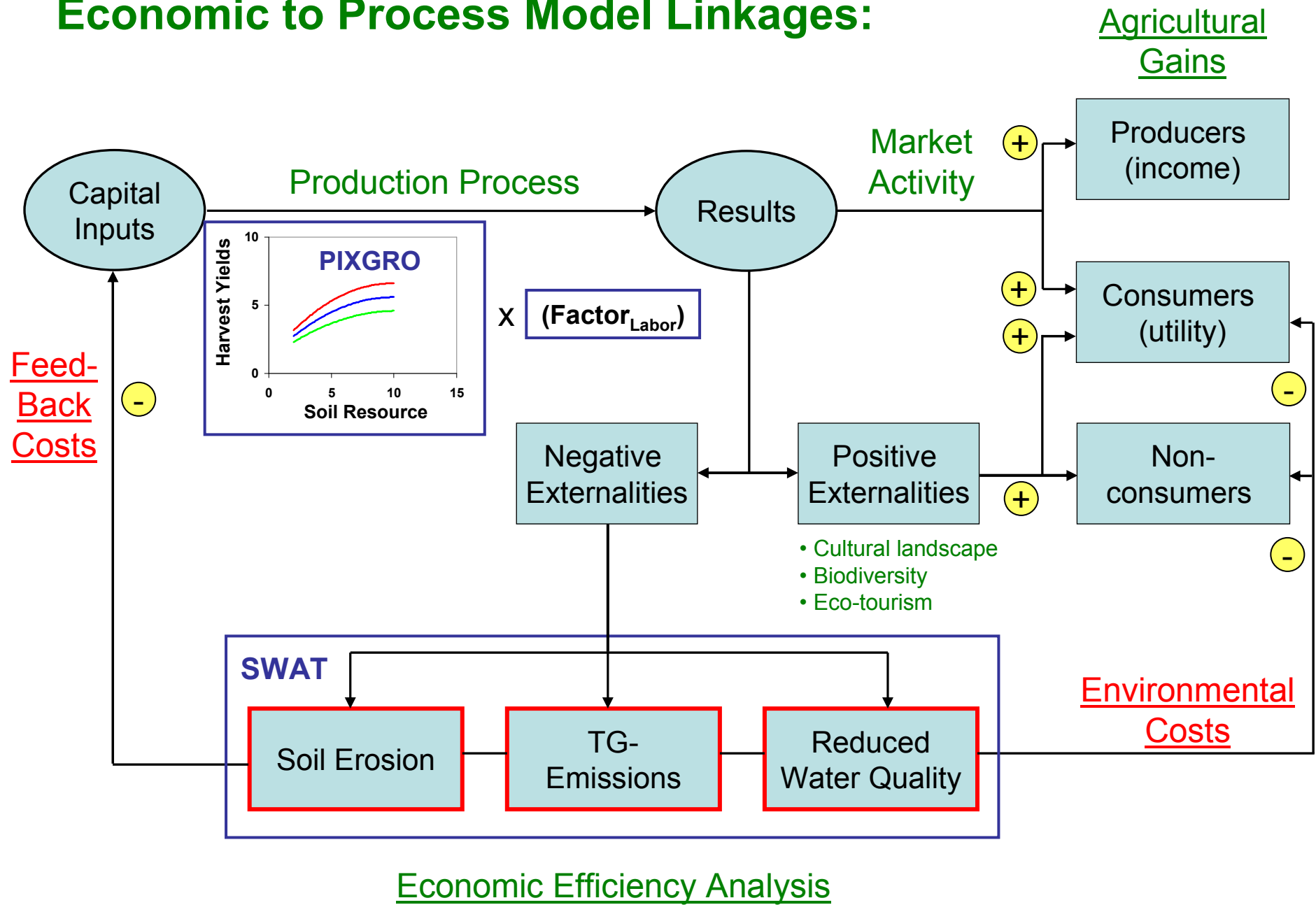
**PIXGRO**



**DNDC**



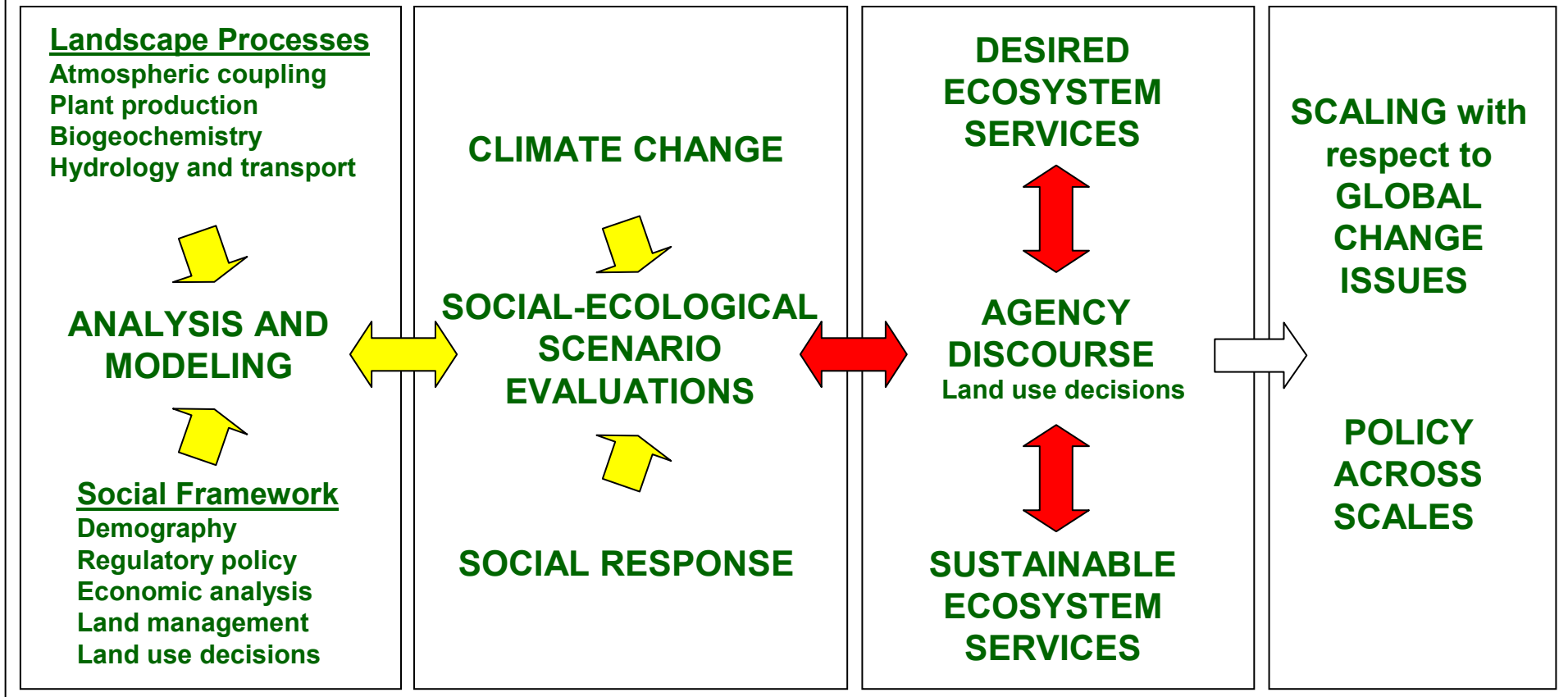
# Economic to Process Model Linkages:



# Agency Discourse and Scenario Development



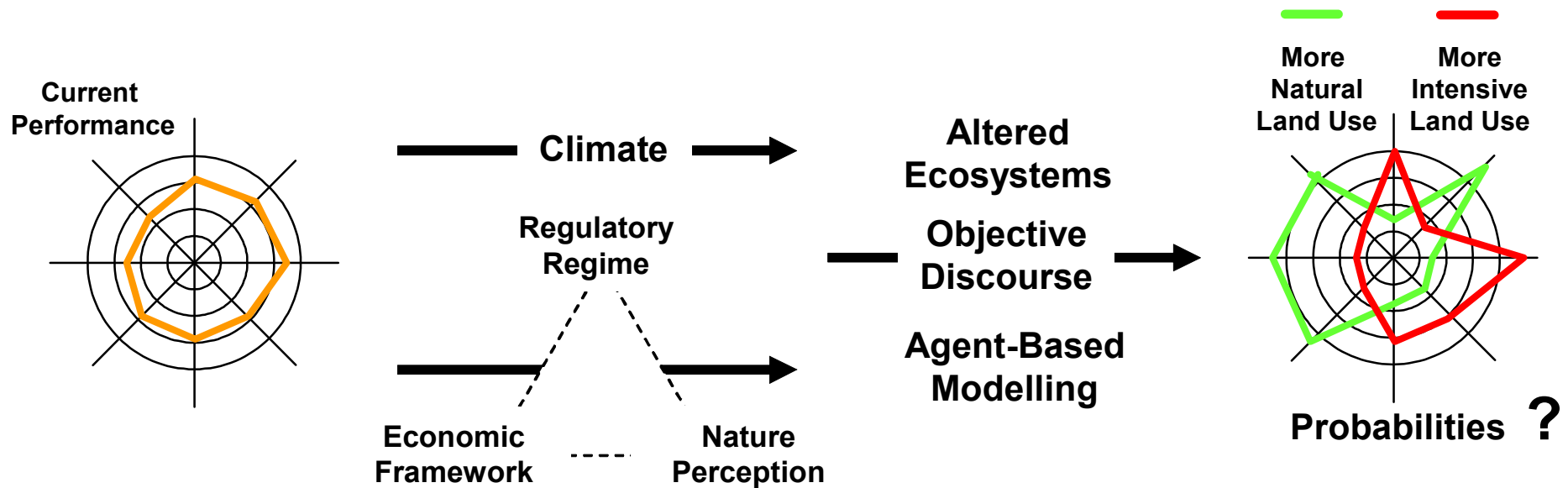
## Complex Terrain and Ecological Heterogeneity (TERRECO)





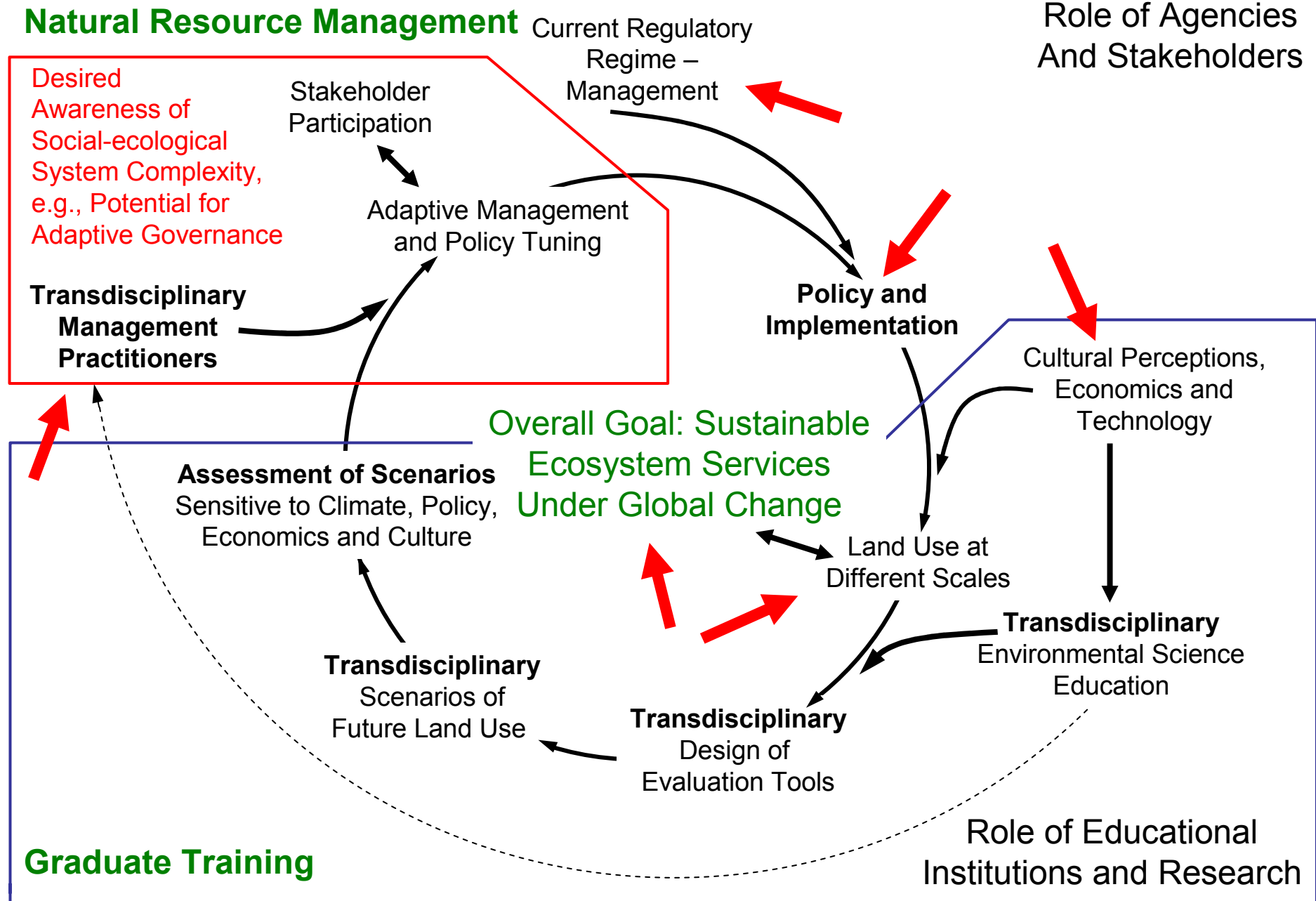


## Social – Ecological Analysis Ultimately, A Focus on Scenario Evaluations



Development of Scenarios: Future Climate and Land Use  
Fertilizer and pesticide reduction, subsidies for land use with erosion control, new pricing of clean water supply, modification of water distribution . . . even reunification (?)

# The Vision for Social-Ecohydrological Analyses





## Conclusions:

Vulnerability/sustainability assessments and resource planning in large river basins require multi-dimensional tools and transdisciplinary study.

Case studies that permit learning by doing are essential for problem solving and developing new approaches. Selection of scale is a critical decision.

Ecosystem service oriented approaches require experimentation and integration in appropriately constructed models across time and space scales. Data and conceptual compatibility across disciplines is THE challenge – how do we support both natural and social science objectives.