THE TALANOA APPROACH:

HYDROLOGIC-MICROECONOMIC MODELLING SYSTEM

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SESSION 1: MULTI-SYSTEM MODELING FRAMEWORK

THE TALANOA APPROACH

Centro Euro-Mediterraneo sui Cambiamenti Climatici

Colorado River Basin, US

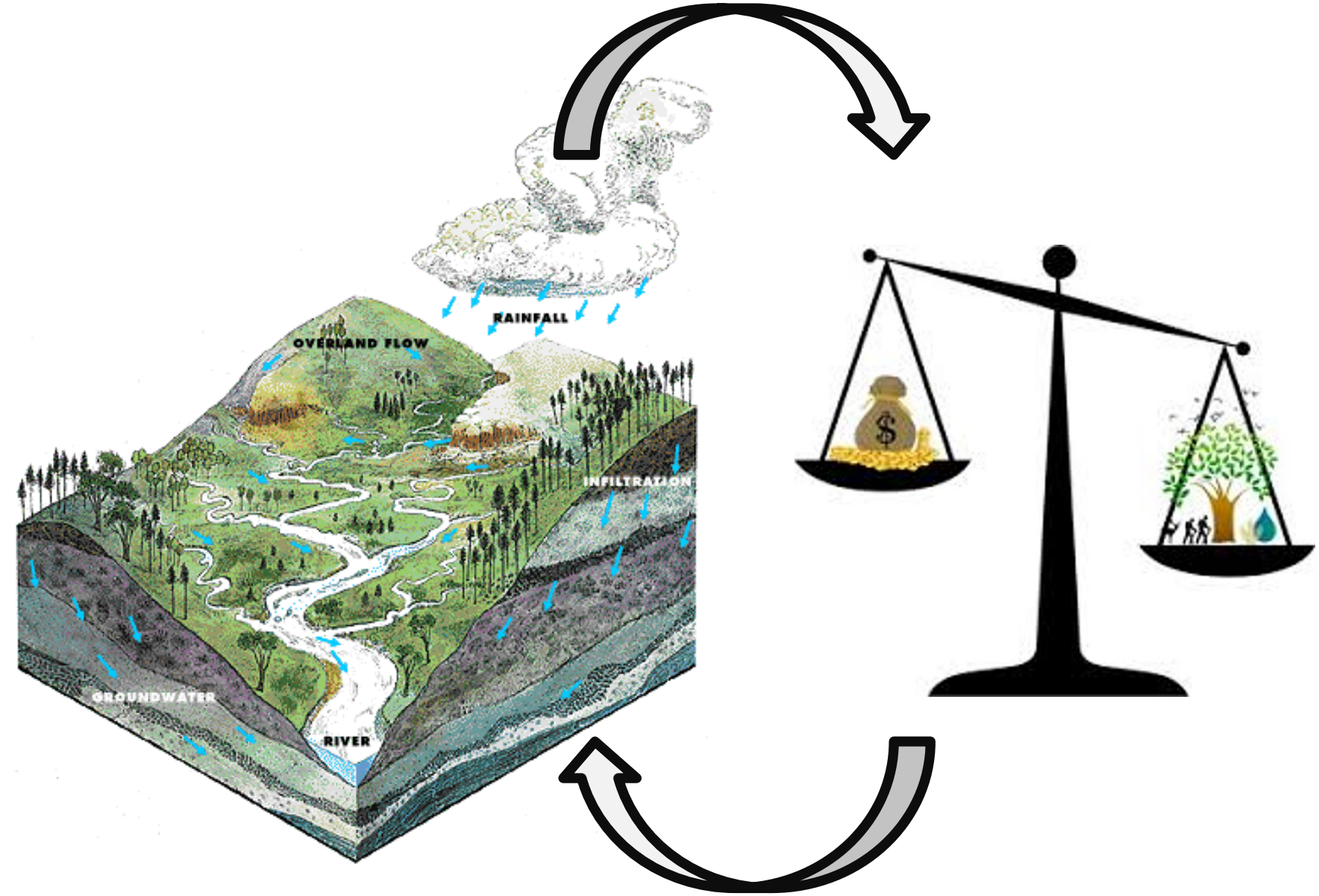
"Too many natural scientists embrace the comforting assumption that nature can be studied, indeed should be studied, in isolation from the human world, with people as mere observers."

Editorial in The Economist, May 26th 2011

INTRODUCTION

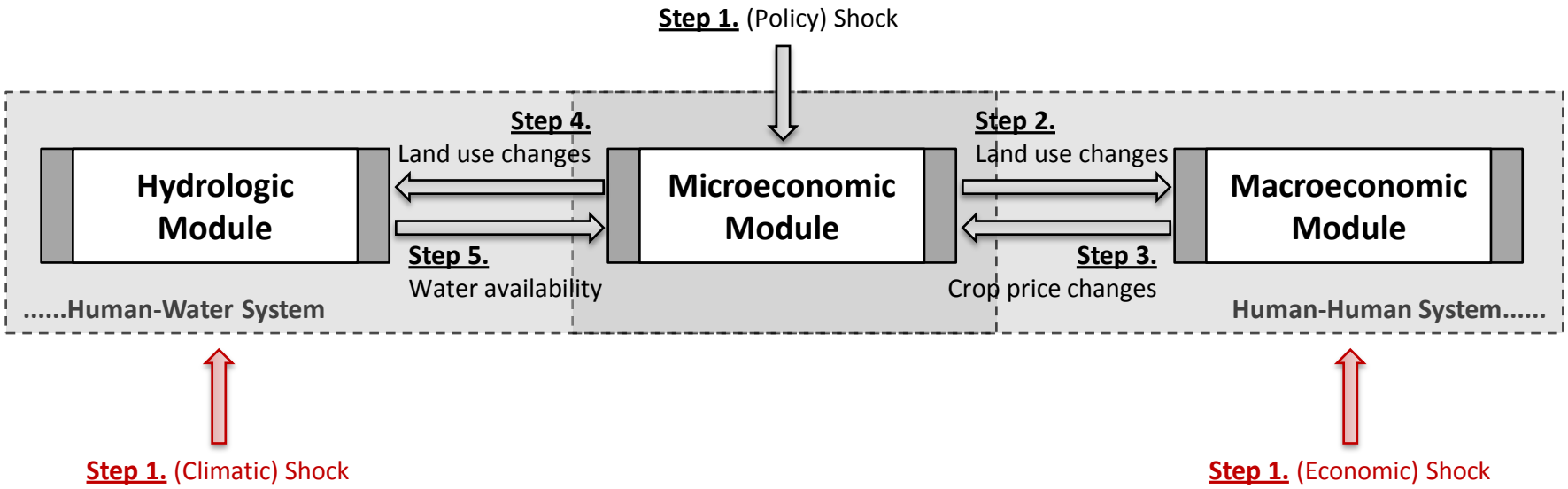
- Water is fundamental for geophysical, ecological and socio-economic systems
- Water connects nature and humans:
  - Social-ecological system *(Berkes & Folke, 1998)*
  - Anthropocene *(Crutzen, 2002)*
  - Socio-hydrology *(Sivapalan et al., 2012)*
- In this context, economic principles and policy instruments offer a means of managing water resources in complex human-water systems.

However…


RAINFALL
OVERLAND FLOW
INFILTRATION
GROUNDWATER
RIVER
$

INTRODUCTION

– Integrating impacts and responses from/to water systems into the multi-system modelling framework



INTRODUCTION

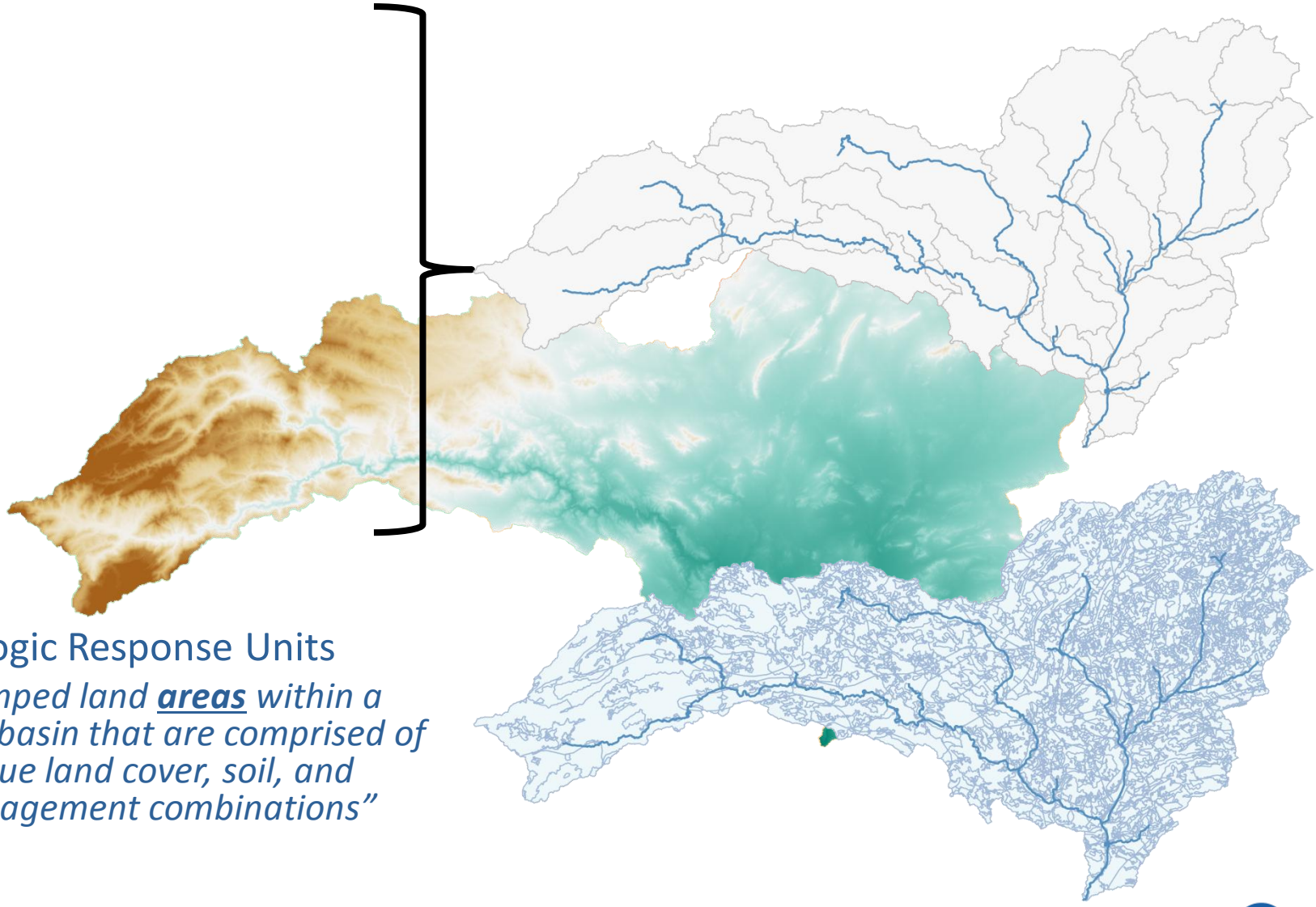
HYDROLOGIC MODELS

- **Definition:**
  - (Mathematical) constructs to simulate the **water cycle** of **hydrologic-defined units**
- **Capabilities:**
  - Estimate **surface runoff**, **reservoir management**, **groundwater** dynamics, etc.
- **Limitations:**
  - Human impacts on the environment are considered as external forcings;
  - No feedback from the human system.

MICROECONOMICS MODELS

- **Definition:**
  - Branch of economics that studies the **behaviour** of agents in **decision-making** with respect to the **allocation of resources**.
- **Capabilities:**
  - Estimate the relationship between of **crop portfolio**, **land management**, revenues, and costs.
- **Limitations:**
  - No impacts of the human system on the environment (intrinsic);
  - No feedback from the natural system.

METHODOLOGY – SWAT

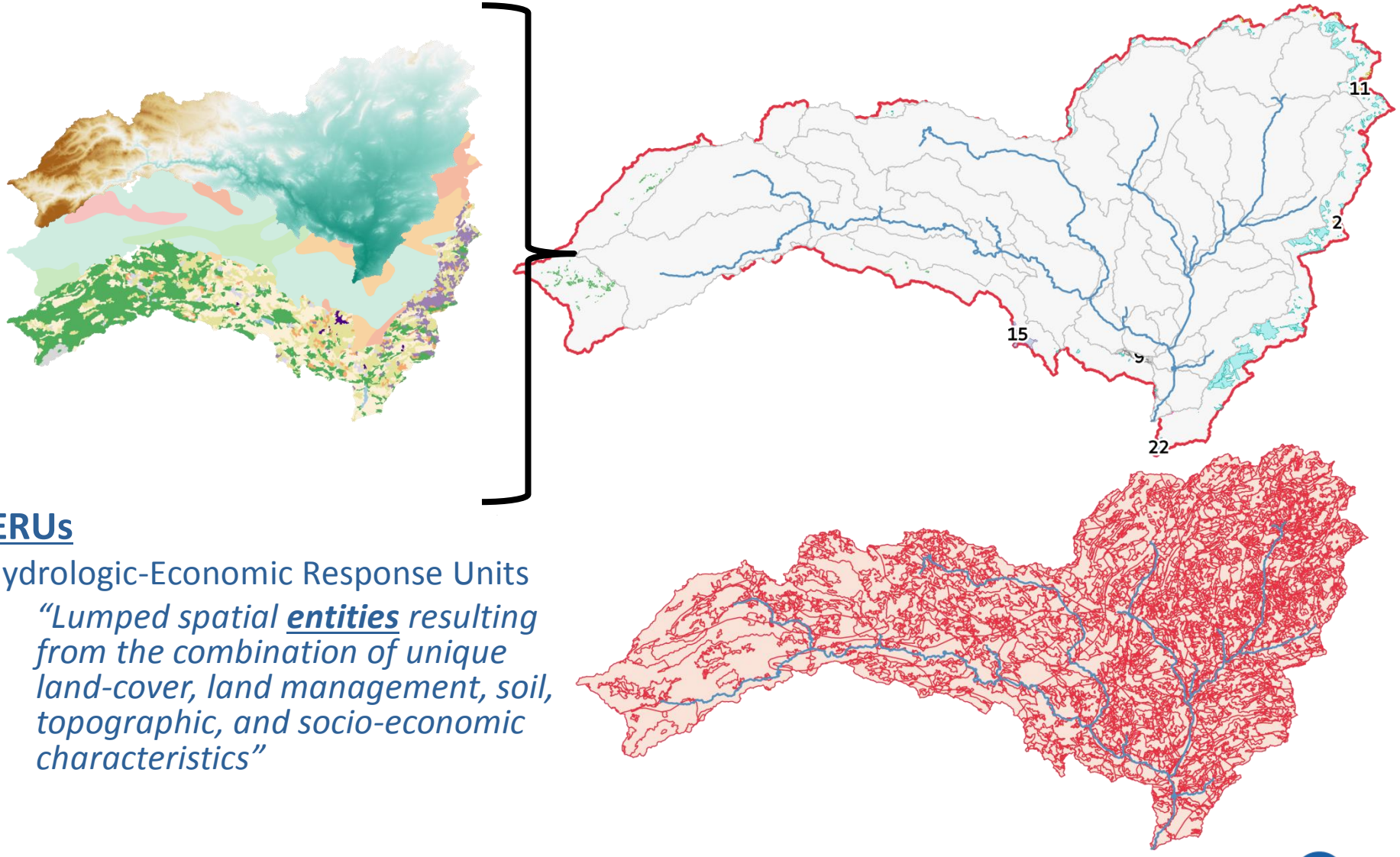


HRUs

Hydrologic Response Units

*"Lumped land **areas** within a sub-basin that are comprised of unique land cover, soil, and management combinations"*

METHODOLOGY – TALANOA APPROACH

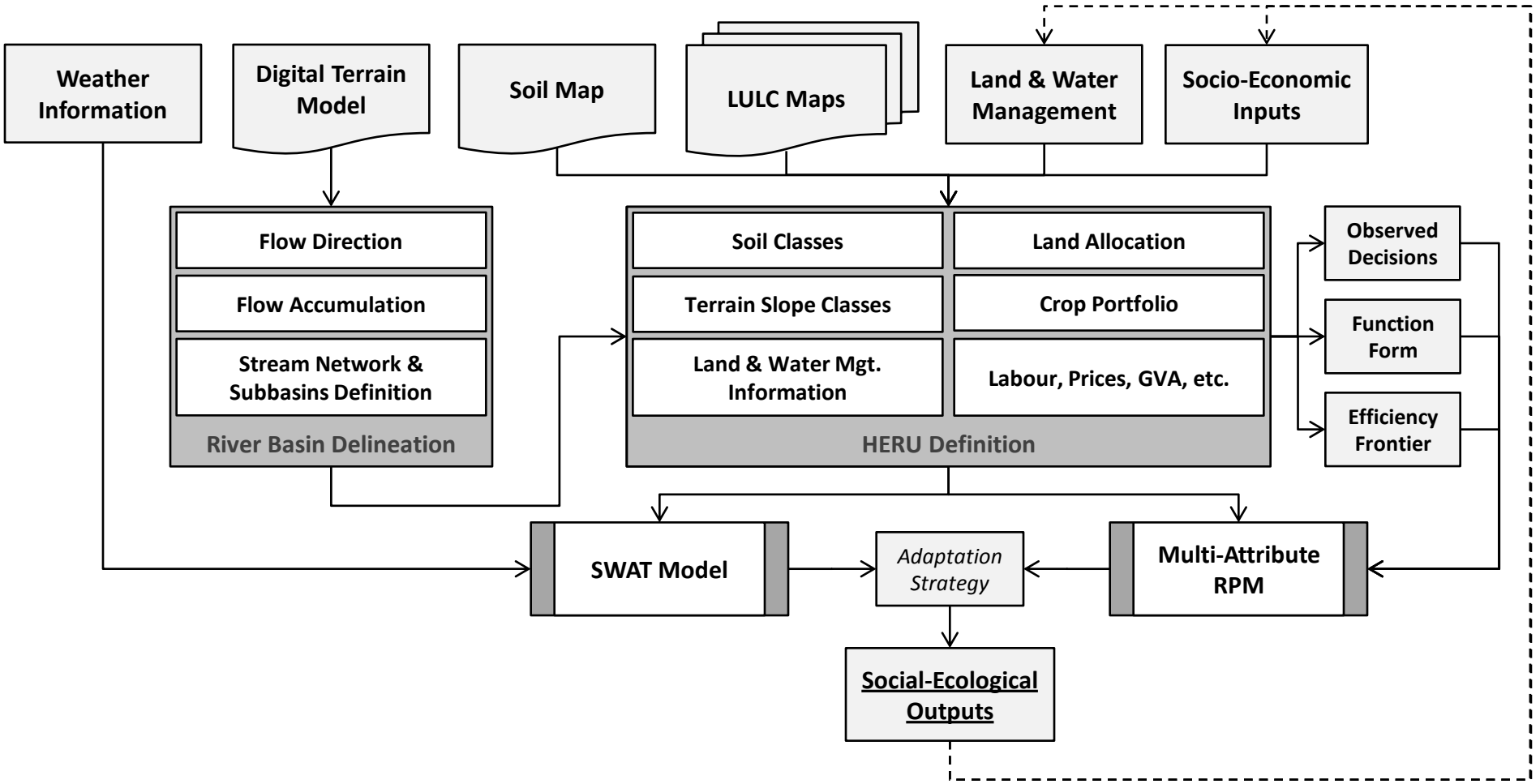


HERUs

Hydrologic-Economic Response Units

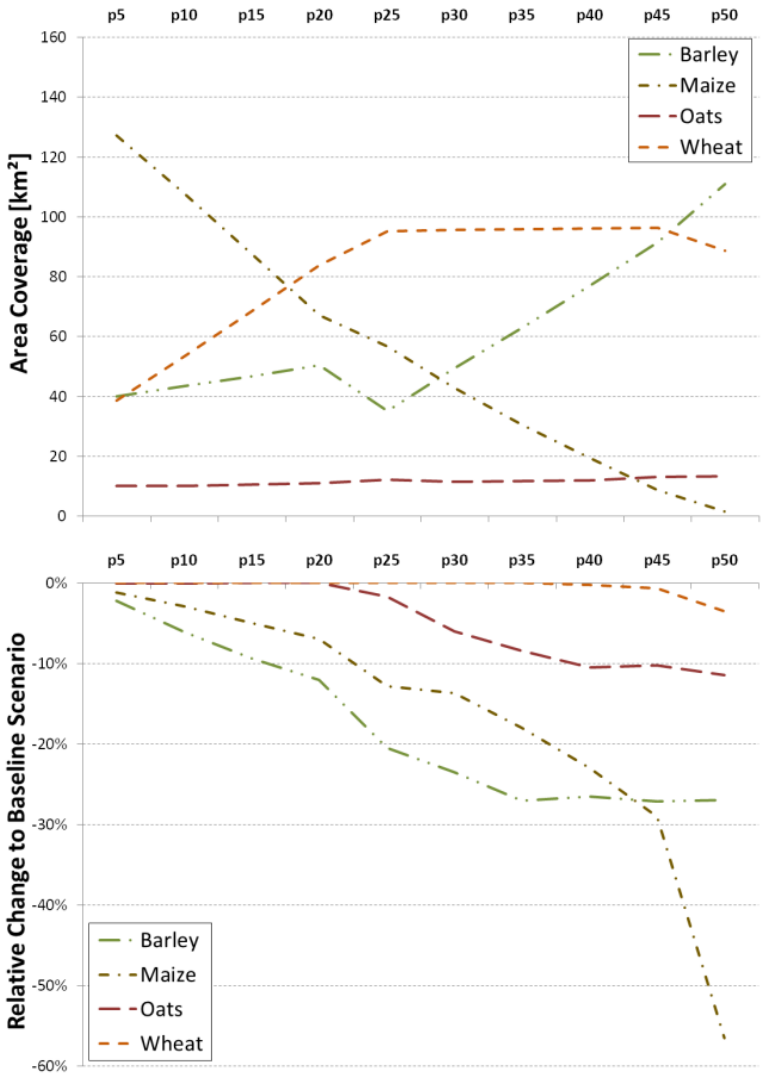
*"Lumped spatial **entities** resulting from the combination of unique land-cover, land management, soil, topographic, and socio-economic characteristics"*

THE TALANOA APPROACH

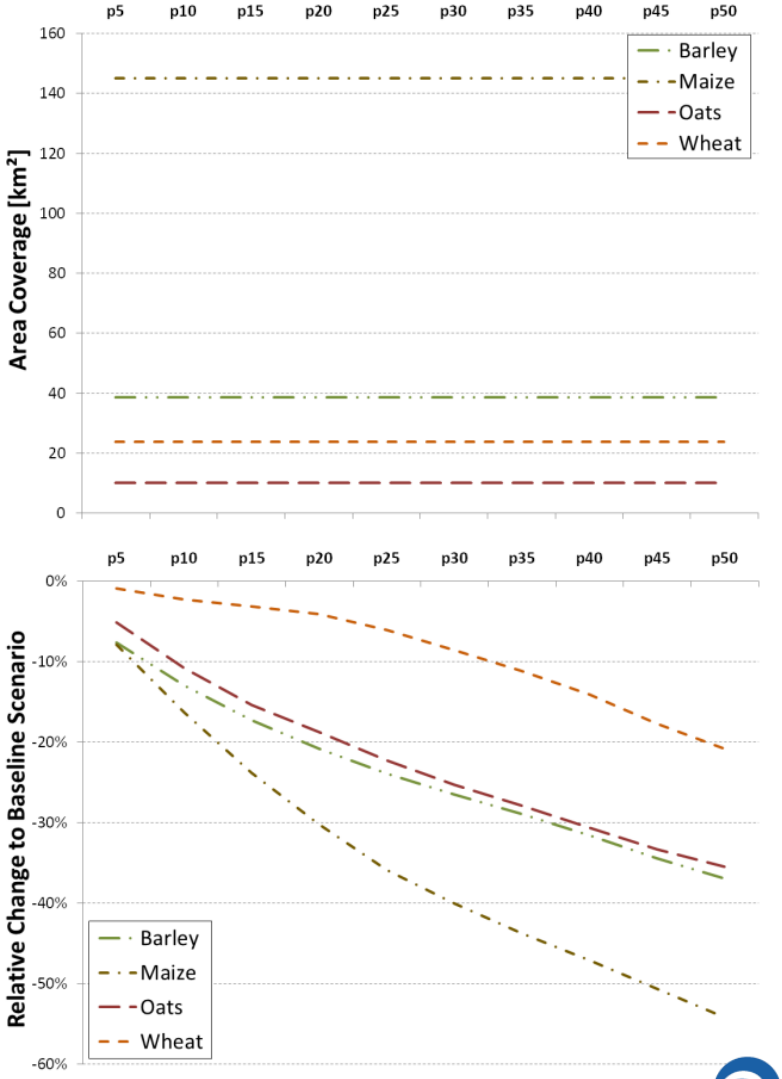


RESULTS

Agents endowed with Rationale



Agents deprived of Rationale



PREVIOUS AND ON-GOING RESEARCH

Earth's Future

Research Article | Open Access

Rationalizing Systems Analysis for the Evaluation of Adaptation Strategies in Complex Human-Water Systems

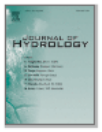
Arthur H. Essenfelder, C. Dionisio Pérez-Blanco, Alex S. Mayer

First published: 05 July 2018 | https://doi.org/10.1029/2018EF000826 | Citations: 18

ELSEVIER

Journal of Hydrology

Volume 584, May 2020, 124676



Research papers

A tale of two rivers: Integrated hydro-economic modeling for the evaluation of trading opportunities and return flow externalities in inter-basin agricultural water markets

C. Dionisio Pérez-Blanco [a], Arthur H. Essenfelder [b], Carlos Gutiérrez-Martín [c]

ELSEVIER

Environmental Modelling & Software

Volume 136, February 2021, 104943

Beyond piecewise methods: Modular integrated hydroeconomic modeling to assess the impacts of adaptation policies in irrigated agriculture

C. Dionisio Pérez-Blanco [a], Héctor González-López [a], Arthur Hrast-Essenfelder [b]

CONCLUSIONS

- A holistic, multi-factor perspective is required to evaluate the impacts of policy interventions in complex systems («human-natural systems»);
- The rationality of socio-economic agents is a determinant factor driving/affecting both hydrologic and economic processes;
- A better allocation of (water) resources can be achieved when considering the impacts and feedbacks in human-water systems;
- Socio-hydrologic analysis requires both innovative and integrative socio-economic and eco-hydrologic modelling frameworks («feedbacks between the systems»)
- Thus, it is possible to avoid paradoxes ... e.g.
  - *Hydrologic:* ↑ *irr. Eff.* ↑*wtr. Cons. (???)*
  - *Jevons' Paradox:* ↑ *irr. Eff.* ↑*investment* ↑ *productivity (why use less?)*
  - *Sustainability:* ↑ *irr. Eff.* ↑*energy Cons. (???)*

Thank You