XINGU Project

Integrating land use planning and water governance in Amazonia:
towards improved freshwater security in the agricultural frontier of Mato Grosso

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IGFA - International Group of Funding Agencies For Global Change Research

THE BELMONT CHALLENGE

To deliver knowledge needed for action to avoid and adapt to detrimental environmental change including extreme hazardous events.

This requires:

- Assessments of risks, impacts and vulnerabilities, through regional and decadal-scale analysis and prediction
- Information on the state of the environment, through advanced observing systems
- Interaction of natural and social sciences
- Enhanced environmental information service providers to users
- Effective international coordination mechanisms

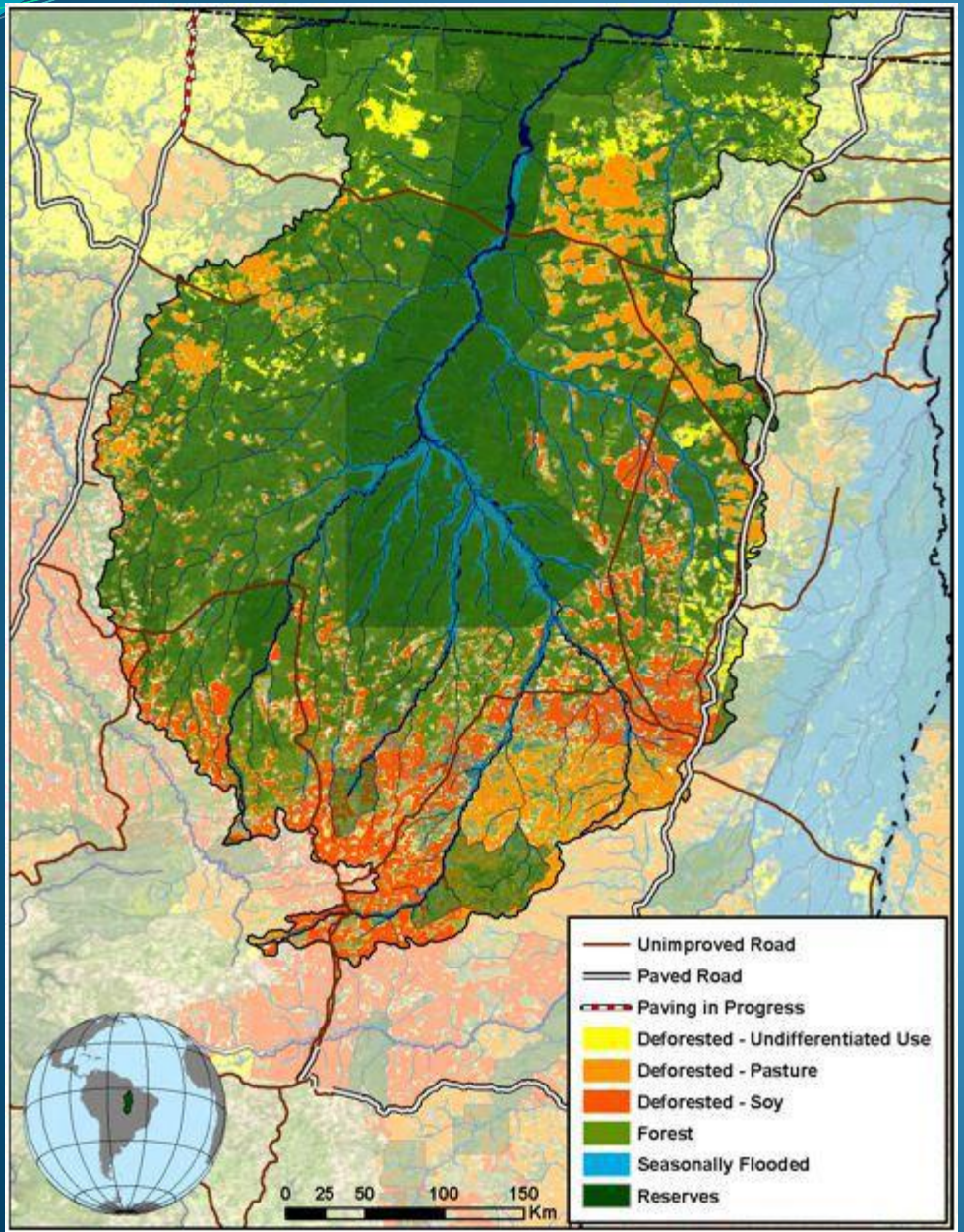
With priority foci being:

- Coastal vulnerability
- Freshwater Security
- Ecosystem Services
- Carbon Budgets
- Most vulnerable societies

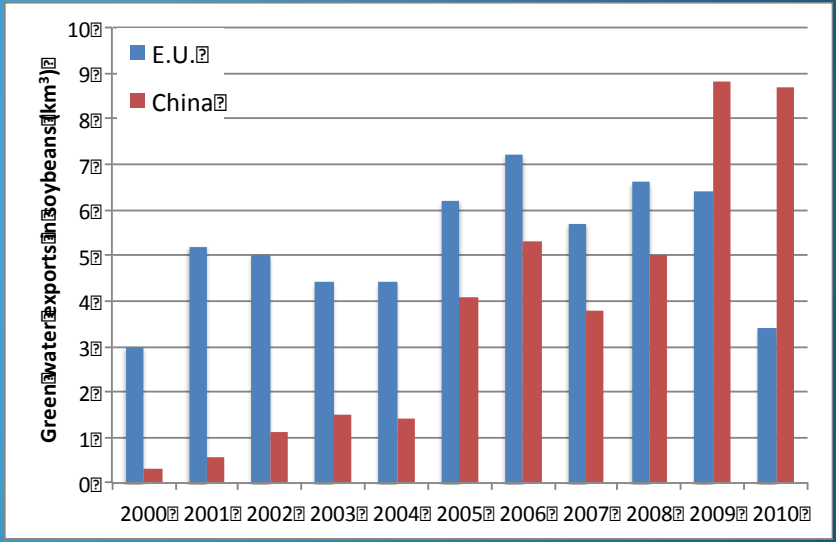
XINGU Project

What approaches to water resource governance, land management, and information transfer among regions and among water use sectors will improve the sustainability and equity of water resources within socio-environmental systems, and ensure the well-being of ecosystems and humans?

UPPER XINGU BASIN



Annual green water from Mato Grosso soybean production exported to China and E.U. from 2000-2010



(Lathuilliere et al. 2012, Aliceweb 2012).

Critical issues for freshwater security of the expansion of agriculture:

(1) *Expansion* of cropland into areas with a shorter rainy season or more variable rainfall ***increases vulnerability*** of agricultural production to changes in rainfall and climate;
(2) *Intensification* of agricultural practices (such as shifts to double-cropping) extends the period of crop growth to the edges of the rainy season when rainfall is less frequent or more sporadic, also ***reduces resilience*** of the system by increasing the proportion of renewable water utilized by agriculture;
(3) Changes to land cover and cropping practices caused by agricultural expansion and intensification ***alters local patterns of evapotranspiration*** (ET) and runoff in ways that can lead to ***feedbacks at the regional scale***, decreasing regional rainfall while increasing river flows and potential flooding;
(4) Expansion and intensification of cropping can ***degrade water quality*** by increasing surface runoff and the concentrations of sediment and nutrients in streams and rivers;
(5) Expansion and intensification of agriculture can ***alter aquatic ecosystems*** by reducing riparian forest, increasing stream temperatures, restricting fish movements and degrading the quality of stream channel habitats and lowering fish production;
(6) Integration of animal production facilities within more intensive agricultural landscapes can ***increase water use requirements*** *and* degrade water quality, especially if animal waste is not carefully managed.

Impacts on environmental and ecosystem services also affect societies in several ways:

(1) Expansion of cropland promotes ***changes in social structures*** that will impact daily practices such as food intake;
(2) Changes in land use will impact water availability and consequently ***how people perceive and use water*** in their daily practices;
(3) The shift to new agro-economic practices such as export crop agriculture promotes changes to formal and informal institutions, which will ***influence how water is allocated in the region***;
(4) The shift in land use practices also promotes a ***changing power dynamics*** related to the control and of access to resources such as land and water;
(5) Land use patterns can lead to conflict situations among stakeholders, particularly if ***water governance practices*** based on negotiation are not in place;
(6) The environment and the importance of the natural resources have different meanings and uses among different stakeholder groups. ***The lack of equitable water governance can lead to marginalization***, and undesirable outcomes including reduced water security, particularly among some users, populations or locales

Landscape analysis

- Land cover/use in past decades
- Development of land changes trajectory matrix

Hydrology

- Balanço hidrico
- Modelagem hidrológica e projeção futura

Water biogeochemistry

- Intensive sampling at coupled micro-basins
- Extensive synoptic sampling over whole upper Xingu

Soil hydrology – resilience to agriculture

Water balance and Virtual Water

Representations and practices of human populations about water as a natural resource

- Identification of local social categories
- Stratified sampling of human populations
- In-depth-interviews about practices and representations related to water as a natural resource
- data analysis and report of results for discussion, interpretation, and implications with participating stakeholders.

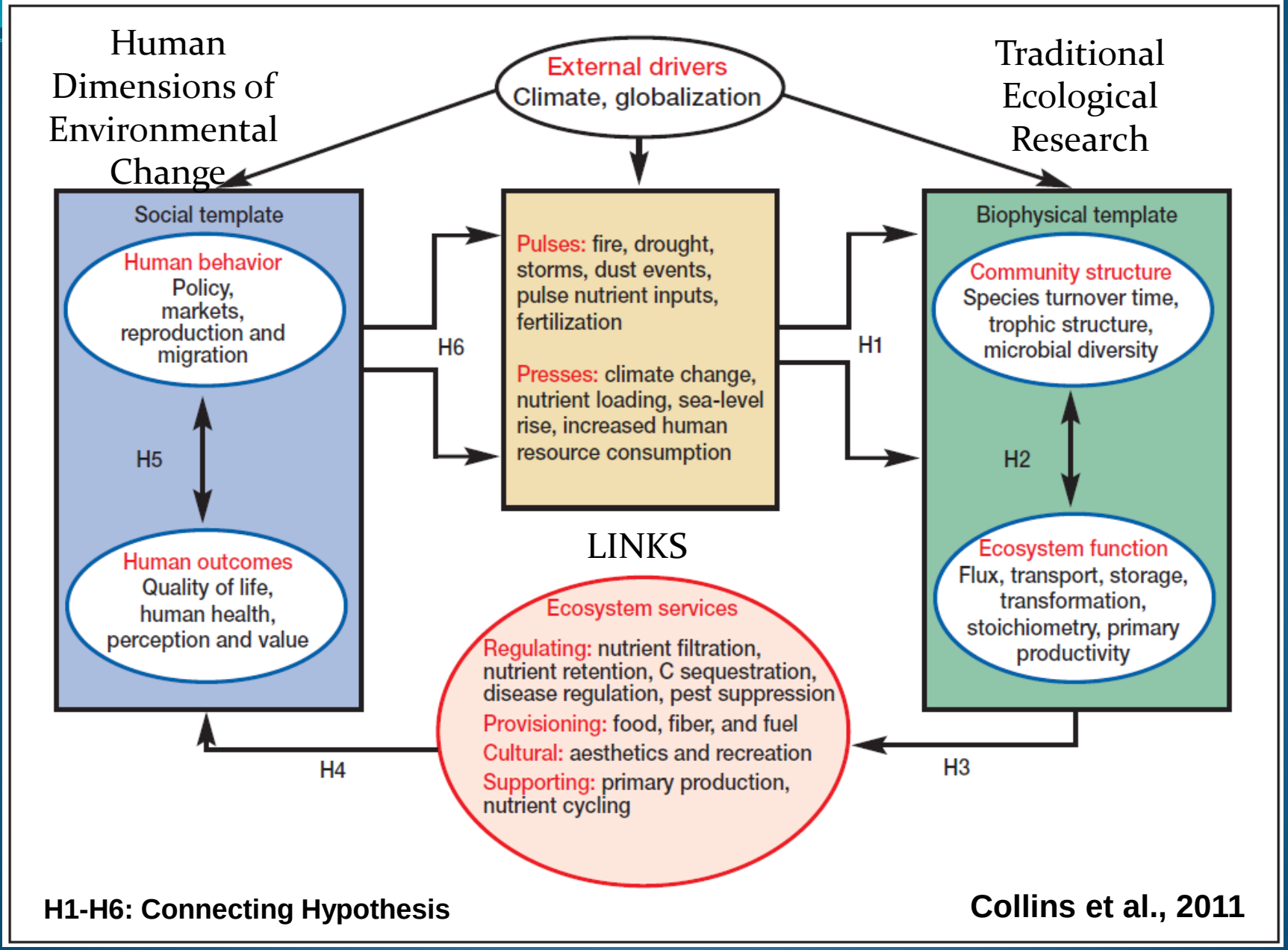
Institutional Arrangements

- Understand the power structures behind decision-making processes
- Promote participatory spaces for negotiation

Evaluating Communication Strategies for Policy/Decision Making

Environmental legislation and social representation of human population problems

SYNTHESYS MODEL



H1-H6: Connecting Hypothesis

Collins et al., 2011