

Understanding and Modeling the Scope for Adaptive Management in Agroecosystems in the Argentine Pampas in Response to Interannual and Decadal Climate Variability and Other Risk Factors

Biocomplexity in the Environment/Dynamics of Coupled Natural and Human Systems
 FY2004 Competition Award Number BCS-0410438
 September 1, 2004 to August 31, 2007

1. Motivation

Agricultural ecosystems play a central role in world production and food security. Managed agroecosystems combine the complexity, multiplicity of scales, and feedbacks of biophysical interactions in natural ecosystems with the additional intricacies of human decision-making.

2. Project goals

The overarching goal of the project is to understand and model the dynamic interactions of natural and human components in agroecosystems, with emphasis on assessing the scope for adaptive management in response to climate information

Specific objectives include:

- (a) To understand and model impacts of interannual and inter-decadal climate variability and experiment with the use of climate information within an adaptive management framework,
- (b) To understand and model agricultural decision-making in the light of climate variability, probabilistic climate information (eg, seasonal forecasts) and other factors (economic, social, technological), and
- (c) To assess the environmental consequences of production systems that evolved in response to changing climate and technologies.

3. The area of study

The geographic focus of the project is the Pampas of central-eastern Argentina. We chose the Pampas because of its importance to Argentina's economy (51% of exports, and 12% of GDP) and because the region has marked interannual and inter-decadal climate variability. The similarity in production scale, crops grown and technology of the Pampas to those in other major areas with comparable climate signals suggest a broader relevance of our results.

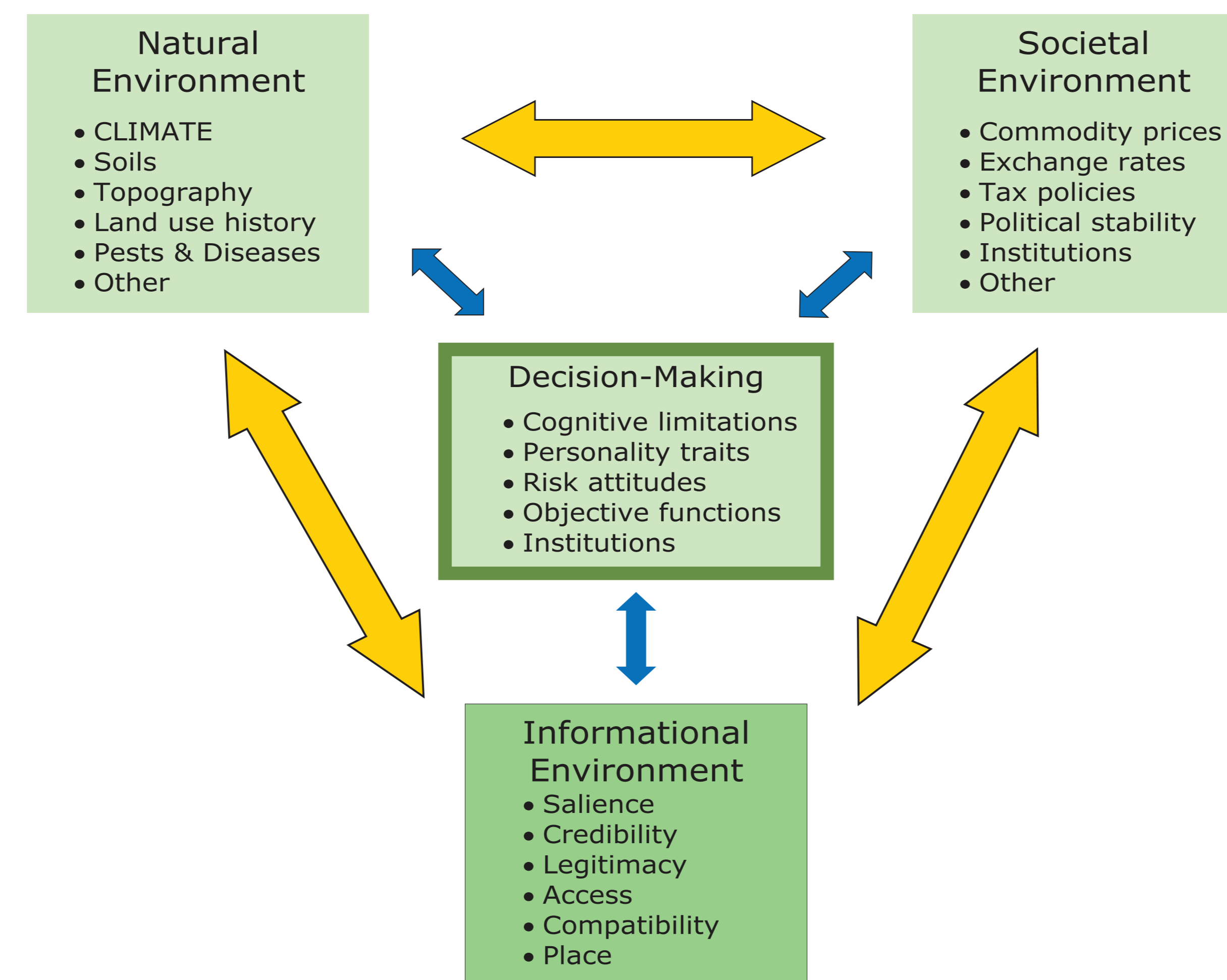
4. Conceptual framework

Our conceptual framework includes three domains (natural, societal and informational) and a mediating process (decision-making). In this project, we emphasize climate variability at interannual and decadal scales as an important component of the natural environment.

A distinctive component of our framework is the information domain, as we believe it plays a central role in inducing active adjustments and adaptive behaviors in complex systems.

5. Some tasks we are performing...

- Building plausible scenarios of inter-annual and inter-decadal climate variability: We are "translating" seasonal climate forecasts (often probabilistic in nature) into specific ensembles of relevant climate variables (precipitation, temperature).
- Assessing the impacts and outcomes of inter-annual and inter-decadal climate variability, and the scope for adaptive management in response to climate and other contextual factors: We link synthetic daily weather with process-level crop models and financial models to simulate outcomes (yields, profits) of alternative decisions under various climate scenarios



Although there are other interactions between domains (externalities, orange arrows), we focus here on decision-making as the major process (from stakeholder point of view) mediating between domains. This component involves common human limitations in information processing, individual characteristics along cognitive or affective dimensions and individual differences in goals for decisions, ie, different objective functions.

For adaptive responses, the decision-making process mediates and "filters" linkages (dark blue arrows) among domains: the result is a set of subjective perceptions on the values and likelihood of decision inputs and outcomes.

- Seeking to understand how probabilistic climate information and uncertainty about outcomes are received and acted upon: We implemented and assessed alternative objective functions. We are using these alternative functions to explore responses to climate information and value of the information.
- Exploring environmental consequences of human decision in agroecosystems: We are exploring the implications of current high-input agricultural productions systems on environmental conditions and sustainability of life support systems.

6. Project highlights

Several elements of this project are distinctive

- A rich set of perspectives combining (a) linked modeling approaches for generation of climate scenarios and decision outcomes (b) controlled experiments on decision-making, and (c) participatory research that will draw on stakeholders' experiences and preferences
- The development of tools to support adaptive decision-making and learning by exploring outcomes of alternative actions in response to plausible climate scenarios
- A strong focus on understanding the dynamics of human behavior and decisions particularly with respect to the twin problems of choice and uncertainty in the context of a real-world complex natural/human system
- A probabilistic treatment of uncertainty integrally designed into the project
- A reflective analysis of the interdisciplinary, multi-space collaboration and stakeholder involvement in integrative science
- The active involvement of farmers and producers of climate forecasts

Who are we?

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