Climate Change Impact Assessments: Moving from the Local to the Global

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INTRODUCTION

The vast majority of climate change impact assessments evaluate how local or regional systems and processes may be affected by a future climate. Alternative strategies that extend beyond the local or regional scale are needed when assessing the potential impacts of climate change on international market systems. These industries have multiple production regions that are distributed worldwide and are likely to be differentially impacted by climate change. Furthermore, for many industries and market systems, especially those with long-term climate-dependent investments, temporal dynamics need to be incorporated into the assessment process, including changing patterns of international trade, consumption and production along with evolving adaptation strategies by industry stakeholder groups. A framework for conducting climate change assessments for international market systems is described below.

CCIAV ASSESSMENT METHODS

Previous Assessment Strategies

The most recent report of the Intergovernmental Panel on Climate Change (IPCC) Working Group II outlines several approaches to assessments of climate change impact, adaptation and vulnerability (CCIAV) (Carter et al. 2007) including:

Traditional or "top-down" approaches: Local or regional climate scenarios are developed from projections from Global Climate Models (GCMs) and the climate scenarios are then applied to evaluate how a local/regional process or system may be impacted by a perturbed climate

Comprehensive integrated assessments: The emphasis is on interactions and feedbacks between multiple drivers and characterized by a global rather than local or regional viewpoint; frequently the focus is on a sector or even multiple sectors of the economy

An Expanded Approach

Assessment strategies for international market systems require a broader spatial perspective compared to a traditional assessment, but more detail than the often broad-brush comprehensive integrated assessment. An expanded assessment approach is proposed that allows for continuous, evolving projections for those system components for which this is possible and uses a time slice approach for those components where dynamic modeling is not feasible. Later time slices are informed by the outcomes from earlier time slices.

Types of Climate Change Impact Assessments

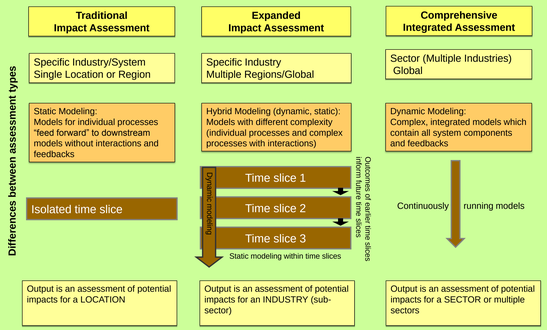

Figure 1: Comparison of the proposed "expanded" assessment to traditional and integrated approaches for climate change assessments.

ASSESSMENT COMPONENTS

Within Time Slice System Components

- The length of the time slices and separation between time slices are industry specific
- The chain of linked models likely would include climate projections, models of the dependency of production on weather and climate, and one or more models of flows, trade and decision making
- Time slices should be sufficiently long to capture climate variability
- Output of weather/climate dependency models is a joint probability distribution of production across regions
- A trade model links markets between production regions

Projecting between Time Slices

- Global and national changes in macro-level variables need to be projected between time slices
- The set of variables over which an individual can make a choice must be identified and allowed to vary between time slices
- Adaptation decisions should incorporate willingness to adapt as well as adaptive capacity and technology constraints

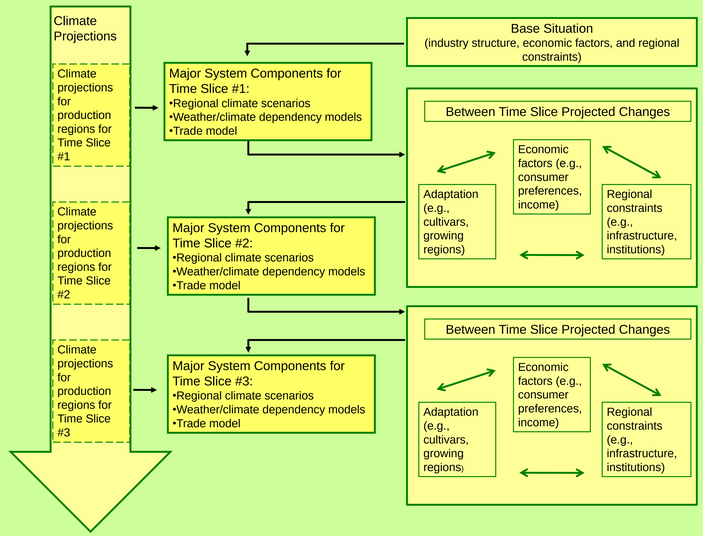

Figure 2: Schematic of within and between time slice components of an expanded assessment. See Winkler et al. (2010) for more details.

PROOF OF CONCEPT: INTERNATIONAL TART CHERRY INDUSTRY

- Climate sensitive: susceptible to extreme events (e.g., spring frost)
- Long-term investment: perennial crop with 25-30 year life cycle
- Diverse regions: global production base, multiple economic stages
- Diverse locations: landscape variability within and across regions
- Tractable: five countries account for over 42% of world production
- Mix of adaptation strategies over multiple time frames: new varieties, trade adjustment, management practices
- Human Dimensions: decision-making over adaptation strategies, international trade, regional development

META-UNCERTAINTY

Meta-uncertainty is defined as the aggregated uncertainty due to differences in functional form, or structure, of the suite of linked models. An ensemble of outcomes can be constructed from multiple model chains resulting from the use of parallel models for each of the major components of the assessment. This meta-uncertainty approach is consistent with the aggregated uncertainty over final outcomes as perceived by stakeholders.

SUMMARY

A conceptual framework for climate change impact assessments for international market systems that involve long-term investments is provided. The proposed framework hopefully will act as a catalyst for further research on climate change assessments for industries with production regions that are dispersed globally and that are vulnerable to climate variations and change, especially climate extremes.

RESEARCH TEAM AND AFFILIATIONS

The research team is composed of agricultural economists, climatologists, computer scientists, geographers, and horticulturalists from Michigan and central and eastern Europe. Affiliations for the authors listed above are:

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