Incorporating Adaptation to Climate Change into Farm Management and Agricultural Policy

Ben Bradshaw, Barry Smit, Ellen Wall & Suzanne Belliveau, Dept. of Geography
Univ. of Guelph

Acknowledgements: Ontario Ministry of Agriculture, Food and Rural Affairs
The CC Mitigation Side: A Sad Story

Data released in the lead up to the COP 11 Conference in Montreal, showed the we, the hosts, were failing miserably...

Change in GHG emissions 1990-2003:
– Canada: +24.2%
– United States: +13.3%
Climate Change including variability and extremes

Human Interference

Mitigation of GHGs
- emissions
- sequestration

Impacts on Agriculture
- production
- economics

Responses

Adaptation to the Impacts
CC Adaptation in Agriculture:
Some strands of research

• modeling adaptive behavior - or rather incorporating adaptation into impact models (e.g. Easterling et al., 1992a&b; Mendelsohn et al., 1996)

• ‘anatomizing’ adaptation (e.g. Smit et al., 2000)

• identifying potential adaptations (e.g. Smit and Skinner, 2002) and evaluating their suitability (e.g. Dolan et al., 2001)

• assessing “actual” adaptive behavior to past or current climatic variability (e.g. Smit et al., 1996; Brklacich et al., 1997; Bradshaw et al., 2004)…
Calls for Further (empirical) Assessments of Adaptive Behavior

• “the important questions in the climate change context are all empirical: When will people adapt? How much will they adapt?...” (Hanemann, 2000, p.572)

• “the ability of, and perceived need for, prescriptive models [of adaptation] may be overrated” (Kandlikar and Risbey, 2000, p. 531); we need descriptive analyses of “actual” adaptive behavior

• “[there is a need for] qualitative research on individual [adaptive] behavior” (Polsky and Easterling, 2001, p.142 in their conclusion to a model-based assessment of adaptation in the US Great Plains)
Some Problems Associated with Assessing Adaptive Behavior (regardless of the chosen approach)

• the inherent variability of individual adaptive behavior (e.g. dumb vs. clairvoyant vs. realistic farmers)?

• adaptation to “inter-periodic climatic variability” vs. adaptation to longer term climatic change (necessary distinction?)…
Extreme weather events, not gradual shifts in mean conditions, tend to grab the attention of farmers...
Problematic Conditions of Climate as identified by our producer surveys

<table>
<thead>
<tr>
<th>Condition</th>
<th>% Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>58</td>
</tr>
<tr>
<td>Excessive Rain</td>
<td>58</td>
</tr>
<tr>
<td>Hail</td>
<td>8</td>
</tr>
<tr>
<td>Frost</td>
<td>7</td>
</tr>
<tr>
<td>Wind</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
</tr>
</tbody>
</table>

Message sent back to climate scientists: “tell us what we might expect with regards to these problematic weather events”
Some Problems Associated with Assessing Adaptive Behavior (regardless of the chosen approach)

• the inherent variability of individual adaptive behavior (e.g. dumb vs. clairvoyant vs. realistic farmers)?

• adaptation to “inter-periodic climatic variability” vs. adaptation to longer term climatic change (necessary distinction?)

• the interactive effects of multiple (i.e. not just climatic) sources of risk (and opportunity)…
Current Precipitation Compared to Historical Distribution
(Previously Precipitation Percentiles)
September 1, 2001 to August 31, 2002 (A.M.)

Percentile Classes
- Record Dry
- Extremely Low (0-10)
- Very Low (10-20)
- Low (20-40)
- Mid-Range (40-60)
- High (60-80)
- Very High (80-90)
- Extremely High (90-100)
- Record Wet

Extent of Agricultural Land

Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from the Timely Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.

Protecting beef from BSE

U.S. FARM POLICY

Canada lives in the shadow of American agricultural programs

WP Illustration by Michelle Houlden
Farm System Vulnerability

**Exposures/Sensitivities**
- Government Regulations
- Environment
- Macroeconomics
- Technology
- Market
- Climate

**Adaptive Capacity**
- Government Programs
- Technology
- Market Demand
- Institutions
- Resources

**Land**
- Location
- Farm type
- Env. Constraints

**Human**
- Age
- Family
- Perception
- Information

**Capital**
- Finance
- Technology
- Land Tenure

Source: Belliveau, 2005
Current Exposure / Sensitivity

Current Adaptive Capacity

Future Climate Probabilities

Future Exposure

Future Adaptive Capacity

Future Social Probabilities

Future Vulnerability

Source: Ford & Smit 2004
Okanagan Valley, BC: Apples and Grapes Study
Problematic Exposures/Sensitivities for Grape Growers

- **Weather**
  - Cold and wet
  - Frost
  - Winter
  - Extreme heat

- **Market**
  - Less tourists

<table>
<thead>
<tr>
<th>Number of Respondents</th>
<th>Weather</th>
<th>Market</th>
<th>Pests</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Problematic Exposures/Sensitivities for Apple Growers

Market
Price
Weather
Hail
Extreme Heat
Frost

Number of Respondents

Market | Weather | Quantity | None
---|---|---|---
18 | 8 | 4 | 1
### Grape Adaptations

| Weather       | ▪ Drop crop  
|               | ▪ Irrigate   
|               | ▪ Wind machine
|               | ▪ Crop Insurance
|               | ▪ Make sparkling wines |
| Market        | ▪ Be more aggressive in other market channels |
# Apple Adaptations

| Weather          | - Crop Insurance  
|                 | - Apple juice     
|                 | - Irrigate        
| Market          | - Reduce spending 
|                 | - Produce high quality fruit 
|                 | - Income stabilization 
|                 | - Replant program |
Vulnerability as a function of interaction

market factors

climatic factors
market demands

Vitis vinifera (grapes)

dwarfed rootstock (apples)

reduced quality

(subsidized) crop insurance

vulnerable to weather (variability)

vulnerable to market competition (reduced prices)
Adaptation in Southern Ontario Agriculture (soybean, corn & winter wheat)

Grand River Watershed (6400 farms)
Moisture Extremes: Dry vs. Wet

- **Exposure/Sensitivity**
  - lack of rain given no irrigation
  - too much rain

- **Adaptation**
  - conservation tillage
  - crop insurance
Soybean Aphid

- 2001 and 2003 damage
- Drought conditions
- Not prepared
Farm Economics as a key driver

Climatic Variability

Pests & Diseases

Market Prices

Input Costs

Diversification
- Crops/livestock
- Business
- Off-farm
So what for Farm Management and Agricultural Policy

• climatic conditions are experienced by farmers in combination with highly uncertain economic, social and policy conditions

• the climate-related conditions that challenge operators are not the norms but the extremes

• production risks are managed via a wide array of farm-level strategies; adaptations are seldom directed at just climatic risks

• more fundamentally, farm-level adaptation to a variety of risks and opportunities is ongoing
Continuous adaptation is the norm
The ‘Trajectory’ of Commercial Agriculture

- increased productivity
- larger and fewer farms
- more specialized
- more intensive
- integration of farms into the agri-food system
- more ‘pluriactivity’

‘Post-productivist’?
Production of Wheat, Canada
(1914-98)

Source: Statistics Canada
Cattle Feedlot, Alberta

Typically 250 head per pen
(i.e. approx 24,000 total here)

Source: MacLachlan, 2002
Hence, rather than ask ‘what are the implications of CC for agriculture?’ perhaps we should ask ‘how might CC impact agriculture's historical trajectory?’