

**Global Warming Commission**  
**Natural Resources Committee Meeting – Agriculture Subcommittee**  
**July 17, 2008**

**Participants:**

[Note: Not everyone signed in. If you're aware of other attendees, please let us know!]

Sybil Ackerman, Lazar Foundation  
John Aguirre, Oregon Association of Nurseries  
John Audley, The Nature Conservancy  
Gary Banowitz, USDA Agricultural Research Service  
Brenda Bateman, Oregon Water Resources Department  
Roger Beyer, Oregon Seed Council  
Sarah Bryant, Defenders of Wildlife  
Linc Cannon, Oregon Forest Industries Council  
Katy Coba, Oregon Department of Agriculture  
Mike Dennis, The Nature Conservancy  
Pat Dudley, Board of Agriculture  
Andrea Durbin, Oregon Environmental Council  
Bernie Faber, Board of Agriculture  
Katie Fast, Oregon Farm Bureau  
Chantel Heisel  
Kathryn Higgs, Oregon Dairy Farmers Association  
Erica Keeley, The Climate Trust  
Jim Krahn, Oregon Dairy Farmers Association  
Eric Lemelson, Global Warming Commission member  
Dan Long, USDA Agricultural Research Service  
John McCulley, Processed Vegetable Commission  
Holly Michael, Oregon Department of Fish and Wildlife  
Helen Moore, Water for Life  
Stephanie Page, Oregon Department of Agriculture  
Annette Price, Port of Portland  
Paulette Pyle, Oregonians for Food and Shelter  
Thad Roth, Energy Trust of Oregon  
Salie Schullinger –Krause, Oregon Environmental Council  
Brent Searle, Oregon Department of Agriculture  
Steve Van Mouwerik, Board of Agriculture  
Phil Ward, Oregon Water Resources Department  
Jim Welsh, Oregon Cattlemen's Association/Beef Northwest  
Gary Whitney, Oregon Association of Conservation Districts  
Terry Witt, Oregonians for Food and Shelter

**1. Introduction**

Katy Coba explained that the role of the subcommittees is to draft recommendations and forward them to the natural resources subcommittee, which will forward a package of recommendations to the Global Warming Commission.

Andrea Durbin explained that another purpose of the meeting is to identify what we don't know – what kind of research gaps exist, and what do we need to know to help adapt and mitigate climate change.

**2. State budget needs related to agriculture and global warming**

Katy Coba explained that she went through the Oregon Department of Agriculture budget package and identified the items that have a relationship to climate change. She distributed a handout with a summary of the items. The first package relates to air quality. This is the result of an initiative that came out of the last legislative session. One pollutant that was identified in the legislation and task force is methane, which is also a greenhouse gas, so dealing with methane is an action item that came out of the task force.

There are five packages that deal with existing programs, including water quality and confined animal feeding operations. ODA lacks monitoring resources in these programs, and currently relies on the Oregon Department of Environmental Quality's budget to track impacts. Their monitoring budget was severely cut in the past. As we heard in the water subcommittee meeting yesterday, quality and quantity are closely related. ODA is requesting a full-time staff person to deal with water quantity issues, including improvements in water conservation and working closely with the Oregon Water Resources Department on water quantity issues.

Another request relates to invasive species, and keeping the base program going. The Invasive Species Council was created a few years ago, and a staff person was funded for the first time during the last session. There will be a summit next week in Salem regarding invasive species issue. ODA has served as the house for invasive species issues, including serving as the fiscal agent.

Finally, ODA is asking for a position to deal with climate change issues.

### **3. Climate change impacts and adaptation for Pacific Northwest Agriculture,** *Chad Kruger, Washington State University*

Chad Kruger explained that much of the climate change research in Washington has parallels to Oregon. In addition, several researchers in the Oregon University System are looking at climate change, including Stella Coakley at Oregon State University.

We can model general scenarios of climate change impacts to agriculture, but it's tough to model specific scenarios. In addition, it's difficult to predict what the extremes will be, and extremes can have serious consequences.

There are several areas where climate change can affect Pacific Northwest agriculture. Both weather averages and extremes/variability will likely change. Averages set general guidelines, but extremes really limit what you can and can't do.

Agriculture also affects climate in several ways. There are small, localized effects such as changes to relative humidity because of irrigation and evapotranspiration from the crop. Agriculture can also emit greenhouse gases, including methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>).

In the past, carbon emissions to the atmosphere were lower than what was absorbed by terrestrial ecosystems and the oceans, but now we're emitting more than terrestrial systems and oceans can absorb. Emissions appear to be increasing, and at some point, our terrestrial systems and oceans might lose their ability to absorb as much carbon.

When we start cultivating crops in dryland conditions, we lose soil carbon. If we irrigate, particularly in the desert, we start building up carbon in the soil.

Soil nitrogen follows carbon – as you lose carbon, you lose nitrogen. Some of the nitrogen is lost as nitrous oxide. As nitrogen becomes more expensive, folks are more interested in plugging those nitrogen losses.

Washington research has looked at adding carbon to soils. We can reverse the trend of soil carbon loss, but we'll always have some level nitrous oxide emissions if we want to grow crops.

To reduce emissions from agriculture, we need to improve nitrogen management. With nitrogen fertilizer prices these days, there are a lot of incentives to reduce nitrous oxide emissions anyway.

Most Pacific Northwest weather stations show a decline in snow water equivalent. Oregon will probably have more of a problem than Washington. We can model averages well, but it's harder to map the variability.

There is some other work that has looked at frost-free days. The Pacific Northwest has about 3 more frost-free days than we did in 1948.

One clear effect of climate change is snowpack loss. Warmer temperatures generally mean higher snow levels. If you're part of the Columbia basin, you're probably in good shape. The Yakima basin will probably not fare as well. Oregon may be worse off because of latitude.

There will be a shift in the snowmelt/streamflow pattern further away from the time we need to use it.

Pests and disease are another potential issue. We know a lot less about this issue than we do about water. A British Columbia model predicted significant pine beetle kill if nothing is done to deal with it, suggesting cost increases in dealing with pests.

Washington State University is working on a climate impact assessment study, with the final report expected in December 2008. The study is trying to downscale climate predictions to an agricultural resolution, and is also looking at the codling moth, weeds, impacts to grape production, dryland cropping system zone changes, impacts to potato production, key pathogens of orchard crops and hops, changes in temperature and moisture availability, and economic impacts of changes for farmers. In addition to local effects, some global issues potentially related to climate change, such as droughts in Australia, can impact Pacific Northwest agriculture.

Weeds are generally more genetically diverse than crops, so they adapt more quickly to climate change. Warmer, wetter winters increase the potential for weed and disease overwintering. An increase in atmospheric carbon dioxide favors some weeds. Fire blight is predicted to increase in early season models and remain the same under late season models. Models are very sensitive to various climate conditions.

We may see new diseases introduced to the region. It's important to look at regions with a current climate similar to our future climate conditions to see what diseases they have that we don't currently have.

"Precision agroecology" can help us prepare for climate change. As we have more challenges, increased biodiversity in our systems will give us more tools to deal with these challenges. We also need to look at the technical tools we need to go forward.

Local researchers are looking at breeding perennial wheat, which has greater resilience because of its larger root structure. Researchers have also looked at cover crops that will help increase agricultural lands' disease resistance.

Technology will help growers make more site and time specific management decisions. For example, AgWeatherNet can help people make onsite decisions. Climate change will add more uncertainty to systems that are already challenging to manage.

Washington has put \$10 million into climate change research, including energy research. Much of that funding has been on the energy side, especially technology development. Monitoring has been a smaller part of the spending.

If you've got water, you can probably deal with rising temperatures more easily, but water is the limiting factor in our region.

Nitrogen is currently tradable in some greenhouse gas markets.

#### **4. Climate Change and Water Supply,** *Richard Adams, Oregon State University*

Recent climate change research findings aren't significantly different than results from 20-25 years ago, but it has come to the attention of policymakers more. Most of Dr. Adams' work dealt with economic impacts to agriculture of climate change, and he has more recently got involved in water resource impacts.

The Oregon Water Resources Department has commissioned a valuable study on future water supply and demand. The study's intent is to educate Oregonians on the amount of water available and tradeoffs in managing the water. This will be a very useful exercise.

All general climate circulation models predict more precipitation, because higher temperatures will cause more evaporation and put more moisture into atmosphere. The question is whether that precipitation is really usable. Even if precipitation goes up in a region, temperature increases may still be enough to cause shortages. It's very hard to look at models and understand how they will affect the Pacific Northwest.

Important questions in the Pacific Northwest include drought frequency and severity, as well as the frequency of El Nino events. Modelers believe that there will be more frequent El Nino events, as well as more frequent and severe droughts.

Policymakers are considering water supply solutions that were unpopular in the past, because we may have a high snowline in the future with less water. For example, California is looking at two very large offstream storage facilities.

With less snow and runoff, we can expect warmer water. Also, with a rise in sea level, we can expect more saltwater further inland. Saltwater intrusions can affect coastal communities and drinking water.

It's very beneficial to use climate forecasts to make management decisions. It doesn't always work out – for example, predictions are not always correct – but generally, it's a useful strategy.

Biotechnology, irrigation technology, and others will help us adapt, although many of these technologies are more expensive. Extreme weather events will affect insurance and contingency costs. Also, there are environmental consequences of lower water availability, including endangered species issues. We need to come up with mechanisms to help prevent situations like the Klamath water crisis of 2001.

Fundamentally, we have a lot of water issues in the state, and climate change is just another reason to look at these issues. Anything that we as a society can do to improve water management is good public policy.

#### **5. Climate change research in ARS: a national and PNW perspective** *Dan Long, USDA Agricultural Research Service*

USDA-ARS climate change research looks at what we need to do to adapt to climate change, and mitigating impacts of agriculture on climate change, including emissions reductions and sequestration. A network of scientists is looking at the environmental effects of systems developed to decrease greenhouse gas emissions and enhance soil carbon storage.

Corvallis and Pendleton researchers are part of the network. At Pendleton, researchers have long-term no-till plots. They have also set up sampling procedures to look at trace gas emissions.

Studies have looked at carbon dioxide flux and emissions under conventional and no-till cropping systems. Flux and emissions were higher in conventional till plots, low in first-year no-till plots and slightly higher 16-year-old no-till plots. Soil organic matter was basically equal in conventional till and 1<sup>st</sup> yr no-till plots, and much higher in 16-year-old no-till plots. 40-year wheat-pea rotation plots in Pendleton showed higher organic matter at the surface under no-till, but higher organic matter below the soil surface in more conventional systems. In eastern Oregon and eastern Washington, there is not much potential to fix a lot of carbon, regardless of conservation practices.

Studies found that soil carbon levels increased with adequate moisture, but in dry years, soil carbon levels crashed.

A study that looked at fields across northeast Oregon found that adding manure helps build soil organic matter, as does no-till; soil organic matter decreased over time with conventional tillage.

USDA-ARS soil resource management research looks at the tradeoffs between using residue to prevent soil erosion and removing residue for biomass to bioenergy projects. Mapping has helped identify regions of fields where straw can be removed while still protecting the soil resource.

Over 7 million tons of residue are available beyond the soil conservation requirement in the Pacific Northwest; there are potential profits in that residue. Corvallis researchers are looking at new technologies available for local-scale use. A dual-phase gasification reactor heats straw to 1000 degrees F; producing gases that can be converted to ethanol. Also, researchers are looking at converting municipal cellulosic waste materials to ethanol, and commingling straw with municipal waste to produce ethanol.

Key points on carbon sequestration:

- Cereal crops grown with summer fallow do not appear to provide net greenhouse gas mitigation.
- No-till cultivation may result in sufficient carbon sequestration to offset greenhouse gas sources.
- Increasing soil organic matter and carbon is slow, especially under semiarid conditions.
- Importance of increasing organic matter may lie more in enhancing water infiltration and protecting the soil surface from erosion by wind and water.
- Perception of an abundance of straw for energy conversion may be misleading if we allow for soil carbon sequestration and soil protection.
- Cropping with conventional tillage likely will not provide enough straw for both soil protection and bioenergy.
- No-till cultivation provides the best opportunity for both protecting the soil and producing bio-feedstocks.
- Benefits of straw-to-energy conversion:
  - Alleviate field burning.
  - Value-added approach to increase revenue stream.
  - Local-scale technology is commercially available.
  - Less need for large centralized conversion facility.
  - Alleviate transportation costs.
- Benefits of municipal solid waste-to-energy conversion:
  - Abundance of municipal solid waste.
  - Create value from refuse.
  - Reduce landfill volume.

- Technology is commercially available.

Enzymes that are just coming online in the southeastern United States with softwood industry are just beginning to become commercially available. Scientists seem to believe it will be available soon.

## 6. Discussion

Katy Coba and Andrea Durbin summarized some of the main points covered so far by the presenters, and some of the key issues that they identified. They separated needs into two main categories: adapting to climate change, and mitigating climate change by reducing emissions and/or sequestering carbon. Meeting participants added items to the adaptation and mitigation action item list, and also mentioned several important considerations.

### Adaptation:

- Water availability, including storage
- Increased crop diversity
- Precision weather monitoring
- Genetically engineered crops that are drought-tolerant
- Water conservation
- Water allocation – use of water markets
- Providing water
- Invasives
- Restoring watershed health
- Better data

### Mitigation:

- Soil management; tillage
- Nitrogen management
- Cover crops; biodiversity
- Access to water increases carbon sequestration (works for annuals, but not perennials)
- Crossover with transportation committee
- Research into best management practices and effects on emissions
- Digesters
- Use of perennials
- Biofuels
- Recognize Oregon's agricultural diversity; allow opportunities for all to be offset providers
- Credit for past actions
- Consider incentive-based program, supported with research and economic analysis
- Clarify how emissions are calculated
- How can we fill in gaps for agriculture to participate in markets

### Other considerations:

- Look at mitigation/adaptation strategies with crossover
- Keep farms in production; maintain economic viability
- Can also expect labor costs to go up
- Need valid, accurate baseline
- How to focus dollars & prioritize?
  - % emissions?
  - Easiest to reduce?
  - Focus on items that provide highest greenhouse gas reduction benefit
  - Impacts of cap and trade on energy costs? Would like more information on how agriculture will adapt to higher cost energy environment. If our region has higher energy cost than other regions because of cap and trade, how will that affect agriculture?

## **7. Climate change: economic implications and opportunities for agriculture**

*Susan Capalbo, Oregon State University*

Dr. Capalbo has looked at terrestrial carbon sequestration in addition to geologic sequestration; it's important to consider all of the options. She explained that geological sequestration involves pumping carbon dioxide deep below the earth's surface.

Studies of the economic impacts of climate change to Oregon have diverse conclusions because of the diversity of agriculture. In some regions, climate change will mean decreased yields; in others, a longer growing season will mean increased yields. There will likely be increased drought frequency and greater constraints on our water supply. Crops will mature more quickly at higher temperatures, and this may be problematic for certain types of crops, including wine grapes. Other potential effects include increases in pest and disease problems, and a variety of economic effects.

The economic potential for carbon sequestration is important – what is it going to cost? Technical potential for sequestration cannot be achieved unless farmers are willing to adopt management practices.

Economic studies are relatively inexpensive compared to field research. Dr. Capalbo conducted research in Montana to determine costs and incentives for growers to change practices. The rate that people would need to be compensated for converting to no-till is the difference between the profitability of no-till and conventional till.

Dr. Capalbo explained she would like to design web-based survey to determine the incentive amounts needed for carbon sequestration practices. Her research in Montana found a lot of variability by region in the opportunity costs of switching to no-till. She displayed a supply curve for carbon generated through her research, and explained it's important to find the low-cost suppliers of the carbon sequestration benefits.

Dr. Capalbo identified several research needs:

- Expanded role for research at land grant institutions: biotech, measurement technologies, environmental-economic-biophysical modeling.
- Baseline information on carbon in soils.
- Information on the technical potential for additional sequestration by cropping systems and regions (research by land grant institutions)
- Information on the economics of cropping systems (opportunity costs of switching)
- Protocols for monitoring and verifying carbon – credible carbon

Meeting participants also identified other research needs:

- Balance monitoring with cost
- Need same carbon supply curves developed for forest industry

Dr. Capalbo concluded that it's important for agriculture to identify things that they can do and offer those things in carbon sequestration and emissions reductions programs.

Matt Donegan added that economic adaptation also important – what are the implications on our trade position and how do we deal with that.

Katy Coba and Andrea Durbin explained that they would distill the information presented and discussed at the meeting, identify a small working group to develop recommendations, and share draft recommendations with the meeting participants for review and comment.