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CLIMATE FRIENDLY FARMING™

Climate Friendly Farming and Renewable Energy

Chad Kruger
Director of Outreach, CSANR

Northwest Renewable Energy Festival
September 24, 2004

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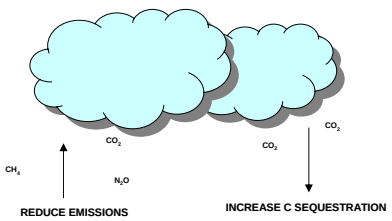
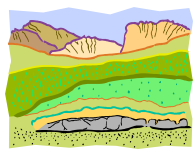
Washington State University helping farmers develop and implement agricultural systems and practices that mitigate global climate change.





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Impacts of Climate Change in the Pacific Northwest

The University of Washington's Climate Impacts Group is predicting that Cascade snow packs could be reduced by as much as 60% in the next 50 years, reducing the reservoir of stored water for . . .

- Irrigation (~75% of crop values in WA)
- hydro-elect power (~70% of electricity in WA)
- fish
- recreational use
- residential use

Another study is suggesting that Sierra Nevada snow packs could be reduced by 90% - increasing Californian demand for PNW resources.

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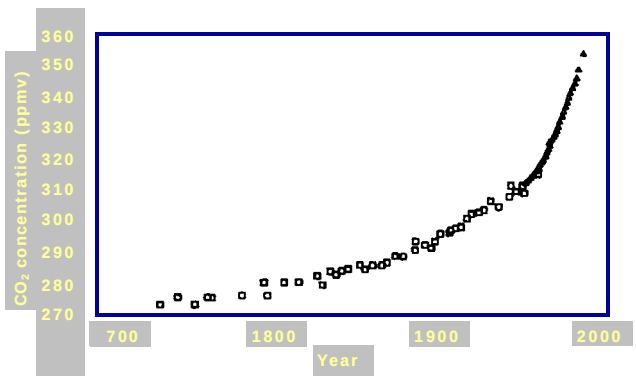
Agriculture as a source of GHG's



Change in Atmospheric Carbon Dioxide

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Agriculture as a source of GHG's

- EPA (2004) estimates that agriculture emits approximately 7% of US greenhouse gas emissions, the third largest source after the energy and transportation sectors.

- 65% of methane emissions are from agriculture (methane is 21 X's as potent of GHG as CO_2).

- 40% of N_2O emissions are due to agriculture (nitrous oxide is 296 X's as potent of GHG as CO_2).

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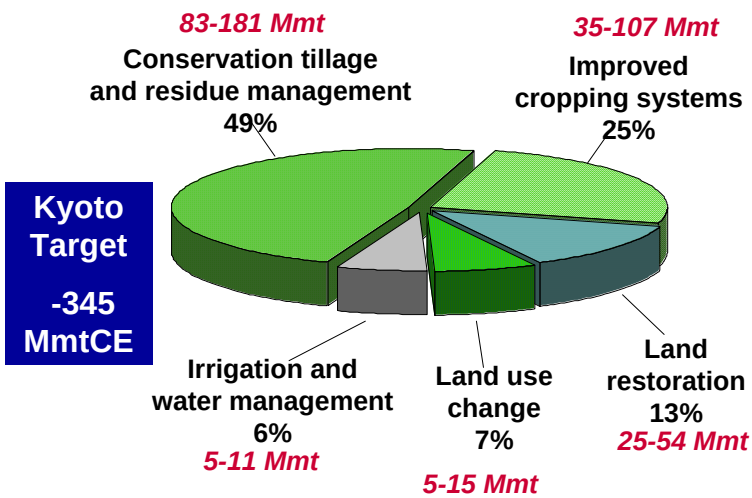
Agriculture as a sink for GHG's



From Lal et al., 1998.

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Climate Friendly Farming & Renewable Energy

Energy Efficiency through improved agricultural systems

Agricultural Wastes to Energy

Energy Crops

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Climate Friendly Farming & Renewable Energy

1. Agricultural Wastes to Energy: Anaerobic Digestion
2. Dedicated Energy Crops: Oilseed Production
3. On-farm Energy Efficiency: Reduced Use of Petro-chemicals and Fuels

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Waste biomass to energy: Anaerobic Digestion (AD)

Annual impact If AD is applied to all 250,000 dairy cows in Washington (just over 600 dairies):

- **Capture of 6.3 million tons of Carbon Equivalent (over $50 million at $8/ton).**
- **55 MW of electricity ($19 million) + waste heat (30% efficiency). Total energy value = 5.42 trillion BTU. (Approximately 45 – 50,000 average homes)**
- **45 million lbs of Nitrogen recovered, 8 million lbs of Phosphorous recovered ($21 million)**
- **$8 million worth of digested fiber**
- **~$400 / cow total annual value**

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Anaerobic Digestion (AD)

Obstacles to the adoption of AD on PNW dairies:

- **Capital Costs! $400-800 / cow (minimum 500 cows)**
- **Low electrical power rates in PNW**
- **Unreliable information on AD**
- **Insufficient "public" support (public policy and private mechanisms)**

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WSU Research Efforts on AD

- Monitor and evaluate AD performance for GHG & $$
- Co-product evaluation and market development
- Process improvements to reduce costs
- Small-scale digester applications
- Educational outreach

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Home-Grown Energy: Oilseed Crops

Crambe

Mustard

Rapeseed

Safflower

Soybean

Sunflowers

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Benefits of Energy Crops

1. Agronomic

- soil fumigant effects save $150/acre in pesticide costs for potato production
- Impact in crop rotation improves performance of reduced tillage systems

2. Fuel Performance

- 1% blend of biodiesel restores lost lubricity of low-sulfur petro-diesel.
- Biodiesel yields 3.24 times the energy as it takes to produce it (ethanol is 1.24)

3. Economic

- Oilseed production in PNW would be the least expensive feedstock for biodiesel production (retail price = $1.80 gallon including taxes)
- Irrigated region of Washington State could equal current biodiesel production (20 million g) in US with introduction of oilseed crops in rotation.

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Energy Crops: Comparative Advantage for PNW

• Nearest refinery is 1100 miles from Seattle.

• Yields of oilseed crops can be 30-40% higher in irrigated regions of PNW.

o Yields of canola and rapeseed can be 3500-4500 lbs/acre under irrigation. Amount of acreage necessary to produce canola can be cut in half.

• Use of biodiesel in sensitive marine environments in Puget Sound.

• Co-products / alternative bio-products from bio-refining process (organic pesticides/fumigants, animal feed, other bio-chemicals/products).

Plant	Yield (seed) lbs/acre	Biodiesel gal/acre
Corn	7800	18
Soybean	2000	48
Mustard	1400	61
Crambe	1000	65
Safflower	1500	83
Sunflower	1200	100
Rapeseed	2000	127
Coconut	3600	287
Oil palm	6251	635

Dryland production estimates

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Obstacles / opportunities for biofuel production

- **Need for bio-refinery and oilseed crushing facilities**
  - **Canola crusher is under construction in Creston, Washington (west of Spokane). Others are planned.**
  - **A variety of feasibility studies for a refinery are completed or in process.**
- **Ownership of the "value chain". Ie. Helping farmers, communities, and local industry to *realize* the economic benefits of biofuel production**
- **Importance of multiple feedstock / multiple end product capacity. Feedstocks: oilseed crops, wheat stover, wood pulp etc. Products: biodiesel, ethanol, bio-chemicals, etc.**

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On-farm energy efficiency

Reduced petro-fuel consumption:

- **Direct-seeding (25% reduction in machine hours, 15 – 50% reduction in energy use)**
- **Perennial crops**

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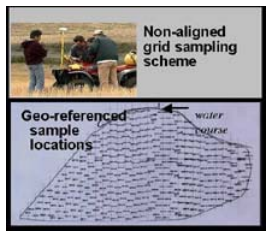
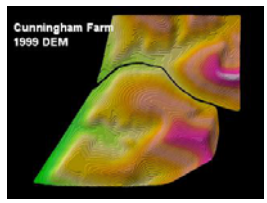
On-farm energy efficiency

Reduced use of petro-chemical inputs:

- **Water/nutrient management**
- **Improved soil fertility**
  - **(+1% SOM = 21% increase in yield potential – MI)**
  - **Each inch of soil loss requires additional 12 g gasoline equivalent / acre to maintain productivity)**
- **Legumes for N fixation**
- **"Precision farming"**





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The Multiple Benefits of Agriculture

1. **Improved environmental management on farms.**
2. **Improved environmental protection (reduced pollution, reduced GHG emissions).**
3. **Distributed sources of renewable energy generation.**
4. **Multiple feedstocks and product lines (power, fuels, products), value-added products, multiple value streams.**
5. **Economic development for the local, regional economy – many-tiered "value chains" that benefit farmers, communities, and local industry.**

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Climate Friendly Farming Research Team

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Management / Outreach: **Chris Feise, David Granatstein, Chad Kruger,** Center for Sustaining Agriculture & Natural Resources

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