



Climate Friendly Farming™ and Pacific Northwest Water Resources

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WSU Center for Sustaining Agriculture and Natural Resources
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Background

Researchers, policy-makers, consumers and farmers are beginning to realize that agriculture can provide multiple benefits to society, beyond the production of food and fiber. Many of these benefits are environmental benefits, such as wildlife habitat and water quality. Washington State University's Climate Friendly Farming™ Research and Demonstration Project is developing and implementing agriculture systems and practices that maximize the potential for agriculture to mitigate global climate change while providing other environmental benefits.

Recent predictions by the University of Washington's Climate Impacts Group (as published in Science Magazine) indicate that climate change could have severe consequences for water resources in the Pacific Northwest (Service 2004). The Cascade snow packs could be reduced by as much as 60% in the next 50 years, reducing the reservoir of stored water for irrigation, hydro-elect power, fish and residential needs. This concern is further complicated by the likelihood of shorter winters, more erratic precipitation events and longer droughts.

In addition to researching the potential contribution of agriculture to the reduction of greenhouse gas emissions and sequestration of carbon, Climate Friendly Farming™ is tackling water use and quality issues. The use of reduced tillage, crop rotations and cover crops can benefit soil quality by improving the water and nutrient retention capacity of the soil and by reducing erosion. Research on N₂O emissions reduction from irrigated crops is centered on improved efficiency of irrigation water and nitrogen management. The dairy component of the project is focused on improving dairy nutrient management and alternative electricity generation through anaerobic digestion. A related component of the project, the development of biomass-based energy sources, could further contribute to alternative sources of electricity generation, supplementing or reducing our demand for hydro-electric power.

Project Components

Dryland: Direct-seeding and/or reduced tillage and soil disturbance help mitigate the release of soil carbon into the atmosphere as CO₂ and improve the carbon sequestration capacity of the soil. In addition, the buildup of organic matter (soil carbon) in the soil improves the nutrient and water holding capacity of the soil, reducing overall water and nutrient needs, soil erosion and protecting water quality. The use of cover crops in cropping systems contributes toward greater total carbon sequestration of the cropping system, nutrient availability, weed and pest suppression, and reduces the need for chemical inputs which can have negative impacts on water quality and public health. Research and development of perennial polyculture cropping systems could further improve water quality by reducing soil erosion.

Irrigated: In addition to affecting the global carbon cycle, agriculture alters the terrestrial nitrogen cycle. Through nitrogen fertilization, annual cropping, monocropping, and improper water management, nitrogen is prone to being lost to both ground and surface water and to the atmosphere. According to the Intergovernmental Panel on Climate Change (2001), nitrous oxide (N₂O), a common emission from agricultural soils, is more than 296 times as potent as a GHG than CO₂ and it has increased in atmospheric concentration by 15% during the past two centuries (Mosier, 1998). Reductions can be achieved through improved nitrogen and irrigation water management, with the use of technologies such as drip irrigation and precision agriculture. Improved nitrogen and irrigation water management has multiple benefits beyond reducing GHG emissions, such as reduced surface and groundwater pollution and reduced demand for irrigation water from the Columbia River system.

Dairy: The USDA and EPA (1999) established the Comprehensive Nutrient Management Plan (CNMP) strategy in 1999 to reduce negative water quality impacts of Animal Feeding Operations (AFOs). The strategy considers the use of manure for power generation from large Confined Animal Feeding Operations (CAFOs) -- operations exceeding 1,000 animal units or that are significant pollution risks -- an acceptable alternative to land application of manure under

the CNMP's. Anaerobic digestion of manure from dairy farms has the potential to reduce greenhouse gas emissions which lead to climate change and to reduce water pollution. The Climate Friendly Farming™ project is also researching improved methods of nutrient extraction from manure to facilitate the export of excess nutrients from dairies with limited land through high-value fiber and liquid by-products from the digester.

Modeling: Intensive environmental monitoring is necessary to evaluate, document and model the performance of each agricultural system. In each case, state-of-the-art technologies are being used to assess how shifts towards Climate Friendly Farming™ practices impact fundamental processes that regulate the cycling, flow and use of energy, water, carbon and nitrogen. Greater understanding of these fundamental processes will lead to improvements in biophysical modeling and socioeconomic evaluations and provide major insights into the design and development of Climate Friendly Farming™ systems. Models of C, N, water, and energy cycles and flows are being developed for the irrigated and dryland systems. The models will be process-based and reflect the impacts of the specific soil characteristics, land use and management practices, and climatic conditions. Computer-assisted tools such as crop models, weather generators, geographic information systems, and multi-objective optimization are being used to diagnose points of intervention that will improve performance for greenhouse gas mitigation, energy conservation, soil and water conservation, and water quality protection.

Socio-economic analysis: Farmers have not traditionally been paid for the multiple environmental benefits they can provide to society. The lack of economic incentive has slowed the adoption of technologies that can contribute toward environmental goals. Socio-economic analysis is an integral part of the Climate Friendly Farming™ Project and cuts across all the components. Adoption of any changes in agricultural practice requires changes in policy, market circumstances and farm behavior. Identification of new systems and practices has limited value if no one adopts them. Socio-economic analysis will help identify practices and policy instruments that are economically justified, socially acceptable and financially feasible.

Related efforts: Climate Friendly Farming™ practices and technologies are one element of the multiple benefits of agriculture. Members of the research team are investigating related issues that also could impact water resource issues in the Pacific Northwest. An example of one of these efforts is the development of biomass energy crops and technologies

that could help offset demand for hydro-electric power. It has been estimated that there is sufficient biomass in Eastern Washington to produce energy for nearly 40% of residential needs in Eastern Washington (Chen et al 2003).

Resources

The Climate Friendly Farming™ Research and Demonstration Project's website is <http://cff.wsu.edu>.

The US EPA maintains a definition of Confined Animal Feeding Operations (CAFOs) at:
http://www.epa.gov/npdes/pubs/sector_table.pdf

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