Climate Friendly Farming:

Improving the Carbon Footprint of Agriculture in the Pacific Northwest

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Rationale

Agriculture is both a source and a sink for the most important greenhouse gases (GHGs) involved in climate change, including methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2). Direct greenhouse gas emissions from agriculture account for an estimated 10-12% of total global anthropogenic emissions (IPCC, 2007). However, including "indirect" greenhouse gas emissions that are generated as a consequence of agricultural production but accounted for in other sectors, such as agricultural fuel use, emissions from agrochemical and fertilizer production, and emissions from land use changes to produce agricultural products raises this figure to 17-35% (Bellarby et al., 2008; World Bank, 2007).

The Climate Friendly Farming™ (CFF) Project was established to provide research-based information to support agricultural GHG mitigation policies and the deployment of "climate-friendly" agricultural practices and technologies in three of the most common agricultural systems of the Pacific Northwest: dairy, dryland grain production, and irrigated horticultural crop production. The project was intentionally multi-disciplinary, combining field research, technology research and development, computer modeling and economic and policy analysis.

Anaerobic Digestion

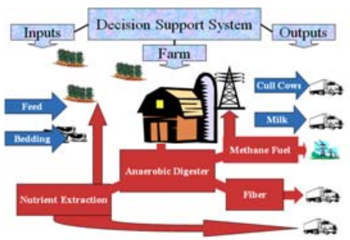


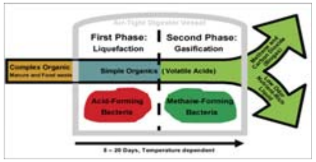
Figure 2.2: Next generation dairy farm and manure management system

What Emissions this Strategy Addresses:

Methane (CH_4) is released from manure when it is stored under conditions that enhance anaerobic decomposition, such as the wastewater lagoons that are used on large dairies. We estimate that anaerobic digesters installed on 40 Washington dairies totaling 70,000 wet cow equivalents (WEC) could provide GHG mitigation of roughly 1.1 MMT CO_2e/yr.

What this Strategy Includes:

Modern anaerobic digestion (AD) technology converts complex organic materials like manure to methane-rich biogas. The AD process diminishes odors, stabilizes waste, decreases pathogen counts, and reduces GHG emissions (Martin and Roos, 2007; US-EPA, 2004; US-EPA, 2005; US-EPA, 2008). The methane-rich biogas can be used to generate renewable energy (US-EPA, 2006).



Climate Friendly Farming Research Highlights:

- Novel AD systems suited to our PNW context
- Evaluation of commercial AD technology and co-digestion of food waste and manure
- Co-digestion model technology
- Nutrient recovery technology
- Horticultural-grade peat moss replacement
- Compressed biomethane for transportation fuel

Improving Nitrogen Use Efficiency

What Emissions this Strategy Addresses:

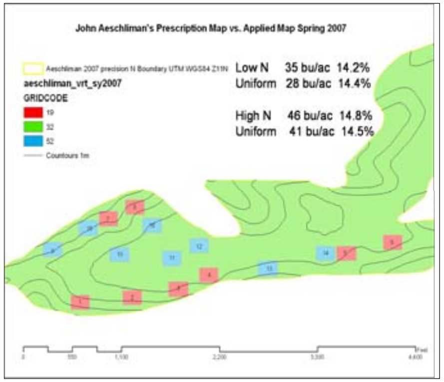
Nitrous oxide (N_2O) emissions occur in agricultural cropping systems through a natural soil microbial process. N_2O emissions are greatly enhanced when available nitrogen exceeds plant requirements, especially under wet conditions (Oenema et al., 2005; Smith and Conen 2004, as cited in IPCC, 2007). Reducing the amount of synthetic fertilizers applied relative to expected yields can reduce N_2O emissions from soils and CO_2 emissions from fertilizer production.

What this Strategy Includes:

Precision N technologies include a variety of strategies to improve the efficiency by which crops use nitrogen inputs, often by matching N availability more closely with plant needs.

Climate Friendly Farming Research Highlights:

- Field-tested existing precision N technologies
- Decision support tools to inform management



Conservation Tillage

What Emissions this Strategy Addresses:

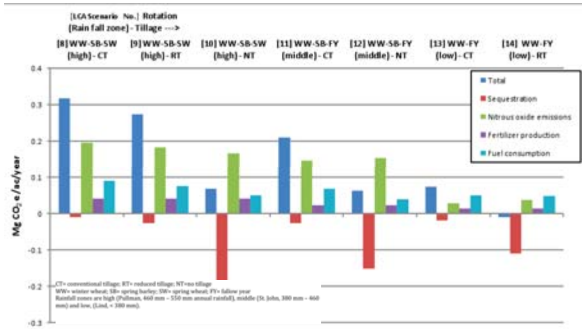
Intensive tillage has caused severe soil erosion and depleted more than 50% of the native soil carbon (C) in dryland grain cropping region of the Pacific Northwest. Conservation tillage reduces the direct emissions of carbon dioxide (CO_2) to the atmosphere caused by oxidation of soil carbon, can contribute toward increasing the sequestration of carbon in soils, and decreases CO_2 emissions from on-farm fuel use.

What this Strategy Includes:

Conservation tillage reduces the number and/or intensity of tillage operations.

Climate Friendly Farming Research Highlights:

- Tested reduced tillage systems in irrigated and dryland cropping systems
- Enhanced CropSyst, an agricultural process model, and used it to explore the impacts of conservation tillage on C sequestration and N_2O emissions
- Conducted a partial Life-Cycle Assessment of conservation tillage




Conventional Tillage


Reduced Tillage

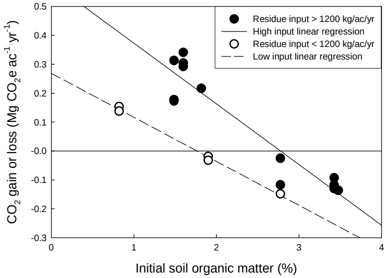
Managing the Carbon Cycle

What Emissions this Strategy Addresses

Carbon dioxide (CO_2) is absorbed from the atmosphere when it is incorporated into plant tissues through photosynthesis, and a portion of this carbon can be sequestered as stable soil organic matter as plants decompose. However, increasing C inputs may also impact additional GHG emissions (N_2O and CH_4) which will need to be more fully understood.

What this Strategy Includes:

Carbon inputs can be increased through the use of higher biomass crops or rotations, cover crops, perennial crops or organic amendments. Increasing carbon inputs and improving residue management can both positively affect carbon sequestration.



Climate Friendly Farming Research Highlights:

- Field evaluation of perennial grass-based cropping systems for bioenergy production, such as switchgrass
- Evaluation of manure applications for increasing carbon sequestration
- Evaluation of improved crop rotation for increasing soil organic carbon
- Assessment of the removal of crop residue for bioenergy production on soil organic carbon