

Center for Greenhouse Gas Mitigation through Natural Resource Management (CGGM)

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Current Graduate students involved in GHG Emissions and Mitigation Projects

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Summary

Greenhouse gas (GHG) emissions and climate change pose one of the greatest long-term challenges to human society. While fossil fuel combustion is the single greatest source of greenhouse gases, land use and agricultural activities contribute *almost one-third* of the human-induced warming of the planet. Hence, improved management practices are essential for reducing greenhouse gas (CO₂, N₂O and CH₄) emissions from land use. Carbon sequestration - by which carbon dioxide (CO₂) is removed from the atmosphere through the build up of carbon stocks in soils and biomass with improved land use practices - is a low cost, early-action mitigation option, which also rebuilds soil fertility. Practices that improve the nitrogen use efficiency of crops can reduce nitrous oxide (N₂O) emissions and greatly enhance environmental quality. Currently, nearly one-quarter of the nitrogen fertilizer used (11 million tonnes in the US) is lost from soils, resulting in nitrate pollution of groundwater, coastal 'deadzones' and degradation of pristine ecosystems. Reducing methane (CH₄) emissions from livestock production can increase animal productivity, yield renewable energy (CH₄ capture from manure storage), and improve air quality. Over the longer term, renewable energy from agricultural biomass offers great potential to reduce fossil fuel use. New crops and management systems for bioenergy production are needed to fully realize this potential in an environmentally sustainable way.

The mission of the proposed Center is to facilitate the adoption of improved land management practices to mitigate greenhouse gas emissions in an economically and environmentally sustainable fashion. We will accomplish this by providing the knowledge and tools needed by land managers and policy makers to design and implement land use-based mitigation strategies, including GHG emission reductions, carbon sequestration and bioenergy production. Implementing such strategies can provide a new source of income to farmers and ranchers, both from the emergence of emission reduction trading systems, which are under development in the US and internationally, and as energy producers. Additional benefits of GHG mitigation practices include improved air, water and soil quality.

NREL scientists are among the world leaders in terrestrial greenhouse gas assessment and mitigation. Our expertise spans agricultural, grassland, and forest ecosystems and we work closely with agronomists, foresters, atmospheric scientists, remote sensing experts, economists, and social scientists across CSU and around the world. For over 30 years we have led the development of ecosystem biogeochemical modeling and basic research on soil carbon and nitrogen dynamics. In addition, we are leading numerous efforts to provide terrestrial greenhouse gas inventories at national, region and state levels within the US and abroad, working with representatives of industries, state and federal agencies, and non-governmental organizations to help them integrate greenhouse gas mitigation into their activities.

Our ongoing work has had a direct impact on informing policy and decision makers. We provide the estimates for soil CO₂ and N₂O emissions for the greenhouse gas inventory

submitted annually by the US to the UN Framework Convention on Climate Change. We developed the accounting system for agricultural carbon sequestration used in the US voluntary emission reduction program, administered by the Department of Energy. We work with farmers and industry to develop environmentally sustainable use of agricultural residues and energy crops for renewable bioenergy. We work with economists and social scientists to assess the potential for emission-offset trading, whereby farmers and ranchers would receive financial incentives from industry to implement GHG mitigation practices. Our work has been used by USDA in setting conservation targets for government programs in the Farm Bill and we've worked with environmental organizations like Environmental Defense and the Nature Conservancy to implement 'on-the-ground' mitigation projects. Internationally, we are working with developing countries in Latin America, Africa and Asia to bolster their greenhouse gas inventory capabilities and develop strategies for mitigation and adaptation to climate change. Further, we are routinely involved in national and international efforts to inform society about land use impacts on climate as well as establish guidelines for GHG methodologies and reporting.

New initiatives for the proposed center include

- An assessment of terrestrial GHG emissions and mitigation options for Colorado, including carbon sequestration and biomass energy opportunities for farmers and ranchers in the state.
- Collaborations with plant breeders, economists and engineers to develop new, sustainable bioenergy production systems.
- Expansion of our research to include wetlands as well as livestock systems and urban environments.
- Improved assessment technology for local-level mitigation projects.
- Further development of regional and national analyses capabilities to support policy design and analysis and emission-offset accounting.
- Expanded collaboration with developing countries to assess and mitigate GHG emissions from land use activities.

Resource needs of the proposed center

- Support for core scientists and technical support staff
- Funds for visiting scholars, 'think-tank' activities and public outreach
- Graduate and postgraduate fellowships
- Support for training workshops for scientists from developing countries
- Resources to upgrade and maintain high speed-high capacity computing facilities and laboratory equipment

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