Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: Agricultural Carbon Capture in Western North Dakota

Applicant: ND Natural Resources Trust

Principal Investigator: Dr. Rebecca Phillips

Date of Application:

Amount of Request: $500,000

Total Amount of Proposed Project: $1,051,000

Duration of Project: 2 years

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ABSTRACT

The North Dakota Natural Resources Trust (NDNRT) proposes a collaborative, multidisciplinary research project to address technical information challenges facing agriculture and energy industries with respect to biological carbon (C) capture and Environmental Social Governance (ESG). Biological C capture refers to utilization of atmospheric C by conversion of gaseous CO2 to solid forms of C known as organic matter. Grasslands are uniquely suited for utilizing and sequestering C in soil, since most of the C captured by grassland ecosystems is allocated belowground. This allocation pattern contrasts with croplands or forests that primarily allocate C into aboveground production. Grassland ecosystems, therefore, play an essential role in drawing down atmospheric CO2 through processes following conversion of gaseous CO2 known as the C cycle that result in sequestration of C in soil as soil organic carbon (SOC).

Grassland ecosystems are highly effective at utilizing and sequestering excess C in the atmosphere, according to a recent study published in *Nature* (Terrer et al. 2021). This study monitored atmospheric, plant and soil C in ecosystems around the world for one or more decades; however, questions of how grazers influence the C cycle were not addressed. Data are lacking that quantitatively evaluate how managed grazing systems influence utilization and sequestration of C as compared to ungrazed control. Positive effects of grazing on C sequestration have been reported for Florida (Gomez-Casanovas et al. 2018) and New Zealand grasslands (Hunt et al. 2016). However, experimental data are not available for western North Dakota and other areas across the upper Midwest, a region dominated by grazing lands agriculture. The goal of this proposal is to quantify effects of managed grazing on C sequestration in western North Dakota grasslands.

This proposal is represented by a cohort of ranchers, scientists, conservationists, university extension, and oil company representatives that assert managed grazing systems can be used to enhance C utilization and sequestration in western ND grasslands. The key, according to these specialists, is grazing management. Using grazers to stimulate leaf production, root production and root exudates in a manner that adapts to the environment will enhance rates of C utilization and sequestration (Wilson et al. 2016). We aim to determine how managed grazing influences the C cycle because these data are essential for understanding how grazing lands agriculture could enhance business and local economies through ESGs and the C market.

The goal of quantifying C utilization and sequestration on working lands in the western ND will be achieved in three phases. This proposal describes Phase I. Information generated from this project will positively affect the oil industry and ranching communities by illuminating how C sequestration in grazing lands could enhance ESG portfolios, complement direct air C capture, improve natural resources, and advance energy and agricultural sector goals.

Objective: Demonstrate the role of managed grazing lands in reducing the environmental footprint of oil and gas exploration through biological C utilization and sequestration. Subobjectives to meet the stated goal are: 1) scientifically collect, process and analyze high frequency atmospheric C data and environmental covariates (precipitation, soil and air temperature, soil moisture, net radiation) using state-of-the-art micrometeorological instruments and associated sensors at grazed and ungrazed pastures; 2) report how rotational, managed grazing influences rates of biological C utilization (using net C uptake data) and C sequestration (using net C uptake and export data); 3) frame results as a prototype to illustrate how North Dakota grazing lands can be managed to improve C utilization and sequestration for the benefit of agricultural and energy industries and rural economies.

Expected Results: Prototype for expanding agriculture and energy into C markets and ESGs.

Duration: (May 2022 to January 2024).

Total Project Cost: The amount requested from the Oil and Gas Research Program (OGRP) is $500,000. Co-funding and non-cash match will be provided by the North Dakota Natural Resources Trust, the National Fish and Wildlife Foundation, the North Dakota Petroleum Council, the Northern Great Plains Joint Venture, and the North Dakota Game and Fish Department.

Participants: NDNRT, Ecological Insights, Dickinson State Univ., North Dakota Grazing Lands Coalition, the National Fish and Wildlife Foundation, the North Dakota Petroleum Council, the North Dakota Stockmen's Association.

PROJECT DESCRIPTION

Objectives:

The contemporary increase in atmospheric CO_2 has spurred investigation and investment into biological and mechanical methods of capturing and storing C belowground. Biological C capture refers to plant utilization of atmospheric CO_2 and sequestration as soil organic C (SOC), while mechanical C capture refers to methods that directly capture air from a smokestack or flue for deep storage as liquified CO_2. Mechanical C capture reduces the amount of CO_2 that would normally be emitted from power plants. Biological C capture effectively captures CO_2 in the atmosphere through photosynthesis and then stores a fraction of photosynthate as SOC. The NDNRT sees North Dakota grasslands agriculture as integral to the Governor's plan for achieving C neutrality by 2030. Mechanical and biological methods can both contribute to reaching the Governor's goal, but agricultural C capture offers an immediately available, cost-effective option for increasing utilization and sequestration of C as SOC. While previous reports indicate broad patterns in grassland C utilization, they do not address potentially positive grazing impacts reported by Conant et al. (2017) and others cited in this proposal. Consequently, this proposed research is needed to bridge the knowledge gap for the economic and environmental benefit of agricultural and energy sectors in North Dakota.

The overall objective of this proposed project is to quantify how agricultural C capture in managed grazing lands could serve to reduce the footprint of oil and gas exploration in western North Dakota. Three subobjectives for meeting this goal are: 1) scientifically collect, process and analyze high frequency atmospheric C data and environmental covariates (precipitation, soil and air temperature, soil moisture, net radiation) using state-of-the-art micrometeorological instruments and associated sensors at grazed and ungrazed pastures; 2) report how rotational, managed grazing influences rates of biological C utilization (using net C uptake data) and C sequestration (using net C uptake and export data); 3) frame results as a prototype to illustrate how North Dakota grazing lands can be managed to improve C utilization and sequestration for the benefit of agricultural and energy industries and rural economies. These goals require measurement of net C uptake and exports as forage in grazing animals. The final report will provide guidance materials for land managers and investors interested in optimizing biological utilization and sequestration of C. Guidance will show how asynchronous grazing influences plant production, diversity, and rates of C sequestration in grazed and ungrazed grasslands. This proposal represents an initial set up and data collection phase, covering two years of work. We anticipate additional years of data and economic impacts over subsequent years, in Phases II and III.

This proposed research will address a critical information need. The NDNRT will provide, for the first time, annual rates of biological C utilization and sequestration in North Dakota grasslands under managed grazing. Data will be framed to show that biological C sequestration leads not only to reductions in the C footprint from oil and gas exploration but also benefits to natural resources and rural economies. The role of C as a bridge between energy and agricultural industries is the project theme, abutted by ecosystem-scale, biological C flux data resulting from this project.

A recent *Nature* article reports grasslands are more effective at capturing and storing excess atmospheric C belowground than forests, based on over a decade of research at 108 free-air CO_2 enrichment sites (Terrer et al. 2021). Grasslands are also reportedly a more stable reservoirs of C than forests, particularly when future climate models are included in the analyses (Dass et al. 2018). These experimental sites and models, however, do not include the most important component to grassland agriculture worldwide—livestock grazing. Most grasslands are grazed by livestock, and positive ecophysiological responses to grazing have been widely observed (Wilson et al. 2018; Gomez-Casanovas et al. 2018). In today's world of C budgeting and marketing, the need to understand the role of grazing lands in the C cycle cannot be overstated.

North Dakota ranchers and grassland managers in recent years have refined practices to model historical bison grazing patterns because grasslands are well-adapted and tend to thrive under periodic, intensive grazing (Savory and Butterfield 2016). These grazing practices, commonly referred to as regenerative, employ a holistic, ecosystem-scale approach to grassland management. A fundamental tenant to regenerative grazing management is to rotate livestock among multiple paddocks, so that periods of short, intensive grazing are followed by periods of rest and recovery. North Dakota ranchers anecdotally report greater biodiversity, forage production, wildlife habitat, and soil health under regenerative grazing. Greater plant productivity would mean greater C utilization and likely greater rates of C sequestration. If management that increases C sequestration or other ecosystem services yield an economic value, ranching communities should benefit. For this reason, grazing coalitions and associations are calling on the NDNRT to quantify the role of regenerative grazing in the C cycle. Since the NDNRT currently works with ranchers on implementing managed grazing systems across North Dakota, this is a logical next step.

Project planning is currently underway in anticipation of Oil and Gas Research funding. Objective 1, after funding is secured, will include purchase of micrometeorological measurement systems. These are referred to eddy flux systems, which will be deployed in selected western North Dakota pastures. Eddy flux systems measure molecular CO_2 and water vapor exchange and 3-D wind speed at high frequency (20 hz) continuously and year-round. These are research-grade instruments requiring monitoring, calibrating, data screening, and data processing. The system measures CO_2 and H_2O concentrations in vertical eddies of air, along with temperature, pressure, and humidity. Approximately 3,600 data points are collected every 0.5 hr, and these data are used in the calculation of

CO_2 and H_2O fluxes every 0.5 hr. The spatial extent of the measured flux varies with wind speed and turbulent momentum but tend to average over a 40-acre area for any 0.5 hr period. The covariance is calculated between the fluctuating component of the vertical wind and the fluctuating component of gas concentration. The measured flux is proportional to the covariance. Eddy flux measurement systems have been deployed at thousands of sites since the 1990s and are the most widely published instrument for measuring rates of C exchange worldwide. Eddy flux systems will be deployed in each of two neighbouring pastures: One pasture developed for managed grazing system (Figure 1) and one in a rested pasture. Environmental data (soil moisture and temperature, air temperature, wind speed and direction, vapor pressure, etc) will be collected continuously every minute and averages computed every 0.5-hr. All data will be converted and reported as units of C and used in calculations explained in the subsequent paragraph.

The second objective will be achieved by collecting, processing, and integrating plant, soil, atmospheric, and management data into a cohesive annual accounting of net C utilization (the annual amount of C uptake by the ecosystem) and the amount of C sequestered, referred to as the net ecosystem C balance (NECB). The NECB is a calculation representing C sequestration at an ecosystem scale, which differs from collecting soil cores over a 5- or 10-year time span at specific points in the pasture. The NECB is calculated using a full year of net ecosystem C uptake and export data. A full description may be found in Hunt et al. (2016) but can be summarized as follows:

$$\text{NECB} = \text{NEP} + F_{\text{import}} - F_{\text{export}}, \quad \text{(Eq. 1)}$$

where NEP is the balance between C uptake (GPP) and C emissions (ER) measured by eddy flux:

$$\text{NEP} = \text{Gross primary production (GPP)} - \text{Ecosystem respiration (ER)}, \quad \text{(Eq. 2)}$$

The terms F_{import} and F_{export} represent additional C gains and losses from the ecosystem, respectively. For example, grazing livestock are considered as agents of export which quickly remove large amounts of biomass, expressed by the term F_{harvest}. The amount of hay harvested in the rested pasture is an export, also expressed as F_{harvest}. Livestock are also agents of C import when depositing urine and manure, F_{excreta}. Another form of C export in grazing land ecosystems is dissolved organic C, expressed as F_{DOC}. This term is included in the NECB equation, although in this semi-arid region, it is considered negligible.

$$\text{NECB} = \text{NEP} + F_{\text{excretata}} - F_{\text{harvest}} - F_{\text{DOC}} \quad \text{(Eq. 3)}$$

Calculation of F_{harvest} is estimated by collecting dry biomass clipping data before and after harvest. Calculation of $F_{\text{excretata}}$ is estimated based number of animals in the herd, cattle weights, time on pasture, biomass removed, forage digestibility, typical urine volumes, and typical C contents of manure and urine. Publication of annual rates of C utilization and sequestration, according to the NECB, is fundamental to the project impact and successful accomplishment of the third objective.

The third objective is necessary for expanding the scope and impact of this project from sound scientific research results into a new paradigm for regenerative agriculture and energy industry partnerships. The NDNRT will orchestrate this outcome by engaging with its extensive land manager network in North Dakota and by leveraging current conservation. The fuel, metaphorically speaking, for achieving this objective is the great interest in C as a commodity and as an ESG asset. The interest in biological C sequestration by C buyers, validators, aggregators, and sellers continues to rise. Ranchers, land administrators, energy companies, and educators are calling for C sequestration data in North Dakota grazing lands. This project is geared to meet these demands through education, outreach, and program delivery.

Methodology:

The NDNRT will work closely with landowners, universities, conservation agencies, soil conservation districts, and scientists to implement a state-of-the-art research program, with results published in an internationally recognized, peer-reviewed journal. Results will be framed to show how the oil industry's C capture objectives can economically benefit ranchers and how regenerative ranching can benefit oil companies with ESGs. Key findings will be integrated into a prototype biological C capture plan with guidance for optimizing biological C utilization and sequestration. The figure below (Figure 1) summarizes the managed grazing system for the regenerative pasture.

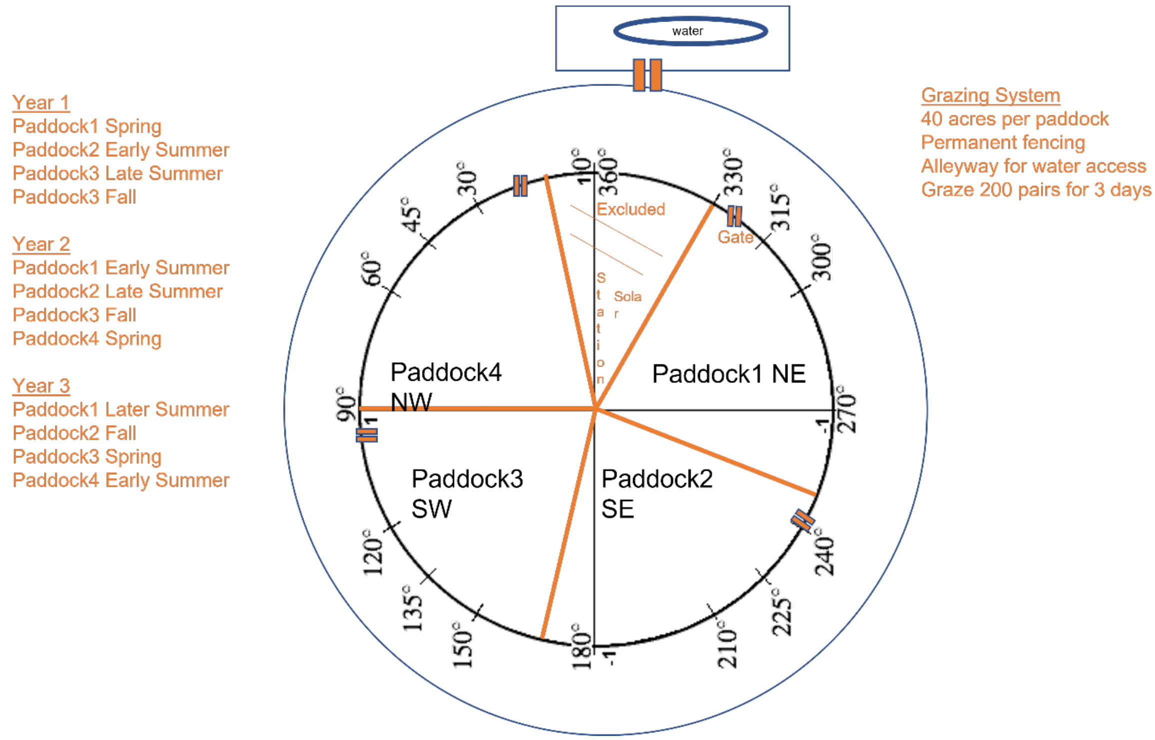


Figure 1. Managed grazing paddock development. Instruments are permanently deployed in the northeast quadrant of the pasture footprint, the direction where winds are least frequent. Equipment and water structures interfere with air flow, so this quadrant is excluded from the data. Livestock are directed away from data collection area when they need water.

Objective 1. Scientifically Collect, Process and Analyze High Frequency Atmospheric C Data

Subobjective 1.1. Site Selection and Characterization: Select grazing lands in western North Dakota where ranchers are interested in learning how grazing management influences ecosystem C and where experimental criteria are met. Criteria include level terrain and similar site and vegetation characteristics for two pastures that vary with respect to land management. A preliminary sketch of the grazing management system is outlined in Figure 1. Water, alleys, and fencing are required before implementing the grazing system. The rested pasture would not be grazed but instead harvested once each year. Field site selection would be followed by plant surveys, soil sample collection and evaluation for soil health variables expected to be influenced by management. These first soil samples would represent conditions at the onset of the research, or T0. Activities for this subobjective will occur during the summer and autumn of 2022.

Subobjective 1.2. Field Station Set Up: Procure, deploy, and test eddy flux measurement systems at rested and managed pastures (Figure1). Calibrate and confirm instruments are correctly measuring 3-D wind speed and direction, moles of CO_2 and H_2O, soil temperature, soil moisture, and net radiation. Calculate energy balance at each pasture. Process initial datasets to account for uncertainties around factors including air density changes, coordinate rotation, frequency corrections, and atmospheric turbulence. Run gap-fill algorithm and evaluate data gaps and uncertainties. Summarize results for site initial conditions and micrometeorological data for biannual report (D1). Due to current instrument lead times, this subobjective will begin in autumn of 2022.

Subobjective 1.3. Instrument Monitoring and QC: Monitor field stations using remote data access twice daily and set alert for station loss of power to minimize data gaps. Data gaps can occur in the event of power losses, extreme weather events or sensor failures. Since data collection and access depend on continuous power, power issues must be resolved immediately in the field. Sensor inspection and calibration are required following extreme weather events. Soil moisture measurements are regularly compared with actual soil moisture to construct a site-specific calibrated curve. Inspections and maintenance of precipitation gauges, relative humidity filters, radiometer desiccant, logger connections, batteries, and solar panels are conducted weekly. Assess data quality using non-stationarity, turbulence, and wind direction queries to assign data quality grade. Determine if energy in net radiation (Rn) is balanced by sensible (H), latent (LE) and soil heat (G) fluxes measured and calculated at the field station. Instrument monitoring and quality control will begin during the winter of 2023 and continue throughout the length of the project.

Objective 2. Report Influence of Rotational, Managed Grazing on Rates of Biological C Utilization C Sequestration

Aboveground biomass data must be collected before and after animal or hay harvest. The difference is the amount of C exported and will be used in the calculation of F_{export}. For the rested pasture, this will occur in July or August. For the grazed system, this will occur at four times each year—once for each of the four respective paddocks (Figure 1). Plant diversity measurements will also be collected prior to harvest. Soil samples will be collected in fall each year and analyzed for fertility, SOC and other soil health variables. Students at Dickinson State University will have the opportunity to participate in summer field work and use the data to evaluate how soils, plant production and biodiversity are influenced by this alternating, intensive grazing system for their senior theses.

At the end of a data collection year, the net C balance (NECB) will be reported for each pasture according to Hunt et al. (2016). The NECB is a measure of net C sequestration beyond classical measures of SOC. NECB represents all remaining pools of organic C in the ecosystem (from fungi to roots) and deposits of C from the animal, less C harvested. Key data for this calculation are 1) the amount of biomass C exported from each paddock, determined from dried biomass data collected before and after harvest; 2) the net daily uptake of CO_2 for each paddock, based on spatial footprint modelling; 3) cumulative net CO_2 uptake for each paddock and data collection year, based on temporal analysis of filtered, corrected and gap-filled, high frequency flux data; and 4) annual input of manure and urine C by livestock. Item 4 will be estimated based on livestock number and number of days on paddock, amount grazed, forage digestibility, typical urine volumes, and typical C contents of manure and urine. The dissolved organic C represents another potential C export that, in semi-arid ecoregions, is assumed to be negligible.

A complete dataset is key to minimizing uncertainty in the annual NECB, particularly for the grazing system. While the vegetation and soils and grazing intensities will be similar among paddocks, the timing of grazing events will vary, as well as the amount of forage harvested at each event. Fluxes are determined based on parcels of air or eddies moving toward the sensors from a particular direction. The air parcel size and location over a specific 30-minute period is spatially represented by a 'footprint.' The eddies from the southeasterly direction collected at the sensor would represent paddock 2 but not paddock 4. These spatial analyses will provide new insight for grazing, rest, recovery, and seasonality responses. The number of C flux data points for each paddock will vary according to prevailing winds. In addition to specific paddocks, the entire data set for the pasture, representing an overall average NECB, will also be reported and compared with rested pasture NECB. Preliminary rates of annual net ecosystem CO_2 utilization and sequestration will be reported at the end of each year of data collection (D2).

Potential rates of grassland C capture will be modelled based on significant covariates to C flux over time. Expected covariates known as drivers to net ecosystem production (or net C uptake) across multiple biomes, including grasslands, are radiation, precipitation, temperature, and leaf area (Beringer et al. 2016). Eddy data will be statistically modelled to assess covariates measured at the pasture sites, including soil moisture, soil temperature, air temperature, relative humidity, solar radiation, and precipitation. A model for estimating effects of managed grazing on the C cycle in agriculture will be developed (D3), including significant environmental covariates. This objective will begin in 2023.

Objective 3. Frame Results as Prototype to Illustrate how North Dakota Grazing Lands can be Managed to Improve C Utilization and Sequestration

Framing the results in Objective 3 will require participation and input from stakeholders throughout the project to help design a communication strategy. The biological C capture prototype and its association with managed grazing and healthy grassland soils is a concept that is not necessarily obvious and will require some steps towards public education. For this reason, interpretation and dissemination of results are fundamental to successful implementation of this project and the reason for including Objective 3 in the proposed plan. Project leader Jesse Beckers is currently and will continue to work closely with energy and agricultural stakeholders in Phase 1 of this project, as well as in Phase 2. The NDNRT will help lead efforts to engage participation by ranchers, soil conservation districts, university extension, the USFS Dakota Prairie Grasslands, and industry groups and individuals throughout the project. The economics around C markets will provide the incentive, and engagement will be facilitated by a common interest in the environmental value of grazing lands agriculture. The NDNRT will help lead research discussions with Ecological Insights at biannual meetings with project stakeholders and organize field tours at the site each year. The first field tour will take place in the summer of 2022. The vision of this objective is to bridge energy and agriculture by the common C currency, as shown in Figure 2.

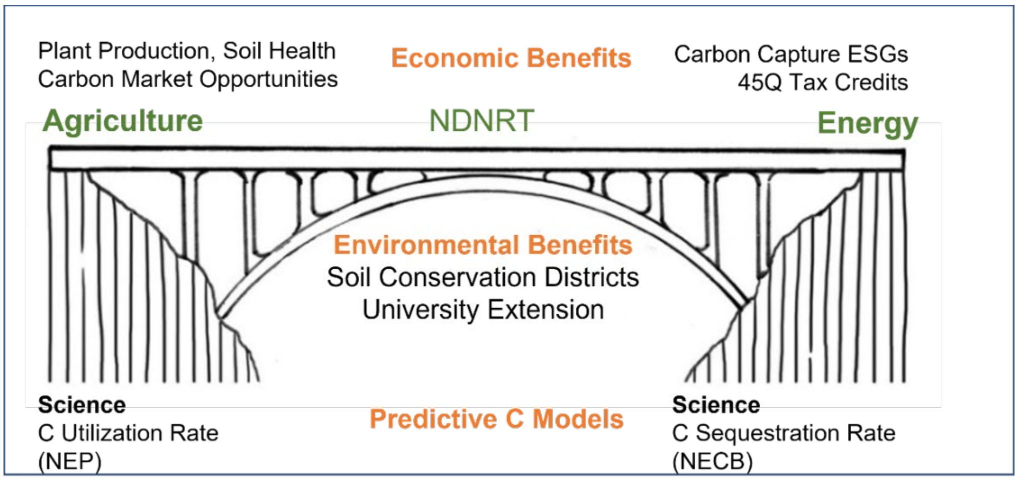


Figure 2. Prototype for bridging North Dakota agricultural and energy industry stakeholders and conservation groups abutted by biological C utilization and sequestration science.

As the preliminary data become available each year, participants will have an opportunity to query results with the field station scientists and research associates. Dr. Phillips has several years of experience communicating research results to farmers, ranchers, educators, and the public. Discussions among stakeholders will be essential for communicating the importance of these results to rural communities and the energy industry.

Beyond dissemination to the public and industry stakeholders, results will provide an important link currently missing in most grassland C agricultural models. Currently, C offset programs that forecast rates of SOC sequestration in grasslands, such as BCarbon, rely on models that use published relationships written into code by developers and marketed as process models known as Denitrification-Decomposition (DNDC), Century and DAYCENT. While the potential role of ranchers in managing for greater C storage is acknowledged by the modeling community, few data are available to accurately model effects of managed grazing on SOC on an ecosystem scale. We address this very important need by complementing efforts by BCarbon and others to incentivize agricultural C management with real-time rates of C utilization and rates of sequestration to include all forms of biological C belowground.

This project represents a first step towards challenging myths around grazing and the environment. The assertion that rotational grazing management can be a tool for improving rates of C sequestration (reported as NECB), C utilization (reported as NEP), SOC, and soil health have not previously been published, and the need for agriculture to understand C in grazing lands is immediate. Partners engaged with this project understand the urgency, with rigorous science and attention to deadlines. Prototype guidance documents, girded by careful peer review and input from ranchers and natural resource managers, will provide strategies for optimizing biological carbon capture in grasslands using livestock as a tool (D4).

This proposed project's focus is on meeting the immediate C information needs for ESGs and carbon markets in North Dakota. Additional dollars will continue to be pursued to expand the project beyond the initial two-year period. Given additional funding, we would expand data collection to an additional site in western North Dakota and include continuous measurement of methane flux in the field (Gomez-Casanovas et al. 2018).

Proposed Deliverables (D)

D1—Biannual Reports: Reports will be submitted to NDIC biannually, within 30 days of July 1 and Dec 31 each year.

D2—Data Analyses: Preliminary rates of annual net ecosystem CO_2 utilization and sequestration will be reported at the end of each year of data collection

D3—Modeling Effect of Managed Grazing over Time: High-frequency, time series data will be modeled on a daily time step (metric tonnes C/acre/day) and analyzed to assess effects of weather and grazing events.

D4—Carbon Capture Prototype: Research results will scaffold the C capture in grazing lands prototype. Guidance documents, including potential strategies for optimizing biological C capture in North Dakota, will be crafted with input by the project team and disseminated through conservation and extension agencies following peer review.

D5—Final Report: Annual rate of C utilization for pastures under managed grazing, as compared with rested pasture, will be reported each year of the project as net C uptake. Annual rate of C sequestration for pastures under managed grazing, as compared with rested pasture, will be reported each year of the project as the net ecosystem carbon balance (NECB). Environmental and management decision drivers to net C uptake and NECB will be evaluated and reported. A peer-reviewed manuscript reporting effects of managed grazing on the NECB will also be part of the final report.

Facilities, Resources, & Techniques to Be Used, Their Availability and Capability: Ecological Insights Corporation is equipped with hydraulic soil coring equipment and laboratory facilities for processing soil and plant samples. Dickinson State University facilities include plant sampling and processing equipment, as well as the University of North Dakota (UND), which is available to Dr. Phillips as adjunct faculty at the John D. School of Aerospace Sciences and the School of Arts and Sciences. Students and faculty at Dickinson State will have the opportunity to participate in field work during the summer and explore grazing research questions for student projects. Equipment for collecting data will either be purchased or supplied by facilities being employed to carry out specific tasks. Eddy flux system maintenance and data processing will be in accordance with established methods published by Phillips and colleagues (Polley et al. 2010; Polley et al. 2010; Polley et al. 2011; Beringer et al. 2016; Hunt et al. 2016), as well as others in the literature (Gomez-Casanovas et al. 2018).

Environmental and Economic Impacts while Project is Underway: There are no anticipated negative environmental or economic impacts during this project. Through utilization of a managed rotational grazing system, the participating producer(s) will expectedly see positive environmental and economic impacts to their grasslands including but limited to greater biodiversity, forage production, wildlife habitat and soil quality.

Ultimate Technological and Economic Impacts: This project represents a phenomenal opportunity for the energy industry to support state-of-the-art science that will benefit rural North Dakota. This is evident by the strong interest among farmers and ranchers, educators, and grassland enthusiasts throughout the state. Ranchers are asking for these data because they need tools for managing C sequestration and negotiating with companies that purchase C offsets. Biological C capture can effectively complement mechanical C capture while enhancing agricultural environmental and economic sustainability. Ranchers know that learning how to manage annual rates of C sequestration will increase their bargaining position for C offset dollars each year. In addition to rural community benefits, the state of North Dakota will lead the nation in regenerative research for C sequestration optimization, with clear ESG potential.

Why the Project is Needed: Governor Burgum recently emphasized the importance of coupling energy and agriculture as North Dakota considers the future of economic growth. This proposed project is an ideal framework for coupling energy and agriculture with interest from multiple sectors of the economy. The project is needed because mechanical capture of CO_2 emissions at stacks alone will not solve the problem and bring the state to a C-neutral economy. Experts agree that multiple avenues for sequestering atmospheric CO_2 are needed. The specific avenue proposed here, is conservation and ag production friendly and practical across a broad range of demographic groups and a way of building agricultural and energy alliances.

STANDARDS OF SUCCESS

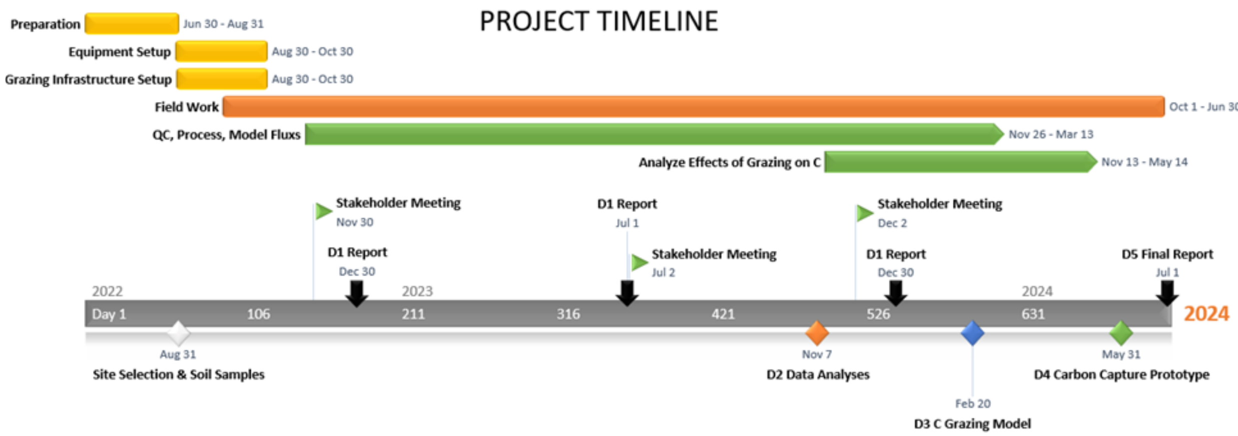
This proposal addresses the Program goal of reducing the carbon footprint associated with oil and gas exploration and expanding economic opportunities by quantifying effects of regenerative ranching on agricultural C capture for the benefit of North Dakota agriculture and energy sectors. Success will be measured by data collection and publication quality, public education and outreach, and stakeholder engagement. Deliverables and milestones will be incorporated into a contractual agreement to ensure the project is carried out on schedule and in a manner that best ensures the objectives will be met. Progress reports will be prepared biannually (due 30 days from the end of the second and fourth quarters) and will serve as a means of evaluating the project with respect to budget, schedule, and technical achievement. The evaluation points (i.e., deliverables and milestones) are identified in the Timetable.

BACKGROUND/QUALIFICIATIONS

Jesse Beckers is the project manager and Dr. Rebecca Phillips is the principal investigator (PI) on the project. Other key advisory personnel include Drs. Bradley Rundquist and Soizik Laugette at the University of North Dakota, Dr. Kevin Sedivec at the Streeter Grassland Research Center, and Toby Strohat Dickinson State University. Jesse has worked for the North Dakota Natural Resources Trust for seven years and has 16 years of habitat and conservation program delivery experience in North Dakota and has extensive experience working with energy companies in oil producing counties, and coordinates and develops partnerships with local government personnel and stakeholders in the area. Jesse is currently managing four grants related to energy and habitat conservation in North Dakota. Grassland restoration, oil field reclamation and relationship development are key aspects to his position. The lead scientist on the project, Dr. Rebecca Phillips, and other faculty on this project have worked together in the past on grassland ecology, grassland spatial modeling, and C biogeochemistry. Click on the link for a list of publications and credentials.

MANAGEMENT

The North Dakota Natural Resources Trust has managed 20 grants in the last seven years, delivering 16 programs, consisting of hundreds of contracts with producers. Jesse Beckers will manage the project and evaluate the following: 1) Biannual flux data quality report by science contractor; 2) Monthly budget tracking; 3) Biannual field site management report; 4) Partner/stakeholder meeting summaries with discussions of education and outreach strategies; 5) Adherence to milestone deliverables and dates.



BUDGET

Project Associated Expense	NDIC Request	Applicant's Share (cash)	Applicant's Share (In-Kind)	Other Project Sponsor's Share	
Science Contractor (EIC)	$500,000.00	$75,000.00	$25,000.00	$415,000.00	*
Contractor (DSU)				$6,000.00	**
Consulting (ME)				$30,000.00	***
Total	$500,000.00	$75,000.00	$25,000.00	$451,000.00	

* $368,000 of in-kind match from the National Fish and Wildlife Foundation, $19,000 cash match from the North Dakota Game and Fish Department, $10,000 in-kind support from the North Dakota Petroleum Council, $15,000 in-kind support from the Mercer County Soil Conservation District, and $3,000 in-kind support from the Northern Great Plains Joint Venture.
** $6,000 cash match from the North Dakota Game and Fish Department
*** $30,000 in-kind match from the National Fish and Wildlife Foundation

NDNRT requests NDIC funding of $500,000 to complete Agricultural Carbon Capture in Western North Dakota. A detailed and itemized budget is found in Appendix A. NDNRT will be contributing $100,000 of cash and in-kind support to the Project for contractor time and expertise. NDNRT will coordinate with above listed contractors on landowner permissions, outreach to Project partners, education, and relationship building with landowners in the Bakken as well as industry representatives. The North Dakota Game and Fish Department has committed $25,000 cash to the Project for Science and Contractor Support. The North Dakota Petroleum Council has dedicated $10,000 of in-kind match to promote biological carbon capture at petroleum events, newsletters, and outreach. The Mercer County Soil Conservation District is contributing $15,000 in-kind for habitat program delivery, and the Northern Great Plains Joint Venture has committed to in-kind support of $3,000 to export the results of this research to appropriate audiences. NDNRT has submitted and received funding from the National Fish and Wildlife Foundation (NFWF), and match from that request is in-kind of $398,000.

Ecological Insights Corporation (EIC) will provide technical (analytical, laboratory, and reservoir engineering) and data management support for this effort, with budget listed in Appendix A. If the requested amount of funding is not available, the stated goals and objectives will be unattainable, as project success is directly tied to integration of the proposed technical activities. Dickinson State University students and faculty will be involved in summer field work.

PATENTS/RIGHTS TO TECHNICAL DATA

No patentable technologies are expected to be created during this work.

STATUS OF ONGOING PROJECTS (IF ANY)

The North Dakota Natural Resources Trust has not previously been awarded an OGRP funding.

APPENDIX A

Subcontractor Ecological Insights Corporation (EIC) budget detail for proposed project entitled "Agricultural Carbon Capture Optimization in the Bakken." April 6, 2022

BUDGET SUBCONTRACTOR	January 2022- January 2023	January 2023 - January 2024
Maintenance & Repair Supplies	$8,000.00	$2,000.00
Travel	$25,000.00	$23,676.00
Telecommunications and Software	$4,000.00	
Manuscript Prep & Publication	$50,000.00	
Labor in Bakken, Reports, Outreach	$130,000.00	$130,000.00
Lab Fees	$4,896.00	
Equipment Cost- Year 1 Set Up	$122,428.00	
Total Subcontract Budget, EIC	$344,324.00	$155,676.00
TOTAL	**$500,000.00**	

APPENDIX B

Work Cited

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