# The Ethos Farm Ecosystem and Carbon Trial {EFECT}

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**Overview: Ethos Farm Ecosystem Carbon Trial ('EFECT'),** is part of the Ethos Farm meadow restoration initiative. This initiative seeks to reestablish native warm season grasses (WSG) to drawdown atmospheric carbon, regenerate soil health and provide ecosystem services (such as providing food and water, regulating climate and water systems and providing cultural benefits like recreation). EFECT will take a scientific approach to measuring carbon sequestration and ecosystem services under different land management strategies. It is anticipated that demonstrating benefits in carbon sequestration, soil health, and water quality, establishment of WSG could become a model for reducing atmospheric CO2 levels while restoring vast stretches of conventional corn-soybean cropland, recreating habitat for native species facing extinction and providing living soils for the production of the whole plant foods vital for human health. A team of scientists will periodically measure the effects on soil carbon, soil microbiology, hydrology and biodiversity of the system when using different strategies to manage WSG such as prescribed burns, mowing, haying and grazing and orchard production.

**The Problem:** The food we eat and the way it is produced has become one of the major threats to human and planetary health. Intensive agricultural practices employed to meet the world's growing appetite for industrially produced animal foods degrade soil health and water quality, harm human health, and produce a great amount of greenhouse gas (GHG) emissions (1,2,3,4,5,6). There is growing demand that transformation to regenerative agricultural practices is necessary to restore soil, human, and planetary health. In May 2019, a UN commission report issued a stark warning: *Either quickly reign in greenhouse gas (GHG) emissions or face the likelihood that humanity will not be able to feed itself in the not so distant future* (7). The report went on to say that it is not yet too late to save ourselves, if we were to quickly change how we produce food and significantly reduce our consumption of animal foods and eat plant-centered diets. The esteemed EAT-Lancet commission produced a report that preceded the UN's by a few months: *"Civilization is in crisis. We can no longer feed our population a healthy diet while balancing planetary resources"* (8). The Commission recommends that we adopt plant-based diets and grow our food without damaging the environment and refers to the changes as "The Great Food Transformation". Specifically, the Commission urges farmers to adopt regenerative practices that promote the sequestration of carbon in agricultural soils.

Carbon in the soil plays a vital role in regulating climate, nutrient cycling, and biodiversity and therefore in providing the ecosystem services that are essential to human well-being (9,10). Through photosynthesis plants fix carbon dioxide (C02) into their biomass-( roots, shoots, and leaves) and subsequently feed soil microbes creating a carbon pump, taking C02 stored in the atmosphere and transferring it to the soil as short and long-term reserves. However, intensive agricultural practices (monocropping, chemical fertilizers, pesticides, tillage, and the destruction of native grasslands, forests, and wetlands) have caused 30-50% losses in soil carbon in the last century (11). Maintaining the balance between soil carbon is crucial because it improves soil structure, soil fertility, crop production, and ensures long-term sustainability of terrestrial ecosystems (12,13). Also, sequestration of carbon as soil organic matter (SOM) - the fraction of the soil that consists of plant or animal tissue in various stages of decomposition is seen as having the potential to offset a significant amount of current GHG emissions (14,15,16). As a result, managing soils to maintain and enhance soil carbon can lead to multiple economic, societal and environmental benefits.

The goal of EFECT is to document the benefits of moving from a conventional, chemically intensive approach of agriculture to a regenerative form that works with nature by re-establishing native, warm season grasses on land that is currently under intensive conventional agricultural production, to improve soil carbon stock and measure the ecosystem and economic benefits (soil health and water quality) of such conversion.

**The Opportunity:** The 342-acre Ethos Farm, located in Long Valley NJ, has been a working farm for all its 280 years. Restoration of native meadow to WSG offers an unmatched opportunity to help mitigate climate change, restore water systems and provide both economic and societal benefits. EFECT will focus on a 100-acre parcel of the farm currently under conventional corn and soybean production, utilizing monocropping and chemical inputs, including glyphosate, that will be planted to WSG in spring 2020 through a grant by the USDA NRCS EQIP. Soil measurements will be taken before WSG establishment to determine baseline soil health. Periodic plant biomass and soil health measurements will determine the potential for this system to sequester atmospheric carbon and improve water quality. If this initiative confirms positive ecosystem service benefits through meadow restoration, it is our hope that this model will be replicated on conventionally farmed lands across the nation and the world.

Why this opportunity is so special:

- The farm itself - is situated on rich prairie-derived soils and consists of prime ranked farmland by the United States Department of Agriculture Natural Resource Conservation Service's Environmental Quality Incentives Program (USDA NRCS EQIP). This is unusual in that for thousands of years it had been covered with an eastern prairie of the same WSG species.
- Current corn/soybean production on this 100-acre parcel is typical of the intensive conventional methods that characterize American agriculture thereby creating a model for transformation.
- The farm is owned by Dr. Weiss, a primary care physician and expert in plant-based medicine and lifestyle. His approach to healing highlights the direct connection between human health and soil health.
- Collaboration with Rutgers University and Rodale Institute - Rodale Institute is the world's leading authority on regenerative organic agriculture. The term Regenerative Agriculture was coined by Bob Rodale, previous Director and son the Rodale Institute founder (J.I. Rodale). The potential for regenerative organic agriculture was outlined in the Rodale Institute white paper, *Regenerative Organic Agriculture and Climate Change* and research from the Rodale Institute Farming Systems Trial, a forty year comparison of organic and conventional agriculture has demonstrated that regenerative agricultural practices sequester carbon and can play a major role in offsetting global greenhouse gas emissions. Rutgers University is an original Land Grant University. It is known as one of the most important agricultural colleges in the country with renowned agricultural research expertise.
- An unmatched opportunity to transform agricultural land use across the country by offering a replicable model of transition and restoration. Restoring these soils into native WSG and ultimately returning much of it to agricultural production utilizing regenerative methods provide a great opportunity to measure the carbon sequestration potential and the benefits in ecosystem services associated with these conservation practices.

**The potential benefits of warm season grasses (WSG):** In the summer of 2019, a $45,000 conservation grant was awarded to the Ethos Farm owner, Dr. Ron Weiss, by the USDA NRCS EQIP to carry out a five-year plan beginning in 2020 that involves the planting and management of WSG in a way that is beneficial to habitat, on the 100 acre parcel. (For example, the land cannot be mowed until mid-July to allow native birds to nest; and may not be put into production for five years.) The USDA NRCS EQIP recognizes the establishment of WSG as a method to protect soil from erosion and provide habitat for wildlife, especially birds. These native grasses produce thick fibrous roots that can reach 3 meters deep thus putting carbon

matter deep into the soil where it can be stored and stimulate soil biology at depths much greater than most agricultural plants (17,18). Several important studies show that WSG have significant potential to sequester carbon and mitigate climate change (19,20). Additional expected ecosystem service benefits include improved water quality (reduced erosion, higher soil water holding capacity, increased infiltration rates, elimination of water-soluble chemicals); improved habitat for wildlife (birds, mammals, insects); increased above and below-ground biodiversity. The ability for WSG to sequester carbon and improve water quality has not been thoroughly studied in northeastern U.S.

In the spring of 2020, it is essential to collect baseline data before the WSG are planted. This includes baseline soil chemical (including carbon), physical, and biological measurements along with hydrologic properties such as infiltration rates and water holding capacity. Over five years, there will be repeated measurement and modeling of carbon sequestration, soil health, watershed health, and other ecosystem services that may include pollinator, bird, and mammal diversity that result from the outcomes of the 100-acre parcel. The $45k grant allows ONLY for planting grasses. It does not include planning, ongoing maintenance, data collection, analysis and outreach costs associated with implementing EFECT to measure carbon sequestration and ecosystem services of WSG meadow restoration. Measuring carbon sequestration over a five-year period including, 1m deep soil sampling, soil preparation, soil carbon and soil health measurements, data collection, data analysis, outreach, and preparation of publications is estimated to cost $515,000 This does not include annual maintenance and treatments of the warm season grasses.

The management practices and outcomes will be conducted in parallel form in a model that can be replicated that will give landowners and farmers information about WSG and the best way to manage them to be most effective. Because the US government already funds the planting of WSGs, there is potential to increase the number of farmers taking advantage of this program if they see positive economic returns. There is recurring discussion among for-profit and non-profit organizations to develop a carbon market and define the metrics that will be used to compensate participating parties. This project will help define the potential.

**History of Ethos Farm:** The 342-acre Ethos Farm is a National Historic Landmark located in Long Valley, NJ. This grassland ecosystem was favored by native Americans due to the high productivity that food production and native game similar to the US Great Plains. The soils of the US Great Plains are some of the highest quality soils in the world and are characterized by high carbon levels. When European settlers arrived in the early 18th century, most of the remaining forest was cleared, and the native prairie was converted to conventionally managed cropland utilizing intensive tillage and eventually chemicals fertilizers and pesticides.

Dr. Ron Weiss, who purchased Ethos Farm in 2011 long ago realized that human health is inextricably linked to the health of the world around us. Continued reports of the dire consequences of our inaction understandably lead to a sense of hopelessness. Dr. Weiss envisions a shovel-ready solution to climate change in the act of restoring these ancient agricultural soils. As Greta Thunberg has admonished, “The one thing we need more than hope is action.”

At the time of purchase, all fields were already under lease to a conventional (chemical) corn/soybean farmer and had been in chemical production for decades. Farming practices utilizing these chemical fertilizers, herbicides and pesticides have caused untold soil and ecosystem degradation. Dr. Weiss began restoration work immediately.

- In 2011 fifteen acres were pulled out of the land lease for a vegetable growing field which has been certified organic since 2018.

- That same year an additional ten acres were pulled out of the leased land for a future organic fruit orchard. It was cover-cropped for three years then planted in warm season grasses (WSG) for restoration/conservation purposes.
- In 2013 a Forest Stewardship plan established with the New Jersey Forest Service. These plans assist owners of forest land with good agroforestry practices to enhance and sustain forest resources and contribute to healthy and resilient landscapes.
- In 2014 a USDA Farm Services conservation grant was awarded to Ethos farm to remove a 22-acre field from conventional production and plant it in WSG. Dr. Weiss committed to maintain the grasses and support the natural habitat through management practices for a 10-year period.
- In 2017 and 2018 in collaboration with the conventional farmer lessee, enrolled in a combined North Jersey Resource Conservation & Development - NRCS fly over cover cropping program so that the 100-acre parcel could experience the soil health benefits of cover cropping.
- Early 2019 – Dr. Weiss conceived of the EFECT research project to measure the capability of WSG to capture and hold carbon in the soil. He established relationships with Rutgers University and Rodale Institute to design and conduct the research.
- At the end of 2019, the lease agreement with the conventional farmer covering the 100-acre parcel expires. Ethos will take control of the final piece of the farm in chemical production. The entire 342-acre farm will be managed using restorative conservation management practices eliminating the use of toxic chemicals.

**Background on the Applicant:** EFECT is part of the Ethos Farm Project, which since July 13, 2019, has been fiscally sponsored by the 501c3 nonprofit PlantPure Communities, Inc. (PPC). The Ethos Farm Project consists of three components: i) Ethos Farm Days events, which educate the public on the benefits of regenerative farming and plant based diets; ii) The Young Farmers Incubator Program, which seeks to raise a new generation of farmers by giving young people land, housing and mentorship in regenerative farming methods; and iii) the **Ethos Farm Ecosystem Carbon Trial (EFECT),** which seeks to measure ecosystem services associated with reestablishment of native warm season grasses (WSG) to drawdown carbon, provide ecosystem services and regenerate soil health. The Ethos Farm Project is compatible with PPC's charitable mission to build stronger, healthier, and more sustainable communities. The goals of the Ethos Farm Project are consistent with the recommendations of the UN and EAT-Lancet commissions, which place the connection between climate change and animal agriculture front-and-center, calling for a reduction in meat consumption if we are to have any hope of avoiding a significantly heightened risk of extreme heat, droughts, floods and poverty affecting hundreds of millions of people around the world.

## The Team:

**Ethos Farm**

Ron Weiss, M.D. Owner and Executive Director of Ethos Health. He is a board-certified internist and botanist, as well as an assistant professor of clinical medicine at Rutgers New Jersey Medical School. He runs a lifestyle medical practice at Ethos Farm and is an expert on the health benefits of a whole food, plant-based diet.

Nora Pugliese, Farm Manager. MS Pugliese has over 20 years of experience in organic crop production. She will assist with field management practices and administrative work.

**Rodale Institute**
Andrew Smith, PhD, Chief Scientist, Rodale Institute will oversee project planning and assist with data analysis, outreach, and preparation of publications. Dr. Smith has over 11 years of experience conducting agricultural, field-based research and over 25 years of agricultural experience including managing a diversified organic fruit, vegetable and sheep farm. http://willowcreekfarmpreserve.org/
Yichao Rui, PhD, Soil Scientist. Dr. Rui has 14 years of experience in soil health and microbial ecology research and education. He will conduct the statistical analysis, write the report and manuscript, and present research findings in conferences and webinars.

**Rutgers University**
Daniel Gimenez, PhD, Professor, Dept. Environmental Sciences, Rutgers University. Dr. Gimenez has over 30 years of experience on basic and applied research on soil hydrology. He will conduct carbon, soil health and hydrology measurements and oversee graduate students working on the project on all aspects of their degree requirements, including publication of their results.
Stephanie Murphy, PhD, Director Rutgers Soil Testing Laboratory. Dr. Murphy teaches in the Department of Plant Biology and Pathology and assists researchers with projects in Soil Science and Environmental Science. Dr. Murphy will be responsible for the Rutgers soil tests and will participate in the planning and execution of this project.

**The Challenges:** This proposal specifically seeks funding for year one deep soil analysis prior to establishment of warm season grasses. Year one is critical to establish baseline soil C and soil health data in order to measure the change in soil carbon over time. Soil types differ in their inherent carbon carrying capacity and without baseline data it will be nearly impossible to determine if meadow restoration had any impact on soil carbon levels or if the practice is simply maintaining standard levels for that soil.

Scientists at the Rodale Institute have been taking 1-m deep soil cores at research sites and documenting change in soil health and carbon at different soil depths based on GRACENET protocols (https://www.ars.usda.gov/anrds/gracenet/gracenet-home/). Research from the long-term (39 years) Farming Systems Trials indicates that farm management (organic vs. conventional; levels of tillage intensity) significantly impact soil health and soil carbon levels up to 30 cm depths. Often deep soil cores are taken after a farm or system has been in place for many years and only surface soil samples (0-15 or 0-20 cm depths) were taken at the inception of the research project. Therefore, it is difficult to truly capture and understand the carbon drawdown and change in soil health that occurred from transition to a new farm practice. The reason for not taking more comprehensive soil measurements prior to beginning long-term trials is usually the availability of equipment, time, and the additional cost of analysis when analyzing multiple depths in the soil profile. Many projects simply test organic matter which is a basic measurement of carbon related material prone to differences in short-term management and seasonality. Additional soil carbon tests such as particulate organic matter (POM) permanganate oxidizable carbon (POxC), and microbial biomass are more expensive. Also, this project seeks to take 3-meter deep soil cores which will require renting specialized equipment that may add an additional expense.

## Budget

- $5,000 - collect and store 1m soil samples - spring of 2020
- $125,000 – analysis of soil samples, recording of all data generated-completed in one-year timeframe – begin spring/summer of 2020
- $650,000 – 5-year basic carbon modeling study - 2020-2024 – includes basic soil sampling, analysis, salaries, supplies, peer review publication
- $1.7-2M – 5-year comprehensive carbon modeling/ecosystem services study – 2020-2024 – includes comprehensive measurement and analysis of carbon modeling and full ecosystem services including microbiology, hydrology and higher life form species. A Rutgers graduate student will complete and defend a thesis dissertation. Peer reviewed publication, conference and webinar presentations will be part of the project outreach.

## Timeline and Key Tasks & Milestones to Achieve Tangible Outcomes

- December 2019: Secure funding and begin planning
- February 2020: Hold planning meeting at Ethos Farm
- April – May 2020: Task #1 and #4 - Take deep core samples at Ethos Farm prior to establishing warm season grasses
- May 2020 – November 2020: Task #2 and #3 - Process deep soil cores and send for soil health and carbon analysis.
- December 2020: Conduct data quality review; hold planning meeting Ethos Farm to plan for 2021 and beyond.
- Add key dates through end of fundraising period. If a year – it should be November 2020…

### Task #1: Deep Soil Cores

- Prior to the establishment of warm season grasses, and again every three years, in March 2020, Rodale Institute and Rutgers University soil scientists and research technicians will take soil health measurements. This involves taking 1-m deep soil cores that will be broken down by 0-10, 10-20, 20-30, 30-60, 60-100, cm depths for carbon and soil health analysis.
- The estimated cost to carry out this task is $50,000.
- The deliverables/measures of progress – A representative sampling occurs that captures different soil types across the 100-acre field and in locations where different land management strategies will occur. The outcomes of their efforts to capture the lessons learned - so that information can help inform the Initiative as it unfolds.

### Task #2: Process Deep Soil Cores

- Once the deep soil cores are taken, they will be transported to Rodale Institute where they will be cut down and separated by soil depth, soil partitioned for different analysis to be performed at Rodale and Rutgers University soils labs. Additional soil preparation will be needed for each individual soil test. This will be carried out by Rodale Institute and Rutgers University technicians under the direction of soil scientists. It will take the majority of 2020 or more to complete soil processing, preparation and analysis.
- The estimated cost of this task is $150,000
- The deliverables/measures of progress – All soil processed and sent for analysis to respective labs by December 31, 2020.

**Task #3: Soil Health and Carbon Analysis**

- Soil laboratory analyses to include pH, total carbon, total nitrogen, extractable P, K, Ca, Mg, B, S, respiration, POM, POxC, SOM, SOC, CUE aggregate stability. This will be conducted by Rodale Institute staff and Rutgers University graduate students and staff. This activity is predicated on timely processing of soil cores but should be completed by the end of 2021. This could be the work of a Rutgers graduate student who may not begin until fall 2020 but some analyses can be conducted in the Rutgers soil lab.
- $75,000 [soil analysis: $150 per sample x 500 samples (5 per acre)] + $75,000 [1 year of graduate student] = $150,000
- The deliverables/measures of progress – All analyses completed by the end of 2021.

**Task #4: In-field soil health and hydrology measurements**

- In-field soil health and hydrology measurement testing will be undertaken, which includes bulk density, penetration resistance, soil moisture meters.
- Conducted by Rutgers University Graduate student under the mentorship of Dr. Gimenez
- Testing to occur at the first sampling and throughout the first three years of the project.
- $150,000 [2 years of graduate student] + $50,000 [equipment/consumables] = $200,000
- The deliverables/measures of progress – All analyses completed by the end of 2021. A peer-reviewed publication of results submitted by the end of 2020. A graduate student writes and successfully defends Master's thesis or PhD dissertation.

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