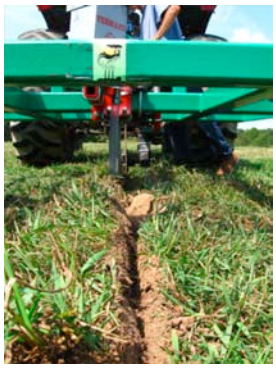
Carbon Farming Tennessee
Agriculture for Bioregion Repair
184 Schoolhouse Road, Summertown, TN 38483
carbonfarmingtennessee@gmail.com

Welcome to Community Supported Research!

The human species exists in a delicate and eroding balance within the global ecosystem. The climate is in chaos, 2/3rds of all species are threatened with extinction, and our over-population-fueled patterns of greed, consumption, and oppression are causing massive suffering for all species.



The ecological technology to bring our external systems back into harmony with the earth already exist. Combined applications of keyline design & plowing, Holistic Management planned grazing, water-harvesting earthworks, regenerative food forestry, and aerated compost tea have the potential to **sequester massive amounts of carbon dioxide in our soil systems.**

BUT, **we're lacking a few key pieces of data** to show to the global scientific community that these simple, locally-available tools can work. After twice being denied federal funding to carry out this important basic research, we are turning to the farmers, holistic managers, gardeners, ecological engineers, green architects, permaculture designers, and the rest of the ecologically aware global community – **we are turning to you to make this research happen.**

Benefits of Community Supported Research:

- Direct connection with the researchers – we are part of the farming & permaculture community.
- We empower communities and farmers to understand the science and do their own research, and not depend on the 'expert' to tell us about our soil and our land.
- Research sovereignty: Freedom from federal, corporate, or academic funding.
- Transparent commitment to objective science. Full disclosure: Carbon Farming Tennessee is a community-owned for-profit business. We are committed to responding to the pressing needs of farmers around the world, and are not controlled by hidden corporate agendas.
- Direct communication of results: We are committed to open-source data, and will freely post all the results of our research for everyone to see and use. Check our website for updates: www.carbonfarming.wordpress.com

Your investment achieves the following results for Community Supported Research:

$10	=	1 completed soil test (out of 588 required)
$50	=	3 completed soil tests and 1 completed foliage analysis
$100	=	1 soil core tool to speed up sampling
$500	=	1 day of keyline plow rental & cultivation
$1000	=	1 full year of testing for 1 farm
$5000	=	3 full years of testing AND plowing for 1 farm

To invest in Community Supported Research, visit
www.carbonfarming.wordpress.com

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Regenerative Effects of Keyline Soil Conditioning on Pasture Soils, Carbon Sequestration & Production

Community Supported Research Investment Proposal

FINAL Version, September 2009

Prepared by Mary Johnson, Mark Krawczyk and Ethan Roland

1. The Problem

Several interconnected problems are addressed. Our primary issue in this study is the overall health of pasture soils in northeastern North America. Throughout the past century, agricultural soils throughout the country have been subject to heavy abuse due to the widespread effects of machinery, livestock, tillage and agro-chemicals. As such, many of these soils suffer severe compaction, low organic matter and soil life, and compromised moisture-holding capacity. As the health and fertility of our soils ultimately determines its productivity as well as the health of the food it in turn produces, we need to study and then promote the best land management practices that help restore the structure and fertility of our soils and thereafter work continually to improve them. The Northeastern United States is an ideal landscape for pasture-based farming systems, improving land management techniques and improving soil productivity will help Northeast farmers maintain profitable farming enterprises and their continued support of vibrant rural communities.

On a wider scale, erratic weather patterns and rapidly growing levels of atmospheric CO_2 and other greenhouse gases are combining to compromise the relative climatic stability we have come to know in the northeast and across the planet. In 2007, extended drought conditions affected significant parts of the northeast (see figure 1 below), while the nation's southeast and southwest zones are currently suffering greatly due to extreme drought. These conditions not only affect localized agricultural productivity but also threaten the economic feasibility of agricultural livelihoods in these regions. Farmers throughout the country and the world need to explore and adopt management practices that catch and store water in their agricultural landscapes – especially in soil, which offers the most effective means for on-site moisture retention.

Increases in atmospheric greenhouse gas concentrations, measured in CO2 equivalents are believed to be one of the primary causes of growing climatic instability and rising global temperatures that alter local weather patterns. Professor of Soil Science at Ohio State University Dr. Rattan Lal, has calculated that 476 Gigatons (Gt) of carbon have been emitted from farmland soils due to inappropriate farming and grazing practices (Christine Jones, PhD, www.amazingcarbon.com). In contrast, 270 Gt have been emitted over the past 150 years of fossil fuel burning (Jones, www.amazingcarbon.com). In their study, "Carbon Sequestration Potential Estimates with Changes in Land Use and Tillage Practices in Ohio, USA," Zhengxi Tan and Rattan Lal explain that the conversion of natural ecosystems to those managed agriculturally can reduce the soil organic carbon pool by up to 50% in the top 20 cm of the soil and 25-30% in the top 100 cm depth after 30-50 years of cultivation (Tan, Lal, 2005). There is currently a significant need to reduce the release of carbon into the atmosphere while at the same time, instituting large-scale initiatives to sequester the excessive carbon that has already accumulated in the atmosphere.

2. Our Proposed Solution

Our proposed solution is careful and well-timed Keyline subsoiling of compacted pasturelands using the Yeomans Keyline plow™, combined with community supported scientific documentation of the changes in soil carbon levels that result over a three year growing period in treated (Keylined) and untreated (control) observation plots on 7 farms.

Though keyline practices have been adopted throughout Australia due to the easily observable enhancements the system creates in water storage capacity of soils and in decompaction, there is a lack of well-documented studies that actually quantify the effects of keyline design on soil carbon levels, especially in cool temperate climates with 30+ inches of annual rainfall.

The Keyline system of whole-farm planning, including land treatment with the highly specialized compaction reducing keyline plow, were developed in Australia in the 1950s by P.A. Yeomans and his sons. The resulting keyline farm design provides multiple benefits to agricultural landscapes:

- Drought-proofing, water storage, and water distribution through the use of the sub-soiling plow in a keyline pattern that distributes water from the valleys out towards the drier ridges in the landscape, in conjunction with construction of water catchment ponds at the keypoints, and use of gravity-fed irrigation systems
- Rapid development of biologically active, fertile soil through use of a keyline design and an initial two year treatment of subsoiling using the Yeomans keyline plow that reaches down to a 24" soil depth by the second year.
- A perennially abundant landscape that functionally connects farm infrastructure, holistic pasture management, and diversified tree-crop agriculture based on a fully rehabilitated and effective water cycle

P.A. Yeomans was a mining ecologist with an uncanny ability to read landscapes. In drought-prone dryland Australia during the post war period, poor land management had led to the abuse and erosion of the scant topsoil cover throughout the country. In response to the dominant emerging land use ethic of conservation, Yeomans developed his Keyline design system™. Yeomans strongly believed that it was not enough to simply work to conserve the already abused landscape; the need was instead to work to develop managed systems that act to regenerate it. In 1953, he published his first book, entitled The Keyline Plan in which he first began to unveil his theories on soil rehabilitation through water harvesting and non-inversion (subsoiling) tillage. Early in his work, Yeomans and his sons used a conventional chisel plow to do their subsoiling, later developing their own specialized design in 1974. Over the past thirty+ years, the design for this plow has been repeatedly modified and refined so it is distinctly more effective at soil regeneration than the chisel plow for a number of important reasons.

A series of rigid shanks (typically three to five) with trademark shaping mounted on a heavy steel frame comprise the bulk of the implement. Typically a coulter disc precedes the shanks, slicing open the upper soil layer, helping to minimize soil surface disturbance. The keyline plow differs significantly from traditional sub-soiling implements in two main ways:

1. The plow shanks' thin profile, characteristic aerodynamic tip shape, and knife-like edge combined with the sod-cutting action of the coulters are engineered to smoothly decompact and aerate subsoil with minimum effects on the pasture surface reducing run-off and increasing water retention in the soil.
2. Soil layers are not disturbed or mixed by the plow because the angle of action on the foot of the shanks is very slight – only 8%. Most subsoilers or chisel plows have steeper angles closer to 25%, which causes disturbance as well as lifting and mixing of subsoil into topsoil layers, or tunnel formation along the tip and sealing of soils that leads to underground channels of water rather than uncompaction and soil infiltration. When using the keyline plow, little to no inversion or tunneling is observed thus water infiltration results are maximized leading to significantly greater potential for soil carbon formation in a rapid timeframe.

Figure 2. Yeomans Keyline plow shank with attached coulter.

Behind the coulter and shanks, a roller bar can be mounted to the rear of the plow, acting to lightly compress the de-compacted soil, helping again to minimize the surface disturbance. (Please see the attached diagrams/images to help illustrate the action of the Yeomans plow.)

Figure 3. Yeomans Keyline plow in operation. Note the minimal disturbance to the soil surface.

The enhanced soil conditions that result from cultivation with a keyline subsoiling plow (decompaction, aeration, improved landscape scale water infiltration, rapid increase in soil organic matter), provide the potential for a significant increase in the rate of regrowth of just-grazed pasture plants. This study proposes to measure indicators to test the effectiveness of the keyline methods for increasing the productivity of pastures. It is this grazing of the plants' aerial parts and the subsequent root die-back and cyclical regrowth, that makes considerable quantities of once-living organic matter available to soil life. The consumption and conversion of this organic matter by soil microorganisms has been observed to enhance soil fertility, forage production, soil water-holding capacity as well as the cultivation of a rich and healthy soil ecosystem. Additionally, the development of soil organic matter helps to provide a significant means by which to sequester excess atmospheric carbon, helping regenerate pastures while also mitigating the effects of global warming and climate change.

Our cooperative farm-based research project proposes to scientifically explore the keyline design system through monitoring of soil carbon levels through a baseline study on eight farms in four states and yearly monitoring on these farms over three years as farmers apply Yeomans keyline design and subsoiling to their pastures. It is our hypothesis that the keyline landscape treatment will work to rapidly transform and enrich soil, improving its structure, organic content and moisture-holding capability. Results should help us determine if the keyline design and plow method can truly enhance these important soil qualities as has been anecdotally suggested by many farmers in Australia since they began adopting these methods in the 1950's. If positive results are found in this preliminary study, there is great potential for this land management tool to remedy several of the

global problems farmers face due to the effects of climate change already being felt in many parts of the world.

The Carbon Farmers of America report summarizes that studies have shown a 12% increases in agricultural productivity resulting from a 1% increase in organic matter down to six inches of soil depth. Additionally, "Enhancing Soil Organic Carbon sequestration with changes in land use and management practice has been recognized as one of the important strategies for reducing atmospheric CO_2 levels" (Tan, Lal, 2005). In 1999, Lal, et al. estimated that improvements in the management of US cropland could potentially sequester between 75 and 208 Tg C $year^{-1}$ (83-230 million tons of Carbon) for several decades.

3. Project Methods

Our intent is to develop a community supported research process. Our approach for these studies is intended to have a practical value to farmers. Our long-term goal is to collect information to answer the questions most farmers are interested in:

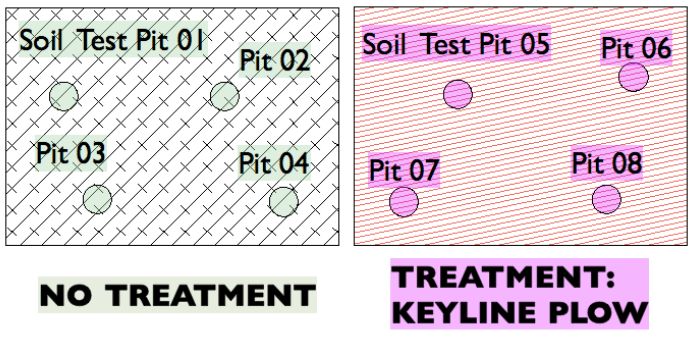
1. *What will this do for my soils?*
2. *What is the overall cost/benefit?*

In this pilot project, we are focusing almost exclusively on the first question, with a small bit of data to inform us about the others. In the future, we also intend to expand this pilot study to a larger project through this community supported research model, in order to more completely address each question and build a sound scientific body of knowledge useful to farm managers and carbon farming policy makers.

Our project proposes to record key pasture production parameters over a three-year period as farmers on eight farms in four states apply keyline soil conditioning strategies to their pastures (MA, NY, VT, TN). We will implement a keyline design as a simple single variable to study the effects of keyline plowing techniques on soil compaction, organic carbon levels, soil nutrients, forage quality and production on these farms. All methods and results will be posted on an open access website. The proposed treatments are

1. Control (no treatment)
2. Keyline-plowed (treatment)

Each farm will choose paddocks of uniform slope and soil type and delineate areas for the keyline treatment and the control. In the paddock, we will mark out 4 permanent plots where soil carbon will be sampled at both a 5" depth and at a 20" depth. Four soil bulk density samples will be taken as a baseline per farm along with forage quality analysis and nutrient analysis. The following diagram (not to scale) illustrates the conceptual layout of the research paddock:



Soil conditioning will occur 3 times over the project timeline, with 4 soils data collection events:

Timeline	Soil Sample	Keyline conditioning
May 2010	1st Soil sample - baseline	-
Jun 2010	-	1st Soil conditioning with Keyline plow
May 2011	2nd Soil sample	-
June 2011	-	2nd Soil conditioning
September 2011	3rd Soil sample	
October 2011	-	3rd Soil conditioning
May 2012	4th Soil sample - final	-

Table 1. Soil conditioning and data collection timeline.

Each data collection includes 5 parameters:

Number	Parameter	Units	Assay
1	Soil organic matter	(%, tons/ac)	Soil Nutrient Analysis
2	Soil cation exchange capacity (CEC)	Meq	Soil Nutrient Analysis
3	Soil nutrient levels	Ppm	Soil Nutrient Analysis
4	Soil bulk density		bulk density analysis
5	Forage nutrient analysis		forage nutrient analysis

Table 2. Parameter descriptions, units, and proposed assays.

Soil nutrient analysis (1-5) will be conducted by the University of Vermont Agricultural and Environmental Testing Laboratory, The Cornell University Soil Testing Laboratory,and the University of Tennessee Soil Testing Laboratory using standardized soil carbon testing procedures described in our Sampling & Lab Methodology appendix. We will collect and record data for parameters 6-7 in the field with the appropriate protocols and calibrated instruments.

Each plot will also have a farmer conducted visual inspection using a pasture health indicators bulls-eye test. This method uses qualitative indicators to evaluate functionality of the four ecosystem processes: water cycle, mineral cycle, energy flow, and community dynamics (Gadzia, & Graham, 2009 - download data sheets from www.quivira.org). The methodology includes recording a digital photograph of the same sampling point at each data collection event from year to year. The data can easily be used by the farmer to evaluate pasture condition from year to year and should become a practice that the farmer can use beyond the life of this study to aid in pasture management decisions. By including the farmer in the scientific team, we will help create ownership of the research by the farmer on each site. Participating farmers will be asked to contribute towards the costs of the study. This investment in turn will increase it's long term value to the farmer and thus help achieve a model of sustainable community supported research.

4. Project Timetable

Our study runs from spring 2010 until spring 2012 (See also table 2 above). Depending on soil moisture conditions, we will begin the study sometime in May 2010, collecting soil data for each of the test plots on each of the eight participating farms. After allowing stock to graze the designated test plots, we will immediately make the first ripping pass with the keyline subsoiling plow on all the appropriate pastures being studied at each farm.

When pasture plants have reached the early boot stage of their growth cycle, farmers will turn stock onto the fields to graze once again. This will then be followed by another round of soil data collection during the month of May 2011. Immediately following this grazing, we will again subsoil our "treated" test pastures. This sequence is repeated September-October 2011.

We will reconvene our study in early 2012 with our fourth series of soil data collection and a final forage data collection. With trials complete, we will collate results and draw conclusions, completing our final report by the end of 2012.

5. Open Source Results

We plan to share and distribute the results of our study collaboratively with our farm partners and the community supported research community via three primary avenues:

- Presentations, workshops and speaking engagements including on-farm field days
- Digital photographic & video media to be dispersed through our existing active websites, blog posts and twitter networks via the internet.
- Printed 3-fold pamphlets to be distributed to extension, NRCS and farm implement dealers in the areas surrounding the test farms.

Our most direct and effective efforts will be through lectures, workshops and pasture walks. We will present our results at the winter Northeast Organic Farm Association conferences as well as local agriculture related conferences, tractor shows, county fairs, and farm community events and farming news sources. We will also be offering pasture walks during the prime pasture subsoiling events in our respective regions while also demonstrating these subsoiling techniques at farm shows so as to more effectively transmit the theory and practice behind our endeavors to the broader farming community.

Using simple digital video, photographs, and audio recordings, we will produce a concise 5-minute piece of electronic media explaining the basics of keyline design and the results of our experiment. This media will accompany our conference and workshop presentations, and be made freely available on the internet through the Carbon Farming website (www.carbonfarming.wordpress.com).

Additionally, we will produce a pamphlet explaining the process of keyline pasture management as well as the results of our study and subsequent recommendations. This pamphlet will be simple and informative and it will be made available through NOFA and local agricultural extension services.

6. Project Team

Ethan Roland

- Chief Financial Officer, Carbon Farming Tennessee. Premier Carbon Farming Course September 2009 offered Holistic Management, Keyline Design, Food Forestry, Soil Foodweb, and Economic Relocalization.
- Founder and principal, AppleSeed Permaculture. (www.appleseedpermaculture.com) Regenerative design & development firm focusing on the design and maintenance of agriculturally productive ecosystems that integrate humans and landscape to sustainably produce food, water, energy, and shelter.
- Keyline Design Course graduate, 6- and 2-day intensives with Darren Doherty and Abe Collins in 2007 & 2009.
- Educator – over 40 national and international invited lectures on sustainable agriculture and orchard management.
- M.Sc. Collaborative eco-social design, Gaia University 2008.
- B.Sc. Biology, Minor Mathematics, Haverford College 2004. Undergraduate thesis won Ariel G. Lowey award for best original research.

Mary Johnson has worked with Winrock International's Forestry unit on carbon sequestration project design using the VCS, CCX and CCBA standards. She has led field crews in preliminary forest carbon sequestration baseline development, and has used remote sensing and high quality digital aerial imaging systems for, avoided deforestation modeling, carbon credit projections and monitoring, and has assisted with carbon project verification under CCX. She has worked on carbon projects in Peru, Ecuador, Haiti, Indonesia and the US and has 10 years professional experience working as a natural resource management specialist. With proven project design, training, management and implementation skills, she is also a USDA NRCS certified farm conservation planner. She completed a 6-week SARE funded Holistic Management course and a six day Keyline Design Course with instructor Darren Doherty of Australia Felix Permaculture in 2009. She was Director of the MA Association of Conservation Districts Accelerated Conservation Planning Project from its inception in 2005 through the fall of 2008 where she worked directly with farmers to develop whole farm plans and implement NRCS cost-shared conservation practices. She has a M.S. in Plant and Soil Science from the University of MA, and a B.S. in Agriculture from Cornell University.

Mark Krawczyk has worked in a range of agricultural settings since receiving his B.S. in Environmental Studies from the University of Vermont in 2001. His thesis focused on the development of a directory of useful plants for use in integrated perennial agricultural systems in climate zones 5 and below. He completed a six and two day Keyline Design Course with instructors Darren Doherty and Abe Collins in 2007. Currently, he is the director and founder of Keyline Vermont – a farm design/consulting business specializing in the development and implementation of soil building and water harvesting techniques. Thereafter he has spent time working as an intern/employee for tree crop and greenhouse specialist Jerome Osentowski, Basalt, CO; a coppice forester, apprenticing with woodsman and author Ben Law at his woodland in West Sussex, England 2003/4; and as an intern for Dan Hemenway, traditional agricultural specialist in Sparr, FL 2002. Additionally he maintains his own traditional woodworking business, RivenWoodCrafts

(www.rivenwoodcrafts.com), and is a builder and educator, working as a member of Seven Generations Natural Builders (www.sgnb.com).

Darren Doherty is one of the world's most experienced Permaculture Design professionals and Registered PDC Teacher who has designed and developed over 1100 properties across 4 continents and has taught many PDC's, including with both Bill Mollison & David Holmgren (the co-originators of Permaculture). Darren has been a full-time Permaculture Designer since 1993 (at age 24) and focused the first half of his career on design and development work, to the point where he became the most prolific Permaculture Designer in Australia, designing and developing over 1000 properties in that period, with a large development and management team backing his design efforts.

Greg Landua studied marine and terrestrial ecology and evolutionary biology in the Galapagos Islands, translated for Amazonian rainforest guides, fought wildfires in the wilderness of Alaska, and studied the nuances of ecology and ethics. Greg has B.S. in Environmental Science and Ethics from Oregon State University, and is receiving a graduate diploma in Organizing Learning for Ecosocial Regeneration from Gaia University. He is currently the director of the Ecovillage Training Center on The Farm in Summertown, Tennessee. He is an active permaculture and ecovillage design educator and the CEO of Carbon Farming Tennessee.

7. Cooperating Farmers & Advisors

Farm	Description	Location	Contact Person	Phone	Email
Stony Pond Farm	Og beef and milking cows	Fairfield, VT	Tyler Webb	802-827-3693	stonypondfarm@verizon.net
Doe's Leap Farm	Organic Goat Dairy	Bakersfield, VT	Kristen Doolan	802-827-3046	doesleap@pshift.com
Blue Hill Farm	Organic cattle & chickens	Great Barrington, MA	Sean Stanton	413-528-2092	seanstanton@hotmail.com
Threshold Farm	Organic cattle	Philmont, NY	Hugh Williams	518-672-5509	threshold@taconic.net
Moveable Beast	Organic beef	Accord, NY	Charles Noble	-	francesca@westwoodrealty.com
Highland Realm	Cattle	Hampshire, TN	Deanna Naddy	931-285-2543	djnaddy04@earthlink.net
The Farm	Horse pasture	Summertown, TN	Gregory Landua	931-964-4474	greg@gaiauniversity.org

Advisors	Specialty	Entity	Location	Phone	Email
Darren Doherty	Keyline Design + Planning	Australia Felix Permaculture	Australia	+0418 254 605	darren@permaculture.biz
Rachel Gilker & Jennifer Colby	Soil Science, Pasture Management	VT Pasture Network @ UVM Ctr of Sustainable Ag	VT	802-656-3834	rgilker@uvm.edu, jcolby@uvm.edu
Dr. Elaine Ingham	Soil Microbiology	Soil Foodweb, Inc.	OR	-	info@sustainablestudies.com

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Regenerative Effects of Keyline Soil Conditioning: Community Support Research Budget

September 2009

Expense	Units	Quantity	Cost per unit	Cost per Site	Cost: All Farms	Notes
Monitoring Tools						
Soil Core	tool	1	$ 100	$ 100	$ 700	clean, fast, soil sampling
Penetrometer	tool	1	$ 280	$ 280	$ 1,960	measures soil compaction
Keyline Plow						
Keyline plow transport	days	3	$ 100	$ 300	$ 2,100	fuel - $50 / one way
Keyline plow rental & operation	days	3	$ 500	$ 1,500	$ 10,500	fuel, operator @60/hr for 6 hrs
Researcher/Designer						
Initial consultation, cost proposal, keyline survey, design	hours	12	$ 50	$ 600	$ 4,200	-
Farmer education & outreach	hours	8	$ 50	$ 400	$ 2,800	-
Soil sampling	hours	14	$ 20	$ 280	$ 1,960	3.5 hrs/sampling session
Analysis & report writing	hours	8	$ 30	$ 240	$ 1,680	-
Field days, conferences, outreach materials (pamphlets, video, presentations)	hours	6	$ 50	$ 300	$ 2,100	-
Soil Sampling						(See proposal Table 2.)
Soil Carbon Sample 1: Baseline	samples	16	$ 10	$ 160	$ 1,120	before 1st conditioning
Soil Carbon Sample 2	samples	16	$ 10	$ 160	$ 1,120	before 2nd conditioning
Soil Carbon Sample 3	samples	16	$ 10	$ 160	$ 1,120	before 3rd conditioning
Soil Carbon Sample 4: Final	samples	16	$ 10	$ 160	$ 1,120	after 3rd conditioning
Soil BD Sample 1: Baseline	samples	4	$ 8	$ 32	$ 224	before 1st conditioning
BD 2	samples	4	$ 8	$ 32	$ 224	before 2nd conditioning
BD 3	samples	4	$ 8	$ 32	$ 224	before 3rd conditioning
BD 4: Final	samples	4	$ 8	$ 32	$ 224	after 3rd conditioning
Leaf Tissue Analysis 1: Baseline	samples	2	$ 18	$ 36	$ 252	before 1st conditioning
Leaf Tissue Analysis 2: Final	samples	2	$ 18	$ 36	$ 252	after 3rd conditioning
TOTAL COST + 15% CONTIGENCY			$ 1,288	$ 4,840	**$ 38,962**	

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Bioregion Repair Enterprises

Community Supported Research
Extension Modules 1-3

This proposal outlines a strategy to boost the Community Supported Research CSR Initiative's ability to:

A) Gather baseline data and establish control sites
B) quickly treat large acreages with soil building techniques to collect data
C) Create mechanisms for CSR to self fund into the future.

These extra modules will greatly increase the ability of Community Supported Research to quickly asses the potential carbon captured using keyline and soil food web techniques. This information can be used to attract future funding and leverage cap-and-trade carbon markets, and create locally run community carbon markets. This research is the first step towards establishing community run monitoring systems for soil carbon sequestration and will provide the investors with cutting edge data.

Module outlines:

1. Keyline Plowshare
    a. Rent to own Yoeman's Plow bank to create cooperatively run Keyline Design and Plow businesses
    b. Support broad-acre treatments in a wide rand of terrain and ecosystem.
2. Gaia University Research Associate Support
    a. Scholarship fund to attract competent Graduate level University Associates to:
        i. Support local research treatment and data collection
        ii. Manage non-local project activities and data analysis.
3. Soil Foodweb Enterprise Assessment
    a. Implementation of soil treatment using Compost Tea.
    b. Comparison of relative organic matter composition of treatments compared to control

In addition to exponentially increasing the breadth and depth of data, module one and three provide self funding enterprises to create transparent funding for research continue into the future without grant or charity support.

We are working to create enterprise models for other regenerative ag and land management technique to compliment and expand the current scope f the CSR proposal.

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Proposal Module One: Keyline Plowshare.

Initial Investment:

Equipment	Cost Per Unit	Total Cost
Keyline Plow (Fully Equipped)	11000	55000
Survey Equipment	1000	5000
Research Kit	4000	20000
	Total Cost	80000

Return on Investment: 8% per year, $6400

Initial Investment	return per unit per year	one year total return	two year return	five year return
80000	4200	21000	42000	105000

Yearly working budget: $14,600

Increase in research ability: (Two orders of magnitude increase in treatment area)

Treatment Acres per Plowshare per year	Treatment estimate without Keyline Plowshare	Treatment Estimate with Keyline Plowshare Module
1000	50	5000

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Proposal Module Two: Gaia University Research Associates

Initial Investment:

Scholarships

Research Role	Cost Per Scholarship	Total Cost
Regional CSR support	2000	10000
CSR Local Research Associate	1000	8000
CSR Admin	8000	8000
CSR Lead Research Associate	8000	8000
	Total Cost	24000

Return on Investment:
Linked with Module one, with the guarantee of 8% ROI:

Plowshare Investment	Scholarship Investment	Total Investment	Yearly Return On investment
80000	24000	104000	8320

Increase in research capacity:

- University Level Associates trained in Keyline plow and design, soil carbon research methodology, project management.
- 160 hours per week of research assistant time
- 30 hours per week of administrative time
- 30 hours per week of lead research associate time

Carbon Farming TN yearly net cash flow from CSR endeavor: 12,680
proposed use of yearly net:
- Investment in new CSR Plowshares 50% = $6,340
- Admin/overhead 25% = $3,175

- Travel 25% = 3,175

Proposal Module Three: Soil Food Web Technology Assessment

This module is awaiting continued discussion with Dr. Elaine InghamSoil Foodweb Inc. to clarify collaborative research goals and enterprise possibilities.