Budgeting & Selecting Soil Health Practices

Using partial budgets & cost-benefit analysis to select soil health practices

Transferring soil health costs to the ‘conscious consumer‘

What we‘ll cover in this presentation:

- **Using your lab results and soil health goals** to choose soil health practices;
- **Using costs and benefits analysis** to compare and prioritize between soil health practices or between an existing and new soil health practice;
- How to calculate *savings* from windbreaks, carbon amendments, cover crop practices;
- Examples of cost-benefit analysis conducted with farmers in this cohort;
- How to take it one step further by looking at increased or reduced revenue with a **Partial Budget;**
- Questions on how your lab results, costing and designs.

Lab Results/In-Field Assessment	Goal for soil health	Recommended SH Practices
Low scores in Biological properties (CO2 burst, mineralizable nitrogen, glucosidase enzymes)	Increase OM by 1 % in 3 years	Cover Crops Compost
	Increase biological activity	Compost Tea
Low scores in Chemical properties (pH, Organic carbon, Hot water extractable C, DOC:DON*) *If DOC:DON higher than 15:1, add nitrogen	Add carbon to the soil system	Cover Crops Biochar Green mulch
	Increase CEC	Cover crop Compost
Low scores in Physical Properties (Bulk density, water holding capacity, water stable aggregates)	Increase soil moisture	Cover crop Windbreak
	Reduce soil temp	Cover crop Windbreak
	Improve aggregation	Compost Biochar

Rank 1-5	Should installing a windbreak be a priority practice now?
2	Meets SH Goals
1	Low cost to install now
4	Low labor hours to install and maintain
5	Will make it easier to install other soil health practices
5	Will improve the cash crop this season or within this year

Selecting an order of operation for your soil health practices

Soil Health Practice	**Installation Date**
In-field windbreak (Saran screen)	Summer 2022
Mulch	Summer 2022
Cover crop	Late Fall 2022 *wait for first consistent days of rain
Perennial ground cover	Late Fall 2022 *wait for first consistent days of rain
In-field windbreak (herbaceous)	Winter 2022
Compost tea & liquid tankage	Spring 2023
Compost (apply on new fields being brought into production)	Spring 2023
Perimeter windbreak (trees)	Early Winter 2023

How to calculate savings for windbreaks, carbon amendments & cover crops

Practice	Savings Category
Windbreak	Reduced evapotranspiration rate of 20-30%, estimated as a reduction in your irrigation bill by this amount.
Carbon amendment	Nutrient contribution amounts from organic matter (estimated in percentage of lbs. of each nutrient from the total OM lbs. for top 6” of soil, est. 2,000,000 lb.)
Cover Crop	Reduced pesticide/weed management (cost of herbicide and labor), reduced fertilizer (accounting for the nitrogen contribution & reduced nitrogen leaching and nutrient contributions from OM).

Supply Price List

Last updated 2021

This list is meant as a rough guide to help you think through your potential start up and annual costs for some common supplies.
True costs will need to be verified with your chosen vendor and may include additional delivery/transport fees not included here.
Note that many supplies are listed in the quantity that the supply comes in instead of buying the exact quantity of your specific need (many farmers hui together to split an order).

Item	Price	Notes:
IRRIGATION		
1 roll (7500') 8-mil, 8-inch drip tape	$250	3000' per 1/8 acre plot (10 beds with 3 drip each)
Drip connectors	$0.35/each	300 per 1/8 acre plot (10 beds with 3 drip each)
Drip connector on/off valves	$1.50/each	300 per 1/8 acre plot (10 beds with 3 drip each) *Choose either regular connectors OR on/off valve connectors
Drip Couplers	$0.75/each	Plan to buy 25 to start for 1/8 acre plot
PVC ball valve (1.5")	$9/each	This group of supplies is an example that assumes that you will pull off water from a 1.5 or 2" main source pipe (riser) and you will need to reduce it to a mainline poly tube that is your header for drip to be connected into. For example, for 1/8 acre plot (50'x100'), you will need 50' mainline 1.5" poly tubing and most likely a few elbows, adpaters and an on/off valve.
Slip/barbed poly adapter (1.5")	$3/each	
Barbed poly elbow (1.5")	$3/each	
500' roll HPE poly tubing (1.5")	$66/roll	
Mini wobbler or micro sprinkler line to cover 10(	$150-200	For one 100' line of sprinklers, spacing @ 10' = 11 sprinklers plus poly tubing and nipples/adapters.
Irrigation timer	$50	
Fertigation set up (in line)	$15	https://www.ebay.com/itm/3-4-Garden-Irrigation-Device-Venturi-Fertilizer-Injector-Switch-Water-Tube-Set/113804371627?hash=item1a7f44e6ab:g:zsMAAOSwXvRdGxPV
Irrigation Water Meter	$75-$100	
FERTILIZER, AMENDMENTS & PESTICIDES		
Soil Testing & Analysis	$25-75	Estimated price range depends on which lab you go with and quantity of soil samples submitted
Compost	$35-$50 per cubic yard i.e. $100 per crop cycle per 1/8 acre plot	Rate varies accoring to soil test results. Range often varies between 7-20 tons/acre. For 7 tons/acre this works out to be 100lbs per 300 sq ft bed (3' x 100' bed). If you have 10 beds (1/8 acre) this would be 1000 lbs. To convert

How much savings anticipated from Cover Crop/Windbreak Design: Windbreak Costs

Windbreak Details:

- **570 ft. long**
- **Bamboo *(Bambusa heterostachya)***
- **~3 acres of farm protected**

Total Cost: $8,651

Materials	Measurement **	Unit	Water rate ($/1000gal)	Cost	Source
1' polytubing	570	feet	* Input the rate you pay for water (i.e. dollars per 1,000 gallons) in the cell below.	$188.10	Home depot
6 ft weed mat	570	feet		$342.00	Home depot
2 gal drip emitters	57	number		$57.00	Nutrien
Riser	1	number		$300.00	Nutrien
4-6-4 fertilizer	50	lbs		$50.00	Nutrien
Gypsum	40	lbs		$24.00	Nutrien
Bamboo	65	10 gal pot		$6,500.00	
Water	2,000	1,000 gals	$0.47	$940.00	
Mini excavator (rental)	1	day		$250.00	
	Total estimated cost for windbreak establishment:			$8,651.10	

* Adjust the measurement column to reflect the length of your windbreak. The cost column will automatically recalculate.

Estimate water requirements for your windbreak and adjust the water measurement cell. This farm will be establishing a 570 ft long bamboo windbreak, and estimated it would need 2,000,000 gals of water for establishment.

How much savings anticipated from Cover Crop/Windbreak Design: Cover Crop Costs

Cover Crop Design:

- Sunn Hemp & Piper Sudan
- Planted on 3 acres
- Irrigated for 4 months

Total Cost: $1,798

Cover crop species	Seed Cost (per lb.)	Area planted (Acre)	Seeding Rate (lbs/acre)	Seed costs for total planted area	Irrigation requirements (1000gal/acre/month)	Water rate ($/1000gal)	No. of months irrigated	Total Irrigation Costs
Sunn hemp	$2.00	3	40	$240.00	994.8	$0.47	1	$467.56
Piper sudan	$2.83	3	15	$127.35	872.4	$0.47	1	$410.03
Sunn hemp	$2.00	3	20	$120.00	460.2	$0.47	2	$432.59
		Total Cover Crop Seed Cost:		**$487.35**		**Total Cover Crop Irrigation Cost:**		**$1,310.17**

Total cost of cover crop implementation:	**$1,797.52**

How much savings anticipated from a windbreak/cover crop design:

Cost of cover crop *without* windbreak:

$1,798
($487 seed cost + $1,310 irrigation cost)

Cost of cover crop *with* windbreak:

$1,469
($487 seed cost + $982 irrigation cost*)

Annual cover crop irrigation savings estimate = $330

*Irrigation savings based on an leading research, which estimates 20-30% reduced evapotranspiration rate. For this example, we used a 25% reduction in water requirements & irrigation costs.

**Benefits such as potential increase in plant health & productivity due to cooler soil temperatures, less erosion, and less disturbance were not included in the savings estimate.

How much savings anticipated from a windbreak/cover crop design: Example 2

- 1 acre farm with diverse crop rotation, with annual irrigation cost of **$3,060**

Cost of windbreak to protect ~1 acre:	**$2,100**
Years to break-even:	**Around 3**

Annual irrigation savings estimate =

$765

*Irrigation savings based on an leading research, which estimates 20-30% reduced evapotranspiration rate. For this example, we used a 25% reduction in water requirements & irrigation costs.

****Benefits such as potential increase in plant health & productivity due to cooler soil temperatures, less erosion, and less disturbance were not included in the savings estimate.**

How much savings anticipated from compost: Costs

Field size (acres)	Rate	CuYd needed	Location	Delivery cost (HI Earth)	Delivery cost (Island TS)	Compost cost (Island TS)	Compost Cost (HI Earth)	Total Costs (Island TS)	Total Costs (HI Earth)
0.125	Low (2 tons/acre)	0.5	North Shore Region	$125	$200	$19	$20	$219	$145
0.125	Medium (5 tons/acre)	1.25	North Shore Region	$125	$200	$46	$50	$246	$175
0.125	High (10 tons/acre)	2.5	North Shore Region	$125	$200	$93	$100	$293	$225
0.125	Xtra High (20 tons/acre)	5	North Shore Region	$125	$200	$185	$200	$385	$325
1	Low (2 tons/acre)	4	North Shore Region	$125	$200	$148	$160	$348	$285
1	Medium (5 tons/acre)	10	North Shore Region	$193	$400	$370	$400	$770	$593
1	High (10 tons/acre)	20	North Shore Region	$213	$450	$740	$800	$1,190	$1,013
1	Xtra High (20 tons/acre)	40	North Shore Region	$406	$950	$1,480	$1,600	$2,430	$2,006

How much savings anticipated from compost: Savings

Value of Soil Organic Matter

Assumptions: 2,000,000 pounds soil in top 6 inches
1% organic matter = 20,000#

Nutrients:

Nitrogen: 1000# * $0.50/#N = $500
Phosphorous: 100# * $0.70/#P = $ 70
Potassium: 100# * $0.50/#K = $ 50
Sulfur: 100# * $0.50/#S = $ 50
Carbon: 10,000# or 5 ton * $?/Ton = $ 0

Value of 1% SOM Nutrients/Acre = $670

Original Jim Kinsella/Terry Taylor(2006)/revised Jim Hoorman (2011)

How much can you anticipate saving from cover crops?

Cover crop savings can be calculated for:

- Reduced compaction (cost of subsoiler);
- **Reduced herbicide (cost of herbicide + labor to apply or weed);**
- Contribution of nutrients from cover crop (reduced nitrogen & phosphorus fertilizer needed);
- Reduced nutrients leached/tied-up, standard estimate of up to 80% captured .vs. 30-50% in conventional system.

Compare weed control using conventional practice verses cover crops?

Costs of conventional practice	**Savings**	**Costs**	**Balance**
Herbicide = $$$ (per acre)	$150		$150
Labor per herbicide application = 10 hours x 1 pers x $25 per hour = $250 x 5 applications = $1,250.	$1,250		$1,250
Total cost of existing practice	**$1,400**		
Costs of cover crop			
Seed (per acre)		-$60	-$60
Irrigation - parts		-$450	-$450
Irrigation- water		-$700	-$700
Total cover crop costs		**-$1,210**	
TOTAL SAVINGS			**$190**

Template for a Partial Budget

Benefits (Positive Effects):

- Increased revenue
- **Reduced costs**

Costs (Negative Effects):

- Decreased revenue
- **Increased costs**

T-Chart, Level I, Cropland – Soil Quality Improvement

Name: Sandy Clayton **Location:** Columbia Basin, Oregon **Date:** 2008	**Resource Concerns/Benchmark Condition:** 600 acres of cropland producing 70 bushels wheat and 50 bushels barley per acre in a two year rotation. Conventional tillage, nutrient and pest management. Resource concerns include: Sheet & Rill Soil Erosion, Organic Matter Depletion, Compaction, Surface Water Contaminants, Plant Productivity, and Wildlife.
Conservation Treatment: Conservation Crop Rotation (Winter Wheat/Canola/Spring Barley) Residue Management (Direct Seed/No-Till) Pest Management (Annual Grasses and Aphids) Nutrient Management (Fertilizer Management)	
Positive Effects ***Reduced Costs*** Change in Crop Rotation Decreased fertilizer applied Reduce six tillage passes over the field Reduce fuel and labor ***Increased Revenue*** Wheat yield increase Financial Assistance Payment ***Other*** Improved soil and water quality Upland bird habitat improvement	**Negative Effects** ***Increased Costs*** No-Till Drill Pest Management Nutrient/Fertilizer Management ***Reduced Revenue*** Possible lost grazing opportunities

NRCS
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/tools/

Technical Resources

- ⊞ Conservation Practice Standards
- ⊞ Ecological Sciences
- ⊞ Natural Resources Assessment
- Data, Maps & Analysis
- ⊞ Tools & Applications
- Field Office Technical Guide (FOTG)
- Engineering
- ⊟ Economics
  - Costs
  - Data & Analysis
  - State Resources
  - References
  - Prices and Indexes
  - Tools
- Environmental Markets & Conservation Finance

Economic Case Studies

Case studies are a tool to document producer experiences, and a practical method for improving our planning, prioritizing assistance, and reaching out to new agricultural producers. These experiences provide a practical source of information that shows how a prescribed treatment can work.

Case studies or "Producer Experiences" are actual stories developed to present social, economic and environmental information on the conservation effects of implementing NRCS conservation practices. Typically, field conservationists will make observations of conservation treatments applied by one or more land user(s) ar record the effects. Case study information may also be available from conservation field trials, Conservation Innovation Grant projects, university research plots or other field demonstration sites.

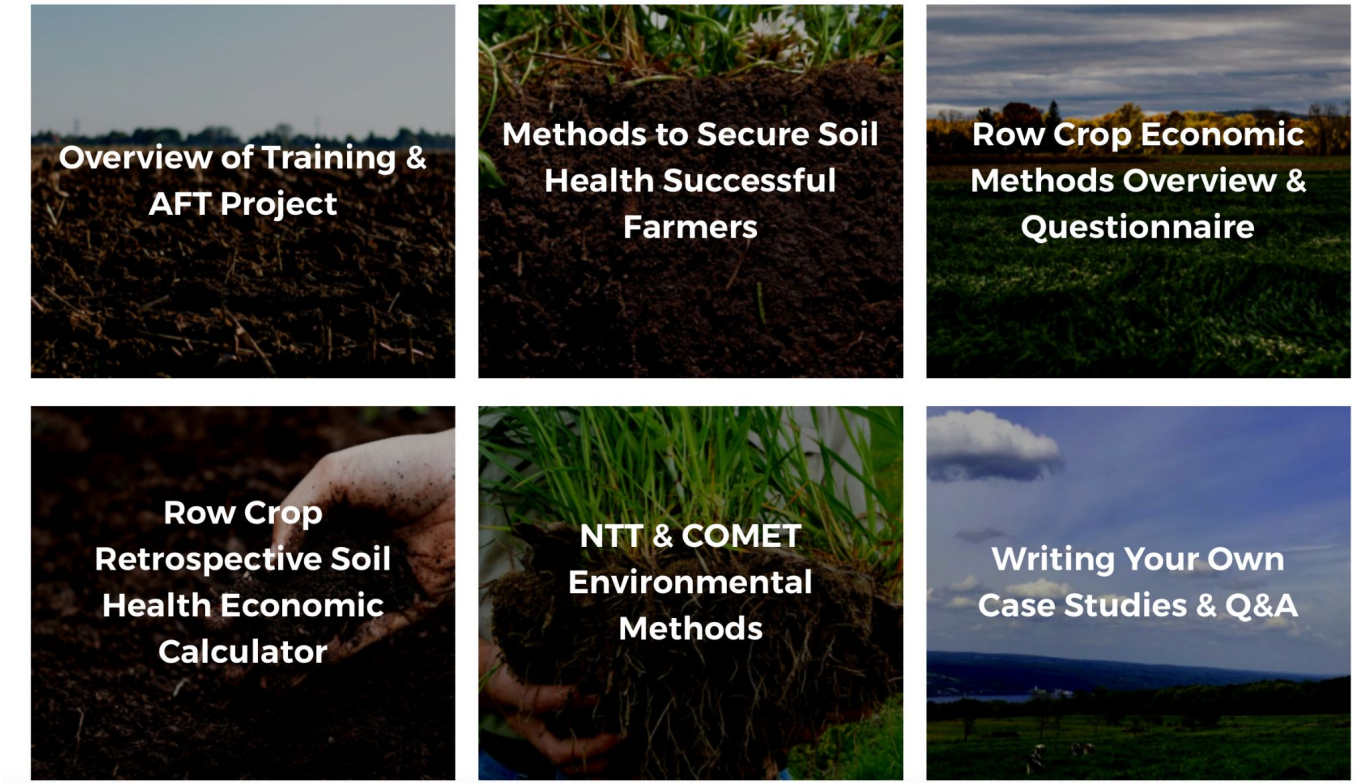
Case studies are used to evaluate the effects of conservation and do not require the degree of detail or the rigo of analysis used in university level research. However, they should be much more insightful than casual observation and help us gain a better understanding of the ecological implications of change from current production systems to conservation treatments.

Agency policy states that case studies should be stored in the Field Office Technical Guide (FOTG), Section V, titled "Producer Experiences" or "Case Studies" for use in future planning efforts and training activities. Differer states' FOTG may place case studies in either "Producer Experiences" or "Case Studies" depending on State policy.

- ECONOMICS TECHNICAL NOTE 200-ECN-6: Developing Conservation Case Studies for Decision-making
- Additional training is available: Conservation Webinar, Using Case Studies to Facilitate Farmer Conservation Decisions

Example of AFT‘s Partial Budget:

https://farmland.org/soil-health-case-studies-methods/



Example of AFT‘s Partial Budget:

https://farmland.org/soil-health-case-studies-methods/

Economic Effects of Soil Health Practices on MadMax Farms (2018)

Increases in Net Income

Increase in Income

ITEM	PER ACRE	ACRES	TOTAL
Yield Impact Due to Soil Health Practices	$69.00	1,250	$86,250
Total Increased Income			$86,250

Decrease in Cost

ITEM	PER ACRE	ACRES	TOTAL
Nutrient Savings due to Soil Health Practices	$17.51	1,250	$21,881
Reduced Seeding Rate for Soybeans	$5.00	625	$3,125
Pesticide Savings due to Soil Health Practices	$18.75	1,250	$23,438
50% Reduction in Treated Soybean Seed	$6.00	625	$3,750
Reduced Machinery Costs Due to Reduced Tillage	$35.45	1,250	$44,317
Field Repair Savings due to Soil Health Practices	$1.00	1,250	$1,250
Total Decreased Cost			**$97,761**
Annual Total Increased Net Income			$184,011
Total Acres in this Study Area			1,250
Annual Per Acre Increased Net Income			$147

Decreases in Net Income

Decrease in Income

ITEM	PER ACRE	ACRES	TOTAL
None Identified			$0
Total Decreased Income			$0

Increase in Cost

ITEM	PER ACRE	ACRES	TOTAL
Variable Rate Application Cost	$3.00	1,250	$3,750
Increased Soil Testing Every Two Years	$10.00	1,250	$12,500
Residue and Tillage Mgt. Learning Activities	$1.17	1,250	$1,465
Cover Crops Learning Activities	$5.86	1,250	$7,326
Nutrient Management Learning Activities	$3.32	1,250	$4,151
Using Biologicals in Furrow	$30.00	1,250	$37,500
Increased Machinery Costs due to Change in Nutrient Management	$6.30	1,250	$7,875
Cover Crop Costs	$49.50	1,250	$61,875
Total Increased Cost			**$136,442**
Annual Total Decreased Net Income			$136,442
Total Acres in this Study Area			1,250
Annual Per Acre Decreased Net Income			$109

Annual Change in Total Net Income = $47,569

Annual Change in Per Acre Net Income = $38

Soil Health Institute Partial Budget Resources:

https://soilhealthinstitute.org/economics/

ABOUT THE RESEARCH

Farmers and ranchers are businesspeople, and the questions that often present the most significant barrier to adoption of soil health management systems pertain to the business case. The Soil Health Institute interviewed 100 farmers in 9 states who have adopted soil health systems and used partial budget analysis to evaluate their economics and answer the following question:

DO SOIL HEALTH PRACTICES INCREASE OR REDUCE PROFITABILITY?

SOIL HEALTH INSTITUTE RESOURCES

https://soilhealthinstitute.org/wp-content/uploads/2021/02/Partial-Budget-Methodology-used-by-SHI-v.-02-08-2021.pdf

SOIL HEALTH INSTITUTE

Table 1. Description of Costs and Benefits Analysis

BENEFITS	COSTS
Reduced Expense	Additional Expense
Production Inputs *Labor* *Other Operating Expenses* *Equipment Ownership*	*Production Inputs* *Labor* *Other Operating Expenses* *Equipment Ownership*
Additional Revenue	Reduced Revenue
Increased Yield *Increased Crop Price* *Grazing Value* *Forage Harvested*	*Decreased Yield*
Total Benefits	Total Costs
Benefits - Costs = Change in Net Farm Income	

Table 3. ***Partial budget analysis[1] of adopting a soil health management system for 100 farms in the nine-state region. Unless shown otherwise, the units are $/acre (2019 dollars).***

	CORN		SOYBEAN	
	Benefits	Costs	Benefits	Costs
Expense Category	Reduced Expense	Additional Expense	Reduced Expense	Additional Expense
Seed	4.08	12.62	2.79	10.02
Fertilizer & Amendments	22.36	1.14	9.20	0.25
Pesticides	9.22	7.90	10.00	8.07
Fuel & Electricity	3.91	1.90	4.33	1.80
Labor & Services	11.13	8.24	10.94	8.24
Post-harvest Expenses	0.18	3.48	0.00	0.93
Equipment Ownership	16.18	11.08	18.41	10.72
Total Expense Change	67.06	46.36	55.67	40.03
	Additional Revenue	Reduced Revenue	Additional Revenue	Reduced Revenue
Yield, bu./acre	7.73	0.39	2.91	0.00
Price Received[2], $/bu.	4.21	4.20	10.05	10.00
Revenue Change	32.54	1.64	29.25	0.00
	Total Benefits	Total Costs	Total Benefits	Total Costs
Total Change	99.60	48.00	84.92	40.03
Change in Net Farm Income	51.60		44.89	

SOIL HEALTH INSTITUTE RESOURCES

https://learn.oahurcd.org/training-sessions/course/soil-health-cohort-8

Session 8: Regenerative Enterprise, Decision-Support and Budgeting for Soil Health Practices, (

This session introduces farmers to ways they can begin to market, brand and tap into regenerative mar

Throughout this cohort, farmers have refined the ways they build soil health and restore on-farm ecosys
value-added products using regenerative practices is important to conscious consumers and our greate
session that will help farmers in the cohort start to think about ways they might expand their farm busine
As part of this session,Trinity Asing introduces Mauka Market and examples of ways they've started to

Search Lessons...

1 - Partial Budgets & Cost-Benefit Analysis

2 - Creating & Tapping into Local Regenerative Enterprises

3 - Social and Economic Considerations - Marlon Winger

Soil Health Indicators & Interpretation from UH CRow Lab

Indicator	Function and Interpretation
Physical Properties	
Bulk density (g/cm^3)	Porosity and rooting environment; lower values are better; low bulk density soils are light, porous, and promote root growth
Water holding capacity (%)	Plant water relations; higher is better
Water stable aggregates (%)	Water infiltration, porosity, aeration; higher is better; soils with a high percentage of stable aggregates promote water infiltration, hold water, have high porosity, and promote root growth
Chemical Properties	
pH	Nutrient availability; 6.0—7.0 is ideal, this is the pH range where plant essential elements are most available and toxicities are negligible
Total organic carbon (%)	Natural resource reserve and overall soil function; higher is better; TOC is a measure of the amount of soil organic matter in soil, soil organic matter benefits all aspects of soil function
Hot water extractable organic C ($mg\ kg^{-1}$)	Energy source for microbes and readily mineralizable N; higher is better; this pool of extractable C is involved in aggregate formation in addition to its bioavailability
Biological Properties	
CO_2 burst ($mg\ C\ kg^{-1}$)	Metabolic activity of microbes; high equals active microbial community
Mineralizable nitrogen ($mg\ kg^{-1}$)	Soil biological activity and available substrate for N mineralization; higher is better; this is a measure of the soil's natural capability to supply plant available N
β-glucosidase ($mg\ kg^{-1}$)	Microbially produced enzyme associated with C decomposition; higher is better; a measure of soil's natural ability to cycle C
β-glucosiaminidase ($mg\ kg^{-1}$)	Microbially produced enzyme associated with N mineralization; higher is better, a measure of soil's natural ability to cycle N

QUESTIONS & FEEDBACK