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ILLINOIS SOIL HEALTH APPRAISAL METHODOLOGY & PILOT OVERVIEW

FALL 2024

SOIL HEALTH INSTITUTE

Enriching Soil, Enhancing Life

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EXECUTIVE SUMMARY

Illinois farmers may build soil health and improve water quality by adopting Soil Health Management Systems (SHMS), such as cover crops and no-till. However, prior stages of work by Delta Institute have shown that despite evidence that suggests improved soil health may create more profitable farming operations (American Farmland Trust, 2019; American Farmland Trust, 2020; Soil Health Institute, 2021), Illinois farmers require greater financial incentives to adopt SHMS.

Farmers may be incentivized to adopt SHMS if building soil health can demonstrably increase the value of their land, helping to provide a clear value proposition to undertake soil health- and water quality- focused efforts. To do so, soil health must be valued as a property characteristic and a replicable process to incorporate soil health into commonly accepted appraisal practices must be created. However, in Illinois (and more broadly in the Midwest), no real estate appraisal approaches currently exist to empirically assess the value ($/acre) of soil health. Instead, land values are closely tied to soil Productivity Index scores, which are derived from measurements of inherent soil properties (e.g., texture, drainage, and parent material). In other words, the condition (or health) of the soil is not considered due to a lack of commonly accepted metrics by real estate professionals.

The appraisal process is critical to the functioning of the agricultural sector. Real estate market participants use appraisals to negotiate fair prices when buying or selling farm properties. Lenders use appraisals to assess the value of the farm property as collateral for operating loans or mortgages. Appraisals assist in estate planning by providing an accurate valuation of farm properties for inheritance and tax purposes. Investors utilize appraisals to evaluate potential returns and risks associated with investing in agricultural properties. Government authorities may employ appraisals to assess property taxes on farm properties based on their fair market value. Taken as a whole, if appraisers are able to value soil health as an asset or improvement on farmland, then soil health can be traded in the marketplace and building soil health by adopting SHMS may become an attractive business strategy for farmers.

Through generous support from the Walton Family Foundation, a project team comprised of Delta Institute, Compeer Financial, and the Soil Health Institute (the Project Team) provides a proof-of-concept approach to incorporating measurements of soil health into the farm real estate appraisal process in Illinois. The Project Team piloted this approach on 11 subject properties in DeKalb County, IL in 2024 that were viewed to be reasonably indicative of many Midwestern farm properties.

Briefly, the Project Team implemented the following modified Sales Comparison appraisal approach, which filtered information into a transferable system that can be replicated in other agricultural real estate markets:

1. Foundational, widely recognized metrics of the subject properties and comparable land sales in the defined market area were collected.
2. Soil health data of the subject cohort was collected and analyzed to observe trends specific to soil health indicators. A ranking system was used to make comparisons among “peers”. Land management history data collected via farm owner/tenant interviews was used for qualitative bracketing.

3. A simple and replicable “soil health index” score was created specific to each subject to determine the extent of any value influence and form an opinion as to how these ultimately influence property value.
4. The subject cohort was analyzed and any trends specific to the soil health indicators (soil organic carbon percentage, potential carbon mineralization, and aggregate stability) were observed. The association between assessed value ($/acre) and soil health was then assessed by regression analysis.
5. Finally, appraisers incorporated the soil health index specific to the subject to form an opinion as to how/whether these ultimately influence property value.

It was the appraisers' opinion that as of the effective date there are not enough conclusive market data to suggest that a farm’s soil health impacts the value of that property. While soil health was able to be analyzed as a potential adjustment within the Sales Comparison Approach, a review of the individual soil health index scores among pilot participant farms did not warrant an adjustment simply due to lack of market evidence. In other words, at the moment, appraisers lack the baseline data required to identify and isolate any quantifiable market reactions to soil health.

The Project Team not only successfully created a replicable soil sampling methodology and “soil health index” to be utilized in future appraisals but also determined that the Sales Comparison approach is best suited for incorporating soil health into the land valuation process at scale. However, through this process, the Project Team has found that major barriers, such as limited information and high transaction costs preventing the institutional adoption of this novel appraisal methodology and have created a “missing market” for soil health in land valuation.

The results of this Pilot Program also contribute empirical evidence that suggests land management has a significant effect on soil health. The soil health indicator values among cropland sites and the references were markedly different - with the maximum values in cropland sites almost always lower than the minimum values in the references. Given that all but one undisturbed, perennially vegetated sites had significantly higher soil health indicator values than any of the cropland sites, these results clearly suggest that tillage and conventional agricultural management may decrease soil health. This is valuable towards the incorporation of soil health into land appraisals because it not only shows that soil health can be measured and compared among sites, but also that reference sites provide a ceiling for improvement for farmers to achieve by adopting SHMS.

The next steps of our work will be to fill the gaps of this “missing market” by further building market evidence of the value of soil health and lowering the prohibitive costs/time of soil health testing. Therefore, Delta seeks to further compile baseline data and test the soil health appraisal approach in similar Midwestern markets, such as Iowa and Indiana. Delta also has identified loan officers as crucial partners needed to catalyze the creation of a soil health market. For example, if building soil health can be tied to greater land values and deliver more equity to farmers, then farmers may adopt soil conservation practices to secure lower interest rate operating loans. The Project Team will test this modified Sales Comparison approach in new Major Land Resource Areas and refine to identify the emerging market pathways and platforms in which the appraised value of soil health may be traded.

The novel approach outlined in this document has not been officially approved or adopted by

any governing organizations or regulatory bodies within the appraisal industry. The effectiveness and reliability of this approach may vary depending on specific circumstances, local regulations, and market conditions. Therefore, it is recommended to consult with certified appraisers or relevant authorities for guidance on conducting farm real estate appraisals in compliance with established standards and best practices. This document is provided for informational purposes only and does not constitute professional appraisal advice or endorsement of the approach described herein.

About Delta Institute

Delta Institute collaborates with communities to solve complex environmental challenges throughout the Midwest. Delta exists because environmental, economic, and climate issues hit communities—urban and rural—through disinvestment, systemic inequity, and policy decisions. We collaborate at the community level to solve our home region's new and legacy issues, by focusing on the self-defined goals and needs of our partners.

Delta Institute improves the living conditions of more than five million Midwesterners by transitioning one million acres to more resilient, conservation-focused practices, and by improving water quality and reducing flooding by capturing 100 million stormwater gallons. By 2025 we will achieve these goals through our agriculture, climate, water, and community development projects.

This is what a more resilient, equitable, and innovative Midwest looks like. Visit us online at www.delta-institute.org.

Acknowledgements

- This project was produced with generous support from the Walton Family Foundation.
- Compeer Financial is a member-owned, Farm Credit cooperative serving and supporting agriculture and rural communities. They provide loans, leases, risk management and other financial services throughout 144 counties in Illinois, Minnesota, and Wisconsin. Based in the upper Midwest, Compeer Financial exists to champion the hopes and dreams of rural America.
- The Soil Health Institute is a global non-profit with a mission of safeguarding and enhancing the vitality and productivity of soils through scientific research and advancement. The Institute brings together leaders in soil health science and the industry to conduct research and empower farmers and other landowners with the knowledge to successfully adopt regenerative soil health systems that contribute economic and environmental benefits to agriculture and society.

This document and the tools provided aim to be action oriented and to provide the most current, correct, and clear information possible, but some information may have changed since publication. We encourage practitioners to reach out to us at delta@delta-institute.org with questions, corrections, or to discuss implementation challenges.

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AN OVERVIEW OF THE SOIL HEALTH APPRAISAL PILOT PROGRAM

Program Basics

The Project Team partnered to implement a Soil Health Appraisal Pilot Program (the Pilot Program) to test a proof-of-concept appraisal approach towards factoring soil health in the land valuation process on 11 Illinois farms in Summer 2024. The goals of the Pilot Program were to:

1. Determine the extent to which measures of soil health can be incorporated into the farmland appraisal process.
2. Create a quantifiable metric for soil health that can be incorporated into the farmland appraisal process.
3. Review and revise (if necessary) the proposed approach to analyze the effect of soil health assessment on sales price of farmland parcels and test the methods on the pilot study data set.
4. Provide a framework to track soil health and create awareness for producers who may want to adopt Soil Health Management Systems (SHMS) such as cover crops or no-till.

The Pilot Program was a partnership between 10 Illinois farmers (the Farm Cohort) and Delta Institute (Delta), which included an agreement to permit the Project Team access to each subject property to conduct soil health testing and to gather land management history data. In total, 11 subject properties were analyzed. By collecting soil health measurements and land management history data, the Project Team created a database of ranked participating farms using a novel soil health index. In return, each member of the Farm Cohort received a free appraisal, soil health testing, and a personalized Soil Health Report, which included recommendations to improve their soil health through best practices in SHMS.

Timeline

The following timeline demonstrates the sequential order of each milestone of the Pilot Program:

Milestone	Winter 2023	Spring 2024	Summer 2024	Fall 2024
Identify Pilot Program Geography				
Farm Cohort Recruitment				
Data Collection: Soil Samples & Land MGMT History				
Appraisals & Soil Health Analyses				
Evaluation & Reporting				

Partners and Roles

- Delta: project administration, facilitate agreements with Farm Cohort, support project partners, synthesize and present results.
- Compeer Financial: lead recruitment and correspondence with Farm Cohort, market research and analysis, appraisal approach implementation.
- Soil Health Institute: advise farm selection based on soil and physiographic conditions, select and sample sites within farms, send samples to applicable soil testing laboratory, analyze and report soil health results.

Delta Institute and Soil Health Institute shared responsibility for establishing soil health as a metric. Compeer Financial was responsible for integrating this metric into the appraisal process.

Program Geography

The Project Team determined that subject properties should only be selected from one Soil Health Sampling Group (SHSG) within Major Land Resource Area (MLRA) 108 (Figure 1). A SHSG represents an area with similar soil texture and drainage while an MLRA represents a specific geographic area of constrained parent material and climate. In other words, several SHGS can be found within the same MLRA.

Major Land Resource Area 108

The following information comes directly from the USDA Agriculture Handbook 296 (USDA, 2022). The Handbook is a collective effort by the National Soil Survey Center and regional natural resource managers to subdivide land into resource units with similar soils, climate, and vegetation or crop types.

Overview

MLRA 108 is located within Land Resource Region M - Central Feed Grains and Livestock Region (Figure 1) and covers about 32,967 square miles over large portions of central and northern Illinois, central and

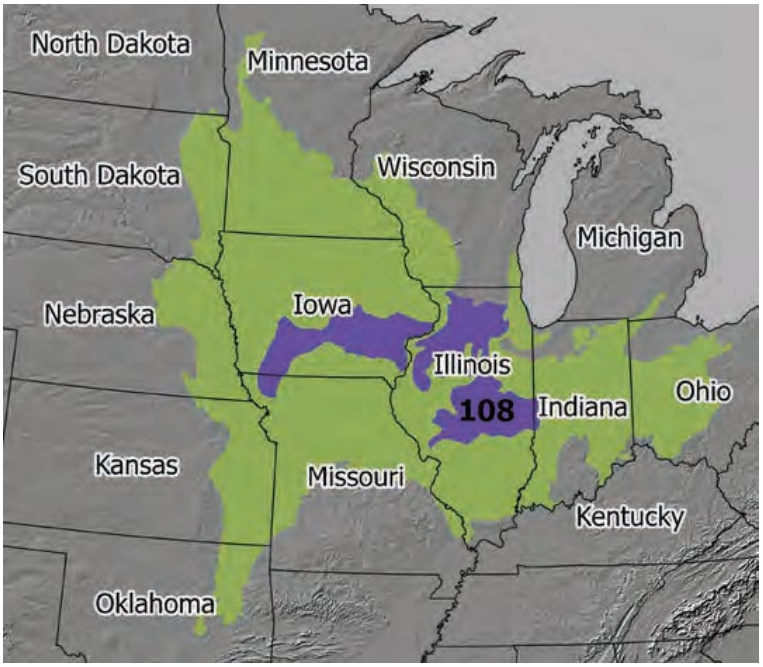


Figure 1: Location of MLRA 108, which covers 32,967 miles^2. Source: USDA Agriculture Handbook 296, 2022.

southern Iowa, as well as small portions of Missouri and Indiana.

The average annual precipitation of MLRA 108 is 38 inches (mostly falling during the growing season) and the average temperature is 51 degrees F.

The vast majority of MLRA 108 is cropland devoted to corn and soybean production (Figure 2). Indeed, MLRA 108 contains the two highest Corn and Soybean-producing states in the US: IL and IA (USDA Economic Research Service, 2023). As such, the major resource concerns in MLRA 108 are soil erosion and water quality.

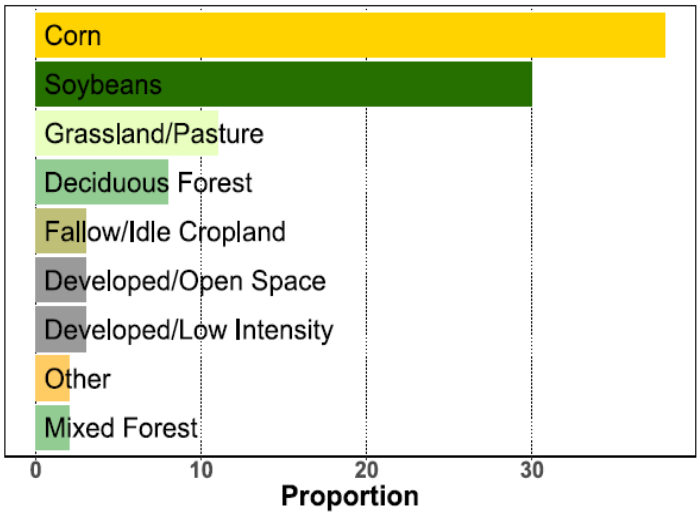


Figure 2: Relative proportions (percentages) of land use in MLRA 108. Source: USDA Agriculture Handbook 296, 2022.

Soils

MLRA 108 is dominated by mineral-rich, well-draining loamy agricultural soils derived from Pleistocene (2.58M – 11.7KYA) glacial deposits of loess and till, which once supported tallgrass prairies (Mollisols) in the western portion and deciduous forests (Alfisols) in the eastern and southern portions. As such, MLRA 108's soils are characterized as: moderately deep to very deep, poorly drained to moderately well drained, and silty to loamy to clayey. Mean annual soil temperature is between 46 and 59°F.

Soil Health Sampling Group – Southern DeKalb County, IL

The Project Team selected the southern portion of DeKalb County as well as the eastern portions of Lee and Ogle counties as the Soil Health Sampling Group (SHSG) for the Pilot Program. This territory was first selected for its homogenous distribution of fine-silty, well & intermediately drained soils. Due to the uniformity of the overall soil profile, the hypothesis was that this portion of the state would be an appropriate location to identify and isolate any quantifiable market reactions to soil health. The fine-silty, intermediately drained and fine-silty, poorly drained groups make up greater than 75% of row crop acreage. Additionally, the southern portion of DeKalb County has exhibited little population growth and conversion of farmland to more intensive land uses. The rural nature of this area helped to isolate meaningful physical characteristics which currently impact land values. Figure 3 shows the dominant SHSGs in MLRA 108 across DeKalb and eastern portions of Lee and Ogle counties.

Overview

DeKalb County occupies 636 miles^2 in northeastern Illinois. The climate is continental with a wide annual temperature range with average maximum and minimum daily temperature of 31° and 16°F respectively in January to 85° and 64°F in July. Mean annual precipitation is 35 inches with monthly averages greatest in late spring and summer months. Agriculture is the main enterprise in the County with corn and soybeans as the major crops. The County has relatively

low relief varying from 650 to 950 feet above sea level.

While western Kane County was also suitable for recruitment because its soil qualities resemble those of DeKalb County, other factors disqualified these properties from our study. Chief among them was urban influence and metropolitan development pressure. Areas along major highways and properties near villages and cities showed significant premiums over rural farmland. Inclusion of these properties would have introduced substantial variation in the data and greatly skewed results. It is not uncommon for marginal farmland to sell for over $20,000 per acre in these areas of Illinois whereas 10 miles west that same quality of farm may sell for approximately half that price.

Additionally, in an effort to reduce the number of acres being converted to more intensive land uses, Kane County instated an at-will “Farmland Protection Program” which essentially purchases the development rights from a property owner. By doing this, the farm will remain in agricultural production into perpetuity (or until the land rights are resold). While there are still rural areas of Kane County that have little to no developmental pressure, there are a number of farms that no longer have these development rights. Comparing properties with differing property rights would not be appropriate without adjustment (support of market evidence) and would open the Pilot Program’s results to a high level of scrutiny.

Soils

Soils in DeKalb county are mostly on uplands formed in glacial till plain covered by loess.

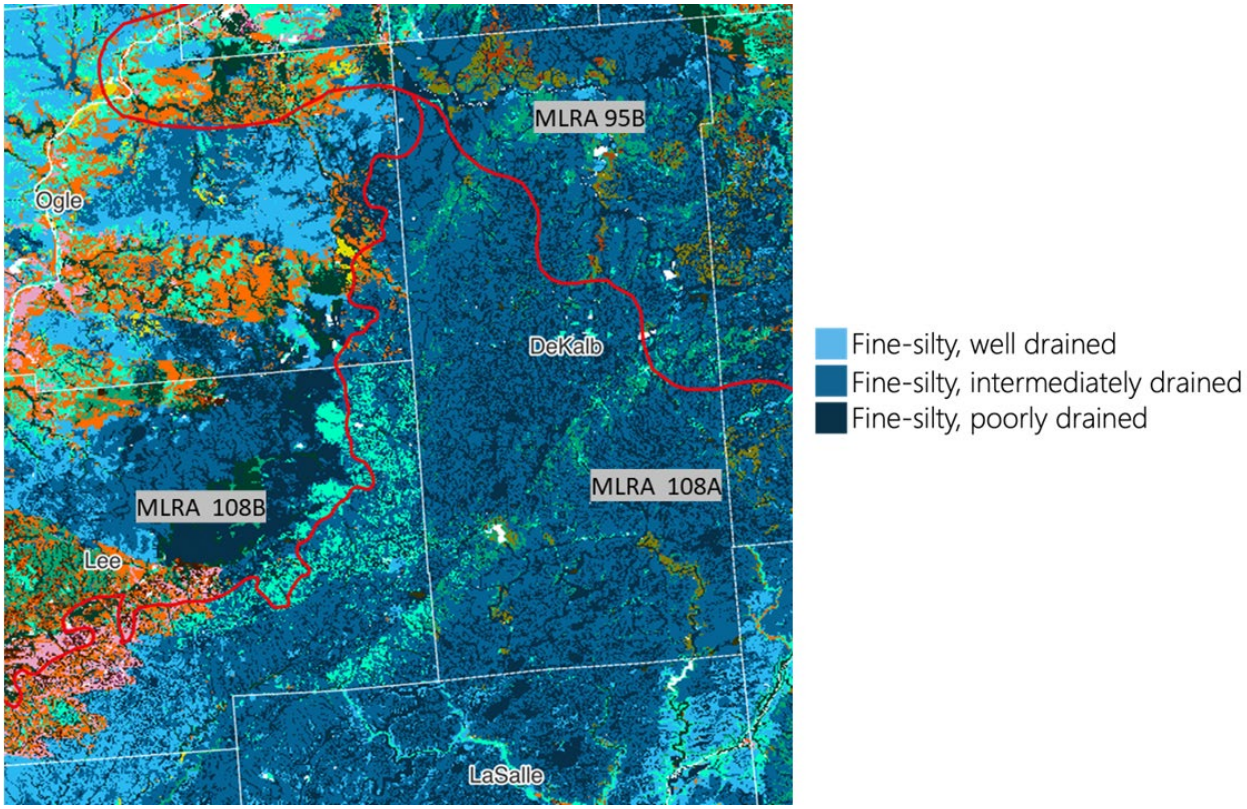


Figure 3: Dominant Soil Health Sampling Groups across Dekalb and eastern portions of Ogle and Lee counties. The fine-silty, intermediately drained and fine-silty, poorly drained groups make up greater than 75% of row crop acres.

Examples of common soil series across the county are Drummer silty clay loam (29% of total area), Saybrook silt loam, 2-4% slope (15.2% of total land area) and Flanagan silt loam (11.9% of total land area). Drummer soils are on large, somewhat flat areas and in drainageways. They are nearly level and poorly drained. Surface layer is typically black silty clay loam about 18 inches thick. The subsoil is olive-gray and gray silty clay loam with underlying material of stratified silt loam and loam. Flanagan soils are on the edges of gentle slopes. They are nearly level and somewhat poorly drained. The surface layer is typically black silt loam about 13 inches thick and the subsoil is mostly brown silty clay loam. The underlying material is loam till below a depth of 45 inches. Saybrook soils are gently sloping to sloping, well drained and moderately well drained that commonly occur on ridgetops. The surface layer typically is very dark brown and brown silt loam about 12 inches thick. The subsoil is dark yellowish-brown and dark-brown silty clay loam and clay loam. It is underlain by loam till below a depth of 44 inches.

Program Eligibility and Recruitment

In order for comparisons among subject properties to be made, the Project Team utilized the following eligibility criteria to identify possible participants for the Pilot Program:

- Similar size range acreage (40 – 320 acres)
- Comparable slope, Class and erosion susceptibility
- Shared underlying soil types and soil Productivity Index greater than 130
- Greater than 90% tillable acreage
- Arms-length transactions (sales that were publicly advertised and typically sold by realtor or auctioneer)
- Vacant (Unimproved)
- Within a 25 +/- mile range
- Signed agreement with Project Team regarding confidentiality of property information and appraisal results publishing.

Once southern DeKalb County was identified as the Pilot Program's geographic region and eligibility criteria was agreed upon by the Project Team, Compeer Financial utilized financial officers, crop insurance agents, and regional technical service providers to identify potential participants. A database of recent sales that fit the eligibility criteria previously described was generated and served to identify potential pilot participants. Compeer Financial focused primarily on sales that occurred in DeKalb County; however, eastern portions of Lee & Ogle Counties were also considered given similar soil characteristics. Recently sold farms were utilized both as a subject property and as a comparable sale. Therefore, farms that have recently sold were sought first to participate in the Pilot Program. It was imperative to have participation by recently sold farms so Compeer could analyze and extract market preferences with quantitative data.

At first, a major factor the Project Team considered in the recruitment strategy was the amount or degree to which soil health management was being implemented on the farms. Preferably there would have been variety among the data set, with respect to SHMS. However, during recruitment, the Project Team only found minimal variation in terms of SHMS among recently sold farms, which limited our ability to express a spectrum of soil health values that could be found in a given geography. In total, ten farmers and eleven subject properties were selected as the Farm Cohort for the Pilot Program. Subject properties ranged in size from approximately 40

acres to approximately 172 acres.

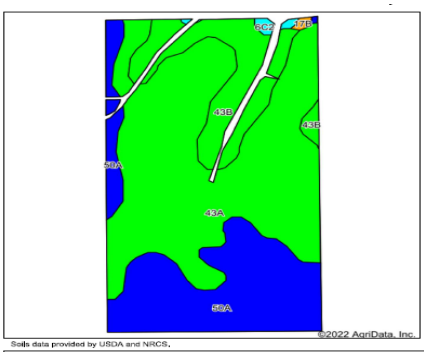
Expected Outcomes

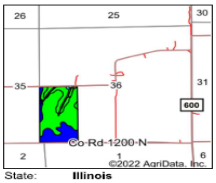
- Increased understanding of the relationship, if any, between soil health and land value in Illinois' agricultural real estate market.
- Development of a "proof of concept" place-based appraisal approach for factoring soil health in the land valuation process that can be applied to other regions.
- Increased awareness and adoption of best practices in soil health management systems among Illinois farmers.

MODIFIED APPRAISAL APPROACH METHODOLOGY

Property Information

The first step was to define the extent to which the subject property is identified, including: the property's street address; legal description; plat of survey; deed plot survey; plat book; aerial map; soils map and soils analysis; county aerial map (Figure 4); deed; title commitment; assessor's parcel identification number (PIN #); County / Township zoning map; and Illinois real estate transfer declaration. Compeer Financial collected factual information regarding each subject property from Surety/AgriData Mapping, local County records, public courthouses, and interviews with the property owner and/or tenant.





State: **Illinois**
County: **Brown**
Location: **36-1N-4W**
Township: **Pea Ridge**
Acres: **77.66**
Date: **12/6/2022**

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Soils data provided by USDA and NRCS.

Area Symbol: IL009, Soil Area Version: 17

Code	Soil Description	Acres	Percent of field	Il. State Productivity Index Legend	Subsoil rooting a	Corn Bu/A	Soybeans Bu/A	Wheat Bu/A	Oats Bu/A b	Sorghum e Bu/A	Alfalfa of hay, T/A	Grass-leg tame e hay, T/A	Crop productivity index for optimum management
43A	Ipava silt loam, 0 to 2 percent slopes	43.33	55.8%		FAV	191	62	77	100	0	0.00	5.90	142
50A	Virden silty clay loam, 0 to 2 percent slopes	22.36	28.8%		FAV	182	59	71	93	0	0.00	5.27	135
**43B	Ipava silt loam, 2 to 5 percent slopes	11.27	14.5%		FAV	**189	**61	**76	**99	0	0.00	**5.84	**141
**802	Fishhook silt loam, 5 to 10 percent slopes, eroded	0.50	0.6%		UNF	**119	**38	**46	**57	0	0.00	**3.50	**87
**17B	Keomah silt loam, 2 to 5 percent slopes	0.20	0.3%		FAV	**159	**50	**64	**82	0	0.00	**5.09	**118
					Weighted Average	187.6	60.8	74.9	97.5	*-	0.00	5.69	139.4

Table: Optimum Crop Productivity Ratings for Illinois Soil by K.R. Olson and J.M. Lang, Office of Research, ACES, University of Illinois at Champaign-Urbana, Version: 1/2/2012 Amended Table S2 B811
Crop yields and productivity indices for optimum management (B811) are maintained at the following NRES web site: http://soilproductivity.nres.illinois.edu/
** Indexes adjusted for slope and erosion according to Bulletin 811 Table S3

Figure 4: Soil Map produced during farmland appraisal describing tillable acres of a parcel and a weighted average for each soil's Crop Productivity Index score. Source: Compeer Financial.

Comparable Sales Data

Next, Sales Data was gathered by Compeer Financial, analyzed in a consistent format, and stored in a Uniform Agricultural Appraisal Report which allowed for the sales information to be incorporated into the appraisal process. Sales Data was gathered via attendance at in-person and virtual public auctions, as well as conversations with loan officers, appraisers, and other real estate professionals. Information gathered in these conversations was then verified via transfer documents filed at the County courthouse. The subject properties were analyzed utilizing widely accepted quantitative metrics (e.g., % tillable acres, soil Productivity Index, soil type and class) as well as qualitative factors (e.g., drainage and utility) that usually is at the

discretion of the appraiser.

Market Trends / Economic Indicators

A combination of USDA National Agriculture Statistics Services (NASS) (USDA National Agriculture Statistics Services, 2022) and University of Illinois Farm Doc (University of Illinois, 2024) tools/resources provided recent market trends. Further insights into local market trends were gathered from the Compeer Financial Benchmarking System (Compeer Financial, n.d.). A "benchmark" refers to a farm that is found to be representative of a commonly sold property type in a given county/region. This farm is then appraised on consistent intervals. Compeer began appraising benchmark farms on a monthly basis as of July 2021. Consistently appraising a singular farm with new comparable sales provides insight into an approximate indication of appreciation or deprecation the farm has experienced over a defined period of time.

Agricultural Production Data

This data was gathered during interviews with the property owners or tenants during soil and land management history data collection in Summer 2024. However, with recently sold properties, there was no guarantee that the previous owners or tenants would be willing to share yield data. Yield Data is dependent upon the accuracy of a yield monitor, harvest records, and is not typically marketed in the advertisement of a property.

Soil Health Data Collection

Figure 5: GPS-guided soil sampling. Source: Delta Institute.

In parallel to the above appraisal steps, the Project Team sampled soils at subject properties and corresponding "reference sites". The Soil Health Institute recommends the use of reference sites to compare against "business-as-usual" – management practices (e.g., conventional corn/soybean rotation with no SHMS) to bridge gaps in soil health testing availability, establish benchmarks for land management decisions, and be scaled up from site-specific to regional (Maharjan et al., 2020). Reference sites were chosen to maximize the local potential expression of soil health principles (minimize disturbance, maximize soil cover, maximize presence of living roots, maximize biodiversity) within a SHSG. Reference sites were chosen for each subject property where the soil has been largely undisturbed in the last 10 years and perennial plants are growing. Each subject property had a reference site to compare soil health.

Three soil health indicators were measured at each subject property and corresponding reference site to diagnose soil health:

1. Total Soil Organic Carbon (SOC) (Soil Health Institute, 2022)
2. Potentially Mineralizable Carbon (PMC) (Soil Health Institute, 2022)
3. Soil Aggregate Stability (Soil Health Institute, 2022)

For most row-crops in temperate climates, the preferred sampling period is in spring prior to planting or pre-plant field operations (e.g., seedbed preparation, pre-plant fertilizer application, planting, etc.). A second preferred window is about 3-to-4- weeks after planting. Our in-field sampling was completed June 3rd and June 4th, 2024, with corn crop ranging from approximately V2 – V4 stages and soybeans from VC – V1.

Measurements of these three soil health indicators (and associated soil properties such as soil texture needed to better interpret the soil health measurements) were collected within a ~30-foot radius of a GPS-marked sampling location (Figure 5).

The SOC and PMC samples were collected as composites of ten, 1" diameter samples with a push probe from 0-6" depth (Figure 6).

Figure 6: Collection of composites of ten, 1" diameter samples for SOC and PMC analysis with a push probe from 0-6" depth. Source: Delta Institute

The aggregate stability samples were collected by hand from aggregates remaining after using a 2mm sieve to remove the finest material, then selecting approximately pea-sized aggregates to fill a 50 mL centrifuge tube from the top 3" of soil (Figure 7). The SOC sample was analyzed by dry combustion. The PMC was determined as the CO_2 produced after a 24-hour incubation of rewetted air-dried soils. Aggregate stability was quantified with a visual assessment of slaking (slakes) 10 minutes after rewetting, also known as slakes. The texture will also be measured to confirm that the sampled soil matches the soil health sampling group.

Figure 7: Collection of pea-sized aggregates to fill a 50 mL centrifuge tube from the top 3" of soil for soil aggregate analysis. Source: Delta Institute

Given the small project area, the Project Team did not expect any meaningful differences in climate. The Project Team sampled from a similar topographic position for all the positions by avoiding low spots that may be at a smaller scale than the soil maps.

Land Management History Data Collection

No two farm sites are managed identically, and soil health is assumed to be greater on properties where SHMS have

been adopted for longer (Bender et al., 2016; Krupek et al., 2022). Therefore, the Project Team collected land management history data from the previous 5 years (2019-2024) of each subject property, to evaluate differences among the cohort in terms of crop rotation, soil physical disturbance, and cover cropping. The majority of subject properties in the Pilot Program represented regionally common agricultural production management such as corn and soy rotation with tillage before the corn. Organic corn and soybean operations were also represented where winter wheat is included in the rotation and cover crops are used in the winters without wheat. Specifically, the management data collection focused on:

1. The identity of cash crops or cover crops and the timing of planting and harvesting, and
2. The timing of tillage and the type of equipment used.

Based on this information, the management among subject properties was evaluated categorically (e.g., tilled vs. no-till) and continuously based on an index calculated from the type of implement used for tillage. Each index is designed so that a higher index value represents a more "soil health promoting" management. The subject properties were compared to nearby reference sites that have had perennial vegetation growing for at least ten years.

Soil Health Index Creation

Currently, there is no widely accepted holistic metric by the agricultural real estate market as it pertains to soil health. For the purposes of this Pilot Program, soil health on each of the subject properties was ranked as the ratio of each property's measured value to its paired reference site.

Table 1 below demonstrates the use of a relativized value for each soil health indicator and the final average value to create the soil health index.

Table 1: Example of subject property soil health indicator values being relativized against the reference site's towards an overall average, or soil health index.

Site ID	Soil Organic Carbon (%)	SOC % of Reference Average	Potential Carbon Mineralization (mg C/ kg soil)	PCM % of Reference Average	Aggregate Stability	Aggregate Stability % of Reference Average	Average of 3 values
Cropland 1	2.25	56%	31.52	21%	0.34	52%	43%
Cropland 2	1.66	41%	31.60	21%	0.47	72%	45%
Cropland 3	1.69	42%	26.92	18%	0.30	46%	35%

Valuation Approaches

After relevant appraisal data was collected, Compeer Financial identified the extent and type of analysis applied by the appraisers to reach the final value conclusion. The real estate appraiser

does not set the market but rather interprets the market from the market data available. In a professional real estate appraisal, three approaches to value are considered and typically applied: (1) Cost Approach (2) Income Capitalization Approach and (3) Sales Comparison Approach. All approaches apply data derived from the market and are applicable to the subject.

Cost Approach

The Cost Approach adds the depreciated reproduction or replacement cost of improvements to the value of the vacant land. The approach emphasizes the premise that an informed buyer would pay no more than the cost of producing a substitute with similar utility - presuming no undue or costly delays. Use of the approach to value is best when land values are well supported, which is typically the case in agricultural assignments.

Income Capitalization Approach

The Income Capitalization Approach analyzes the subject's capacity to generate benefits and converts them into an indication of present value. This approach presumes that no prudent buyer will pay more for a property than the present value of these anticipated future benefits. The steps in the process are as follows: (1) determine market Potential Gross Income (2) analyze Vacancy and Collection Loss (3) determine market Operating Expenses (4) summarize Net Operating Income and (5) select a Capitalization Rate. Given agricultural properties are purchased based on their ability to provide income, the Income Capitalization Approach is a market value indicator.

This approach is a set of procedures through which an appraiser derives a value indication for an income-producing property by converting its anticipated benefits (cash flows and reversion) into property value. This conversion can be accomplished in two ways.

One year's income expectancy can be capitalized at a market-derived capitalization rate or at a capitalization rate that reflects a specified income pattern, return on investment, and change in the value of the investment. Alternatively, the annual cash flows for the holding period and the reversion can be discounted at a specified yield rate. This approach to value involves an analysis of the property in terms of its ability to produce an income stream. The net income is then capitalized at a rate commensurate with relative certainty of its continuance and the risk involved in ownership. Net operating income is derived after deducting annual operating expenses from gross income prior to debt service payments. This approach assumes that competent management is necessary to produce the income stream upon which the present value is predicted. There are various methods of capitalization available to the appraiser to convert the future benefits of ownership to a present value. The two methods of capitalization are direct capitalization and yield capitalization. Each method is based on different measures of anticipated earnings and has different assumptions regarding the relationship between earnings and value.

Direct capitalization is a method which converts an estimate of a year's income into an indication of value by either dividing the income estimate by an appropriate rate or by multiplying the income estimate by an appropriate factor or multiplier.

Yield capitalization is a valuation method which converts future benefits to a present value by applying an appropriate yield rate. The basis for the income approach sustains an indication of

value from the investor's perspective by estimating what a typical investor would pay to capture an income stream resulting from the operation of the subject property.

The estimated gross income (cash rent per acre) is derived from the Productivity Index attributed to the subject property, and a complementary/corresponding rental rate is assigned to the subject property farm based on a per acre basis. The rental data used in the report is supported by actual market rents throughout the county area, and also through surveys and studies conducted by Compeer Financial.

The sales used in the Income Capitalization Approach are those also used in the Sales Comparison approach. The sales selected are comparable because of their proximity, timeliness, and consistency of soil composition. The capitalization rates developed are determined by dividing the estimated net incomes by the sales price of the sale property.

An appropriate capitalization rate is then applied to the subject property's net income, which develops the opinion of value for the income capitalization approach.

Sales Comparison Approach

The Sales Comparison Approach involves market analysis of comparable properties that have been sold. This approach is based on the economic principle of substitution, which states an informed buyer will not pay more for an item than for another item of equal utility. Reliability of this approach is dependent upon: (1) the degree of comparability of the sales to the subject (2) the date of sale in relation to the effective date and capturing market condition changes (3) reliability of the sales data and (4) appropriate adjustments for any unusual conditions. The Sales Comparison Approach is typically used on vacant or minimally improved agricultural properties.

The Sales Comparison Approach is based upon the principle of substitution which implies that an informed purchaser would not pay more for a property than the cost of acquiring a similar property with equal utility. The Dictionary of Real Estate Appraisal, Fourth Edition defines the Sales Comparison Approach as “A set of procedures in which a value indication is derived by comparing the property being appraised to similar properties that have been sold recently, then applying appropriate units of comparison, and making adjustments to the sale prices of the comparables based on the elements of comparison.”

The process involves gathering sales data of recent bona fide arm's length sales of comparable properties and comparing their most important characteristics to the subject property. After acquiring sales that the appraiser feels are justifiably comparable, adjustments are made from the comparable sales toward the subject property for any significant difference. The value of the subject property by the Sales Comparison Approach is derived after a comparison with similar sales. The subject property is the base of comparison, superior characteristics of the comparable sales are adjusted downward and inferior characteristics of the comparable sale are adjusted upward toward the subject property. This process results in an indication of what the comparable sales would have sold for on the appraisal date had they possessed all of the important characteristics of the subject property. The adjusted sale price of all the comparables is then reconciled to arrive at an indication of the market value of the subject property.

Final Valuation

The final step in the appraisal process is the reconciliation or correlation of the value indications, and places major emphasis on one or more of the approaches which appear to be the most reliable and applicable solution to the specific appraisal problem. These factors result in an opinion of market value on the effective date of this appraisal.

Both the individual and holistic soil health indexes of recently sold farms were compared to traditional appraisal metrics (Cropland A; $/Acre; $/PI Point; & $/Tillable Acre.) The Sales Comparison Approach and Income Approach were both given consideration in determining the final value opinion of the subject property, with less than a 3% difference between values.

The soil health indicator values were also assessed in the context of land management data. The first evaluation of the soil health indicators was to compare the reference sites to the cropped fields. This comparison gave the Project Team an estimate of the "innovation space", or the difference between soils in their current state compared to their potential. If there were meaningful differences in the amount of tillage or the use of cover crops among fields, the Project Team also evaluated how the indicators have responded to soil health practices. The Project Team did not expect cropped soils to have identical soil health indicator values to the references, but this sampling approach allowed the Project Team to determine how different they are and if there are opportunities to improve with the adoption of SHMS. The association between assessed value ($/acre) and soil health (for both land management scores and soil health measurement scores) was then assessed by regression analysis.

SUMMARY OF RESULTS

Soil Health Index

Given the small sample size and the recent sale of the properties (n=10), it wasn't possible to evaluate the role of land management history on soil health in the cropland sites. In general, the major difference in land management across farms was the intensity of tillage after the corn crop was harvested. For example, some operations used an intense implement like a chisel plow or disk with ripper, others used less intense methods such as a cultivator, while a few planted no-till soybeans. Organic farmers generally used even more frequent tillage to terminate cover crops and control weeds than their conventional peers.

However, the soil health indicator values for the cropland sites and the references were markedly different among each of the three indicators. Overall, soil Organic Carbon (%) was shown to be greater among reference sites (Figure 8). Potential Carbon Mineralization was also shown to be overall higher

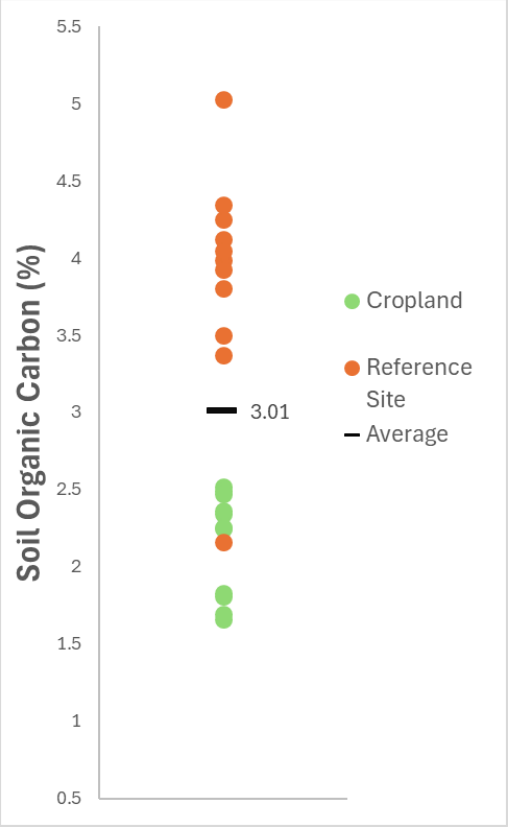

Figure 8: Soil Organic Carbon (%) measurements among cropland vs. reference sites.

among reference sites than cropland sites (Figure 9). Finally, aggregate stability was shown to be greater overall among the reference sites than the cropland sites (Figure 10).

Indeed, with only one exception, the maximum values of each of the three soil health indicators among cropland sites was lower than the minimum values in the references (*Table 2*). In other words, a clear distinction in soil health indicators was observed between croplands and their perennial vegetated, undisturbed reference pairs (*Table 3*).

Overall, these findings suggest that differences in soil health values among sites may be related to differences in management. The values and dynamics of all three soil health indicators are closely linked to management practices, such as reduced tillage.[15]

Enhanced Soil Organic Carbon improves soil structure and increases microbial activity, water retention, and nutrient availability. Increased carbon mineralization potential indicates a greater capacity to cycle plant residue and nutrients. Soils with greater aggregate stability are more resistant to erosion and are associated with improved water infiltration, storage, and aeration for plant roots. Therefore, it follows that the absence of tillage among reference sites may have delivered greater soil health benefits.

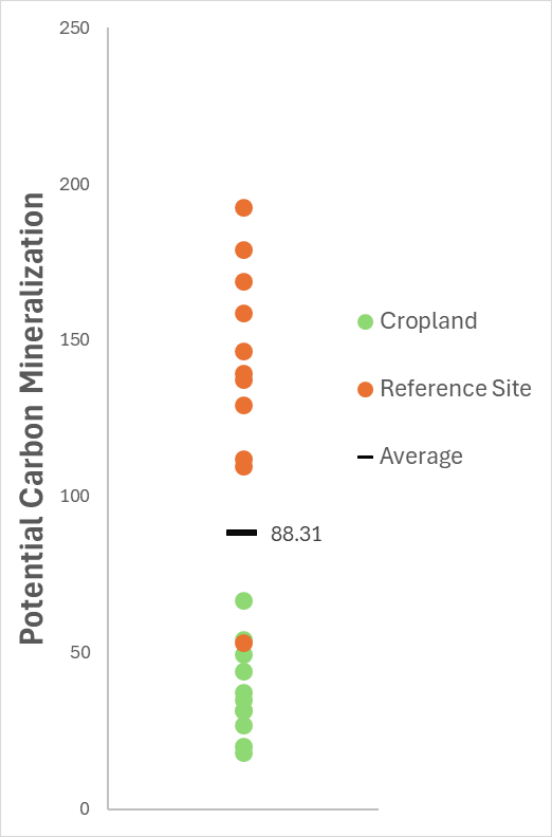

Figure 10: Potential Carbon Mineralization values among cropland sites vs. reference sites.

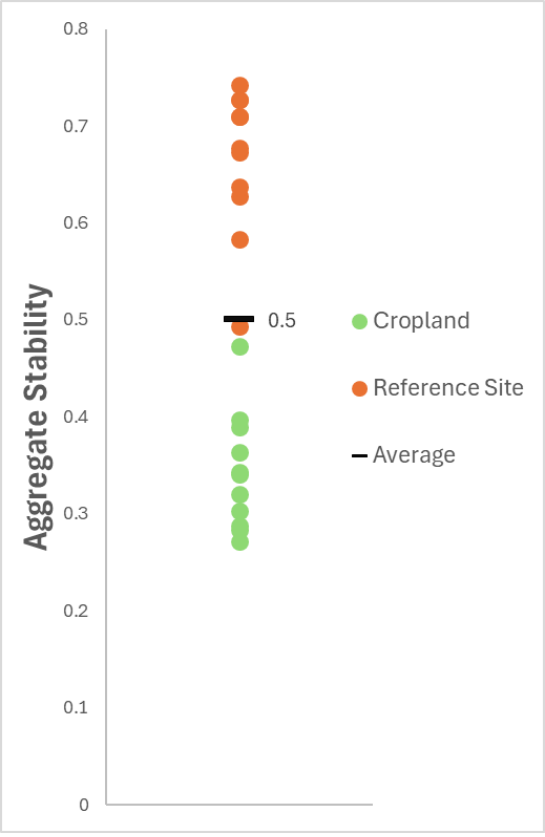

Figure 9: Aggregate Stability values among cropland sites vs. reference sites.

Table 2: Summary of Soil Health Indicator Values of all subject properties and reference sites as well as the relativized values and final Soil Health Index values.

Site ID	Soil Organic Carbon (%)	SOC % of Reference Average	Potential Carbon Mineralization (mg C/ kg soil)	PCM % of Reference Average	Aggregate Stability	Aggregate Stability % of Reference Average	Average of 3 indicators
Cropland 1	2.25	56%	31.52	21%	0.34	52%	43%
Cropland 2	1.66	41%	31.60	21%	0.47	72%	45%
Cropland 3	1.69	42%	26.92	18%	0.30	46%	35%
Cropland 4	2.34	58%	49.52	34%	0.34	52%	48%
Cropland 5	1.81	45%	66.63	45%	0.38	59%	50%
Cropland 6	2.52	62%	18.00	12%	0.39	60%	45%
Cropland 7	2.25	56%	37.35	25%	0.28	44%	42%
Cropland 8	2.49	62%	44.22	30%	0.32	49%	47%
Cropland 9	2.46	61%	54.13	37%	0.27	41%	46%
Cropland 10	1.83	45%	20.30	14%	0.36	55%	38%
Cropland 11	2.36	59%	34.96	24%	0.28	43%	42%
Reference 1	3.98		137.52		0.62		
Reference 2	4.12		129.41		0.67		
Reference 3	3.37		109.70		0.70		
Reference 4	4.04		139.58		0.58		
Reference 5	3.92		146.70		0.72		
Reference 6	5.02		192.61		0.72		

Reference 7	3.80		158.84		0.70		
Reference 8	2.16		53.31		0.74		
Reference 9	4.25		179.12		0.63		
Reference 10	3.49		112.01		0.49		
Reference 11	4.34		168.87		0.67		

Table 3: Summary of the Average Minimum, Mean, and Maximum of the Soil Health Indicators among Subject Properties (Cropland) vs. Reference Sites.

	Cropland			References		
	Min	Mean	Max	Min	Mean	Max
Soil Organic Carbon (%)	1.7	2.2	2.5	3.4	4.0	5.0
Potentially Mineralizable Carbon (mg C/ kg soil)	18	38	67	109	147	193
Aggregate Stability	0.27	0.34	0.47	0.49	0.66	0.73

The indicators clearly capture the differences in soil health between the cropland and the references suggesting they are appropriate for this region. While this Pilot Program was not aiming to quantify the role of soil health practices, the difference in soil health indicator values between the cropland and reference sites suggests that there is considerable room for innovative management to increase soil health in the region. The variability in soil health indicators among farms was relatively small and could be due to land use history, recent management, or natural variability.

Final Valuation

It was the appraisers' opinion that as of the effective date there are not enough conclusive market data to suggest that a farm's soil health impacts the value of that property.

Soil Health was analyzed as a potential adjustment within the Sales Comparison Approach. However, a review of the individual soil health statistics among pilot participant farms and the traditional appraisal metrics captured on the most recent date of sale (Cropland A indication; $/PI Pt; & $/Tillable Acre) did not warrant an adjustment due to lack of market evidence. Furthermore, the real estate market has been extremely volatile from the 4th quarter of 2021 to the effective date. Additional comparable sales have been incorporated into the report that have not been subject to the soil sampling process and therefore, no soil health data exists.

CONCLUSIONS

Delta Institute completed a Soil Health Appraisal Pilot Program to test a proof-of-concept appraisal approach, which incorporated measurements of soil health into the land valuation process. The goal of this Program was to test a replicable methodology towards soil health sampling and soil health index creation to be novel components of a modified Sales Comparison appraisal approach. The Pilot Program showed that while soil health was able to be analyzed as a potential adjustment within the Sales Comparison Approach, a review of the individual soil health index scores among pilot participant farms did not warrant an adjustment simply due to lack of market evidence. In other words, at the moment, appraisers lack the baseline data required to identify and isolate any quantifiable market reactions to soil health.

From this, the Project Team concludes that limited information on the return on investment of building soil health for farmers operating budgets may prevent the institutional adoption of this novel appraisal methodology and have created a “missing market” for soil health in land valuation. Here, we see that the next steps should be to fill the gaps of this “missing market” by further building market evidence of the value of soil health.

An appraisal produces a meaningful, defensible value estimate by fulfilling three important criteria - appropriateness, accuracy, and quantity of evidence. The independent approaches to value are market derived and provide a range of value for the subject property. The final value estimate involves the exercise of judgment by appraisers, not simply applying qualitative or quantitative techniques. Integration of a novel soil health index into the advertisement of agricultural properties that are available for sale and further education of auctioneers, brokers, buyers, and other market participants of agricultural real estate will be necessary to monitor and capture soil health’s influence on market value.

The agricultural real estate market is becoming more quality oriented with growing interest in soil health but until buyers and sellers recognize the economic benefits of healthy soils, this approach is not likely to be able to be fully developed into a measurable matrix for valuation. Continued education, for lenders, buyers, sellers and other participants in the farmland market will need to be developed for this methodology to gain traction in the agricultural valuation practices of farmland appraisers. Delta also has identified loan officers as crucial partners needed to catalyze the creation of a soil health market and identify the emerging market pathways and platforms in which the appraised value of soil health may be traded. For example, if building soil health can be tied to greater land values and deliver more equity to farmers, then farmers may adopt soil conservation practices to secure lower interest rate operating loans. The Project Team will also continue to test the soil health metric creation protocol in new Major Land Resource Areas and other Midwestern markets, such as Iowa and Indiana.

In summary, soil health is measurable and may be improved given the right practices and context. Building soil health protects local water quality and may make farm operations more climate resilient and profitable. However, Illinois farmers lack the incentives needed to adopt Soil Health Management Systems (SHMS) (e.g., cover crops and no-till) at scale. No farm real estate appraisal approaches currently exist to empirically assess the value ($/acre) of soil health. Soil health is more than yield; therefore, appraisers cannot explicitly establish a link between soil health and land value. For soil health to become a standardized metric and SHMS to become widely-adopted on farms across the Midwest, Delta must build upon the findings of this Pilot

Program to compile and demonstrate in-depth market evidence to raise awareness of the value and return on investment of building soil health to farmers and appraisers, resolve bottlenecks in the soil testing industry, and actualize the proof of concept into a viable appraisal approach.

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