Field to Market®




Harnessing Sustainability Insights & Unleashing Opportunity

Leveraging Data to Deliver Operational Efficiencies & Build Consumer Trust

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Introduction

Just as science and technology have unlocked agronomic insights, they can also unleash opportunities for sustainability improvements that deliver operational efficiencies, demonstrate continuous improvement to the supply chain, and build consumer trust in food and agriculture. That's exactly what the eight sustainability metrics of Field to Market's Fieldprint Platform—developed through the Alliance's multi-stakeholder and consensus-driven process—offer commodity crop farmers.

To help you harness sustainability insights and unleash opportunities for your farm, we have developed this guide to better understand how your management practices intersect with sustainability metrics and potential factors that can influence improved outcomes in the areas of:

- **Biodiversity**
- **Energy Use Efficiency**
- **Greenhouse Gas Emissions**
- **Irrigation Water Use Efficiency**
- **Land Use Efficiency**
- **Soil Carbon**
- **Soil Conservation**
- **Water Quality**

Each guide explains the environmental, economic and community-level importance of the sustainability indicator; how it is measured by the Fieldprint Platform; the field characteristics and management practices used to calculate sustainability outcomes encapsulated in a Fieldprint Analysis; and the top ways to improve your results. Included at the end of each guide are a set of practical questions to explore with your trusted adviser about potential opportunities to improve your operation and utilize resources available through conservation programs.

This guidance is not intended to be prescriptive. We acknowledge that farm management decisions are crop-dependent and strongly influenced by local factors such as climate, soil and topography as well as financial constraints imposed by input and land costs. We hope that by giving you a better understanding of how your management practices relate to sustainability outcomes, you will be able to find opportunities to fine tune your operations and continuously improve the resource efficiency, profitability and environmental outcomes of your farm.

Interpreting The Metric

Biodiversity

Why It Matters

MMost farms are in rural landscapes and tend to be near natural forests, prairies, wetlands or deserts that give wildlife a place to forage for food, breed and nest. Few sustainability issues are as visible and understandable by consumers than the preservation of wildlife habitat. In addition, outdoor enthusiasts value these areas for hunting, fishing and enjoying nature with their families. As farmers and landowners work to build and maintain trust in agricultural production, it's important to take steps to conserve healthy ecosystems.

Of course, most producers already understand that productive farming systems depend on biodiversity. For example, native pollinators provide the majority of crop pollination and support resilience where domesticated honeybees struggle. Integrated pest management relies on ecosystems that support sufficient populations of natural pest predators. Both cultivated and non-cultivated areas on the farm can be managed in ways that support biodiversity.

How It Is Measured In The Fieldprint® Platform

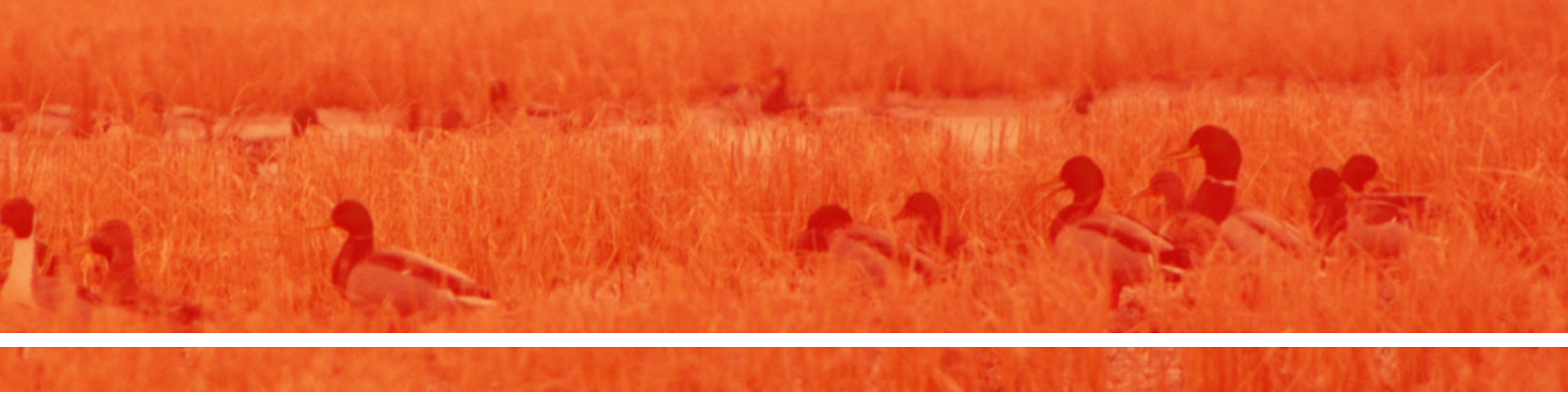
The Fieldprint Platform assesses biodiversity using the Habitat Potential Index (HPI). HPI scores the *potential* for a given farm to provide wildlife habitat on land or in the water. HPI scores range from 0-100 and measure the level of opportunity to improve or maximize habitat potential.

Higher scores are desirable and indicate a greater potential to support wildlife habitat. Separate scores for cultivated cropland and non-cultivated lands, e.g. pasture, forestland and water as applicable, plus an aggregated score for the whole farm are calculated. Scores less than 50% represent significant opportunities for improving habitat potential, whereas values of 50-80% indicate moderate realized potential and scores greater than 80% demonstrate farms that have maximized opportunities for biodiversity to flourish.

Factors That Affect The Fieldprint Score

HPI is a complex measurement that factors in several variables:

- Attributes of the farm, including the acreage of both cultivated and non-cultivated land, the land cover type and ecoregion where the farm is located. Some combinations of land cover and ecoregions, such as natural wetlands, inherently have greater potential to support biodiversity than others, such as non-native grasslands.
- Changes in land use. For instance, putting previously uncultivated land, particularly native landscapes, into production significantly lowers scores. Conversely, converting field edges into vegetated buffer strips managed for biodiversity will improve scores.
- Land management practices, such as field borders, that provide forage and cover for breeding and nesting wildlife.
- Crop production practices including water, nutrient and pest management that conserve and protect water quality.



How To Improve Your Score

Provide **forage and nesting habitat** for wildlife. Maintain vegetative cover on cultivated areas with cover crops and retain crop residues on fields. In uncultivated areas, encourage native plants.

Implement **integrated pest management**, which discourages the development of pest populations while ensuring the least possible disruption to agroecosystems.

Develop and follow a **nutrient management plan** that implements 4Rs of nutrient stewardship to optimize fertilizer utilization by crops.

Other factors to consider:

Irrigation water source and water use efficiency
Irrigation water drawn from surface sources may deplete wetlands and other aquatic ecosystems that support diverse populations of organisms.

Tile drainage and drainage water management
Drainage water may contain excess nutrients and crop protectants. Drainage water management plans and systems improve HPI scores when tile drainage is used.

Opportunities To Explore With Your Trusted Adviser

- How can the non-cultivated areas on the farm be managed to provide nesting habitat and forage for wildlife?
- Does my farm qualify for federal, local, or state conservation programs?
- How could I reduce or eliminate tillage to increase the amount of crop residue on the soil?
- Does my IPM plan include regular scouting and early interventions to optimize utilization of chemical interventions?
- How can cover crops, particularly leguminous types, be included in my crop rotation?
- What changes would you suggest to how I am managing nutrients to maximize habitat potential?
- Are there invasive species present?

Interpreting The Metric

Energy Use

Why It Matters

Energy use is a variable cost of farming and is strongly affected by diesel and electricity prices. Reducing energy use can lead to significant cost savings for your operation. In a price-constrained market, farms that utilize their energy efficiently have a better prospect of remaining competitive in challenging economic times.

Energy use efficiency is one of the fastest and easiest ways to improve your profitability, while also producing environmental benefits by reducing greenhouse gas emissions. Combustion of diesel releases the potent greenhouse gas carbon dioxide which is a primary contributor to climate change[1] (discussed in *Interpreting the Metric: Greenhouse Gases*). In addition to forcing climate change, fossil fuels must be mined or drilled, often in sensitive wildlife habitats.

How It Is Measured In The Fieldprint® Platform

The Fieldprint Platform measures all the energy required to produce a crop, from pre-plant to first point of sale or delivery at the processing facility. This includes **direct energy** used for operating equipment, pumping irrigation water, grain drying and transport as well as **embedded energy**, which is required to produce crop inputs like seeds, fertilizers and crop protectants.

Energy use is expressed as British thermal units (BTU) per unit of crop production *(i.e., bushel, pound or hundred weight)*. It takes one BTU to raise the temperature of one pound of water by 1° F. One gallon of diesel produces 137,452 BTU.

Lower numbers are desirable and indicate less energy used to produce a unit of crop.

Factors That Affect The Fieldprint Score

Energy Use Efficiency in your Fieldprint Score is affected by both direct and embedded energy use.

- **Direct:**
  - Irrigation pumping – the amount of water pumped has the greatest impact, but pumping depth and pump energy source are also factors.
  - Grain drying – the number of points of moisture removed by mechanical drying is the primary factor, drying system and energy source have lesser impacts.
  - Equipment operation – fertilizer application and aerial sprays, soil fumigation, land prep and tillage.
  - Hauling – haul weight and distance traveled to first point of sale or processing.

- **Embedded:** The energy embedded in seed production, fertilizers and crop protectant products will depend on the crop grown and the products used. Field to Market uses a combination of USDA data on crop protection products used, literature data on energy required to produce products, and literature and research on energy required for fertilizer production.

How To Improve Your Score

Follow the **principles of 4R nutrient stewardship** to ensure optimal uptake of fertilizers and reduce embedded energy use.

For irrigated crops, use **irrigation scheduling technology** to improve irrigation efficiency and reduce the amount of water that must be pumped.

Ensure grain is **dried to the optimum moisture and temperature** for storage and delivery.

Opportunities To Explore With Your Trusted Adviser

- Am I optimizing the rate, source, timing and placement of applied nutrients for maximum uptake by my crops?
- Can I use solar or another renewable energy source to pump water for irrigation?
- What irrigation scheduling technology will increase application efficiency?
- What is the optimal amount of moisture to remove from my grain to balance long-term storage with energy use efficiency?
- Is it possible to reduce the moisture in my grain before mechanical drying?
- Can I consolidate equipment passes on my fields?
- Am I using the most appropriate herbicide formulations to manage weeds, terminate cover crops and aid harvest?
- How can I improve germination and stand establishment through variety selection and planter settings?

[1] *Global Climate Change: Vital Signs of the Planet.* https://climate.nasa.gov/causes/.

Interpreting The Metric

Greenhouse Gas Emissions

Why It Matters

Like a greenhouse trapping heat inside enclosed glass, greenhouse gases hold heat inside the Earth's atmosphere, causing the atmosphere to warm and weather patterns to become more volatile. Warmer temperatures extend insect, weed and disease pressure, increase plant heat stress and crop irrigation requirements. Extreme weather events like prolonged drought and severe flooding can cause catastrophic crop losses. And in coastal areas, farmland may be impacted by salt water intrusion in future years, or lost entirely, due to rising sea levels.

Agricultural activities are known to produce three types of greenhouse gases: carbon dioxide, nitrous oxide, and methane.

- Carbon Dioxide (CO_2) is released to the atmosphere by burning fossil fuels and when soil organic matter is oxidized by aerobic respiration. The concentration of CO_2 in Earth's atmosphere has increased 42% in the last 60 years[1].
- Nitrous Oxide (N_2O) is released from nitrate in fertilizer, manure, or other organic matter by bacteria. Up to 20% of applied nitrogen is lost as N_2O. One molecule of N_2O is 298 times as potent as one molecule of CO_2 when released to the atmosphere, and for most farmers, it is the largest contributor to their greenhouse gas emissions.
- Methane (CH_4) is produced by bacteria in anaerobic conditions such as in the guts of livestock or water-saturated rice fields. One molecule of methane is 25 times as potent as one molecule of CO_2.

How It Is Measured In The Fieldprint® Platform

Greenhouse gas emissions are reported in the Fieldprint® Platform as pounds of carbon dioxide equivalent (CO_2e) per crop unit produced (e.g. bushels or pounds). "CO_2e" simply means all other emission sources are converted to the equivalent amount of CO_2. This conversion provides a common unit for all emissions in one measure, which is comparable over time and influenced by all the actions a farmer takes.

To calculate CO_2 emissions, the Fieldprint® Platform uses standard U.S. government assumptions regarding fuel use, such as the 22.3 pounds of CO_2 that are emitted per gallon of diesel combusted. CO_2 emissions also result from electricity and fuel usage as well as from burning crop residues.

The Fieldprint Platform uses data on crop type, region of the country and soil texture to determine the "emissions factor", which means how much N_2O results from additions of nitrogen (N). This factor is used to convert N from fertilizer and manure additions into N_2O, based on a look-up table from detailed crop modeling performed for the annual U.S. government inventory of emissions. Corn, soybean and wheat producers can utilize this default emissions factor or complete an optional module on advanced nutrient management practices scientifically shown to reduce N_2O emissions. By demonstrating advanced nutrient management, the N_2O emissions factor can be reduced between 7%-14%. As the science advances, we hope to make this approach available for other crops.

Methane is only calculated for rice, and emissions are based on region of the country. To calculate CH_4 emissions, the Fieldprint Platform evaluates a farmer's responses to questions about water management, organic and fertilizer amendments and other management practices.

Low scores are desirable and indicate less greenhouse gas emitted per unit of crop produced.

Factors That Affect The Fieldprint Score

- Greenhouse gas emissions are directly related to energy use. Energy-intensive practices that produce CO_2 as a by-product are:
  - Manufacturing crop seed, protectants and fertilizers
  - Grain drying
  - Irrigation pumping
  - Transportation to first point of sale
- Burning crop residues to prepare a field
- Nutrient management practices and the amount of applied nitrogen in fertilizer or manure
- Management of water, amendments and other management for rice fields

How To Improve Your Score

Reduce on-farm and embedded energy use. See *Interpreting the Metric: Energy Use*.

Follow the **4Rs of nutrient stewardship** to ensure optimal uptake of fertilizers and reduce nutrient loss.

Plan crop rotations and consider use of cover crops to **fix nitrogen biologically**.

Other factors to consider:

Carbon sequestration

While the Greenhouse Gas Emissions Metric does not currently factor the amount of CO_2 stored in soil in its calculations, it is well recognized that certain farming practices can remove CO_2 from the atmosphere and sequester it in soil. See *Interpreting the Metric: Soil Carbon* to learn more.

Opportunities To Explore With Your Trusted Adviser

- Where can I reduce energy consumption in my operation?
- Which 4R nutrient stewardship practices can I adopt to more efficiently use the nitrogen I apply?
- How can I update my rotation to incorporate a nitrogen-fixing crop?
- Am I optimizing fertilizer and/or manure applications?
- How can I build and preserve organic matter in the soil?
- Since burning crop residues impacts GHG emissions, what alternatives do you recommend?
- Can I adopt alternate wetting and drying approaches for flooding of my rice fields?

[1] *IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. R.K. Pachauri and L.A. Meyer (eds.) IPCC, Geneva, Switzerland, 151 pp. Available at http://www.ipcc.ch/report/ar5/syr/.*

Interpreting The Metric

Irrigation Water Use

Why It Matters

Applied water can significantly improve yields, and in arid locations production is impossible without supplemental irrigation. Irrigation can be expensive; there are costs associated with the purchase of water, irrigation equipment and the energy needed to pump it into fields.

There is a finite supply of fresh water; expanding urbanization puts ever-increasing demands on this limited resource and water availability is restricted for agricultural use in parts of North America. In some water-scarce areas, extensive groundwater pumping has caused sinkholes to form, leading to destruction of property and loss of human life. Diverting water for agricultural use impacts natural environments and wildlife habitats.

Worldwide, the availability of clean water to support the world's growing human population is a cause for concern. In the United States, agriculture accounts for 80% of fresh water consumed[1]. The people in our communities rely us to make the best use of the water resources all life depends upon.

How It Is Measured In The Fieldprint® Platform

Irrigation Water Use (IWU) is expressed in the Fieldprint Platform as the amount of water, measured in acre-inches (ac-in) required to produce a unit of crop (pound, bushel, etc.). IWU is calculated using the difference irrigation contributes to yield improvement. In places where production is impossible without irrigation, the non-irrigated yield is zero.

IWU = ac-in water applied / (irrigated yield – non-irrigated yield)

Lower numbers are desirable, indicating less water required to produce a unit of crop.

Factors That Affect The Fieldprint Score

The amount of water required by a crop is determined by

- The crop species, variety and stage of crop development
- Evapotranspiration – the combined losses of water through direct soil evaporation and transpiration through leaves. Warm temperature, high windspeed, low relative humidity and high light intensity increase evapotranspiration and crop irrigation requirements.
- Physical and chemical characteristics of the soil, including soil texture, structure and salinity.

The amount of water applied to bring a crop to harvest is determined by factors within and outside the direct control of the farmer. For example, although a grower cannot feasibly change the texture of the soil, the impacts of soil texture can be mitigated using management practices that improve water holding capacity and infiltration.

How To Improve Your Score

Use soil moisture meters and irrigation scheduling programs to **precisely apply water when and where it is needed**. Laser level fields and regularly maintain irrigation equipment.

Select crop varieties adapted to local soil and **climate conditions** and **able to manage pest/ disease pressure**. Healthy plants use applied irrigation water more efficiently than stressed plants.

Improve soil water holding capacity and infiltration by **increasing organic matter content to reduce run-off, evaporation** and **leaching**. (See *Interpreting the Metric: Soil Carbon* for more information).

Other factors to consider:

Soil salinity

Applied water becomes less available to crops as soil salinity increases. Manage soil salinity with infrequent, deep irrigations rather than frequent, shallow applications of water. Reduce water evaporation from soils by reducing or eliminating tillage and other activities that disturb the soil.

Opportunities To Explore With Your Trusted Adviser

- Is irrigation being applied according to actual crop requirements, or by the calendar?
- Am I using the best seed varieties for my local conditions?
- What irrigation scheduling technology is available?
- Should I convert to drip irrigation?
- Can pest pressure be further reduced using integrated pest management?
- How can I reduce or eliminate tillage in my operation?
- How can cover crops and residue management improve the water holding capacity and infiltration in my field?

[1] *United States Department of Agriculture Environmental Research Service. 2017. Irrigation & Water Use. Available at https://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/.*

Interpreting The Metric

Land Use

Why It Matters

High quality farmland is one of the most valuable resources in the world; protecting that land is at the heart of sustainable agriculture. Efficient use of agricultural land is necessary for the financial stability of any farming business. Since 2000, the average value of an acre of U.S. farmland has nearly tripled, leading to rising land rental costs[1]. As the global population continues to grow and become more affluent, the demand for meat and dairy is rising. Farmers are challenged with growing more food, fiber and fuel on less land with minimal environmental impact.

The best land for agricultural use is already under cultivation in the U.S. Expanding production into marginal lands is less sustainable because it requires more inputs to produce acceptable yields, thereby increasing production costs and cutting into profits. Increased inputs may not be optimally utilized by crops and are prone to loss by volatilization, run-off and leaching. In addition, when new land is brought into cultivation, natural areas and the habitats they provide to wildlife are lost.

How It Is Measured In The Fieldprint® Platform

Land use efficiency is a measure of the amount of land (acres) used to produce a unit of crop (bushels, pounds, etc.) Examples: In corn, land use is measured in acres/bushel; in cotton as acres/pound of lint. This is an inverse of yield measures, which are expressed as bushels per acre or pounds of lint per acre.

Lower scores are desirable and indicate greater land use efficiency.

Factors That Affect The Fieldprint Score

Balancing yield with input optimization is the single factor that affects Land Use Efficiency in your Fieldprint Score. Although yields are heavily influenced by yearly fluctuations in temperature, rainfall and other weather events outside the control of the farmer, management decisions within your control such as variety selection, planting and harvest dates, irrigation, pest and nutrient management and crop rotation can have positive impacts on productivity. Increase yields in existing fields to improve your land use efficiency.

How To Improve Your Score

Select **crop varieties** and **plan rotations best suited to your location** to optimize yields and return on investment.

Work closely with your trusted adviser to evaluate your operation and **identify opportunities for improvement**.

Monitor yields in every field to determine return on seed and input investment and **remove consistently unprofitable fields from production**.

Opportunities To Explore With Your Trusted Adviser

- Am I using the seed varieties best suited for my field conditions?
- Does my integrated pest management plan need modification to reduce pest pressure?
- How can I optimize irrigation to drive greater yields?
- How can I improve my soil health?
- Am I applying fertilizer from the right source, in the right place at the right time and rate?
- Is my crop rotation the most efficient it can be?
- Are any of my fields not providing a reasonable yield return on input investment?
- Within my fields, are there trouble spots that should be managed differently or removed from production?
- What practices are eligible for cost-sharing through NRCS or other sources that can improve my productivity and profitability?[2]

[1] *USDA National Agricultural Statistics Service website: https://www.nass.usda.gov/quickstats*

[2] *USDA-Natural Resource Conservation Service Financial Assistance website: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/*

Interpreting The Metric

Soil Carbon

Why It Matters

Carbon is a primary component found in organic matter, which is an important indicator of soil health. Organic matter is beneficial in soils because it:[1]

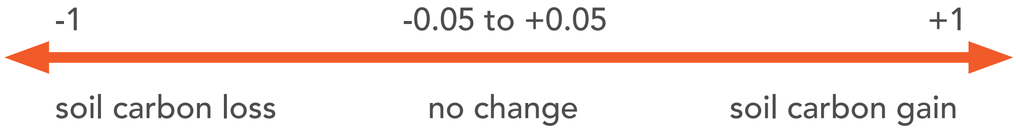
- Serves as a reservoir for plant nutrients that become gradually available over time, decreasing the amount of applied fertilizer needed to meet crop requirements;
- Stores water that is available to plant roots, reducing irrigation water requirements and improving resilience to drought; and
- Causes aggregates to form, thereby improving soil structure and water infiltration.

The importance of soil health cannot be emphasized enough. Investing in increasing soil carbon is a long-term investment in the productivity, and ultimately, the profitability of your land.

Carbon dioxide, a greenhouse gas, is removed from the atmosphere by photosynthesis and is tied up in living organisms. Because the soil stores carbon long term, enhancing soil carbon removes carbon dioxide from the atmosphere. By adding more carbon to the soil than is removed, farmers play a crucial role in reducing greenhouse gases and the impacts of climate change.

How It Is Measured In The Fieldprint® Platform

The Soil Carbon Metric in the Fieldprint® Platform is measured using the USDA Natural Resources Conservation Service's Soil Conditioning Index. Scores ranges from +1 to -1 and are unitless, relative, and crop-specific.

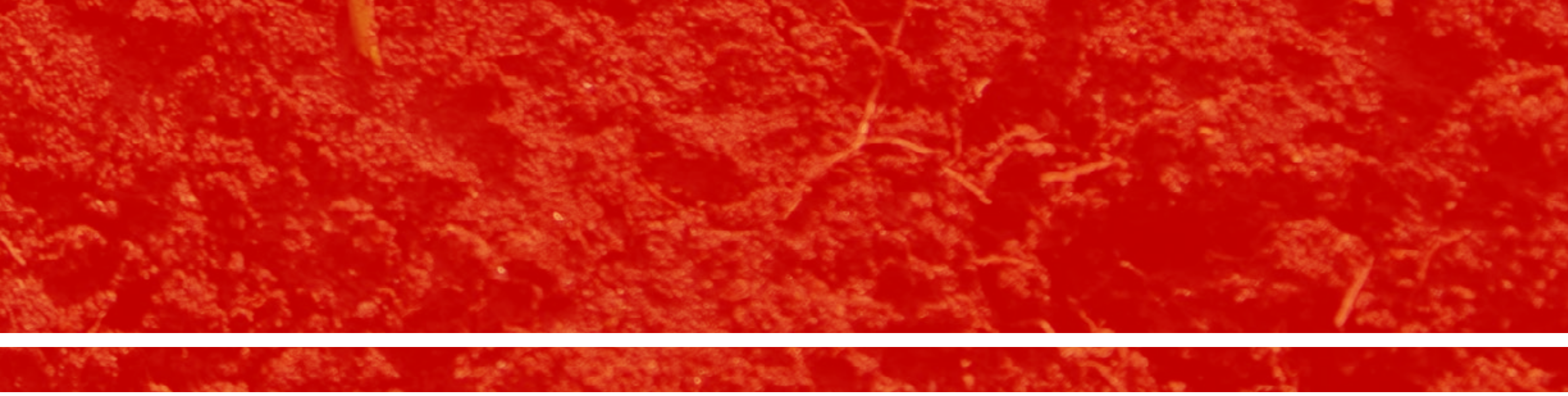


Positive values (>0.05) indicate that soil carbon is increasing. As the value approaches +1, the confidence that there is a gain in soil carbon increases. Inversely, as the value (<-0.05) approaches -1, the confidence increases that you are losing soil carbon. As a result, **positive numbers are desirable**.

Factors That Affect The Fieldprint Score

The Soil Carbon Fieldprint Score is calculated using three factors:

- Organic matter – residues from cash and cover crops left on the soil, animal manure and other organic material added to the soil.
- Field operations – practices that accelerate decomposition of organic matter and resulting carbon loss as carbon dioxide into the atmosphere. Tillage and other practices that disturb soil stimulate decomposition and change the location of organic matter in the soil profile.
- Erosion – the loss of soil carried by water or wind.



How To Improve Your Score

Minimize soil disturbance and consider strip- or no-till to conserve soil carbon and **prevent release of CO_2** from organic matter decomposition.

Keep soil covered to **prevent erosion** and manage tillage, planting date, harvest timing, row spacing, crop residues and cover crops to **maintain constant coverage**.

Increase organic matter by adding residues from both cash and cover crops while minimizing soil disturbance to **increase soil carbon**.

Other factors to consider:
Some factors that affect soil carbon are easily within the power of the farmer to manage, others are not. For example, a farmer can reduce soil disturbance, plant cover crops and improve crop residue retention to increase soil carbon. Field characteristics such as slope and soil texture affect soil erosion, and therefore soil carbon, but cannot realistically be modified. Other factors that affect the Fieldprint score include:

Wind barriers
Usually trees or shrubs planted to provide a break from prevailing winds, barriers reduce wind erosion and conserve soil and the carbon stored within.

Crop type and variety
Some produce more carbon-rich residues than others.

Field characteristics
Slope, slope length and surface soil texture are estimated from USDA soil surveys and are therefore not easily modified.

Opportunities To Explore With Your Trusted Adviser

- Can I adopt a no-till or strip-till system?
- Are there cultivation tools that will cause less soil disturbance when planting or managing pests?
- How can I incorporate cover crops into my rotation?
- Should I be managing crop residues differently?
- How can I rotate in higher residue crops?
- Can I reduce soil losses by installing a wind barrier?

[1] *Funderburg, E. 2001. What Does Organic Matter Do In Soil? Available from www.noble.org/news/publications/.*

Additional Opportunities to Measure Soil Carbon

- The Soil Carbon metric in the Fieldprint Platform is a qualitative measure of soil carbon. The NRCS COMET-Planner is now available to Fieldprint Calculator users without leaving the site. COMET-Planner offers insight into how adopting NRCS conservation practices can sequester carbon in your field. To learn more, explore a factsheet on COMET-Planner in Fieldprint Calculator 4.0.

Interpreting The Metric

Soil Conservation

Why It Matters

Soil is one your farm's most valuable assets. Ensuring that soil remains on your fields rather than being washed or blown away is essential. When soil leaves the farm due to wind or water erosion, it takes valuable inputs with it, including nutrients, crop protectants, irrigation water and the associated investment of financial and energy resources.

Soil loss is not only expensive, but it also directly and negatively impacts farm productivity and yields[1]. Plants are only as healthy as their root system and well-developed crop roots depend on deep, healthy soil.

When soil washes into waterways, there are broader impacts on your local economy and surrounding community. When rivers, gulfs and ports fill up with sediment, they must be dredged to maintain water levels high enough to accommodate the barges and ships that are relied upon to move commodity crops through inland waterways. This is costly and can reduce transportation efficiencies.

Sedimentation of drinking water lakes also costs municipalities and water suppliers millions of dollars every year in dredging costs. Water induced erosion can cause crop nutrients and protectants to wash into rivers, lakes and streams, negatively impacting water quality (See *Interpreting the Metric: Water Quality*).

In arid regions or during a drought, unprotected soil can be picked up and carried away by strong winds. This wind erosion can lead to severe dust storms, which dangerously limit visibility for drivers and have been implicated in deadly traffic accidents. Also, inhaling soil particles is associated with respiratory problems, particularly among children and the elderly.

How It Is Measured In The Fieldprint® Platform

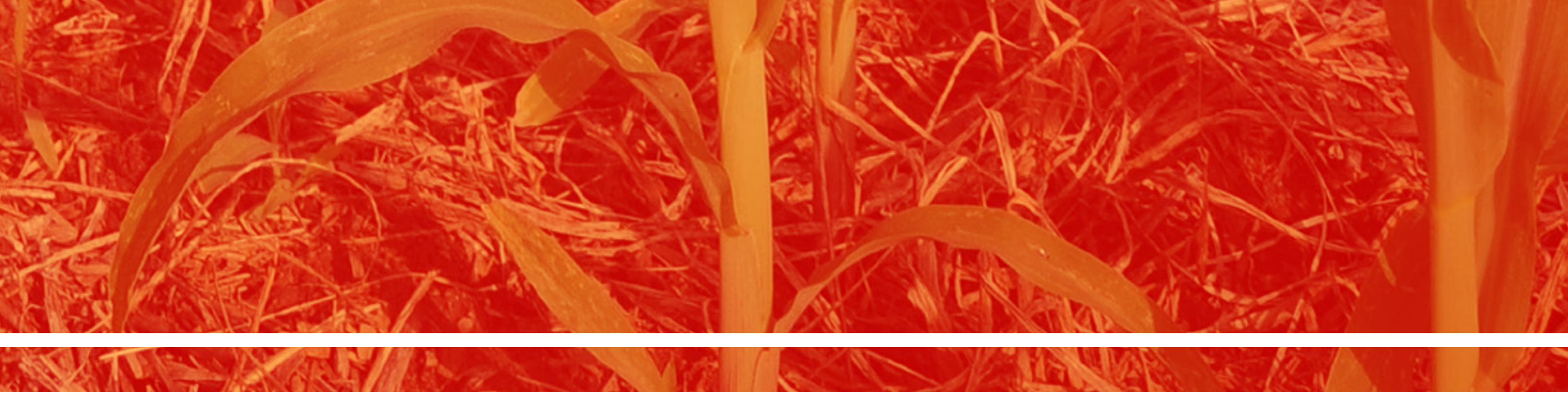
The Soil Conservation metric is expressed as soil erosion and is measured as tons of soil lost (T) per unit of land area (acre) per year for all crops.

Lower numbers are desirable and indicate less soil lost from erosion per acre. A Soil Erosion Fieldprint Score of 0 would indicate that no soil was lost in that year.

Factors That Affect The Fieldprint Score

The Soil Conservation Fieldprint Score is most affected by:

- Field characteristics including slope, soil texture and wind barriers. The greater the slope (%) and longer the slope length, the more potential for soil to be washed away by water. In the Fieldprint Platform, the value for slope is automatically entered, based on soil survey data. Users can adjust this estimate if they have measured the field's slope or have determined a more accurate measurement. Fine soils, high in clay and silt are more prone to erosion than sandy soils.
- Soil disturbance. Soil that has been tilled, plowed, amended or otherwise disturbed is easily picked up by wind and water and carried offsite.
- Coverage by living plants and residues. Soils covered by cash crops, cover crops, weeds and crop residues are less likely to be lost to erosion than bare soil. Plant roots hold soil in place, reducing erosion potential.



How To Improve Your Score

Minimize soil disturbance and consider strip- or no-till to conserve soil carbon and **prevent release of CO_2** from decomposing organic matter.

Keep soil covered to **prevent erosion** by managing tillage, planting and harvest timing, row spacing, crop residues and cover crops

Install wind barriers like hedgerows of appropriate trees and shrubs upwind from fields to **reduce soil loss** due to wind erosion.

Other factors to consider:

Mitigate slope
Consider laser-leveling or terracing fields in areas where water erosion is a problem.

Opportunities To Explore With Your Trusted Adviser

- Can I combine reduced tillage with cover crops to conserve soil on my farm?
- How do yields in fields with the greatest slope compare to flatter fields?
- Should I laser level my fields or install terraces?
- What species of trees and shrubs work well in my area as a wind barrier?
- Should my rotation be adjusted to include higher residue crops?
- Can I leave coarser crop residues without interfering with planting?
- Is it feasible to narrow my row spacing?
- Are there crop varieties that perform well in my conditions that close canopy sooner?

[1] *Pimentel, D., C. Harvey, P. Resosudarmo, et. al. 1995. Environmental and Economic Costs of Soil Erosion and Conservation Benefits. Science 267(5201): 1117-1123.*

Water Quality

Why It Matters

When water leaves the farm field it takes the soil and residual crop inputs with it resulting in lost investments, reduced yields and negative impacts on water quality. Protecting water quality is beneficial for the economic health of the farm and the health of the local and downstream communities and industries that rely on clean water.

Crop protectants and nutrients can runoff directly into surface waters; leach through the soil profile and enter either tile lines that discharge to surface water; or leach into groundwater. Groundwater supplies approximately 95% of people living in agricultural communities with drinking water[1]. Agricultural chemicals can give drinking water a foul odor and flavor. More importantly, there are known negative health effects of nitrates in drinking water, particularly for infants and children[2].

Excess nutrients from fertilizer and manure that run off of fields into surface water are also known to stimulate rapid expansion of algae populations. The massive algal "blooms" cause hypoxic, or oxygen-scarce, zones in ecologically and economically important bodies of water. Wildlife and fishing industries have been negatively impacted by hypoxia.

To reduce the amount of crop nutrients in watersheds, some states have created laws regulating nutrient application and manure management. These states may require nutrient management plans to be filed by growers with their state department of agriculture.

How It Is Measured In The Fieldprint® Platform

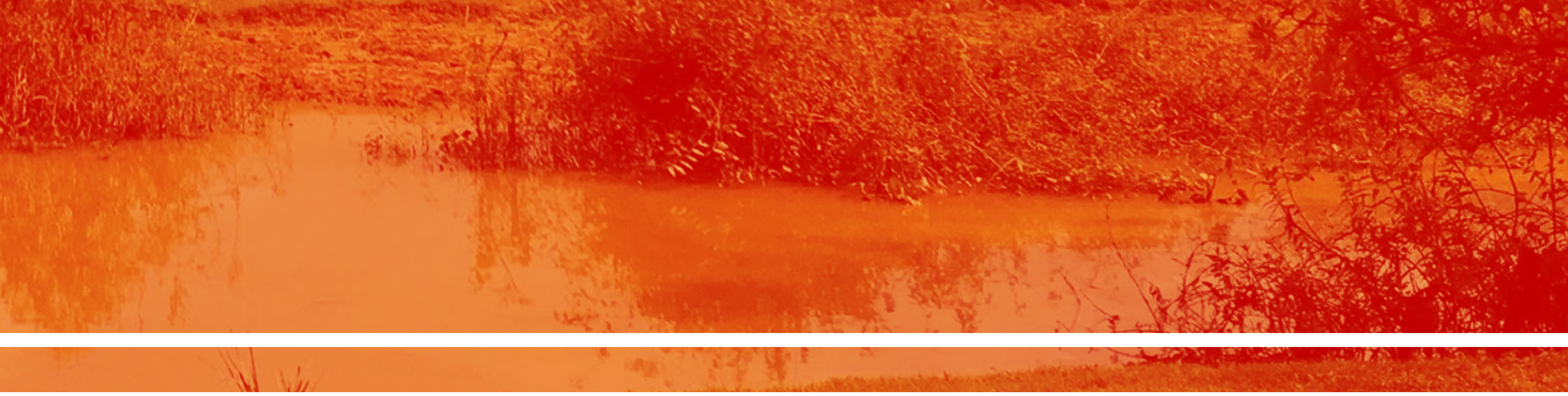
The Water Quality Metric uses the Stewardship Tool for Environmental Performance (STEP), developed by NRCS, to assess how likely a field is to lose nutrients to waterways. Based on soil properties and local climate characteristics, STEP assigns a Field Sensitivity Score (FSS) to each field that represents the potential for nutrient losses, either by runoff beyond the edge of the field (surface loss) or leaching below the rootzone (subsurface loss), for each of four loss pathways: Surface P (Phosphorus), Subsurface P, Surface N (Nitrogen), and Subsurface N. STEP then assigns mitigation points, the Risk Mitigation Score (RMS), for management practices that impact nutrient loss.

The goal is to mitigate all four nutrient loss pathways. A pathway is considered to be mitigated if the pathway ratio (RMS/FSS) is equal or greater than 1. Higher pathway ratios are desirable.

Factors That Affect The Fieldprint Score

WQI is a complex index with several components. First, a WQI sub-factor is calculated by averaging the values of four sub-indices:

- STEP calculations are dependent on the crop being grown.
- FSS is assessed using the location of the field, the soil type, rainfall amounts, tile drainage and the amount of irrigation water applied (if relevant).
- RMS is determined by nutrient management techniques, such as the use of nitrification inhibitors and precision application, presence of a cover crop, tillage type, 4R nutrient management techniques and the implementation of NRCS conservation practices.



How To Improve Your Score

Work with your adviser to develop the combination of practices that work best for your cropping system and location.

Adopt NRCS conservation practices, such as installing a riparian forest buffer, tailwater recovery system or vegetative barrier.

Optimize nutrient applications using 4R Nutrient Stewardship **to maximize plant uptake and keep inputs on the field**, including regular soil and manure testing.

Reduce soil disturbance and keep water on the field. This can be achieved through **reducing or eliminating tillage,** and **managing drainage and irrigation** to reduce runoff.

Opportunities To Explore With Your Trusted Adviser

- What financial incentives are available to install NRCS conservation practices?
- How can I reduce or eliminate tillage?
- Should I convert to a drip irrigation system?
- Can my rotation be adjusted to increase the amount of vegetative cover on the fields each month?
- What are the best cover crops to include in my rotation?
- Is my nutrient management plan up-to-date?

[1] *Pesticides in Groundwater, https://water.usgs.gov/edu/pesticidesgw.html*
[2] *Nitrates in Drinking Water, https://extension.psu.edu/nitrates-in-drinking-water*

Understanding

COMET-Planner

Growers interested in participating in carbon markets need a strategy to quantify potential gains in soil carbon resulting from agricultural conservation practices. COMET Planner is a research-based evaluation tool that estimates potential greenhouse gas mitigation and carbon sequestration resulting from the adoption of NRCS conservation practices on cropland and grazing land.

Now, users of the Fieldprint Platform can access this powerful tool without leaving the site.

Although not a standalone offset measurement tool, COMET-Planner provides a snapshot of the on the field conditions and an estimation of the potential amount of carbon that could be sequestered in the soil by adapting and implementing conservation practices.

The COMET-Planner tool is available as an optional feature to provide additional insight into soil carbon. The Soil Carbon metric in the Fieldprint Platform that is used for assessment of continuous improvement and calculated for all users remains the Soil Conditioning Index (SCI), a qualitative, directional measure of whether soil carbon is increasing or decreasing in a field.

How COMET-Planner Works

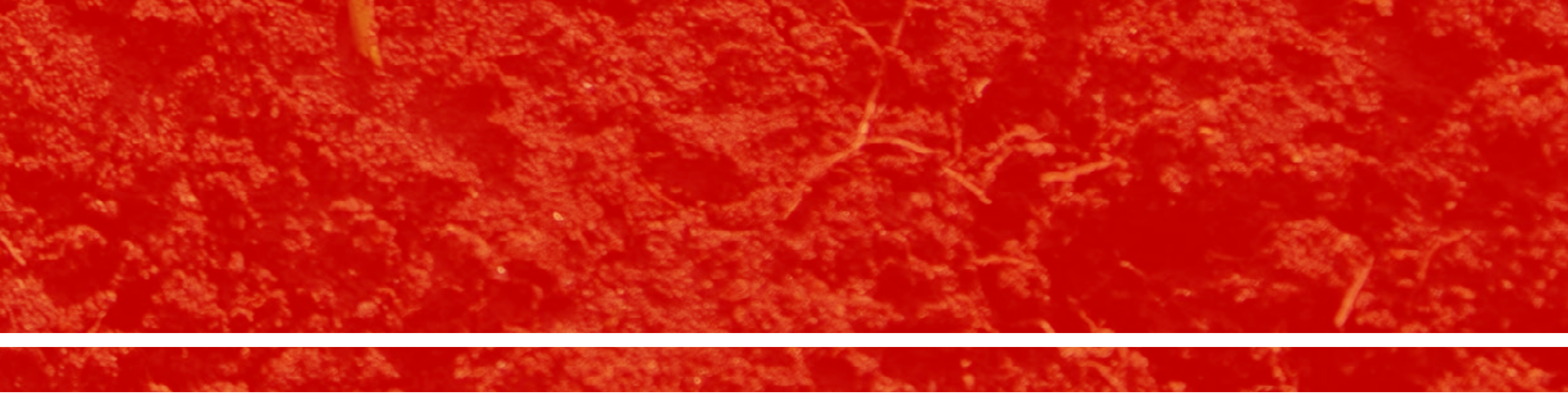
COMET-Planner allows producers to see the gain in soil carbon that can be achieved on their fields by adopting specific practices. Estimates of potential soil carbon sequestration are specific to each of 227 discreet Major Land Resource Areas (MLRA). These MLRA are distinguished from one another by their unique physical geography, climate, soil, biology and land use.

The values produced by COMET Planner are expressed as Mg CO_2e per acre per year, where 1 Mg (mega gram) = 2,200 pounds and CO_2e refers to "carbon dioxide equivalents". In addition to providing soil carbon sequestration, the scenario tool provides estimates of change in nitrous oxide emissions from the soil. The amount of nitrous oxide released from agricultural soils is converted to CO2e, based on its global warming potential which is 298 times the global warming potential of carbon dioxide.

COMET-Planner users select the appropriate NRCS Conservation Practice from a menu to evaluate the potential increase in soil carbon that would result from adoption. This practice can be one that was adopted within the last 10 years or one that users are considering adopting:

- Conservation Crop Rotation (CPS 328) – Growing crops in a planned sequence on the same field.
- Cover Crop (CPS 340) - Crops including grasses, legumes, and forbs for seasonal cover and other conservation purposes.
- Mulching (CPS 484) – Applying plant resiudes or other suitable materials produced off site, to the land surface.
- Nutrient Management (CPS 590) – Managing the amount (rate), source, placement (method of application) and timing of plant nutrients and amendments.
- Residue and Tillage Management - No-Till (CPS 329) – Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.
- Stripcropping (CPS 585) - Growing planned rotations of erosion-resistant and erosion -susceptible crops or fallow in a systematic arrangement of strips across a field.

Learn more about each standard and associated practices at: https://www.nrcs.usda.gov/wps/portal/nrcs/main/



Each Standard has one or more associated Conservation Practice Implementation. Selecting the appropriate Conservation Practice Implementation is determined by several factors, such as irrigation, use of manure and other soil amendments, tillage intensity and cover crop type. Users can also select multiple conservation practices.

How To Use COMET-Planner With The Fieldprint® Platform

Fieldprint Platform users can use the COMET Planner scenario tool in two distinct ways to gain greater insight into the potential of their fields to store carbon.

- If a practice has been adopted within the last few years, users can run a scenario and receive an estimate of how much annual soil carbon sequestration is currently resulting from that practice.
- For farmers looking to understand the impact of future practices, a user can run a scenario to evaluate what the potential carbon sequestration would be from adoption of a new practice in a future year.

COMET Planner provides a basic estimate of soil carbon sequestration that can be then used to help make informed decisions about conservation practice adoption, and can be considered a starting point for evaluating potential participation in carbon markets and other programs.

COMET- Planner Carbon and Greenhouse Gas Evaluation for NRCS Conservation Practice Planning, https://planner-prod-dot-comet-201514.appspot.com/static/media/COMET-Planner_Report_Final.3de20776.pdf

A diverse collaboration working to create opportunities across the agricultural supply chain for continuous improvements in productivity, environmental quality, and human well-being. Our work is grounded in science-based tools and resources, unparalleled, system-wide collaboration and increased supply-chain transparency.

We bring together a diverse group of grower organizations; agribusinesses; food, beverage, apparel, restaurant and retail companies; conservation groups; universities; and public sector partners to define, measure and advance the sustainability of food, fiber and fuel production in the United States.

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