II. Metrics

The SISC Metrics (Beta Version 1.1) includes metrics for energy, nutrients, soil, and water. Below is an explanation of each metric and relevant calculations. Many of the metrics can be considered on a per-area or per-yield basis. A user may choose to view metrics with one denominator or the other depending on their needs. Further explanation of how each metric is calculated, data sources, and how the data provided will be used is provided in Appendix B – Technical Notes and References.

Energy Use Metrics

Crop production requires a substantial amount of fuel and electricity to power farm machinery and irrigation. In addition, a sizeable amount of energy is required to produce fertilizers and pesticides, particularly those fertilizers containing nitrogen. Energy production is resource-intensive regardless of the production method. As energy costs rise, energy will continue to be an important agricultural input to track.

The SISC energy metric includes direct energy from fuel and electricity and indirect energy in the form of energy required to produce fertilizers and pesticides ("embedded energy"). Because growers of multiple crops often do not know how much fuel and electricity was used any particular crop, we have developed a tool to help allocate data to a particular crop or management area. This may also be useful to growers of a single crop who would like to estimate energy use by field.

	By Unit of Production	*By Area*
Energy Use Metric	**1a. Total BtU/ ton harvested**	**1b. Total BtU/ acre planted**
	Total BtU: Direct energy (fuel + electricity) + indirect energy (energy utilized to produce fertilizers and pesticides)	

Nutrient Metrics

Nitrogen and phosphorous are key nutrients for crop production. Nutrients transported off the farm pose an economic loss to the grower and can have detrimental impacts to surface and groundwater quality. Nitrogen lost to the atmosphere as nitrous oxide (N_2O) is a potent greenhouse gas, with ~300 times the warming potential of carbon dioxide (CO_2).

The SISC nutrient metrics are the total amounts of nitrogen and phosphorous applied, with the aim of increasing the efficiency of nutrient use in crop production. Nitrogen and phosphorous were chosen as they are widely recognized as pollutants and are a higher priority for environmental improvement than potassium.

	By Unit of Production	*By Area*
Nutrient Metrics	**2a. Pounds nitrogen applied/ton harvested** **3a. Pounds phosphorous applied/ ton harvested**	**2b. Pounds nitrogen applied /acre planted** **3b. Pounds phosphorous applied/acre planted**
	Pounds nitrogen and phosphorous: sum of all synthetic and organic N and P fertilizers applied.	

Soil Metrics

Soil Organic Matter (SOM) is the organic fraction of soil excluding non-decomposed plant and animal residues.[1] SOM is usually measured by the amount of Total Organic Carbon (TOC) present in the soil. Increasing amounts of SOM, and hence organic carbon, provide significant agronomic and environmental benefits including improved nutrient delivery to plants, water retention, drainage, and resistance to disease and erosion. A soil's ability to store SOM varies greatly depending on climate, soil texture and soil type. To normalize against this variability, SOM is compared with a site-specific estimate of the soil's potential to hold SOM.

The SISC soil metric is the measured TOC of the soil divided by that soil's potential to store organic carbon, as modeled using USDA's Soil Management Assessment Framework (SMAF).

	By Unit of Production	*By Area*
Soil Metric	**4. Soil organic matter / soil organic matter potential** *Soil organic matter requires lab test. Soil organic matter potential is calculated using the Soil Management Assessment Framework.*	

Water Use Metrics

Water is already in short supply in parts of the world and will become increasingly scarce as populations increase and climate change continues to alter weather patterns. It is also increasing in cost in many places. Therefore, efficient irrigation is a critical component of sustainable crop production.

The SISC water use metric has two components: 1) a Water Use Efficiency metric, which measures the total amount of water used to produce the crop; and 2) a Simple Irrigation Efficiency metric, which measures the amount of water applied to the crop relative to the crop's water need resulting from transpiration and soil evaporation (ETc)[2]. This provides a different perspective on water efficiency by taking into account the specific crop and climate conditions.

	By Unit of Production	*By Area*
Water Use Metric	**5a. Acre-inches applied water/ton harvested** **6. Acre-inches applied water/ETc** - *Applied water: Total ground and surface water applied.* - *ETc: Amount of water lost to transpiration and soil evaporation during the growing season.*	**5b. Acre-inches applied water/acre planted**

[1] USDA Fact Sheet, "Soil Quality Indicators" http://soils.usda.gov/sqi/assessment/files/toc_sq_biological_indicator_sheet.pdf

[2] The Simple Irrigation Efficiency metric will be included in a future version of the calculator and described in detail in the accompanying User's Guide.