NYU STERN

Center for
Sustainable Business

Improving Soil Health: Proposed Benefits & Monetization Methods

April 2023

ROSI™ Framework

Return on Sustainability Investment (ROSI™) Framework

By embedding ESG risk and opportunities within core business strategy, the return on sustainable investment can be quantified, delivering the possibility of both financial value and positive societal impact.

Overview of Food & Agriculture Framework

NYU Stern CSB is developing a ROSI™ framework for food & agriculture with publicly available monetization tools to help the industry understand where and how sustainability can unlock financial value.

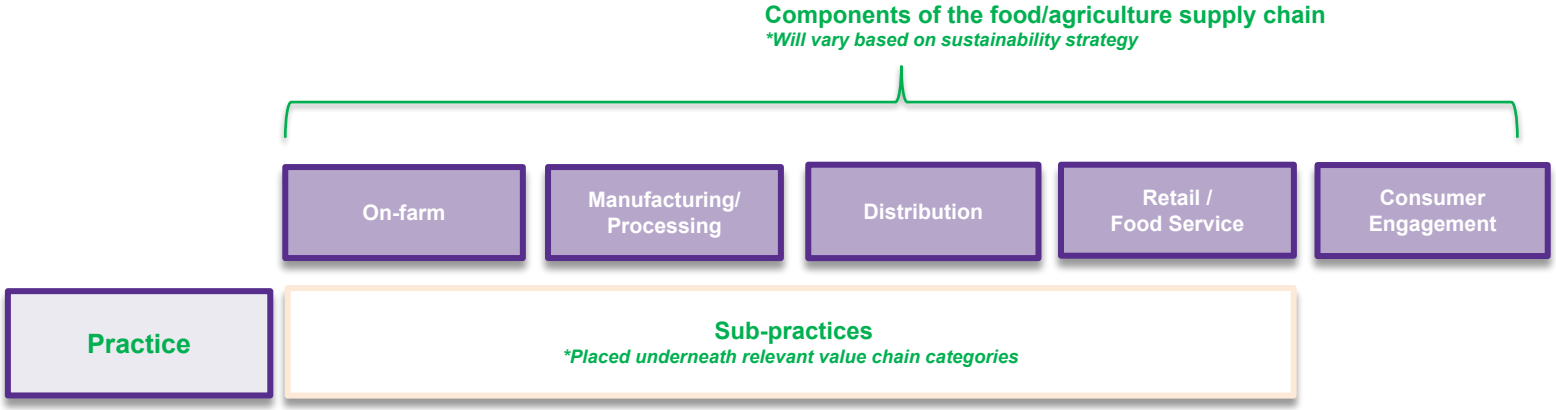
Based on research, experience, and engagement with industry leaders, we have identified the following sustainability strategies* used by the industry to include in the framework:

Water stewardship	Soil health	Climate change	Chemical management
Biodiversity and ecosystem conservation	Animal stewardship	Food waste management	Sustainable sourcing
Food safety and nutrition	Sustainable packaging	Employee and supplier well-being	Brand marketing and communications

Identified Sustainability Practices and Sub-Practices

Framework Layout

- Through our research, we identified key sustainability practices and sub-practices food and agriculture supply chains are implementing to achieve their sustainability strategies
- Each strategy includes sub-practices which are mapped under the relevant components of the food/agriculture supply chain, (if not relevant to a part of the supply chain, it is excluded)
- There are some benefits that are referenced across multiple strategies
- Compliance / enforcement practices are not explicitly listed in this framework but should be considered when implementing the twelve strategies
- Please see diagram below of the framework layout, which is illustrated for each strategy in the subsequent slides



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Improving Soil Health

Improving Soil Health

	On-farm			Manufacturing/ Processing	Distribution	Retail/ Food Service	Consumer Engagement
Improve land use and productivity	Implement conservation tillage to improve soil structure and increase organic soil	Adjust herbicides and pesticides based on improved biodiversity	Measure carbon sequestered/ reduction in carbon emissions	Incentivize the farmer to adopt soil health practices			
	Identify useful/naturally fertilizing crops across seasons (Crop Rotations)						
	Maintain perennial plantings to improve soil structure and organic content						
	Install buffer zones to reduce soil erosion						
	Adjust livestock grazing intensity						
Improve nutrient management	Manure management						
	Implement 4R practices like nitrogen inhibitors, organic/low carbon fertilizers and soil testing						

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Monetization Approach

Improving Soil Health

Overview of Sustainability Strategy and Impact Categories

In the following slides, we will be focusing on benefits from the *Soil Health* strategy, which are categorized based on the impact categories highlighted below

Sustainability Strategy Definition	
Improving Soil Health	Food and agriculture value chain participants are investing in strategies to improve land use and productivity through implementing soil health practices (conservation tillage, use of cover crops, crop rotations and nutrient management)

Impact Categories	Benefits that…
Operational Efficiency (OE)	Optimize corporate and supply chain efficiencies to lower cost and increase profits
Sales and Marketing (SM)	Increase volume of sales through brand and marketing policies
Customer Loyalty (CL)	Attract an increasing community of conscious buyers & consumers, while reducing retention costs
Risk Management (RM)	Encourage risk mitigation and resilience within the value chain

Improving Soil Health

Overview of Sustainability Strategy and Impact Categories

In the following slides, we will be focusing on benefits from the *Soil Health* sustainability strategy, which are categorized based on the impact categories highlighted below

Impact Categories	Benefits that…
Stakeholder Engagement (SE)	Improve goodwill among the broader stakeholder community (i.e. NGOs)
Talent Management (TM)	Attract and retain high-quality internal talent
Supplier Relations (SR)	Improve upon the relationships between the company and its suppliers
Media Coverage (MC)	Increase a company's media presence with the development of traditional and social media content
Innovation (IN)	Create new revenue streams using sustainable business models

Investing in Land Use and Productivity, ON FARM

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric Number	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Land Use and Productivity	Implement **conservation tillage** (avoiding soil disturbance) to improve soil structure and increase soil organic soil	SH-1	Implementing low or no-till practices minimizes equipment costs	OE	Calculate the current cost of equipment used (depreciation, ROI, insurance) as amount per acre annually and compare to amount per acre before conservation practices were instituted and multiply by # of acres. Net out the cost of any new investment in equipment. **Alternative approach is to use custom rates, # of passes, and acres covered per hour to capture the labor and machinery cost benefits of no and reduced till.**
		SH-2	Implementing low or no-till practices minimizes fuel costs	OE	Calculate fuel cost savings by comparing costs per acre before and after implementing conservation tilling and multiplying by the # of acres. Alternative approach is to use custom rates, # of passes, and acres covered per hour to capture the labor and machinery cost benefits of conservation tillage.
		SH-3	Implementing low or no-till practices minimizes equipment repair and maintenance costs	OE	Calculate maintenance & repair cost savings by comparing costs per acre before and after implementing conservation tilling and multiplying by the # of acres. Alternative approach is to use custom rates, # of passes, and acres covered per hour to capture the labor and machinery cost benefits of conservation tillage.

Investing in Land Use and Productivity, ON FARM

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Categories	Suggested Monetization Methods
Improving Land Use and Productivity	Implement **conservation tillage** (avoiding soil disturbance) to improve soil structure and increase soil organic soil & Identifying different useful/naturally fertilizing crops across seasons (**Crop Rotations)** & Maintaining perennial plantings (**cover crops)** improves soil structure and organic content	SH-4	Conservation soil health practices leads to carbon sequestration which the farmer can be compensated for and can reduce Scope 3 emissions for companies	OE, RM	Use a research based estimate for amount of carbon reduced/sequestered per acre related to a specific soil health practice adoption and multiply by impacted acres. Multiply the total amount of carbon reduced/sequestered by an estimate of market value to parties seeking carbon offsets to quantify the benefit
		SH-5	Conservation soil health practices lead to improved soil structure reducing soil erosion and leads to reductions in nitrogen and phosphorus (N&P) runoff minimizing water use and pollution	RM	Use a research based estimate for amount of N&P reduction per acre related to a specific soil health practice adoption and apply to impacted acres. Multiply the total amount of N&P reduced by estimates of market value to parties seeking water quality offsets to quantify the benefit
		SH-6	Implementing conservation soil health practices increases soil biota and improves soil fertility reducing pesticide use	OE	Calculate pesticide cost before and after implementing practices to improve soil biota and divide by the # of acres farmed during each period to get cost per acre. Multiply difference in cost per acre by total acres to calculate the benefits
		SH-7	Implementing conservation soil health practices can lead to an decrease (or in some cases and increase) in herbicide use	OE	Calculate herbicide cost before and after implementing practices to improve soil biota and divide by the # of acres farmed during each period to get cost per acre. Multiply difference in cost per acre by total acres to calculate the benefits or costs

Investing in Land Use and Productivity, ON FARM

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Categories	Suggested Monetization Methods
Improve Land Use and Productivity	Implement **conservation tillage** (avoiding soil disturbance) to improve soil structure and increase soil organic soil & Identify useful/ naturally fertilizing crops across seasons (**Crop Rotations)** & Maintain perennial plantings (**cover crops)** improves soil structure and organic content	SH-8	Implementing conservation soil health practices increases soil biota and improves soil fertility reducing fertilizer use and/or cost	OE	Calculate fertilizer cost before and after implementing practices to improve soil biota and divide by the # of acres farmed during each period to get cost per acre. Multiply difference in cost per acre by total acres to calculate the benefits
		SH-9	Implementing conservation soil health practices increases soil biota and improves soil fertility leading to improved yields	OE	Compare average yields per acre for periods before and after implementing specific practice and multiply yield differential by average price and number of acres to calculate the benefit (alternatively yields can be compared to county yields to estimate the improvement)
		SH-10	To encourage adoption of soil health strategies and/or offset initial costs of adoption, producers often are paid incentives (often in the form of reduced insurance premiums)	OE	Calculate the benefit of amounts received as incentive payments by government, NGOs, or 3rd parties (including insurance rebates) related to implementation of specific practices

Investing in Land Use and Productivity, ON FARM

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Land Use and Productivity	Installation of buffer zones to reduce soil erosion	SH-11	Farmers that install buffer zones experience less soil erosion leading to improved ability to withstand drought or flooding	OE	Estimate likelihood of a drought or flood event occurring and impact on yields, and multiply yield reductions by average prices to capture avoided loss in revenues
		SH-12	Farmers that install buffer zones experience less soil erosion leading to reduced risk of liability related to chemical run-off	RM	Estimate probability of restrictions on water use occurring and the potential impact on yields. Multiply potential yield reduction due to restricted water use by average crop price to calculate benefits of avoided costs. Estimate the probability of potential fines and multiply by the estimated fine amount to calculate the avoided cost.
	Adjust livestock grazing intensity	SH-13	Improve pasture quality through pasture renovation, fertilisation, irrigation, adjusting stock density, avoiding overgrazing & allowing plant recovery (incl fencing and controlled grazing), appropriate rotations, and introduction of legumes leads to reduced feed costs	OE	Calculate animal feed cost before and after implementing new grazing practices and divide by the unit of measure (i.e. head of cattle) to get unit cost. Multiply difference in unit cost by total units to calculate the benefits or costs
		SH - 14	Improve pasture quality through pasture renovation, fertilisation, irrigation, adjusting stock density, avoiding overgrazing & allowing plant recovery (incl through fencing and controlled grazing), appropriate rotations, and introduction of legumes leads to increased soil biota and associated benefits such as reduced soil erosion, savings in fertilizer, pesticide, herbicide use.	OE	Compare input use and yield outcomes before and after practice adoption to estimate cost savings and revenue increments. Additional benefits for carbon and N&P run offs could be estimated using research from local land grant universities.

Investing in Improve Nutrient Management, ON FARM

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Nutrient Management	Manure management	SH-8	Improved collection and storage of manure can allow for recollection of nutrients to replace chemical fertilizer and lower input cost	OE	Calculate fertilizer cost before and after implementing practices to collect and use manure as fertilizer and divide by the # of acres farmed during each period to get cost per acre. Multiply difference in cost per acre by total acres to calculate the benefits
	Implement 4R practices like nitrogen inhibitors, organic/low carbon fertilizers and testing	SH-4	Efficient fertilizer use leads to lower carbon emissions and and can reduce Scope 3 emissions for companies	OE	Use a research based estimate for amount of carbon reduced/sequestered per acre related to a specific soil health practice adoption and multiply by impacted acres. Multiply the total amount of carbon reduced/sequestered by an estimate of market value to parties seeking carbon offsets to quantify the benefit
		SH-5	Efficient fertilizer use leads to reduced nitrogen and phosphate run-off and exposure to liability	RM	Use a research based estimate for amount of carbon reduced/sequestered per acre related to a specific soil health practice adoption and apply to impacted acres. Multiply the total amount of carbon reduced/sequestered by estimates of market value to parties seeking water quality offsets to quantify the benefit
		SH-8	Farmers that implement variable rate technology for nutrient management experience a reduction in fertilizer use	OE	Calculate fertilizer cost before and after implementing practices to improve soil biota and divide by the # of acres farmed during each period to get cost per acre. Multiply difference in cost per acre by total acres to calculate the benefits

Investing in Improve Nutrient Management, ON FARM

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Nutrient Management (*continued*)	Implement 4R practices like nitrogen inhibitors, organic/low carbon fertilizers	SH-4	Nutrient management practices lead to improved soil content and carbon sequestration which the farmer can be compensated for and can reduce Scope 3 emissions for companies	OE, SM	Use a research based estimate for amount of carbon reduced/sequestered per acre related to a specific soil health practice adoption and multiply by impacted acres. Multiply the total amount of carbon reduced/sequestered by an estimate of market value to parties seeking carbon offsets to quantify the benefit
		SH-5	Nutrient management reduces fertilizer use and leads to reductions in nitrogen and phosphorus runoff minimizing water use and pollution	RM, OE	Use a research based estimate for amount of carbon reduced/sequestered per acre related to a specific soil health practice adoption and apply to impacted acres. Multiply the total amount of carbon reduced/sequestered by estimates of market value to parties seeking water quality offsets to quantify the benefit
		SH-12	Farmers that use natural fertilizers reduce the risk of liability related to chemical run-off	RM	Estimate probability of restrictions on water use occurring and the potential impact on yields. Multiply potential yield reduction due to restricted water use by average crop price to calculate benefits of avoided costs. Estimate the probability of potential fines and multiply by the estimated fine amount to calculate the avoided cost.
		SH-8	Farmers that use natural fertilizers may result in lower fertilizer cost as opposed to chemical fertilizer	OE	Calculate fertilizer cost before and after implementing practices to improve soil biota and divide by the # of acres farmed during each period to get cost per acre. Multiply difference in cost per acre by total acres to calculate the benefits

Investing in Nutrient Management, ON FARM

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Nutrient Management *(continued)*	Implement 4R practices like nitrogen inhibitors, organic/low carbon fertilizers	CC-13	Reduce GHG emissions from fertilizer input by replacing it with bio-based fertilizer (livestock manure, crop waste, anaerobically digested bio-waste, or other low carbon options)	RM	Calculate the GHG emission reduction obtained by converting to bio-based fertilizer (as compared to using chemical fertilizer). Multiply the amount of GHG emission reduced by the market price for carbon. Benefit can be calculated as an avoided cost of potential liability or compare to the ROI of alternative investments to reduce emissions.
		CC-14	Reduce input costs by relying on bio-based fertilizer (livestock manure, crop waste, anaerobically digested bio-waste)	OE	Calculate the input cost of bio-based fertilizer as compared to conventional, chemical fertilizer while maintaining output level constant. Include any administration, machinery, or organizational costs associated with this technological change.

Investing in Land Use and Productivity, COMPANIES

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Land Use and Productivity	Incentivize farmers to adopt soil health practices	SH-15	Supporting farmer activities by participants within the supply chain can lead to carbon sequestration which can be a more efficient means of achieving Scope 3 targets	OE, RM	Convert volume of commodity purchased into acres impacted and estimate # of acres farmed using soil health practices. Calculate and apply average CO2 recapture amount per acre and multiply by assumed cost of carbon. Benefit can be calculated as an avoided cost of potential liability or compare to the ROI of alternative investments to reduce emissions
		SH-16	Supporting farmer activities by participants within the supply chain can lead to reductions in nitrogen and phosphorus runoff used to achieve Scope 3 targets	OE	Use research based estimates of amount of reduction in nitrogen and phosphorus related to specific soil health practice adoption within the supply chain and estimates of market value to parties seeking N&P offsets to calculate value and compare compareto capture benefit
		SH-17	Activities lead to carbon sequestration and reduced N&P run-off which can possibly traded in the existing and developing markets for environmental offsets	SM	Use research based estimates of amount of carbon sequestered related to specific soil health practice adoption. Calculate the value of the carbon sequestered by multiplying by the estimated market value and estimate an apply a margin to reflect trading fees as an incremental revenue stream
		SH-18	Enhances relationship with the farmer - enabling incremental revenues from ancillary products	SM	Calculate or estimate the different attachment rates for ancillary services between conventional and soil health farmers. Forecast growth in volumes from soil health farmers and multiply the volume of supply from soil health farmers times the attachment rate differential and by the company estimate of profits per bushel earned on ancillary services

Investing in Land Use and Productivity, COMPANIES

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Land Use and Productivity	Incentivize farmers to adopt soil health practices	SH-19	Enhances relationship with the farmer - increasing stability of supply and reducing costs associated with less optimal sourcing alternatives	OE, RM	Calculate the amount of commodity purchased directly from farmers. Estimate the expected increase in direct purchases and the time period for which the increases occur. Calculate the incremental amount of commodity purchased direct from farmers and apply an estimate of margin improvement versus alternative sourcing channel to measure the benefit
		SH-20	Supporting sustainable agriculture creates a more resilient supply chain (because producer yields remain stable under different weather conditions) thus **stabilizing prices**	OE	Calculate the amount spent on commodity raw materials. Forecast future demand (purchases) and multiply by the potential price volatility (based on historical -or research based evidence- of supplier costs), probability of occurrence (based on historical percentage of occurrence) and an assumption on the soil health farmer yields drop as compared to conventional farmer to measure cost avoided by sourcing from farmers with more stable yields
		SH-21	Supporting the procurement of sustainably grown food commodities can improve relationships with customers, enabling more **long term contracts**	OE	Gather costs related to contract administration and divide by the number of customer contracts to estimate costs per contract. Calculate the percentage of contracts that are long term, as well as average tenor, and estimate the growth in number of contracts and the growth in percentage that are long term. Calculate the administrative cost savings linked to contract negotiation by multiplying the reduction in number of contracts being negotiated due to term extension by the cost per contract and applying a factor of impact related to sustainable sourcing.

Investing in Land Use and Productivity, COMPANIES

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Metric #	Proposed Benefits	Impact Category	Suggested Monetization Methods
Improve Land Use and Productivity, Nutrient Mgmt	Incentivize farmers to adopt soil health practices	SH-22	Engaging with a supplier supporting sustainably grown food commodities can reduce the administration costs of preparing sustainability reports and responding to customer sustainability requirements and surveys	OE	Calculate the number of hours and administrative costs spent to collect data relating to sustainability initiatives of suppliers and the company. Estimate expected increase in data requests and costs, and expected savings achieved by working with suppliers supporting sustainable sourcing. Multiply with wages to estimate cost savings
		SH-23	Supporting soil health practices with farmers enhances the company's sustainability profile which can lead to increase share of wallet or incremental growth in revenues and profits with retailers/key clients & customers focused on sustainability	SM	Gather product revenues and margins for those products made with commodities associated with the soil health programs being supported. Estimate a % increase or shift in revenues and multiply by the applicable margin to calculate the value of increased revenue
		SH-24	Supporting soil health practices with farmers enhances the company's sustainability profile reducing the risk of losing sales to sustainability focused customers	RM	Estimate the likely decline in sales volume from high sustainability focused customers and margin impact. Apply an attribution factor to estimate the impact of supporting farmer activities reduces the risk.
		SH-25	Supporting soil health practices leads to an increasing supply of sustainably sourced ingredients improving the company's sustainability profile and its ability to market products as "sustainable" leading to higher revenues	SM	Identify volumes and revenues of product line(s) associated with farmer support for soil health practices that could be marketed as sustainable along with current margins. Estimate the cost (additional marketing, payments to farmers, etc) and benefit (incremental volume growth or price) associated with marketing products as sustainable. Multiply incremental revenues by average operating margins to capture benefits.


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