April 2018

Eroding Value

Why Dirt Matters for Business Leaders & Investors

TERRA ALPHA
INVESTMENTS

Terra Alpha Investments, LLC is an advocacy investment firm established in 2014.

Our vision is to drive systemic change in the economy, so that it is more aligned with our natural systems.

Our firm's mission is to demonstrate that Environmental Productivity enhances long-term returns as expressed in real investment results and to advocate for the widespread adoption of Environmental Productivity across the global economic system.

At Terra Alpha, we believe that a portfolio of the world's most fundamentally strong, attractively valued, and environmentally productive companies will provide our investors with better long-term risk-adjusted returns. We believe that asset owners also want their investments to reflect their shared interest in a better environment for all. We believe that our investment process and our advocacy work will drive the global economy to be more aligned with the world's finite natural systems to help create a better world.

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ACRE Investment Management (AIM) is a leader in conservation capitalism, as a project development and natural capital management company organized in 2003 to integrate energy assets for ecological purposed on scale. Initially our primary focus developed a scalable reforestation program for the Lower Mississippi Alluvial Valley. AIM currently has four divisions: *Big River* is the leading cottonwood nursery producing 10 million cuttings per year. *Forest Green* works with consumer-facing companies to offer decarbonized products. *GreenTrees* is the leading carbon reforestation entity in North America. With its 500-landowner partners, the *GreenTrees* program is comprised of 120,000 acres of bottomland hardwood forests producing 99% of all issued reforestation credits in North America to date. Finally, *Conservation+* works with landowners to create a portfolio approach to their land holdings incorporating carbon, nutrients, wetlands, stream, water storage credits, land preservation credits and so much more.

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Introduction

Healthy soil literally underpins our societies and economies across the globe. Yet, surprisingly little is known about the dirt that provides food, fibers, grains, water filtration, and carbon sequestration, as well as fosters biodiversity. We do know that feeding the growing global population will require a 60% increase in food production over the next thirty years; meanwhile, the planet's stock of healthy soil is declining due to poor land management, deforestation, and industrialized agricultural practices.

The impact of declining soil health is evident today primarily at the farmer level, though it will increasingly be felt all the way up supply chains to the consumer. Business leaders and investment professionals who seek to better understand and manage the risks of declining soil health and the opportunities in better soil management - and incorporate this information into their investment decisions - will reap higher returns for their companies and their investors.

As opposed to most other key environmental resources (clean air, water, raw materials, and forests) there are limited datasets of measured soil health. In fact, there are not even agreed upon global standards to measure or define healthy soil. An incomplete patchwork of definitions, maps, and measurements of varying quality make the objective assessment of the true state of the planet's soil health very challenging for a business leader or investment professional.

In order for business leaders with significant exposure to agricultural inputs - and their investors - to improve long-term returns, better tools and methods for measuring and maintaining soil health are desperately needed. Investors, business leaders, and stakeholder organizations must work to develop the protocols and tools to allow for better management of the planet's soil.

This report seeks to alert business leaders and investors to what is known about soil health, its economic and societal importance, and what action is needed to alter the trajectory of declining soil health.

Key Takeaways

- **Dirt - The Facts:**
  - Soil is a critical natural resource for global economies, ecosystems, and societies
  - Demand on arable land is growing (by 6 million hectares/14.8 million acres/year)
  - Globally, soil health is degrading with impacts on crop production, water use, deforestation, and carbon release

- **Risks and Opportunities Are Very Real:**
  - Inaction heightens risk of production disruption, higher costs, and damage to reputation
  - More productive and resilient soil lowers long-term costs and supports proactive brands

- **Much Work Is Needed to Reverse the Decline of Soil Health:**
  - A common methodology for measuring healthy soil
  - Widespread change in field and crop management to more sustainable practices
  - Corporate leadership to set examples and broaden understanding of the issue

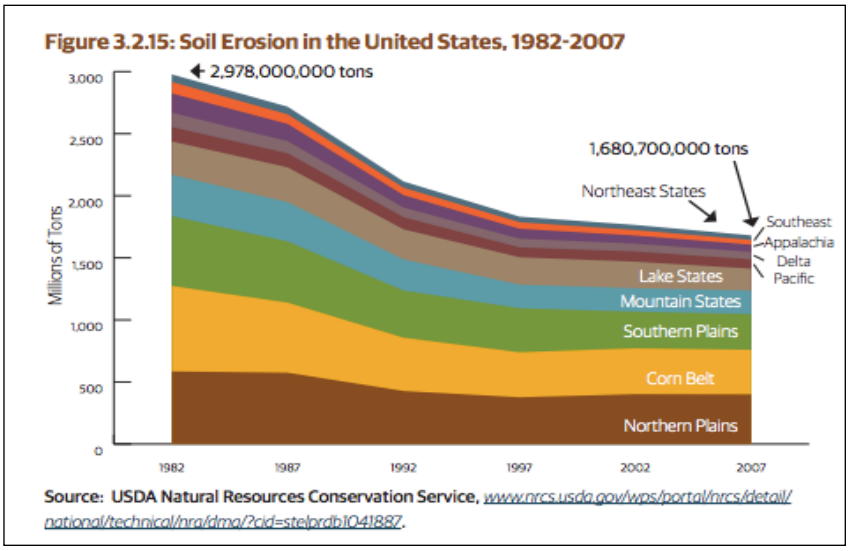
Dirt - The Facts

Soil supports and impacts essential elements of societies, including food production, water filtration and retention, forest growth, and general ecosystem health. Yet the demands on healthy soil - a shrinking resource - are intensifying from multiple directions. The lack of broad awareness about soil health, and the lack of standards that C-suite executives and investors can use to measure soil health in supply chains, is a major hindrance to progress.

Limited Awareness: Like other natural resources, soil health has not been traditionally included in financial analysis, but it needs to be. "Natural capital assets - land, soil, air, water, and biodiversity - have been undervalued and unaccounted for in business balance sheets, [while] their contribution to asset stranding, directly and indirectly, is extensive and the impacts can ripple across markets and into other sectors of society."[1] Unlike the other natural resources, there is relatively limited media or NGO focus on soil health and business impacts.

Lack of Standards: In addition to the general lack of awareness, one of the most challenging aspects of assessing and tracking soil health is the lack of robust historical data and agreed-upon methodologies for measurement and reporting. This is in stark contrast with the relatively robust infrastructure and standards that exist for monitoring and reporting on other major natural resources (e.g. carbon emissions). The scarcity of established historical records compounds this problem by inhibiting trend analysis and deeper understanding of soil health.

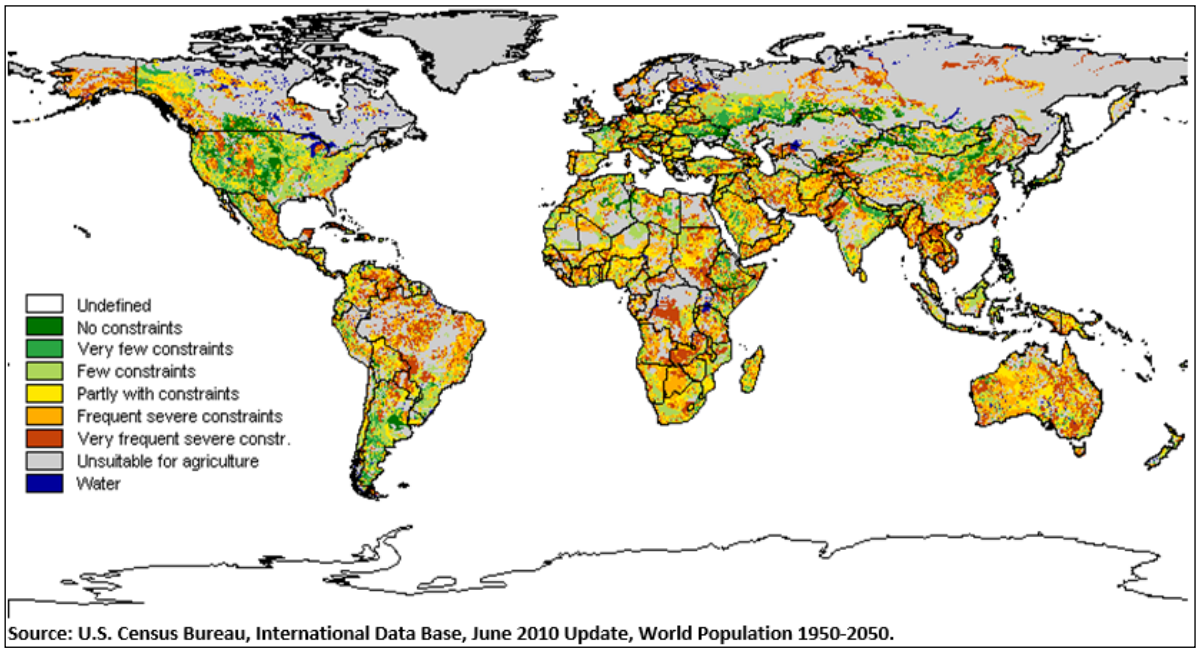
Limited and Degrading Quantity of Arable Soil: There is a looming shortage of available, healthy soil to serve global needs. Today, the total area of land with sufficient soil resources and health to support agricultural production is at its lowest point in history.



Soil is being eroded 10-40x faster than it can be replenished.[2] The U.S. alone is losing more than one billion tons of fertile soil per year. Over the past 100 years, the intensity and industrialization of farming, along with human development has increased soil erosion significantly. At the current rate of erosion and use, the UN Food and Agriculture Organization estimates **the world has 60 more years of growing crops.**[3]

The challenges of assuring enough healthy soil to serve current societal needs are significant. Already, ⅓ of the world's soil has been degraded moderately-to-highly from: erosion, nutrient depletion, acidification, salinization, compaction, and chemical pollution. The following map (pg. 4) shows the

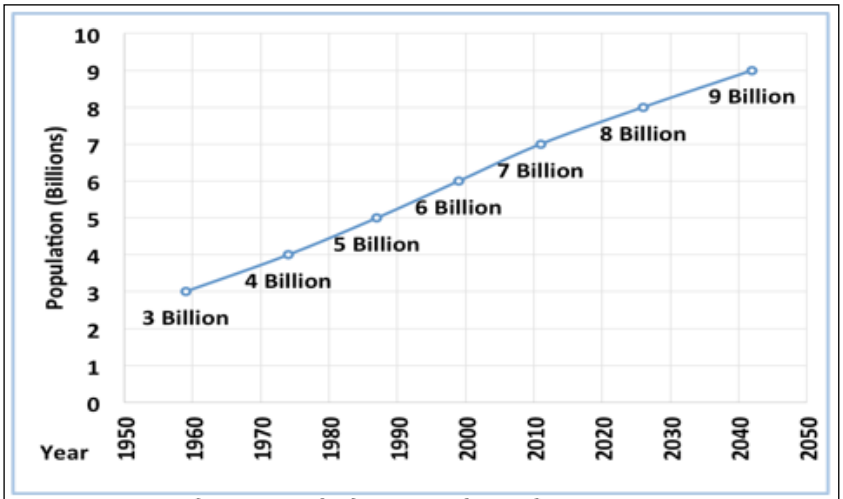
constraints on viable soil considering all limiting factors: water availability and retention, soil chemistry and biology, and average temperature, to name a few.



Source: U.S. Census Bureau, International Data Base, June 2010 Update, World Population 1950-2050.

Greater Population = Greater Demands on Existing Soil: With a growing global population, all natural resources are under increasing strain. In order to feed the growing population, the planet will need to increase annual food production by 60% to feed the 10 billion people on the planet by 2050. To keep up with this growing demand, 6 million hectares/14.8 million acres of new farmland will have to be planted each year.[4] **Twice that amount is lost annually through soil degradation**.[5]

As the global population grows, the planet's soil stocks will be farmed to not only supply more food crops, but also more **clothing fibers, animal feed, and agriculture-based fuels**.



Source: Food and Agriculture Organization of the United Nations

Healthy Soil = Excellent Water Filter: Healthy soil hosts nutrients that act as **water filters**, removing pollutants from rainwater and runoff. Soil filtration helps ensure availability of clean drinking water in aquifers. When these nutrients are depleted through heavy use, soils can lose this filtration capacity.

Soil Acts as a Carbon Sink: Organisms living within soil, and the overall soil organic matter, sequester carbon. Grasslands, peat fields, plants, and forests that soil supports are similarly powerful natural mechanisms for removing carbon from the atmosphere. Healthy soil management practices support lower carbon dioxide levels in the atmosphere and thus mitigate further changing climate stresses.

"Carbon Farming" refers to looking at farmland and grasslands as places to store carbon. Climate scientists differ on just how much carbon storage is possible on the planet's agricultural lands, though some studies suggest that farms have the capacity to absorb as much as the carbon equivalent of worldwide greenhouse gas emissions annually — roughly 36 gigatons – while agricultural land currently absorbs only about .03 gigatons.[6] [7]

Isn't Dirt, Dirt? What is Healthy Soil Organic Matter (SOM)?

From a biological perspective, soil organic matter (SOM) in its various forms greatly impacts the physical, biological and chemical properties of the soil. ***High organic matter means soil is nutrient-rich and tends to require lower fertilizer inputs, and is more resilient to drought and extreme rainfall.*** *It comes from the biomass of microbial communities in the soil (bacterial, fungal, and protozoan), plant roots and detritus, manure, green manures, mulches, composts, and crop residues. SOM is depleted when plant growth does not replace its mixture of nutrients, or is simply physically displaced.*

Source: https://www.ecosystemrestorationcamps.org/its-the-organic-matter-that-really-matters/

Healthy Soil = Lower Environment Costs: Broad reductions in environmental impact, as well as specific business opportunities, are possible for the agriculture sector through improved soil management. It is estimated that if steps were taken to improve soil management of just 50% of U.S. soil by 2025, roughly 25 million tonnes of GHG emissions, 116 million tonnes of soil erosion, and 344 million pounds of nutrient loss to the environment could be avoided, as well as 3.6 million acre-feet of water capacity in cropland soils retained.[8] These large environmental benefits from better soil management are also business opportunities for farmers and their customers.

Source: The Nature Conservancy, ReThink Soil

Risks and Opportunities around Soil Health

The primary soil risk for businesses and investors is an unchecked decline in available, productive farmland. Unhealthy soil is increasingly vulnerable and costly to growers to try to keep productive over time. Lower yields and higher costs then move up the supply chain. As transparency in sourcing is demanded by consumers, the risk to brand reputations from poor management practices is real.

Risks from unhealthy soil:

- **Greater vulnerability to declining crop yields and weather disruption**
- **More costly to growers over time**
- **Lack of transparency is increasingly a reputational risk**

It should be recognized that most farmers are well aware that better, healthier soil lowers their long-term costs. However, a collection of factors from government farm policies, immediate financial constraints, and high demand for certain crops (soy and corn) make initiating changes risky.

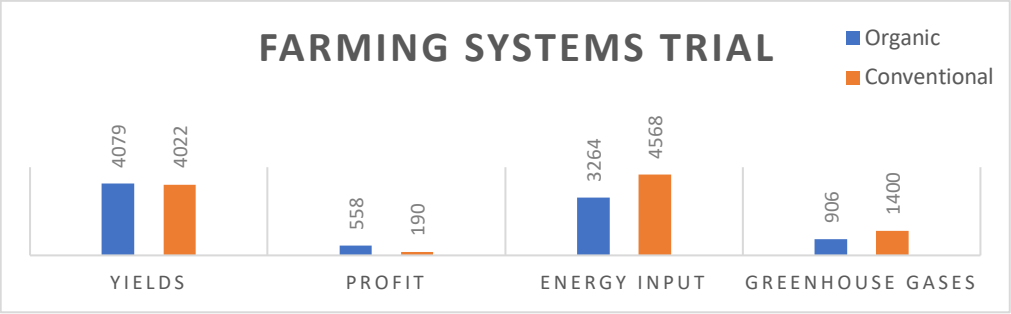
Fertilizer Risk
Fertilizer has been intended to boost soil productivity, yet it is not regenerative to soil health. Unlike replenishing nutrients through manure and crop diversification, the increased use of fertilizers in global agriculture has been known to cause harm in various ways: downstream pollution effects throughout a watershed on water supplies and noted human health impacts; excess fertilizer washed away as runoff into surrounding bodies of water pollutes waterways with excess nitrogen and results in algal blooms, anoxic "dead zones," and detrimental impacts on aquatic life; damaged aquatic ecosystems lead to economic costs for fisheries and other connected industries.

There are significant positive **opportunities to maintaining healthy soil**. Good soil health management is an issue of resource efficiency and a benefit for both businesses and investors. It can create direct business opportunities when a business takes steps to improve how it operates its agricultural supply chain and its impacts on soil.

Opportunities stemming from healthy soil management:

1. **Higher crop productivity**
2. **Lower long-term costs for farmer and business**
3. **Competitive opportunities in reputation/marketplace**

Recent comparisons increasingly illustrate benefits in emphasizing healthy soil farming practices:[9]



1. Higher Crop Productivity from Healthy Soil Practices: Healthy soil increases a farmer's crop productivity. Crop diversification maintains soil health quality, as one of the healthy soil practices increasingly closing the productivity gap between alternative and conventional methods, e.g. 2014 study illustrating the gap could be as small as 10%, and be no more costly nor less productive than conventional farming methods.[10] Encouragingly, soil can be "brought back to health" as well as maintained using "non-conventional" healthy soil practices growing methods.[11]

2. Lower Long-term Costs for Farmers and Business: When soil is kept healthy, less money is spent on purchased nutrients and fertilizers, and less water is required for irrigation as well. Typically, fertilizer is the third highest agricultural production expense in the U.S. (9% of total expense after feed (23%) and livestock purchases (13%)).[12] By comparison, seeds are 6% of costs, and pesticide 5%.[13] If soil quality can be maintained then fertilizer expenses drop. Recent research suggest better soil management may also lower the need for pesticides, as alternative farming practices show comparable productivity levels without their use.[14]

3. Reputation - A Driver for Better Practices: Growing demand for "healthy food," sustainable farming practices (e.g. organic farming, fair labor practices, non-conventional cropping methods), and traceability in supply chains, reinforce the strong brand benefits that come from healthy soil practices.

Going Forward, What is Needed?

What is necessary to help investors and C-suite executives measure and manage their soil risks?

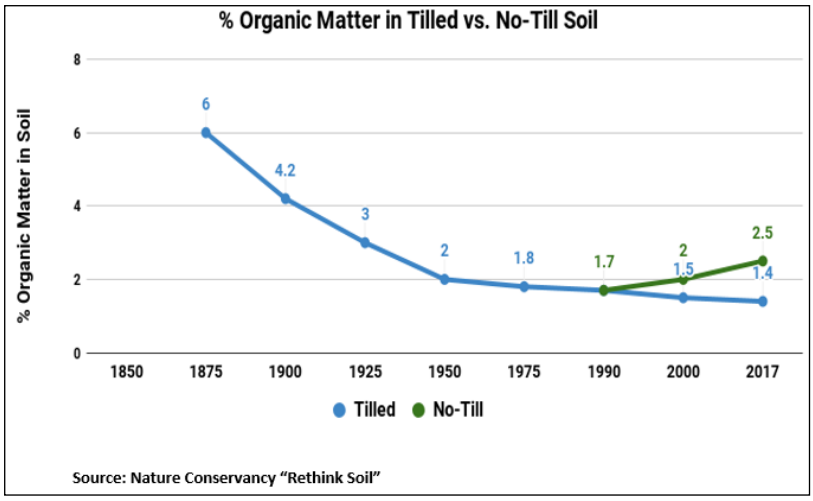
1. **Standards to define, monitor, and report on soil health**
2. **Faster adoption of best farm management practices (e.g. no-till, crop rotation, cover crops)**
3. **Leadership by example and incentivizing**
4. **Awareness/education on the nexus of soil health and business success**
5. **Supply chain traceability**

1. **Standards for "Healthy Soil" and a Common Set of Indicators:** Some awareness of the importance of soil health exists, but there is no global standard of what constitutes "healthy soil" nor a replicable, "total system" of measurement and assessment. There is a need for broadly defined standards against which to measure soil health, which in turn will make managing soil health easier.

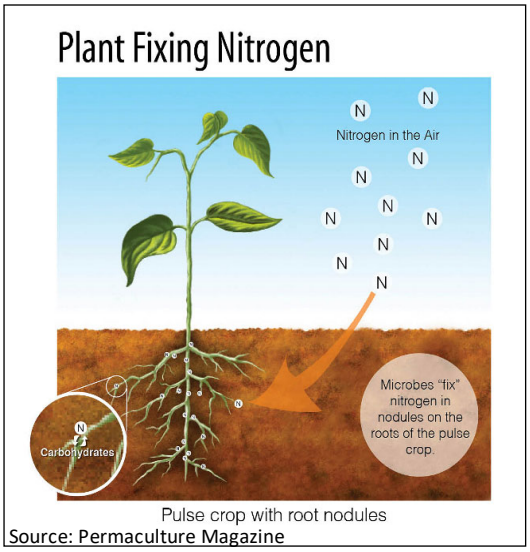
Currently, the burden of determining and monitoring "good" soil health falls on the specific farmer/producer to gauge and to decide whether to implement healthy soil practices. Their indicators for soil health are specific composition for their usage - specific ph balance and other desirable factors, which can all vary per location and per type of crop.

2. Utilize Healthy Soil Best Farm Management Practices as Standard: Healthy soil management has evolved from existing, conventional practices - to "alternative" **methods of no-till, cover crops, crop rotation, and rotational grazing** - to keep soil healthy, often with non-chemical amendments to the soil, and to optimize a state with resilient, productive organic matter soil.

- **No-Till** practices in the past 25 years have shown increased "soil fertility" and can be changed to ridge, strip, or zone tillage, all of which improve the quality of the soil.
- **Crop Rotation**, instead of fertilizer, goes back to early practices of farming with a rotation of crops - alternating nitrogen-fixing crops every season with nitrogen-limited crops.
- **Cover Crops** integrate nitrogen-fixers and nitrogen-limited crops between growing seasons.
- **Rotational Grazing** moves livestock and allows grasses to rejuvenate.



Source: Nature Conservancy "Rethink Soil"

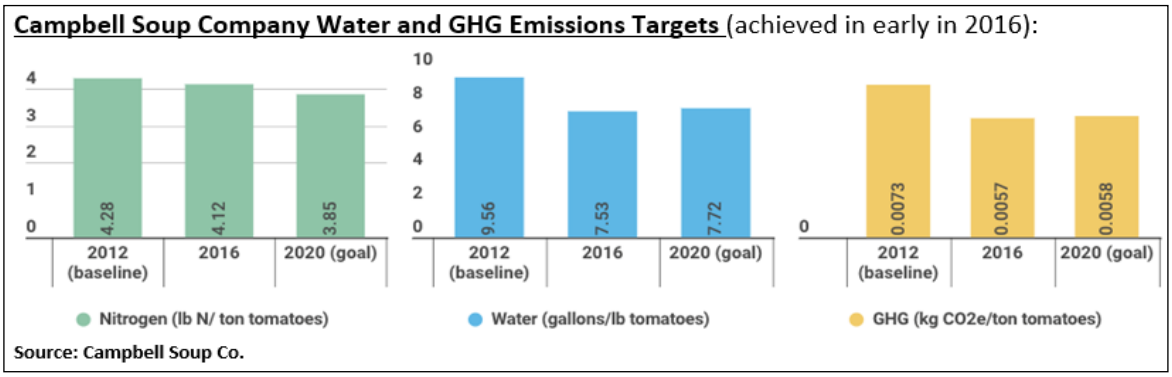


Pulse crop with root nodules
Source: Permaculture Magazine

3. Leadership on Best Practices for Soil Management: Agro-businesses can help secure their future profitability by thinking longer term and creating healthy soil practices. Building leadership awareness across Boards of Directors and C-Suites may start with simply understanding what company-specific pilot programs are indicating about the importance/impact of soil health. "Farmers that employ good soil management practices tend to also practice other strong management systems because they're thinking ahead."[15] Leaders can incentivize sustainable practices to reward healthy soil management.

Some corporate leaders are thinking through soil health and its importance to their business success on a longer-term basis already. Examples and leadership need to come from large companies that have the ability to think and force action "down the chain," with an eye toward longer-term sustainability and profitability.

- **Campbell Soup Company** has prioritized soil health and good soil practices in addition to reducing water usage, waste generation, and greenhouse gas emissions through their Sustainable Agriculture Program. It uses a "'measure to manage' approach" to provide farmers with data about their crop performance, and strategies to increase productivity. Since 2012, the company has reduced by 22% both its agricultural water use (per gallon per pound of raw tomato) and GHG emissions related to fertilizer usage per ton of tomatoes, and even already met some of its 2020 environmental goals[16].



- **Kellogg, General Mills,** and **Campbell Soup Company** currently work together in a consortium addressing soil health.
- **Wrangler** adopted a soil health initiative in 2017 to produce sustainable cotton.
- **General Mills** in 2018 invested in 34,000 acres in South Dakota to convert it to grow organic wheat by 2020 for their **Annie's** macaroni and cheese organic brand.[17]
- **Blue Apron** models soil health: "**Blue Apron** already provides a free soil testing service to the farmers it works with that allows them to evaluate the nutrient load in their soil. With that data, [they] then makes recommendations for crop families the farmers could be growing to improve soil health and yields. For example, if a farmer grew a brassica last season, the company might recommend it grow a legume this season to fix nitrogen naturally. **Blue Apron** then guarantees that it will purchase the full crop production and uses it in a future recipe."[18]

4. Awareness/Education Campaigns: The importance of soil health needs to find a broader platform of understanding. The Resources Appendix highlights organizations and tools that enhance understanding around soil management best practices, where they are currently being demonstrated, and how to access information on land regeneration and healthy soil management practices. Organizations such as **Soil Health Institute** as well as the **UN Food and Agriculture Organization** are working to make data, methodologies, and practices available for adopting healthy soil management practices. Other important avenues for dispersing information and implementing action are:

- Landowners/institutional buyers of land adopting healthy soil management practices.
- Academic and NGOs focusing on communicating soil health to business communities.
- Investors advocating to business leaders.
- Corporations connecting directly to the farming community. E.g. **Wrangler** partnered in 2017 with Future Farmers of America to demonstrate and educate about soil health as a key element of sustainable farming and business.[19]

5. Supply Chain Traceability: Because increasingly consumers expect to know the origins of their food and products, there is reputational value and risk mitigation in traceability and supply chain management. This will likely catalyze investors and businesses to engage more deeply in understanding the agricultural risks and opportunities in soil-based products and inputs. "The most progressive [companies]are now sending a message that in the near future, non-transparent sourcing will not be acceptable. The [companies and] mills that engage with buyer support programs now will be the ones who see maximum benefit later."[20]

Implementing audits of supply chain soil health will be the first step in creating and maintaining steady traceability. Rather than solely relying on commodity sellers, a company may need to oversee their own

supply chain - firms like **GeoTraceability** have developed databases of growers and work to engage and track data for traceability information.

- **Campbell Soup Company** is building capabilities to trace ingredients' sourcing, commodity mapping, and know water scarcity risk.
- **Unilever** recently announced it has full traceability for its palm oil supply chain, including both direct and indirect suppliers.
- Transparency is coming for commodity crop companies – soybeans, palm oil, and corn, as well as beef and/or livestock (e.g., 45% of current crops grown are for livestock feed). **Golden Agri-Resources** says it uses supply chain mapping methods and technology to track 100% traceability back to the source plantation for suppliers to its owned mills – which account for more than 39% of the company's total supply of palm oil – and plans to have finished mapping the supply chains of its 427 independent mills by the end of 2020.[21] To their credit, commodity companies like **Cargill** and **Bunge** have begun to adopt standards for their Tier 1 suppliers. (Higher variation remains for Tier 2 or 3 company practices.)[22]
- Vertically-supplied textile products are also becoming a reality. "**Red Land Cotton** is unique, maybe the only farm-to-home maker of sheets in the country right now. But there are others also succeeding in this small—but growing—marketplace, including **Homegrown Cotton**, **Jones American Clothing**, and **T&S Designs**, all makers of shirts and tees using cotton produced right on their farms."[23] They are responding to the consumer-driven demand for transparency.

Amidst more consumer-driven demand for transparency, the more connected a company is to the site of production, the better they can implement and incentivize farmers to maintain high levels of soil health management.

Conclusion

The ongoing decline in our planet's soil health is a global challenge. Awareness of this developing crisis remains low and standardized methodologies and tools needed for business leaders and investors to measure and manage it are not yet available. The intention of this report has been to provide a general understanding of the soil health crisis globally, identify some of the risks and opportunities to businesses and investors, provide examples of efforts to make changes, and provide references to resources for a deeper understanding for business leaders and investors.

Business leaders (and investors) with significant exposure to agricultural inputs need standardized methodologies to measure and better manage soil health in their operations and supply chains. Globally, there are many local or crop-specific examples and models of effective, productive, healthy soil management practices. To reverse the global decline in healthy soil, we need greater promotion and adoption of the best soil practices and the development of standards for measuring and reporting soil health.

Investors, business leaders, farmers, scientists, and NGOs must work together to develop broadly the protocols and information to allow for rapid adoption of better management practices of the planet's soil. **Business leaders - and their investors – have a shared interest in taking a lead in this effort.**

Appendix – Resources for Companies

Targeted Toward Companies	Targeted Toward Investors	Measuring Tool	Disclosure Tool

[Aid by Trade Foundation]

Works toward ensuring that all cotton is produced in a more sustainable manner.

[Better Cotton Initiative]

Implements the Better Cotton Standard at the farm and ginner levels and works toward more transparency in the supply chain. **BCI, organic, Fairtrade, myBMP (Australia), ABR (Brazil).**

[CERES Engage the Chain]

CERES has brought together companies to address and identify examples of good practices including resources and experts about soil health.

[Cotton LEADS™]

Cotton LEADS™ is a program born out of partnership between the Australian and U.S. cotton industries. The goal: engage and connect businesses across the global supply chain with the leading efforts in sustainable cotton production. Cotton LEADS connects textile manufacturers, brands and retailers with opportunities to support cotton growers' sustainability efforts and to share data, resources and technologies globally for the benefit of improving cotton around the world.

[Field to Market]

Field to Market "emerged as a collaborative effort emphasizing the inclusion of diverse perspectives, a foundation of science-and outcomes-based approaches to sustainability, and a focus on commodity crops with recognition of their unique supply chains." It is a multi-stakeholder initiative, including agribusiness, brand retailers, civil society, and grower organizations.

Targeted Toward Companies	Targeted Toward Investors	Measuring Tool	Disclosure Tool
■ ■	[GeoTraceability]		GEOTRACEABILITY
GeoTraceability is a company that utilizes its software solutions to assist suppliers, including small and medium sized mills, in compiling traceability information. The company's supporting tools continue to be developed, tested and enhanced as it works with the over 250,000 smallholder farmers in its database.			
■ ■	[Global Soil Partnership]		GLOBAL SOIL PARTNERSHIP
Global Soil Partnership is an effort by the UN to provide information on better soil management.			
■ ■	[Midwest Row Crop Collaborative (MRCC)]		MIDWEST ROW CROP COLLABORATIVE
The **MRCC** is a coalition of businesses and NGOs—is addressing nutrient loss in the Upper Mississippi River Basin head on. The Collaborative is focused on key watersheds in Illinois, Iowa, and Nebraska to advance farmer-led solutions that protect air, water, and improve soil health. Earlier this year, Conservancy field staff in Nebraska, Iowa and Illinois—the three MRCC pilot states—evaluated the focal watersheds: Middle Cedar River Watershed, IA, Middle Platte River Watershed, NE, and the Upper Sangamon River Watershed, IL. These analyses will help determine opportunities to scale up nutrient reduction work and develop meaningful strategies to achieve an overall 20 percent nutrient reduction goal by 2025." -The Nature Conservancy			
■	[reThink Soil (Nature Conservancy)]		reThink Soil A Roadmap to U.S. Soil Health
The Nature Conservancy has outlined ten steps on a 'Roadmap to Soil Health', identifying ways that adopting new practices would reap $50 million annually in social and environmental impacts.			
■ ■	[Soil Health Institute (SHI)]		SOIL HEALTH INSTITUTE

Targeted Toward Companies	Targeted Toward Investors	Measuring Tool	Disclosure Tool

The SHI is a resource for soil health information and research. "The SHI endorsed 19 measurements—ranging from organic carbon to pH—that all farmers can use to chart their progress towards achieving healthy soils…(to) **create a common set of indicators** that will help all of those involved in soil health (farmers, scientists, etc.) measure the same thing across fields and over time, allowing for apples-to-apples comparisons".

Soil Health Partnership

"This effort is the largest farmer-led soil health research project of its kind. SHP is working with the farmers to identify, test and measure results from practices like cover crops, conservation tillage and nutrient management. Through annual field days and peer-to-peer communication, SHP and the demonstration farmers are sharing results with other farmers and showing how sustainability through soil health practices can lead to increased farmer profitability and multiple environmental benefits."

The Status of the World's Soil Resources

Food and Agriculture Organization of the United Nations

2015, by the UN Food and Agriculture Organization is the first UN report survey the state of soil globally. The second is due in 2020.

Stewardship Index for Specialty Crops (SISC)

SISC is "a multi-stakeholder initiative dedicated to developing tools for measuring sustainable performance across the specialty crops supply chain. SISC offers a suite of outcomes-focused metrics enabling operators to benchmark, compare, and communicate their own performance." SISC includes a range of interested parties to establish and share metrics that prioritize land stewardship. SISC is fiscally sponsored by Social and Environmental Entrepreneurs (SEE).

Sustainable Apparel Coalition (SAC)

SAC is a coalition of manufacturers, brands, and retailers joined together to identify and measure their sustainability impacts. They have developed the Higg Index and a protocol called the Facility Environmental Module to help companies track and measure their efforts and progress.

Targeted Toward Companies	Targeted Toward Investors	Measuring Tool	Disclosure Tool
	[SUSTAIN program]		SUSTAIN™ ENVIRONMENTALLY SUSTAINABLE AGRICULTURE
SUSTAIN is a collaboration between Campbell Soup company, United Suppliers, and Environmental Defense Fund. United Suppliers is "a cooperative of locally owned and controlled agricultural retailers, to help deploy the SUSTAIN™ platform in target areas in 2015, including Nebraska and Ohio. SUSTAIN™, combines a set of proven, effective technologies, practices and products that improve nutrient use efficiency and reduce soil erosion while enhancing productivity."			
	[World Wildlife Fund]		WWF World Wildlife Fund
World Wildlife Fund (WWF), among its areas of focus, looks at the challenges facing soil.			

Endnotes

[1] Environment and Society: Human Perspectives on Environmental Issues, Charles Harper and Monica Snowden, Routledge, 2017, p. 301
[2] Soil Erosion Threatens Human Health and Welfare as Well as the Environment, Cornell University, 2006
[3] Only 60 Years of Farming Left if Soil Degradation Continues, *Scientific American*, Chris Arsenault
[4] We Are Treating Soil Like Dirt, *The Guardian*, George Monbiot, March 25, 2015
[5] Input Constraints to Food Production: Impact of Soil Degradation, Rickson, RJ, *Food Security*, 2015
[6] Action is Needed to Make Stagnant Carbon Dioxide Emissions Fall, *Stanford University News*, Ker Than, January 30, 2017
[7] Regenerative Organic Agriculture and Climate Change Rodale Institute white paper
[8] Soil Health Roadmap from The Nature Conservancy
[9] Regenerative Organic Agriculture and Climate Change Rodale Institute white paper, p.3
[10] Diversification Practices Reduce Organic to Conventional Yield Gap , *The Royal Society,* Lauren C. Ponisio, Leithen K. M'Gonigle, Kevi C. Mace, Jenny Palomino, Perry de Valpine, Claire Kremen, December 10, 2014
[11] Regenerative Organic Agriculture and Climate Change Rodale Institute white paper, p.3
[12] USDA Farm Economics Table 4, Agricultural Expenses, 2007 and 2012
[13] USDA Farm Economics Table 4, Agricultural Expenses, 2007 and 2012
[14] Farms could slash pesticide use without losses, research reveals *The Guardian*, April 6, 2017
[15] Food Fight: Companies, Investors, Farmers Debate Sustainable Agriculture CERES blog
[16] Campbell Soup Company – Agriculture webpage
[17] General Mills, Annie's, Tap South Dakota Farm Foxbusiness.com, Steve Karnowski, March 6, 2018
[18] Blue Apron to Invest More in Regenerative Agriculture, Foodtechconnect.com, Daniele Gould, June 29, 2017
[19] Wrangler – Soil Health webpage
[20] GAR Traces Palm Oil Back to the Plantation - Why Should You Care? *Environmental Leader*, Jennifer Hermes, March 2, 2018
[21] Golden Agri-Resources - Sustainability webpage
[22] Julie Nash, CERES Soil Expert, February 2018
[23] Growing Crops that Brings Agriculture and Fashion Closer than ever agamerica.com, Celeste Walls