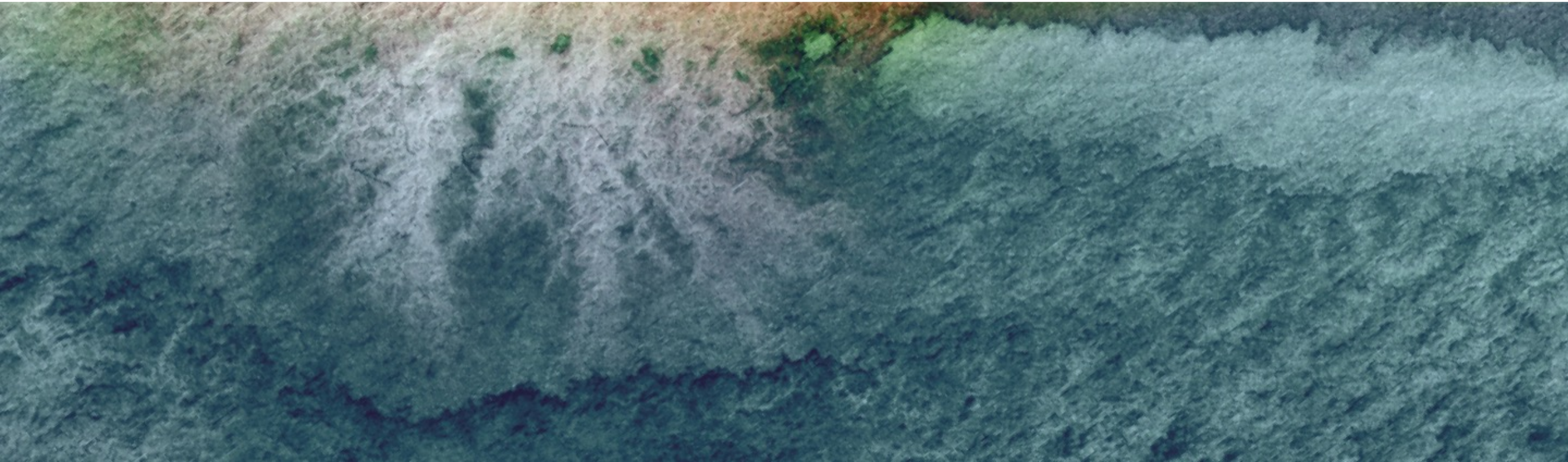
s2gventures

REGENERATIVE AGRICULTURE

Three Trends Enabling the Transition to Regenerative Agriculture



Executive Summary

Healthy soil is the foundation of our food system. 95% of the food we eat is produced directly or indirectly on topsoil, but the soil that remains is increasing degraded. Stemming from an urgent need to manage our soils better, produce more food at less cost, and address climate change mitigation, we see regenerative agriculture as the next frontier, taking a more central role in sustaining agricultural production in the near- and medium-term. Especially in an increasingly volatile world (e.g., inflation, supply disruptions), these practices can achieve not only better environmental outcomes but can help farmers gain better yield and profitability.

Regenerative ag as a term is not well understood today. Rather than viewing the term as marketing jargon, it is helpful to think about regenerative ag as a system of practices, ranging from cover crops, crop rotation, no till, reduced use of synthetic inputs, to integrated crop and livestock systems and managed grazing. Some of these practices are already being implemented to varying degrees across our agricultural system, while others are emerging. It is not an all or nothing approach. To the extent farmers can maximize regenerative practices, our perspective is that the farmers and the land can be better off for it.

In this report, we emphasize three key trends in the industry that are pushing forward regenerative practice adoption: 1) biologicals, 2) carbon / climate-smart commodities, and 3) data and the digital ag revolution. In biologicals, we see fast growth and product iterations, with renewed interest from key agricultural stakeholders considering recent macro shocks. In carbon, there is significant tailwinds to standardize and scale the soil carbon market to incentivize regenerative practices. With digital ag, innovations are building critical infrastructure and technology stacks to enable additional product innovation, tailored regenerative ag advice, and the ability to measure and monitor key outcomes. All three trends work in each others' favor to eliminate frictions for regenerative ag adoption and to advance the next chapter of our food system.

S2G Ventures

Regenerative agriculture includes a system of practices that are beneficial to the environment and to grower yield / profitability

The term “regenerative ag” is not well understood. We believe defining regenerative ag in terms of a system of practices can increase specificity, openness and adoption.

No Till

Minimization of soil disturbance. Enriches soil biodiversity and maintains soil carbon.

Cover Crops

Use of plants to cover a field in the off season. Manages soil erosion, enriches soil biodiversity and maintains nutrients.

Managed Grazing

Use of grazing animals on farmland or pasture. Improves soil health, carbon sequestration and soil water retention.

Crop Rotation

Growth of different crops each season on the same plot of land. Improves soil health through enriching biodiversity.

Integrated Crop & Livestock Systems

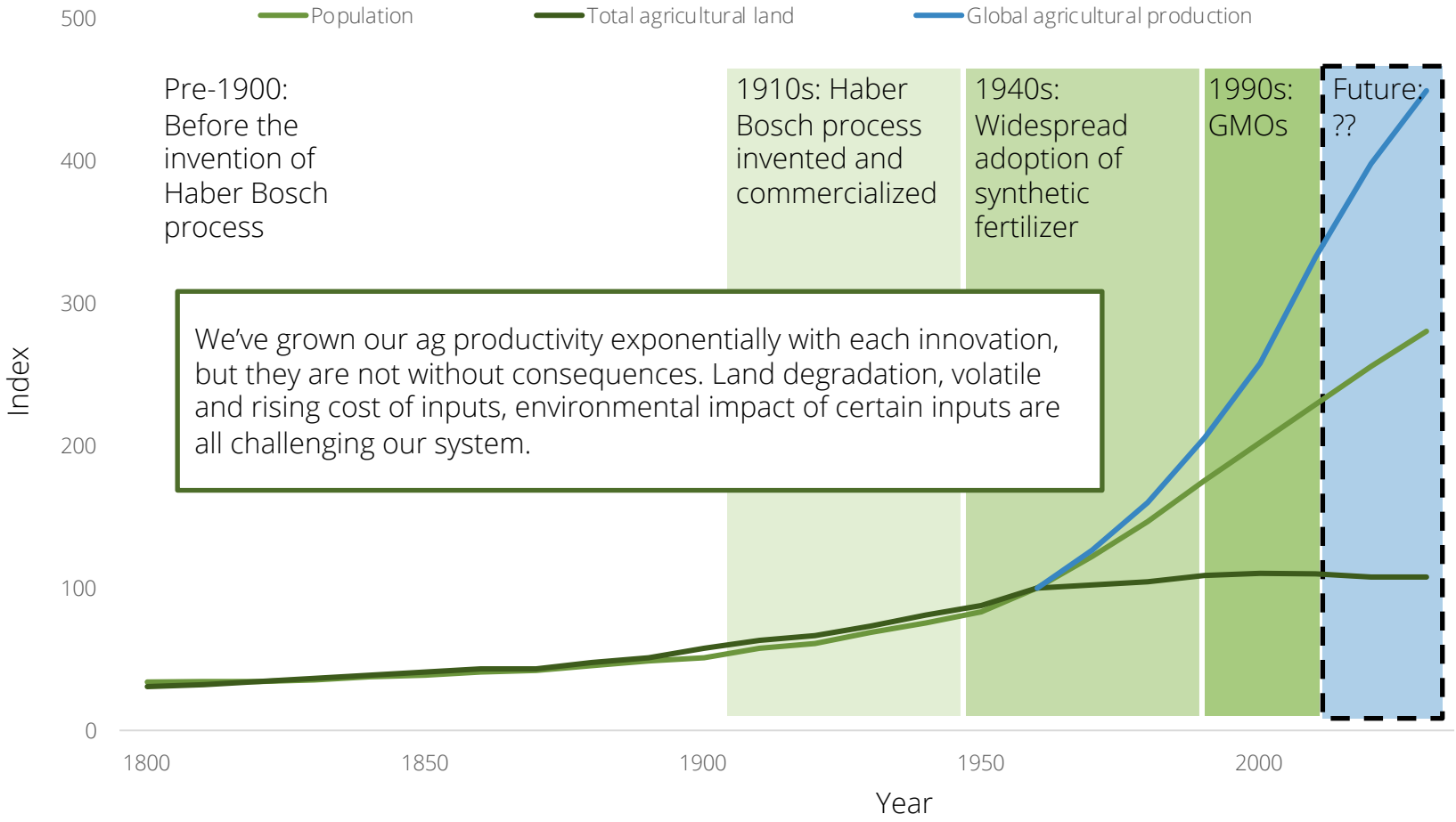
Use of crops and animals in tandem to create a closed loop farming system. Increases soil health through enriching biodiversity.

Precise Input Application

Less addition of synthetic fertilizers and synthetic crop protection products, or use of other products that can improve soil health and carbon sequestration (e.g., use of compost on fields to increase soil nutrients).

Defining trend in agriculture will need to be regenerative

Evolution of the agricultural system, 1800-present day



The Imperative

- The current agricultural system is vulnerable to macro and environmental shocks.

  We will need to feed more people with less land and less environmental impact. We need to decarbonize and help farmers stay financially healthy.

- **The answer lies with soil.** We need to transition ag by increasing productivity per acre (soil) while improving performance of our inputs.

Regenerative ag helps improve soil health.
Soil is the most important operating system the world has known

Healthy soil is the foundation of our food system

95% food

is produced directly or indirectly on topsoil

60 years

before we run out of topsoil due to land degradation

30,000 taxa

of microbes in the soil that determine soil health, but the how remains a black box

500 years

for healthy topsoil to replenish

Regenerative practice help with increased soil health: increasing soil organic carbon concentration, carbon mineralization potential, and increasing aggregate stability.

Understanding soil can help us unlock key outcomes

- **$80bn** fertilizer savings

  if we minimize inefficient use of fertilizer

- **10%** of GHG

  emissions sequestered in soil

- **20pt** increase in biologicals

  performance possible, on par with synthetics

- **1%** increase in organic matter

  can store the amount of water that flows over Niagara Falls in 150 days

Sources: Soil Health Institute

Regenerative ag is increasingly impactful amidst macro shocks

Example: Nitrogen Fertilizer

Increasing LNG Prices

European and global dependence on Russian natural gas driving volatility in natural gas prices, which are highly correlated with fertilizer prices

Up to 80%

Of nitrogen fertilizer costs are driven by natural gas inputs

Higher Fertilizer Prices

Fertilizer prices have risen dramatically since the COVID-19 pandemic and the War in Ukraine; while off highs, significant volatility remains

+200%

Increase in fertilizer prices since 2020

Decreased Nitrogen Use

Rising input costs have caused farmers to consider planting decisions in 2022 – notably, input usage decisions and planting mix.

High fertilizer cost and limited supply leads to more selective application.

Decreased yields

Fertilizer prices have risen dramatically since the COVID-19 pandemic and the War in Ukraine; while off highs, significant volatility remains

-40%

Estimated decline in average US corn yields if nitrogen fertilizer is not used

Regenerative ag practices reduce risk of volatile ag input prices and dependency on synthetic fertilizer usage – ultimately improving yield consistency and reducing associated input cost

Sources: Understanding Fertilizer and Its Essential Role in High-Yielding Crops | Mosaic Crop Nutrition ; Fertilizer Prices Spike Again As Russia Cuts Natural Gas Supply (forbes.com); Fertilizers Price Index (ycharts.com)

Three major trends will shape the future of regenerative ag

1 Biologicals

Innovating on what farmers use on their fields

Innovation in soil environment and plant data allows farmers to place inputs with more confidence on their specific fields. Goal is to help farmers reduce synthetic input use and transition from synthetics to biological inputs over time, without impacting yield or productivity

2 Carbon / Climate Smart Commodities

Incentivizing regenerative practices through measurement

Standardization and policy support for carbon markets will allow a system of financing climate-smart agricultural practices. This climate- and policy-driven push encourages enabling technologies to increase robustness of emissions measurement and monitoring, with potential to capture additional environmental co-benefits

3 Digital Ag

Enabling successful regen ag transitions across the board

The agricultural industry is amidst a critical transition from data poor to data rich. Digitalization of ag allows farmers and the ag value chain to make system-wide change, including increasing efficiency and improving traceability, decision-making, and connectivity

S2G Ventures

Biologicals

Biologicals: Strong case for ag industry players to switch from chemically formulated synthetics to biological inputs

Demand

Changing Consumer Preferences

$50B

in US organic food sales in 2019, up 4.6% from 2018. 15% of all US fruit and vegetable sales are organic, having doubled in 10 years

Strong ESG Push

22+

food and CPG companies have made regenerative agriculture commitments (see details in appendix)

Input Costs

Better Farmer Economics

300%

increase in fertilizer prices since early 2021 in select locations. On average, various forms of chemical fertilizers have increased 40-150% from last year

Skirts Pesticide Resistance

800+

unique cases of pest species and fungi disease resistant to pesticides worldwide. Farmers lose yield and spending on chemical input

Product Quality

Increased Crop Performance

Better

at managing abiotic stress (e.g., heat, drought); better taste and product quality

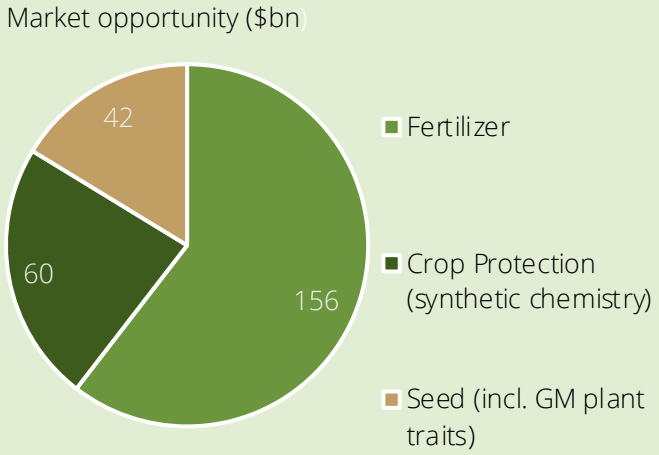
Better Soil Microbiomes

33%

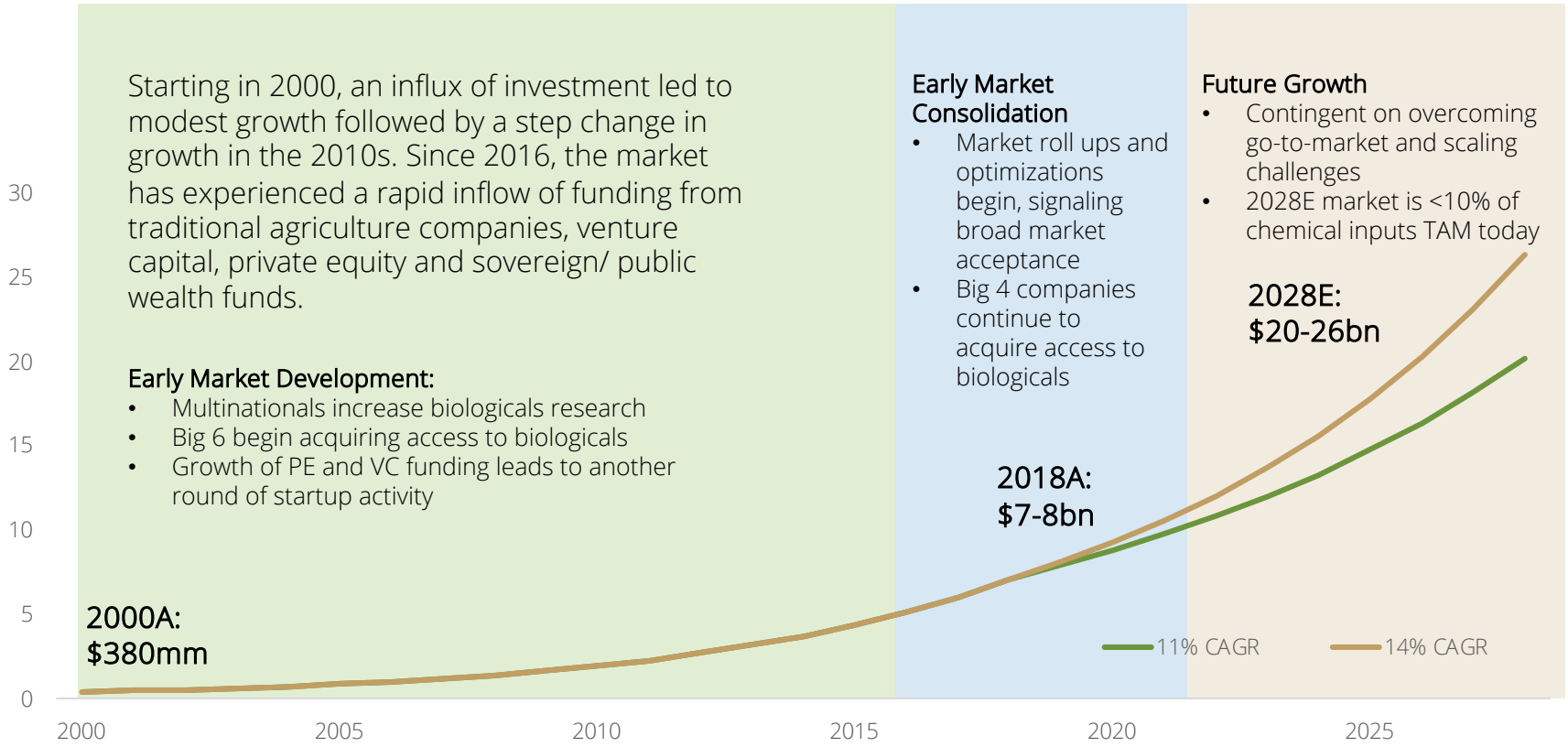
of Earth's soils are already degraded, with equivalent of one soccer pitch of soil eroded every 5 seconds

Tailwinds point to significant market potential, but more needs to be done to scale product efficacy

Combined Market Opportunity Available for Disruption:
$250bn+ in 2019 TAM



Biologicals Market Evolution



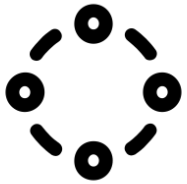
Source(s): The Context Network, company investor presentations

Projected CAGR between 2018-2028

A systems approach is needed to scale biologicals

Farmers want a product that works 90-95% of the time.

Product companies & downstream players will likely benefit from full tech stack to create the data for (i) sales/marketing of biologicals and (ii) improve profitability of regen practices including biologicals.



Systems Approach		Components
A GTM/ scalability	Fill the production gaps in a sustainable farming system with credible information and digitize as much as you can	▪ Measure & model ▪ Third party validation ▪ Direct to decision maker connectivity
B Tech stack	Provide product companies a compelling tech stack system	▪ Re-define performance beyond yield (carbon sequestration, bio-diversity, water management, soil health, production resiliency) ▪ Integration of above and below ground data layers to provide actionable information that makes decisions easier with performance assurances ▪ Combine current production tools with new tech to make more sustainable systems

S2G Ventures

Innovation Spotlight: GreenLight Biosciences

Agricultural pests are responsible for more than $100 billion in annual global crop loss but traditional pesticides are increasingly falling short of providing reliable solutions. The price volatility of chemical pesticides, growing awareness around their harmful environmental and human health impacts, and the increasing prevalence of pesticide resistance, have made it clear we need alternative crop protection solutions.

Greenlight Biosciences has cracked the code for rapid and affordable RNA production, making it a viable solution for commercial agriculture. The company has developed a cell-free system for the synthesis of biomolecules which can produce quality RNA products that are price competitive with today's chemical pesticides. One of GreenLight's first products, a solution aimed at the Colorado potato beetle which accounts for more than $500 million in annual crop loss worldwide, received validation as a new mode of action by the Insecticide Resistance Action Committee. In recent months, the company has demonstrated first-of-a-kind field control of fungal pathogens, progressed work to develop RNA seed treatments, and conducted trials of their proprietary pollinator solution to protect honeybees that showed control of varroa destructor mite.

By making RNA production flexible, scalable, and cost efficient, GreenLight is unlocking the potential of these molecules to improve crop protection outcomes.

S2G Ventures

Carbon

S2G Ventures

Carbon:

We believe the industry will evolve to a **Carbon Plus** approach

Carbon markets can support regenerative ag practices and incentivize more widespread adoption

What's good for carbon offset projects...

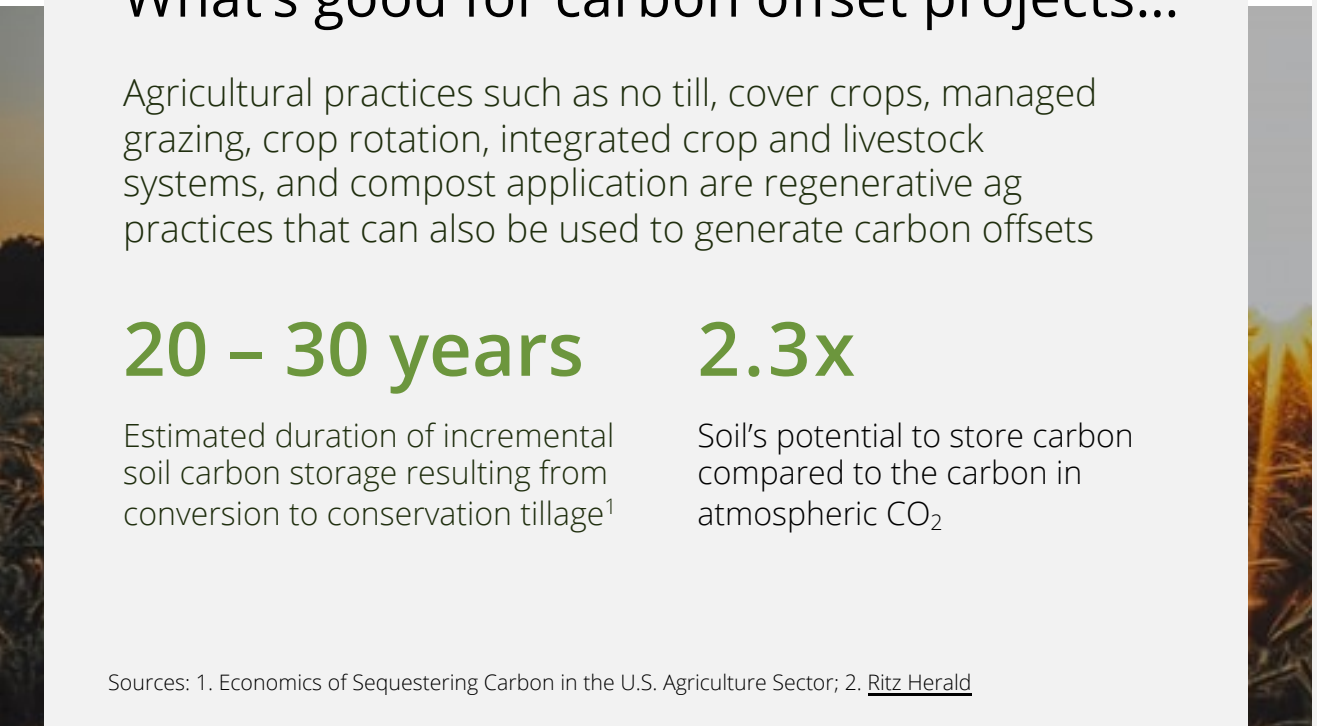
Agricultural practices such as no till, cover crops, managed grazing, crop rotation, integrated crop and livestock systems, and compost application are regenerative ag practices that can also be used to generate carbon offsets

20 – 30 years

Estimated duration of incremental soil carbon storage resulting from conversion to conservation tillage[1]

2.3x

Soil's potential to store carbon compared to the carbon in atmospheric CO_2



...is also good for the agrifood system

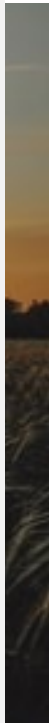
Food production practices that are carbon-smart and regenerative offer economic and environmental co-benefits for upstream participants (e.g., farmers and ranchers) and downstream players (e.g., CPGs).

Target input application

Targeted input application can save money and reducing environmental impacts

Improved soil health

Soil carbon sequestration helps restore degraded soils, which can improve agricultural productivity.



Sources: 1. Economics of Sequestering Carbon in the U.S. Agriculture Sector; 2. Ritz Herald

S2G Ventures

To ensure carbon market momentum, we will need to build a scalable, standardized system that address the following barriers

For agriculture to play a meaningful role in carbon sequestration, each of these friction points must be mitigated.

POLICY

- Potential for policy incentives and clear regulatory parameters

SUPPLY CHAIN INFRUSTRUCTURE

- Resilient value chain infrastructure for regenerative farms

MARKET DIFFERENTIATION

- Need for market differentiation for regeneratively produced products

DATA

- Need for farm management and biophysical data, as well as the lack of appropriately calibrated financial models for regenerative practices

FINANCING

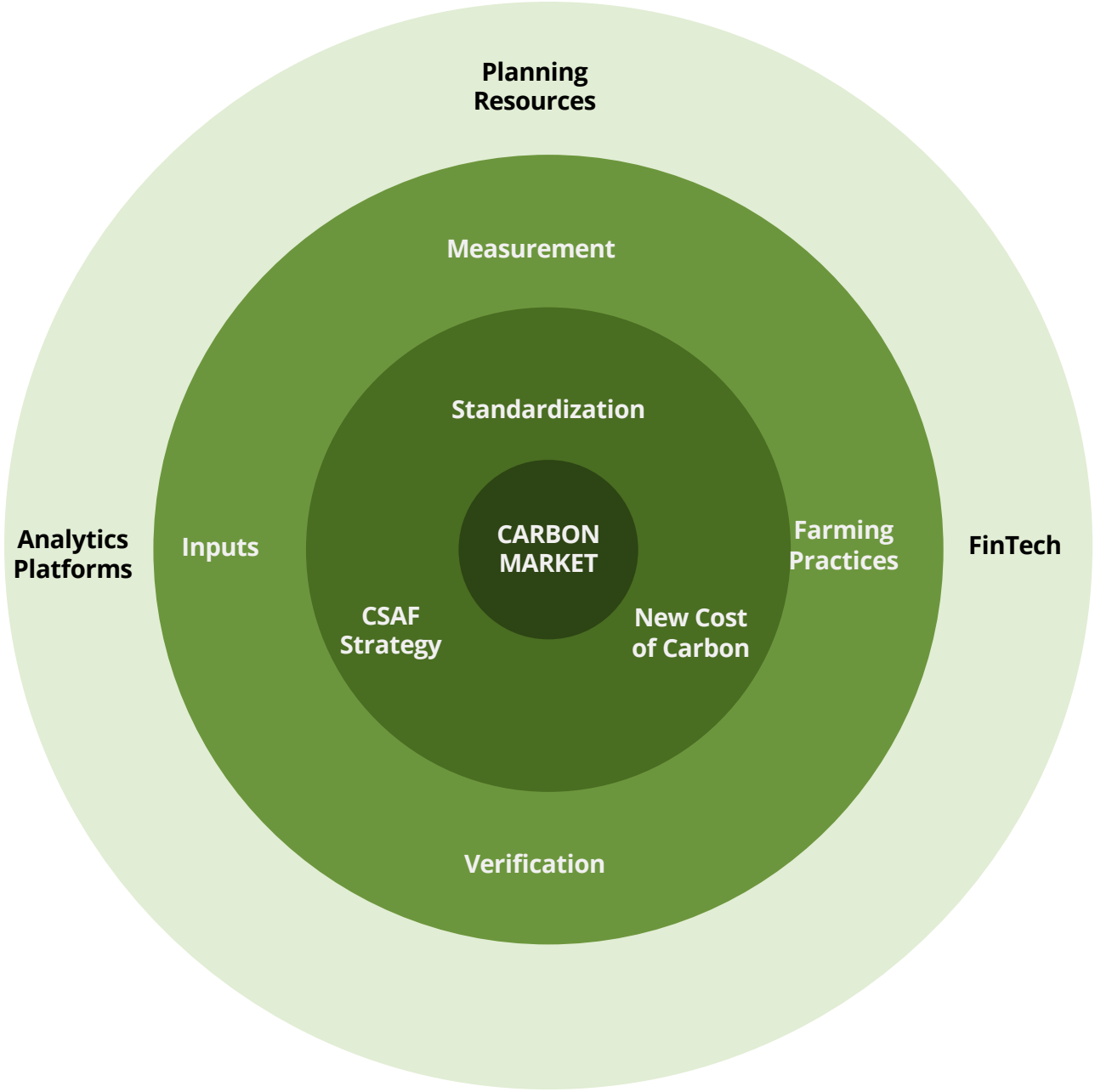
- Need for flexible financing instruments to support regenerative conversions

INFORMATION DIFFUSION

- Need for appropriate channels for the diffusion and distribution of data, financing alternatives and market opportunities for regenerative farmers and products inhibit the formation of catalyzing partnerships

We have a multilayered view of carbon market catalysts

Carbon market scale is anchored by efforts to build standards and infrastructure around regenerative ag. Efficacy and adoption is then driven by technology that can cultivate, measure, and verify regenerative ag practices.



Note: CSAF stands for climate-smart agriculture and forestry and refers to USDA's May 2021 strategy and subsequent actions to improve market adoption and standardization of these practices.

Capital is needed in these areas to enable widespread adoption

These layers are developing in tandem, however, each step is necessary for the foundation and success of the next step.

LAYER 1 Validation and Measurement

- **Policy/ Market Driver:** Soil positioned as the "next frontier for storing carbon. Growing climate solutions
- This phase will lay the foundation for soil carbon sequestration. Carbon cannot be touted as meaningfully beneficial or viably traded without measurement and validation.
- **Emerging technologies:** Ground truth measurement tools (sensors, satellites, etc.), modeling prediction and estimation digital tools

LAYER 2 Tracking and Monitoring

- **Policy/ Market Driver:** Climate Smart Agriculture and Forestry Strategy prioritization of quantifying, tracking and reporting climate smart activities.
- Tracking and monitoring will be vital to validation over time, and key to ensuring that sequestration has a degree of permanence.
- **Emerging technologies:** Digital monitoring platforms, field data aggregation tools

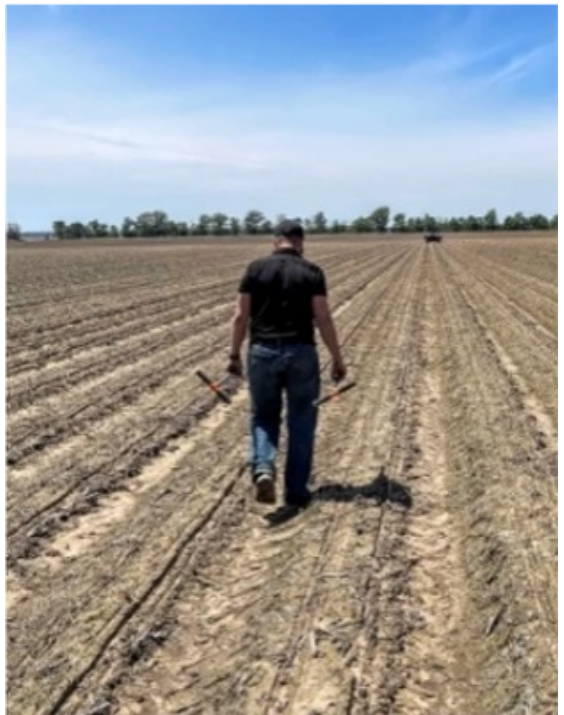
LAYER 3 Supportive Technologies

- **Policy/ Market Driver:** Anticipation of an appropriate cost of carbon that offers meaningful ROI for farmers against the rising costs of conventional inputs.
- Scalable and robust marketplaces are enabled by layers 1 and 2, complemented by tools and financing to support these practices coming to market.
- **Emerging technologies:** Inputs and equipment, fintech platforms

Innovation Spotlight: EarthOptics

There is a lot of data that would be immensely helpful for farmers to help prevent soil degradation. However the only way to get an accurate measurement for soil properties is to stick a probe in the ground and send the sample to a lab to be analyzed. But soils are incredibly variable and within a field one soil sample can have completely different microbiome characteristics and even soil type than a sample 30 feet away. Collecting soil samples and having them analyzed is costly so getting a dense rich map over hundreds or thousands of acres would be impractical for most agriculture applications.

It is this challenge that EarthOptics has set out to solve. Instead of completely eliminating soil samples, they take a few soil samples and treat them as training data for a machine learning platform to interpret measurements coming from vehicle or tractor based sensors and other satellite data sets. The result is a low cost, very detailed map that's feasible to create over thousands of acres.



S2G Ventures

Digital Agriculture

Digital Ag: The digitization of food & ag can accelerate carbon neutrality, food system traceability, and agtech adoption

ENABLING A CARBON NEUTRAL / NEGATIVE FOOD SYSTEM

25-30%

of total greenhouse gas emissions are generated by food systems

.45 gt / year

decrease in global GHG emissions (1.2%) could result from a 30% increase in crop input efficiency

$50B

projected demand for carbon credits by 2020

UNLOCKING TRACEABILITY ACROSS THE VALUE CHAIN

75%

of consumers say that they would switch to a brand that provides more in-depth product information beyond what's provided on the label

1 IN 6

Americans get sick and 3,000 die from foodborne illnesses annually

$18B

Expected food traceability market size by 2024

ACCELERATING AGTECH ADOPTION

>$700B

US agriculture market

8%

Ag Input online penetration, compared to 60% for Media and 23% for Apparel

100X

Fall in cost of visual sensors in the last 10 years, while increasing in resolution 100x

Digitalization is the next frontier for regenerative ag

Development of scalable and accurate measurement and tracking tools that quantify cross-value chain benefits of carbon-reducing and -sequestering activity can help derive environmental and economic value for multiple stakeholders, from farmers to CPG companies.

At a moment where the agricultural industry is amidst a critical transition from data poor to data rich, technology and innovation around carbon represents an exciting, and valuable, whitespace.

THE ROLE OF DIGITIZATION

Increased digitalization of historically physical industries is contributing to decarbonization and greater food system efficiency. The ability for platforms to collect more and better data on the agriculture industry, supply chain & logistics, and consumer-facing food companies can contribute to carbon market efficacy and better food production decision making.

>1.5mm

Estimated average daily datapoints generated by the average farm per day by 2030[1]

$18.2bn

2021 global upstream agtech investment by category (33% YoY increase)[2]

DRIVING FOOD & AG ROI

Better use of data can highlight inefficiencies from food production to final sale. These insights can not only reduce carbon emissions but also minimize waste and increase food company profits.

>50%

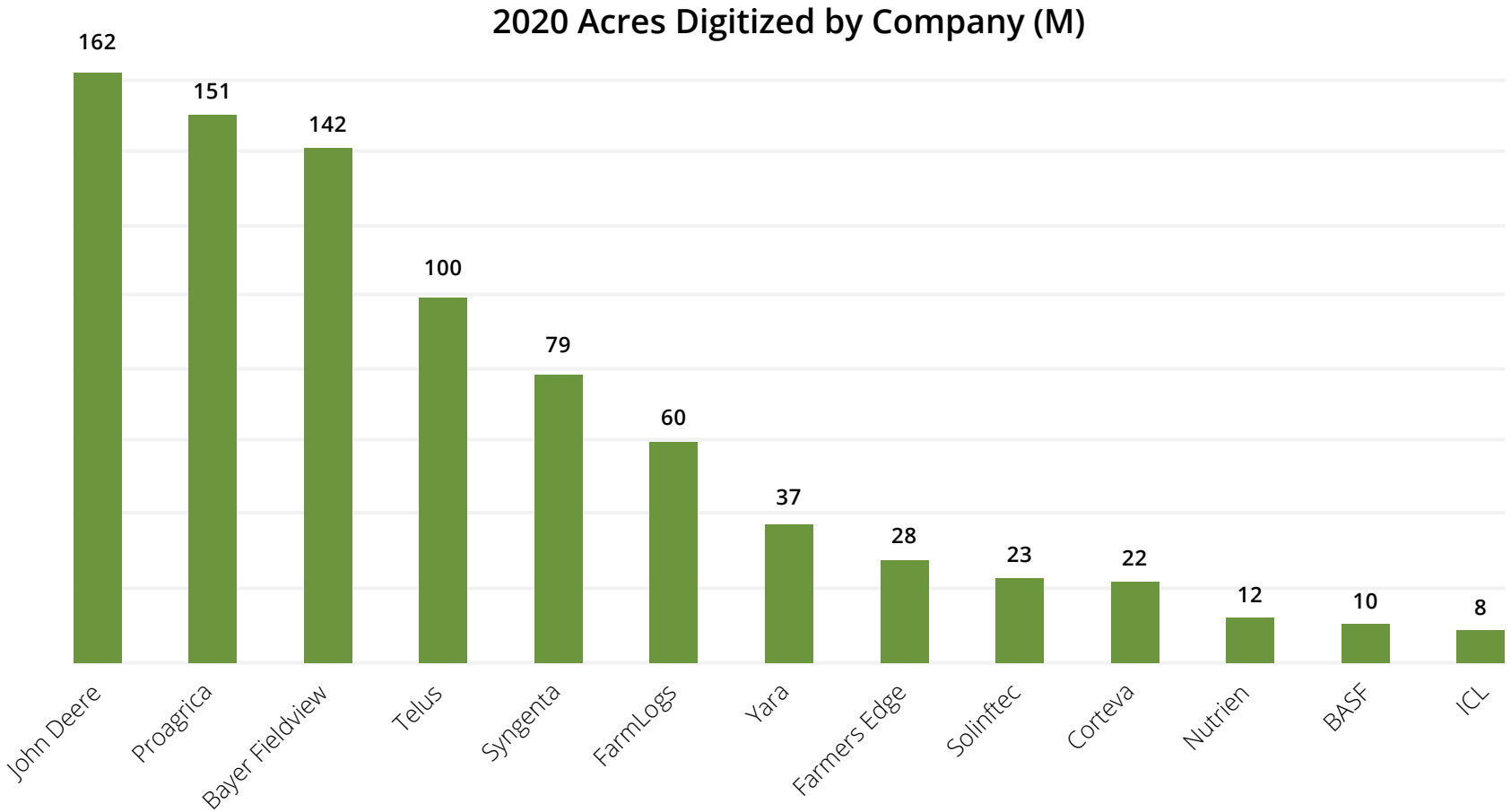
Of surveyed consumers are willing to change their eating habits to help reduce negative environmental impact[3]

73%

Of Millennials are willing to pay more for a transparent product[4]

Sources: 1. The Context Network; 2. AgFunder; 3. National Retail Federation; 4. based on a Label Insight study

Past five years have seen significant acres digitized, allowing for a connected and scaled agtech industry



Farm equipment companies like John Deere have established a relatively large presence and will continue to play a key role in digitization.

There is clear differentiation across traditional ag input companies in terms of acres digitized successfully.

Several disruptive companies such as Proagrica and Telus are becoming key players in the sector, achieving significantly more digitized acres than some traditional ag input companies.

While digitized data is a critical factor, it does not guarantee success; companies must have a product that the market demands and a clear path to monetization.

Source: Context Expert Analysis based on investment reports, company sites, press releases, etc.Non-exhaustive. Not all companies included

Ag financing: A data-rich ag ecosystem allows fintech to transform opportunities in agriculture

Moving away from data-poor, risk averse financing allows farmers to be supported in the transition to regenerative practices

Current State

- Operating/input loans for farmers using traditional agricultural practices are typically 1-year loans and take a short-term view
- These loans are backstopped by land and crop insurance, but certain stipulations mean farmers are not incentivized to experiment with sustainability practices
- Non-digital lending results in poor data landscape when it comes to understanding and backing regenerative practices
- It's more expensive to farm regeneratively. However, the market lacks price premiums today, making easy of financing and creative financing a necessity

Opportunities

- Longer term loans for regenerative agriculture inputs/practices and for organic transition and structured credit enhancement mechanisms through warranties are some of the tools available to finance the transition
- These require financiers to leverage data rich and digital lending environment to more precisely assess risk for each farmer
- Digital ag allows for the introduction of new fintech products and risk management solutions for growers
- Warranty products provide acceleration of new technology development and adoption, while improving on-farm income for growers

Digital ag is building the underlying infrastructure to enable the regenerative ag transition

While standalone services are expected to decline, several of these technologies – imagery, sensors, recognition applications – remain key enablers to final solutions and actionable insights.

Promising Sectors

Decision Ag
Technologies capitalizing on the increasing volume of available data captured from sensors and other tech combined with advancements in machine learning and AI to deliver actionable insights to growers

Operational Efficiency
Technologies including automation and robotics that allow producers to run operations more efficiently and overcome any risks associated with labor availability

Input Management (Systems Approach)
Technologies focused on improving farmer ROI and the environment by enabling precision applications of crop protection, fertilizer and other inputs

Connecting Growers to End-Users
Technologies that enable consumers to know where and how their food was grown/raised will continue in prevalence

Innovations in this space establish a technology stack that can both inform regenerative practices (e.g., crop planning, input applications, testing of effective products) and help measure outcomes of these practices on yield, soil health, and carbon.

Declining Sectors

Data Collection Lacking Insights
Services and technologies that require farmers to interpret the data themselves or do not provide clear next steps will likely fade or be bought by an integrator that can provide actionable insights based on the data

Standalone Visualization
Satellite and drone imagery, as well as sensor data, as a standalone service is expected to decline unless the technology moves beyond “pretty pictures” and into actionable intelligence

Independent/Unconnected Solutions
Platforms and products that are not easy for the farmer to implement, are data entry intensive, and do not connect to other aspects of the farm

S2G Ventures

Innovation Spotlight: Arable

With increased resource scarcity, extreme weather events, and growing consumer demand for supply chain transparency, abundant and high-quality agricultural data is more important than ever. Arable has developed an integrated hardware, agronomic modeling, and software suite that enables stakeholders across the food supply chain to understand the full agricultural system at the plant, field, and regional level.

The Arable Mark 2 collects granular data from the field on more than 40 weather, soil and crop measurements and transmits it in real-time. Arable's platform then synthesizes this data into actionable insights and alerts that are easily accessible to farmers through a website or mobile app.

One of the major benefits that farmers see from using the platform is the ability to reduce input use, thereby saving money and improving environmental outcomes. Arable's technology has enabled farmers to reduce pesticide use by 15 percent and helped customers reduce irrigation by 50 percent without sacrificing yields or quality. By providing farmers with the premium data and actionable insights they need, Arable is making farming operations more profitable, sustainable and resilient.

Meet S2G Ventures

As the direct investing team of Builders Vision, an impact platform dedicated to building a more humane and healthy planet, we are guided by the belief markets can and should benefit society and the environment.

S2G Ventures invests in solutions to some of the world's greatest challenges across the food, agriculture, oceans, and clean energy markets. We provide capital, mentorship, and value-added resources to entrepreneurs pursuing innovative market-based solutions that generate positive social, environmental, and financial returns.

Cristina Rohr
Managing Director,
Food and Agriculture

Jinchen Zou
Associate,
Food and Agriculture

S2G Ventures

Connect with us

We want to work with you. Implementing more sustainable technologies and business models we're working toward healthier people and a healthier planet driven by healthier ocean, food and energy systems.

We hope you'll join us.


s2gventures