

Sustainable Agriculture: From Tech Solutions to Ecosystem

Empowering AgriTech companies to evolve from suppliers of specialized solutions into pioneers of borderless ecosystems.



intellias



A guide for AgriTech innovators, big and small, on how to combine discrete agricultural technologies into borderless ecosystems to solve the most challenging tasks farmers are facing today: feeding the growing global population, mitigating the effects of climate change, and implementing sustainable agricultural practices for business growth



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Summary

The seeds of change are vigorously sprouting, and farmers are seeking greater yields.

That's exactly where the agriculture industry is at right now. A growing population is demanding more food, but resources are running out. Meanwhile, climate changes are affecting agriculture in irreversible ways. Many breakthrough solutions are around the corner, but few farmers are prepared to adopt them to respond to global challenges.

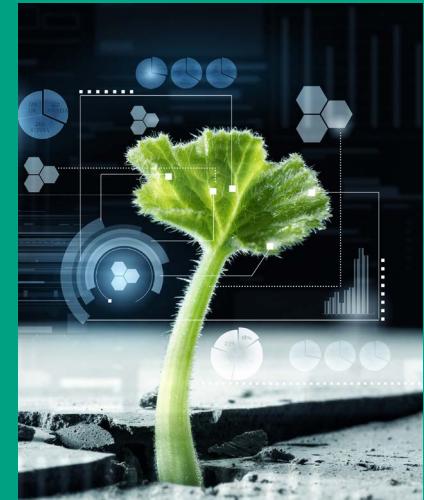
AgriTech enterprises and startups have been doing titanic work to tailor technologies to farmers' needs. But farmers are still waiting for the next big leap to remove borders between these discrete technologies. In the meantime, they're getting along with a hodge-podge of specialized solutions.

This research is focused on advanced digital technologies designed specifically for the agriculture industry as well as on technologies adopted from other industries undergoing digital transformation.

The main question is how to fuse discrete agricultural technologies into one sustainable ecosystem to improve the efficiency and profitability of agribusinesses while mitigating global challenges.

With a borderless ecosystem, agriculture technology companies can provide farmers with the right combination of solutions to produce more food while consuming fewer natural resources.

After reaping the benefits of these ecosystems, farmers will spend less time planning the path for the harvester and more time focusing on the path toward sustainable agriculture and profits.



*What keeps farmers from more sustainable production?
41.3% of respondents pointed to the lack of knowledge about actions and measures that can be taken to become more sustainable.*

**Sustainability Survey
by Syngenta**



How agriculture has been evolving throughout history

Look back to see what lies ahead.

The legacy of the agriculture industry stretches back to the dawn of time. Throughout the centuries, agriculture has undergone many technological transformations. Some were revolutionary. The two most prominent technologies that brought farmers to the next level of productivity were agricultural machinery and genetically modified organisms (GMOs).

Since the introduction of GMOs, agriculture has not been very amenable to innovation. That is, until the recent millennium, when digital technologies are changing the world almost overnight. This digital revolution has come to agriculture as well, promising to save farmers from the severe challenges imposed by a changing climate and a growing population.



Three main technological revolutions in agriculture



Agricultural machinery revolution

First machines in the late 19th century; early adoption between 1900 and 1930

1900

1 farmer feeds 26 people



1950

1 farmer feeds 155 people



2000

By 2050, 1 farmer will feed 265 people

2050



Types of agricultural machinery

- Tractors
- Soil cultivation machinery
- Planting, seeding, fertilizing, and irrigation machinery
- Harvesting, haymaking, and post-harvest machinery
- Milking machinery
- Grinder mixers, wool presses, and windmills

Commonly modified products

- Alfalfa
- Canola
- Cotton
- Corn
- Soybeans
- Eggplant
- Carnations
- Potatoes
- Roses
- Squash
- Sugar cane
- Tobacco
- Rice
- Tomatoes
- Apples

Digital agriculture technologies

- Big data analytics
- AI and machine learning
- Cloud computing
- Blockchain and DLT
- IoT and connected sensors
- Weather monitoring
- Guidance, mapping, and location technologies (GIS, GPS, GNSS, RFID)
- Satellite and drone imagery
- Automated machinery and robotics

Prominent leaders



Prominent leaders

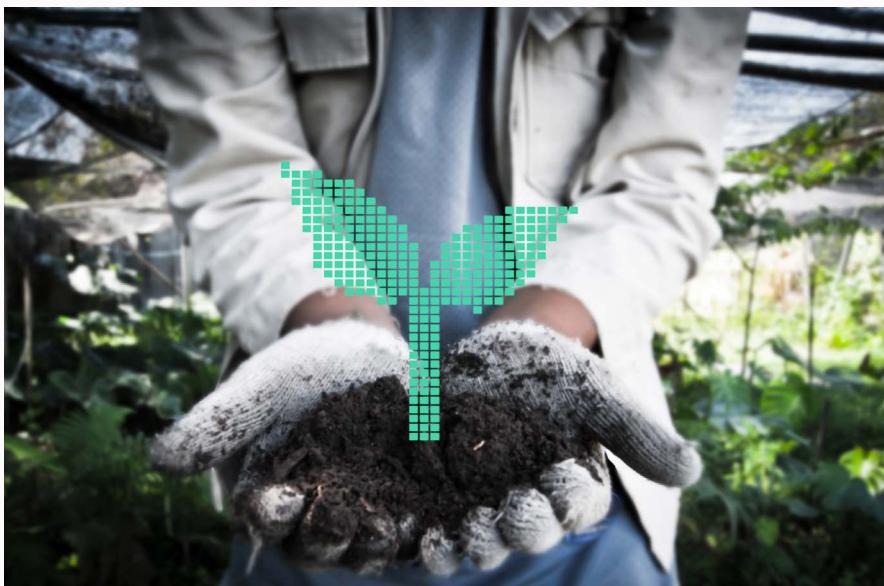


Prominent leaders



What drives the need for innovations in agriculture today?

Global challenges are the prime reason to innovate.



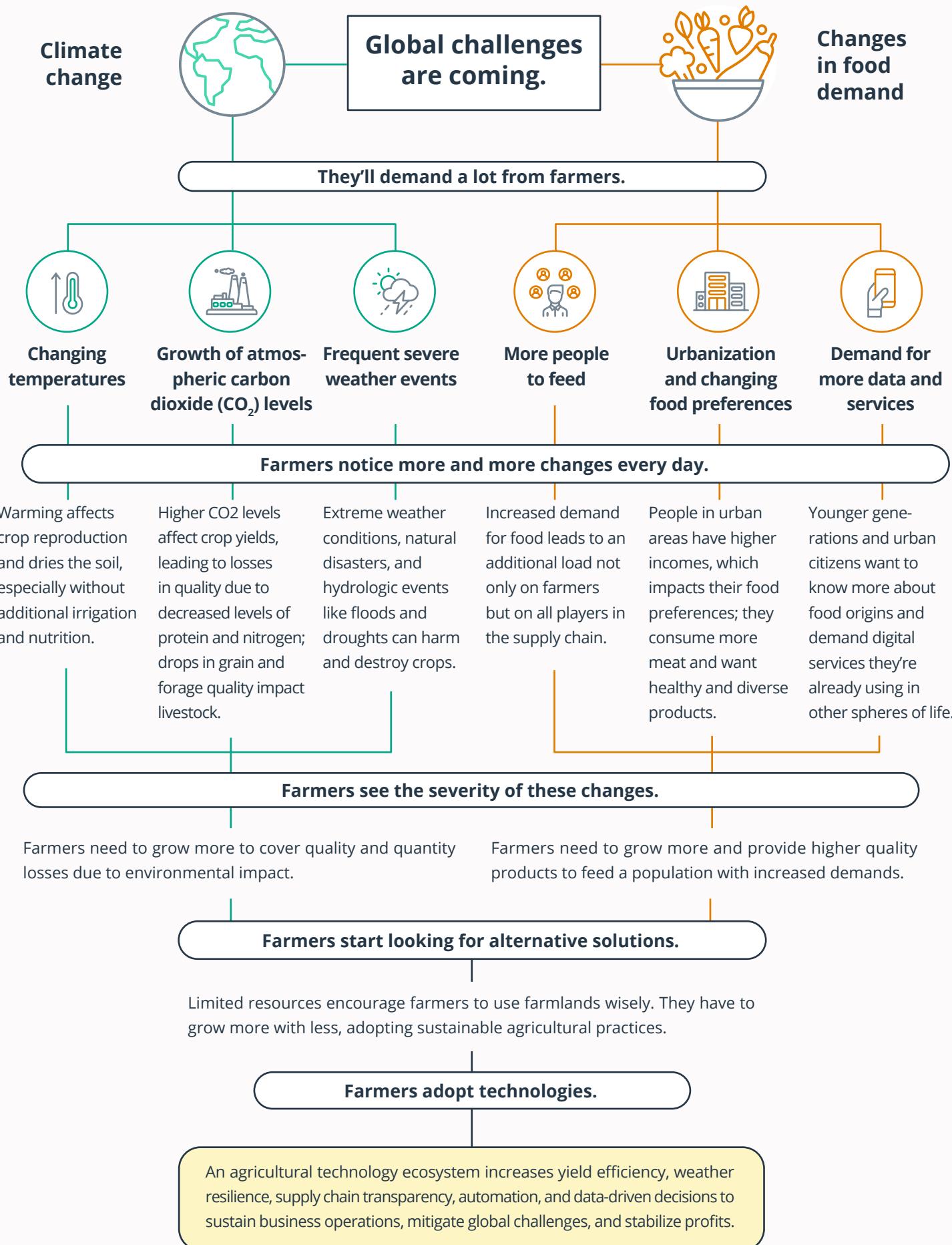
Global challenges like climate change and a growing demand for food are affecting agriculture like never before. Additional factors accelerating innovation are the food preferences of younger generations, revolutionary technologies, the rerouting of supply chains, and a flow of venture capital investment into disruptive AgriTech startups that are nurturing the seeds of change in this industry. Agriculture is shifting from an old-fashioned family business to smart farms.

Agriculture technology companies should note these tremendous changes as the core motivation for farmers to adopt digital technology. As it turns out, the most severe challenges bring the greatest opportunities for innovation in agriculture.

"We're going to have to figure out how to grow a lot more food on a lot less land and do it sustainably. This is something we need to do over the next 5, 10, 15 years as we see the challenges we're going to be facing in order to feed a planet that's going to be much more populated, probably a lot drier, and certainly a lot hungrier."

Michael Stern,
CEO of The Climate
Corporation

Two main global challenges driving the need for agricultural technologies



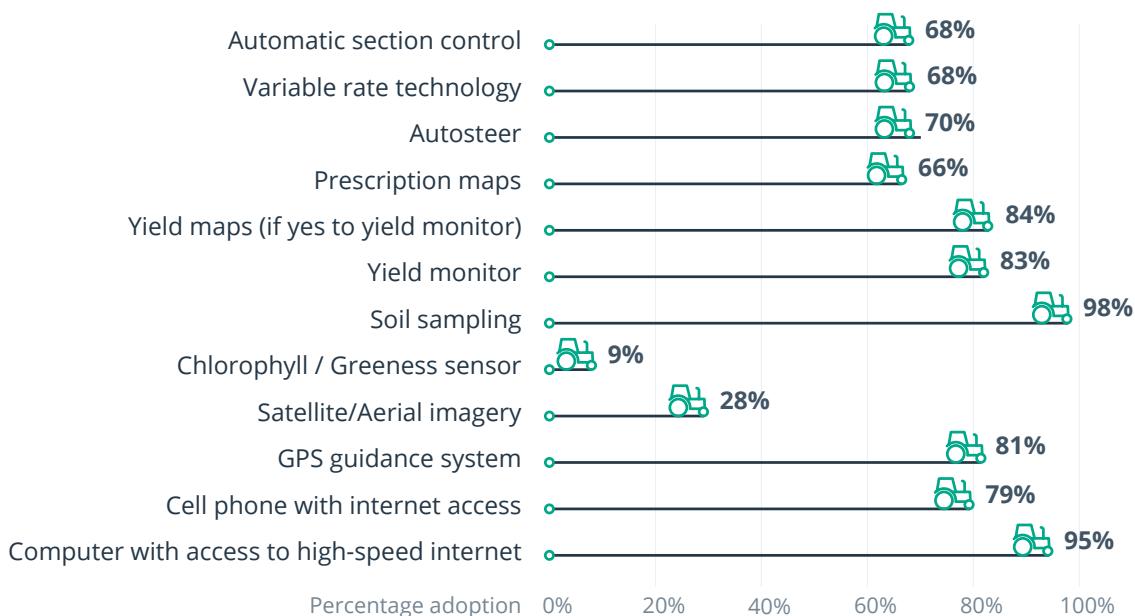
Technologies are already within farmers' grasp

Farmers are adopting technologies grain by grain.

Each technology helps solve a particular problem. AgriTech companies are succeeding in targeting their solutions to the unique needs of customers. But a cohesive ecosystem of technologies is called for to assist agribusinesses in responding to much bigger problems while sustainably growing profits. At the end of the day, digital technologies will help farmers and agribusinesses build resilience, scale, and enable sustainable operations.

The benefits of agricultural technologies are indisputable. They improve efficiency, save limited resources, build accurate weather predictions, empower data-rich planning, decrease losses in the quality and quantity of products, increase crop yields, encourage smarter use of fertilizers and pesticides to minimize environmental harm, and provide transparency across the entire supply chain.

Adoption rate of technologies in agriculture



As we can see, farmers are already adopting technologies tailored to their needs. Millennials and Generation Z are going to adopt even more technologies they use in everyday life. However, more traditional farmers are still responsible for the lion's share of the business. They require thorough explanations of the values technology can bring.

Different types of farmers may require different approaches and different technology that's relevant to their needs. But to facilitate sustainable operations, all of these technologies should work together as one ecosystem.

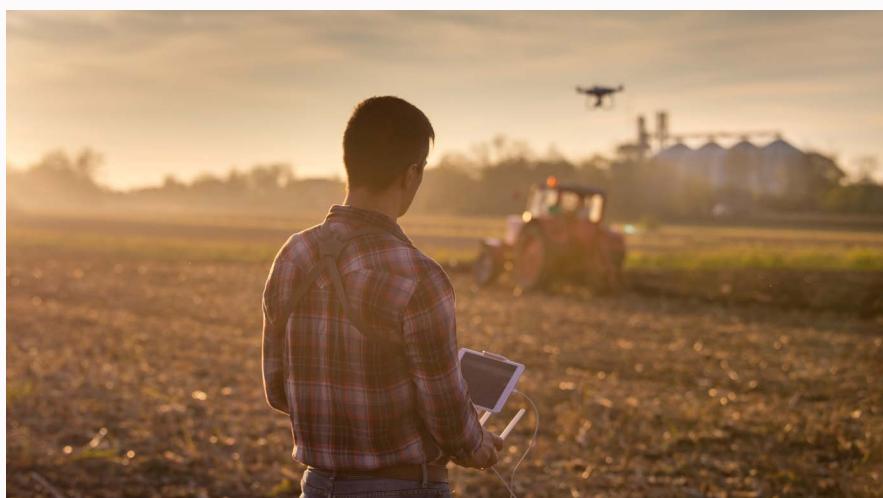
Technology and the plant-based movement are driving change at a pace few anticipated. Gen X and Gen Z consumers are forcing this dramatic shift in our food supply. They demand transparency, convenience and rapid delivery, and have a global mindset and demand products that align with those values."

Michael Bowman,
Co-founder of First Crop



Finding a new way to set up farms with better technologies

Ensure all technologies are relevant to farmers' needs.



Technology companies operating in the agriculture business should put customers at the center of their value propositions. They need to know their customers and find a way to reach them with the right offer not only to solve particular challenges they face today but to educate them on how to scale technology for sustainable business growth and to mitigate global changes lurking around the corner.

Regardless of their age and the size of their farms, farmers are becoming technically fluent. And as soon as farmers achieve measurable success using one solution, they often start looking for a new one. The problem appears when farmers need to learn things from scratch each time they buy new technology from a new provider. After investing money, time, and effort in one technology, farmers may still have doubts about adoption of others.

A borderless ecosystem of solutions built around users' needs offers the choice of what technologies to use and when to add more — all without leaving the ecosystem. As their experience with an ecosystem evolves, farmers can adopt more solutions within that ecosystem, combining them in a perfect mix. This is especially relevant to farmers who are already using solutions from one provider and do not want to switch simply because they don't want to figure out how another system works.



Lifecycle of technology adoption among farmers



"The technology that permeates society today is just beginning to hit farm country. This is going to be the tool that helps us unlock that yield gap."

Michael Stern,
CEO of The Climate
Corporation



Meet your end customers

Regardless of age and acres in use, farmers are bonded to technology.



Catalina

- ⌚ Farming is mission
- ⌚ 35 years
- ⌚ Bachelor's in organic agriculture



- Valencia, California
- 8 fields, 600 acres total
- Tomatoes, beans, peppers, squash, lettuce



- Unstructured data, no automation
- Uses iPhone and iPad

Desires

- Simple solutions to optimize operations
- Transparency in distribution
- Fast and easy event creation
- Sustainable practices to protect the land

Avoids

- Technical details
- Notifications
- Finances

Tech opportunities

- Data collection
- Weather prediction
- Decision-making
- Event visualization
- Sustainable and organic practices

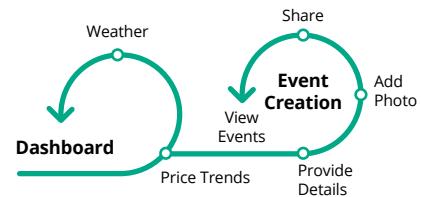
Drivers

- Ease of use
- Relevance to needs
- Sustainability
- Compliance

Constraints

- Learning technology is hard
- Growing business requires more technologies

User flow (Time < 5m/day)



Roy

- ⌚ Farming is life
- ⌚ 63 years old
- ⌚ Basic education



- Ames, Iowa
- 5 farms, 28 fields, 2,400 acres total
- Corn, soy, wheat



- Limited automation, no data
- Uses Windows desktop, sometimes iPad

Desires

- Simplicity
- Legibility
- Scalability

Avoids

- Event tracking
- Notifications
- Uncertain technologies

Tech opportunities

- Data collection
- Reach more customers
- Decision-making
- More automation

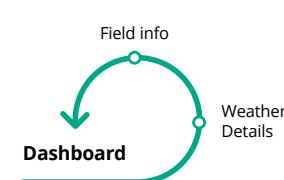
Drivers

- Ease of use
- Recommendations of peers, relatives
- All-in-one solution

Constraints

- No time for learning technology
- No single solution for all needs
- Bound to time-proven habits

User flow (Time < 3m/day)





Bishop

- ⌚ Farming is business
- ⌚ 41 years old
- ⌚ Master's in agronomy



- Chillicothe, Missouri
- 40 farms, 5,000 acres in total
- Corn and soy



- Some automation, lots of data
- Uses iPhone, iPad, and Windows laptop

Desires

- Customizable events
- More field data
- More time for scaling the business

Avoids

- Event tracking
- Technical details
- Additional expenses

Tech opportunities

- Data management
- Visualization
- Field mapping
- Automation

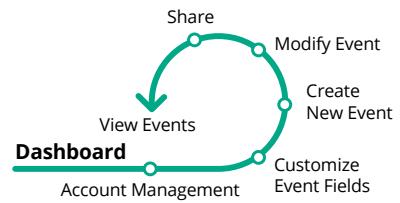
Drivers

- Increased efficiency
- Recommendations of peers
- Profitability

Constraints

- Technologies are expenses
- Limited tech background
- Compliance

User flow



Mike

- ⌚ Farming is fun
- ⌚ 35 years old
- ⌚ Bachelor's in agriculture



- Gretna, Nebraska
- 2 farms, 4 fields, 180 acres in total
- Soy, wheat, hay



- Moderate automation, some data
- Uses iPhone and MacBook

Desires

- Social connectivity
- Advanced technology
- Robotics

Avoids

- Notifications
- Boring routine

Tech opportunities

- Data collection
- Predictive analytics
- Automation

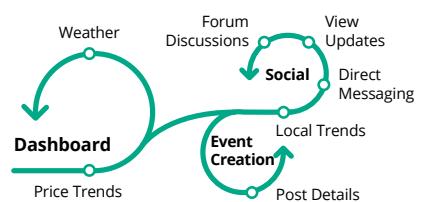
Drivers

- Following trends
- User experience
- Performance
- Recognition

Constraints

- Price of technology
- Possibility to add more features
- Ability to integrate with existing system

User flow





Planting the seeds of change in the minds of AgriTech providers

Farmers' tasks have changed. What about the solutions?

Agricultural technologies promised to give farmers peace of mind. Instead, we now see farmers are overwhelmed with technologies and tons of data they don't know how to apply to meet their core needs. AgriTech providers are adopting best practices from other industries, pushing agribusinesses to the edge.

A farmer's typical day now includes viewing analytical dashboards. Some farmers already know what artificial intelligence means and how to apply it to agriculture in a meaningful way. But often, they can't keep pace with all the startups that are appearing and burning out every day. They stop at a single solution, afraid to go further.

But how about combining several technologies like weather monitoring, smart guidance, and automated harvesting machinery into one ecosystem? That's what would make a difference in the adoption of technologies. It's easier for customers to build on solutions they've already adopted than it is for them to start with something new.

Farmers have to accomplish unique tasks, but all them are influenced by global factors. To face the challenges of a new era, farmers need complex solutions that are accessible much easier. Technology ecosystems can respond to both the unique needs of farmers today and the global challenges of tomorrow.



Tech-enabled actions to mitigate global challenges

Agricultural value chain and resilience practices

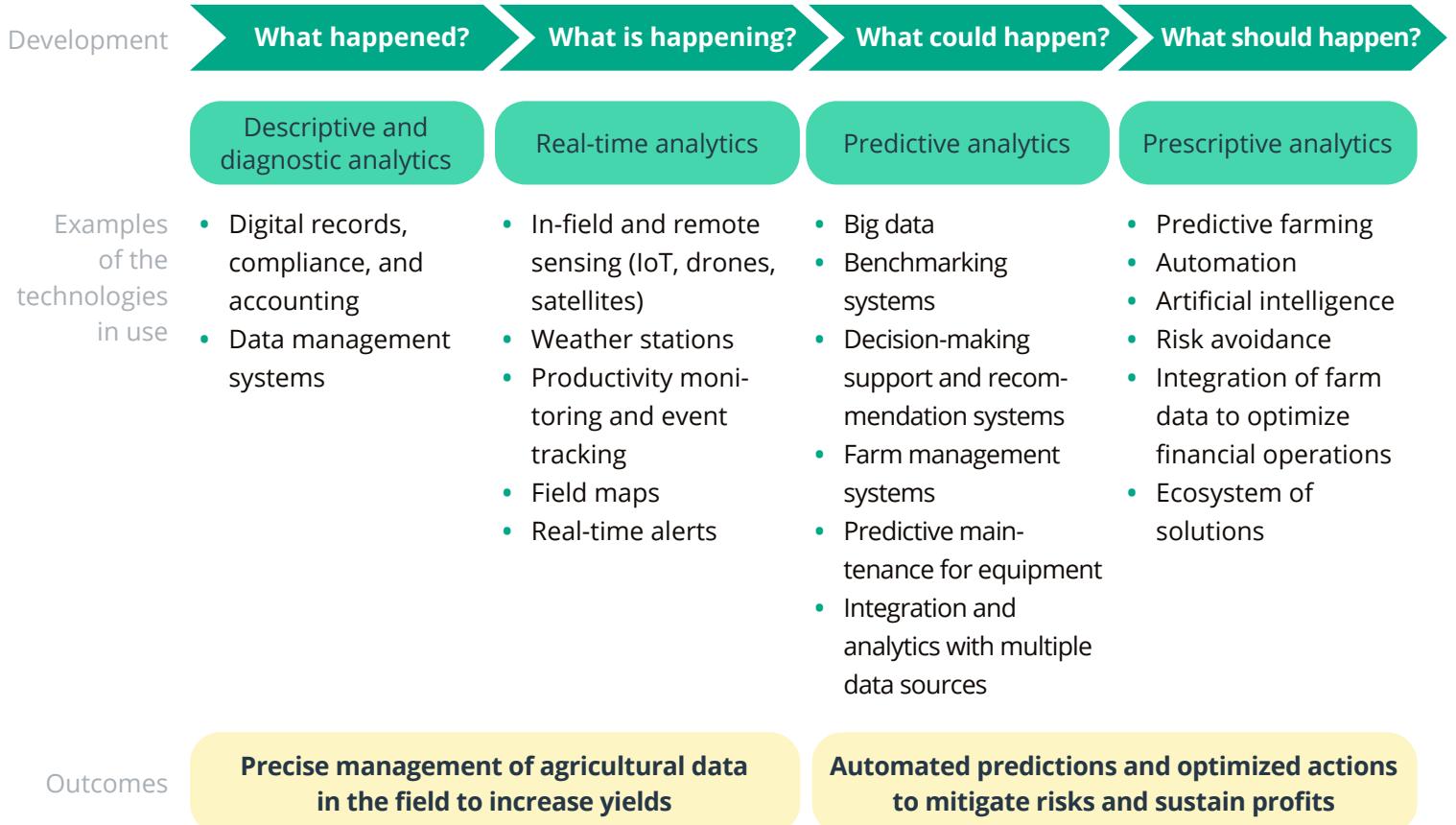
Pre-production	Production	Post-harvest	Marketing	In addition to farming
<ul style="list-style-type: none">Identify risks and protect agricultural assets from actual and projected climate hazardsProvide new approaches to agricultural and natural resource management that are resilient to climate changes	<ul style="list-style-type: none">Improve the quality, quantity, and health of agricultural productsDevelop and apply new ways to use natural resources efficientlyDevise and adopt technologies to reduce the risks of climate change to production through sustainable practices	<ul style="list-style-type: none">Climate-proof agricultural infrastructure and minimize the impact of natural disasters and severe weather conditionsAdjust post-harvesting technologies to upcoming climate realities	<ul style="list-style-type: none">Establish harvest failure systems to avoid disastrous losses	<ul style="list-style-type: none">Establish contingency plans for extreme weather conditions: resettlement, alternative employment

What challenges do AgriTech companies face while implementing innovations?

- In agriculture, technological innovations take time to prove themselves
- Scaling innovation in agriculture is much harder than in other industries
- Collecting and accessing data from equipment in the field
- Issues with privacy of data collected from farms and equipment
- Connecting rural areas to the internet and keeping them online
- Long cycle of experiments and high cost of mistakes
- Complexity of indirect factors like weather and climate change
- Global factors pushing farmers to find scalable solutions



Stages in the development of agricultural technologies to mitigate global challenges



Precision and automation technologies in the hands of farmers

Agricultural technologies help farmers make profitable decisions. These technologies are critical for sustainable farming. In years past, farmers were able only to reflect on previous seasons to avoid mistakes in the future, relying on experience and historical data. Nowadays, they have a long list of technologies at hand.

Delivering the right solutions to farmers is the main task for technology companies. Considering the optimistic development scenario of what should happen with technologies in agriculture, we can emphasize on two main divisions of AgriTech solutions: predictive farming and automation. They can work together to meet farmers' needs. Predictive farming provides all the necessary inputs for farmers to sustain operations, while automation acts in response to predicted situations.

Setting the groundwork for automation results in the growth and adoption of digital tools including farm management software, digital grain marketing services, and agronomic decision-making models that use various data sources and various levels of integration to increase farmer ROI and input use efficiency."

Darcy Pawlik, VP of Global Agriculture at Understory, Inc.

Predictive farming technologies

Turn data into actionable inputs for automation.



Collect data from IoT sensors, machinery, satellites, and weather stations



Structure and analyze the collected data together with historical data



Capture field images from drones, satellites, and other aerial imaging equipment



Predict weather and project crop yields



Analyze soil moisture and measure soil parameters



Create precise maps using collected data, images, and GPS and GIS services



Improve decision-making and increase farm efficiency



Wisely use resources: land, fertilizers, and water



Precisely plan irrigation, fertilization, and harvesting



Ensure a high quality of products and sustainability thanks to wise use of fertilization, irrigation, and land



Create measurable plans for production to meet projected food demand



Take data-driven responses to climate and weather changes



Use predictions and data as inputs for automated actions

Technologies used:

- Drone images
- Satellite images
- GIS tools
- GPS tracking
- IoT sensors
- Data analytics
- Farm and crop management systems
- Location intelligence
- Intuitive dashboards
- Machine learning and AI



In the past, ag data provided farmers a look in the rearview mirror. Today, we're seeing a rise in predictive tools and new ways to apply advanced tech like machine learning and other forms of AI. We're now able to build models that take decades of our own seed performance data across geographies that can factor in variables from our customers' farms. Farmers then receive performance rankings of which seeds will perform best on any given field."

Mark Young,

CTO & Head of Product at
The Climate Corporation

Automation of farming operations

Minimize human effort and minimize mistakes.



Technologies used:

- Automated steering and guidance
- Navigation and mapping
- GPS and GIS services
- ISOBUS
- Drone management
- Robotics systems
- Blockchain and distributed ledger technology
- Route optimization for heavy machinery
- AI image recognition
- Machine learning and AI
- Location intelligence



Ecosystem of technologies: What does it mean to AgriTech companies?

Connect them all to unlock the true power of agricultural technology.



Put the right technology into farmers' hands. We hear this everywhere. What's important is how we combine technologies, so they work together. We suggest considering other industries that are shifting to ecosystems of solutions and services as role models.

A better world of borderless ecosystems

Customer-centricity – Users can fully leverage a wide range of solutions that reinforce each other's capabilities. These solutions can be accessed through a single gateway, without leaving the ecosystem.

Diversity – Different players with cross-industry experience can join efforts and share experience to provide solutions that best suit users' needs and follow a unified user flow.

Trustful relationships – Participants in ecosystems rely on commercially beneficial contracts to regulate payments, service quality, formal rules, and access to ecosystem data.



Take a look at auto manufacturers, for instance. World-known OEMs have recently claimed themselves to be mobility companies, as they undertake much more than vehicle production. Car brands are now overseeing entire ecosystems of solutions and services including carsharing, mobile apps, urban mobility, cloud platforms, and smart infrastructure. OEMs are expanding their digital capabilities by cooperating with product startups, map data providers, and software development vendors. These relationships empower OEMs to learn from others, discover the untapped potential of ideas like agile development methodologies, and gain specific expertise to provide better services for customers.

What does an ecosystem mean for AgriTech companies?

- Integration of solutions for cumulative value
- Tight connection to customers' needs
- Reimagined partner relationships
- Flow of data from everywhere
- Cross-industry experience
- Adoption of new cooperation models
- Enormous growth of the customer base
- Open marketplace to access data and capabilities
- Learning from other players
- Possibilities for tech platform integrations

As this new model of cooperation plays out, we believe other industries can follow the same route to more connected, broader, and more customer-centric solutions in the form of borderless ecosystems.

We also see a tendency toward increasing cooperation across the agricultural industry. Big enterprises continue to acquire breakthrough startups with desirable technology expertise and better targeting of digital-savvy customers. Their end customers, farmers, already use technologies but in limited use cases. There's a long way to go until we achieve the implementation of technology at scale. That's why some gaps may appear in farming practices, blocking agriculture from moving ahead to the sustainable future. Scalable innovation provided by an ecosystem is the key for sustainable farming and mitigating global challenges and business risks.

Today, a lot of agricultural activities are being driven by data, smart farming technologies as well as the sharing economy model. Big data is already revolutionizing the sector by enhancing the process of supply tracking and supporting predictive modeling techniques amongst other things. The shared economy model is also playing a huge role in making sure that farmers are able to have access to farm machinery that they otherwise can't afford."

Jehiel Oliver,
CEO of Hello Tractor

Use case for a technology ecosystem

What a borderless ecosystem will look like

In a galaxy not so far, far away... All the fears of farmers have come true. Global changes are shaping a new world. Farmers are standing tall against the challenges, fighting for the highest yield on every acre of land. Initial mismatches between technologies and farmers' needs have been overcome. AgriTech providers have found a way to help farmers feed a growing population with limited resources. They have unchained scalable innovation for agriculture – a borderless ecosystem has become a reality.

The projected future of our world



A unified ecosystem now combines narrow solutions to collect and process data in the cloud. Analytics provides actionable inputs for agricultural equipment, which is adjusted with self-learning AI systems. By matching all historical data, including data on previous harvesting periods and weather conditions, with data from maps and aerial images as well as the current weather, machinery can automatically start harvesting areas where crops are ready. Other fields can get the required irrigation and fertilization from automated robots and drones.

With the implemented ecosystem of technologies, a farmer doesn't need to wake up at 4 or 5 am. Instead, the farm can work automatically. Analytics from fields and connected machinery can be shown on user-friendly dashboards to help farmers make decisions based on relevant data. Sustainable practices and farming automation minimize the use of resources, keep profits growing, and create a resilient, eco-friendly environment.

Consumers are demanding greater transparency about where their food comes from and how it is produced and are seeking out producers who are using technologies such as blockchain, IoT and smart labelling to provide this level of detail.

Emma Weston, CEO and Co-founder of AgriDigital

Use case of a borderless ecosystem for AgriTech companies and farmers

Data collection, mapping, and weather monitoring

- Collect data for further processing: mapping data, aerial and satellite images, soil measurements, GIS and GPS localized data
- Collect, store, and use this data to project crop yields, irrigation, fertilization, harvesting, and get prepared for protection from dangerous weather

AI algorithms, analytics, and cloud computing

- Transform input data into actionable commands through training on previous and newly acquired data
- Recognize patterns and apply rules for the economical use of resources
- Build projections in near-real-time and send commands to automated machinery, drones, and robotics equipment

Robotics, drones, and autonomous machinery

- Execute AI-based commands built on data
- Machinery can start harvesting on command, guided by a navigation system with a predetermined path
- Autonomous tractors can reroute their paths in real time using auto-steering based on weather changes or new predictions from the AI system
- Self-driving farm machinery may prove more reliable than self-driving cars as this machinery operates in less risky environments that are easier to predict and contain fewer obstacles than busy city streets
- Drones and robots can start irrigating or harvesting, navigated by precision maps
- AI can control climate conditions for indoor farms, recognizing crop yields with image and video processing algorithms

Traceable supply chain, blockchain, and delivery

- Track the quality of products
- Producers can mark seeds and products with QR codes.
- Distributed ledger technology can provide traceable and transparent data on food origins at each stage of the supply chain, while delivery companies carry products to retailers' shelves

Accessible payments, sharing economy, transportation

- Provide easier options to pay
- Smart contracts can be made available as a payment option for small farms to make rent of equipment affordable to farmers without advanced prepayments
- The sharing economy breaks into agriculture, providing easy ways to share equipment and heavy machinery between farms and fields
- New route optimization solutions for heavy machinery transportation assist in delivery, considering all risks along the way



What tech companies should do to make technology ecosystems a reality

To create such a technology ecosystem, AgriTech companies should have enough flexibility to experiment, profound experience in agile development practices, and technology expertise in previously untapped fields. Sometimes, it is overwhelming and requires additional resources, time, and effort. AgriTech companies and agribusinesses may look for new partnership models with software development vendors and R&D service providers to access proven engineering expertise and development approaches. Partnering with an engineering service provider helps to create digital solutions and integrate them into an ecosystem, tapping into the functionality of cloud platforms.

Advice to AgriTech providers in pursuit of sustainable farming:

- **Move toward ecosystems** – Joint efforts lead to interlinked solutions, open data, better defined standards, and improved user satisfaction.
- **Rethink R&D functions** – Experimenting with new solutions helps you meet farmers' needs faster by collecting user feedback, validating ideas, testing solutions, and scaling development only when you find a successful idea.
- **Tap into talent** – Extending your engineering capacity and consulting with technology experts can help you adopt agile practices already in use across a range of industries.
- **Get a clear look at customers** – A deeper understanding of the customer journey puts farmers' challenges, both global and local, at the center of the value proposition.
- **Collect data from users** – Getting insights from farmers into how they use solutions helps you make improvements and prove to investors that technologies are worth more investment.

About Intellias

Intellias empowers established agribusinesses and AgriTech startups to devise innovative ways for farmers to run their operations.

Quick facts

1,600

in-house engineers:
73% senior and
middle

18

years scaling
teams of 3 to 300
engineers

10

offices across
Europe: Germany,
Poland, Ukraine

43

active clients,
including Fortune
500 companies

Our technology expertise in agriculture



Farm
management
systems



Aerial
imaging and
analytics



Smart IoT
sensors



Supply chain
and food
security



Robotics
and
automation



Weather
monitoring
and prediction



Indoor and
vertical
farming

Digital Lab for AgriTech innovations

Intellias has established a [Digital Innovation Lab](#) to help agribusinesses and AgTech startups introduce innovative solutions that empower sustainable changes. These solutions are based on digital technologies that have been adopted and proven in other industries. We can cover your R&D needs in six steps:

01

Set up a
Scrum
team

02

Conduct
user
research

03

Design the
interface

04

Develop
your PoC

05

Ramp up
the team

06

Deliver
continuously



Dmytro Lenniy

AgriTech Practice Leader at Intellias



Dmytro is constantly looking for the perfect balance between product and outsourcing strategies to lead AgriTech companies to market success. With his knowledge of business processes

and both agile and waterfall methodologies, Dmytro is able to adjust workflows in agriculture projects and quickly grasp business requirements to apply the right technology.



Ukraine

Panasa Myrnoho Street 24
Lviv 79034
[+38 \(032\) 290 36 90](tel:+380322903690)
info@intellias.com

Germany

Pappelallee 78/79
Berlin 10437
[+49 \(30\) 080 67 31](tel:+4930806731)
berlin@intellias.com

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