



Transforming Agriculture through Digital Technologies

January 2020

Foreword



In a world where population is expected to grow significantly, natural resources become scarcer and climate changes dramatically, we need to produce much more with much less. In this sense, the role of the agricultural industry becomes fundamental in supporting global food supply.

This is also demonstrated by the latest developments in regulatory frameworks and policies, including the expected changes in the Common Agricultural Policy (CAP) within the EU.

To respond to the rapid changes in their external environment and maintain their global competitive footprint, companies and organizations operating in agriculture should adopt a high level of awareness, practicality and timeliness when forming and implementing their strategies.



In this context, recent technological advancements in Artificial Intelligence, Internet of Things, Blockchain and other digital areas, are employed in agricultural production and value chain. Indicatively, the use of precision farming, robotics and drones not only increase production and optimize the use of resources, but also reduce waste and ensure food traceability and quality.

As we will see in this report, we are moving towards a challenging, yet exciting period of the agricultural industry.

The increasing convergence of tech and agriculture (“AgTech”) makes the industry attractive for new entrepreneurial initiatives, financial investment and enterprise clustering and this is evident by the developments across companies and organizations that Deloitte serves.



Megatrends

The Agricultural sector is in the epicenter of a series of megatrends which are reshaping the ecosystem and require a review of the priorities and operating model in order to respond to the challenges.

Growing Population
The world's population will reach 9.5bn in 2050

Urbanization
50% of the world's population lives in urban areas

Technology
New technologies raise productivity and mitigate costs

Societal Changes
The need for clarity, purity and product traceability

Climate Change
Changing weather conditions intensify the need for adaptation in all areas



Globalized Trade
Production is local, then further processing and trade occurs globally

Biotechnology
Ongoing trend to biological production technologies

Integrated value chain
Large firms start integrating vertically to optimize their value chain

International Regulations
Global exports lead to regulatory entanglements between countries

Eco-Friendly Consumption
There is increasing focus on ethical living and how we can be more sustainable

Figure 1

Source: Deloitte Expert Interviews; Destination 2025



The Aspirations of the Global Food System

Inclusivity, efficiency, sustainability and healthy diet are recognized as the aspirations for the global food system, aligned with the UN Sustainable Development Goals. In these terms, the agricultural industry is fundamental to fulfilling said aspirations and addressing related challenges.

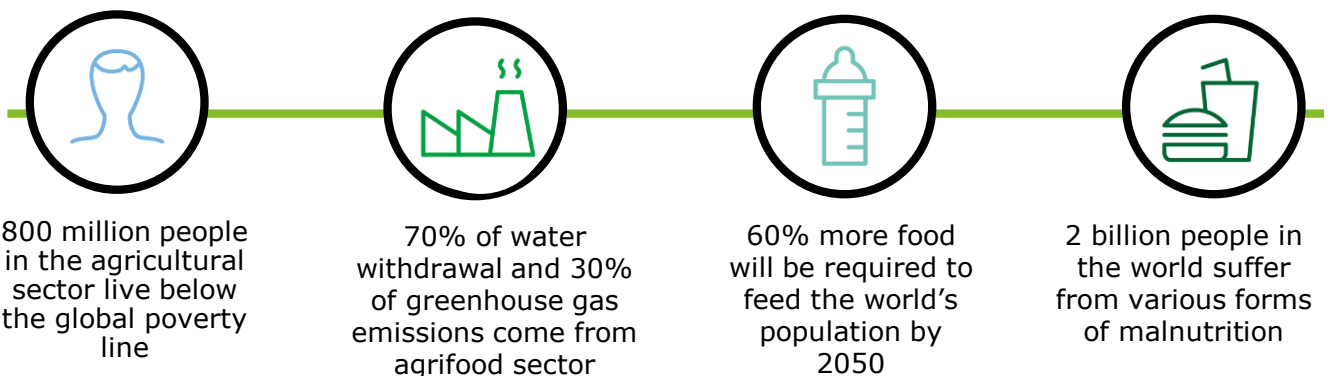
World's Food System Aspirations



Figure 2

Sources: Deloitte and World Economic Forum





POINT OF VIEW: The aspirations for the world's food systems are not currently being met and the agricultural industry is being challenged.



The Current Landscape of the Agricultural Industry

To realize the aspirations, the challenge of increasing food supply significantly yet sustainably arises. We need to produce much more with much less, at both global and local level, and technology could become an important facilitator for this change.

The Global Market in numbers

-  Agriculture constitutes a \$2.4 trillion global industry that is only getting bigger.
-  Farming provides jobs for 1.3 billion people, that's 19% of the world's population. For example, agriculture is the primary source of livelihood for about 58% of India's population.
-  Underdeveloped nations rely on agriculture for a high portion of their GDP, and employ more people than any other industry.
-  In developed nations agricultural production significantly increased in comparison to developing ones, which do not have the means or information to put technology in action.

Agriculture value added per worker, 2017

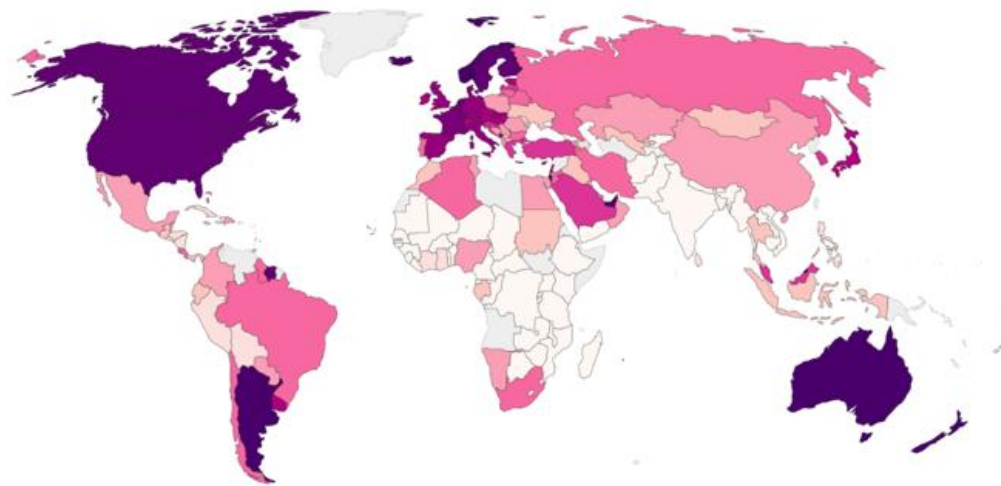


Figure 3

Source: World Bank

A Snapshot of the Greek Landscape

- Agriculture is one of the main pillars of the Greek economy, accounting for **4% of the country's GDP and one third of total exports**.
- 11%** of the arable land is **biological** (9th in EU).
- With 709,500 farmers in total **and only 5.2% below 35 years of age**, Greece faces **aging workforce** challenge.
- In contrast to other EU states, **land productivity in Greece has been in decline**. Compared to the EU, value added per worker is also relatively low.
- The industry mainly consists of small-to-medium size businesses, often with limited capital and inadequate infrastructure, **not able to generate economies of scale**.

Agriculture land productivity € / ha (value added terms)

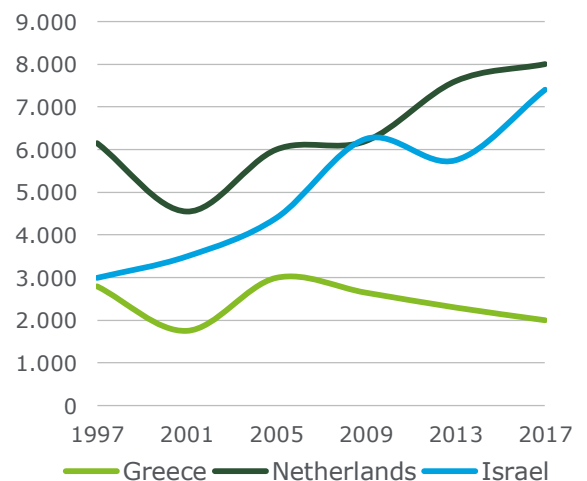


Figure 4

Source: National Bank of Greece

As the productivity gap between Greece and other developed countries increases, applying technological advancements creates big opportunities for the local agricultural industry.

From Traditional Agriculture to AgTech

Agricultural technology already plays a critical role in modern production settings, especially for large corporations. Robotics, sensors, cloud computing and blockchain are core technologies that act as a catalyst to the AI revolution in agriculture.

Robotics / Drones

Advancements in navigation and recognition as well as cost reduction have allowed use of robots for relatively complex tasks like spraying and weeding, fruit picking, nut harvesting and crop monitoring. Robots become cheaper and easier to use, thus facilitating their introduction in a wide range of farms.

Sensors

Coverage and sophistication of sensing equipment for agriculture is continuously increasing, with a simultaneous reduction of hardware, installation and maintenance costs. Factors like moisture levels, sunlight, wind speed and others are already routinely measured.

Cloud Computing

Reduction in costs of accessing powerful data centers through the Internet has allowed producers to collect, store, and analyze massive amounts of data without the need for building and maintaining costly mainframes. These are further reinforced through the interconnection of various machines.

Blockchain

Widespread use of the Web globally, in combination with the necessary infrastructure and well-established cryptographic principles, provide a way for information to be recorded, and shared safely and transparently, positively affecting supply chain.

AI in Agriculture

The global market for AI in Agriculture is valued at **240 million USD in 2017** and is expected to reach **790 million USD by the end of 2023**, growing at a **CAGR of 21.8%**.

The market for crop monitoring accounted for **more than 35% of the global revenue in 2016** and during the forecast period AI-guided drone is expected to be the fastest growing solution.

These technologies allow for an extensive collection of data which through precision agriculture allows farmers to maximize yields using minimal resources while reducing the overall impact to the environment.

Global Artificial Intelligence market in Agriculture (in mil. USD)

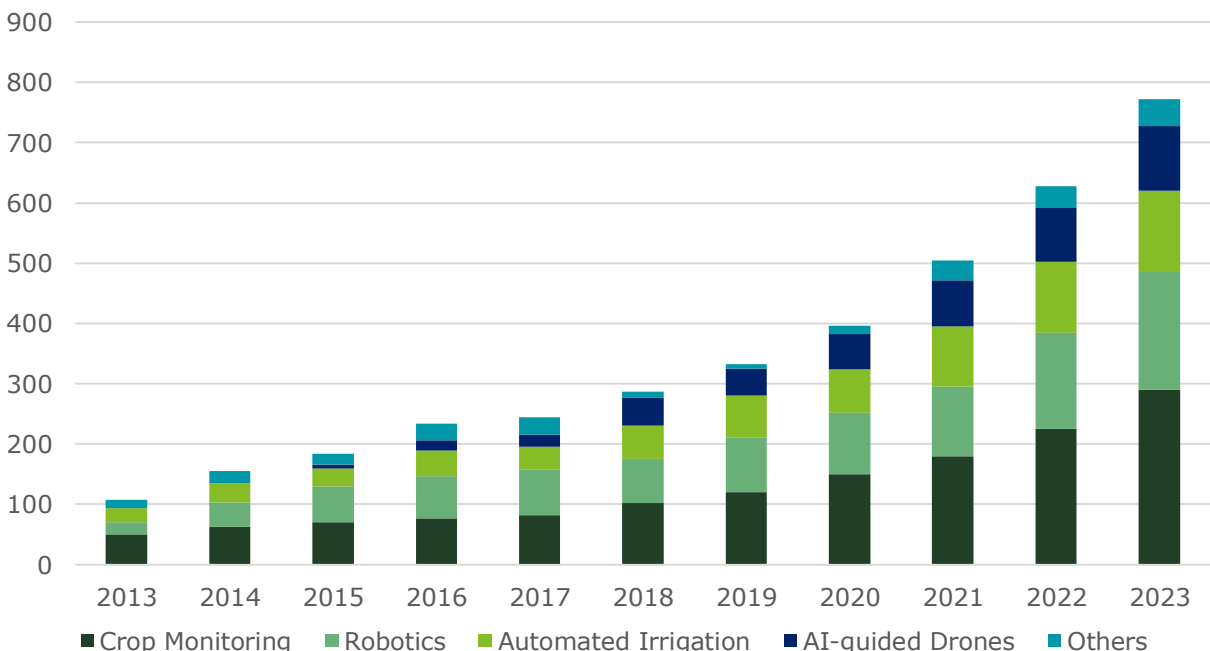


Figure 5

Source: World Bank

Existing AgTech Use Cases

Technological and AI advancements are now adopted in the industry in order to provide solutions and tackle industry challenges- such as workforce shortage, lack of space, prediction accuracy, waste and production management.

Vertical Farming



The future of farming could well involve innovative **vertical farms** like Unit 84, offering an **alternative to the lack of extra farmland**. Sited in an industrial warehouse in Beckton, East London, 6,000 square feet of LED-lit growing space can produce more than 20,000 kilograms of salads and herbs a year, alongside a clever **aquaculture solution** that can produce 4,000 kilograms of fish.

Smart Irrigation System



By monitoring **soil tension** in a field, **Hortau's** irrigation technology gives valuable **insight** into whether or not a plant can use the **water present** in the soil. The system **harnesses** live data on water **needs** of the crop and manages irrigation accordingly. This **ensures** that photosynthesis and transpiration happen at **maximum** levels resulting in maximum yields and a **higher** quality harvest.

Driverless Tractors



Companies like **John Deere** have started placing **sensors, GPS, and radars** on their machineries, coupled with **machine learning** algorithms to distinguish between **complex** tasks, in order to develop **fully autonomous tractors**. This technology could **fill** the gap of inadequate supply of skilled labor during plating and harvesting, allowing for **continuous work**, which as a result could dramatically **increase** output and **reduce** staff costs.

Autonomous Data Collection



Companies like **American Robotics** and **Skycision** are leveraging the **low-cost** availability of **drones** while placing **sensors, sprayers** and sophisticated **AI algorithms**, in order to perform tasks such as spraying pesticides, planting, and more importantly, **collecting data** through sources like pictures and video. The data can be sent through the cloud for analysis and development of predictive models. These actions can have a profound impact on the **precision** of farming.

An Ecosystem Approach

As investments in technology are currently focused on production, a more holistic approach should be applied to both transform subsequent stages of the value chain, such as distribution and retail, and also enhance the role of all key stakeholders including governments, academia and consumers.



An integrated food system is much more complex, as it involves packaging, distribution, sales and depends on global financial and marketing trends as well as funding and investment practices.

Currently, **investments are concentrated upstream of the value chain**. This means that innovation is focusing more on production than on distribution and retailing.

From a technical standpoint, the magnitude and complexity of the aforementioned issues **demand strong cross-cultivation frameworks** across multiple stakeholders, including researchers, small and larger corporations as well as regulators.

Increase of investment in technology across food system, 2016-2018

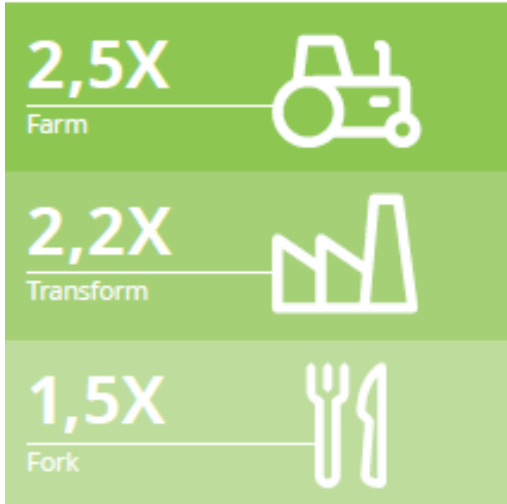


Figure 6 Source: MIND magazine by Deloitte

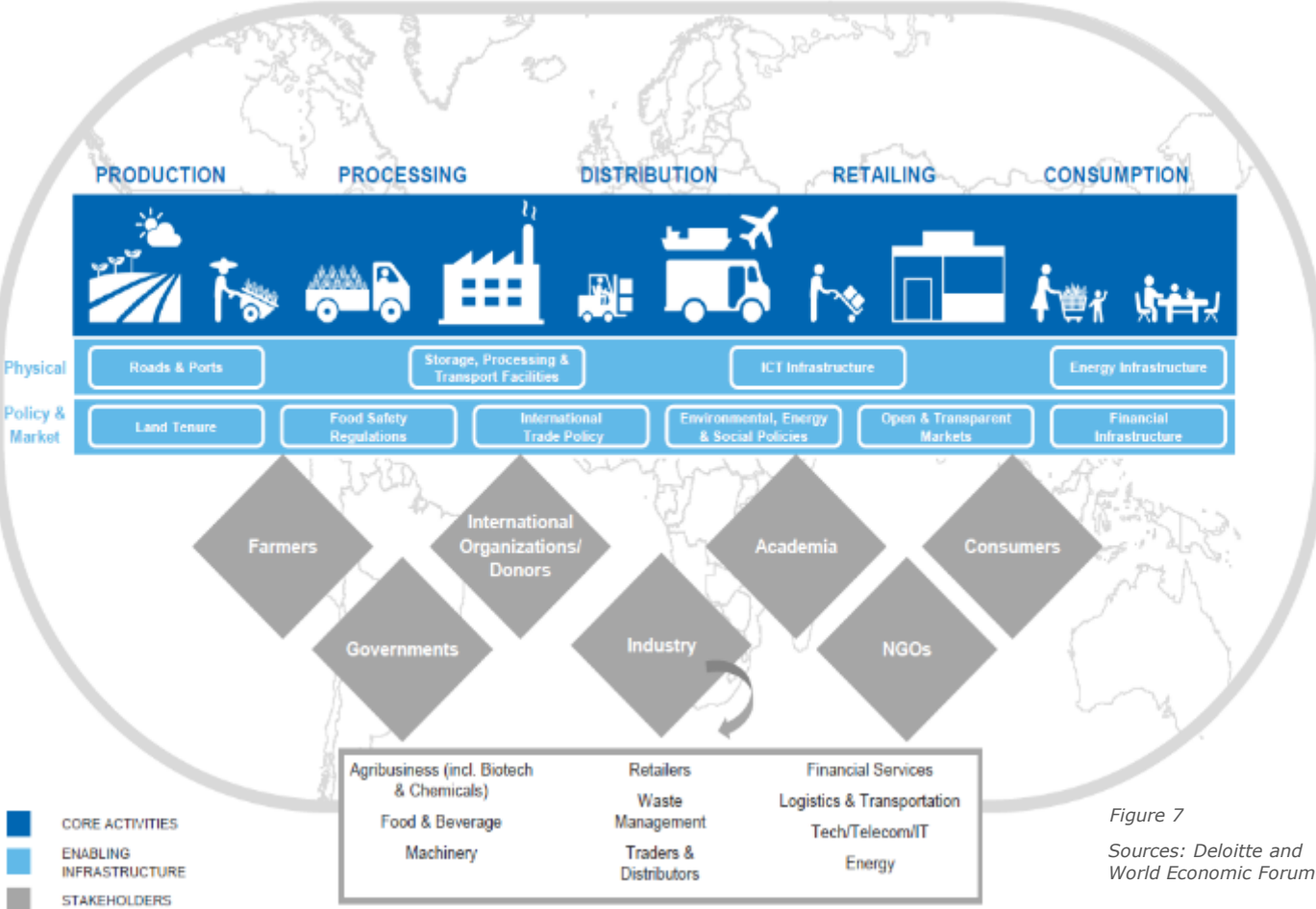


Figure 7 Sources: Deloitte and World Economic Forum

An Ecosystem Approach

The Value Chain

Production & Processing

- Agricultural technology is applied mainly in the farm, for **improving and maximizing yield** and optimizing farm management and operations.
- Drones can collect highly detailed images of crop and field characteristics, **indicating crop health across the field**. Collected images show differences in the amount of reflected light that can then be related to plant health or soil type.
- Accurate prediction of conditions on a global scale can determine **farm insurance, investment on protection and mitigation of destructive events**.

Distribution & Retailing

- Several companies have begun to apply logistics technology to make **food distribution more efficient**.
- Logistics technologies enable **food traceability**, thus **enhancing transparency** and obtaining **full control of information flow within the supply chain**.
- **Predictive capabilities are escalated** when AI in logistics is implemented. Having a tool for **accurate demand forecasting and capacity planning** allows farmers to be more **proactive and save costs**.

Consumption & Recycling

- According to a Deloitte report, **precision agriculture** can **reduce fertilizer** use by as much as 40%, offering healthy, organic, fresh and nutritious products to the final consumer. According to a Nielsen study, **68% of the consumers are willing to pay more** for food **without unhealthy or artificial ingredients**.
- **Circular Economy** facilitates the shift from traditional "Take, Make, Waste" to "Make, Use, Return". Product disposal is replaced by product re-use, which is environment-friendly and enables cost-savings for businesses.

The Role of Stakeholders

Governments

- Establish policies to **allow the use of AI and advanced technologies**, as well as **incentivize innovation** for the development of technological solutions.
- **Support the ahead-of-the-curve small businesses** by providing them favorable tax treatment.
- Promotion of **evidence-driven policy** formulation.

Academia

- Provide **accessibility of research** outcomes. All associated stakeholders should be aiming at embracing **the notion of Open Science**, which includes open sourcing code and data.
- **Inform and educate the new generations** over our ecosystem, as well as the role of the advanced technologies and AI.

Financial Institutions & Investors

- Financial investors should maintain their interest in agricultural technologies. **Investment in AgTech has grown remarkably**, with \$6.7 bil. invested in the last 5 years and \$1.9 bill. in the last year alone.
- EU grants are available to farmers, in order to boost productivity and quality of agricultural products. EU is to introduce **new funding programs** to urge the adoption of new technologies by the farmers.

Farmers

- Perform **long term planning** in order to achieve land preservation and sustainability.
- **Quick adoption and aggressive promotion** of new technologies.

Food Servicers & Retailers

- Retailers and food service providers should embrace the new technologies to **reduce waste** by 25%-50% and meet consumers' current needs.
- AI-bin Winnow is the **first AI-based bin** to support the hospitality industry, aiming at **reducing food waste**. Smart scales and smart meters are programmed to identify food wasted.
- Usage of technology can **secure transparency** by allowing traceability and verification of **the origin of a product**, as well as its attributes.

Technology Players

- Establish **prescriptive analytics** to allow the mass-scale simulation of scenarios.
- To facilitate the presentation and understanding of AI-driven evidence, it is imperative to implement **appropriate, faceted visual paradigms** and introduce **Interpretable AI** to add a layer of explanation to AI systems.

Future Outlook

The future of food systems will primarily depend on the evolution of two key dimensions, market connectivity and consumption patterns. The adoption of digital technologies may contribute significantly in shaping a more sustainable, resource-efficient world.

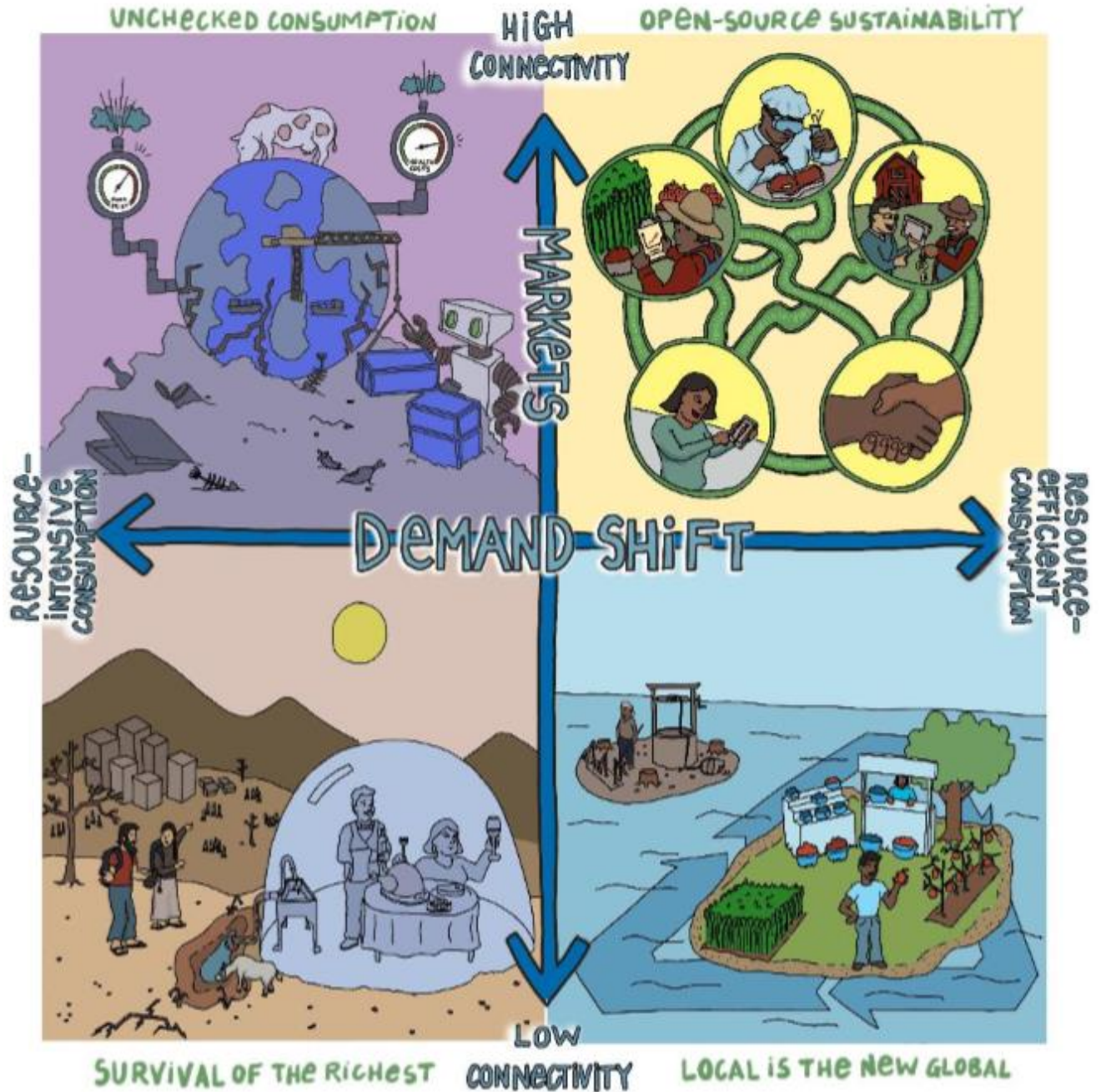


Figure 8

Sources: Deloitte and World Economic Forum

Technological advancements can play a major role in establishing the base ground for optimizing resource consumption and maintaining the right balance between supply and demand.

Key Takeaways



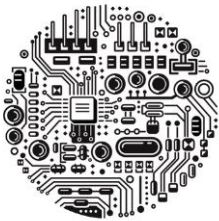
Global Megatrends Create Challenges for the Food System

- Growing population globally, ever-increasing resource scarcity and dramatic climate changes generate uncertainties for the food system.
- Under these circumstances, we need to produce much more with much less.



The Opportunity of Using Technology in Agriculture

- Innovation and technology have advanced with a lot of applicable solutions already evident in agricultural production. Such applications have already helped increase farm productivity and reduce environmental footprint.
- It is essential though to expand use of technology from production to distribution, retail and consumption.



The need to Establish Collaboration Frameworks

- Industry leaders may leverage the opportunity that digital technologies offer in order to transform the food system.
- The magnitude and complexity of the challenges posed, demand strong cross-cultivation frameworks among farmers, SMEs and larger corporations, academia, legislative bodies, retailers and consumers.



A Future where Food System Aspirations are Met

- Investment in technology can generate multiple benefits for early adopters. For the Greek agricultural sector, establishing the right balance between "tradition" and new technologies can create long-term competitive advantage.
- For the food system, technology can help prepare the ground for the realization of global aspirations regarding inclusivity, efficiency, sustainability and nutritious and healthy diet.



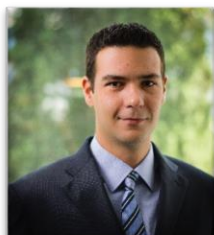
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SCiO was founded by a group of highly experienced and qualified professionals with a deep knowledge of data-intensive problems in the agricultural and food sector. The company specializes in different facets of data analysis from multi-parameter Descriptive Analytics to complex Predictive Analytics over large data volumes. Furthermore, it pushes the envelope on Prescriptive Analysis, building novel methodologies for determining, verifying and explaining analytical results. SCiO is thus able to provide innovative, world-leading, bespoke services that morph data into meaningful answers for practitioners and investors.

What's more important, SCiO aspires to have a meaningful contribution on a necessary paradigm shift on the way ICT is applied to food systems. Beyond the progress in the different applicable Computer Science and Engineering domains, technological evolution needs to extend its reach across countries and sectors and to be viewed under a holistic perspective that reflects the vast complexity of food systems and the associated economies.

Examining the applications of ICT in the different market sectors and providing services to all different stakeholders under this unifying framework is the most surefire way to empower agricultural production and stimulate growth, while also tackling the critical aspects of climate protection and global food security and safety.

By offering a portfolio of services that address the needs of farmers, distributors, investors and suppliers, SCiO is determined to change the way we think about and technologically supported food systems of any scale.

Please see www.scio.systems to learn more.

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