Agricultural Industry

Future Farming

About the Need for Game Changers in the Agricultural Industry

Porsche Consulting

Strategic Vision. Smart Implementation.

Summary

Farming provides food for the world's growing population and is also a pillar of many national economies. Technology and digitalization have been playing an important role in raising yields and productivity on farms for quite a while. Digitalization makes agricultural production more environmentally compatible, which benefits the whole ecosystem. Customers profit by better product quality and greater transparency through traceability. This article sketches the challenges that agriculture faces, and disruptive solutions including the example of vertical farming which clearly shows that farming in the future could look very different from how it does today.

Agricultural sustainability

Digitalization and connectivity as key enhancers

The projected rise in the world's population represents a major challenge for farming. By 2050 there will be around 9.5 billion people on Earth, which corresponds to a growth rate of 40 percent [1]. The amount of arable land is already reaching its limits and cannot be expanded. By 2050 food security will require another two billion acres of land—an area the size of Brazil. [2]. It is not simply the matter of providing the right quantity of food. Societal changes in eating habits and health awareness furthermore increase the demand for high quality and healthy food. A consumer survey in Germany, for example, showed that 53 percent of respondents prefer to buy organic fruits and vegetables. Reasons given include a preference for food without additives or processing aids (90 percent), from regional producers (87 percent), that supports environmentally friendly agriculture (82 percent), and that tastes better (68 percent) [3]. This suggests that the market potential of regional farms and demands for high product quality will increase. Yet the current challenges faced by agriculture are making it more difficult to ensure sustainable and organic modes of farming. As nutrients are removed from the soil, its quality declines. Climate change and water shortages are lowering yields. Around 70 percent of our drinking water supplies are used in agriculture [4].

Given the above considerations, digitalization and connectivity are becoming ever more important for the agricultural and food industries. Every link of the value chain—from suppliers to farmers to consumers—can benefit from digital solutions. For example, sensor systems and data analytics can improve product quality and planning security. New business models and digital platforms can achieve customer proximity. The agricultural machinery industry has already invested strongly in digital solutions. This sector is a pioneer in self-driving vehicles and is considered one of the most advanced providers of IoT solutions. Digitalization already accounted for 30 percent of added value worldwide in 2015, making the agricultural industry three times as advanced as the automotive sector [5].

Thirty-five use cases show how digitalization can heighten growth, customer experience, and efficiency

The factors sketched above show that change is needed in the agricultural sector. The requisite quantity and quality of food products can only be secured by means of new technologies and digital approaches (see figure 1). Such solutions as self-driving vehicles, data analytics, and vertical farming are pointing the way for future farming.

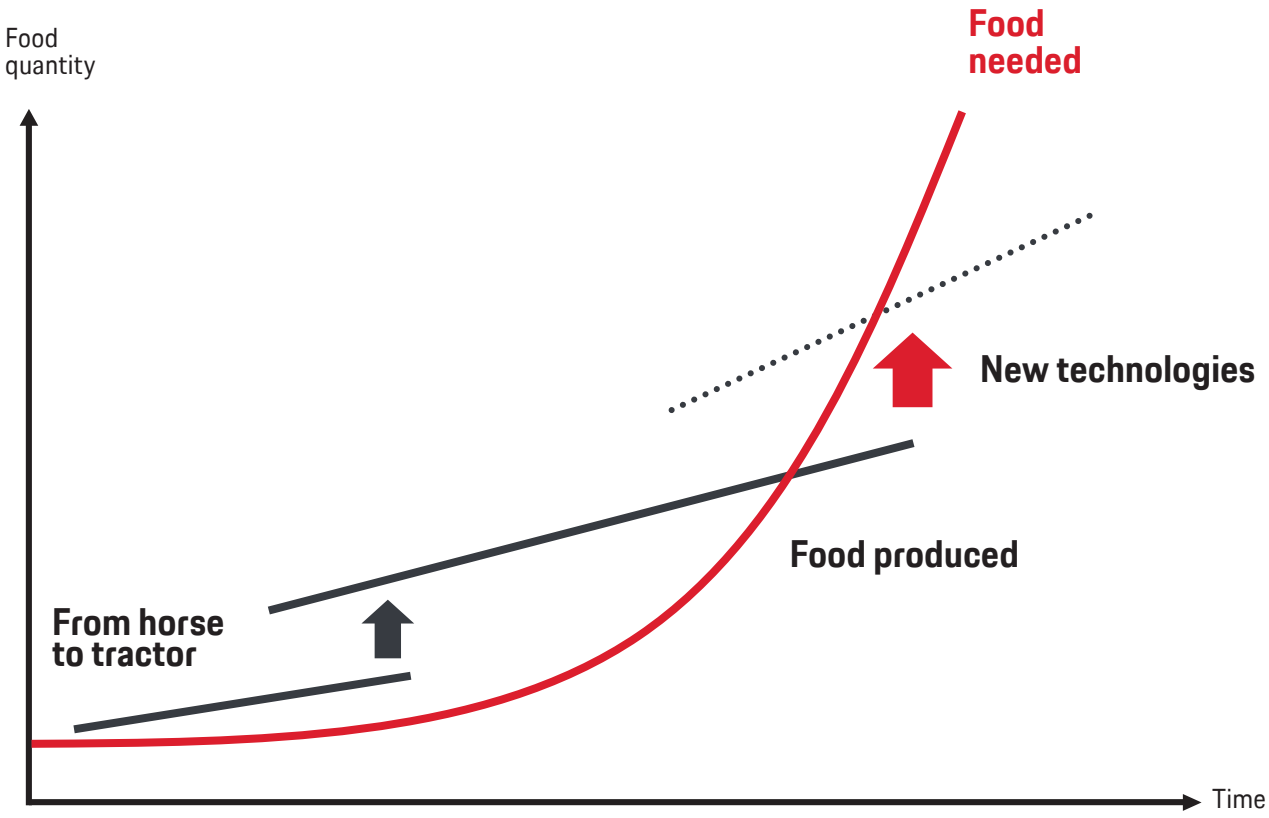

Figure 1. New technologies are necessary to better meet future food needs (own diagram, based on [6])

Porsche Consulting has worked with numerous clients from the farming industry in recent years to help them master managing their digital transformation. The management consultancy processed and structured the thereby gained expertise of agricultural business trends in the form of use cases. A total of 35 use cases can be identified as providing substantial added value for growth, customer experience, and efficiency (see figure 2). The aim is to anchor these use cases in a future scenario in order to derive successful business models and put them into practice.

Growth

Solutions from the fields of autonomous and assistance systems are relevant to the area of growth. They relieve some of the burden on users and also support decision-making processes. The aim is to increase yields as efficiently as possible. Self-driving vehicles, steering systems, and mobile robots are taking over some tasks, freeing farmers to pursue other activities. This raises productivity levels and lowers personnel costs. Data measurements and analyses in a field like precision (livestock) farming lays the decisional foundation for more efficient farming. Losses in yield can be detected early on and outputs can be increased over the long term. Digital nutritional monitoring in the context of precision farming can reduce yield losses by 20 percent and increase productivity in various work processes by 14 percent [7]. Furthermore, a combination of precision planting and irrigation, as practiced in vertical farming, can increase harvests by approximately 70 percent [8].

Customer experience

Shorter technology lifecycles and greater technological diversity are making implementation more complex. Moreover, manufacturers often offer products with specific interfaces and only for certain parts of the value chain, which complicates compatibility for overall process chains. Use cases that focus on customer experience, such as augmented reality and mobile apps, address the problems associated with process complexity. In the future, customers will be able to do maintenance, order replacement parts, receive training, and access support functions on their own. The aim is to reduce the amount of effort for customers. Uniform interfaces can be created by means of standardized data exchange systems and manufacturer-independent control portals. Platform strategies offer new business models that allow customers to share agricultural machinery, for example.

Efficiency

Use cases in this area increase process efficiency within the overall value chain. Primary aims here include reducing errors, establishing transparent traceability, and shortening response times. New information and communication technologies as well as smarter sensor systems can, for example, detect process deviations early on and continuously monitor animal health. Diverse platform strategies such as crowdsourcing offer new possibilities for joint projects, which enable innovative solutions to be developed rapidly with company-independent experts.

	Growth	Customer experience	Efficiency
Incremental changes	01 Automated steering systems 02 Driver-assistance systems 03 Digital farming platforms	12 Automated and combined machines 13 Mobile apps 14 Booking platforms for parking lots 15 Manufacturer integration platforms	22 Connectivity technology 23 Telematics 24 Fleet management platforms 25 Digital knowledge management
Vertical integration	04 Autonomous mobile transportation technology 05 Self-driving vehicles 06 Autonomous mobile robots 07 Drone-based 3-D mapping	16 Manufacturer-independent control platforms 17 Sharing platforms 18 Farm management platforms 19 Standardized data exchange 20 Virtual reality for customer enthusiasm	26 3-D printing technology (replacement parts) 27 Smart supply-chain management 28 Virtual reality (development and design) 29 Crowdsourcing platforms 30 IoT technologies (smart factory and farming)
Game changers	08 Precision farming 09 Precision livestock farming 10 Vertical farms 11 Machine-based learning functions	21 Augmented reality for maintenance	31 Big-data analytics 32 Smart sensor systems (livestock) 33 Open innovation platforms 34 Innovation & IT labs 35 Predictive maintenance

Figure 2. Thirty-five use cases as a basis for implementing new business models in the farming industry

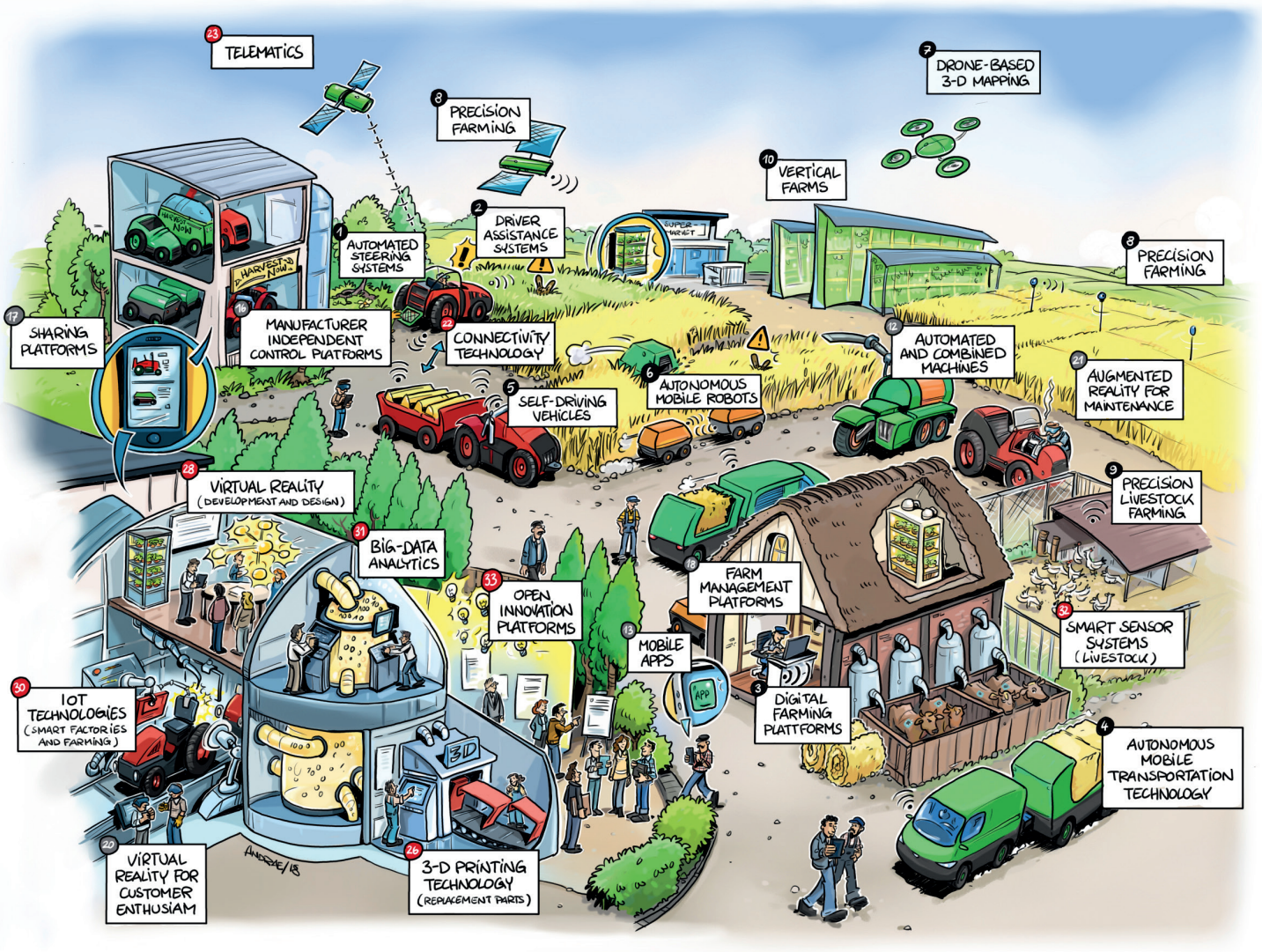

Figure 3. Future farming: new business models in agricultural industry

Every third digital development is considered as being a game changer

For those who apply the aforementioned use cases, numerous benefits arise that help master future challenges. The individual use cases can be assessed in a portfolio by their degree of technological change and their level of market impact. Three categories emerge: incremental changes, vertical integration, and game changers (see Figure 2). Around 30 percent of the use cases bring about incremental changes, which means the technology has already been implemented and has only had a slight impact on the market with respect to new business models. Examples include the use of virtual reality and driver assistance systems. Another 40 percent of the use cases show initial vertical integration measures. These can be based on new technologies such as self-driving vehicles or feature market-changing business models such as crowdsourcing platforms. Vertical integration is especially dangerous to providers of conventional products, because a new service and product portfolio is created that requires know-how from other fields of business with high levels of innovation.

On the road to achieving full digital integration, use cases categorized as game changers are of especially great interest. They are characterized by both high rates of technological change and innovative business models that will radically transform the market. Digitalization is used to generate transparency, increase process efficiency, and strengthen customer-supplier relations. One-third of the 35 use cases listed above can be assigned to the game changer category. One striking example is vertical farming. These agricultural operations produce organic food under artificially created conditions and move to the vicinity of their customers. They can sustainably cultivate fruits and vegetables without the use of either sunlight or soil. Classical customer-supplier relations are called into question. Using far lower levels of resources than traditional field cultivation, productivity rates of vertical farms can be 75 times higher [9].

The necessity and benefits of vertical integration have become apparent to both the agricultural industry and consumers. There is a general consensus that growth, customer experience, and the efficiency of traditional business processes can be increased by digitalization and connectivity. 53 percent of German farms surveyed already use digital applications in the sense of Agriculture 4.0. An additional 30 percent would like to increase their level of digitalization and are planning or discussing digital applications [10]. Implementation is failing primarily for lack of infrastructure.

FOUR MAJOR OBSTACLES

FRAGMENTED MARKETS

There are numerous providers and individual solutions that are not compatible within the manufacturing process. Scalability effects and potential cost reductions are therefore limited.

LACK OF CONNECTING SERVICES

Connectivity is what drives beneficial digitalization. At the moment, however, connectivity services lack stability in terms of accessibility and comprehensive coverage.

HIGH INVESTMENT COSTS

Technology has its price, which is especially prohibitive to small to medium-sized farms. Moreover, additional costs have to be incurred to build the necessary infrastructure.

INSUFFICIENT DATA QUALITY

Large volumes of data are required for data-based analytics and decision support. Many of the existing systems and devices cannot process data, or only with considerable difficulty. To ensure an efficient process and data comparability, industrial standards for all systems need to be introduced. Since these standards do not exist yet, data acquisition tends to be extremly problematic.

The vertical farming example

What new business models are arising from this game changer?

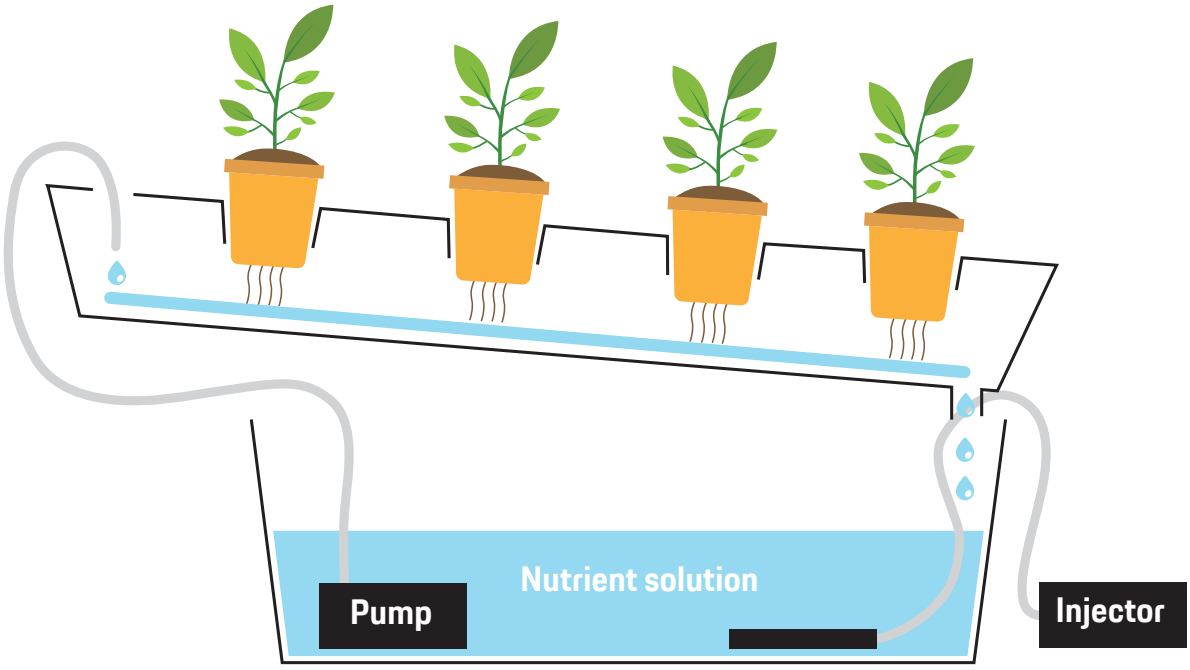

Figure 4. Schematic diagram of vertical farming

Vertical farming is one example of the game changers described above. It addresses the problem of limited land and aims to increase yield per unit of area to secure sufficient food for the population—now and in the future. A vertical farm may consist of multilevel containers in which plant-based foodstuffs are grown with nutrient solutions and artificial sunlight. Closed water circuits (nutrient solution) supply nutrients to each plant (see figure 4).

The system is thus able to sustain the plants using considerably less water. Sunlight is replaced by artificial light tailored to the plants' needs. As a result, vertical farming can be implemented without any of the usual agricultural problems. Its harvests are no longer dependent on climatic and soil conditions, which means that food can be produced everywhere in every season. The possibilities it offers for localized cultivation, even within cities, can eliminate long transport routes and provide customers with fresh, regional products (see figure 5).

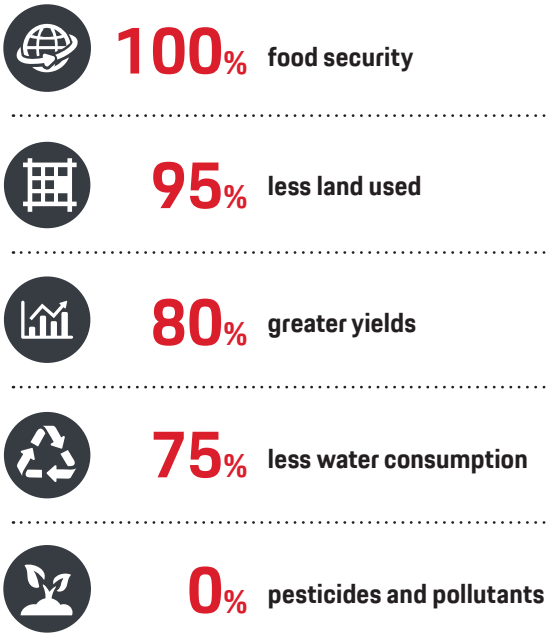

Figure 5. Benefits of vertical farming

Vertical farming radically changes traditional customer-supplier relations

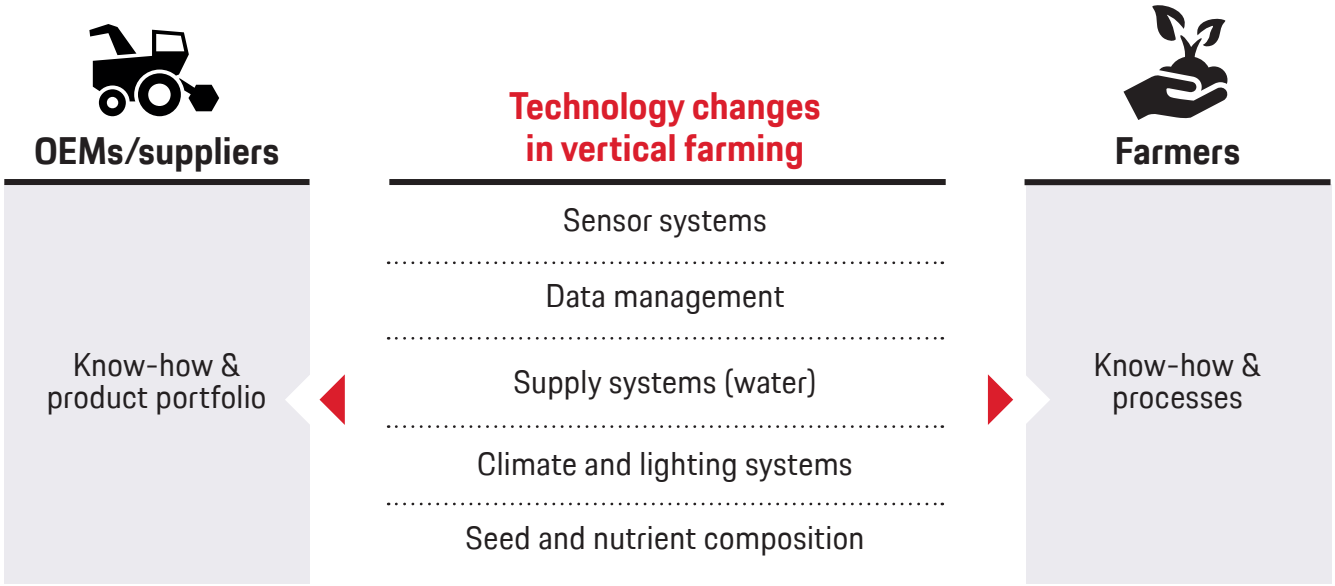

Figure 6. Changes for OEMs/suppliers and farmers

Porsche Consulting compared vertical farming with conventional farming approaches and examined the differences from two perspectives: from the relations between, on the one hand, OEMs/suppliers and farmers (see figure 6) and, on the other, farmers and consumers (see figure 7). For OEMs/suppliers and farmers in particular, food production in high-tech greenhouses will mean a shift in their skills and core tasks. Vertical farming is connected with major changes in technology, which will focus on sensor systems, data management, nutrient supply, lighting systems, and the like. Classic OEM/supplier products, such as tractors and harvesters, will no longer be needed. In this new environment, "fieldwork" will give way to radically changed demands for equipment and systems that must be designed and brought to the market by OEMs/suppliers. The quality of seed and nutrients will be further developed to enable ecological cultivation without sunlight or soil. For OEMs and suppliers this means radically rethinking their product portfolios and areas of expertise. Vertical farming will also bring a shift in the farmer's core skills and processes. In the future, they will need expertise in areas like data management and systems operation and control. Ideally, planting, cultivating, and harvesting processes will run on an automated and autonomous basis in multistory buildings or refrigerated containers using smart sensors and connected systems.

A new picture will also arise from the perspective of farmer-consumer relations (see figure 7). Farmers are traditionally located in rural regions and offer different seasonal and regional products. Customers expect a broad product range at supermarkets, but climatic conditions mean that not all crops can be grown in the region. Food products are shipped around the world, which creates long supply chains. Vertical farming enables farms to move closer to their customers. Farmers can rent space in supermarkets, or rather supermarkets can become farmers. It is also conceivable for a vertical farm to integrate a supermarket, or for consumers themselves to have such a farm in their kitchens.

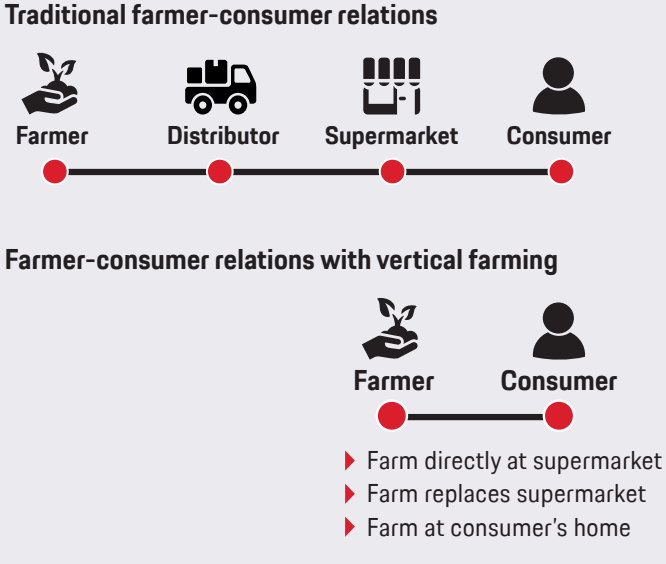

Figure 7. Vertical farming will promote closer farmer-consumer relations

Digitalization makes business models even more efficient: Use cases demonstrate the possibilities

The example of vertical farming shows how greatly agriculture can be changed by new technologies and digitalization. With sensors and data management systems, innovative farms can continuously monitor the need for nutrients, water, light, and new seeds and control the supply thereof via autonomous processes. Seed and nutrients can be automatically ordered from suppliers by direct data transmission. Data-based systems adjust water levels and light intensity to meet plant needs. Farmers become supervisors and can devote greater efforts to cultivating ties with customers.

The 35 use cases identified above provide considerable added value for growth, customer experience, and efficiency in agriculture. New business models can be made even more efficient and customer oriented with the help of digitalization and connectivity. Digitalization and technology can therefore simultaneously solve multiple challenges agriculture faces: on the one hand, securing food for a growing population with less resource expenditure and lower CO2 emissions, and on the other, offering demand-oriented production of high-quality foods in close proximity to customers.

Appendix

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Porsche Consulting

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