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# Longer Term Impacts of the COVID-19 Pandemic on European Agriculture

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## Abstract

The longer-term impacts of the COVID-19 pandemic on the European food supply chain may be substantially different than the short-term adaptation of farmers, food processors and retailers. The main consumer preference changes are likely to be linked to greater on-line ordering, home delivery and in-home consumption. The food industry changes will probably be more persistent and of greater magnitude than those on the consumer side, including a preference for production and processing closer to consumption, and greater flexibility in processing. The COVID-19 pandemic will promote greater automation throughout the food chain with automation of combinable crops leading the way because the engineering is more tractable than for fruits and vegetables. The COVID-19 pandemic will lead to a re-emphasis on food production and food security in agricultural policy throughout Europe. That re-emphasis of food security will be strongest in those countries which saw the largest and longest disruption in consumer level food availability. The COVID-19 pandemic has disrupted the European food system, but in the longer run it could also create opportunities for those ready to adapt to the changing realities.

## Keywords

COVID-19, food system, globalization, robotics, vertical farming, food security

## Presenters profile

Prof. Lowenberg-DeBoer holds the Elizabeth Creak Chair in Agri-Tech Applied Economics at Harper Adams University. He is president of the International Society of Precision Agriculture (ISPA) and co-editor of the journal Precision Agriculture. His research focuses on the economics of agricultural technology, especially precision agriculture and agricultural robotics. He has published 85 articles in refereed journals, two books and six chapters in other books. From 1985 to 2017, he was a professor in the Department of Agricultural Economics, Purdue University, West Lafayette, IN, USA. His research is informed by experience producing maize and soybeans in the US state of Iowa.

## Introduction

The COVID-19 pandemic has been a severe short-term shock to the European food system, but the longer-term effects of the pandemic are unclear. Some think that the economy in general, and the food sector in particular, will bounce back quickly to pre-pandemic conditions when restrictions are lifted. Others envision a radically different food future in which resilience is emphasised and local food production favoured. In spite of the lack of information on longer-term trends, decisions are being made now on farm policy, food safety regulation, infrastructure and other issues that will strongly influence the future food security and the profitability of the food system. To facilitate decision making in this context of uncertainty, this article outlines the key questions about the longer-term impact of the COVID-19 pandemic on the European food system, poses some hypotheses and discusses methodologies that might be used to test those hypotheses. This article is of interest to economists, food scientists, policy makers, food industry managers, farmers and consumers.

This discussion is built on the awareness that pandemics can change agriculture and society dramatically. For example, historians have found that the Bubonic plague killed so many workers in the Middle Ages that wages rose, farmers shifted from grain production which was labour intensive in those days to sheep which required much less labour, and over the longer term the feudal system was undermined laying the basis for the Renaissance and modern agricultural systems (Herlihy, 1997). The 1918 Flu Pandemic shows that the geography and demography of the disease can have a key influence on the longer-term impact. Unlike COVID-19 which kills mainly older and more vulnerable people, the 1918 flu predominantly killed working age adults, but the short-term and longer-term impact on agriculture appears to have been minimal (Garrett, 2008; Jordà et al., 2020; Patterson and Pyle, 1991). This was because the 1918 Flu was concentrated in cities and other high-density areas like military bases, leaving many rural areas less affected.

To respond to these longer-term issues Harper Adams University (HAU) staff working from their homes have searched the research literature, met on-line, exchanged emails and social media messages, and spoken on the phone. This document summarizes the key questions identified, hypotheses posed and the methodologies discussed. The HAU exchange was organized around answering some key questions, including:

### ***Will the COVID-19 pandemic permanently change consumer preferences?***

All around Europe consumers changed food practices during the COVID-19 pandemic, but the degree of change varied widely. In March of 2020, restaurants and food service were abruptly shut down in much of Europe as governments imposed “lockdowns” with varying degrees of severity. Sweden was among those imposing relatively light restrictions, mainly limited to requiring bars and restaurants to follow social distancing rules and restricting the size of public gatherings to no more than 50 people. In contrast countries like the United Kingdom, Germany, Greece, Spain and Italy closed all bars, restaurants and other eat-in food establishments and prohibited public gatherings. This forced consumers to eat at home and increased the demand at supermarkets. In most countries on-line or phone ordering and pick-up or home delivery was allowed, but it took time for many coffee shops, restaurants and other food service establishments to adapt. In the UK in particular, consumers reacted to the lockdown by panic buying of all kinds of food for home preparation, but especially non-perishable items. For many UK consumers this was the first time that they had seen empty supermarket shelves.

Human beings tend to have short memories and soon consumer behaviour will probably go back to being driven by price, convenience and habit regardless of the COVID-19 pandemic experience. Most European consumers are unlikely to willingly pay more for food because it is produced in Europe, even if that supply is more reliable. However, the pandemic may have changed some habits. Some consumers have tried on-line ordering and home delivery for the first time, and they may continue because they like the convenience. This is particularly true of older consumers who were not ordering food on-line before the pandemic.

While it would be possible to create a wholesome, nutritious diet entirely from foods grown in Europe, consumers will probably maintain their taste for citrus fruits, bananas, pineapple and other food products from warmer climates and continue demanding out-of-season produce. In response companies may diversify their supplies, and instead of relying on products from one country, they may decide to source from several.

***The pandemic has revealed the fragility of long-distance supply chains. Will that realization lead to the end of globalisation?***

Company changes due to the pandemic may be greater than those likely to be seen among consumers. If a company experienced major financial losses due to supply chain disruptions, resilience will become a higher priority in planning. The cost and probability of a disruption may be added into the estimates of expected profits when deciding on future strategy.

Strategies to increase resilience lie within sourcing materials, processing, logistics and marketing flexibility. Specialized supply chains focused on a single type of buyer reduces costs, but it also makes them vulnerable to disruption if those buyers dramatically change their orders. This is what led to the milk dumping and ploughing under vegetables when processors focused on products for restaurants and institutions could not quickly switch to serving the individual consumer market via supermarkets and home delivery during the lockdown. Will food supply companies post COVID-19 build in the flexibility to serve alternative marketing and distribution channels?

To reduce costs, most larger European food companies have developed a so-called “lean supply chains” with just-in-time deliveries. For less perishable foods one of the options is holding greater inventories. But who would hold those inventories? The narrow margins in the food sector make it unlikely that the supermarket chains would hold those inventories without some tax or other public policy incentive.

The current pandemic presents food supply chains with a very real need to re-evaluate their business models to face the challenges presented by conditions of social distancing and lockdown. The most affected sectors are those of foodservice and events and their supply chains. Yet, the impact on the agribusiness and food supply industries is more far reaching and has, and will continue to have, a greater impact on structure of food marketing and distribution channels in the future years; arguably more so than any other pandemic to date.

The crux of the issue relates to the current market structures and the variant levels of market concentration throughout supply chains. An evaluation of market structures suggests that across Europe around 87% of food consumed in the home is purchased from supermarkets, who collectively manage the 100 buying desks which procure the items for sale. With some 286,000 food and drink manufacturers, 250,000 wholesalers and distributors, and 12.2 million farmers, retailers play a central role in the distribution of products and wealth throughout the food supply chain. Their hold over the commercial positions in many parts of the supply chain

and the delivery systems to consumers has encouraged the development of a few alternative pathways to market.

The emergence of alternative food networks, involving farmers markets, farm shops and smaller food manufacturing and distributing companies in industrialized countries has been heralded as a means of promoting economic resilience and facilitating an increase in demand for the localisation of sources of food and shorter supply chains. Consumers' need to reconnect time and place, and expressed concerns over climate change and the environmental impact of food production has opened the door to community supported agriculture (CSA), box schemes, farmers markets, farm shops, pick-your-own farms and food festivals. CSAs and box schemes report being overwhelmed with orders after the COVID-19 lockdowns started. This is their opportunity to convince new customers that the convenience and quality offered are value for money.

Therefore, farmers and processors supplying into foodservice through box schemes and direct delivery have responded in a flexible manner, and converted to home delivery, thus assisting in meeting the current shortfall in online delivery. Mainstream retailers have been unable to meet the rising domestic demand, yet the question remains as to whether the apparent immediate inflexibility of the food supply chain to unprecedented changes in demand becomes an event that results in the more permanent reconfiguration of food marketing and distribution channels.

With the right technology and policy are there products that European farmers could produce cost-effectively and reduce the likelihood of disruption? For instance, could highly automated "in-door agriculture" or "indoor vertical farming" produce some of the tomatoes, peppers and fresh winter vegetables? Indoor vertical farming is crop farming in vertically stacked layers or columns practiced in an indoor environment with LED lights.

Three common indoor growing systems are hydroponic, aeroponic and aquaponic. Studies of economics of vertical farming largely rely on simulation or cash flow analysis of secondary data for costs and prices (Banerjee and Adenauer 2014; Liaros et al 2016; Shao et al 2016; Avgoustaki and Xydis 2020). The number of layers in these studies vary from 2 layers to 37 floors. Crops considered include basil, spinach, lettuce, cabbage, pea, strawberry, pepper, potatoes, radish, carrots and tomatoes. Some studies included fish at the lowest level.

All studies show that the main barriers for setting up indoor vertical farming are the start-up costs, lighting costs and human costs. With the innovations in more efficient lighting and robotics in the full process of vertical farming production, packing and delivery, it is believed that the cost of production for indoor farming will be reduced substantially and fully automated robotic indoor farming will increase substantially over the next five years. This can leave the outdoor farming to cultivation of crops more suitable for large machinery (grains, non-soft fruits and vegetables such as carrots, potatoes and cabbage).

### ***How will farm work in Europe be done in the future?***

The pandemic has revealed the flaws in a fruit and vegetable production strategy that depends on seasonal foreign labour. Some firms have been able to hire domestic workers for the 2020 season, but this is unlikely to be a long-term solution. Some newly unemployed workers might be willing to do farm work as a way to earn some money and get out of the house during the pandemic lockdown, but they probably will not change their long-term career plans.

If there were practical, reliable robots to grow and harvest fruits and vegetables today, many producers would probably order them immediately. But the development of horticultural automation is in its “early days”. For example, several universities have worked on robotic strawberry harvesting, but engineers say that creating a robot that can recognize a ripe strawberry and pick it without crushing it is still some years in the future. Robotics for grain and other broadacre crops has fewer technical barriers. The Hands Free Hectare project has shown that grain crops can be completely automated and at a lower cost than many expected (Lowenberg-DeBoer et al., 2019). But the farm labour shortage is mostly in horticulture, not in broadacre crops.

***What are the public policy challenges raised by the pandemic impacts on food security and the viability of the European food supply?***

The focus of recent agricultural policy debate in most European countries and at the European Union (EU) level has been on environmental management. Political parties competed with plans of how many trees they would plant, with almost no mention of the crops and grazing livestock displaced. The pandemic has highlighted the fragility of the European food system and the number of food insecure European citizens. One of the key public policy challenges of the post-pandemic period will be to better balance food security and environmental management concerns.

The departure of Britain from the EU is a mixed blessing in the context of post-pandemic planning for the food system. In many ways BREXIT complicates the post-pandemic agriculture and food supply challenges. The pandemic has highlighted the benefits when countries cooperate. It has also revealed the limits of such cooperation and co-dependence, even where there are long standing relationships as within the EU. In an unexpected way, BREXIT may facilitate the UK adaptation post-pandemic because it provides greater flexibility in deciding on the path forward.

One of the key food system public policy issues will be support for robotics, automation and agri-tech in general. If Europe waits for the technology to be developed elsewhere it probably will not fit the specific needs of the European agricultural sector and European entrepreneurs would miss out on the business opportunity. For public funding of research and development to be effective in making the food system more resilient it must from the beginning involve the whole technology chain from researchers, to product developers, manufacturers and farmers. Research suggests that both technology design and the regulatory framework will determine the impact of robots and automation on the food system. Food supply chain robotics could result in larger firms and greater concentration, or it could create new opportunities for small and medium scale farms.

***Hypotheses:***

1. Consumer food preference changes linked to the COVID-19 pandemic are primarily due to more on-line ordering of both supermarket and prepared food, home delivery and in-home consumption.
2. Food supply chain impacts of the COVID-19 pandemic are of greater magnitude and more persistent than those on consumer preferences, including a preference for production closer to consumption centres and greater flexibility in processing.
3. Automation will increase throughout the food supply chain with co-robotics (human robotic cooperation) everywhere and automation of combinable crops leading the way because the engineering problems are tractable.

4. The COVID-19 pandemic will lead to a re-emphasis on food production and food security in agricultural policy throughout Europe.

## Methods

The methodological challenge is an ex-ante test of the hypotheses. Ex-post the hypotheses could be easily tested with econometric studies, but it will require a decade or more before the data needed for such an analysis becomes available. The length of time series can vary, but generally at least 20 observations are needed, and many models require at least 50 observations for accurate estimation. By that time, business will have made their marketing, infrastructure and other investment decisions. An early test of the changes in consumer preferences may come out of consumer surveys in the months after a COVID-19 vaccine or a treatment for the disease becomes widely available in Europe. This may require using a shorter time series with panel data or cross-section data in each time period. Cross-section data are collected at the same point of time for several individuals or countries. Some evidence regarding supply chain flexibility, shortening supply chains and automation might be provided by cost estimates. If those changes substantially reduce costs they are likely to be adopted. If they substantially increase costs, they are unlikely to be adopted regardless of consumer sentiment or political attitudes preferring local production. Initial evidence might be provided by engineering economic cost estimates based on technical specifications. More accurate cost estimates would be provided by data from on-going agricultural and food supply firms. Optimization models might be used to identify the least cost technology and supply chain combinations. Public policy is obviously a political decision, but “alternatives and consequences” analysis might provide insight on the costs and benefits of alternative environmental management and food security policies. Those alternatives and consequences analyses might use simulation, input/output or optimization models.

## Conclusions

COVID-19 has shown again that in times of great uncertainty, data, analysis and expertise count in making decisions. That is true in public health and it is also true for decisions about agriculture and the food system. Now is the time to begin counting the cost of food supply disruptions and collecting data on how consumer preferences have changed. It is the time for researchers, agri-business and farmers to work together to understand how food supply chains can be shorter and more resilient. What technologies are needed to cost-effectively produce the foods that European consumers want? What food products could be produced closer to home? For which products does holding larger inventories make sense? For which products does diversification of sources hold the greatest promise? How can public policy balance the needs of food security and the environment? The COVID-19 pandemic has disrupted the European food system, but in the longer run it could also create opportunities for those ready to adapt to the changing realities.

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