



THEMATIC INSIGHTS

A Food Revolution?

Climate, technology and the consumer in the re-shaping of the food industry value-chain



Contents

- 04 Introduction
- 06 What are the tailwinds?
- 06 Population growth and the rise in animal-based food
- 08 Agriculture and food production's contribution to emissions
- 09 A digital and more conscious consumer?
- 10 Technology transformation and food production
- 11 Sustainability in the food value chain
- 15 Conclusion



Introduction

For many people, it's easy to imagine the world has come a long way from subsistence farming when food is characterised as an experience to be shared on social media, rather than an answer to a basic need (and one that needs to be satisfied in a sustainable way). So it should, perhaps, come as no surprise that the global food and agribusiness industry is valued at around USD 5 trillion and still projected to grow rapidly¹.

Historically, as we describe below, this growth has been driven by population growth, urbanization and dietary changes that are now harder to reconcile with urgent global initiatives on addressing climate change risk, threats to biodiversity and population health.² In this Thematic Insight, we review the developments that have emerged in recent years that suggest the modes of human food production and patterns in the consumption of food may change significantly.

Alongside the sustainability and climate change challenge, consumer preferences and technological advancements (robotics, artificial intelligence, mobile technologies, biotechnology)³ are all part of a potential re-shaping of the entire food production and supply industry. We assess below the apparent tailwinds driving this megatrend and break down the value chain into such areas as food innovation, vertical farming, lab-grown/cultured meat, organic farming, use of robots, 3D food printing, mobile order and delivery systems, etc.



Finally, and perhaps as a counterweight to the excitement of technological disruption, the experience of the pandemic over the last year has focused the attention of investors on the importance of supply chain control and as part of that, the role of zoonotic disease identification, monitoring and control.⁴ We consider these to be a critical component in the capture of a potential Food Revolution megatrend.

¹ Global agriculture's many opportunities', McKinsey & Co., July 2015
² "The food revolution: the future of food and the challenges we face", UBS research, July 2019
³ See the MSCI Thematic Insights series for more detail, <https://www.msci.com/thematic-investing#insights>
⁴ "Pandemics and food systems - towards a proactive food safety approach to disease prevention & management", Aiyar, A. and Pingali, P. Food Sec. 12, 749-756 (2020).

What are the tailwinds?

The food revolution currently being debated is quite different from the so-called Green Revolution⁵ of the 1960s, where the focus was on improving crop yields and raising production with much less regard to future environmental costs. Instead, in the 21st century we may witness a transformation not only in the way food is produced but also in the way it is stored, delivered and consumed. In this section, we assess the wide range of sometimes competing drivers (i.e. food security and environmental sustainability) of the touted food revolution megatrend.



The Food and Agricultural Organization’s (FAO) estimate⁹ that over 30% of the world’s fish stocks are currently being over-fished is a reminder of how this trend has impacted the planet’s food resources and ecosystems. To compound matters, only about half of global crop calories nourish people directly; the remainder is used as animal feed or as biofuels¹⁰. These data have accelerated interest in a shift to less carbon-intensive protein and meat alternatives, which could also use limited natural resources more efficiently and with less impact on biodiversity.¹¹

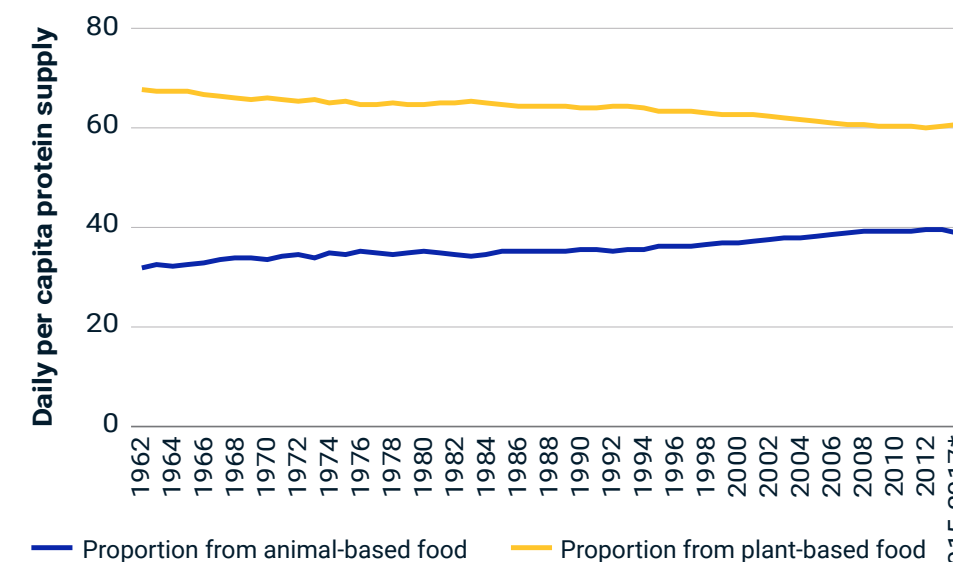
Population growth and the rise in animal-based food

Global population has been projected to increase by another 2 billion people by the year 2050⁶. This population growth is forecast to be associated with rapid urbanization⁷ and hence further potential strain on the planet’s stretched resources: food production accounts for 40% of land use and 70% of freshwater consumption globally⁸.

Moreover, as nations have become more prosperous, their diet has become skewed towards foods like meat, poultry and dairy leading to rising demand for animal feed in the form of corn and soybeans. Exhibit 1 shows that there has been a gradual but steady increase in the proportion of protein sourced from meat, dairy and seafood products vs. that from plant based products over the past 50 years.

Exhibit 1:
Shifting composition of human diet

Source: Our World in Data; FAO



*estimate for the period 2015 to 2017

5 Also called the Third Agricultural Revolution, see https://en.wikipedia.org/wiki/Green_Revolution
 6 World Population Prospects 2019, United Nations, 2019
 7 “Smart cities: Defining the trend, describing the transition”, MSCI Thematic Insights, June 2020
 8 “The food revolution: the future of food and the challenges we face”, UBS research, July 2019; UN
 9 “State of fisheries and aquaculture in the world”, FAO, November 2018
 10 “Feeding the World”, National Geographic
 11 FT Food Revolution online, <https://foodrevolution.ft.com/>

Agriculture and food production's contribution to emissions

The global climate change emergency is a second key driver of the potential food revolution. Estimates¹² of food production's contribution to global greenhouse gas (GHG) emissions can reach as high as 25%+ (depending on the inclusion of associated land use) – in particular, emissions arise from methane released by cattle, nitrous oxide due to the increased use of fertilisers and carbon-dioxide as a result of deforestation. Exhibit 2 shows a breakdown of the emissions from agriculture by various activities.

To exemplify this stark fact, McKinsey and Company calculated that cattle and dairy cows emit enough GHGs to place them second in the league table of the world's biggest emitters¹³. Moreover, many of the UN's Sustainable Development Goals¹⁴ (SDGs), namely, 11 (Sustainable Cities and Communities), 13 (Climate Action), 14 (Life Below Water) and 15 (Life on Land), focus on aspects of sustainable living that are drawing more and more attention from insitutional investors. Hence, more sustainable farming practices to reduce emissions are critical but concerted action is hampered by the fragmented nature of global agriculture (and the involvement of a quarter of the global population).

A digital and more conscious consumer?

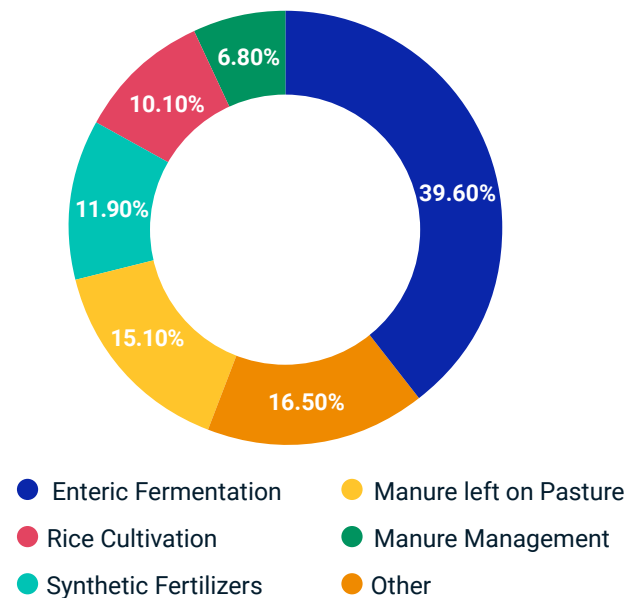
A third element of the megatrend has been the evolution of a more digital and conscious consumer: from using smartphones to check a product's carbon footprint to the use of social media alongside delivery and aggregator apps. Changes in consumer preferences and behaviors are reshaping not just food production but also how it is stored, delivered and eaten. There are greater demands for customisation and convenience and many are keen to eliminate the drudgery of frequent meal planning and supermarket trips. The experience of the pandemic has seen a further surge in the use of food delivery and home shopping apps.¹⁵

Innovations in additive manufacturing have introduced the possibility of 3D-printed food while the rise of social media has enabled instant marketing and customer reviews. The increased use of machine learning coupled with big data has enabled personalised meal planning at scale.

Furthermore, the coronavirus pandemic in 2020 has led to increased consumer focus on food safety practices and supply chains, particularly in the area of zoonotic disease (i.e. infectious disease transmitted from vertebrate animals to humans) mitigation¹⁶. Companies involved in this area focus on food and animal safety solutions for genetic identification, detection and prevention of pathogens. Other players include biotech companies that focus on the development of vaccines and therapeutics for humans affected after zoonotic transmission has occurred.

Exhibit 2:
Average agriculture emissions activity shares (CO2eq), 1990-2017

Source: Food and Agricultural Organization



12 "The food revolution: the future of food and the challenges we face", UBS research, July 2019; "Agriculture and Climate Change", McKinsey & Co, April 2020; "The Contribution of Agriculture to Emissions", FAOSTAT, Feb 2020 states that in 2017, the percentage contribution of agriculture to world CO2eq emissions from all human activities was 20%. This included a contribution of 11% from crop and livestock activities within the farm gate, and an additional 9% from related land use.

13 "Agriculture and Climate Change", McKinsey & Co, April 2020

14 <https://www.undp.org/content/undp/en/home/sustainable-development-goals.html>

15 "Post-pandemic reflections: the digital economy - an assessment of emerging risks and opportunities", MSCI Thematic Insights, June?? 2020

16 <https://link.springer.com/article/10.1007/s12571-020-01074-3>

Technology transformation and food production

Technological advances in agri-genomics, data-driven decision making in farming and robotic farm assistance have also made a significant impact on the outlook for food production, storage and distribution. Robotic milking machines¹⁷, robotic arms sensitive enough for fruit picking¹⁸, drones for 3D soil analysis¹⁹ and crop protection are already a reality on farms. Technological innovation has also enabled adoption of vertical farming techniques which claim to offer the prospect of reducing water usage by 95% and transportation costs by 90% compared to conventional methods²⁰. Moreover, growing conditions (light, humidity, temperature etc.) in vertical farms can be monitored and regulated remotely from a central location using connected devices. In a nod to this opportunity, the UK grocery retailer Ocado invested more than US\$ 20 million in 2019 to grow leafy vegetables near its distribution centres through vertical farming²¹.

17 <https://dairy-cattle.extension.org/dairy-robotic-milking-systems-what-are-the-economics/>
 18 <https://www.roboticsresearch.ch/articles/17565/strawberry-picking-robots-to-gather-enough-fruit-for-wimbledon>
 19 <https://www.sciencedirect.com/science/article/pii/S0168169918301650>
 20 Infarm, a Berlin-based vertical farming startup
 21 <https://www.reuters.com/article/us-ocado-farming-idUSKCN1TB0UU>



Sustainability in the food value chain

The global agribusiness and food industry is valued at around USD 5 trillion²² of which the global meat industry is estimated to be worth approximately USD 1.4 trillion²³. Barclays estimates that in 2020 the size of the plant-based meat segment was roughly 1% of this and project the size to reach 10% by 2029²⁴. Unilever’s recent announcement²⁵ setting a target of EUR 1 billion in annual sales of plant-based meat is consistent with this.

Other segments of the value-chain also need to be considered: smart farming, online food delivery technology, seed treatment and seed science. In Exhibit 3, we present a comprehensive view of the activities in the emerging agribusiness and food value chain.

22 ‘Global agriculture’s many opportunities’, McKinsey & Co., July 2015-
 23 Beyond Meat’s 10K filing for 2020
 24 ‘Carving up the alternative meat market’, Barclays, August 2019

Exhibit 3: A less-linear and more consumer-focused food industry value chain

Source: MSCI Research



A Food Revolution?

The importance of the **food and grocery delivery** segment has been underscored by the experience of the coronavirus pandemic. It has been critical to restaurants, restaurant suppliers, supermarkets and take-outs which have been hardest hit by diners opting to eat-in (or having no choice)²⁶. This segment has many players: from mobile apps that aggregate demand and orders to internet conglomerates that operate food delivery platforms. Exhibit 4 shows the growth of online food delivery users, worldwide, since 2017. It has also attracted e-commerce giants such as Alibaba and Amazon (the latter acquired Whole Foods and partnered with DHL to make frequent and flexible deliveries). Uber Eats and Lyft's (pandemic-driven) 'Essential Deliveries'²⁷ also

offer food and grocery delivery service. The role of cold-chain storage and logistics is a natural extension of food and grocery delivery technology.

Although yet to see wide adoption, **3D printed food** is now practically feasible. Given the importance of catering to consumer preferences, the potential to customise food to reflect nutritional needs could be key differentiator. A recent report projected the global 3D printed food market to grow at c.16% during 2020-2025.²⁸

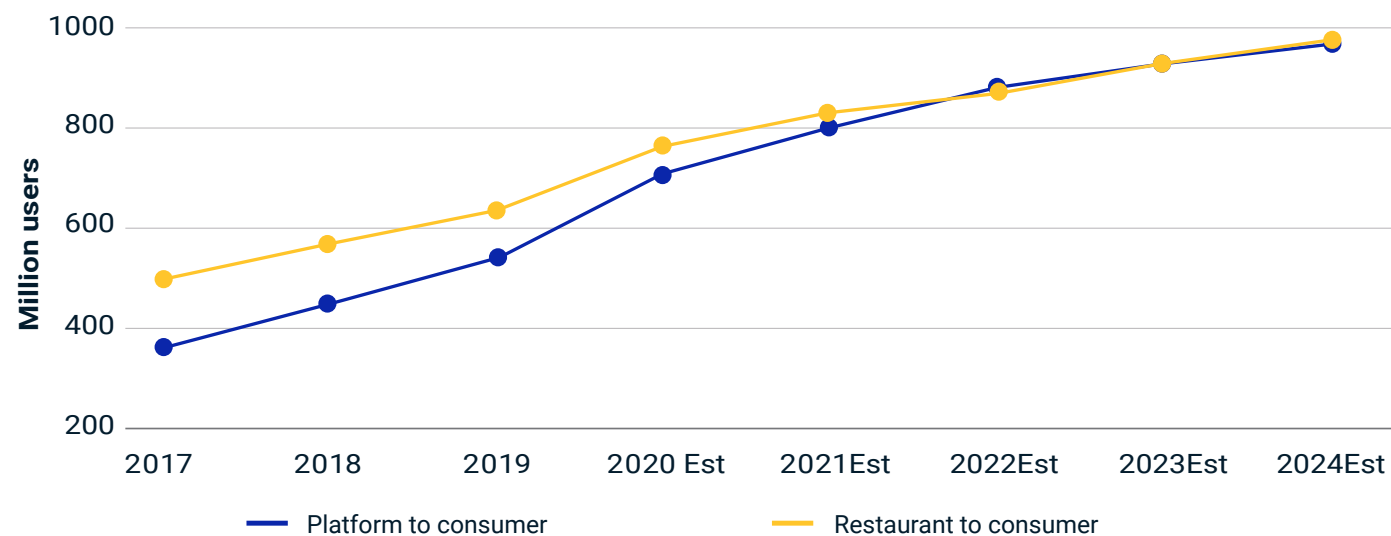
Cultured or lab-grown meat is another example of what a potential food revolution may bring. Recently, Singapore became the first country to approve the sale of cultured meat and a 'test restaurant' in Israel claims to offer the world's first cultured meat chicken burger.²⁹

Reduction of food waste is increasingly being recognised as a critical component of the food value chain. McKinsey & Company estimate that approximately 30% of crop is lost during the harvesting phase in emerging economies while most food waste in advanced economies occurs at restaurants and consumers' homes³⁰. In 2018 BCG estimated³¹ that food worth USD 1.2 trillion goes to waste globally and forecasted that this would grow to USD 1.5 trillion by 2030. The environmental impact of food waste is also staggering. According to Project Drawdown, the food we waste is responsible for roughly 8 percent of global emissions³². Moreover, food waste that is dumped in its original plastic packaging makes its way into the soil or the oceans as microplastics. A research team³³ found upto 440,000 pieces of microplastic in a single ton of compost from domestic organic waste. Companies have responded to this alarming trend of food waste. Apps enabling peer-to-peer food sharing, alerting consumers when food in their refrigerators is about to go past the best by date, and apps that facilitate the creation of secondary markets to sell food that would otherwise be wasted, have all appeared.



Exhibit 4:
Growth of food delivery users, worldwide

Source: Statista, September 2020 (Estimates adjusted for impact of Covid-19)



25 https://www.theguardian.com/business/2020/nov/18/unilever-sets-target-of-1bn-in-annual-sales-of-plant-based-foods?utm_term=.cf3be567091c7c89b727e3f7f77c966a&utm_campaign=BusinessToday&utm_source=esp&utm_medium=Email&CMP=bustoday_email

26 'Grocery delivery apps see record downloads amid coronavirus outbreak', TechCrunch, March 2020

27 <https://www.theverge.com/2020/4/15/21222008/lyft-food-delivery-drivers-service-coronavirus-pandemic>

28 '3D Food Printing', June 2020

29 <https://www.theguardian.com/food/2020/dec/04/no-kill-lab-grown-chicken-burger-restaurant-israel>

30 'Pursuing the global opportunity in food and agribusiness', McKinsey & Co., July 2015

31 'Tackling the global 1.6 billion ton food loss and waste crisis', BCG Henderson Institute, August 2018

32 <https://www.drawdown.org/solutions/reduced-food-waste>

33 <https://advances.sciencemag.org/content/4/4/eaap8060>



Conclusion

We have provided a comprehensive overview of the key activities in the changing food and agriculture value chain. We have illustrated the potentially profound impact of the three key drivers, technology, climate change and changing consumer preferences on the global agriculture and food industry. It is the convergence of transformational changes stemming from these drivers that seems the most intriguing prospect for a USD 5 trillion global agriculture and food market.



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