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Editors

Food Tech Transitions

Reconnecting Agri-Food, Technology
and Society



Springer

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Introduction

Prologue

This book was thought to contribute to the effort of bridging the main domains of academic knowledge in the agricultural field and provide a perspective on the advancement of food technology. The perspective provided here is not merely technical (also in relation to farming practices) and not exclusively social. The authors who contributed to this book come from agronomy, crop science, food technology, and of course social science and have come together to provide reflections on the food technology issues of our contemporary age. In our academic practice, we realized that often we have a fragmented understanding and vision of a sector or of a discipline, not to mention the narrow vision of main events and historical progression of our societies. Such fragmentation is often a consequence of our specializations, focused on a specific subject, which might impinge on a thorough understanding of agri-food issues. To make sense of the state of the art of food technology, there are many good textbooks, but they are of course sectoral books. This book, thought for our students, is at the crossroad of different fields in agri-food and aims at providing support to grasp the effects of some social advancement in agricultural production or, vice versa, how is innovation in a specific sector driving social change. Of course, which one precedes the other is a matter of specific occurrences, and we state the obvious when we repeat that the two are interrelated.

This book, while offering some insights into this, aims at inviting a discussion among professionals in agri-food about food technology in this historical moment, which some colleagues have defined as a transition age because of the many uncertainties in political and economic terms, and for the massive role that technology has come to play in both our private and professional lives. We are aware that the pace of innovation and social change will force new debates soon and will open up new paths in our academic fields.

Why Food Technology Transitions?

This book is designed to integrate knowledge about food-related technology with social sciences and a wider social perspective. The book tackles the advancement in food technologies that affects agronomic practices and also meals creation through the lens of wider social issues, analyzing the implications and challenges we are currently facing. We propose that a critical analysis of food technology cannot avoid questioning the impact it implies, with the disruption potential of agronomic practices, production and consumption logics, nutrition patterns, and human and environmental ethics that are associated to it. To explain why “food tech transitions,” we have to take two separate steps, starting from agri-food, in which we enucleate food tech, and then moving to technology and transitions.

(Agri-)Food and Technology

The term “agri-food” stems from and is used to highlight the development of rural social research starting from the 1980s (see Buttel and Newby 1980; Campbell 2016), but it has been employed freely in many contexts. Basically, we can differentiate three main domains which belong to agri-food: production, processing and supply/distribution, and finally consumption. Production has been for long the focus of agricultural studies, as societies were politically and economically built on the belief that everything revolved around production (Marsden 1989). Maximizing and perfecting it, ensuring that all the issues around production were under control, would have led to prosperity, for all. Whether in a Keynesian or liberist fashion, at least since post-World War II, production has been the key for social stability. This was valid for industry and manufacturing, as well as for agriculture. It has been quite a recent discovery that consumption as well has some importance, especially in agri-food (Goodman and DuPuis 2002). To recognize that the other half of food is for consumption, which has to be taken into account, marked a process of dislocation from limited understandings to a wider gaze over power dynamics, and to recognize that, consumers are embedded in social relations (Carolan 2012:281). The existence of a broader context within which food exists must be taken into account. As a result, the relationship between production and consumption and general food relation gains is of increasing importance in the analysis. It is though slightly different when it comes to the ‘middle step’, that is, processing and distribution. Our attention is for this step as the middle part of this continuum that runs from production to consumption and to which food tech belongs. Food technologies in the guise of food processing date back 2 million years ago with its oldest mode, namely, cooking (Wrangham 2009). Moving through prehistory on, other forms of food processing were framed to preserve food materials in different forms of food processing such as fermentation, drying, and preservation of food resources by additives such as salt. Therefore, our ancestors first learned how to cook the food material

and then how to transform, preserve, and store them. Food processing and preservation enabled the survival of groups, communities, and societies through history. At the end of the last ice age, by evolution of domestication of plants and cultivation methods, followed by domestication of animals, the plant and animal agriculture transformed and enhanced the growth of human communities and conditions. The experience-based knowledge of food processing which was gained through time succored humans to overcome hunger not only by harvesting food material provided by agriculture but also by their preservation (Floros et al. 2010). Although processing, understood as an activity related to transforming food from its raw status into a new one, can be traced back to prehistory, there is agreement that a more modern form of processing which includes fermenting, drying, and early forms of preserving was common knowledge for ancient societies in a quite ubiquitous way. All this happened mainly at the household level or in apt places such as workshops. From the invention and discoveries of Appert, Pasteur, or Liebig, to name just a few of the most famous scientists, so renowned and familiar to food tech and agri-food scholars, who developed important techniques and practices, the past centuries have seen an incredible advancement in terms of food processing (Stewart and Amerine 2012). And it is in the times of these discoveries that we have started to differentiate between household and industrial food, as it is after the Industrial Revolution that food technologies develop (Truninger 2013). Many of the changes in agri-food happened in terms of food being taken from the fields and “worked” before being distributed and made available for consumption, and the most important change for understanding modern food provision can be located historically again after World War II. We cannot stress enough the importance of this historical period, because it was the post-war compromise for promoting peace and stability that provided first the impetus for transformation and restructuring in the agricultural sector ushering in the green revolution as the main event which changed food production for good (Campbell 2012); and secondly the many changes in food consumption to the advancement and solutions of the food processing industry starting from mid-1950s (Pilcher 2016). That political configuration has now gone, and this goes together with the evolution of the production sector and the consumption politics which are quite central for the theme of this book. Indeed, it is in the aftermath of postwar that the term “industry” starts to be applied to agriculture and the food sector in a wider way (Friedmann and McMichael 1989). And in the next 20 years, the products of the food industry, especially of western and specifically American ones, become widely available, affecting meal patterns, supply, habits, and urban development. Thirty to fifty years after the end of war, we saw the then nascent food industry evolving in ways never envisaged before, with a huge focus on specific commodities which are disassembled and reassembled in new forms and whose components are “broken down into dozens of products (...) which found their way into thousands of processed foods” (Bryant et al. 2013:42–43). Further expansion of innovations based on science and technologies during the twenty-first century is nurturing the novel achievements in the thermal and non thermal food processing and technologies including volumetric heating methods (microwave, radiofrequency, ohmic heating, etc.) or non thermal processes such as high pressure processing and pulsed

electric field to replace the conventional methods of processing such as pasteurization and sterilization in the food industry (Floros et al. 2010). Food technologies have been an integral part of the processing industry since the beginning but are now facing a new phase that reflects the transition age we are immersed in. In fact, this millennium has seen the development of agri-food toward provision of healthy, traditional, ethical, environmentally friendly food products: the literature is ripe with research on sustainability, food provenance, and food trends as a result of the massive demand for these food products. Production had to rise to these demands. How technology fits into this last period and matches production issues is one of the key concerns of this book. There is a tension that has to be unveiled in here because production relies on many of the commodities that come from the Global South and are intended to provide for the needs of consumers in the Global North. These relationships date back centuries, inaugurating the age of colonialism (Friedmann and McMichael 1989) and the contemporary organization of food provisioning, which have become unsustainable. The new commodities available in our markets that fulfill our desires for healthy food do not provide for amelioration of these relations, and neither of environmental conditions, for what that matters.

Technological Embeddedness

Technology has been the focus of a specific branch of studies, the science and technology studies (STS), but it has been widely researched from different perspectives. Truninger (2013:87) reminds us that STS “was the result of cross-fertilization among the sociology of scientific knowledge (SSK), the sociology of technology, and the history of technology and science,” and as such, it has included the many themes of sociological, scientific, and historical inquiries. Research has addressed digitization (Peters 2016), informatization (Kallinikos 2006), datafication (van Dijck 2014), and lately also platformization (Helmond 2015). In agri-food as well, there is a long tradition of research on tech along the classical rural sociology themes of political economy and therefore production, capitalist accumulation and labor, and related themes such as ecology, genetically modified organisms, alternative food networks, participation, governance, and neoliberalism (for a lucid overview, see Legun 2016). The World Economic Forum (2017) maintains that some of the technologies now available “could be game-changing for food systems, contributing to radically new approaches along the agricultural value chain and beyond.” A good amount of the contemporary agri-food debates and research on technology revolves on the so-called Farming 4.0 and focuses on data ownership, machines full connectivity, and role of farmers (see, e.g., Carolan 2017; Michalopoulos 2015; Fraser 2018; Silva et al. 2011). The evolution of application of technology and data began in the 1990s. Yield mapping and different rates of fertilizer application have been around since then, moving into precision agriculture in a massive way at the dawn of the millennium (for those interested in a revealing anticipation of these issues back to 1990s, it is worth reading Wolf and Buttel 1996 and Wolf and Wood

1997). If the first decade of the 2000s was technologically devoted to finding integrated solutions for farmers, it is only in this last decade that we have started talking about data and have the ability to combine all of them, thanks to the advent of full connectivity of machines, tablets, and last-generation smartphones, for which user interface is paramount. In fact, “in addition to its ancillary role in delivering conventional goods and services, data has intrinsic value in developing artificial intelligence (AI) capabilities and in enabling targeted marketing” (Ciuriak and Ptashkina 2018: vi), which means that we are just at the beginning of a production and market change. It is impressive to note the acceleration of technology in these past ten years and imagine the ones to come; food tech has followed this same path, and of course, the questions our colleagues researching on technology ask for farming are valid for food technologies, specifically the one about data ownership, even more when it comes to the technologies employed at the household level.

Technology and Transition

For sustainability scientists, we are in the age of transition (e.g., Markard et al. 2012; de Haan and Rotmans 2011), specifically a transition to sustainability understood as “a fundamental transformation towards more sustainable modes of production and consumption” (Markard et al. 2012:955). The main aspect to grasp is the non-defined situation in which the ecological imperatives undermine the very existence of planet Earth; in fact “depletion of natural resources, air pollution and greenhouse gases emissions, nuclear risks, uncertainties related to short- and long- term security of supplies, and energy poverty” together with issues about water, extreme events, micro-pollutants, transportation sector issues aggravated by congestion, fossil fuel depletion, and CO₂ emissions (Markard et al. 2012: 955) have created a fragmented situation in which a new transformed stage has not been reached yet. Food-related fields of production, transformation, distribution, and consumption contribute massively to the issues of (non-)sustainability, because they touch upon many aspects of our lives. New or re-discovered crops are becoming available to global markets and this will change technology in turn. Agri-food is complex, as complex are modern societies. Such complexity is due to the many actors and many activities, coexisting or being more and more stratified. If ancient societies and agricultural practices can be considered as relatively easier to understand, modern ones are characterized by a high level of complexity because of a further element, that is, acceleration. Rosa (2013) talk about social acceleration to explain the tendency implicit in our modern societies to go faster as a result of technological acceleration and more demanding working and social conditions; this has implications on both material and immaterial aspects of our lives as individuals and as groups, as we get trapped into a loop that reinforces itself. Technology plays the central role in this sustainability as well as transition issue, because it is the engine and the outcome of this acceleration, and this is also the reason why we focus on transition as the hallmark of the past years. We have tried to keep track of our daily readings, just in newspapers and magazines,

in which the words “technology” or “data” have appeared. It is basically impossible to document it, as it has become a pervasive topic and it would be a sterile exercise to report it here. It is pervasive, embedded in the very fabric of contemporary neo-liberal society (Smith Pfister and Yang 2018). In the Global North, basically, everybody has experienced the change of our private and professional lives to the point of disruption: technology is not any longer a matter of useful tools which complement our lives, but it has become impossible to work, operate, produce, and relate to each other without it or in a pessimistic view not even to think outside of it. For Zuboff (2019), this is the age of surveillance capitalism, in which technology and data usage have reached a level of alarm for citizenship (for a critical rebuttal on the basis of political economy analysis, see Morozov 2019); for some other commentators, we have reached a critical point in which a serious debate is necessary for preserving the very fabric of humanity, from biotechnology (Harari 2016) to brain and consequent modification (Harari 2018) through biology and neurology mining.

Food Tech Transitions

What makes it a transition age is the potential that technology has now reached and the pervasive role it plays, which forces the debate to exit the mere sectorial boundaries and enter the public arena, likely paving the way to a restructuring of the industry. In fact, some of the issues that affect agri-food, first, and society, second, are relevant for food technologies too, among which we have selected the following as they are present in the literature in a growing way:

- (i) The ecological imperative that forced a change in food production in the light of the advocated sustainable turn (e.g., Friedmann 2017) will affect the industry in a radical way, not much in terms of the longed agronomic revolution but most likely for the necessary adaptation of the needs of the same industry to ecology dictates, instead of the other way around; although the industry has moved steadily into sustainability, a significant change is not yet accomplished because it would undermine the very stability of the industrial system; therefore, a long reaction time is to be expected despite the quick character of recent techno-revolutions.
- (ii) The food security imperative and the issue of food waste have been adopted by some food technology advocates to enhance the social legitimization needed (e.g., Nair 2016; Council and Petch 2015) but have to be yet fully addressed from a more analytical perspective. Both resonate strongly for a part of the audience they are intended for but cannot address some of the core issues at the basis of each, such as the still pervasive underlying productivist logic (Rosin 2013).
- (iii) The shift of emphasis from production to consumption (Goodman and Dupuis 2002) is translated in the food industry by a shift to the household level (Truninger 2013) and professional catering, such as fine-dining, of those tools and techniques previously reserved to the core of the industry, which might cause a permanent alteration of meal patterns toward full digitalization of

meal creation; this might have strong impacts at the nutritional level, might be hindered by cultural stigma for some ingredients and food, would reverse the hyper-diversification of production and specialization of some niche markets, with consequences for both production and distribution.

- (iv) Altered global geopolitics and the social stratification (Bremmer 2018), especially in a period characterized by strong migration flows (UNHCR 2018), will likely be translated in an uneven development of food technology and its adoption, reflecting the already existent divide between macro-geographic areas and cultures and reinforcing much of the inequalities and limitations that the transition age requests instead to eliminate.
- (v) The steady move toward extreme digitalization (Ciuriak and Ptashkina 2018) extended to basically all the realms of life has already started showing its limitations in terms of data access and privacy and seems to be stumbling upon some more wider ethical issues, such as integrity and trust, or compliance with governance; these have to be addressed, including the role of governing bodies in providing regulation for non-directly related aspects.

Organization of the Book

Consequently, the book is divided into two main sections, for which we propose a relevant perspective: Part One includes chapters that provide an overview of the changes of technology in production and in the processing industry and its (often uneven) advancements and the related ecological and production issues. Part Two includes chapters that address the more exquisite social science questions in terms of production and consumption, including also food-related technologies such as apps and social media, issues of societal change such as migration and the role of corporations in helping with transition. Also, we have excluded from our research new technologies such as blockchain for enabling traceability, as this pertains more to other sectors of agri-food while being central for issues of provenance.

Specifically, the first part is dedicated to the production issues in crop science and includes chapters that embrace a more agronomic and wider agricultural perspective, questioning the suitability and adaptation of existing plants and resources and novel food technologies and how they adapt to current trends in consumption and nutrition.

In Chap. 1, Khajehei, Piatti, and Graeff-Hönninger open the book through a historical overview that embraces social issues and set the questions that characterize this first part of the book: what are the food technologies we refer to, how they are situated in between production and consumption, and what are the challenges food technologies will have to face soon to be accepted. The authors embark in a historical journey following some social sciences theories, namely, risk society (Beck 1992) and food regime theory (Friedmann and McMichael 1989), to offer apt theoretical tools to correctly assess what kind of difficulties food technologies advocates and supporters will face. The authors interspersed the historical periodization offered by

food regime theory with insights provided by risk theory, highlighting the difficulties in acceptance related to the political and social situation of each period.

In Chap. 2, Niakousari, Hedayati, Tahsiri, and Mirzaee propose an overview of the food industry and its advancement. This chapter is focused on the technological advancement in the food industry. It discusses the advantages and disadvantages of novel and emerging processing technologies, such as high pressure processing, pulsed electric field, microwave heating, radio frequency heating, radiation, infrared heating, ohmic heating, ozone, supercritical CO₂, etc., to be used for food processes and serves the aim of sterilization and pasteurization, degradation of toxins, modification of hydrocolloids, removal of antibiotics, reduction of insects, peeling, extraction, cooking, blanching, drying, thawing, tempering, concentration, etc. This chapter discusses how these novel technologies can improve the availability and quality of food products while being more fast, energy-effective, and eco-friendly in comparison to conventional heat treatments.

In Chap. 3, Trierweiler and Weinert propose that appropriate post harvest management and treatment of food products, in particular fruits and vegetables, are crucial for effective and efficient use of yield produced in terms of their physicochemical attributes including chemical, nutritional, and sensory characteristics and reduce the post harvest losses. Two of the most important key factors in this regard are temperature and the composition of atmosphere around the harvested fruits and vegetables during transport and storage time, as they affect the respiration rate of fruits and vegetables after the harvest. However, appropriate postharvest storage and transport is not always available specially in developing countries. Therefore, postharvest treatments such as hot water treatment, fermentation, and controlled and modified atmosphere packaging have been used to preserve the quality of fruits and vegetables with the aim to enhance the status of food security in such regions. This chapter primarily explains the methods for determination of quality of fruit and vegetable based on their different measurable physicochemical factors, the optimal cold storage and transport conditions, as well as the process parameters for post harvest treatment of various fruits and vegetables using hot water treatment, fermentation, and controlled and modified atmosphere packaging and UV-C treatment.

In Chap. 4, Acuña-Gutiérrez, Campos-Boza, Hernández-Pridybailo, and Jiménez detail the nutritional and industrial relevance of particular neotropical pseudo-cereals. This chapter discusses briefly the origins, traditional importance, nutritional relevance, and attributes of neotropical pseudo-cereals, namely, common bean, amaranth, quinoa, chia, chan, jicaro seeds, ojoche, and Andean lupine, which are gaining more and more attention of the consumers. Their potential to be included in a diet of specific groups of consumers, such as those with food allergies and chronic diseases such as celiac disease, is explained as these commodities promise to be healthy and nutritionally important and as such fit the expectations of modern consumers. The chapter provides a revision of their application in common food products and the availability of food products designed using these neotropical pseudo-cereals which have a huge potential and are among underutilized crops.

Chapter 5, by Graeff-Hönniger and Khajehei, closes the first part of this book, wrapping the insights offered by previous contributions and focusing on one of the

current trends in the food production and consumption chain, the so-called superfoods, specifically on moringa, quinoa, chia, and yacón. This chapter is at the cross-road between the production field and nutrition issues. In fact, although there is no fixed definition for the term superfood, the term reflects the high nutrient content (e.g., antioxidants, vitamins, and minerals) in food products in general. The authors point to the emergence of low/no fat and low/no sugar products to meet the demand for food products which are healthy and/or health-promoting. The emergence of “all natural,” “free from,” and “no added” next to the trend for new diets such as “all-raw,” “free from,” and “vegan” represents the opportunity to incorporate the superfoods into the food products in such food chains. In reviewing the potentials of few superfoods to be used to new food designed for meeting specific diet requirement (e.g., gluten-free, low sugar, vegetarian, and vegan), the authors note how adaptation of super foods coming from different parts of the world from primary production to the last designed food products may help not only to benefit from their health-promoting aspect but also to enrich and revive the lost diversity of local crops. This chapter discusses the roots of consumers’ behavior and food choices and their demand for superfood as well as the challenges that the current food system faces to meet such demand.

Part Two starts from this last point on food trends and shifts the focus on mainly sociological issues. This second part of the book opens with Chap. 6, which takes us into the micro-specificities of food technology to provide a reflection on the change of production patterns. Skartsaris and Piatti reflect on additive manufacturing and its application in the context of meal creation as a chance to look into production relations. The authors focus on 3D food printers and discuss how the claims of this technology’s advocates extend to the modification of established production paradigms. The overenthusiastic series of claims that permeate this (and other) food technologies is discussed on the basis of post-Fordist paradigms; this results in the assessment of those claims that confirms how much production is still entrenched in unresolved issues that need to harness both internal and external forces and address change not on the basis of futuristic claims but on the basis of contemporary issues, which remain more problematic than envisioned by technology enthusiasts.

Enthusiasm is one of the terms employed in the next chapter, together with greening/sustainability and hedonism as characteristics of modern consumption. Chapter 7, ideally the companion of the previous one, focuses on food consumption, as we argue that a continuum between these two spheres help in addressing the transition character we refer to in this book. In this chapter, Piatti and Khajehei have searched the food-related landscape to make sense of the changes in food consumption. As some scholars (e.g., Warde 2015) have argued that food-related habits are paradigmatic of changes in consumption, the authors focus on food consumption and combine their research on some emerging trends which reflect the ecological, nutritional, health-based imperatives we have become familiar with.

In Chap. 8, Al-Sayed asks how will food technologies contribute to some of the most pressing issues that interest European and Middle East countries, that is, migration. Al-Sayed documents the migration flows of Syrian people fleeing their country, devastated by war, and arriving in Germany. The pressure posed by these

migration flows, which demographics and social stratification are quite different compared to previous migration flows, provides the chance to reflect on the role of technologies, specifically in the context of food security and safety. The embedded role of technologies constitutes a given for both our societies and the migrants; as our secure societies are forced to change in response to the presence of different social groups of migrants, it is still to be understood whether technologies, applied to our everyday life in the context of food supply and consumption, can have a role for inclusion or will impact on further fragmentation.

Chapter 9 ideally takes the questions posed by Al-Sayed in the previous chapter and takes us back to the specificities of transition, discussing the role of corporates in the age of transition. Manning has started from the concepts disseminated throughout the whole book and has reflected on the role that corporations play in transitioning to more sustainable systems. Manning has employed the concept of regimes, suggested in the opening chapter of the book, being at the core of food provisioning, to highlight the structure existing in food provisioning; she has then reflected on the constellation of players, whether they are humans or non humans, which participate in the making of food provisioning and which push for sustainable and ecological relations. This screening drove her to analyze what is central for transitions as a dynamic moment in which all players are bound to each other and co-constitute the reality of societies and markets. Transition is a matter of actions and language employed, for which truth and related values are paradigmatic. Manning arrives at the heart of transition as a matter of social relations in which corporate responsibility is paramount and reminds us that the multiplicity of factors has to coalesce if we are to face the challenges of transition.

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