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Introduction: A research agenda for food systems.

Colin Sage

> "(We) have a global food system. It's based on large multinational companies, private profits, … on the extreme irresponsibility of powerful countries with regard to the environment… on a radical denial of the economic rights of poor people… (We) have a global food system, but we need a different system. We cannot turn the global food system over to the private sector. We already did that about 100 years ago, to the private sector with the U.S. military behind it. That different system must be based on the principle of universal human dignity, the principle of national sovereignty and economic rights". Selected text from transcript of speech made by Jeffrey Sachs at the U.N. Food Systems Pre-Summit, July 27, 2021[1].

"Today's food systems are no longer fit for purpose" (GLOPAN, 2020: 16)

Introduction

Food systems have changed radically over the past 70 years and they are unfolding at an ever-greater pace. While the economic beneficiaries of current arrangements are keen to defend the status quo in order to continue 'feeding the world', a growing chorus of voices share the observations of Jeffrey Sachs – a distinguished mainstream economist - that we need a different system. This book examines some of the key issues that confront the contemporary food system, explores some of the developments that are emerging as possible design 'solutions' to system failings, and points to themes that should inform a research agenda as we move through uncertain times.

Commonly we speak of 'the food system' in the singular that, while offering a misleading sense of uniformity on the ways we eat, does accurately convey the reality that food supply chains that, now criss-cross the world and interconnect many diverse regions, do appear to be part of an integrated whole. In reality it may be helpful to imagine the 'global food system' as a 'system of systems' operating at different spatial scales with variations between and within countries and with strong multi-level interconnectedness (Baker et al., 2021). Individual nation states and their sub-national regions will likely have their own particular composition of primary food production (agriculture, horticulture, pastoralism, wild capture) differentially oriented to provisioning domestic and international markets, with imported products ranging from the critical supply of basic carbohydrate needs to

highly processed, internationally branded foods. Consequently, to speak of 'a food system' is to acknowledge the co-existence of multiple food systems, nested within different spatial scales, comprising many different actors from agricultural input providers through farmers to manufacturers and, ultimately, to eaters ('consumers') where food becomes the final resting place (almost!) for choices made. So, food systems enrol every one of us on this planet, and it is not just CEOs of transnational agribusiness corporations that have an interest as stakeholders in how the system performs.

Box 1.1: Food systems: Two definitions

"Food systems comprise all the processes involved in keeping us fed: growing, harvesting, packing, processing, transforming, transporting, marketing, consuming and disposing of food. They include the inputs needed and outputs generated at each step. A food system operates within and is influenced by social, political, economic and natural environments". (GLOPAN, 2020: 14).

"a food system gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes" (HLPE, 2017: 23).

While the term 'food systems' can be traced back into the late twentieth century, but often where it was treated synonymously with agricultural supply chains, it is only over the last decade or so where a more holistic analysis has brought food systems under greater critical scrutiny. The trigger arguably lies with the 2008-12 financial crisis where a concatenation of political, economic and social upheaval took place that further entrenched neoliberal managerialism. Rising food prices over the course of that first decade of the new millennium ultimately led to widespread civil disturbance in many countries but probably no more so than in North Africa where the rising cost of bread initiated the Arab Spring that saw the overthrow of several long-standing political regimes (Lagi et al., 2011). Food has always been a political weapon – from the Great Famines of Ireland, Bengal, Nigeria and elsewhere – to the selective deployment of relief and aid by powerful states (Sen, 1981; Crowley et al., 2012). The hungry have long known this, but now it would appear that well-fed citizens in rich countries are also becoming more conscious of the shortcomings of food systems: their inefficiencies, injustices, unsustainable foundations, and the burden of dietary ill-health for which they are responsible. In this respect more citizens, businesses and public bodies are observing that we need to create a food system that is fit for purpose. So, if the current UN Special Rapporteur on the Right to Food is correct that "The world's food systems have been failing people for a long time" (Fahkri, 2021), then this may be the moment to contribute to

a process of re-imagining what a more equitable, sustainable, and healthier food system might look like[2].

This collection, then, is a timely contribution to a growing debate about the kinds of food we eat; how, where and by whom these foods are produced; and the consequences of a productivist paradigm focussed on output volume over feeding people well. While this book will ideally attract the attention of food system scholars including graduate students exploring possible research topics that will deepen our understanding of food system failings and possible solutions, the subject matter is of greater public interest. While the act of eating connects us all to the wider, non-human world – and, indeed, can be regarded as a primary ecological practice – for most of us (at least, I assume, the readers of this book) the system which has underpinned our food security has also left us feeling dissatisfied and disempowered in decision making about our consumption choices. The food system has become a global behemoth that appears to pander to, but thoroughly controls, our dietary options. While this might appear a rather ungenerous or begrudging view given the 'success' of a system that today produces more food than at any time in history, the debit column of the balance sheet has been growing steadily longer as our awareness of the world has extended beyond filling our bellies. Section three below takes stock of the major shortcomings but which might be encapsulated here as constituting threats to both planetary health and human wellbeing.

Nevertheless, criticisms – and defence – of a system take many forms and reflect the ways in which we see the world, 'frame' its problems and consequently identify appropriate 'solutions' (Lakoff 2010). This framing process is extremely important in the ways we approach the food system and the priorities that we attach to possible 'pathways of transition' that might lead us toward a currently popular but rather rhetorical promised land: that of a 'sustainable food system'. As we shall see, it is important to pay attention to language and the ways in which powerful actors appropriate discourse in order to justify and defend their activities (maintaining 'business as usual'). Distinguishing between the different narratives of where the food system is 'failing' and their respective 'priorities for action' is the focus of section four. From there this Introduction then explores the issue of sustainability largely through a focus on sustainable agriculture and sustainable diets.

Before proceeding further, it might be as well to establish the parameters of the volume and the perspective shared by its contributors. First, as residents of rich countries, with most of us based in Europe, we are mindful of being beneficiaries of a food system that provides a high degree of dietary choice as well as food security and that such privileges are not shared equitably within our own societies and certainly not globally. Consequently, we all share a concern for a substantial improvement - if not a radical transformation - of the existing food order. Secondly, all contributors are social scientists albeit with different disciplinary backgrounds stretching from health policy to urban design by way of geography, anthropology, sociology, and political science. While attentive to the large and growing body

of health and nutrition evidence that highlight major food system failures, the volume does not examine dietary composition – what foods are eaten by whom – that might typically be found in accounts produced by scholars in the field of public health nutrition. Rather, a social science informed food systems analysis – as in other areas requiring problem-centred attention capable of developing a more holistic appreciation of the interconnections surrounding the field of study – the perspective is deliberately broader and where disciplinary boundaries are regarded as porous and capable of accommodating insights from adjacent fields. Thus, the general approach adopted throughout is one that critically evaluates existing practices and arrangements drawing upon a wide range of evidence and, where appropriate, offers a normative judgement on possible ways forward.

A further caveat on what this volume does not do. The reader will find no typology of food systems representing generalised configurations of production and provisioning arrangements in different societies. Such typologies generate categories ('rural', 'transitioning', 'mixed', 'industrialized') reflecting different levels of urbanization, reliance upon domestic food staples versus manufactured products, household expenditure on food etc. This is work that has been done elsewhere (HLPE 2017; Marshall et al., 2021). It has been suggested that "a typology can help to identify countries with similar food systems that may be more likely to share common drivers of dietary, economic, and environmental change and be responsive to similar policy actions or technological or institutional innovations." (Marshall et al., 2021: 2). Clearly this is an exercise that would harness a range of quantitative universal variables capable of distinguishing between countries in the creation of a national 'type' yet one which can often conceal heterogeneity within countries. While such work has its place in planning exercises this volume does not provide a descriptive content of food systems or ascribe categorical labels, but rather offers insights into a number of different lines of research in the rapidly emerging field of food system studies.

Consequently, the book is organised as follows. After this extended Introduction, Part II ('Issues') comprises five chapters each dealing with separate challenges facing the food system: growing corporate concentration; the climate crisis and how we might respond; the role of migrant labour in agricultural enclave production; food poverty as a structural feature of food systems; and changing configurations of animals in protein supply chains. Part III, which is rather sceptically labelled 'Solutions?' (for it will soon become apparent that there cannot possibly be one way forward), also comprises five chapters. Topics here include: options for a high-tech 'Fourth Agricultural Revolution'; the development of the alternative proteins (AP) sector; the role of municipal authorities in food system governance; the policy and practice for more circular and regenerative food systems; and, finally, a stock-taking of the design implications for the rapidly evolving food environment. Each of these chapters is briefly discussed at the beginning of each Part rather than in aggregate later in this Introduction where an extended synopsis would likely prove rather indigestible.

Representing the food system

It would be helpful at this early stage to identify some of the key elements of food systems and perhaps to attempt a schematic representation that might convey a visual sense of how these various elements are configured and interconnect. Figure 1.1 has been substantially revised from the diagram included in the High-Level Panel of Experts on Food Security and Nutrition Report on Food Systems and Nutrition (HLPE, 2017). Their original drew upon earlier versions and has since subsequently been revised and published elsewhere (Leach et al., 2020; Fanzo et al., 2021). This reveals the efforts of researchers to grapple with and try to accurately represent the complex, dynamic and adaptive nature of food systems. For if there is one abiding truth on which all would agree, food systems maintain multiple interconnections, not only internally amongst the different elements (as represented in the Figure), but also externally with a range of other systems including health care, energy, finance and transport (not shown here). Food systems, then, are complex entities and consequently subject to very different interpretations and schematic representations. In this version of what is consequently a highly iterative ongoing process, a central focus is given to the 'Food Environment', a concept that is of growing public policy attention and is creatively explored in chapter eleven.

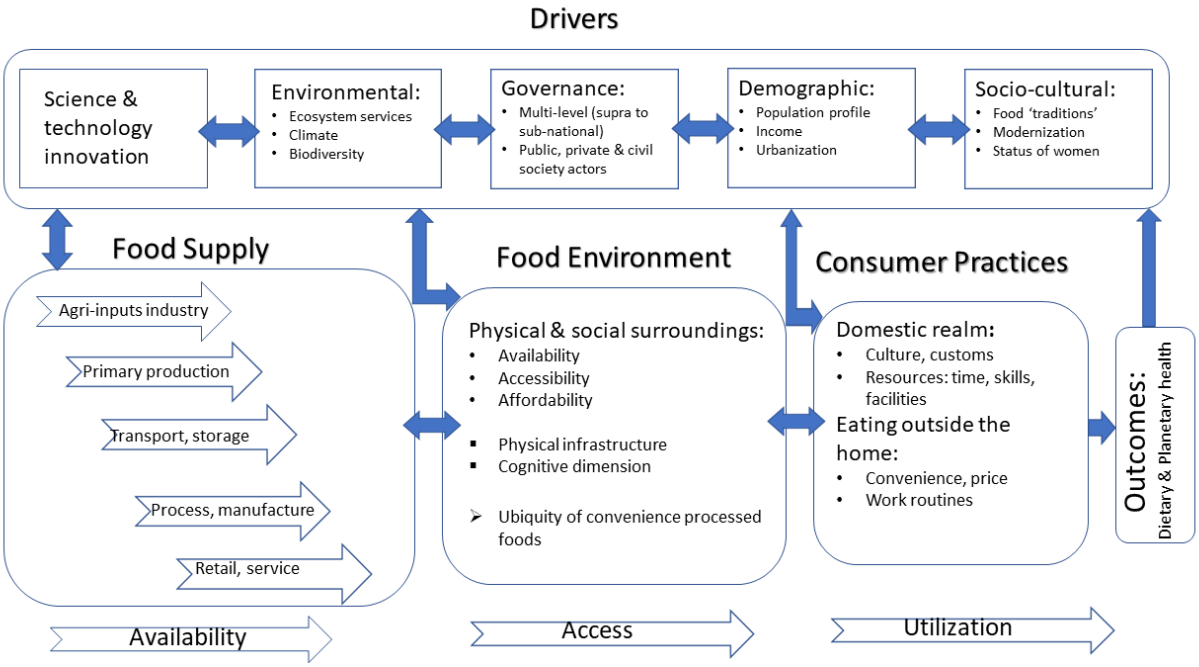


Figure 1.1: A conceptual framework for food systems

Substantially revised from HLPE 2017 Nutrition and Food Systems. Report 12. FAO

Before explaining in some detail what is meant by the food environment, attention is drawn first to the five 'Drivers' at the top of the Figure. While in the interests of visual clarity arrows are used parsimoniously, it should be emphasised that drivers are mutually and dynamically interconnected as well as with the 'food supply', 'food environment', and 'consumer practices' boxes. The first of the drivers, then, 'Science and technology innovation' has been an overwhelmingly influential driver of change in the way food systems have developed. Agricultural mechanization, plant and animal breeding and use of agrichemicals have transformed primary food production in most parts of the world and vested economic interests in this sector maintain a relentless pursuit of innovation, with some of the latest developments in digital farming outlined in chapter seven. Food manufacturing, too, has witnessed extraordinary innovation giving rise to tens of thousands of processed and packaged products which meet stringent safety protocols, many of which have become internationally recognised brands - although they may not necessarily deliver optimal nutrition to their consumers. An opportunity to better understand the pace and sophistication of technological innovation in one area of food manufacturing - the field of alternative proteins - is provided in chapter eight.

A second driver, labelled 'environmental', underpins the food system in the most fundamental way. The availability and sequestering of natural resources such as soil and freshwater together with a host of ecosystem services (the hydrological cycle, climate stability, insect pollination, genetic diversity, wild fish stocks) have enabled food production to grow. However, the demands of the food system have had enormous repercussions on the integrity and functioning of these systems, through depleting stocks and by exceeding their capacity to absorb waste streams. One of the most egregious example here is the level of greenhouse gas emissions from agriculture that is contributing to destabilising the global climate system and threatening food production in many parts of the world (discussed in detail in chapter three). Choices made about what we eat ('consumer practices') and how we produce ('supply') provide critical feedback loops to the environmental driver.

A third, labelled 'Governance' might be regarded as encompassing all forms and levels of regulation, standards setting (including consumer protection), and promotion of economic growth linked to food (e.g international trade). It ranges from the multilateral agencies of the United Nations (e.g. FAO, Codex Alimentarius) and the World Trade Organisation, to supranational entities (the EU and its Directorates-General such as DG Sante and DG Agri), and trade blocs ('Mercosur', 'NAFTA') to national and local government and also food businesses. Globalization, which many of these institutions have promoted, has been a critical factor during the past forty years in reshaping diets around the world and in driving the nutrition transition (discussed below). World trade in food has reached staggering levels with FAO estimating that the world's food import bill in 2021 was $1.72 trillion, up 12 percent from 2020 (FAO 2021). While the orthodox perspective is that growth in world

trade is good for food security and economic prosperity more generally, at the time of writing there is considerable anxiety at rising food prices. While there are likely to be a host of contingent variables, higher energy costs appear to be the most critical factor at this moment (FAO, 2021), and further demonstrates the tight interlocking of the food system with fossil fuel markets (Sage 2013). The higher cost of food does not necessarily imply a lack of availability, but it does severely impact on access by those on low (and increasingly middle) incomes to secure their dietary needs. National governments are generally reluctant to intervene in the market – and so wring their hands over rising prices – but they can implement dietary guidelines, particularly in response to evidence of rising levels of ill-health. The introduction of 'sugar-taxes' on carbonated beverages is one example here, introduced partly to encourage product reformulation by manufacturers as well as purchasing behaviour by consumers, but with limited benefits to date. This driver, then, embraces a large cast of actors as befits accepted understandings of multi-level governance, and where the influence of corporate interests can shape policy outcomes.

The fourth driver is labelled 'demographic' and can be regarded as covering all aspects of a population within a country or region. Besides the usual indicators of growth (birth, death), health and wellbeing, the degree to which societies become more urbanised is a powerful driver of food system change. With two-thirds of the world's population living in cities by 2050, it is likely that demand for more diverse foods including higher protein sources will drive further change within food systems and their supply chains.

The final driver 'socio-cultural' is by no means insignificant simply as it is the last to be addressed here. Food practices and consumption patterns still reflect personal identity and social relationships even in those societies where the food system has been transformed over many decades. Where cultural traditions persist, food is likely to perform an important role in drawing people together, creating moments of commensality. Yet open, 'modernizing' economies not only feature a range of new products introduced through greater international trade but create circumstances for more far-reaching social change, not least affecting women. As the HLPE report argues, the status of women around the world influences food systems and diets: across the multiple roles of care-giving and production inside and outside the home, in most countries women decide what the household eats (HLPE, 2017). On the other hand, some qualitative studies have shown that women's efforts to improve family diets are resisted by male partners and children within the household who are reluctant to change their food preferences (McBey et al., 2019).

The food environment might be regarded as the 'interface' between food systems and diets and, at one level, provides a lens through which to examine physical and social surroundings that enable people to fulfil their dietary choices, with food being available, accessible, and affordable (Turner et al., 2018). In practical terms and at a neighbourhood level this might involve mapping the number and distribution of different food outlets, whether supermarkets, convenience stores, open air or municipal markets, take-away and other food

service establishments. A great deal of research has established the limited availability of fresh and healthier food options in low-income neighbourhoods many of which seem disproportionately served by fast food outlets (Pitt et al., 2017). However, beyond the physical infrastructure of the food environment lies a deeper cognitive world – revealed through the science of semiotics – where messages communicated through promotion, advertising, and incentivisation exert such a powerful influence over actual eating practices (Riley and Cavanaugh, 2017). It is this hidden dimension of food environments that play such a key role in unhealthy eating practices leading to weight gain (Neve and Isaacs, 2021). Paying closer attention to the complex dynamics unfolding in the food environment is consequently critical to understanding the process of nutrition transition (Popkin et al., 2012). This is especially characterised by rising levels of consumption of highly processed foods – foods high in salt, sugar, fats – that underpins the growing burden of diet-related disease in low and middle-income countries (Popkin and Reardon, 2018; Basu, 2015). In this regard it is important to remember that food environments are largely commercially-driven spaces promoting and marketing products designed to optimise revenue streams rather than benefit public health. In doing so they translate patterns of demand into production signals that further entrench the availability of unhealthy and unsustainable foods (EU Food Policy Coalition, 2021).

In the Figure the food environment is sandwiched between boxes representing food supply and that of consumer practices. The first encompasses each of the steps involved in the production and supply of food products available to the food environment. The inclusion of the agricultural inputs sector is essential given its power and influence over what is grown and how. The food processing stage should also be highlighted as its capacity to supply an extraordinary volume and array of durable, hyper-palatable, and convenient ultra-processed products has had far-reaching effects on many of its most loyal customers (see below). However, the overall sequence of stages – from farming, to processing and manufacturing of final foods and their delivery into retail and food service sectors – is straightforward and not under scrutiny here[3]. The food supply 'chain', with all of its logistical and technological sophistication consequently makes food available within the food environment. Consumer practices ultimately determine how food is utilised through the exercise of domestic and individual choice and then metabolically by our bodies as ingested nutrients give rise to dietary outcomes (health and vitality, accretion of body mass, susceptibility to disease etc). However, this physiological observation should not disguise the fact that ultimately individual decisions about what to eat are shaped by advertising, social norms and the daily pressures (time, money, commitments and responsibilities) of life.

Consequently, a schematic mapping of the food system draws together: planetary scale geo-physical processes; decision-making by powerful corporate actors; the work of over two billion farmers, agricultural labourers, food manufacturing operatives and retail staff; the everyday choices and actions undertaken by almost eight billion individual eaters; and, ultimately, the metabolism and microbiology of the human body as it converts food into life.

In this respect it is vital to enquire into the nutritional value of food – its macro- and micronutrient composition, bioavailability of antioxidants, fibre etc – and whether supply chains are providing the basis of a healthy, diversified, and balanced diet. Are supply chains, for instance, delivering into a given food environment sufficient quantities and quality of fruits and vegetables, minimally processed and fortified foods that are physically and economically accessible to citizens? Or is that food environment dominated by ready-to-eat products that contain higher amounts of saturated fat, sugar and sodium and which are heavily promoted - including online and television advertising to children and products that emphasise 'fun' – that result in unfavourable dietary health outcomes? (Chacon et al., 2015; Elliott, 2015) In this regard such questions help us to better understand the distribution of power and the real motivational drivers that lie behind the operation of the contemporary food system.

Food systems failings

Much has been made of the technological achievements of the contemporary food system to feed a world of almost eight billion people. As Barrett and colleagues point out, agri-food systems were engineered primarily to "boost productivity in delivering dietary energy supply" and they have "succeeded fabulously in that goal" (Barrett et al., 2020: 974). While world population doubled between 1961 and 2003, global food production increased by 2.5 times increasing the average per capita availability of food (Caron et al., 2018). For others this 'intensification paradigm' has been "tremendously successful in increasing agricultural productivity and keeping food prices low" (Fanzo et al., 2020: 3). Yet while there has been generally continuing improvement in the per capita availability indicator over recent decades, regional crises have demonstrated inequalities in access to food due to limitations in people's purchasing power particularly, but not only, at times of food price volatility. In this respect a policy focus on boosting production to increase food supply has not significantly improved global food security with the numbers of hungry and malnourished people on the rise since 2015 (FAO et al., 2019).

This suggests that it is becoming increasingly urgent to revise our understanding of what constitutes food system 'success' which has been so closely tied to food security, a concept which is examined in more detail below. For, as we will see, if there is one pillar that has anchored food security discourse over the second half of the twentieth century, it is the central role of interconnected technological developments, involving seeds, chemicals, and machinery, to achieve greater volumes of food output. This productivist paradigm is now coming under increasingly critical scrutiny given the multiple problems that have arisen as part of this singular focus. Some of the key problems are briefly identified and discussed here as we take stock of food system failings.

Inadequate diets: More than one-quarter of the world's population experienced hunger or did not have regular access to nutrient-rich and sufficient food in 2019. An estimated three billion people lack access to affordable, healthy diets (GLOPAN, 2020). Currently, 1 in 9

people – 820 million worldwide – are hungry or undernourished, with numbers rising since 2015, especially in Africa, West Asia and Latin America (FAO et al., 2019). Some 2.37 billion people – nearly one in three – faced food insecurity at the moderate or severe level in 2020. These numbers climbed steadily since 2014 and experienced a sharp increase in 2020 as the COVID-19 pandemic took hold (FAO, 2021; Béné et al., 2021). Globally in 2020 undernutrition was responsible for: nearly 150 million children under 5 estimated to be stunted (too short for age); 45 million estimated to be wasted (too thin for height); and around 45 percent of deaths among children under 5 years of age (WHO, 2021).

Diet-related disease: The links between diet and disease are becoming ever clearer and understood as a triple burden of undernutrition, deficiencies of vitamins and minerals, and diet-related noncommunicable diseases (NCDs) . The paradox of the contemporary food system is that given the numbers that are chronically food insecure, almost two billion are overweight or obese with the fastest rate of growth in middle- and low-income countries. The co-existence of undernutrition, overnutrition (obesity) and climate change has been labelled 'The Global Syndemic', being a synergy of epidemics that interact and share common underlying societal drivers giving rise to complex outcomes (Swinburn et al., 2019). Changes in food systems that have led to the availability, indeed ubiquity, of highly processed foodstuffs that are affordable and convenient have resulted in unhealthy dietary patterns (Moodie et al., 2013). Sub-optimal diets are now responsible for 20 percent of premature (disease-mediated) mortality and at least 11 million people die every year from specifically diet-related illnesses (GLOPAN, 2020). Yet there is considerable inequality in health profiles, including within rich countries, reflecting differential access to healthy diets. For example, in the United States over 16 percent of youth aged between 10 and 17 years of age had obesity with Indigenous, Black, and Hispanic youth recording rates that were more than twice the level of White and Asian youth. This places them at much higher risk of Type 2 Diabetes and high blood pressure (Robert Wood Johnson Report, 2021).

Climate breakdown: the food system's contribution to global heating has come under increased scrutiny in recent years and it has been attributed with responsibility for between 21 and 37 percent of global greenhouse gas emissions (Xu et al., 2021; IPCC, 2021). Based on current trends, food system emissions alone would prevent the achievement of the 1.5°C target established under the 2015 Paris Agreement - irrespective of fossil fuel emissions reduction in other sectors (Clark et al., 2020). The largest source of uncertainty in the remaining carbon budget relates to the short-lived greenhouse gases methane and nitrous oxide both strongly linked to agricultural production. The wider interconnections between climate and the food system, including the benefits from methane reduction efforts, are discussed in more detail in chapter three.

Loss of biospheric integrity: The production of food is the main cause of biodiversity loss through the conversion of land from primary ecosystems to agriculture. The area of land occupied by crop and livestock production has increased by around 5.5 times since 1600 and

now occupies about 50 percent of the world's habitable land (Benton et al., 2021; Ritchie and Roser, 2020). The destruction of habitats such as forests removes sources of food and shelter on which wildlife depends. Since 1970, the collective weight of wild mammals has declined by 82 percent and now account for just 4 percent of global mammalian biomass, while a small number of domesticated livestock species (principally cattle and pigs) account for 60 percent of all mammals by mass, with humans representing 36 percent (Ritchie and Roser, 2020). A similar picture emerges from the realm of birds with 70 percent of global bird biomass now comprising domestic poultry, partly reflecting the catastrophic decline in farmland birds as well as a vertiginous increase in the numbers of broiler chickens. The loss of habitat, removal of sources of food and, of course, the widespread use of agrichemicals have also been responsible for one of the greatest concerns among ecologists today: the disappearance of insects (Goulson, 2021).

Moreover, the expansion of high external input agriculture has resulted in the depletion and contamination of freshwater resources with two-thirds of global withdrawals from rivers, aquifers and groundwater extracted for irrigation. The production of water-intensive commodity crops for globalised supply chains can severely exacerbate the risks of local water scarcity (Qu et al., 2018). Meanwhile, the management of soil fertility under conventional agriculture has been largely reduced to ensuring the availability of three macro-nutrients – nitrogen, phosphorous and potassium – which are provided through copious applications of synthetic fertilisers. With nitrogen uptake by crops worldwide estimated at 43 percent, this means that over half of the fertiliser applied is lost to the environment and contributes atmospheric emissions of N_2O and leaching of nitrate into waterways that causes eutrophication (Sage, 2022). Food production creates around 32 percent of global terrestrial acidification and around 78 percent of eutrophication. These emissions threaten the biological composition and resilience of natural ecosystems (Poore and Nemecek, 2018). Overall, then, the food system constitutes a major driver of environmental degradation and requires a profound change if it is not to put at risk planetary boundaries that constitute a safe operating space for humanity (Springmann et al., 2018).

Wider ecological and health consequences: The intensification of agricultural production has given rise to a wide range of problems given the path-dependent pursuit of industrial technologies particularly around the use of chemicals. The rise of glyphosate, commercially developed by Monsanto under the label 'Roundup' to become by 2015 the most widely used herbicide around the world, is an illustrative example. Clapp (2021) traces the way in which glyphosate was taken up as a less toxic alternative to other herbicides. Yet one of the first problems to emerge given its repeated field applications was the development of glyphosate resistance in weeds. Subsequently, the toxicological effects on human health became more widely recognised, first through direct exposure in application (resulting in cases of non-Hodgkin's lymphoma and other cancers), and then through wider concerns arising from the ingestion of residues on food and through drinking water. Yet the

entrenchment of glyphosate in agriculture, Clapp argues, was through overlapping configurations of technology, market, and regulatory forces – including the genetic engineering of herbicide tolerance in such crops as soy, cotton, maize, and rapeseed/canola. The rapid spread of genetically modified (GM) crops has been one of the most controversial issues within the food system over the past two decades and it remains a highly contested matter involving regulatory agencies, agrichemical corporations, farmers representatives and civil society organisations[4]. Given glyphosate's seemingly irreplaceable role in conventional agriculture it is worth highlighting Arcuri and Hendlin's observation that it has the dubious distinction – alongside tobacco - of having multibillion dollar legal settlements made against it for health harms and deaths of hundreds of thousands of product users, while still being legally available on the market (Arcuri and Hendlin, 2020).

A second issue which we briefly note here is the role of pharmaceuticals in industrial livestock production; specifically, the prophylactic use of antibiotics to accelerate weight gain and control infection in food producing animals. While the use of growth promoting drugs has been banned in Europe, recombinant somatotropin, rBST (previously called bovine growth hormone), which is a genetically engineered hormone injected into dairy cows to increase milk production, is still widely used in the USA. Moreover, while there are complex pathways connecting human and animal health, the widespread veterinary use of broad-spectrum antibiotics commonly used to treat a range of infections in humans is of growing concern. Antimicrobial resistant infections were directly responsible for an estimated 1.27 million deaths worldwide and associated with 4.95 million deaths in 2019 (Antimicrobial Resistance Collaborators, 2022). This is simply a further illustration of the need to develop a more holistic One Health approach to life on earth that works to prevent zoonotic spill-overs of infection via food (as Covid 19) and to avoid inappropriately narrow 'techno-fix' responses such as mass application of veterinary prophylactics (Sinclair, 2019).

***Labour in the food system*:** The first phase of the Covid 19 pandemic brought into sharp relief the issue of labour in the food system. A shortage of seasonal agricultural workers as a consequence of quarantine measures or illness affected many countries especially in the horticultural sector (Stephens et al., 2020) as well as meat processing and packing plants[5]. This sudden interest on labour in food was welcome but may yet be short-lived as supply chains return to normal. For the conditions which characterise many intensive agricultural operations around the world persist. These include: exploitation - long hours, for low pay, often on piece rates; precarity – a lack of certainty about work and pay often on a day-to-day basis; unsafe and hazardous working conditions including exposure to toxic chemicals without adequate protection; and forced labour and human trafficking in global supply chains, including the use of child labour. One illustration of the latter is the 'caporalato' (gang-master) system that controls migrant agricultural labour in Italy and has long been linked with mafia networks in the South (Oxfam 2018). Chapter four provides a more detailed examination of agricultural labour in the food system. However, it should also be noted that long hours for low pay is not confined within the farmgate: many factory

operatives within food manufacturing and shop-floor staff in food retail experience poor working conditions. A continuous downward pressure on costs – including wages – has been an over-riding characteristic of the food system.

Food waste: There is general agreement that food waste is a problem that 'ought' to be addressed given that around one-third of all food produced – around 1.3 billion tonnes per year - fails to reach a human stomach. It is an issue that has been extensively documented at the highest levels for well over a decade (FAO, 2011; HLPE, 2014; EU-FUSIONS, 2016) and so it is not discussed in detail here. Though often treated as an issue of morality – to throw away food when people are going hungry – it is vital to recognise that the production of surplus food in excess of demand is, in fact, a structural feature of the prevailing food system. As Messner and colleagues observe, "large-scale increases in supply, combined with the ongoing rise of food mass retailing and related dietary transitions, have contributed to food waste creation and overconsumption along the entire food supply chain" (Messner et al., 2020: 806). There are, of course, multiple issues arising from food waste creation and its management, not least the loss of embodied resources (energy, water) and the aggregated carbon footprint arising from these inputs and waste decomposition. Together these make food waste the third largest source of greenhouse gas emissions after China and the USA (EU-Fusions, 2016).

***Corporate power and inequality*:** long-standing structural inequities related to class, gender, ethnicity, and the legacies of colonialism reflect the ways vested interests continue to disproportionately exercise power and influence across the food system. Injustices take many forms, for example small farmers lose access to land and other resources necessary for their livelihood as a consequence of state sanctioned appropriations (land-grabbing) in favour of export commodity production. At the other end of the food system nutritional security may be compromised through the unregulated availability of junk foods with little provision for healthier options. The concentration and market power of a small number of corporate entities that exercise enormous control over the food system and exert considerable influence over national and international policy is becoming a concern amongst many observers (Lauber et al., 2021; Clapp, 2018; Stuckler & Nestle, 2012). How do such structures reinforce or alleviate the widespread inequity and injustice in access to food experienced as a lived reality by billions of people? This is addressed by Chapter five which argues that the food system itself, sui generis, can be a cause of food poverty and food insecurity experienced both by those upstream (farmers, labourers) as well as those downstream (consumer-citizens). Arguably, the recent expansion of food banking across most wealthy countries reveals the sharp contradictions of a system oriented to structural over-production disposing of its unwanted surpluses through charitable food 'partners' to those in 'need'. While the dominant narrative is one of 'win-win' benefits – saving food from going to waste by giving it to those who cannot afford to buy it – corporate influence in this sector is powerful and serves to block a more critical analysis of the underlying drivers of food poverty and hunger in rich societies (Kenny and Sage, 2019; Riches, 2018).

In concluding this section, it is acknowledged that the above can only be regarded as a superficial treatment of some key failings of the food system, although subsequent chapters explore some of the issues in greater depth. It is also important to recognise how these different problem categories interconnect in complex ways and why they need to be approached in a manner that facilitates trans-disciplinary enquiry. For example, it is not perhaps widely appreciated that rates of suicide amongst farmers are way above any other occupational category: 3.5 times that of the general population in the United States; with hundreds of thousands of lives lost in India since the mid-1990s. While a complex social pathology underpins such personal and domestic tragedies, indebtedness is invariably the single most common feature – revealing the capacity and determination of financial interests to extract value from land without itself being directly responsible for production – and where ready access to means, especially toxic agri-chemicals, account for the majority of deaths. For agricultural labourers, meanwhile, exposure to extreme temperatures are exacerbated by climate breakdown, and this category accounted for almost half of the 295 billion potential work hours lost due to heat in 2020. Besides toiling in rising temperatures, it is these already vulnerable workers who will also experience the economic consequences as wages disappear in the face of crop failure and drive them, in desperation, into international migration as trafficked labour (Romanello et al., 2021).

While we cannot always anticipate the outcomes of dynamic systems as different elements within them synergise or collide, it does demand that food systems scholars develop a broader, trans-disciplinary and longer-term perspective in their analyses. Events over recent years have clearly demonstrated that food systems at all scales around the world must become more resilient to the kinds of 'black swan' events represented by Covid 19 or cyber-attacks. Instead, the pursuit of 'just-in-time' practices within supply chains leaves the food system vulnerable to breakdown (see Jack, 2021 for an analysis of UK supermarkets)[6]. Let us now turn to better appreciating the different ways in which food system failures are framed and potential solutions for improvement are proposed.

Food system narratives

As noted above, many diverse sources of commentary and analysis have highlighted the 'failings' of contemporary food systems and urged the need for change. In an in-depth review of this literature, Béné and colleagues (2019) sought to identify the different narratives within these documents and the ways they framed the failures of food systems and where the priorities for action (the 'solutions') might be found. Their analysis led them to propose four distinctive narrative themes with each identifying a different structural problem and for which resolution would require divergent trajectories of intervention.

Their first, which they label 'food security', reminds us of the persistent preoccupation with producing sufficient food to feed the global population. This is, of course, a valid anxiety

given that barely half a century ago, before the production achievements of the Green Revolution were visible, large areas of the Global South survived precariously with barely sufficient availability of cereals. Today, however, although the evidence demonstrates that we produce enough food to feed everyone well, as noted above billions of people remain malnourished. The popular food security narrative, however, speaks of the need to 'close the yield gap', that is to produce a greater quantity of calories to feed the growing population. Most frequently it is expressed plaintively as 'How will we feed a population of ten billion by 2050?' (UNEP, 2022).

The concept of food security has existed for many decades although interpretations of how it is understood have evolved. A long-standing definition that emerged from the 1996 World Food Summit proposed that food security is said to be achieved when "all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life." This definition has long rested on four pillars: availability, accessibility, utilisation and stability where availability is regarded as necessary, but not sufficient for access; access as necessary but not sufficient for effective utilization; and stability as a cross-cutting factor that is necessary for the others to hold (Clapp et al., 2022). Arguably this hierarchy has served to privilege availability with an implicit bias toward a global solution: producing more food to feed a growing world population – a neo-Malthusian framing frequently forming part of this narrative. In this way food security is treated as a scientific problem requiring purely technical solutions and where proponents of this narrative focus on the low yields of indigenous farming systems and argue that modern technologies could do much to achieve food security across the poorest countries. Consequently, it is of little surprise that this narrative has been so enthusiastically promoted by those largely in favour of 'business-as-usual' solutions where genetic engineering of seeds (and animal bodies) together with chemicals (proprietary herbicides) alongside new technologies (AI, drones, robotics) are presented as potential saviours[7].

Such a framing of the problem then narrowly circumscribes the kinds of solutions that are consequently proposed. A focus on projected population numbers encourages a sense of urgency, an imperative, for which agricultural technology appears to provide a ready-made solution. This globalised perspective fails to recognize, of course, that food security should largely be embedded in local ecosystems managed by local people (Sage, 2019). This helps to better understand the need to add two further dimensions to the existing four pillars of food security: agency and sustainability (Clapp et al., 2022). Agency can be regarded as the ability to express, exercise, and execute personal views and decisions in the interests of oneself and wider community well-being. However, it extends beyond the idea that people have a voice in matters of food security but, rather, become effective stakeholders within food systems, a change that will unsettle existing inequalities in the distribution of power.

The second additional dimension, sustainability, emphasizes “the connections between ecosystems, livelihoods, society, and political economy to maintain food systems and support food security into the distant future” (Clapp et al., 2022: 5). We explore issues surrounding sustainability in a little more detail below. However, here it is clear that both concepts help to establish a much broader systems perspective that take us from a linear ‘problem ⇨ solution’ approach and toward a place where socially and ecologically appropriate, multi-dimensional measures might be formulated by local people that offer different visions and options for bridging this ‘yield gap’. Such measures might include changes in crops and farming methods, dietary practices including efforts to reduce food loss and waste, as well as social initiatives (work and labour practices, new institutional arrangements, networked collaborations etc).

Béné et al.’s second narrative focusses upon the inability of the food system to deliver a healthy diet and might be captured by the label ‘nutrition security’. Here, as they observe, the problem has shifted from quantity to quality: the reviewed literature acknowledging that sufficient food is being produced today yet so many still remain malnourished with serious implications for human health. Here, issues become more nuanced as we move from the supply of sufficient calories to an appreciation of micro-nutrient deficiencies and even the availability of foods that contribute to dietary ill-health and obesity. This more strongly nutrition-centred disciplinary approach segues into their third narrative category which might be labelled ‘social justice’. This builds upon the second but rather highlights the gross social inequities that underpin differentials in accessing healthy diets. Furthermore, this distributional injustice is intrinsic to a food system increasingly concentrated in fewer corporate hands that reinforces existing structures creating greater vulnerability.

As one might expect, although the second and third narratives share a concern for human wellbeing, their ‘priorities for action’ take quite different pathways: targeted nutrition interventions to improve diets in the former as opposed to a range of social, economic and political measures challenging injustice. However, if the latter might be encapsulated by aspirations for greater food sovereignty – where communities exercise control over what foods are produced and distributed within their territory in the interests of local livelihoods and dietary health – then we might imagine the possibilities for bridging the second and third narratives through the promotion of greater agricultural biodiversity. It has been noted that while 10,000 plant species have been used for food since the origin of agriculture, only 30 crops now provide 90 percent of the world’s calorie intake with four – rice, wheat, maize and potatoes – supplying 50 percent of energy needs (Hunter and Fanzo, 2013). The nutritional and ecological importance of underutilised indigenous crops has been widely recognised (Fanzo et al., 2013) yet remains marginalised by a dominant food system centred upon the intensive production of a narrow range of commercially-bred seeds. The greater deployment of plant genetic diversity by communities offers a pathway towards improving nutritional security while also addressing structural inequities in accessing food, and thereby reveals possible synergies between different narratives if the lens is widened.

The fourth, and final narrative that Béné and colleagues identify is that surrounding the impact of the food system on the environment and natural resources. Some of the most egregious impacts were outlined above including land use change and biodiversity loss; freshwater depletion, and greenhouse gas emissions. Although the entire food system shares responsibility – from primary production through distribution and retail to consumption - the evidence is clear that the greatest impacts occur at the agricultural stage and this has driven calls for more sustainable farming methods in producing our food. However, much as the term 'food security' has required careful consideration with the deployment of additional dimensions to make it 'fit' for our contemporary circumstances, so the term 'sustainable' needs review and recalibration. This is especially so given the way in which it has become a prefix *de nos jours*, appropriated by powerful interests and promiscuously deployed often with little concern for precision or honesty. In order to render more transparent the practice of 'greenwashing', making environmental claims for a product or process that are not borne out in practice, we turn to examine the meaning of 'sustainable' in relation to the food system[8].

'Sustainable' food systems

Approaching the topic of *sustainable* food one is reminded of a character from Lewis Carroll's Through the Looking Glass:

"When I use a word," Humpty Dumpty said, in rather a scornful tone, "it means just what I choose it to mean—neither more nor less." "The question is," said Alice, "whether you can make words mean so many different things." "The question is," said Humpty Dumpty, "which is to be master—that's all." (Knowles, 2009:203).

As is generally well known, the term sustainable development first gained currency in the wake of the 1987 report of the World Commission for Environment and Development (the 'Brundtland Commission'). It famously captured the necessity of longer term thinking through a definition that drew attention to ensuring that meeting the needs of the present generation would not compromise the ability of future generations to meet their own needs. Moreover, it sought to give equal weighting to the pursuit of economic, social and environmental objectives often represented as overlapping circles across which trade-offs would be determined. Given the hazards of attempting to universalise human needs across cultures and over time the notion of 'needs' left unanswered questions about how these might be defined in the context of development, population growth, changes in patterns of consumption and environmental capacities. For many the sheer vagueness of the term as well as being an oxymoron – how can economic development and environmental conservation actually be reconciled? – meant outright hostility in certain quarters where it was regarded as providing 'green cover' for development planning and environmental managerialism. Others, however, saw in the term not strict definitional clarity but the promise of a shared discourse, the basis of a 'thinkable opposition' to the capitalist status

quo, and the space to (re-)imagine environmental justice, ecological rationality, and human wellbeing (Springett and Redclift, 2015).

'Sustainable' is now a ubiquitous feature of the food system vocabulary and while it might 'promise' a shared discourse it remains subject to many different interpretations and vulnerable to being used as something of a Trojan Horse to greenwash 'business-as-usual' practices, as is briefly outlined with regard to Irish agricultural policy in chapter three. Nevertheless, with the adoption by the United Nations in 2015 of the 17 Sustainable Development Goals (SDGs) the world has begun to appreciate the embeddedness of food to human well-being and planetary health. As evidence, of the 17 SDGs there are 160 specific targets with around 70 of these connected to food. There is widespread and high-level agreement that the current food system is not sustainable nor just (Group of Chief Scientific Advisors, 2020) yet there is little agreement beyond generalised statements of what a sustainable food system would look like[9].

A major part of the problem here lies with the multiplicity of components that need to be incorporated and evaluated if a food system is to be assessed on a performance scale of sustainability. Such components might include a host of environmental impacts (greenhouse gas emissions, water pollution, biodiversity loss etc); resource use (land, water); effects on human wellbeing (dietary health); animal welfare; and remuneration and working conditions along supply chains. Measurement of these many different variables then involves a system of trade-offs between them to ultimately deliver some 'index of performance' that might then be communicated to the consumer of a product or service (Broom, 2021).

However, given the complexity of this process it is probably more helpful to look in more detail at two key areas where the term has been applied more concretely: as sustainable agriculture and as sustainable diets. Selecting these points at either end of the food system does neglect the commercial activities of companies working along the food chain in processing, manufacturing, food service and retail. However, there is a wide variety of positions here: from defensiveness including active lobbying against proposed labelling and regulations to improve environmental performance, to enthusiastic engagement with a sustainability agenda. Such diverse attitudes from different board rooms reflect on the particular sector and product mix in which businesses are engaged. For example, the global giant food service company Sodexo, with nearly half-million employees worldwide, has recently renewed its partnership with WWF to improve its "sustainable food offer and purchasing practices" (Sodexo, 2022). Besides 'doing good' it must see in this strategy an opportunity, inter alia, to differentiate itself from competitors; enhance its brand; build customer loyalty; make efficiency savings and reduce costs; raise staff motivation; and, ultimately, improve profit margins (Mason and Lang, 2017). Elsewhere start-up companies have proclaimed their sustainability credentials through engagement with, for example, alternative proteins as meat substitutes. Overall, however, there is too much motivational

and interpretive diversity across the entire food system to do justice to an analysis of the term and so we focus on, first, sustainable agriculture, and then sustainable diets.

Sustainable Agriculture

First, it should be noted that this term is itself a gateway to a rich and diverse landscape of different technical, environmental and, above all, ethical visions of food, farming, and the place of nature in securing human sustenance from the land[10]. Second order labels provide some sense of this agricultural diversity: agroecology, biodynamic, conservation farming, organic, low external input, permaculture, regenerative, sustainable intensification and so on, each with their own array of standards. One of many issues that differentiate sustainable agriculture approaches is with regard to the use of land and the optimal way of conserving biodiversity. For some, 'land sparing' represents the best option whereby agricultural land is farmed intensively to maximise food output, but other land is set aside – spared – for habitat restoration and species protection. Others suggest 'land sharing' might work better, where agriculture retains landscape features such as hedgerows, ponds and woodland and reduced chemical inputs lead to lower overall yields. Despite such differences all proponents of sustainable agriculture agree, however, that the dominant paradigm of industrial, productivist agriculture levies too high a cost in externalities (consequences not reflected in market prices) when set against food output. Indeed, many of the multi-dimensional system failings discussed earlier are largely located within the realm of agriculture and while its own supporters claim to be improving their social and environmental performance while 'feeding the world' (e.g. by developing 'climate-smart' farming solutions), the case for change is becoming increasingly apparent.

One approach that appears to have gained considerable momentum in international policy circles is that of agroecology with the UN's Food and Agriculture Organisation finally acknowledging its potential contribution to resolving many of our contemporary challenges. Drawing upon the FAO's Agroecology Knowledge Hub (FAO, 2022) – which derived from extensive stakeholder consultation and expert input – some of the essential principles of agroecology are briefly outlined here as a way of illustrating the alternative paradigm of sustainable agriculture[11].

Diversity: Possibly the single most important *practical* feature of agroecology is diversity: of plant and animal species and varieties, including intercropping (companion planting) and crop rotations (succession planting) which provides spatial and temporal diversity. Diversified systems might include crop-livestock or crop-fish (aquaculture) combinations. Increasing agrobiodiversity contributes nutritional and environmental benefits by enhancing the provisioning of ecosystem services, including pollination and soil health. Maintaining plant genetic resources in situ – that is in farmers' fields – is recognised as vital to future adaptation to a hotter world. Polycultures – the simultaneous cultivation of different crops – has been a distinctive feature of small-scale farming throughout much of the world yet

despite its overall yield advantages (measured by numbers of people nourished, not by yield volume of a single cereal) it has been increasingly displaced by high-input monocultures.

Knowledge: Agroecology depends on context-specific knowledge and where practices are tailored to fit local circumstances. Co-creation and sharing of knowledge will be vital in building adaptive, synergistic and resilient food systems in the face of climate disruption. This does not exclude learning from Western scientific expertise where this is appropriate, but it rejects the imposition of top-down models of technology transfer in favour of farmer field schools and farmer-to-farmer extension practices.

Efficiency: Avoiding the unnecessary use of external inputs is an essential feature of any sustainable agriculture. Rather, the objective is to optimise the use of natural resources, to enhance biological processes and recycle nutrients. The application of integrated pest management to replace chemical pesticides, and the planting of legumes for biological nitrogen fixation instead of synthetic fertilisers are examples here. Closing nutrient cycles and eliminating waste also reduces dependency on external inputs, increasing autonomy and reducing vulnerability to unpredictable market shocks and other risks. This enhances the resilience of farming communities and improves their capacity to ensure food security.

Circular and solidarity economy: As the Knowledge Hub states, "Agroecology seeks to reconnect producers and consumers through a circular and solidarity economy that prioritizes local markets and supports local economic development..." This feature marks the sharpest contrast with industrialised agriculture and its drive to maximise output for distant markets ('food from nowhere'). By reterritorializing the food system agroecology restores the essential connection between food, people, and place. It also demonstrates that agroecology – and one might arguably extend this to other forms of sustainable agriculture – is a great deal more than a set of farming practices designed to produce food; rather it embodies social, economic, and political objectives.

As one can see from this all-too-brief summary of some of its key features, agroecology offers an integrated approach that applies ecological and social principles to the redesign and management of food and farming systems. The notion of redesign is very important: it is not an ad hoc 'tweaking' of unsustainable practices but rather promises transformative change (Pretty, 2020; Pretty and Bharucha, 2018). It embodies a more deliberative process whereby changes in farming practices – to maximize biodiversity, build healthy agroecosystems while producing nutritious food – are accompanied by a rebalancing of power relations that strengthen local livelihoods and enable greater participation by all food system stakeholders, perhaps best expressed by the term 'food sovereignty'. Agroecology possesses a universal logic for the redesign of food systems: it is not simply a model for smallholder farmers. Yet as IPES-Food (2016) outlines, there are a number of deeply entrenched 'lock-ins' that maintain the hegemony of productivist agriculture: path dependency based on financial investments and returns; globalisation and export orientation (underpinned by claims of comparative advantage); the continuing expectation

of ‘cheap’ food (where true costs are shunted to ‘externalities’); and a great deal of short-term and compartmentalised thinking (especially in agricultural research) amongst other factors. Such obstacles make clear that food system change cannot be left to farmers alone by improving agricultural practices but must proceed together with governments, municipal authorities, civil society organisations and, ultimately, food consumers themselves. This latter group is critical for those in rich countries, especially, need to embark upon a process of dietary change if there is to be any hope of achieving a sustainable food system.

Sustainable Diets

In pursuit of a more sustainable food system the chapter has suggested a necessity for less resource-intensive diets as a way of mitigating climate change, to achieve a lower environmental footprint that will reduce pressure on use of land and freshwater resources, and reduce pollution of aquatic and terrestrial ecosystems (Willett et al., 2019; Springmann et al., 2018a; Tilman and Clark, 2014). As already noted, this means there are a number of very different ecological components each with their own metrics that must be taken into account and traded off in order to create some aggregate measure of environmental performance. Invariably this process involves prioritization as some components are regarded as more important than others. In a systematic literature review of empirical research studies on sustainable diets it was found that greenhouse gas emissions followed by land use then levels of meat consumption were identified as primary measures while other important components were disproportionately underrepresented (Jones et al., 2016).

Yet the ongoing process of nutrition transition continues to enrol greater numbers of people into more westernised diets featuring higher intakes of meat, sugar, fats and salt which not only exert a high environmental load but have increased the global burden of disease (GLOPAN, 2020). Consequently, the notion of a sustainable diet has become inextricably entangled with individual wellbeing such that human and planetary health are increasingly regarded as inseparable. This has led Tim Lang to ask whether this presents a new benchmark for what constitutes a ‘good’ or desirable diet; labels which carry moral and cultural weight as well as practical implications (Lang, 2021). That the term has come to embody a high degree of complexity given the range and importance of policy issues it represents, as well as extraordinary malleability in the meanings it conveys, it is as well to reprise a long-standing and robust definition here:

“Sustainable diets are those with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources” (FAO, 2012: 8).[12]

What, however, should this mean in practice? Mason and Lang (2017) have set out at length and in some depth why sustainable diets matter and they argue strongly for maintaining complexity in the way it should be approached: it cannot be reduced, they make clear, to a matter of 'carbon + calories' but must accommodate, equally, a range of dimensions. These they elaborate under six broad headings: health, social values, economy, food quality, governance, and environment each with their own set of constituent issues and measures that simply cannot be 'traded-off' one against another and where experience tells us that the economic calculation invariably prevails. It means approaching sustainable diets holistically and in a transdisciplinary manner capable of understanding the interactions between the many different variables that ultimately influence the choices and actions of food consumers. As the preceding discussion in this chapter has suggested, unidimensional narratives of food system failure and singular solutions ('productivism will feed the world') will not resolve the complex challenges facing us, nor bridge the large and widening gaps between scientific evidence, public policy, and everyday behaviours.

Nevertheless, a focus on the realm of consumption is essential, particularly in rich and upper middle-income countries, to tackle the planetary and human health burden of contemporary dietary practices. This implies that deep-rooted shifts in values, norms, consumer culture and underlying worldviews will be an inescapable part of the necessary transition (UNEP, 2019). Yet there is considerable personal investment in maintaining eating habits that deliver the tastes and satisfaction to which individuals have become accustomed and many will be hostile to change despite the fact that consumption patterns have been transformed over the past 50 years. Constructing the notion of a 'sustainable diet' is consequently a deeply challenging goal that will need to carefully navigate recommendations of what 'should' or 'should not' be eaten. There can be no *a priori* 'demon' or 'saviour' foods though the scientific evidence points clearly to more ecologically, nutritionally, and culturally appropriate forms of consumption. One way may be to restore a greater sense of the social, cultural, nutritional, medicinal and territorial dimensions of our customary food practices and to communicate the ways these have been transformed - or entirely lost – as a consequence of the modern, industrial food system.

Sustainable diets are most closely associated with greater levels of plant-based consumption which has been shown to reduce food-related environmental impacts and improve health outcomes (Springmann et al., 2018b). In the context of this evidence, the EAT-Lancet Commission – a consortium of 39 distinguished scientists from 16 countries - published a report in 2019 that elaborated a planetary health diet and made a call for dietary change (Willett, et al., 2019). The EAT–Lancet diet can be labelled 'flexitarian', where plant-based foods predominate - with recommended increases in whole grains, fruit and vegetables, nuts and seeds, and legumes - supplemented by small amounts of meat (one serving of red meat per week), fish, and dairy (one serving or glass per day). Modelling the adoption of the EAT-Lancet diet recommendations was associated with large net reductions in greenhouse gas emissions (42 percent or 1.8 Gt CO_2-eq), freshwater use (ten percent) and

nitrogen and phosphorus applications. Besides delivering a reduction in environmental resource use in line with global environmental targets (eg the 2015 Paris Accord on Climate Change), the EAT-Lancet diet also achieved greater health benefits (a 34 percent reduction in premature mortality, saving around 11 million lives/year) than all national food-based dietary guidelines compared in a recent study (Springmann et al., 2020).

Predictably, the EAT-Lancet report quickly acquired a certain notoriety as sectors threatened by its recommendations (the meat and livestock industry) pushed back. However, more considered responses have since emerged highlighting the importance of regionalising any reference diet (including promoting existing territorial patterns such as the Mediterranean Diet); re-evaluating prohibitions on meat, dairy and fish consumption amongst pastoralist and coastal communities where these are key staples; and to ensure that healthy dietary recommendations are also affordable to those on low incomes (Vaidyanathan, 2021). But it is clear that the EAT-Lancet study has opened up space for making planetary and human health an inseparable part of ongoing discussion and policy formulation on sustainable diets and around the food system more generally.

Conclusions

This chapter has presented a broad overview of the dominant system that drives the production, distribution, and consumption of food across much of the world today. It has not sought to provide descriptive detail but rather to offer a critical analysis of some of its key features, dynamics, and outcomes. It identified the main constituent components and mapped the ways in which they inter-relate. While conventionally much attention is focussed upon the stages of the food supply chain, with all of its logistical sophistication, it was suggested that the food environment – comprising both the physical infrastructure (food outlets) as well as the more 'virtual' cognitive world – is key to appreciating how such a commercially successful system can result in sub-optimal, arguably disastrous, outcomes. Major problem areas were only briefly reviewed but together provide sufficient evidence to demonstrate that the current food system is simply not fit for purpose if judged by the criteria of feeding people well. Yet while there may be widespread agreement for change, it was clear that how problems are framed determines what solutions might be identified and pursued. While many readers might agree that the case for radical and urgent structural reform of the food system is overdue, others would make the case for more incremental improvements, perhaps using the language of sustainability to prove their green credentials.

The chapters that follow provide more detailed examination of significant issues confronting the food system and, indeed, confront us all as participants to some degree - whether we are willing to accept them or not! The rise and concentration of corporate power within key stages of the supply chain – from seeds to food retailers – should concern us. So, too, the conditions faced by those who pick and pack the fresh produce found on our supermarket shelves, or the animals whose bodies have been so thoroughly reconfigured and commodified. But writing this is not to generate guilt: it is rather a contribution to clearing

away the smokescreen of disguise, deception and denial that has concealed much of the workings of the food system from public gaze. Above all, it makes clear the importance of developing a research agenda for food systems that highlights key areas requiring interrogation and which can bring insight to wider public attention. There is much work to be done in this regard and social scientists, in particular, have an important role in using their skills by undertaking research that not only documents cases of food system failure but in a way that can engage with and support local stakeholders (farmers, workers, food citizens) in devising strategies for their resolution. It is in this spirit that this volume has been prepared.

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NOTES

[1] Jeffrey Sachs, Speech to UN Food Systems Pre-Summit. Transcript and video here: https://www.jeffsachs.org/recorded-lectures/5jf86pp5lxch35e6z3nct6xnmb8zy5
Also video of this speech available here: https://www.sandersinstitute.org/blog/jeffrey-sachs-speech-at-the-un-food-systems-pre-summit and here: https://www.youtube.com/watch?v=WZ1xc491mnU

[2] This is not to overlook the work that has been ongoing both prior and subsequent to the financial crisis of 2008-12. In particular the landmark publication of the first International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) report in 2009 should be acknowledged not least for establishing the maxim, "Business as usual is not an option". Herren et al., (2020) provide an excellent evaluation of efforts to transform food systems since that publication.

[3] More detail on the various stages of the food supply chain can be found in Sage (2012), and Tansey and Worsley (1995).

[4] There is not space here to unpick the complex interconnected configurations of technology, market, and regulatory aspects that explain how glyphosate has become so central to productivist agriculture. Besides Clapp's article (2021) interested readers are directed to the special issue of the European Journal of Risk Regulation (11, 3; 2020) which

contains a Symposium on the Science and Politics of Glyphosate edited by Arcuri and Hendlin.

[5] The animal slaughter and carcass processing industry has been characterised by unsafe working conditions and low pay for more than a century since the work of Upton Sinclair. These plants – especially in the United States but in Europe too - became notorious for the rapid spread of Covid 19 amongst workers as a consequence of close contact in the working environment. A highly critical piece is provided by Chang et al., 2021. On Covid, agricultural labour and the food system more generally see the special issue of Agricultural Systems, Volume 183: https://www.sciencedirect.com/journal/agricultural-systems/special-issue/10D1KTPPCQ5

[6] Cyber attacks can seriously undermine the functioning of the food system given the complex logistics of supply chains that connect product bar-code scanning at the supermarket checkout to ordering stock via wholesalers (the case of Spar, UK 5 December 2021). On the vulnerability of the UK food system to Covid 19 see Rivington (2021).

[7] At the time of writing BBC Global News is showing on its platform a second series of programmes under the title, 'Follow the Food' which is sponsored by Corteva Agriscience, the rebranded company arising from the merger of Dow and DuPont. The programmes are presented by James Wong, a British botanist with a boyish enthusiasm for all things tech. As the BBC describes it, "Follow the Food is a TV and digital series showcasing the latest in technological innovation and modern agriculture. Sponsored by Corteva Agriscience, it takes audiences on a journey from field to fork; exploring the ways in which the world's rapidly growing population can be fed, without exhausting the Earth's resources." It is instructive to note how reference to population growth prefaces every item in each episode. https://www.bbc.com/mediacentre/worldnews/2020/follow-the-food-feeding-world-during-pandemic Accessed 11 Jan 2022.

[8] Making claims for the sustainability of a product is only part, of course, of the myths that are spun as a way of deceiving customers, policymakers and less than vigilant regulators. A good example is the Spanish pork industry which has boomed in recent years on the back of a narrative that claims it is based on small, artisanal firms, creating large numbers of quality jobs in rural areas, and helping to reverse population decline; that it is a model of sustainable production and economic success. The reality is that the sector is heavily industrialised, extremely polluting, and guilty of violating basic human rights (Win 2021).

[9] "A sustainable food system delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised" (Group of Chief Scientific Advisors, 2020: 14). And "food system practices that contribute to long-term regeneration of natural, social, and economic systems, ensuring the food needs of the present generations are met without compromising food needs of future generations" (HLPE, 2020, 10).

[10] A sense of this diversity of perspectives – which extend back to the work of Sir Albert Howard in colonial India – and which far exceed any notion of narrow technical disputes over how to farm, can be garnered from the reader compiled by Pretty (2005).

[11] An immensely rich yet concise introduction to agroecology highlighting a wealth of web-based resources is provided by Anderson and Anderson (2020).

[12] A collection of articles exploring many different aspects of sustainable diets appear as a special issue of the International Journal of the Sociology of Agriculture and Food edited by Sage, Quieti and Fonte (2021).