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Perspective

Towards Healthy Planet Diets—A Transdisciplinary Approach to Food Sustainability Challenges

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Abstract: The future of food is one of the major world-wide challenges. In this perspective paper, we set-up a framework for a multi-disciplinary future food systems approach, building on the UN Sustainable Development Goals. We hereby combine a truly sustainable approach including social science aspects combined with the One Health approach. Scientists from a large number of backgrounds have addressed four key areas that are discussed in more detail in this paper: (i) nature inspired food production, (ii) sustainable immune resilience, (iii) social and cultural change of food behavior, and (iv) food fairness. We believe that transformations to integrated future food system approaches should move beyond single solutions and can only be solved by working in transdisciplinary settings of science, society, and industry.

Keywords: nature inspired; immune resilience; behavior; fairness

1. Introduction

Currently, 820 million people are undernourished, which equals to 11% of the global population [1]. At the same time, following WHO numbers and definitions, 650 million people are obese and one-third of all produced food is wasted (e.g. [2]). Additionally, humankind needs to increase food and feed production by 70% by 2050 to keep at pace with the anticipated growth of the human population [1] if peoples' diets will not change radically and food waste will not be reduced. However, the current rate of implementing the necessary innovations and behavioral and societal changes are far from on track to meet these global future food challenges. As a context to this, current food systems are not sustainable, illustrated by global terrestrial biodiversity loss, greenhouse gas emissions, degradation of arable land, depletion of fish populations, and overexploitation of water resources [3] and also produce an increasing amount of unhealthy (fast) food, like caloric-rich, saturated fat-rich, low nutrition-value, and processed foods [4].

To ensure decent living conditions for all, the UN adopted the Sustainable Development Goals (SDGs) in 2015, aiming for a balanced food system in 2030. Sustainable development must be taken up by society at large because it requires profound changes in thinking and behavior, in consumption and production patterns, and in economic, health management, and social structures. It also requires a policy context and institutional environment that supports and encourages healthy, sustainable, environmentally friendly, and fair production and consumption choice—both at the global level and within a given society or community.

Numerous approaches are developed to work on this most-pertinent grand challenge of future food. For instance the major drivers affecting the global food system between current and 2050 in four different sets: (i) demand for food, (ii) trends in future supply, (iii) exogeneous factors affecting the food system, such as competition for resources, and (iv) interdisciplinary themes [2]. With these interdisciplinary approaches, it indicates that a sustainable agriculture system should feed the world population while reducing climate change and stabilizing global land use. They in particular propose various strategies such as increasing yield, reducing waste, and changing dietary patterns [5].

Very recently, the EAT-Lancet Commission postulated a range of scientific targets and global strategies to achieve an environmentally sustainable production of healthy diets for the growing global population [4]. They defined an evidence-based universal healthy reference diet of appropriate caloric intake that consists of a diversity of plant-based foods, low amount of animal source foods and unsaturated fats. These scientific targets all focus on environmentally sustainable production of healthy diets (win-win diets) regarding climate change, nitrogen and phosphorus cycling, freshwater use, biodiversity loss, and land-system change (cropland use).

We realize that the grand challenge of future food is a wicked problem [6], due to interrelations with other economic or social problems, the limiting availability of natural resources, and the rapidly changing economic, social, and environmental conditions [7]. Further, an integrated food policy is often lacking as it calls for integration of health promotion and environmental sustainability [8]. Future projections often are for a horizon of 50 years or more, as current trends can evolve unexpectedly. Therefore, a large variety of different solutions should be analyzed [9]. A common approach is to use scenarios, in which multiple futures can be analyzed. Currently, a wide-set of model-based scenarios have been provided as basis for decision-making on climate change [10] and on sustainable resource use including food and water [11]. However, there is an urgent need for new scenarios that provide a basis to ensure decent living conditions for all, which are reflected in the Sustainable Development Goals (SDGs) adopted in 2015, aiming for such a balance in 2030.

In the current scenarios, new insights in, for instance, health effects of sustainable food products, food safety, food fairness, cultural consumer choices, policies, and regulations are missing. In addition, food demand models, local income inequality, and income-based food wastage should be included to become truly sustainable including social aspects, whereas competition for resources with other sectors, for instance, analyzed in the water-food-energy nexus, should also be taken into account [11–13]. In addition, the alternative One Health (OH) approach should be considered as this approach ensures that human, animal, plant, and environmental health questions are evaluated collectively in a sustainable way in an integrated and holistic manner (e.g., [14]).

Universities and research institutes around the globe have rightfully embraced the future food challenge and mobilized their scientists to make a difference. We have joined forces to develop a future food systems approach. In this multi-disciplinary approach of Future Food Utrecht (FFU), scientists from very diverse backgrounds collectively address pertinent future food-related research questions to not only provide new knowledge-based leads for sustainable innovations, but also to maximize their success when it comes to actual implementation in societies, and to sustainably reduce our "food" print on planet Earth.

In this position paper, we will discuss our ideas regarding food sustainability and healthy planet diets specifically aiming to transdisciplinary-oriented approaches by connecting scientists to industry, government, and society by using co-creation and evaluations of solutions in the context of the Sustainable Development Goals. Four key research areas are identified by FFU and will be discussed in detail in this paper: (i) nature inspired food production, (ii) sustainable immune resilience, (iii) social and cultural change of food behavior, and (iv) food fairness (see Figure 1).

Figure 1. The four key areas of food research–Future Food Utrecht.

The four key areas are interconnected in that they all follow a similar future food system approach to address urgent issues on the global food challenge agenda. Together, these areas of this approach have the overarching goal to discover and implement novel concepts that contribute to a food supply that is sustainable, healthy, safe, accessible, and reliable for the growing world-wide human population, and thereby contributes to reaching multiple Sustainable Development Goals.

2. Key Areas

2.1. Nature Inspired Food Production

The rational and industrial approach to food production that was adopted in Europe after the Second World War has led to vast increases in agricultural productivity and concomitantly to higher food security in the global north [1]. In recent decades, the process of rationalization of agriculture and its associated environmental problems have been exacerbated by the increased globalization of food and feed markets [15]. Producing for a competitive world market with its low margins has forced farmers into a productivist regime [16] in which reducing cost prices is the only way to make a profit. At the same time, these developments have led to severe environmental impacts including reclamation of natural land for agriculture, loss of landscape aesthetics due to extreme rationalization of agricultural landscapes, widespread loss of agrochemicals (such as pesticides, fertilizer, and antibiotics) to the environment, and strong biodiversity loss both in natural as well as in agricultural landscapes [4,17–19]. Recognition of these problems led to the foundation of alternative approaches to agriculture, in which production systems utilize ecological processes rather than controlled input of agrochemicals as is customary in more industrial forms of agriculture. Although some of these agro-ecological approaches have been around for a very long time, none of them have gained enough traction to be a serious competitor or alternative for the productivist regime. Organic farming, for instance, started directly after the Second World War as a counter-movement to the increased rationalization of the agricultural system that started then, but currently still only has a market share of below 6% on average in Europe (Eurostat agricultural data 2018). Instead, agricultural policy embraced the productivist model, and incentivized incremental greening measures within that model, rather than considering alternative models [4,16,20].

Currently, however, there is renewed interest in considering alternative and more nature-based approaches to food production [4,21]. This interest is mainly driven by the recognition that incremental greening measures have not been able to sufficiently reduce the environmental pressures of modern, industrial agriculture (e.g., [20,22]), but increasingly also by the observation that the lack of sustainability as a core value in the current agricultural system poses a risk to the continuity of the vested interests in the current food system, both in terms of access to raw materials as well as financial return on investment [23,24].

Proponents of the current food system point to the lower yields of agro-ecological systems, that could pose a threat to future food security of a growing human population, and a sometimes higher environmental impact per unit product (most notably for greenhouse gas emissions and land system change), due to the lower productivity per unit area (for reviews and criticism, see [25,26]). These have culminated in the somewhat polarized land sharing-land-sparing debate, which revolves around the question whether, from a sustainable development point of view, it is better to set aside large areas of land for nature and use the remaining agricultural lands as intensively as possible so as to provide for sufficient food for the growing world population, or that food production and nature should be integrated at landscape level, which would pose considerable restrictions on the environmental externalities of agriculture, but may render larger areas available for agriculture while maintaining a significant part of biodiversity [27].

Apart from the arguments that food security is not only a matter of production but also of global food distribution and preventing losses during harvesting and storage as well as food waste at the retail and consumer level [27,28], there is increasing evidence that agro-ecological production methods can be as productive as conventional approaches and can provide a viable economic model due to lower input costs and lower risks, especially at the long term [29,30]. This is reinforced by the observation that the large monocultures of crops, which have often been bred to flourish in high (external) input systems, and that grow on impoverished soils with highly simplified food webs [31], are not very resilient to pests and extreme weather events, which are expected to occur more often in the future because of climate change. Instead of relying on control of the system by using external inputs, and responding to disturbances with more external inputs, agro-ecological approaches harness the adaptive capacity of natural processes to increase the resilience of food production, resulting in sustained levels of productivity over long time spans, rather than optimizing productivity at the short term [29].

In any case, new, nature-inspired enhancements to food production are being developed that could further increase yields per unit area in agro-ecological systems, thereby further closing the yield gap between agro-ecological and conventional approaches where necessary and that can increase the resilience of agro-ecosystems to prevent losses to pests and increased environmental variability due to global change. Soil communities, and thereby the supporting function of soils, can be enhanced by altered management practices, active modification of the rhizosphere microbiome can enhance the crops' resistance to pests and facilitate nutrient uptake [32], new plant breeding techniques to improve immune resilience of plants may reduce susceptibility against diseases and extreme environmental conditions [33,34], and innovative fertilization techniques and promoting facilitative plant processes in multi-species cropping systems may enhance crop access to soil nutrients, resilience to pests, and productivity [35,36]. At the landscape level, more evidence is accumulating that the spatial organization (amount, diversity, and layout) of natural elements in agricultural landscapes can reduce pest pressure, and can increase natural pest control and pollination, as well as biodiversity in general [37,38]. Some of these techniques can also be applied in conventional systems to reduce their dependency on external inputs, which may contribute to changing the mindset of farmers and opening up the institutions of the current food system to accept more drastic changes towards sustainability [29,39].

The current knowledge base for agro-ecological and other nature-inspired production methods, however, is strikingly small compared to the knowledge system available for conventional agriculture. Innovation science has shown that building such a knowledge base can significantly accelerate a transition towards a more sustainable system (e.g., [40]). Given the rise of agro-ecological farming globally [41], there appears to be a wealth of tacit knowledge about nature-inspired production methods in farmer communities, but hitherto this knowledge is not widely accessible, nor are new approaches such as described above easily disseminated through a common knowledge network. The challenge for future food science here is that nature-inspired food production is highly context dependent, because it relies on local landscapes and ecological processes which are highly place dependent. Instead of a 'one size fits all' approach, which has led to the uniform production systems we know today, the new knowledge systems for the sustainable production of our food in the future need to find a way to address this context dependency by translating general agro-ecological principles to the local contexts that farmers have to work with. This local context also includes the social-economic setting in which these sustainable food systems need to function. This social-economic setting not only relates to the production function of farms (e.g., farmers and consumers), but also to the institutional setting in which farms operate (e.g., banks, policies), as well as the non-production functions of farms (e.g., traditions, social cohesion, landscape, and biodiversity). This means that a transition towards sustainable and healthy food systems requires a true inter and transdisciplinary effort from science, because knowledge systems will require input from both the natural sciences and the social sciences and can only link to local contexts with input from local stakeholders.

2.2. Sustainable Immune Resilience

The relation between food and health is visible in societies around the world. In developed countries, the occurrence of obesity (defined by WHO as abnormal and excessive fat accumulation) that may impair health and possible related incidence of non-communicable diseases is increasing. Ample (pre)clinical studies point out a role for obesity in low-grade inflammation, detailed immune response, and the development of non-communicable diseases (for recent reviews see: [42,43]). Though unhealthy food consumption and overconsumption-induced obesity, even normal weight obesity, are suggested to be the major contributor to the increased prevalence of non-communicable diseases, other more complex societal factors might also be involved [44,45].

A good measure for health and health promoting sustainable food/feed concepts is immune resilience: the capacity of the immune system to react or tolerate internal or external triggers by establishing, maintaining, and regulating a proper immune homeostasis. Improper immune responses can lead to auto-immune related diseases and allergies. Nutrition e.g., specific nutritional compounds can positively, but also negatively, influence the immune system directly or indirectly, impacting immune resilience and sustainable health [46,47]. A fit and thus resilient immune system (of humans and animals) is essential for a healthy start, healthy growing, and healthy aging in addition to prevention and handling of chronic diseases [46]. To improve immune resilience of human beings, a holistic and sustainable approach is necessary, including the improvement of sustainable health of plants and animals, whilst reducing the use of pesticides and arresting the development of antimicrobial resistance in humans and animals. In this pathway, a co-creation approach will be followed to investigate effects of food and feed concepts on human and animal immune fitness.

Problems in relation to a Western lifestyle (e.g., overweight/malnutrition/food allergies/autoimmune diseases/brain disorders/cancer/metabolic and cardiovascular diseases), the safety and benefits of novel dietary proteins, and the pressure on life quality by intensive animal and fish farming demands, health-improving dietary solutions for human and animals. Health-improving food and feed concepts (consisting of healthy and sustainable ingredients) can lead to improvement of (early life) immune resilience with positive consequences for quality of life of humans and animals (later in life). The major challenges for future food science in regard to immune resilience to be addressed, are: Food/feed-induced immune resilience, Food safety, and One Health.

A compromised immune resilience of humans and animals will lead to increased risk of infections or cancer (weak responses) or to non-communicable diseases (allergies or auto-immune diseases; too strong responses). A unique opportunity to influence the development of immune resilience lies in early life, an important time window where the immune system of humans and animals is developing the capability to mount appropriate immune responsiveness, so-called immune resilience blue print [48,49]. Nutrition is an important and major environmental factor that can positively influence the developing immune system directly, or indirectly through the gut microbiota, thereby improving a fit and resilient immune system and sustainable health e.g., preventing non-communicable diseases and proper immune responses towards infections. In addition, health-improving food and feed concepts can also be used to sustain or induce immune resilience during adulthood and ageing and can thereby possibly be used for the treatment of non-communicable diseases. In addition to the unique opportunities to influence immune resilience in early life, there is increasing evidence that the immune system can also be educated at adult age to tolerate proteins that were previously not tolerated, e.g., in case of allergies [50,51].

Combining unique research expertise and citizens' know-how to investigate effects of food and feed concepts on health and disease by means of analyzing immune resilience, particularly in relation to non-communicable diseases, is essential. Through deeper insight into the pathways in which cells and mediators of the immune system interact, innovative food concepts need to be investigated for prevention and/or treatment with a strong focus on chronic inflammation management and non-communicable diseases. Typical examples are the immunomodulatory properties of milk-derived carbohydrates and milk vesicles that have been shown to prevent the development of allergic diseases through integrative interdisciplinary translational in vitro, animal, and clinical studies [52–54]. Bridging preclinical and fundamental research with observational studies as well as with citizens' experiences have already led to translational approaches such as proof of principal human trails (for example, NutriBrain) as well as citizen science-driven programs (for example, My Own Research, see: mijneigenonderzoek.nl). In addition, sustainable in-feed concepts for livestock have been shown to induce proper immune resilience, leading to healthy food products and reduced antimicrobial interventions.

Immune parameters, such as single/nonkinetic cytokine measures, are often used as biomarkers to assess the activity of the immune system linked to health and disease. Changes of immune parameters are temporary and subject to strong homeostatic control [47,55]. In the case of health assessment of food/feed concepts, indicators of the condition of the gastro-intestinal tract such as microbiota composition and activity, barrier function, and inflammatory status are included as well. There is a wealth of human studies aiming at assessment of health effects, both in healthy individuals and in patients with infections or with a non-communicable disease. For instance, prebiotic oligosaccharides have been widely studied in many different cases [56–58]. However, health benefits and changes in immune parameters vary largely between studies and some studies show clear effects but others show only minor or no effects. In animal studies, effects of oligosaccharides appear more pronounced, indicating that under strictly controlled circumstances, oligosaccharides may indeed be beneficial for health. However, human circumstances and environment are usually less controlled and most physiological parameters used are influenced by many personalized confounding factors. Most studies do not even consider kinetics of immune responses which is more predictive and even required for assessment of true immune resilience. To test immune resilience, it is therefore crucial to use standardized protocols that include a well-defined stressor and kinetic readout of relevant parameters. Moreover, individual variation in responses to nutritional concepts due to microbiome, genome, and immune blue prints opens the way for the development of personalized-nutrition for humans [47] and livestock species.

In view of the importance of immune resilience for evaluating health-promoting or disease preventing/treating food and feed concepts, a Sustainable Immune Fitness Lab, allowing transdisciplinary research, in which—besides public and private partners–citizen/patient researchers, (local) health professionals and policy makers participate, is essential (see Box 1).

Box 1. Sustainable Immune Fitness Lab.

The human body is an integrated whole with the environment and our immune system plays an important role in this. Immune fitness can be defined as the capacity of the body to respond to health challenges by activating an appropriate immune response in order to promote health and prevent and resolve disease, which is essential for improving quality of life; in other words, a good or optimal immune resilience. Perceived immune fitness is the individual subjective judgment of this capability [59].

At the moment, science and healthcare are still too much split into separate boxes. We have to practice system thinking, especially in complex systems as future food and human health. In a human immune fitness lab, the effects of sustainable and healthy food interventions on resilience of our immune system should be investigated from many angles, such as biological, psychlogical and social perspectives through the use of deep learning and complexity science [46].

2.3. *Food, Behavior, and Culture*

The sustainable transition of our food system requires fundamental changes in the production, distribution, and consumption of food. While the production and distribution of food on a global scale in itself poses a major threat to the environment, patterns of food consumption also bear important risks to the environment, on top of the well-known risks of unhealthy food consumption for obesity and non-communicable diseases [4]. The transition to sustainable and healthy diets is urgent and requires not only a drastic transformation of food policies, industry, and retail, but also for changes in the behavior of consumers. However, food consumption patterns are deeply rooted in traditions, culture, and everyday routines. In particular, consuming less meat and dairy, as would be required to implement sustainable healthy diets (e.g., [4]), challenges most traditional diets and consumers' everyday routines, and is in sharp contrast to most traditional food cultures that have their own definitions of healthy food.

Consumers' food choices are complex as they are influenced by many factors [60]. As a result, changing food choices has proven to be difficult [61,62]. In particular, food choices are driven by a variety of factors including ideals, personal factors, resources, social relations, and other contextual factors such as presentation, labeling, advertisement, media coverage, and trends factors [60]. These factors sometimes even have opposing influences and confront consumers with the challenging task to balance a need for tradition and novelty, economy and extravagance, health and indulgence, care and convenience [63]. Even when people hold good intentions regarding healthy and sustainable diets, they often fail to implement these goals in their daily lives. Moreover, successful changes are often short lived and abandoned after a few weeks. A desire for change is also challenged by the so-called obesogenic environment that is characterized by a multitude of convenient, cheap, and unhealthy food temptations. In this complex field, consumers have to decide on a daily basis what, how, and where to consume their food, whether they prepare meals themselves or opt for ready-to-eat meals, order meals, or eat out. However, it is no longer only passed-on traditions that define consumers' decisions. There is a variety of trends that shape any consumer's daily choices in a world of abundant food and food discourses [63] obvious in off and online media representations of food [64], as 'individualization', 'informalization', 'communification', and 'stylization'. Trends also create opportunities for a transformation to more healthy and sustainable diets.

Diets in the industrialized world have (been) changed fundamentally, neoliberal governments are reluctant to regulate the industry and to restrict consumers' choices. We need to realize that diets are rooted in long-standing cultural or religious traditions and therefore are 'very personal' [65,66]. At the same time, food movements [67], food related media content, cooking shows, food documentaries, consumer surveys show that consumers' awareness of the food crisis is growing as well as the market for healthy and sustainable food products.

2.4. Food Fairness

There is extensive literature on questions of fairness and justice in the food system today (e.g. [68–71]). Focusing on questions of access, distribution, as well as recognition of identity and culture, this literature offers a compelling articulation of fairness particularly as this is expressed by the experiences of the most vulnerable and marginalized (see also [72]). Instead of focusing on a single dimension, here we understand food fairness as a multidimensional concept that covers the material as well as political, social, and environmental dimensions of life [73]. This multidimensional understanding of fairness is also supported by broader environmental justice literature, which argues that both the theory and practice of fairness and justice need to embrace the diverse notions that are associated with it [74].

Starting with the material dimension, we posit that achieving food security, referred to as the ability to access sufficient, safe, healthy, and nutritious food [1], is the primary material concern (see also [73]). Indeed, everyone needs food in order to survive before undertaking any other functions in life. However, a key focus of public policy in many countries on food security together with market forces has led to large scale farming, global food chains, and a powerful food industry in developed countries. In turn, the detrimental environmental and social consequences of large scale farming, the adoption of controversial technologies, and food safety scares have triggered an increasing interest of consumers and policy makers in how food is produced, and who benefits from food purchase [75]. Overall, it becomes increasingly obvious in the material dimension of food fairness that the benefits and disadvantages are not equally distributed among all participants in the global food chain [69]. In this context, food sovereignty is also emphasized by peasant movements and broader civil society as an important condition to claim ownership of food for food security especially among vulnerable members of the human population (La Via Campesina).

Politically, fairness emphasizes agency, i.e., people's will to be active in their struggle even at the expense of other values, such as personal satisfaction [76–78]. Agency is impaired by distancing, the geographical expanse of global supply chains and the knowledge gaps about the impacts of food production as this affects the ability to influence the governance of food. Distancing also applies to chain governance, i.e., the bargaining position of different actors within the food chain [79]. Power increasingly concentrates with companies at the end of the chain, i.e., chain organizers who control access to the market. Social fairness requires the recognition of race, gender, and cultural considerations in the production, distribution, and consumption of healthy food [80]. Here, the literature underlines, in particular, the limited ability of low income communities and ethnic or cultural minorities to access, that is to produce and consume, healthy food, because of lack of income or social assistance [68]. While public policy tends to emphasize food supply and increased production, the core of the problem tends to be poor people's access to available food [81].

In the environmental dimension, fairness is concerned with the disproportionate negative environmental impacts on the poor, and also more broadly about human ethical obligations to non-human species and future generations [82]. Large scale farming, due to market forces and the neglect of social and environmental externalities in the past decades, has to a large extent replaced small local and regional food producers (ibid). Globalization and the corresponding integration of the developing countries in global flows of capital and commodities (but not people), are now diverting extensive areas of arable land (and water) to the commercial production of foods for non-local uses, displacing local communities of farmers and pastoralists [83]. At the same time, a powerful food industry benefited from the fact that regulators hesitate to impose restrictions that could hamper economic growth, e.g., systematically restrict fats and sugar in food products [84]. While food products became cheaper and broadly affordable for larger parts of humanity, substantial inequalities among consumers as well as producers emerged within local and regional societies as well as between various members of the world economy [68]. For small scale organic farming and producers of healthy and sustainable food products, production costs are usually higher, resulting in higher prices and lower sales, and thus lower profits [85]. Moreover, since healthy and sustainable food products are often more expensive, people with less disposable income are less able to afford them. Increasing obesity rates, specifically among those with lower socioeconomic status, indicate that environmental and economic conditions implicitly seem to encourage the consumption of greater quantities of energy-dense, low-nutrient foods (while explicitly discouraging physical activity). These issues are exacerbated by large-scale urbanization now taking place around the world, with unprecedented consequences for people's diets, as well as along the entire food chain from farmer through consumer: anonymous processed food replaces fresh products, 'supermarketization' undercuts market traders and vendors, plantations outcompete smallholders [86].

The desired transition requires new business models to turn the above mentioned trends and increase food fairness globally as well as locally. Numerous private initiatives to address fairness considerations in the food system can already be identified, including certification schemes, such as Fairtrade, as well as social movements, such as La Via Campesina, to name a few. While public policy is aiming at delivering huge quantities of food for an increasing world population, it needs to shift focus to more explicit links with environmental, social, and public health considerations [87]. Regulatory opportunities exist at the national, state, and local levels to mandate action and to allocate funds for promising health and sustainability promoting strategies. What is required is a systematic understanding of the interactions between the multiple efforts to foster fairness and a harnessing of synergies and complementarities at multiple levels of governance. Transdisciplinary research is essential regarding the following questions/issues.

3. Co-creation and Transdisciplinary Research

Based on the above interdisciplinary key-areas, we believe that research should be promoted between different scientific fields and also between academia, industry, citizens, NGOs, and governments. Therefore, our vision is to merge fundamental research related to innovations for future food in terms of production, behavior, and health. As we believe that solutions can be achieved in a transdisciplinary approach, our mission is to offer a platform for scientists and external stakeholders where they can contribute to the transition in the food chain.

Co-creation and transdisciplinary research is essential regarding the following questions or issues for the upcoming decade (Table 1).

Transdisciplinary research means that scientific disciplines from natural and social sciences will collaborate both among each other and with relevant societal groups [88]. With successful transdisciplinary research, there is room for co-creation of research objectives, knowledge, and solutions for society [89]. Consortia will exist of academia, industry, NGOs, and governments, but we also will actively search for relevant citizen partners, as patient associations, non-commercial communities such as Immunowell, to broaden the view of possible new pathways.

Such transdisciplinary community–academia collaborations, and community-based research initiatives, are increasingly recognized as significant societal movements shaping sustainable transition pathways in food studies. Examples of such localized, citizens- or community-based research are local food communities [90,91], makerspaces [92], and community-supported agriculture [93]. These community-based research activities share specific intrinsic and diffusion challenges regarding social needs and ideological commitment, scaling up, risk aversion, and institutional challenges [94,95]. Rooted in a discontent with, or disbelief in conventional systems of food provision, grassroots organizations typically provide protected spaces that shelter alternative forms of social and economic life [96,97]. In their position outside the market-based economy of food provision, grassroots communities offer "visions of radical transition pathways and mobilize marginalized values, organizational forms and institutional logics" [98]. The network of interactions in terms of sustainability, food production, food behavior and fairness, and health is complex, involving multi-stakeholder interactions between researchers, policy makers, and societal stakeholders. Previous sources published interesting work around the concept of 'sustainable healthy diets' as a bridging devise, an inclusive approach around health and sustainability discussions in food [5,99,100].

Table 1. Transdisciplinary research question per key area.

Nature Inspired Food Production	**Sustainable Immune Resilience**
• What scientific and technological innovations can we develop to reinforce agro-ecological approaches? • How dependent are soil type, landscape settings, and climate in the land sparing-land sharing discussion on grassland ecosystems? • How can landscape configuration contribute to sustainable and resilient production systems? • How can knowledge about sustainable production methods best be disseminated among farmers while taking local contexts into account? • How can we use diversity to increase the productivity and resilience of farming systems? • How can we minimize external inputs for production, while maintaining production levels? • Can we produce sufficient and healthy food in a sustainable way within the current food system, or does this require transformative systemic change? • If so, how can policy, industry, civil society, and primary producers work together with academia to trigger such a transformation?	• How do we assess the health-promoting effects of nutritional concepts on immune resilience in humans and livestock using standardized controlled protocols, with kinetic read out? • How do we include functional non-invasive biomarkers (rather immune cell levels and activity than cytokine levels) to monitor the effects of nutritional concepts on immune resilience in humans and livestock? • How can we design and study the effects of nutritional interventions in humans and other animal species that will contribute to personalized immune resilience and health promoting food/feed interventions? • How can we design and develop sustainable and affordable food and feed concepts that can be used to maintain, improve, or restore immune resilience in humans and livestock? • How can we apply immune resilience models for evaluating food and feed concepts that are useful in developing countries where specific food shortages and infectious diseases are more common? • How can we establish the economic and societal impact of immune resilience, improving sustainable food and feed concepts? • How can we create public awareness and acceptance of the importance of immune resilience and food and feed-concepts developed based on immune resilience inducing concepts?
Food, Behavior, and Culture	**Food Fairness**
• How will consumers' food choices shape and can be changed; • How will consumers process the available information about food, be it on labels, in stores or on the media? • How can consumers be supported to develop a more sustainable food literacy? • Which sustainable policy measures (pricing; taxes, limit setting for unhealthy ingredients) would be accepted by citizens and under what circumstances; • What are the social, psychological, and cultural factors that support a transition to more healthy and sustainable food choices, on an individual, but also collective level.	• What are the fair or true prices for food? • Can market forces be used to create food fairness, and if so how? • How can we create public awareness for the negative environmental and societal effects of low food prices? • What is the role of regulatory authorities in the transition, and on what level (supranational, national, regional, or local) lies the different tasks and responsibilities? • How can inclusive business models throughout the food chain internalize social and environmental externalities? • Can the economy transition to a system of "fair prices" of food that reflect their true costs to society on the one hand and grant access to everyone on the other, and if so how? • What is the equitable access to food? At all times, everywhere on the planet, for everyone? How can short local production chains with a focus on seasonality be maintained in a globalized world? • What are the synergies and trade-offs between the variety of private initiatives and public policies that aim to foster food fairness at local, national, and global levels?

To address emerging opportunities and challenges of future food and to merge fundamental research related to innovation for future food in terms of production, behavior, and health, stakeholders in academia, public policy, civil society, and private sector from all fields, especially in climate change, environment, nutrition and food research, economics, psychology, behavioral change, anthropology, and health and agriculture should interact and co-create.

Co-creation is defined as the cooperation of multiple actors in a creative process, working together in networks and aligning a variety of ideas, expertise, and interests [101]. In co-creating platforms for interaction and sharing information and practices, the preferences and trade-offs of the different transdisciplinary stakeholders involved could be taken into account, reflecting their values, tradition, history, politics, and culture [102]. In order to promote such transdisciplinary multi-stakeholder interactions to make healthy planet diets available, accessible, affordable, safe, and desirable (culturally acceptable), the current food system changes could be guided by the following (inter)actions:

1. Co-creating *an enabling environment* through government mechanisms and (dis)incentives, legal frameworks and regulatory instruments to promote production and consumption of healthy planet diets (based on [99]);
2. Ensuring *policy coherence* by aligning policies across all sectors (from agriculture to health, education, environment, water, trade, etc.), from local to regional, national to international level, and discussing with all societal stakeholders [99];
3. Developing *context-specific* healthy planet diets taking into account social, cultural, economic, and ecological circumstances [99];
4. Engaging in *transdisciplinary participatory design processes* to develop *systemic instruments*, that is, a set of aligned interventions that collectively aim to tackle food sustainability challenges and that are likely to accelerate the transition to sustainable healthy diets. These instruments are based on co-creation of multiple stakeholders involved in healthy planet diets developments beyond the level of individual organizations, as a source of experiential knowledge and as co-developers of food innovations, developing new functions for technologies, solving unforeseen problems, and proposing or even developing innovative solutions [103–105].

4. Future Food Impacting SDGs

A fundamental change of direction is required to put the food system to a sustainable course [106]. Until now, current responses from public policy to private sector are all failing [106]. We believe that integrated future food research can contribute to the wicked-problems by using the SDG framework and focusing on a truly transdisciplinary approach.

A possible way to explore various pathways to move towards future food is applying a *multi-path mapping approach* [107]. In this approach, firstly, the perspectives on future food options are proposed by a wide range of transdisciplinary stakeholders involved in sustainable food production, behavior, and health issues are taken into account. Various aspects of these options are included, such as regulatory, legal, ethical, consumer- and citizen food practices, economic, innovation incentives, and entrepreneurial activities. Secondly, different socio-technical pathways could be sketched, as well as factors influencing these paths. Such mapping event articulates how paths are competing, diverging, converging, or synergetic and can articulate possible bottlenecks, challenges, and bifurcations of emerging processes. In this way, together with stakeholders, potential future contestations and frictions can be identified and pre-empted early on in the transition process. Thirdly, *multi-stakeholder constructive technology assessment (CTA) workshops* need to be set up with the transdisciplinary stakeholders (e.g., researchers, companies, consumers, citizens, regulators, public agencies, policy makers, NGOs). Within those assessment workshops, various socio-technical pathways are jointly co-devoloped, stakeholders's meanings and interpretations of future food are discussed. By co-creation, strategic choices can be made by stakeholders and can operationalize the findings into their future development plans, strategies, and roadmaps. Finally, these innovation pathways also sketch *joint dynamic narratives* *towards healthy planet diets*, supporting the wide range of transdisciplinary stakeholders to combine research on innovations for future food in terms of production, behavior, and health.

Further, a sustainable diet promotes environmental and economic stability through low-impact and affordable, accessible foods, while supporting public health through adequate nutrition. Importantly, sustainable diets help promote sovereignty and preserve tradition involving culturally sensitive and acceptable foods [102].

Our research agenda hereby will follow the definition of Johnston et al. [102] on sustainable diets promoting environmental and economic stability, with affordable and accessible food and public health. It hereby also promotes sovereignty and preserves cultural traditions. To make this more countable, we aim to contribute within the framework of the Sustainable Development Goals and especially estimate the effect on the 12 pre-selected SDGs (Figure 2). The SDGs which are impacted by those are on social needs: poverty (SDG1), hunger (SDG2), health (SDG3), gender equality (SDG5), reduced inequalities (SDG10), sustainable cities and communities (SDG11), responsible consumption and production (SDG12), peace, justice, and strong institutions (SDG16); and on biophysical goals: fresh water (SDG6), climate (SDG 13), life in sea (SDG14), and life on land (SDG15).

Figure 2. The integrated Future Food Utrecht (FFU) proposal will contribute to 12 out of 17 SDGs (United Nations).

In Figure 3, we have set-out these SDGs and connected those to the four themes within the research program.

With scenario analyses, the food choices will be evaluated by using integrated assessment and modeling methodologies, that will evaluate 12 out of the 17 UN SDGs (Figure 2). Further, the approach specifically aims to make an impact by connecting scientists to industry and society by using co-creation. Many trade-offs between the SDGs are expected. For instance, higher agricultural productivity helps SDG2 but could impact biodiversity (SDG15) but also often water quality (SDG6) due to fertilizer and pesticide use, both in freshwater systems and ocean, with dead zones due to runoff of fertilizers. The challenge is to develop scenarios which try to find synergies between all SDGs and avoid trade-offs, not only local but also via teleconnections.

Figure 3. Integrated future food research contributing to wicked-problems by using the SDG framework.

5. Conclusions

The future of food is one of the major world-wide challenges. It is clear that not one single standard diet will be healthy, sustainable, as well as fair. Recently, the World Health Organization (WHO) also pulled their support from a global move to plant-based foods [108] as proposed in the EAT-Lancet diet [4]. The main points the WHO raised are that: 1) a plant-based diet destroys traditional diets that are part of cultural heritage, 2) it eliminates consumers' freedom of choice, and 3) there is no scientific proof for the benefits of a standard diet for the whole planet.

Although the EAT-Lancet commission [4] did present an integrated framework for healthy diet and sustainable food production, we think that crucial steps are missing. For example, the EAT-Lancet report is remarkably silent on the governance challenges that go along with the required transformation of food consumption and production systems. There is by now ample evidence that moves towards a more sustainable food system, that is impeded by vested interests that favor the status quo [109,110], which includes the knowledge system underpinning innovation, thereby hampering the development of alternative approaches to food production that go beyond the current agricultural regime [111]. Additionally, the current compartmentalization of policy-making hampers a truly integrated perspective that enables connecting production and consumption challenges in policy-making [112]. A final important impediment to change is the current lack of fairness principles to spread the risk and costs of a transition, which is caused by the weak position of farmers in the value chain, the disconnect between consumers and producers, and the vested interests of financial institutions in the current way of working, resulting in limited markets for sustainably produced and healthy food and the lack of access to capital and land of frontrunners fueling the transition. To answer the major challenges of future food, we believe that a wider framework is necessary, one that can be evaluated by using scenarios and the defined social and biophysical SDGs. Our proposed framework follows the One Health concept including health of planet, health of humans, and health of livestock, thereby covering the first two themes as discussed in the paper: (i) nature-inspired food production and (ii) sustainable immune resilience. A further integration of the social domain by (iii) social and cultural change of food behavior, and (iv) food fairness as discussed in this paper gives the wider framework to answer the major challenges of future food [108].

Evidence shows that alternatives to the dominant intensive and hugely concentrated agri-food system are possible and thriving [82]. Yet, to truly create transformations at a larger scale, we need concerted efforts to move beyond intensive agriculture, create links and speak with a common voice, while recognizing and respecting diversity. Working in a transdisciplinary setting is fundamental in this respect, as these future challenges can neither be solved by academy, society, or industry alone.

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References

1. FAO. The state of food security and nutrition in the world 2018. In *Building Climate Resilience for Food Security and Nutrition*; FAO: Rome, Italy, 2018.
2. Godfray, H.C.J.; Crute, I.R.; Haddad, L.; Lawrence, D.; Muir, J.F.; Nisbett, N.; Pretty, J.; Robinson, S.; Toulmin, C.; Whiteley, R. The future of the global food system. *Philos. Trans. R. Soc. B Boil. Sci.* **2010**, *365*, 2769–2777. [CrossRef] [PubMed]
3. IPBES Global Assessment Report on Biodiversity and Ecosystem Services. Available online: https://ipbes.net/global-assessment (accessed on 10 September 2020).
4. Willett, W.; Rockström, J.; Loken, B.; Springmann, M.; Lang, T.; Vermeulen, S.; Garnett, T.; Tilman, D.; Declerck, F.; Wood, A.; et al. Food in the anthropocene: the EAT–lancet commission on healthy diets from sustainable food systems. *Lancet* **2019**, *393*, 447–492. [CrossRef]
5. Foley, J.A.; Ramankutty, N.; Brauman, K.A.; Cassidy, E.S.; Gerber, J.S.; Johnston, M.; Mueller, N.D.; O'Connell, C.; Ray, D.; West, P.C.; et al. Solutions for a cultivated planet. *Nature* **2011**, *478*, 337–342. [CrossRef]
6. Batie, S.S. Wicked problems and applied economics. *Am. J. Agric. Econ.* **2008**, *90*, 1176–1191. [CrossRef]
7. Candel, J.; Breeman, G.; Termeer, C.J. The European commission's ability to deal with wicked problems: an in-depth case study of the governance of food security. *J. Eur. Public Policy* **2015**, *23*, 789–813. [CrossRef]
8. MacRae, R.; Winfield, M. A little regulatory pluralism with your counter-hegemonic advocacy? Blending analytical frames to construct joined-up food policy in Canada. *Can. Food Stud.* **2016**, *3*, 140–194.
9. Raskin, P.; Monks, F.; Ribeiro, T.; Vuuren, D.; Van Zurek, M.B.; Alonso, A.; Field, C. Global Scenarios in Historical Perspective. In *Ecosystems and Humun Well-Being: Scenarios-Findings of the Scenarios Working Group Millenium Ecosystem Assessment Series*; Stephen, C., Prabhu Pingali, E.B., Eds.; Island Press: Washington, DC, USA, 2005; pp. 35–44.
10. Van Vuuren, D.P.; Edmonds, J.; Kainuma, M.; Riahi, K.; Thomson, A.; Hibbard, K.; Hurtt, G.C.; Kram, T.; Krey, V.; Lamarque, J.-F.; et al. The representative concentration pathways: an overview. *Clim. Chang.* **2011**, *109*, 5–31. [CrossRef]
11. Van Vuuren, D.P.; Bijl, D.L.; Bogaart, P.W.; Stehfest, E.; Biemans, H.; Dekker, S.C.; Doelman, J.C.; Gernaat, D.E.H.J.; Harmsen, M.J.H.M. Integrated scenarios to support analysis of the food–energy–water nexus. *Nat. Sustain.* **2019**, *2*, 1132–1141. [CrossRef]
12. Bijl, D.L.; Bogaart, P.W.; Dekker, S.C.; Van Vuuren, D.P. Unpacking the nexus: Different spatial scales for water, food and energy. *Glob. Environ. Chang.* **2018**, *48*, 22–31. [CrossRef]

13. Bijl, D.L.; Bogaart, P.W.; Dekker, S.C.; Stehfest, E.; De Vries, B.J.; Van Vuuren, D.P. A physically-based model of long-term food demand. *Glob. Environ. Chang.* **2017**, *45*, 47–62. [CrossRef]
14. Lebov, J.F.; Grieger, K.; Womack, D.; Zaccaro, D.; Whitehead, N.; Kowalcyk, B.; Macdonald, P. A framework for One Health research. *One Heal.* **2017**, *3*, 44–50. [CrossRef] [PubMed]
15. Anderson, K. Globalization's effects on world agricultural trade, 1960–2050. *Philos. Trans. R. Soc. B Boil. Sci.* **2010**, *365*, 3007–3021. [CrossRef] [PubMed]
16. Duru, M.; Therond, O.; Martin, G.; Martin-Clouaire, R.; Magne, M.-A.; Justes, É.; Journet, E.; Aubertot, J.-N.; Savary, S.; Bergez, J.-E.; et al. How to implement biodiversity-based agriculture to enhance ecosystem services: a review. *Agron. Sustain. Dev.* **2015**, *35*, 1259–1281. [CrossRef]
17. Stoate, C.; Baldi, A.; Beja, P.; Boatman, N.; Herzon, I.; Van Doorn, A.; De Snoo, G.; Rakosy, L.; Ramwell, C. Ecological impacts of early 21st century agricultural change in Europe—A review. *J. Environ. Manag.* **2009**, *91*, 22–46. [CrossRef] [PubMed]
18. Geiger, F.; Bengtsson, J.; Berendse, F.; Weisser, W.W.; Emmerson, M.; Morales, M.B.; Ceryngier, P.; Liira, J.; Tscharntke, T.; Winqvist, C.; et al. Persistent negative effects of pesticides on biodiversity and biological control potential on European farmland. *Basic Appl. Ecol.* **2010**, *11*, 97–105. [CrossRef]
19. Van Dijk, J. Biodiversity and Nature. *Geogr. Ga.* **2018**, 81–104. [CrossRef]
20. Pe'Er, G.; Zinngrebe, Y.; Moreira, F.; Sirami, C.; Schindler, S.; Müller, R.; Bontzorlos, V.; Clough, D.; Bezák, P.; Bonn, A.; et al. A greener path for the EU common agricultural policy. *Science* **2019**, *365*, 449–451. [CrossRef] [PubMed]
21. European Commission. Farm to Fork Strategy—For a Fair, Helathy and Environmentally-Friendly Food System. Available online: https://ec.europa.eu/food/farm2fork_en (accessed on 10 September 2020).
22. Kleijn, D.; Bommarco, R.; Fijen, T.P.M.; Garibaldi, L.A.; Potts, S.G.; Van Der Putten, W.H. Ecological intensification: Bridging the gap between science and practice. *Trends Ecol. Evol.* **2019**, *34*, 154–166. [CrossRef]
23. Dalberg, W.U.R. *What Works to Increase Smallholder Farmers' Income? A Landscape Review*; Farmer Income Lab: Wageningen, The Netherlands, 2018.
24. OP2B. One Planet Business for Biodiversity (OP2B) Statement of Ambition. Available online: https://op2b.org/wp-content/uploads/2019/09/OP2B_Ambition_Statement.pdf (accessed on 10 September 2020).
25. Ponisio, L.C.; Ehrlich, P.R. Diversification, yield and a new agricultural revolution: Problems and prospects. *Sustainability* **2016**, *8*, 1118. [CrossRef]
26. Wilbois, K.-P.; Schmidt, J.E. Reframing the Debate Surrounding the Yield Gap between Organic and Conventional Farming. *Agronomy* **2019**, *9*, 82. [CrossRef]
27. Tscharntke, T.; Tylianakis, J.M.; Rand, T.A.; Didham, R.K.; Fahrig, L.; Batary, P.; Bengtsson, J.; Clough, Y.; Crist, T.O.; Dormann, C.F.; et al. Landscape moderation of biodiversity patterns and processes eight hypotheses. *Boil. Rev.* **2012**, *87*, 661–685. [CrossRef] [PubMed]
28. Fojt, W.J. The nature conservation importance of fens and bogs and the role of restoration. In *Restoration of Temperate Wetlands*; Wheeler, B.D., Shaw, S.C., Fojt, W.J., Robertson, R.A., Eds.; Wiley: Chichester, UK, 1995; pp. 33–48.
29. Erisman, J.W.; Van Eekeren, N.; De Wit, J.; Koopmans, C.; Cuijpers, W.; Oerlemans, N.; Koks, B.J. Agriculture and biodiversity: A better balance benefits both. *AIMS Agric. Food* **2016**, *1*, 157–174. [CrossRef]
30. Pimentel, D.; Hepperly, P.; Hanson, J.; Douds, D.; Seidel, R. Environmental, energetic, and economic comparisons of organic and conventional farming systems. *Bioscience* **2005**, *55*, 573. [CrossRef]
31. Holtkamp, R.; Kardol, P.; Van Der Wal, A.; Dekker, S.C.; Van Der Putten, W.H.; De Ruiter, P.C. Soil food web structure during ecosystem development after land abandonment. *Appl. Soil Ecol.* **2008**, *39*, 23–34. [CrossRef]
32. Berendsen, R.L.; Pieterse, C.M.J.; Bakker, P.A. The rhizosphere microbiome and plant health. *Trends Plant Sci.* **2012**, *17*, 478–486. [CrossRef]
33. Hartman, S.; Liu, Z.; Van Veen, H.; Vicente, J.; Reinen, E.; Martopawiro, S.; Zhang, H.; Van Dongen, N.; Bosman, F.; Bassel, G.W.; et al. Ethylene-mediated nitric oxide depletion pre-adapts plants to hypoxia stress. *Nat. Commun.* **2019**, *10*, 4020–4029. [CrossRef]
34. Voesenek, L.A.; Van Veen, H.; Sasidharan, R. Learning from nature: the use of non-model species to identify novel acclimations to flooding stress. *AoB PLANTS* **2014**, *6*. [CrossRef]
35. Zhang, F.S.; Li, L. Using competitive and facilitative interactions in intercropping systems enhances crop productivity and nutrient-use efficiency. *Plant Soil* **2003**, *248*, 305–312. [CrossRef]

36. Schenkeveld, W.D.C.; Wang, Z.; Giammar, D.E.; Kraemer, S.M. Synergistic effects between biogenic ligands and a reductant in Fe acquisition from calcareous soil. *Environ. Sci. Technol.* **2016**, *50*, 6381–6388. [CrossRef]
37. Van Dijk, J.; Van Der Vliet, R.E.; De Jong, H.; Van Emmichoven, M.J.Z.; Van Hardeveld, H.A.; Dekker, S.C.; Wassen, M.J. Modeling direct and indirect climate change impacts on ecological networks: a case study on breeding habitat of Dutch meadow birds. *Landsc. Ecol.* **2015**, *30*, 805–816. [CrossRef]
38. Connelly, H.; Poveda, K.; Loeb, G. Landscape simplification decreases wild bee pollination services to strawberry. *Agric. Ecosyst. Environ.* **2015**, *211*, 51–56. [CrossRef]
39. De Snoo, G.R.; Herzon, I.; Staats, H.; Burton, R.; Schindler, S.; Van Dijk, J.; Lokhorst, A.M.; Bullock, J.M.; Lobley, M.; Wrbka, T.; et al. Toward effective nature conservation on farmland: making farmers matter. *Conserv. Lett.* **2012**, *6*, 66–72. [CrossRef]
40. Lamine, C. Transition pathways towards a robust ecologization of agriculture and the need for system redesign. Cases from organic farming and IPM. *J. Rural. Stud.* **2011**, *27*, 209–219. [CrossRef]
41. Pretty, J.; Benton, T.G.; Bharucha, Z.P.; Dicks, L.V.; Flora, C.B.; Godfray, H.C.J.; Goulson, D.; Hartley, S.; Lampkin, N.; Morris, C.; et al. Global assessment of agricultural system redesign for sustainable intensification. *Nat. Sustain.* **2018**, *1*, 441–446. [CrossRef]
42. Frasca, D.; Blomberg, B.B. Adipose tissue, immune aging, and cellular senescence. *Semin. Immunopathol.* **2020**, 1–15. [CrossRef] [PubMed]
43. Keane, K.N.; Calton, E.K.; Carlessi, R.; Hart, P.H.; Newsholme, P. The bioenergetics of inflammation: insights into obesity and type 2 diabetes. *Eur. J. Clin. Nutr.* **2017**, *71*, 904–912. [CrossRef]
44. Maejima, Y.; Yokota, S.; Horita, S.; Shimomura, K. Early life high-fat diet exposure evokes normal weight obesity. *Nutr. Metab.* **2020**, *17*, 1–8. [CrossRef]
45. Monaghan, L.F.; Colls, R.; Evans, B. Obesity discourse and fat politics: research, critique and interventions. *Crit. Public Heal.* **2013**, *23*, 249–262. [CrossRef]
46. Te Velde, A.A.; Bezema, T.; Van Kampen, A.H.C.; Kraneveld, A.D.; 't Hart, B.A.; Van Middendorp, H.; Hack, E.C.; Van Montfrans, J.M.; Belzer, C.; Jans-Beken, L.; et al. Embracing complexity beyond systems medicine: A new approach to chronic immune disorders. *Front. Immunol.* **2016**, *7*, 587. [CrossRef]
47. Barnig, C.; Bezema, T.; Calder, P.C.; Charloux, A.; Frossard, N.; Garssen, J.; Haworth, O.; Dilevskaya, K.; Levi-Schaffer, F.; Lonsdorfer, E.; et al. Activation of resolution pathways to prevent and fight chronic inflammation: Lessons from asthma and inflammatory bowel disease. *Front. Immunol.* **2019**, *10*, 1699. [CrossRef]
48. Jeurink, P.V.; Knipping, K.; Wiens, F.; Barańska, K.; Stahl, B.; Garssen, J.; Królak-Olejnik, B. Importance of maternal diet in the training of the infant's immune system during gestation and lactation. *Crit. Rev. Food Sci. Nutr.* **2018**, *59*, 1311–1319. [CrossRef] [PubMed]
49. Renz, H.; Adkins, B.D.; Bartfeld, S.; Blumberg, R.S.; Farber, D.L.; Garssen, J.; Ghazal, P.; Hackam, D.J.; Marsland, B.J.; McCoy, K.D.; et al. The neonatal window of opportunity—Early priming for life. *J. Allergy Clin. Immunol.* **2018**, *141*, 1212–1214. [CrossRef]
50. PALISADE Group of Clinical Investigators; Vickery, B.P.; Vereda, A.; Casale, T.B.; Beyer, K.; Du Toit, G.; Hourihane, J.O.; Jones, S.M.; Shreffler, W.G.; Marcantonio, A.; et al. AR101 oral immunotherapy for peanut allergy. *N. Engl. J. Med.* **2018**, *379*, 1991–2001. [CrossRef]
51. Sampson, H.A.; Shreffler, W.G.; Yang, W.H.; Sussman, G.L.; Brown-Whitehorn, T.F.; Nadeau, K.C.; Cheema, A.S.; Leonard, S.A.; Pongracic, J.A.; Sauvage-Delebarre, C.; et al. Effect of varying doses of epicutaneous immunotherapy vs placebo on reaction to peanut protein exposure among patients with peanut sensitivity: A randomized clinical trial. *JAMA* **2017**, *318*, 1798–1809. [CrossRef] [PubMed]
52. Zempleni, J.; Aguilar-Lozano, A.; Sadri, M.; Sukreet, S.; Manca, S.; Wu, D.; Zhou, F.; Mutai, E. Biological activities of extracellular vesicles and their cargos from bovine and human milk in humans and implications for infants. *J. Nutr.* **2016**, *147*, 3–10. [CrossRef]
53. Kremer, A.N.; Zonneveld, M.I.; Kremer, A.E.; Van Der Meijden, E.D.; Falkenburg, J.F.; Wauben, M.H.; Hoen, E.N.N.-T.; Griffioen, M. Natural T-cell ligands that are created by genetic variants can be transferred between cells by extracellular vesicles. *Eur. J. Immunol.* **2018**, *48*, 1621–1631. [CrossRef]
54. Zonneveld, M.I. What Mother is Telling You: The Messages Encoded in Milk-Derived Extracellular Vesicles: Implications for the Immune System and Epithelial Barrier Function. Ph.D. Thesis, Utrecht University, Utrecht, The Netherlands, 2017.

55. Nagai, M.; Noguchi, R.; Takahashi, D.; Morikawa, T.; Koshida, K.; Komiyama, S.; Ishihara, N.; Yamada, T.; Kawamura, Y.I.; Muroi, K.; et al. Fasting-refeeding impacts immune cell dynamics and mucosal immune responses. *Cell* **2019**, *178*, 1072–1087. [CrossRef]
56. Roberfroid, M.; Gibson, G.R.; Hoyles, L.; McCartney, A.L.; Rastall, R.; Rowland, I.; Wolvers, D.; Watzl, B.; Szajewska, H.; Stahl, B.; et al. Prebiotic effects: metabolic and health benefits. *Br. J. Nutr.* **2010**, *104*, S1–S63. [CrossRef]
57. Deehan, E.C.; Duar, R.M.; Armet, A.M.; Perez-Muñoz, M.E.; Jin, M.; Walter, J. Modulation of the gastrointestinal microbiome with nondigestible fermentable carbohydrates to improve human health. *Microbiol. Spectr.* **2017**, *5*. [CrossRef]
58. Ashwini, A.; Ramya, H.; Ramkumar, C.; Reddy, K.R.; Kulkarni, R.V.; Abinaya, V.; Naveen, S.; Raghu, A.V.; Reddy, K.R. Reactive mechanism and the applications of bioactive prebiotics for human health: Review. *J. Microbiol. Methods* **2019**, *159*, 128–137. [CrossRef]
59. Van De Loo, A.J.; Kerssemakers, N.; Scholey, A.; Garssen, J.; Kraneveld, A.D.; Verster, J.C. Perceived Immune Fitness, Individual Strength and Hangover Severity. *Int. J. Environ. Res. Public Heal.* **2020**, *17*, 4039. [CrossRef] [PubMed]
60. Shepherd, R. The psychology of food choice. *Nutr. Food Sci.* **1990**, *90*, 2–4. [CrossRef]
61. Branca, F.; Nikogosian, H.; Lobstein, T. *The Challenge of Obesity in the Who European Region and the Strategies for Response: Summary*; World Health Organization: Geneva, Switzerland, 2007.
62. Vandevijvere, S.; Barquera, S.; Caceres, G.; Corvalán, C.; Karupaiah, T.; Kroker-Lobos, M.F.; L'Abbé, M.; Ng, S.H.; Phulkerd, S.; Ramirez-Zea, M.; et al. An 11-country study to benchmark the implementation of recommended nutrition policies by national governments using the Healthy Food Environment Policy Index, 2015-2018. *Obes. Rev.* **2019**, *20*, 57–66. [CrossRef] [PubMed]
63. Warde, A. *Consumption, Food and Taste: Culinary Antinomies and Commodity Culture*; Sage: London, UK, 1997.
64. Rousseau, S. *Food and Social Media: You are What You Tweet*; Altamira Press: Plymouth, UK, 2012.
65. Mazzocchi, M.; Brasili, C.; Sandri, E. Trends in dietary patterns and compliance with World Health Organization recommendations: a cross-country analysis. *Public Health Nutr.* **2008**, *11*, 535–540. [CrossRef] [PubMed]
66. Popkin, B. The nutrition transition: An overview of world patterns of change. *Nutr. Rev.* **2004**, *62*, S140–S143. [CrossRef]
67. Mazel, A.G. *Governing Food: Media, Politics and Pleasure*; UvA: Amsterdam, The Netherlands, 2019.
68. Alkon, A.H.; Agyeman, J. *Cultivating Food Justice Race, Class, and Sustainability*; MIT Press: Cambridge, MA, USA, 2011.
69. Gottlieb, R.; Joshi, A. *Food Justice*; MIT Press: Cambridge, MA, USA, 2010.
70. Guthman, J. *Obesity, Food Justice and the Limits of Capitalism*; University of California Press: Berkeley, CA, USA, 2011.
71. Nicholls, A. Fair trade: Towards an economics of virtue. *J. Bus. Ethic* **2010**, *92*, 241–255. [CrossRef]
72. Schlosberg, D. Reconceiving environmental justice: Global movements and political theories. *Environ. Politi.* **2004**, *13*, 517–540. [CrossRef]
73. Kalfagianni, A. Addressing the global sustainability challenge: The potential and pitfalls of private governance from the perspective of human capabilities. *J. Bus. Ethic* **2013**, *122*, 307–320. [CrossRef]
74. Schlosberg, D. *Defining Environmental Justice: Theories, Movements and Nature*; Oxford University Press: Oxford, UK, 2007.
75. Briggeman, B.; Lusk, J.L. Preferences for fairness and equity in the food system. *Eur. Rev. Agric. Econ.* **2010**, *38*, 1–29. [CrossRef]
76. Fraser, N. Rethinking recognition. *New Left Rev.* **2000**, *3*, 107–120.
77. Nussbaum, M.C. Aristotle, politics, and human capabilities: A response to antony, Arneson, charlesworth, and mulgan. *Ethic* **2000**, *111*, 102–140. [CrossRef]
78. Sen, A. *Development as Freedom*; Oxford University Press: Oxford, UK, 1999.
79. Gereffi, G. Global value chains in a post-Washington Consensus world. *Rev. Int. Politi. Econ.* **2013**, *21*, 9–37. [CrossRef]
80. Fuchs, D.; Kalfagianni, A.; Havinga, T. Actors in private food governance: the legitimacy of retail standards and multistakeholder initiatives with civil society participation. *Agric. Hum. Values* **2009**, *28*, 353–367. [CrossRef]

81. Van Westen, A.; Mangnus, E.; Wangu, J.; Worku, S.G. Inclusive agribusiness models in the Global South: The impact on local food security. *Curr. Opin. Environ. Sustain.* **2019**, *41*, 64–68. [CrossRef]
82. Kalfagianni, A.; Skordili, S. *Localizing Global Food: Short Food Supply Chains as Responses to Agri-Food System Challenges*; Routledge: London, UK, 2018.
83. ActionAid International. *The Rights to End Poverty*; ActionAid International: Johannesburg, South Africa, 2005.
84. Hayne, C.L.; A Moran, P.; Ford, M.M. Regulating environments to reduce obesity. *J. Public Heal. Policy* **2004**, *25*, 391–407. [CrossRef] [PubMed]
85. Klooster, D. Environmental certification of forests: The evolution of environmental governance in a commodity network. *J. Rural. Stud.* **2005**, *21*, 403–417. [CrossRef]
86. Reardon, T.; Echanove, F.; Cook, R.; Tucker, M.; Berdegué, J.A. *The Rise of Supermarkets and the Evolution of Their Procurement Systems in Mexico: Focus on Horticulture Products*; International Food Policy Research Institute: Washington, DC, USA, 2005.
87. Lang, T.; Barling, D.; Caraher, M. Food, Social policy and the environment: Towards a new model. *Soc. Policy Adm.* **2001**, *35*, 538–558. [CrossRef]
88. Mauser, W.; Klepper, G.; Rice, M.; Schmalzbauer, B.S.; Hackmann, H.; Leemans, R.; Moore, H. Transdisciplinary global change research: the co-creation of knowledge for sustainability. *Curr. Opin. Environ. Sustain.* **2013**, *5*, 420–431. [CrossRef]
89. Lang, D.; Wiek, A.; Bergmann, M.; Stauffacher, M.; Martens, P.; Moll, P.; Swilling, M.; Thomas, C.J. Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustain. Sci.* **2012**, *7*, 25–43. [CrossRef]
90. Grasseni, C. Seeds of trust. Italy's gruppi di acquisto solidale (solidarity purchase groups). *J. Politi. Ecol.* **2014**, *21*, 178–192. [CrossRef]
91. Kirwan, J.; Ilbery, B.; Maye, D.; Carey, J. Grassroots social innovations and food localisation: An investigation of the local food programme in England. *Glob. Environ. Chang.* **2013**, *23*, 830–837. [CrossRef]
92. Smith, A. Social innovation, democracy and makerspaces editorial assistance. *SSRN* **2017**, *10*. [CrossRef]
93. Van Oers, L.; Boon, W.; Moors, E.H. The creation of legitimacy in grassroots organisations: A study of Dutch community-supported agriculture. *Environ. Innov. Soc. Transitions* **2018**, *29*, 55–67. [CrossRef]
94. Seyfang, G.; Smith, A. Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environ. Politi.* **2007**, *16*, 584–603. [CrossRef]
95. Smith, A.; Fressoli, M.; Thomas, H. Grassroots innovation movements: challenges and contributions. *J. Clean. Prod.* **2014**, *63*, 114–124. [CrossRef]
96. Hargreaves, T.; Hielscher, S.; Seyfang, G.; Smith, A. Grassroots innovations in community energy: The role of intermediaries in niche development. *Glob. Environ. Chang.* **2013**, *23*, 868–880. [CrossRef]
97. Seyfang, G.; Longhurst, N. What influences the diffusion of grassroots innovations for sustainability? Investigating community currency niches. *Technol. Anal. Strat. Manag.* **2016**, *28*, 1–23. [CrossRef]
98. Martin, C.J.; Upham, P.; Budd, L. Commercial orientation in grassroots social innovation: Insights from the sharing economy. *Ecol. Econ.* **2015**, *118*, 240–251. [CrossRef]
99. FAO and WHO. *Sustainable Healthy Diets-Guiding Principles*; FAO and WHO: Rome, Italy, 2019.
100. Garnett, T. Changing What We Eat: A Call for Research & Action on Widespread Adoption of Sustainable Healthy Eating. Available online: https://www.fcrn.org.uk/sites/default/files/fcrn_wellcome_gfs_changing_consumption_report_final.pdf (accessed on 10 September 2020).
101. Prahalad, C.K.; Ramaswamy, V. *The Future of Competition*; Harvard Business School Press: Boston, MA, USA, 2014.
102. Johnston, J.L.; Fanzo, J.C.; Cogill, B. Understanding sustainable diets: A descriptive analysis of the determinants and processes that influence diets and their impact on health, food security, and environmental sustainability. *Adv. Nutr.* **2014**, *5*, 418–429. [CrossRef]
103. Boon, W.P.; Moors, E.H.M.; Kuhlmann, S.; Smits, R.E. Demand articulation in emerging technologies: Intermediary user organisations as co-producers? *Res. Policy* **2011**, *40*, 242–252. [CrossRef]
104. De Vries, G.W.; Boon, W.P.; Peine, A. User-led innovation in civic energy communities. *Environ. Innov. Soc. Transitions* **2016**, *19*, 51–65. [CrossRef]
105. von Hippel, E. *Democratizing Innovation*; MIT Press: Cambridge, MA, USA, 2005; Available online: https://ssrn.com/abstract=712763 (accessed on 10 September 2020).

106. IPES Food. Towards a Common Food Policy for the European Union the Policy Reform and Realignment That Is Required To Build Sustainable Food Systems in Europe Report. Available online: http://www.ipes-food.org/pages/CommonFoodPolicy (accessed on 10 September 2020).
107. Robinson, D.K.; Propp, T. Multi-path mapping for alignment strategies in emerging science and technologies. *Technol. Forecast. Soc. Chang.* **2008**, *75*, 517–538. [CrossRef]
108. Torjesen, I. WHO pulls support from initiative promoting global move to plant based foods. *BMJ* **2019**, *365*, l1700. [CrossRef] [PubMed]
109. Lang, T.; Heasman, M. *Food Wars: "The Global Battle for Mouths, Minds and Markets"*; Earthscan Publications Ltd.: London, UK, 2015.
110. Nestle, M. *Food Politics: How the Food Industry Influences Nutrition and Health*; University of California Press: Berkeley, CA, USA, 2013.
111. Gernert, M.; El Bilali, H.; Strassner, C. Grassroots initiatives as sustainability transition pioneers: Implications and lessons for urban food systems. *Urban Sci.* **2018**, *2*, 23. [CrossRef]
112. Candel, J.J.L.; Pereira, L. Towards integrated food policy: Main challenges and steps ahead. *Environ. Sci. Policy* **2017**, *73*, 89–92. [CrossRef]