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Trends Shaping Western European Agrifood Systems of the Future

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Abstract: Western Europe's agrifood systems are highly developed, extremely complex, and dependably produce food for billions. Securing their functionality is imperative whilst dealing with varieties of major challenges and opportunities in the future. Multiple stakeholders are involved in system transitions; therefore, synthesizing views from different scientific disciplines is essential for a robust trend analysis. Through workshops with a variety of experts, extensive research, followed by close monitoring over 5 years, we identified trends that will influence the shape of the evolving agrifood systems. Based on this, we determined which trends need addressing by agrifood research to secure the system's future functioning. We detected nine trends with 50 sub-topics that will shape the future of Western European agrifood systems, of which 5 are classified as macro- and 4 as micro-trends. Our second objective was to improve the efforts of the stakeholders in- and outside of the agrifood area to secure functioning and further improvement through giving a comprehensive overview. This contributes to enhanced strategies for sustainable and resilient agrifood systems that produce sufficient affordable nutritious food for a planetary health diet, and hence, supporting successful implementation of selected goals from the 2030 Agenda for Sustainable Development and the European Green Deal.

Keywords: trends; agrifood systems; foresight; sustainability; resilience; agricultural systems; transition

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1. Introduction

Well-functioning, sustainable and resilient agrifood systems secure societies' survival in the future. Historical examples have shown severe consequences when agrifood systems lost their ability to function, ranging from natural causes (e.g., potato blight in Ireland) to political disruptions (e.g., the Cultural Revolution in China) or humanitarian and health crises demonstrated by the current COVID-19 pandemic or the war in Ukraine. Disrupted supply chains that lead to food scarcity and price-raises demonstrate unforeseen new challenges for food security. Providing the knowledge to shape resilient and sustainable agricultural systems of the future is therefore one of the main goals for agricultural, horticultural, climate and food research. In Western Europe, as defined by the United Nations [1], almost 196 million people [2] depend on this. According to the Food and Agriculture Organization of the United Nations FAO, food security in the year 2100 is highly uncertain if 11 billion humans will need to be fed; let alone to do so using the natural resource base sustainably [3]. The conducted trend analysis presented in this article is concerned with providing insights that aid in mainly reaching the following Sustainable Development Goals (SDG) defined by the UN [4]: SDG 2, Zero Hunger, to end hunger, achieve food security and improved nutrition and promote sustainable agriculture, SDG 11, to make cities and human settlements inclusive, safe, resilient and sustainable, and SDG 12, to achieve sustainable management and efficient use of natural resources.

While the goals for sustainable development were agreed upon, the pathway to achieving these goals is much more complex and not nearly as clear. Western European agrifood systems are highly developed and industrialized. However, this does not result in resilience, let alone sustainability. Instead, they are less flexible to assimilating the challenges ahead (e.g., climate change, the COVID-19 pandemic) [5]. Solely focusing on agriculture will not suffice; a systemic approach that focuses on agrifood systems research and policy is key to the complex and holistic transformations that will lead to sustainable and secure agrifood systems [6]. Present efforts in science and research are dedicated to exploring how today's agrifood systems could (or should) be altered to feed billions securely and sustainably [7–10]. Simultaneously, current developments triggered by different forces inside agrifood systems are manifesting with (potentially) strong impacts on future agrifood systems. Exploring what trends, developments and topics will influence and shape them in the future and thus, providing insights about areas that researchers and other stakeholders with a focus on sustainable and resilient developments should cover and monitor, is needed. Our research results so far are less normative but explorative—with the goal of highlighting areas that require covering to strive towards secure and resilient agrifood systems in the future.

Mapping all challenges, facets and interconnections is impossible by the means at hand as agrifood systems are one of the most complex sets of systems that humankind has created. Plus, the information content of such an effort would be lost in the complexity and density necessary to have an accurate description and analyzation of a real-world agrifood system [11]. This limitation in mind, we aim for a better understanding of the detectable trends. Evaluating the different levels of the identified trends—from macro to micro—aids the allocating of resources to research areas or surveillance. Anticipating those trends needs a combining of the expertise of multiple scientific and industrial disciplines. This interdisciplinary approach is a key element in strategic foresight and supports the conquering of narrow thinking [12–14]. The inter- and transdisciplinary research approach promotes resilience and future robustness when looking at a complex system.

Evaluating which trends in society, technology, economy, ecology, research and industry will influence the shape of future agrifood systems in Western Europe is the objective of our study, by focusing on natural resource and environmental dimensions as well as on socioeconomic dimensions of agrifood systems and including, too, neighboring systems such as the health system, ecological systems and the energy system according to Braun et al. [11]. To achieve this, the article addresses the following three key questions:

- Which current detectable trends will influence the future of Western European agrifood systems and hence, food security?
- Which trends are key drivers (macro trends) and which trends show strong influential potential (micro trends) for the future development of agrifood systems?
- What importance do those trends have for the strategic aims of research related to agrifood systems?

2. Materials and Methods

The results presented here are based on four consecutive workshops aiming to identify trends that aid in further exploring options for a future agrifood system in Western Europe. They were part of the preliminary and ongoing work within the BMBF framework "Agricultural systems of the future" for the joint project food4future (www.food4future.de (accessed on 20 August 2022). See Figure 1 for the steps taken in identifying the trends and topics discussed here.

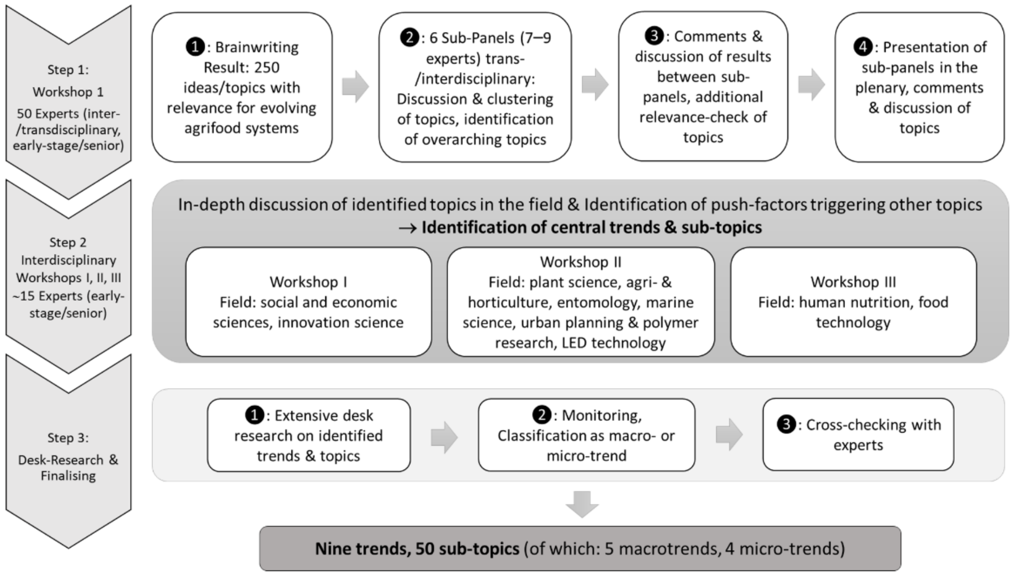

Figure 1. Research design and steps taken to identify trends and topics that are central in exploring future agrifood systems in Western Europe.

Almost 50 participants attended the first workshop, representing a wide spectrum of expertise in science and industry ranging through agriculture and horticulture, plant physiology, entomology, marine science, food science and human nutrition, agriculture and food technology, innovation science, urban planning, social and economic sciences. A mixture of early-stage researchers and senior scientists joined. This inter- and transdisciplinary approach was deployed to synthesize and extend discipline-specific perspectives to yield innovative solutions [15]. The combination of experts allowed a holistic approach to capture the different fields that shape a future agrifood system and how they influence each other. The brain-writing method was chosen for the beginning of the workshop to enable the experts to freely express their ideas in a structured manner and to collect a sufficient number of trends [16].

After this initial round, the expert-panel was split into six trans-/interdisciplinary sub-panels with 7 to 9 participants. During the subsequent discussions, the topics were clustered, discussed from scientific and industrial viewpoints, and overarching trends/topics were identified as well as new trends/topics added, that were identified through the exchange between experts/disciplines. To include new viewpoints, preliminary results as well as the relevance of the identified trends/topics were discussed between sub-panels (see Figure 2 as an example). In the subsequent presentation and discussion of the sub-panels' outcome in the plenary, topics/trends were synthesized and agreed on as the first step of the trend-identification-process.

In four consecutive workshops, we explored the trends/topics with smaller panels focusing on different aspects of future agrifood systems. Expert groups of about 15 participants were combined as follows: (I) social and economic sciences, innovation science; (II) plant science, agriculture and horticulture, entomology, marine science, urban planning and polymer research, LED technology; and (III) human nutrition, food technology.

One goal of these consecutive workshops was to identify which trends trigger other trends/topics and thus, are central to future developments in the agrifood system, such as the various topics concerning citizen/laypeople involvement in agriculture or with producers/farmers and the nexus of evolving relationships between consumers/farmers/producers (e.g., producer–consumer networks or consumer reactions to food scandals). After extensive discussions it was agreed by the experts that most of these topics can be traced back to a shift in societal values as well as the changing importance of nutrition as a status symbol—both are discussed here as macro-trends.

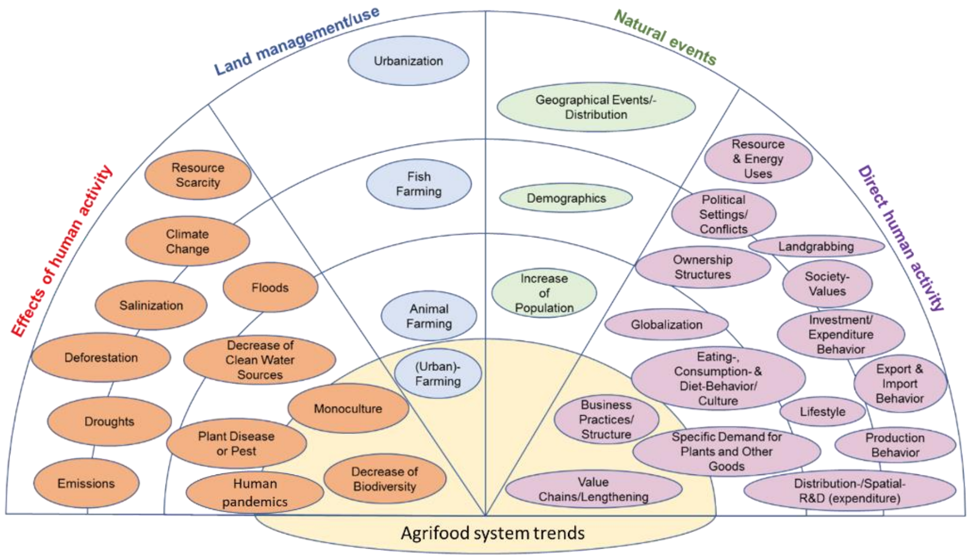

Figure 2. First detection and clustering of trends. These trends identified during the first food4future (f4f) workshop were evaluated as important for future agrifood systems in Western Europe. The semicircles show the overarching connectedness between the individual trend clusters.

While there is no widely agreed set of criteria that defines a trend as either macro or micro/emerging, spread (e.g., in the population) and evolution are the basis for classification from foresight and politics [17,18]. As a final step, we verified each trend through extensive research in the scientific literature, databases (e.g., venture-capital databases) and other sources. During the following years, the trends were monitored closely and their relevance and connection to agrifood research verified.

3. Results

This section is divided into the identification of macro and micro trends as our results in accordance with trend research showed that there are very different influence potentials and levels present in different trends.

3.1. Identification of Macro Trends

Macro trends are trends that change the agrifood system slowly but constantly over a long period. Different implications derive from them. Those trends affect all levels in economy, politics, research, technology and culture [14]. Some of those trends have been observed for a while but became more pressing over the last couple years, and also, some of them were catalyzed by the COVID-19 pandemic and the climate crisis, such as "changes in societal values" and "nutrition as status symbol". See Figure 3 for the identified trends and their sub-topics.

3.1.1. Urbanization

The constant migration from rural to urban areas over the last decades is prominent as well as a constant increase, expansion and extension of urban areas in figures, size and inhabitants [3,19–21]. This is directly connected to a spread and strengthening of the urban-shaped lifestyle, behavior and business practices [22].

There are multiple challenges and opportunities for the agriculture sector directly connected to this trend [23]: (I) The logistic supply with healthy and fresh food needs new solutions. New players are already pressing into the market (e.g., delivery services, take-away-services, online meal kits and cooking boxes), trying to disrupt the value chain, accelerated by the COVID-19 pandemic restrictions. (II) Eating behavior and culture in the population may change due to constant urbanization. This will have effects on the demand for plants and other foods. (III) Due to comparatively low agriculture and food production in (sub)urban areas, physical and cultural distance between farmers/food producers and final customers grows [24–26]. This area of tension inside the population is getting more politically charged and controversial and will occupy many Western societies over the next years.

Figure 3. Identified macro trends and their sub-topics. These trends already show a strong influence on agrifood systems in Western Europe.

3.1.2. Globalization

There is a structural change observed in agriculture and food supply towards a higher dependency on import and export of agricultural products [23] driven by globalization and the lengthening of agricultural value chains. This manifests in a rise in resource- and energy-usage and emissions [27–29]. For example, Germany exports about one third of its total agricultural production—with an upward tendency [30]. The year 2018 also showed an immense effect on agricultural production on a global scale due to political conflicts, namely, the so-called trade war between the US and China. This sets an incentive for agricultural producers in other parts of the world (e.g., Brazil) who are not affected by the tariff-raise to drive their productivity up for export—which is connected to different negative effects, especially, further tropical deforestation [31]. Only shortly after, the COVID-19 pandemic and the Russian invasion of Ukraine have shown how vulnerable globalized value chains are and how this affects agricultural production worldwide. A smaller but noteworthy counter-trend to the globalization of value chains is the direct marketing of products to final consumers by producers [32,33].

Three aspects of globalization are analyzed in more detail: (I) investments, (II) productivity, and (III) plant diseases and pests.

(**I**) **Investments**. Agricultural systems worldwide see rising capital- and knowledge-intensities in the production-sector [34]. This becomes apparent when looking at the rapidly increasing investments in the agrifood-sector in the USA over the past five years. Venture capital investments increased tenfold between 2012 and 2017 [35] and again grew around 500 percent in the past five years, as reported by VC-databases [36,37]. Central venture capital providers (e.g., google ventures) that usually only support start-ups in advanced stages are very active in the agrifood-sector and account for big parts of the abovementioned investments. Those huge investments raise the probability for innovative and/or disruptive developments inside the agrifood sector—not only in the USA but also in Western Europe due to globalization. Compared to these sums, venture capital activities in Western Europe are insignificant [38–41]. Meanwhile, the geographic distribution worldwide of expenditures for research and development (R&D) in agriculture changed for the first time since the evolving of modern agriculture [42–44]. In 2016, all middle-income countries combined spent more money on R&D in agriculture than all high-income countries. There is a correlation between population growth rates and expenditures in these countries. Simultaneously, the composition of the expenditures shows some shifts: the spending of the private sector is approaching the level of public financiers [45].

(**II**) **Productivity**. The three global requirements concerning productivity are to produce enough affordable food for everyone, provide sufficient amounts of micronutrients and handle food-over-consumption. In some regions of the world (e.g., Western Europe), a raise in productivity in agriculture—especially in plant production and harvests—is expected due to climate change. Other regions on the contrary—especially those that already struggle with security of food supply today—will face sinking productivity-rates, of up to 50 percent of current production [46]. Research also determines the tipping point in global food production, based on the present trends of a growing world population and raising productivity rates. The point signifies the moment in time when fewer calories are produced than needed to secure food supply of the world population. Assuming a perfect distribution of all available calories, there is a deficit of 214 trillion calories expected for the year 2027 [47]. Today, about one third of all food and agriculture products are going to waste [3].

If productivity can or should be raised, further deploying traditional cultivation methods is controversial. Since 1960, productivity has tripled, and now, humanity has started to understand the consequences: a significant loss in biodiversity, about half of the world's forest areas having been cleared and clean water becoming scarcer [3]. Those undesired effects will become more pressing. How the necessary raises in productivity are achieved affects the development of connected negative trends. If they rise over certain thresholds (e.g., not enough pollinators for plant production), productivity might drop significantly and jeopardize food supply security.

(**III**) **Plant diseases and pests**. Over recent decades, bovine spongiforme encephalopathy (BSE), bird and swine flu and other quickly spreading animal diseases received a lot of public attention because of their possible impact on the animal population as well as possible harm for humans. Currently, the COVID-19 virus is the center of attention in most parts of the world, revealing dramatically how zoonoses impact agrifood systems. Plant diseases and pathogens usually do not receive this amount of attention [48–50], like the bacteria troubling the orange orchards in Florida and which will now be fought by spraying antibiotics [51], stem rust in wheat that has spread quickly throughout African countries in the 1990s and is repeatedly a reason for worry in European agricultural systems [52], or the different streaks of fungi infecting banana plants (e.g., Foc Tropical Race 4) that are and have been the cause significant drops in their production [53]. The lack of public attention concerning these plant diseases and pathogens is unjust, since the spreading of any disease or pest has become more likely due to global value chains, monocultures and global mobility and therefore, their impact on productivity and food supply security is harder to predict but infinitely higher. The last decades have seen a constant rise in the global spreading of crop pests and diseases [54]. Further developing resistances against different countermeasures (e.g., against herbicide or insecticide) make any prediction in that field even harder. Another notable impact factor is climate change, as it could aid in spatial and quicker spreading.

3.1.3. Changes in Societal Values

Growing systemic knowledge about sustainable practices and alternatives to conventional production and consumption [55,56] opens transition pathways while simultaneously showing increasing influence on agrifood systems, research, production, consumption, politics and agrifood business practices [57]. Public discussions about climate change, resource scarcity and sustainability raise awareness and impact plant and food production. Agrifood systems are slowly but steadily penetrated and changed by changing consumer behaviors or new societal opinions about industrial and conventional production of agricultural products and foods as well as their manifestation in political actions [23,58], e.g., the public debate in 2017 about glyphosate in European agriculture. European regulations (e.g., Farm-2-Fork Strategy, Biodiversity Strategy) catalyze this behavior change.

The demand for organic and regional products has risen significantly in Western Europe and was disproportionately pushed in the COVID-19 year 2020 [59]: e.g., sales of organically produced plants and foods in Germany went up five times from two billion Euro in 2000 to 12 billion Euro in 2019 [60]. Within the population, behavior patterns differ strongly and lead to a more fragmented market for plants and other foods and an ongoing product diversification. All these societal value changes demand close monitoring and adjustments by farmers, scientists and food producers if they want to satisfy their customers' wishes and needs. The urge of big parts of society to have a—from their viewpoint—positive impact on agrifood systems through buying decisions or democratic systems will not change anytime soon; and this acts as a strong driver of food innovations [61].

3.1.4. Nutrition as Status Symbol

A growing percentage of citizens display a high interest in agrifood production. Their wish to consume products from regional production and interest in the re-localization [62] is a result of their desire to follow a sustainable and environmentally friendly lifestyle. Young adults value this especially highly [63]. As another consequence, transparency is demanded from plant and food producers alike [64]. Consumers increasingly expect a clear commitment to sustainability [65]. The demand for healthy food in Europe was extremely promoted by the COVID-19 lockdowns [59]. Overall, this shows how nutrition has changed from a mere necessity for most to a societal-political aspect of modern-day life. This makes nutrition a status symbol inside the societal system.

Setting Western Europe in a global context, it is worth noting the occurrence of malnutrition and obesity in countries worldwide. Low-quality diets are especially concerning [66], as proven during the COVID-19 pandemic yet again [67]. Obesity/overnutrition and undernutrition (often associated with micronutrient deficiency) are extreme forms of malnutrition that societies must conquer in the future [68]. Counter-intuitively, the so-called double-, as well as the triple-burden of malnutrition occur in many countries regularly at the same time [69–72]. This reveals vast differences in dealings and access to food or information about nutrition in different cultures and societal groups—and therefore, what an important status symbol nutrition is globally.

3.1.5. Land Grabbing

Land grabbing signifies the massive acquisition of land by states, companies or investors in order to use the land to produce agricultural commodities for themselves. This trend has gained momentum over recent years and a lot of land, and with it biocapacity, has been transferred in international transactions [73]. Often, the legal situation of those acquisitions is unclear, since there is a still ongoing change from traditional land rights to modern ownership structures.

Apart from securing the food supply, profit expectations are a major reason for land grabs. Countries with little natural resources but strong economies buy huge areas of land worldwide. Today, countries like China, Saudi Arabia and South Korea are already struggling to secure the food supply for the population with insufficient land or water resources [74–78]. The boom of fuel based on agricultural commodities, increased demand for biomass and hedge funds that promote land as a secure and profitable investment push this.

As a result, the prices for land in Western Europe have risen rapidly over the last couple of years. In Germany, for example, the prices for agricultural land have risen significantly fast since 2013 [79]. In developing countries, about 227 million hectares of land were sold or leased out long-term between 1999 and 2001 [80]. A closer look at 600 of those land deals shows that about 34 percent are closed to acquire land for the production of food and the rest for the production of forage and energy crops—most of the harvest is exported [81]. For Western European agriculture, this trend will affect exports and imports in the future—probably with very different effects showing in different kinds of crops.

3.2. Identification of Micro-Trends

Micro trends are those trends identified by the experts during the workshops that already are clearly visible but whose further development is unclear [17]. They are not dominant yet and only touch parts of the Western European societies or economies. How strongly these trends will affect the future of the agrifood system depends on their dissemination in the upcoming decades. The identified micro trends are depicted in Figure 4.

3.2.1. Plant and Plant-Based Food Production in (Sub)Urban Areas

As mentioned in the section "changes in societal values", certain population groups show a strong interest in transparency of agrifood systems and sustainability. Answering that need, food-plant production in urban and suburban areas became popular in the last couple of years [82,83]. Two entities in the agrifood system have pushed this trend: (I) private citizens—in most cases, also the final consumers of the produced plants—and (II) businesses, mostly start-ups in the agricultural, horticultural and food sector [84–87]. The COST Action Urban Agriculture Europe project provides a map of urban agriculture projects in Europe—253 of those are currently listed [88].

(**I**) **Private citizens**. In urban areas, a trend emerged when some citizens started growing vegetables, herbs, fruits, ornamentals and other plants at small and larger scales. Under the label "urban gardening", they claim and use urban areas for small-scale horticultural practices. The goal is to produce fresh, regional and sustainably produced plants [89–92]. In many Western European cities, there are numerous urban gardening projects [93]. This do-it-yourself movement and gardening for self-sufficiency of food plants were catalyzed by the COVID-19 pandemic, as healthy food promotes human health and wellbeing.

(**II**) **Businesses**. Production of plants in (sub)urban areas by start-ups or entrepreneurs focuses on supplying fresh and sustainable locally grown plants and other foods all year round. These businesses often are indoor-farming projects based on different systems: hydroponics, aquaponics or aeroponics. Urban rooftop farming is a focus for commercial use [94,95]. Production scales differ from mass-production to small-scale-systems for private households. Innovative technologies are at the center of this development, UV-lamps (LED or mercury) and systems for Controlled-Environment Agriculture combined with a close monitoring of the plant's growth process [96–98].

If the trend of (sub)urban food production gains traction, it will strongly affect future agrifood systems. Partly, allocation of production would change from rural to urban areas—in particular, for plants that grow well without or with little soil. Urban space restrictions bring production methods with reduced space requirements (e.g., vertical farming) to the forefront. If productivity rises, it supports securing a food supply without increasing yields deploying traditional methods. The potential of (sub)urban plant production is still hidden and underutilized [99].

Figure 4. Identified micro trends and their sub-topics. Today, these trends display some uncertainty concerning their long-term effects on the agrifood system and their transforming potential.

3.2.2. Food Production without Fresh Sweet Water

Fresh, good-quality water is becoming scarcer. One reason for this is the spread of salinization; pollution, another. Thus, two trends, (I) halophytic plants and (II) (sub)urban fish farming, are of interest today.

(**I**) **Halophytic plants**. Plants prospering in saline environments show promise to support the future food supply [100,101]. Furthermore, there are huge areas of coastal lowlands in Western Europe that will be flooded should the sea-level rise due to climate change. Halophytic plants and their nutritional and pharmaceutical potential as well as their use as bioenergy plants are a research focus especially in countries where salinization is already a tangible factor for agriculture. If this trend persists, it might change the water consumption of agriculture particularly in areas with direct access to seawater or to brine water [102].

(**II**) **Fish farming in** (**sub**)**urban areas**. Another trend is recirculating aquaculture systems. Fish is a valuable source of protein and other nutrients for the human nutrition and can be farmed in small to big tank-systems. At the same time, wild catches, the long transportation and conventional fish farms are getting more problematic. Land-based fish farming could also serve as a tool for adaption to climate change and other environmental challenges [103].

Using purified waste water from cities for the urban fish farms is one option to include the farms into a circular water system [104]. Furthermore, water of those urban fish farms is full of nutrients (fish-waste)—aquaponics-systems use this water to nurture plants. The concept is based on circular systems that can produce food sustainably and locally [105]. Apart from systems based on sweet water, there are also efforts to use saline water for urban production. The development of land-based, multitrophic cultivation systems under saline conditions is a completely new concept (www.food4future.de/en (accessed on 20 August 2022).

3.2.3. Alternative Protein Sources for Human Nutrition

Sufficient protein-supply is central in securing food supply for the growing population. Meeting the growing demand by only increasing the production of meat or dairy products is unsustainable since land-use and emissions are too high [106]. If human diets shift from meat/dairy, new pathways are opened up for producers of protein-rich plants and the demand for fodder might be affected as well. Willett et al. [66] measured the different yielding effects of changing diet-scenarios, a shift away from animal-based proteins showed opening potential for other crops. Furthermore, the land-use for agriculture would change [107].

In general, consumer acceptance levels of meat alternatives are differing strongly between the different sources and are still relatively low—even for well-established foods such as pulses [108], but have seen a steady increase over the last years [109,110]. Venture capitalists (see the section Globalization for figures) especially target the market segment of alternatives to meat and dairy products for their investments.

We identified three sub-trends for alternative protein sources: (I) algae, (II) insects and (III) cultured/in vitro meat. Another notable development in this context is the efforts to produce plant-based egg-alternatives. However, while efforts are being made, research still struggles to replicate the properties of eggs [111] and without proof of concept, this is not a trend yet.

(**I**) **Algae**. Fast-growing organisms, different species of algae are rich in proteins, vitamins, minerals, antioxidants, phytonutrients and omega-3 fatty acids [112,113]. The demand for microalgal and macroalgal foods has seen a global rise—partly, because of its functional benefits. Microalgae as a more sustainable protein source for humans have gained some traction over the last years but the cultivation as well as the processing are not ready technologies yet [114].

(**II**) **Insects**. Many insect species suit human nutrition. Rich in proteins, minerals and other nutrients [115], the cultivation of insects is very efficient as it requires little space, water and feed [116,117]. In Western Europe, the consumption of insects as food is still connoted by negative feelings (i.e., disgust and neophobia) for the majority [118]. How the acceptance develops is an important factor. Barriers are now falling as the European Union approves draft implementing regulations aiming to authorize the commercialization of dried, ground and frozen house cricket (*Acheta domesticus*) and frozen, dried and powder yellow mealworm (*Tenebrio molitor*), respectively, for the EU market.

(**III**) **In vitro meat**. This trending topic has received a lot of public attention. However, it is still far from mass production at affordable prices. While it is unclear if scale-up is possible at reasonable costs in the future, there are also open questions of acceptance for this kind of artificial food [119,120]. In many countries, the demand for natural products is rising and in vitro meat is in many ways the opposite of that in consumers' perspectives [121]. The question of how the in vitro meat will be produced and if—apart from the starter-cells—it could grow (e.g., on algae-based products) without animal-based ingredients like gelatin or collagen is still under research [122]. This makes it harder to predict if in vitro meat will be a major food source in the future.

3.2.4. Individualization of Human Nutrition

Citizens and scientists are making food and its production an important focus of their attention also, on a personal level interest in the individualization of nutrition rises. Similar to other trends, there are two approaches: one is (I) science-driven and the other (II) citizen- or customer-driven. The overall question concerning this trend is if actual individualization of nutrition is possible at a big scale, and if this can overrule or integrate into strong social and individual routines and values based on eating cultures. While observations point towards a food market shift from a supply to a demand market [123], it is unclear whether this continues under pressure from population growth.

How these developments will affect agrifood systems is yet to be determined. Shifts in consumption choices or changes in (health-)evaluation of foods could affect singular food-supply chains, production methods or demand.

(**I**) **Science-driven**. Various disciplines concern themselves with nutrition and its effect on the human body, ranging from research on what nutrition is healthy for which age to the individual composition of gut microbes, biological gender and other factors and their impact on the digestion of food in humans [124,125] or diets affecting ageing processes. On a broader level, a personalized nutrition or diet based on genetics (e.g., project Nutrigenomics) or other factors is a focus of extensive research as well [126–130]. Science is at an early stage of understanding how the diet affects individuals and these efforts' outcome is unclear.

(**II**) **Citizen- or customer-driven.** Multiple examples show that citizens believe more and more in the idea that each individual needs a special diet. While it is widely accepted that athletes need special diets to maximize their performance, the idea of individualizing the diet has gained popularity in the broader public. The rising revenue of gluten- or lactose-free products—without a simultaneous rise in gluten or lactose intolerance levels in the population—exemplarily shows this [131]. Apps that help one to follow healthy eating habits are popular with adolescents [132] and other special dietary regimens (e.g., paleo diet, clean eating) receive a lot of public interest although there is no scientific evaluation or proof.

4. Discussion

A systemic transformation of agrifood systems is required if we are to feed the world's current and future population sustainably. This article has given an overview of a multitude of trends from differing scientific and industrial viewpoints and combined those views in one comprehensive overview. Accordingly, it is recommended and encouraged to utilize those trends/topics to direct future research or to sharpen the transformation pathway: especially, as a compiled set of factors to develop future scenarios as a vision of agrifood systems of the desired future in Western Europe, those trends should be taken in consideration. This is the opportunity offered by this article: it leaves the single focused perspective of one section of agrifood systems by combining different trends and viewpoints in one article.

We acknowledge that our work has certain limitations. First, our expert panel of 50 participants came from a variety of scientific and industrial backgrounds as stated, but all of them are working in the field of agrifood systems and therefore, their willingness to participate in this work may be connected with expectations regarding the direction and pace of future developments. Therefore, a selection bias cannot be excluded. Additionally, it may be extremely informative to compare the views of the experts with those of other stakeholders such as citizens/laypeople or politicians. Although this was done to an extent during the desk research step of the process with accessible sources on political agendas, etc., this approach could be broadened. Second, identification of trends/topics with relevance for future development can only represent one idea of the future at a certain point in time shared by a collective of humans; new developments or changes might render some results presented here irrelevant at a later time. The static picture drawn in this article should therefore be seen as an iteration that must be re-visited and updated in the future.

To our knowledge, work of a similar design about trends shaping future agrifood systems with a focus on Western Europe has not been undertaken lately, therefore, we believe that our work provides a unique, constructive overview with relevance to the transformation of agrifood systems. The current president of the European Commission, Ursula von der Leyen [133], has envisioned the interconnectedness of trends as key to a greener vision: "Climate change, biodiversity, food security, deforestation and land degradation go together. We need to change the way we produce, consume and trade. Preserving and restoring our ecosystem needs to guide all of our work". We agree that innovations are central to this [134], as multiple trends in this review show. For establishing an approach in sustainable and resilient agrifood systems, the conscious consideration of the interdependencies between these systems from the regional up to the global scale and key trends of various areas (re)shaping the agrifood sector is a prerequisite for an overall acceptance. The recently agreed "European Green Deal" [135] with the farm-to-fork-strategy as one core element requires this for its success.

These urgently needed transformation processes are supported by all stakeholders and political decision-makers only through ecological, economic, and not solely through social acceptance. Within that overarching acceptance, transformations can successfully be implemented. Moreover, it needs consideration that all described micro and macro trends develop at the same time and environment; therefore, we assume a strong interconnectedness in future developments.

How they influence each other in detail and if they promote or disturb each other's future development has to be determined in further research. One example of two trends pushing each other discussed in the workshops exists between the macro trend "changes in societal values" and the micro trend "plant production in (sub)urban areas". The experts agreed that on one hand the changing values in society (e.g., consciousness of planetary health) bolster the interest in locally produced goods (increasing the willingness to pay more). On the one hand, new trends in local production (e.g., multitrophic aquaponics and hydroponics on supermarket rooftops in (sub)urban areas, urban farming) rise societal awareness and hence, acceptance for novel production possibilities. On the other hand, if these new trends of local food production are not developed with a strong focus on sustainability, the opportunities that these new technologies offer could backfire and negatively influence societal values.

5. Conclusions

The trends and topics presented in this article were identified by experts from various disciplines and backgrounds—with the limitations of any foresight study in mind, this approach delivers results with relevance to a broad audience. The nine trends and 50 sub-topics inform on dynamic areas in agrifood systems that need addressing and/or close monitoring—with a focus on sustainability and security. The identified macro trends are urbanization, globalization, changes in societal values, nutrition as a status symbol, and land grabbing. Micro trends are plant and plant-based food production in (sub)urban areas, food production without fresh sweet water, alternative protein sources for human nutrition, and individualization of human nutrition.

Western European countries adopted the SDGs as members of the United Nations already in 2015 and agreed that a transition to a sustainable future agrifood system is core to achieve a secure and sustainable food and nutrition supply. Numerous trends at different levels (global to local) have shaped today's agrifood systems and are shaping the continuing transformation. Thus, various new and ongoing trends and topics pose opportunities and challenges for stakeholders in current agrifood systems. Their interplay and cross-influences may differ between systems and transformation paths and need further investigation. Demonstrated by the multitude of trends affecting agrifood systems, a concerted effort from multiple scientific disciplines and stakeholders is needed to sustainably adapt Western European agrifood systems to these future challenges and opportunities. How these can be directed towards desirable, secure and sustainable future agrifood systems in detail should be the focus of further research and policies.

Agrifood systems are dynamic phenomena, and shaping or governing them should start with a broad view, with care and willingness to correct any decision if it shows un-desirable outcomes. It should be emphasized that this question is central: how to achieve this by following the SDGs of the 2030 Agenda and therefore, securing planetary stability in the future? The different discussed trends suggest that there is a time-limited window of opportunity to strive towards improving agrifood systems for sustainability and resilience.

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