

Statement

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The Future of Food in Europe: Interdisciplinary Perspectives¹ Research Group Sustainability, *Die Junge Akademie*

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This is a translated version of the original German text, which can be accessed [here](#).

Summary

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The food system is undergoing rapid change. Climate change and other environmental impacts are affecting agricultural production patterns, crop yields and food security – not only locally, but also along the supply chains. Adjustments in dietary habits are leading to changes in demand. Globally, a transformation of the food system is needed for at least four reasons: First, agriculture is the main driver of species extinction and contributes to climate change. Second, one tenth of the world's population still suffers from hunger. Third, the health costs of malnutrition and obesity are a major burden on health systems around the world. Fourth, in industrialised countries, the overwhelming majority of farm animals live in factory farms.

In this article, we assess the crisis of our food system in Europe from selected interdisciplinary perspectives. We show that a scientific approach to the causes and potential solutions of the food crisis requires quantitative modelling that maps the complex interactions of natural and socio-economic systems. Further, there is a need for a normative debate on how the burden of the food system transition ought to be shared. Furthermore, the goals of the food system transition depend on the moral value and protection we assign to farm animals and intact ecosystems, and on how we want to create global food security.

As potential solutions to the societal problems of the food system we discuss diversification of trade relations, education for sustainable development, a socially just pricing of the environmental costs associated with the consumption of animal products and steps to implement the public consensus to abolish factory farming.

¹ This contribution is partly based on the activities of some members of *Die Junge Akademie* at the Salon Sophie Charlotte of the Berlin-Brandenburg Academy of Sciences and Humanities on 21 May 2022

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The article draws attention to the fact that the task of food system transformation transcends both the delineation of issue areas - species extinction, public health, global hunger and animal welfare - but also the various evaluation standards such as ethical evaluation, economic efficiency and participatory dialogue. For the latter, however, comprehensive interdisciplinary scientific communication is often lacking.

Introduction

As a result of the pandemic and the Russian war of aggression on Ukraine, the self-image that German society, our health system and our European energy supply were strong and robust has been shaken. In 2020, interrupted supply chains led to shortages hitherto never experienced among younger generations. Yet Covid-19 is still a small one among multiple crises: War, climate change and species extinction pose massive challenges to vital societal foundations: For the supply of food to the world's population. Currently, the war in Ukraine, one of the most important grain suppliers for Europe and the world market, is putting global food supply at risk. The agreement on grain exports with Russia is still fraught with great political uncertainty. In addition, as a result of climate change, there are extreme weather events such as heat waves, droughts and floods. In many places, agricultural production yields are collapsing. If Covid-19 has already shaken our previously stable economic and social fabric, what instabilities do we have to fear for the future?

In Germany, we are unlikely to experience hunger in the coming years. We are a wealthy country - so wealthy that we can currently even afford to use rapeseed in the form of biofuels and to feed grain to fattening pigs. Grain that could soon be bitterly lacking as a food basis for other people. Globally, however, a transformation of the food system is necessary for at least four reasons: Agriculture is the biggest cause of species extinction and there is no reversal of this trend in sight; agricultural activities and associated deforestation also contribute significantly to climate change. Second, one-tenth of the world's population is still suffering from hunger, and the pandemic, as well as the consequences of the Russian war of aggression, continue to drive up the numbers of people at risk of food insecurity (World Food Program, 2022). Third, the health costs of malnutrition and obesity are a major burden on health systems in most countries of the world. Fourth, in industrialised countries, the overwhelming majority of farm animals live in factory farms.

Why do crises keep occurring in our societies? Why is it so difficult to avert such crises, even if at least parts of society are able to foresee them? And what can we do to counter the crisis of the agricultural and food system in Germany?

In order to address these questions, we, as part of the younger generation of scientists, consider interdisciplinary exchange to be indispensable. That is because the topic not only transcends the boundaries of problem areas - species extinction, health, hunger, environmental protection - but also the standards of assessment: ethical evaluation, economic efficiency, participatory dialogue. Every citizen can have a well-founded opinion on suitable diets. However, there is often a lack of comprehensive interdisciplinary scientific communication that adequately reflects the substantive and methodological complexities of assessing the future of food.

We therefore first outline the topic on the basis of current scenarios for the European agricultural and food system: we present five possibilities of how the European food system can change. We then show why our current food system is inadequate from the perspective of four different disciplines - complexity research, educational science, economics and moral



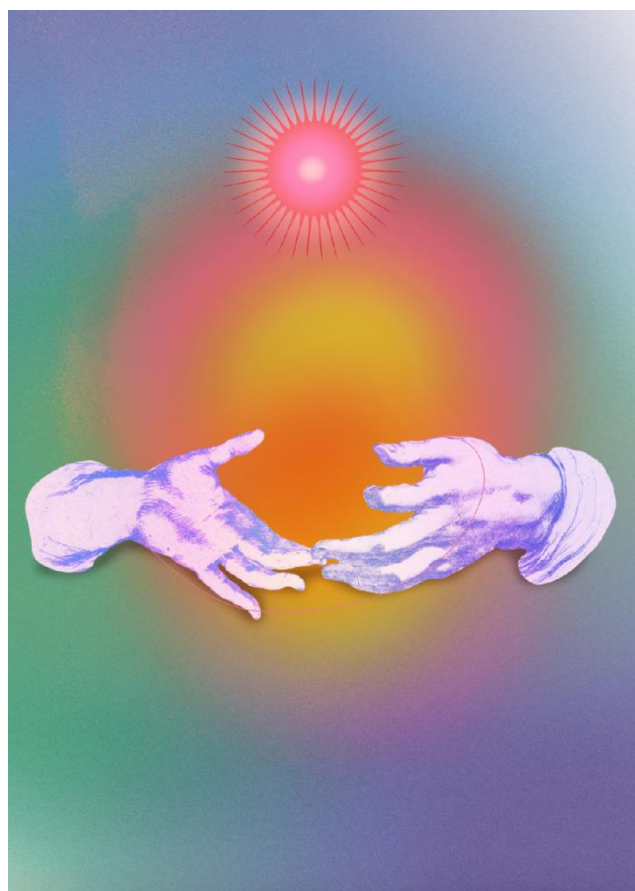
philosophy. The selected interdisciplinary perspectives show that a comprehensive scientific assessment of the food crisis requires quantitative modelling that maps the complex interactions of natural and socio-economic systems. They further show that normative answers are also needed on how the burdens of the food transition are to be shared - for example between regulatory intervention by the state and citizens in their role as consumers. Furthermore, the goals of the nutrition transition depend on the moral value and protection we assign to farm animals and intact ecosystems, and on how we want to create global food security.

The future of the European agricultural and food system in Europe in five simplified scenarios⁹

How the future will develop depends on many factors – some of them well known to us, others unknown. As a result, different alternative scenarios are often quite plausible. Knowing which developments are plausible and which are rather unlikely can help in shaping policy and social progress in a forward-looking way. Scenario-based research is still a young discipline, but it is becoming increasingly important in times of rapid environmental developments, socio-economic crises and complex global networking. It also has played a central role in the COVID-19 pandemic. Using appropriate techniques, alternative, plausible developments can be demonstrated. To introduce the topic, we outline five alternative scenarios for the European agricultural and food system, based on Mitter et al. (2020).

Scenario 1: Development of sustainable paths

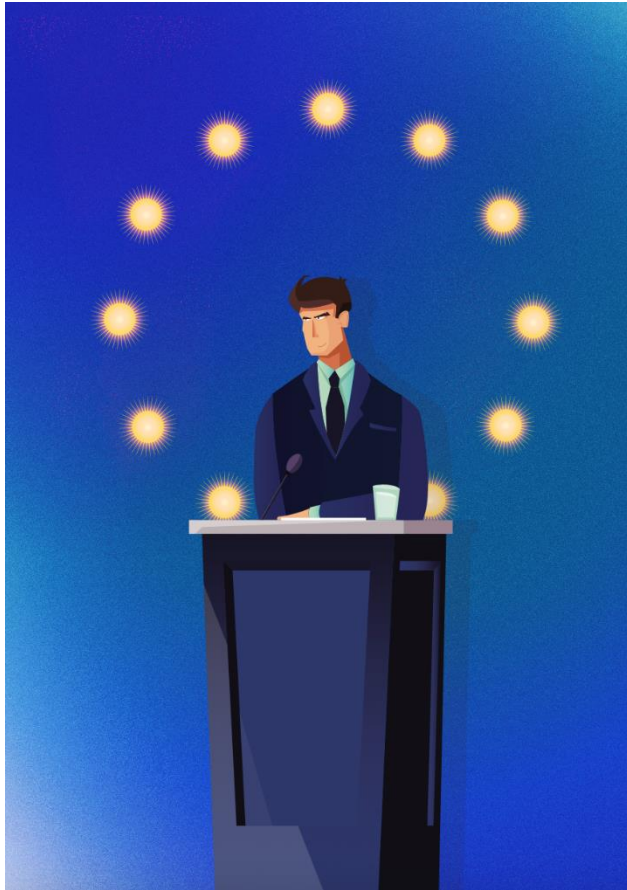
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Citizens, politicians and actors in the agricultural sector work cooperatively. Driven by increased environmental awareness of the population, citizens do not only consciously eat a healthy and often plant-based diet, they also increasingly include environmental protection and fair payment in their purchasing decisions. As a result, on the production side, the agricultural sector becomes a valued employer.

⁹ The illustrations to this section were created by Camelia Cucolea.

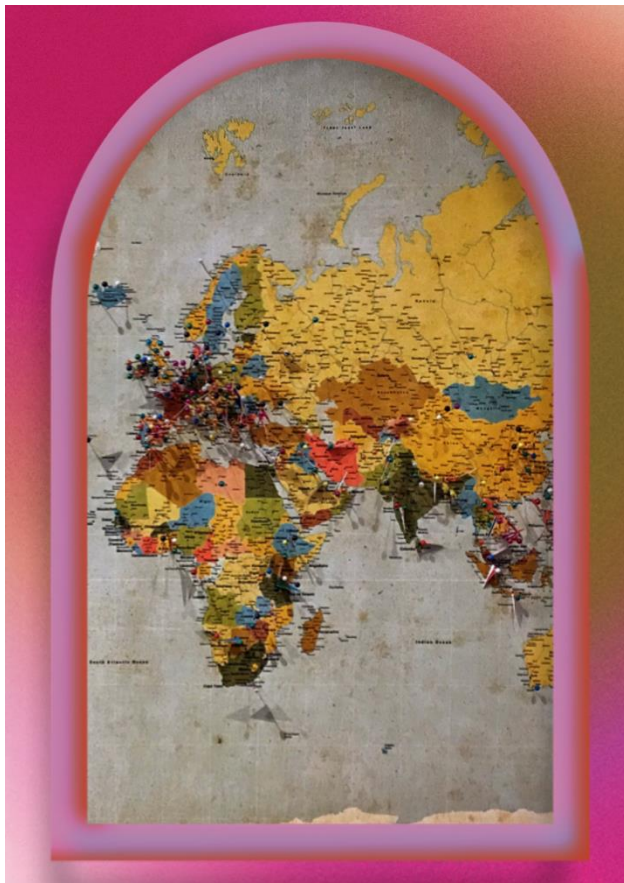
Scenario 2: Development of known paths



European policies and existing institutions set the frame for the future of the agricultural and food system. Historical developments and patterns of behaviour persist. Lobbyism and a hesitant attitude on the part of consumers limit the scope for more sustainable changes. The dietary mix on our plates hardly changes - but food is gradually produced in a more environmentally friendly way.

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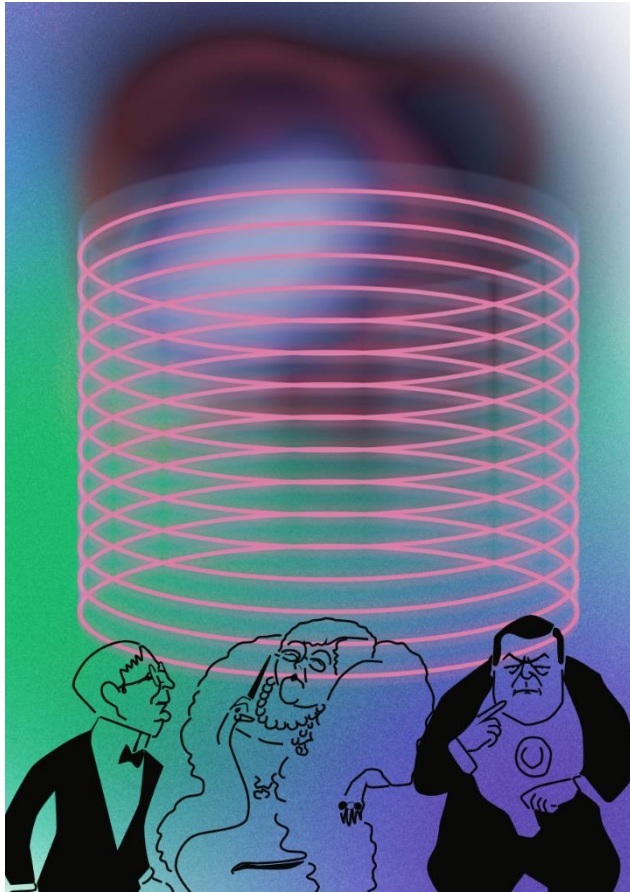
Scenario 3: Development of nation-state paths



Driven by social turmoil and increasing resource scarcity, international relations are no longer cultivated and the global economic system is becoming more protectionist. The nation states act almost exclusively in their own interests. Security of supply with food and energy dominates as the goal of national agricultural policy. This causes food prices to rise at the supermarket checkout.



Scenario 4: Development of unequal paths



A small, wealthy elite is in charge and dominates social processes, political decisions and the value chains in the agricultural sector. Social inequality increases. An ever larger group of people has to make do with few resources and is confronted with rising food prices, while the elite enjoys an ever wider range of exquisite and sometimes innovative "superfoods".

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Scenario 5: Development of high-tech paths



High-tech companies and international agricultural corporations dominate food production. Driven by rapid technological progress and free trade, more and more "artificial meat" made from plant-based substances and cell cultures - that is, the latest innovations of the food industry - ends up on our plates. Society is prosperous, with prosperity based primarily on the still very high consumption of fossil resources.

As a society, it is now up to us to set the course for which version of the future is more likely to occur. But how do we succeed in this? Is society - as a complex system that has been forced to its knees by many crises, especially recently - doomed to fail again? What role do sustainable education and the behaviour of each single individual play? And which political options for action are suitable for combining what makes economic sense with what is socially acceptable? What role do our values about animal suffering play in this?

In this section, we will explain the perspectives of four other disciplines on the global food crisis, without claiming to be exhaustive. In doing so, we deliberately look less at those disciplines with an established expertise on the agricultural and food transition, but also shed light on disciplines that, through experience and knowledge in other scientific contexts, can raise new perspectives on the questions mentioned above.

1. Complexity Research: Why do crises In the global food system keep occurring and what can we learn from the brain's "crisis management" for this?

In biology, more precisely in the brain, there is a tightly interconnected network of billions of neurons, which - and this is rather astonishing - work perfectly together, even though each neuron can be thought of as an explosive cell: A neuron receives electrical signals from the thousands of other neurons which it is connected to. If these signals are strong enough, then the neuron itself becomes active and "fires" a short, electrical signal into the network itself. The question arises why this network of "explosive" cells does not "blow up in our faces". The neuronal network succeeds in reacting very sensitively to the smallest stimuli from the environment, in transmitting and processing them. Only very rarely, the chain reactions of the activated neurons lead to instability, such as an epileptic seizure.

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A central principle that allows this balance between sensitivity and stability is homeostatic plasticity (Zierenberg et al. 2018). Each neuron adjusts its connections with other neurons so that it contributes about as much to network activity as all other neurons. If a neuron is too active, it reduces the connections. If, on the other hand, it is too little involved, the connections are increased. This very egalitarian principle succeeds in keeping the network both sensitive and stable as a whole. In addition, there are a number of other mechanisms, so to speak safety nets, which become effective if the network should get out of control at some point.

Our brain can be seen roughly as an analogy to our economically closely intertwined world: production processes, some of them very complex, often span several sectors and countries. Similar to the closely linked network of billions of neurons, we live in a highly complex network of global supply chains in which the individual links are interdependent. One consequence of the global trade of food, goods and services is that weather extremes - as they are becoming more frequent and more intense due to climate change - not only cause damage in the directly affected areas, but also have supraregional consequences (Wenz and Levermann 2016; Wenz and Willner 2022). As a result, crises and disruptions spread quickly.

This is particularly critical when it comes to food supply. In 2010, for example, heat waves in Russia triggered droughts and forest fires. This led to heavy losses in the grain harvest. In order to secure domestic demand, Russia - one of the world's largest grain exporters - responded by imposing export restrictions. Simultaneous weather extremes in other "granaries" such as Canada tightened the supply even more. As a result, world market prices for grain rose sharply. This particularly affected countries in North Africa and the Middle East, which are dependent on grain imports. The local price increases for staple foods, especially bread, were considered an "accelerant" for the Arab Spring in 2011 (Sternberg 2012).

The global food system is very complex with over 600 million farmers around the world (Lowder et al. 2021), agribusinesses, logistics companies, traders and policy makers (Puma 2019). At the same time, global food security depends on only a few grain types: Wheat, corn and rice provide about 60% of the world's energy intake (Bailey and Wellesley 2017). The associated export markets for grain are often dominated by individual players, such as the market for corn by the USA. On the other side are highly import-dependent and often very poor regions with hardly diversified diets. Taken together, this can result in great vulnerability with regard to shocks in food supply, whereby vulnerability is defined here along two dimensions (Bren d'Amour et al. 2016):

The first dimension is the extent to which a country A is hit by a supply shock of grain in another country B. This extent, in turn, depends firstly on the importance of this specific grain for the calorie intake in country A. Further, country A's vulnerability depends on the share of grain imports from country B. The second dimension is the number of people living in poverty in an affected country. Data for the years 2007 to 2011 indicate highly clustered regional vulnerability patterns. In the first dimension, countries in the Middle East are most vulnerable to wheat shortages, countries in West Africa to rice shortages and countries in Central America to corn shortages. Taking into account the consequences for the population living below the poverty threshold - that is, in the second dimension - Sub-Saharan Africa is the most vulnerable (Bren d'Amour et al. 2016).

Another vulnerability dimension arises from shortages in the transportation network. For example, more than a third of all grain imports in the Middle East and North Africa region depend on maritime transport routes for which there is no alternative (Bailey and Wellesley 2017)¹⁰.

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In Europe, these vulnerabilities are less severe. But even here, extreme events and disasters in other countries can lead to food shortages and price increases. An example of this is the shortage of flour and oil after the outbreak of the Russian war of aggression on Ukraine or the higher coffee prices after weather extremes such as drought and frost in Brazil.

How can we enhance the resilience of this sophisticated network? An orientation for this could be the very efficient "crisis management" of the brain. The very egalitarian principle of homeostatic plasticity, which allows the brain to balance sensitivity and stability, could be emulated by diversifying trading relations and making them more balanced. Creating redundancies in the global supply network and planning ahead could also prevent shocks in one part of the system from having dire consequences in many other, in some cases distant, regions.

In addition, storage capacities should be expanded and joint, i.e., transnational, adaptation measures should be developed (Wenz and Willner 2022). In this way, stable safety nets could be established which take effect if the system gets out of control at one point, for example due to weather extremes. Furthermore, switching to a resource-conserving, mostly plant-based diet, such as the "Planetary Health Diet" developed by the EAT-Lancet Commission, can also enhance resilience to supply and price shocks. Recently, a scientific study found that such a sustainable dietary shift could fully compensate for the production shortfalls resulting from the Russian war in Ukraine (Sun et al., 2022). Hence, there are clear synergies between promoting environmental protection and food security.

¹⁰ Specifically, these imports are transported from the Black Sea first via Russian and Ukrainian railways and ports and then through the Turkish Straits (Bailey and Wellesley 2017).

2. Educational science: Why sustainable education is crucial but cannot replace political action

When considering the future of nutrition from an educational perspective, the reference to the concept of "Education for Sustainable Development" (ESD) is obvious. ESD has been promoted by UNESCO in various programmes for over 15 years. A first UN Decade of ESD was implemented in the period 2005 to 2014. From 2020 to 2030, a second decade is being implemented with the UNESCO framework programme "Education for Sustainable Development: Realising the Global Sustainable Development Goals (ESD 2030)".

The concept includes two central dimensions of sustainable development: the time dimension and the global dimension. The former aims at intergenerational justice. This means that the environment, society and the economy should evolve in such a way that current needs are met only to the extent that future generations will still be able to meet their needs. In a global dimension, the goal of sustainable development means distributive justice. The needs of better-off groups of people (for example, people in wealthy countries) should therefore only be satisfied to the extent that less privileged groups of people can also satisfy their needs.

Now, what does "education" mean for sustainable development? In this context, education is understood as enabling people to think and act sustainably. Through education, people should learn to understand the effects of their own actions in order to be able to make responsible decisions that also take into account the consequences for future generations or life in other regions of the world (Kropp 2019).

The ability to live sustainably through education can be differentiated in a simplified way into three dimensions:

1. Knowledge and world orientation: first of all, one needs knowledge about nutrition, production processes, ecological consequences, etc.
2. Skills and competences: It does not follow from a knowledge of nutrition that one is also able, for example, to independently inform oneself about the sustainability of different products and subsequently look for alternative, more sustainable products. In addition, people must also be able to obtain information and change their consumption patterns. Hence, in addition to knowledge, skills and abilities are needed.
3. Awareness and reflexivity: The third dimension is about ensuring that knowledge and skills do not have purely instrumental character but are also placed in relation to oneself. From a reflexive perspective, people should therefore also be able to direct what they know and can do towards themselves. This can be achieved, for example, by reflecting on their own actions and their consequences and by developing an awareness of their own involvement and responsibility concerning questions of sustainability.

Now, one might think that education is the solution to our problems, and, in fact, there is a fundamental tendency to see education as a universal remedy for societal problems. Especially within the political arena, it seems convenient to pass responsibility for change on to educational institutions.

Even though education is certainly important for enabling people to choose a sustainable lifestyle, its effects are limited. Knowledge about the ecological consequences of food production can enable people to learn about alternative forms of production and to reflect on the role of their own consumption behaviour. However, this does not automatically mean that one is empowered to live a more sustainable life, as the idea of Education for Sustainable Development suggests. On the contrary, more sustainable products may not be available - either because they are not provided or because they are not economically accessible.



Education cannot replace structural political decisions and should not be "misused" in this way. This does not make education for sustainable development obsolete, but requires that expectations that are placed on education are more realistic.

3. Economic policy: a tax on meat as one concrete option for action in the transition to a sustainable diet?

To achieve the shift towards a sustainable agricultural and food system, a broad set of measures is needed, including a shift towards sustainable farming methods and effective protection of ecosystems. In the following, we would like to turn attention to another, in our eyes central, point - the change towards an increasingly plant-based diet. But why is it necessary to have fewer animal-based dishes on our plates in the future? Livestock farming is very resource-intensive and uses about 83% of agricultural lands globally (Poore and Nemecek, 2018). Due to methane emissions from ruminants and land-use change, among other things, the livestock sector contributes to about 13% of global greenhouse gas emissions (Gerber et al., 2013). In addition, deforestation and the cultivation of animal feed in monocultures threaten biodiversity. Fertilisers and manure contribute to soil and water acidification. However, the current prices for meat, milk and other animal products do not currently reflect these environmental impacts.

From an economic perspective, it makes sense to demand that food prices also reflect the associated environmental damage. Carbon prices operate according to this principle: they make environmentally harmful products and behaviours more expensive and reduce emissions through the interplay of supply and demand.

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If we extrapolate the costs of climate change and soil and water pollution to one kilogram of beef, they amount to a global average of 5.76 to 9.21 US dollars, depending on how many of the costs are also applied to dairy products that are produced at the same time. This would increase the average retail price in industrialised countries by about 35-56%. For pork and lamb, it is slightly less (19%). The price of poultry would rise by 25% on average (Funke et al., 2022).

However, these are only initial estimates that do not yet take into account the loss of biodiversity associated with meat production. There is still a need for research at this point. We do not yet sufficiently understand the extent to which meat consumption contributes to the extinction of species, for example through the clearing of rainforests for imported animal feed. Furthermore, the negative health consequences for humans and the impact on animal welfare have not yet been taken into account. High consumption of red and highly processed meat poses significant health risks - also independent of the social costs of obesity. Taken together, then, the social costs of meat consumption could be many times higher. Exactly how these are quantified is also always a question of value judgements, for example with regard to animal welfare and the value of intact ecosystems.

The first modelling results for Germany show that an ambitious tax on meat products could indeed lead to a significant decrease in meat consumption. On the basis of consumption data, Roosen et al. (2022) estimate that a carbon price on meat products of US\$100 per ton could reduce the consumption of particularly climate-damaging types of meat such as beef, veal and certain mixed meat products by more than 20%.

A legitimate concern with a change to a sustainable agricultural and food system is that it will lead to significantly higher food prices, at least in the medium term, and thus burdens particularly those on low incomes. Environmental taxes on agricultural products can indeed be regressive: Since low-income households spend more money on food relative to their income, they are disproportionately burdened by a tax. This does not seem fair, especially in view of



rising inflation rates and high world market prices for food as a result of the Russian war of aggression.

Now, does this mean that one should do without pricing in externalities, or without a meat tax?

From an economic policy perspective, there are ways to ensure that environmental taxes on food or a meat tax do not exacerbate existing social injustices. After all, environmental taxes generate revenue that can be used, for example, to relieve low-income households or to subsidise foods such as vegetables and fruit. Based on consumption data, it can be shown that poorer households even benefit if the revenue from a meat tax is redistributed evenly to the population (Klenert et al. 2022). This is because richer households on average buy more expensive and more environmentally intensive types of meat, such as beef fillet, and also buy more meat products in total. Thus, they pay a higher share of the meat tax.

Moreover, in the debate about a just nutrition policy, the fundamental question is often overlooked: Is the real problem not rather that in an affluent country like ours, so many of our fellow citizens remain on the brink of poverty that even a clearly necessary environmental policy measure threatens to jolt them into precarity? More and more people see the urgency of narrowing the gap between rich and poor. The instruments for this are well known in economic policy: Redistribution through higher top tax rates, a wealth levy for the super-rich. If we instead burden environmental policy, which is so urgently needed, with the task of ensuring fairer distribution, however, we risk failing to do justice to both tasks.

Animal ethics in the food system transition: "The question is not: can they think? or: can they speak? but: can they suffer?"¹¹

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In academia, the topic of nutrition is mainly discussed in the context of health and environmental protection. Most studies focus on the need to change our diet to protect the climate and the environment and to improve health. In contrast, when it comes to the broad societal debate on the future of food, the concern for animal welfare is perhaps the most prominent aspect of concerns. Most people think that there are actions on animals that are morally bad and should therefore be avoided. In the eyes of many citizens, factory farming, i.e. the intensive and mechanised rearing of many high-performance animals of one species in a confined space, fed almost exclusively with imported dry fodder, does not even come close to meeting the requirements of respectful and humane treatment of farm animals. Nevertheless, more than 90% of the animal population in Europe is reared under factory farming conditions.

There is a broad societal consensus that this form of husbandry should be abolished as soon as possible. This is also reflected in the growing trend towards a vegetarian or vegan diet. According to a survey conducted by POSpuls in Germany in 2020, around 70% survey participants eat a vegetarian diet because they are concerned about animal welfare (Eikermann 2020). Similarly, a representative survey on the "animal welfare levy", which is currently being discussed in Germany, shows significantly broader approval if animal welfare and not climate protection is presented as the main motive for its introduction (Perino and Schwickert 2022). The animal welfare aspect should therefore always be considered in the academic debate on sustainable food systems.

So far, if at all, animals have only been considered "indirectly" in economic analyses. Their welfare only counts if it influences the welfare of humans. It therefore only has an instrumental value: this means that animal suffering is not considered bad in itself, it only has negative value if it negatively affects the welfare of humans. The majority of moral philosophers criticise this

¹¹ Jeremy Bentham (1789)

exclusive focus on human welfare. They argue that the well-being of all living beings capable of suffering, i.e., also the well-being of animals, has moral value.

In economic research, too, there are already some approaches to consider animal welfare "directly", i.e. independently of human welfare. This direct consideration of animal welfare affects how different policies are evaluated in terms of their welfare effects. A price surcharge on meat would thus perform better in terms of its welfare effects if the revenues were invested in improving the conditions under which animals are kept, as is the case with the animal welfare levy being debated in Germany, for example. The reason is that the levy would then have a greater positive impact on animal welfare than a mere reduction in meat consumption.

Conclusion

What does the future of the agricultural and food system look like? On the one hand, this question can be understood as an explorative endeavour. On the other hand, it is also a normative question about which of the many future scenarios we wish to happen and by what political and social means we want to make it become reality. What the explorative and normative interpretations of this question have in common is that they thrive on an exchange between the different scientific disciplines. Scenario analyses must simultaneously map scientific, societal and economic processes and combine them into one coherent picture. Likewise, the normative debate is enriched by the exchange of different disciplines and perspectives on how certain value concepts on the future of the agricultural and food system are related to concrete options for action as we move towards it.

In this contribution, we discussed the origins of and options for action in the impending food crisis through the lens of five disciplines. As representatives of the young generation of academics, we want to bring the topic of the future of the agricultural and food system to greater attention in academia and society. Not only because the crises and challenges of the global agricultural and food system are becoming increasingly urgent, but also because many academics in our generation share a certain self-image: in order to find solutions for the complex challenges of our time, the various branches of science must occasionally leave their narrowly defined professional structures and enter into dialogue with each other. Complexity and scenario research are still very young fields of research, while environmental economics, educational science and animal ethics are becoming increasingly interdisciplinary. The thoughts we have compiled here as examples are only a small excerpt - we wish it to be an invitation for further exchange.



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