Designing food supply chains efficiently to reduce food waste

The interview with Prof Dr Christian Fikar from the University of Bayreuth deals with the challenges and potential of food supply chains, particularly with regard to sustainability and the reduction of food waste. Prof. Fikar explains that food supply chains involve complex logistical processes that require transparency and coordination to minimise waste. He emphasises that uncertainties and delays are key problems that can be reduced through better use of data and artificial intelligence. He also emphasises the role of consumers, who can contribute to improving supply chains through conscious purchasing behaviour. He sees the challenges of regional supply chains primarily in their small-scale nature and the associated high logistical effort. Ultimately, he is optimistic that progress in logistics can contribute to achieving the global goals of halving food waste.

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KUestions is a video podcast format produced by the Akademie für Neue Medien (Bildungswerk) e.V. and the University of Bayreuth for the project Ernährungsradar. Experts are interviewed on various topics in the context of nutrition and report on the current state of research. The interview was conducted by Helen Regina, a Master's student of Food Quality and Safety at the University of Bayreuth.

Recommended literature on the topic

Fikar C (2024). Decision Support for Time-Critical Logistics Operations. https://christianfikar.com/

Kump a B, Fikar C (2021). Challenges of maintaining and diffusing grassroots innovations in alternative food networks: A systems thinking approach. Journal of Cleaner Production. https://doi.org/10.1016/j.jclepro.2021.128407

Paciarotti C, Torregiani F (2021). The logistics of the short food supply chain: A literature review. Sustainable Production and Consumption. https://doi.org/10.1016/j.spc.2020.10.002

Renkema M, Hilletofth P (2022). Intermediate short food supply chains: a systematic review. British Food Journal. https://doi.org/10.1108/BFJ-06-2022-0463

English translation of the German interview transcript

Helen Regina: Dear audience, the topic of sustainability in nutrition has many facets. One of them is logistics. How do food supply chains work and how can they help us waste less valuable food? Answers to these and other questions can be found in this interview on food supply chains from the Ernährungsradar series. Partners are the University of Bayreuth, the Akademie für Neue Medien and the Kompetenzzentrum für Ernährung in Freising and Kulmbach. I am Helen Regina, a Master's student at the University of Bayreuth. Our interview partner is Professor Dr Christian Fikar. Prof Fikar's research focuses on business management issues relating to food supply chains with an emphasis on time-critical logistics processes. Prof Fikar, welcome, we are delighted that you are here today. Firstly, could you explain in simple terms - what are food supply chains?

Prof Fikar: Yes, it's relatively easy to explain. In order to eat food at home, there are many steps that have to take place beforehand. It starts with the field, but a lot happens before production in the field. But above all, transport to the supermarket, where the food is later bought, is an important step until the food finally reaches the customer. A lot of work happens between these steps, it has to be coordinated, it has to be ensured that the quantities are correct, and that the information is available. Everything that happens in between is supply chain management. That's what we do.

Helen Regina: The United Nations' 2030 Agenda has ambitious goals. Germany has committed itself to halving food waste by 2030. What contribution can your field of research make to this?

Prof Fikar: There are several aspects to this. Firstly, you have to define what you mean by waste. Waste can be understood both quantitatively and qualitatively. When we talk about food waste, it's usually about the quantitative view: we can eat it or it's wasted. But it makes a difference whether my food is still very high quality or has a medium shelf life and so on. Supply chain management, as we call the subject in English, or Lebensmittelwertschöpf-ungskettenmanagement in German, is primarily about two things that we don't like. One is uncertainty and the other is delays. In the food sector in particular, we have both in many aspects. We don't know how good our products will be at harvest - it depends on the weather and many other factors. There are also a lot of uncertainties among customers, e.g. depending on the weather, but also personal taste and personal shopping behaviour. That changes, we all know ourselves, sometimes I go shopping and maybe buy a bit more, the next day I buy less and sometimes I eat my things and sometimes I am perhaps too lazy and do something else. And that's what it's all about, transparency and coordination using data, different variants, with lots of communication to make better decisions and reduce uncertainty. If I know what I need and it's really right, then I can automatically reduce waste, and these are the goals we want to achieve in supply chain management.

Helen Regina: Around 12 million tonnes of food end up as waste in Germany every year. What are the most common problems in food supply chains?

Prof Fikar: Again, this has to be split according to the focus. Basically, we know from data that consumers, i.e. all of us, are the biggest problem. We sometimes store food incorrectly, we buy too much, this can come from different impulses, but it can also simply be incorrect planning or without unexpected events. So the first thing we should look at is what we as consumers can do better to reduce waste. The second aspect involves all the steps before the consumer, it's about good planning to know how much food is needed. Perhaps some of our viewers have already been to a catering event, a wedding for example, and when you see how much food is left over at the end, it's usually pretty sad. However, nobody wants to celebrate at a wedding, invite the whole family and guests and then after ten minutes the food is gone and we have nothing left. In the end, that's what it's all about, coordinating it so that it fits. You will never be able to say that there is no waste at all. We also need food waste to be safe. Even 1000 years ago, there were food storage facilities for crop failures and so on. But there's a lot we can do to improve, and that's exactly what we want to achieve.

Helen Regina: You look at food supply chains from an operational perspective. Are there any positive examples (best practice), e.g. companies that stand out in terms of food supply chain management?

Prof Fikar: Yes, there are many at different levels, whether start-ups, family businesses, small and medium-sized enterprises (SMEs) or large companies, whether in Germany or internationally. But I'm not a fan of emphasising a single company. We also know of many initiatives where private individuals put a lot of commitment and private time into saving food and then distributing it to people who need it. This is a very interesting field, especially during the Covid pandemic we have seen that there are fewer and fewer volunteers who want to help because they are afraid of infection and contagion and because society is also getting older. Conversely, we also see in the data that we are making our food better and better in the supply chains, resulting in less waste and losses, which in turn limits donations. So there are many examples and I can only motivate everyone to become active themselves, to see where there are initiatives in the neighbourhood to do something better, because you can achieve a lot together. It's about saving food or putting it to better use.

Helen Regina: The Goethe-Institut recently reported on an AI (artificial intelligence) that saves food from being thrown away. To what extent can digitalisation, and artificial intelligence in particular, contribute to improvements in food supply chains?

Prof Fikar: That is a very exciting aspect. We collect a lot of data in food companies due to legal and operational aspects. We know the temperature of many machines that produce food. At home, we also know the temperature of the fridge and freezer compartment. We know the humidity. This data is often not used because we have neither the capacity nor the personnel to utilise the information properly. AI is of course a way of quickly screening the data to get ideas on what can be done better. But AI is certainly not the only method; there are also classic methods such as simulation and optimisation. Ultimately, it's about giving us more transparency. For example, in a research project with one of my doctoral students, we looked at strawberries and assumed that we knew the residual quality of every single strawberry on the farm at any given time. Based on this, we considered which decisions I would make differently. Then I could say, for example, okay, I have a strawberry, I know this strawberry won't make it to the shop, so I'll make juice from it now or I'll make jam from it. If you have an AI and the right data and can therefore see this situation in the data more quickly, then you can make the right decisions more quickly. The potential here is incredibly high. There will be many exciting results in this area over the next few decades.

Helen Regina: What are the major challenges in establishing regional food supply chains?

Prof Fikar: Regionality is a slightly different topic. It starts with the fact that the quantities are smaller. This means that if you want to deliver regionally, you often have different concepts. As a traditional agricultural business, the simplest thing I can do from a logistical point of view is to sell my entire harvest. If I sell my entire harvest, then I usually deliver it to one place, either in one or several transport operations. Then I don't have many customers. This is often not the case in the regional sector because the quantities are smaller, which means that there are sometimes several players involved. That makes it more complicated. We've just seen this during Covid, where many farms have started doing home deliveries and that is not easy. It gets very complex very quickly. I then have 50, 100 or 200 customers. Deliveries are difficult in urban areas anyway, as we all know from package deliveries. We have problems with car parks, traffic jams and so on. And in the regional sector, it is precisely this small-scale nature that is exciting and has potential. You can have more contact again and you know more about where the food comes from, which is what many consumers want. However, the logistical effort is much greater. Regional supply chains are all about trying to minimise these logistical problems through cooperation and coordination and ultimately finding good solutions.

Helen Regina: What effect does globalisation have? Is it damaging the establishment of regional food supply chains?

Prof Fikar: I don't see it as a black or white question. There are many shades of grey in between. It's actually a mistake to talk about food supply chains, because every product is different, every company is different, every geographical environment is different. It makes a complete difference whether I transport strawberries to country A or B, whether I buy from a large or a small company, whether the strawberries are frozen or not frozen. It all makes such a big difference that I think it's much better to focus on the individual product. That's what I also teach the students. Look at the product. Focus on the product. Understand your company, understand the environment and then make the right decision. And it's never a black or white question. There is a lot in between. There can be completely different strategies for two products within the same company. So globalisation and regionalisation are not mutually exclusive, they complement each other. You always have to look at each case to see what makes the most sense.

Helen Regina: How can consumers help to make food supply chains more ecological and efficient?

Prof Fikar: There are several options. Firstly, you can think about what you buy. It is very important to know your own preferences and priorities, because what is sustainable and ecological for me is not for my neighbour. There are wonderful examples with plastic and a cucumber wrapped in plastic. On the one hand, plastic is bad for the environment, but on the other, it's good for reducing food waste. These aspects are important. Then you have to decide for yourself what is more important to me. If I now think more about logistics and my area of research, we often talk about cooperation. As a consumer, I can think about whether I really need to go shopping every day or whether I can go every two or three days, for example. If I go shopping less often, I might have the problem that I generate more waste, but on the other hand I save on emissions from transport. I can also think about whether I want to take something home for my neighbours. Especially here in Upper Franconia, there are some very interesting initiatives where neighbours do the shopping for other neighbours. This has worked very well during Covid, it has shown that it also works throughout Germany and on a large scale. The last and most important point in logistics that I would like to mention is time windows. As consumers, we want to know as precisely as possible when the delivery will arrive when we have ordered something. For the other side, i.e. the logistics companies or farmers, time slots can lead to huge problems. If you allow yourself a little more flexibility in the time window, you can save a lot in terms of sustainability.

Helen Regina: And finally, back to the initial question: will the goal of halving food waste by 2030 be achieved because we will have established sustainable food supply chains by then?

Prof Fikar: Yes, anything is possible, that's my opinion. But I'm certainly not the right expert on this question. There are economists and experts on political and legal issues. My research is more focussed on individual companies. What I can say is that a single company can do a lot. The conflicting goals are sometimes very exciting, as we have shown in our research. Especially when we talk about AI or computer systems, they always optimise to the last percent, the last thousandth. In some cases, we have been able to find solutions in our research that can reduce food waste or losses by 20-30%, for example, but are only a few euros more expensive than the optimal solution. It is simply important to understand this and to optimise each individual aspect based on your own criteria. If everyone does this, then it is certainly possible. But as I said, there are other experts who are better placed to assess this from an aggregated economic perspective.

Helen Regina: Prof Fikar, thank you very much for the interview and the very interesting answers and your insight into food supply chains. Thank you very much.

Prof Fikar: Thank you