

Three scenarios for Europe's food sector in 2035



The FOX project

FOX is a unique collaboration between universities, research institutions, small to medium enterprises, industries and associations, who are extremely grateful for the financial support of seven million Euro from the European Commission's Horizon 2020 Research and Innovation programme. The project lasts for 4,5 years (2019–2023).

FOX stimulates short food supply chains for fruit and vegetables by applying small innovative mild processing technologies. The approach creates business opportunities for regional hubs and provides qualitative processed foods to be indulged by the local community.

www.fox-foodprocessinginabox.eu

The FOX partners

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Authors

Björn Moller, Ariane Voglhuber-Slavinsky, Ewa Dönitz

Introduction

Vertical farming and urban gardening, artificial intelligence in food retail, burgers made from insects as alternative proteins, or online grocery shopping – many social trends and technologies are influencing the food system today and will shape how the European food sector will look like in 2035. These trends are already apparent today, but which of them could change the whole food system on the long term? Which trends are only hypes and temporary? These and many other questions are part of the EU Horizon 2020 project FOX, and are at the core of FOX's foresight research component.

The recently published "Farm to Fork Strategy" of the European Commission shows the need for action for the food sector. Sustainable food production, ensuring food security, reducing food losses and waste and many other aspects are essential to reach a fair, healthy and environmentally-friendly food system. But how will these challenges be tackled? Who is driving the actions for sustainability? And how do these measures look like?

The Competence Center Foresight of the Fraunhofer Institute for Systems and Innovation Research ISI derives and conducts a foresight process for developing future scenarios that outline the framework conditions of the European food innovation system of 2035. In a first step, scientists and experts have identified and analysed a variety of trends influencing the food sector. The most compelling were published in the brochure "50 trends influencing Europe's food sector by 2035". Taking these trends as a starting point, we designed and conducted an online foresight scenario process to draw three alternative pictures of the future, how the European food sector could look like in 15 years. Our aim is not to predict exactly how the food sector will develop because this is impossible. However, we want to contribute to the discussion by reflecting and studying possible influencing aspects and alternative futures, as a look into the future creates the possibility to develop together ideas for improvement strategies to be better prepared.

FOX – Food processing in a Box – is a project in which more than 25 European partners aim to transform large-scale technologies for the processing of fruits and vegetables, to small, flexible and mobile units in your neighbourhood. FOX is all about health and sustainability – and how technologies can support and promote these goals. The innovative processing solutions are therefore flexible, resource-efficient, and based on seasonality and demand. It considers the expectations of farmers and small food businesses, looks at the technical and economic feasibility, and takes into account the needs of consumers and the food chain. The latter will be actively involved in the development of new products and new business options for sustainable consumption. This allows for transparency and trust in the food chain. FOX stimulates short food supply chains; transitioning from a more centralised industry, to local production hubs. So-called food-circles are the European regions in which the FOX technologies will be demonstrated to be integrated into the entire food production chain.

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Why different scenarios?

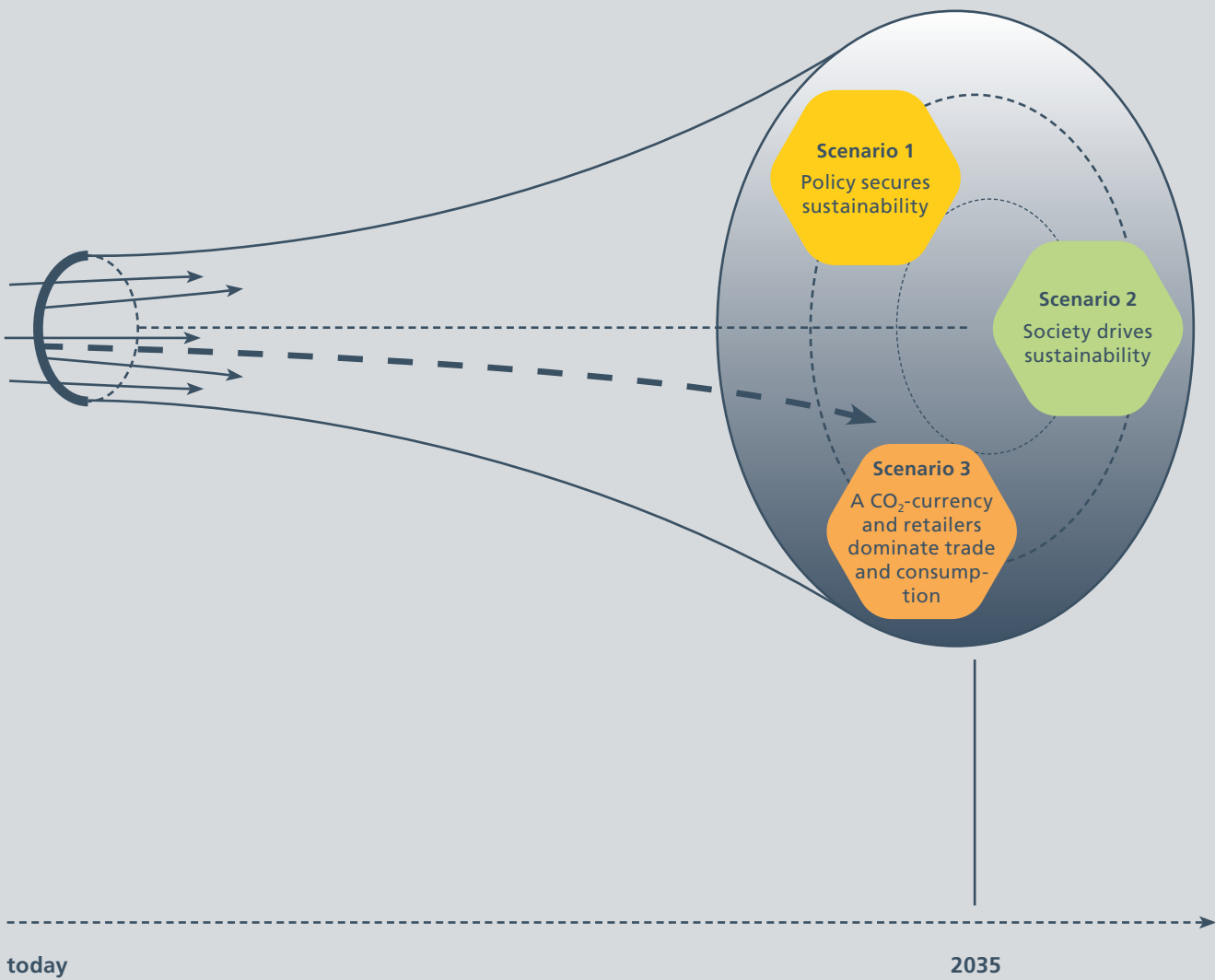
Alternative Futures instead of predictions

How have we proceeded to project the development in the European food sector into the year 2035? We have developed detailed, consistent and pointed “pictures of the future”. The focus was on alternative developments for the food sector along its entire value chain, from production and processing to packaging and logistics as far as sales and consumption. The scenario method applied here, enables a structured examination of conceivable alternative development paths. In this way, we raise awareness of the fact that complex topics do not allow a simple distinction between a best-case and a worst-case. Scenarios make the future tangible today and enable their users to act in a future-oriented manner.

Starting from three core scenarios, described by six key factors, an online scenario-process was conducted with participants from research and industry. During this, alternative developments for different key factors were discussed. These future assumptions were then combined to form consistent combinations of assumptions describing the future world. The scenarios are presented here using a future funnel. This makes it clear that the uncertainty of the developments increases the further one looks into the future. It is important to note that scenarios are not forecasts. They shed light on different options and promote an understanding of what lies ahead. On this, options for action can be discussed very concretely – to support decision-making. The three scenarios for the European food sector 2035 presented here, outline three different development paths. None of them is a simple continuation of current developments. There are relevant changes compared to today, each of which is the result of the interaction of individual future assumptions.

Europe’s food sector

The focus of the scenarios presented here is on the European food sector and its policies, industries and research. However, the high import and export rates in this sector on the one hand and the close intertwining of raw material, trade of food and agricultural products and finally digitalisation in global value-added networks on the other hand, also required consideration of the international perspective, especially with regard to sustainability and food security. We first summarise the characteristic features of the three developed future scenarios and then describe the scenarios in detail.



Future funnel: Intersection in 2035 with possible consistent futures. Different characteristics of key factors have an impact on the future. The further away the scenarios are from the centre in 2035, the more fundamental the changes are.

The three scenarios at a glance

Scenario 1 Policy secures sustainability

Welfare states centrally ensure national food security

This scenario drafts a future world where the states own agricultural land, produce food according to local conditions and care for the well-being of all their citizens. Consumers do not understand the complexity of food production nor do they care about how it influences the environment around them. They trust their government in providing nutritious food and ensuring accessibility for all citizens. The awareness for the necessity of environmentally friendly and sustainable food production is present and promoted by science. In this future, politicians have recognised that sustainable agriculture is vital to national food security. More about how this future state is achieved will be presented in the following pages.

However, the state not only owns and manages agricultural land, it also has data sovereignty and access to data along the whole food value chain, e.g. to the purchase data of all e-commerce grocery stores. How this data is used and what are the implications for citizens will be explained.

Furthermore, it will be discussed how citizens' freedom of choice is influenced, what drives the buying criteria for food, how important labels will be and what role indoor farming will play.

Scenario 2 Society drives sustainability

Consumers enjoy a green and healthy lifestyle

In this future, people are driving developments forward through their search for a healthy lifestyle in harmony with nature. They are aware of many interconnections and see the big picture. Sustainable behaviour is in the heart of society. Economic growth is no longer the main paradigm to follow. Agricultural land is in the hand of many, especially local biodiversity is of high value and many fresh foods are produced within a 1-mile radius.

In this future, the role of the national government is limited, but there are well-organised governments at the local level. Consumers' opinions are significantly determining a sustainable and local production of food. This has an effect on the availability of certain products, but for other reasons than in scenario 1.

Further important aspects, like which values the society thrives for is further explained. The role of local communities in reaching high levels of self-sufficiency in food production and the contribution of individuals in living a sustainable life is elaborated in the scenario description.

Why high food prices are accepted, whether consumers become producers, how the relationship between citizens and farmers evolved, which role retailers play in logistics, and what other properties food must fulfil is at the core of this future world. Additionally, "Food as a Service" evolves as a distinctive concept combining technological innovation with decentralisation and resource savings.

Scenario 3

A CO₂-currency and retailers dominate trade and consumption

In a globalised world, markets and technologies ensure prosperity for top performers

High-specialised global markets rule the world. Dynamic technological progress, a competitive surrounding and unlimited growth characterise this future scenario best. Retail and sales have huge market power, e-commerce is mainly in the hands of the big box retailers and the shift towards online consumption of food is completed.

In this world, flexibility is highly valued by consumers. Willingly provided transparency about consumer data gives retailers data sovereignty. Foodservice platforms evolve and are in the large part successful because of consumer profiling.

Agricultural production has to be efficient and economically successful in the first place. The effects on land and biodiversity are of minor importance. How agricultural and processing technologies evolve in this environment is further explained in the scenario description.

The role of global trade on the variety and prices of food as well as on its security is as central in this future as CO₂-prices, the large-scale industrial processing of food and the use of side streams. Other questions are how powerful national and local governments remain, how AI and new digital solutions are used to help consumers, why circular economy is the new paradigm to follow, and why natural resource and biodiversity protection, as well as climate change mitigation, are still of importance.

Foresight and scenario methodology

Strategic decisions are mostly based on future expectations and visions. What the future actually looks like is open. However, the development of alternative scenarios of the future helps, to become capable of action. An active examination of possible, as well as desired future developments strengthens the knowledge base of the decision-makers. The future scenarios developed within the FOX project are characterised by the fact that they have been generated in a methodically comprehensible manner, are based on transparent documentation of assumptions and relevant actors have been involved in the entire process. The future scenarios were designed to discuss implications for the FOX technologies, the FOX regions and the stakeholders involved and to develop robust action strategies and business models. During the scenario process, existing future studies as well as expert knowledge were taken as a starting point. The integration of different perspectives ensured a “collective intelligence”. A precise alignment and customisation of the selected scenario-approach was applied in order to address the object of research and the current framework conditions.

The figure on the right shows the different steps we have taken. The resulting future scenarios do not claim that one of them will happen in exactly the described way. Unlike forecasts, however, the underlying assumptions are transparent. They can be questioned, changed and, if necessary, adapted and are thus a means for all players to draw conclusions about their own business, develop suitable strategies and thus be prepared for change.



Trend analysis

- Identification of key factors influencing the food sector on the basis of existing future studies



Development of core scenarios

- Development of future assumptions for the six key factors with the highest impact
- Consistency matrix to develop core scenarios



Online scenario process

- Enriching the core scenarios by future assumptions of 12 more key factors
- Online foresight scenario process with FOX consortium and external experts



Development of final scenarios

- Combination of raw scenarios and additional factors
- Storytelling to illustrate the different pictures of the future



Communication

- Communication of the scenarios to the community



Interpretation

- Evaluation and discussion of the impacts on different technologies, regions and stakeholders

Approach and key factors

Trend analysis

Our study “50 trends influencing Europe’s food sector by 2035” was the starting point for this scenario process. An environmental analysis has identified and structured several issues that may influence the development of the European food sector and food value chains today and in the future. Based on the analysis of future studies as well as an internal workshop, a total number of 18 “key factors” were identified. In the process, both the framework conditions that are already relevant today and those that could have an influence on the food system in the future were identified.

Development of core scenarios

Out of this 18, the most relevant six key factors have been chosen. These are: “Appreciation of products promoting ecosystem services”, “Degree of centralisation of food production”, “Purchasing behaviour related to food”, “Measures to reduce climate change in the food sector”, “Public and private investment in food and agriculture”, and “AI in the value chain”. To create future scenarios, alternative developments for these six key factors have been discussed. Based on a consistency check, conflicts and synergies between the future assumptions of different key factors were analysed in pairs by the project team in a consistency workshop and described by a consistency value. The consistency value represents the extent to which the two assumptions are mutually exclusive or compatible. The value scale ran from “-2” (strong inconsistency) to “+2” (strong consistency). The pairwise combinations with a neutral correlation between the considered assumptions are assigned a consistency value of “0”. The consistency values of all combinations of assumptions of different key factors were compiled in a consistency matrix. The consistency analysis includes a check of all possible assumption bundles for consistency. Thus, the overall consistency for each combination of assumptions was

determined using a software algorithm. From these assumption bundles, three bundles were selected as the basis for scenarios. This way, so-called raw scenarios are created. The selected assumption bundles are not only consistent in themselves but should also differ significantly from one another.

Online Scenario process

In an online foresight scenario process, external experts and the partners of the FOX consortium have been asked to develop future assumptions for the remaining 12 key factors in the three core scenarios. By doing so, the scenarios have been enriched by more aspects and thus gain more detail. From a methodological perspective, there are three main requirements for the quality of future assumptions: First, clarity and comprehensibility, means the projections should be logical and understandable. Second, plausibility, meaning that projections must first and foremost be plausible, not necessarily be probable. The human brain tends to think linearly and to project trends from the recent past further into the future. Third, the freedom from overlap, which means the assumptions, must be disjunctive, i.e. there must be no overlap between the assumption. In this online process, two more topics have been identified and chosen as additional key factors.

Development of final scenarios and storytelling

To create the final scenarios, the core scenarios and the future assumptions of the additional factors were combined and described in a written form. This description included a possible development of the relevant areas in the year 2035. This served to illustrate the interconnection of the key factors in the form of comprehensible “stories” and to show the connection to the future of the European food sector and its value chain.



Appreciation of products promoting ecosystem services



Purchasing behaviour related to food



Degree of centralisation of food production



Measures to reduce climate change in the food sector



Public and private investment in food and agriculture



AI in the value chain



Sustainability in the food sector



Food safety and security



Growth paradigm in transition



Resource availability: land, water, energy



Food losses and waste



Quality and quantity of labels



Packaging of food



Online grocery shopping



Ownership of Data



Society's attitude towards new technologies



Balance of power within the value chain



Platforms and "Product as a service" in the food sector

The 18 key factors



Factor: Appreciation of products promoting ecosystem services

This factor shows to what extent products promoting ecosystem services will be appreciated. Agricultural production depends on the use of the natural resource base. More sustainable management techniques can support biodiversity and the provision of ecosystem services. With a growing world population, the challenge of meeting food demand with less environmental degradation is urgent. However, products from sustainable farming have to be demanded by consumers and the additional expenditures to produce them, have to be reflected for example in higher prices for consumers.



Factor: Purchasing behaviour related to food

This factor shows how consumer decisions concerning nutrition could transform. Because of globalisation, the range of food is becoming increasingly diverse. Decisions related to nutrition are dependent on income, degree of industrialisation, cultural influence, knowledge and availability. Packaging, food labelling, product information and price can play an important role in decisions. On the one hand, food is increasingly fulfilling other functions than the mere supply with nutrients, but on the other hand, the way in which food is consumed is also changing.



Factor: Degree of centralisation of food production

This factor shows where most of the food products will be produced in 2035, and how centralised this food production is organised. Highly efficient production can be achieved by extremely high centralisation on the one side and local and sustainable food production on the other side. In order to meet the demand for nutritious and safe food in sufficient quantity various ways can be followed with the specific advantages and disadvantages of global versus regional supply of food. Important developments in this context are the growing world population and urbanisation. Various trade-offs between logistics, natural preconditions, storage, diversity of supply etc. have to be considered.



Factor: Measures to reduce climate change in the food sector

This factor shows how measures to reduce climate change and lower CO₂-emissions could be realised in the food sector. Climate change is driving the food sector as an externality and as an internality: Increasing risks make new management and production systems necessary to ensure food supply. On the other hand, food production is a main cause for climate change. Therefore, new approaches in the food sector are crucial for tackling climate change. Combining adaptation and mitigation is the key challenge. Climate-smart agriculture (CSA) proposes one way of addressing these challenges by a sustainable improvement of productivity, adapting to and mitigation of climate change, as well as reducing greenhouse gas emissions where manageable.



Factor: Public and private investment in food and agriculture

This factor shows how public and private investment in food and agriculture could transform. More than 800 million people still suffer from hunger and malnutrition. Investments in agriculture should boost the economy, fight poverty and improve food security. In low- and middle-income countries, the private sector is the largest investor in agriculture. The private sector often focuses on maximising profits and asserting its own interests. States are increasingly targeting public investment in the food sector to ensure a more sustainable management taking in consideration environmental and social aspects as well.



Factor: Artificial intelligence in the value chain

This factor discusses how intensive and at which steps of the food value chain, artificial intelligence will be used in 2035. Even if food is an economic good that is very analogous – the industry behind it, is no longer. Digitalisation has fully captured the food industry. Whether as sorting machines in logistics or as sales robots in supermarkets – the use of artificial intelligence will influence the food industry in many ways. AI could also play a crucial role in the food supply sector. An example is technology that predicts in which cities which goods will be in demand, when and how often. The correct number of orders and the appropriate route could then be automatically generated.



Factor: Sustainability in the food sector

This factor shows how sustainable food could become more accessible to everyone. Sustainable food becomes more popular with an increasing product range. Sustainable food markets are still niche markets. They are more expen-

sive than conventional products, so they are not accessible to everyone. Sometimes a lack of transparency and greenwashing is also possible. Consumers cannot retrace for all products if they are sustainable and some companies present themselves greener than they are. This leads to uncertainty among the consumers.



Factor: Growth paradigm in transition

This factor shows how the growth paradigm could transform the food sector. Growth is one of the main objectives of the current economic model. A growing GDP is still an indicator for a country's success. Globalisation itself continues and products are available anytime and anywhere in the world. Growth is partly responsible for global social injustice as the negative environmental and social consequences of production are in many cases outsourced to other regions of the world. Consequences are environmental damage and social injustice in places far away from the actual consumption, e.g. unfair working conditions and water scarcity.



Factor: Food safety and security

This factor shows how legal frameworks and regulations could create and ensure food and nutrition security.

The four dimensions of food security are physical availability of food, economic and physical access to food, food utilisation and stability of the three dimensions over time. Food insecurity exists if even one of these conditions is not met. Food security policies have to address those conditions of food security that are not fulfilled. They can be designed to increase food supplies (availability), improve access to food (poverty alleviation), improve utilisation, or ensure stability of food supplies. Policy measures serving more than one food security objective are called "twin-track-" or "multiple-track-approaches".



Factor: Resource availability: land, water, energy

This factor shows how the availability of resources could evolve. Due to growing consumption and industrial production, more and more resources are irretrievably consumed within a very short time. The growing world population demands more space for living and land for food cultivation. The excessive use of resources leads to soil degradation, water scarcity, acceleration of climate change and other consequences. All different stages along the value chain require input of energy; they contribute to environmental pollution and to the greenhouse effect.



Factor: Packaging of food

This factor shows how food packaging could change in the next years. In today's society, packaging is pervasive and essential. It surrounds, enhances and protects the goods we buy, from processing and manufacturing, through handling and storage, to the final consumer. Without packaging, materials handling would be a messy, inefficient and costly exercise and modern consumer marketing would be virtually impossible. When the public think about packaging, they equate it to waste in their garbage bin, litter in the streets (waste in the wrong place) and excessive or deceptive packaging; these dominate the public perceptions of packaging.



Factor: Food losses and waste

This factor shows how losses and waste of food could develop. One-third (1.3 billion tonnes) of food for human consumption is lost or wasted every year. Already during production, storage and transport, but especially in households, many food products are lost. This leads to a wastage of resources and has a negative impact on the environment. A reduction in food waste would lead to less environmental pressure and further on to better production conditions in developing countries.



Factor: Online grocery shopping

This factor shows how e-commerce could develop in the food sector. Supermarkets and discounters have replaced traditional retail trade to some extent. They also offer easily perishable food anywhere at any time. Due to the growing demands of consumers for online solutions, supermarkets are under great pressure. Some large companies have already established B2C e-commerce platforms that offer short delivery times for fresh food.



Factor: Quality and quantity of labels

This factor shows how the quality of labels in the food sector could transform. Highly competitive and saturated food markets require rapid response to consumer needs. Knowledge of the relationship between nutrition and health and perception of quality characteristics is increasing. Quality is a competitive advantage and a subjective evaluation to be considered in the cultural context. Quality labels are extrinsic quality features that help consumers in their decision-making. There is a great lack of transparency because there are many confusing labels.



Factor: Ownership of data

This factor deals with the question "who owns the data?". To unleash the potential of new data-driven opportunities, players in the data market need to have access to large and diverse datasets. Access in relation to data is therefore a crucial factor. However, the new data economy raises unsolved issues. Where a multitude of actors interacts in the elaboration of data, it is often questioned: who owns the data?



Factor: Balance of power within the value chain

This factor shows power relations between the different actors in the food value chain. Value chains that include agricultural products are becoming increasingly global and increasingly closely coordinated. Requirements and standards of lead buyers have led to the restructuring of value chains. Medium-sized companies, as well as large manufacturers and exporters, are the business partners of choice for the big retailers because they meet their requirements more easily. The focus has shifted from the suppliers' offer to the buyer's requirements. Farmers no longer produce in order to find a market for their goods afterwards. Instead, those who control the value chains decide what they think consumers need and design the supply chains accordingly for these products. However, there are tendencies towards shorter and more regional value chains.

that bring providers together with customers on a digital marketplace. Accordingly, digital platforms act as intermediaries. The network effect is a major driver of the platform economy: the more providers there are on the respective platform, the more interesting it is for the customer. Conversely, a large customer base attracts other providers. There are three groups that meet on platforms: There are portals that serve the exchange of companies (B2B), the networking of customers and companies (B2C) and the better exchange with the administration (B2G or C2G).



Factor: Society's attitude towards new technologies

This factor shows the openness and tolerance of agricultural producers as well as consumers towards emerging technologies. Critics raised concerns that machines will replace human labour in agricultural production, while at the same time, to further intensify agriculture and thus promote climate change. Supporters argue that artificial intelligence can help combat climate change and improve the efficiency of food supply. Artificial intelligence in agriculture has exploded in recent years and enables "smart farming" for example with self-learning automated machines.



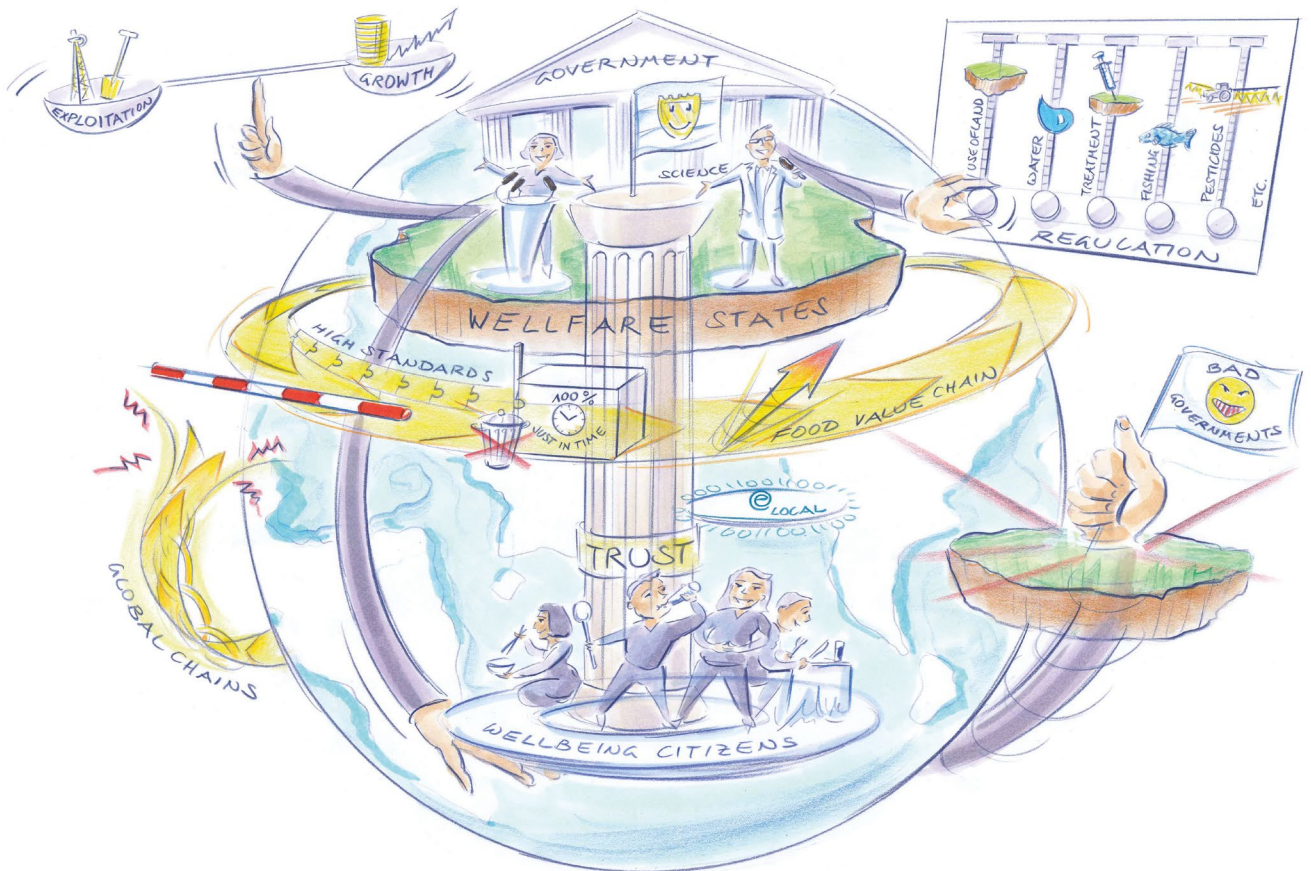
Factor: Platforms and "Product as a service" in the food sector

This factor describes the alternative developments of platforms and service oriented business models. Platform economy refers to internet-based business models

Scenario 1

Policy secures sustainability

Welfare states centrally ensure national food security



In this scenario, agriculture is increasingly being nationalised and has to serve the common good. National states care for the well-being of all their citizens. Every country or every bigger region aims to cover its own needs based on its own rules and natural conditions. Therefore, countries choose adapted crop species or livestock breeds that can be cultivated and raised with high efficiency.

The complexity of food production and its interlinkages to the environment are not understood by consumers. Thus, they do not question restrictions or specifications but trust completely in their government. The state ensures that sustainable and nutritious food is accessible to every citizen. It promotes sustainability through tax relieves for fair and environmentally friendly products, but also intervenes intensively in agricultural production in the form of stricter regulations – e.g. in relation to land and pesticide use, water consumption, soil treatment or fishing quotas. Politicians have recognised that sustainable agriculture is vital to national food security.

The state uses locally implemented e-commerce to promote sustainable consumption. The government not only promotes sustainable food trade, but it also incentivises its citizens to a healthy lifestyle. This is possible because the state has data sovereignty and thus access to the purchase data of all e-commerce grocery stores. This makes it very easy to smartly analyse people's purchasing behaviour. Consumer profiling and instructions on food consumption based on state-monitored e-health data are core elements of a state platform dealing with food and health. For example, catering services are also offered via this platform. National retail companies are integrated into state-run e-commerce platforms.

State control does restrict citizens' freedom of choice but also tackles the big food waste problem effectively. Food waste is prohibited by law in the entire value chain. It can be proven exactly who is causing food waste and can therefore be sanctioned. Plastic packaging is still available as this is the best way to control the shelf life of food. However, the life cycle of packaging is highly optimised.

Consumers view aspects such as sustainable production, fair trade, traceability, nutritional value or regionality positively, but they do not rate them as absolutely necessary. The price is the crucial criterion for consumers when choosing their food. The focus and the fact that providing the population with high-quality food is of great importance to governments, labels are less important in the food sector. As a result, there will be very few labels.

The traditional importance of growth remains strong, but policy generally focuses on restricting growth to ensure limited use of resources. As a result, all resources are managed by the government. The state alone decides how land, water and energy should be used. The globalisation tendencies resulting from economic growth are no longer relevant in the food sector. Ensuring food security will create global tensions, as various resources for production are scarce and not available in many parts of the world. High production and food standards are an additional trade barrier and further, reduce the choice of food.

Since global food trade is limited, food diversity depends on a great extent on the local climatic conditions. Technological progress – such as indoor farming or the cultivation of meat – can alleviate this problem. The state is therefore basically open to new forms of food production, but only if they can provide food in an efficient manner. The centralised supply of basic foodstuffs is supported by highly efficient logistics. Digital technologies are used to better control the entire complex value chain. Since consumers rely mainly on their governments and people do not really understand the structure of food production and its effects, it is mainly the state that decides whether to support a certain new technology or not.

Detail description of all factors and their future assumptions in this scenario

Factor: Appreciation of products promoting ecosystem services | Assumption: No awareness or intentional disregard of ecosystem services

The effects the production of agricultural goods has on the provision of ecosystem services (ESS) is very complex and thus not understood by consumers. There is a lack of information concerning the services provided by ecosystems. Consumers make purchase decisions based on the price or quality of products. The ecological footprint is not relevant for the consumption decisions. Consumers cannot differentiate between conventional products and those supporting the provision of ESS. Consumers are aware of the topic of ESS but do not want to pay higher prices for ecosystem friendly products. The main focus of agriculture is to ensure accessibility of food.

Factor: Degree of centralisation of food production | Assumption: Centralised agriculture in each country

Every country or every bigger region aims to cover its own needs. Countries choose food products that can be cultivated with high efficiency. This means, that different products are produced depending on geographical location and climate conditions. Central production hubs are in place and meet a large part of the demand for food. Supply of staple foods is therefore subject to centralised structures and is supported by highly efficient logistics. The whole value chain is enabled by extensive digitalisation. Even fresh products are produced and processed centralised, but not necessarily in rural areas. Urban farming is used in the same way as in vitro meat production in urban surroundings.



① INTERNALIZATION OF EXTERNAL EFFECTS

Factor: Consumer decisions on food shopping | Assumption: Price driven purchases

The price is the dominant driver for consumer decisions. This is the case for stationary trade as well as for online shopping. Aspects like sustainable production, fair trade, organic production, traceability, nutrition value or regional production are “nice to have” but are only secondary for the consumption decision. These arguments play only a role, when products have comparable prices.

Factor: Measures to reduce climate change in the food sector | Assumption: Internalisation of external effects

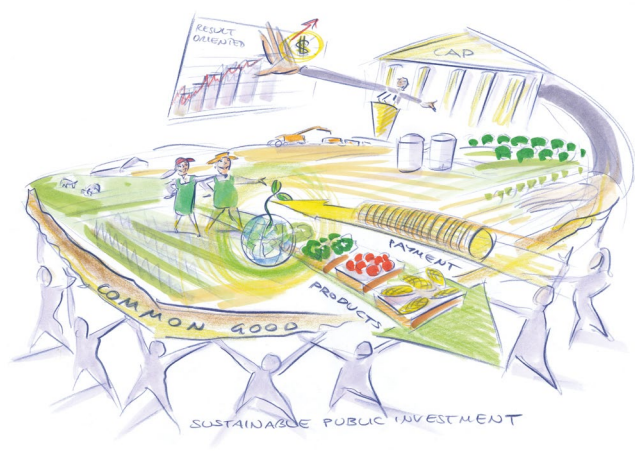
CO₂ intensive products are charged with high prices by application of certain CO₂-taxes. Consumers have then the choice between CO₂-intensive products or services at a higher price or sustainably produced products at a lower price. Governments apply restrictions on food production and logistics to decrease CO₂-emission. These restrictions can affect the use of water, transportation or restrict certain products like meat or other products requiring higher amounts of resources. Food waste is banned by regulations, at all steps of the food value chain. There are different laws and regulations in each country.

Factor: Public and private investment in food and agriculture | Assumption: Sustainable public investment

Agricultural fields are in the hand of the country and bound to the common good. A significant part of agricultural areas belongs to the state again and cannot be owned or sold to private persons. The lease of land is exercised according to economy for the common good. An innovative change of the Common Agricultural Policy (CAP) has taken place: area-based reward of farmers are replaced almost entirely by payments promoting biodiversity, climate protection and ecosystem services.

Factor: AI in the value chain | Assumption: Intelligent Value Chain

Sensors are integrated in every part of the production chain and collect various kind of data. This includes machine data during processing, real time customer shopping behaviour (demand) or information directly from the field like for example the moisture of the earth. These information enables the use of artificial intelligence at each and every stage of the value chain and also between these stages. The necessary information flows seamlessly in both directions from producer to consumer as well as from consumer to producer. The intensive use of AI offers a wide range of possibilities. Farms get information on the sales figures of the next weeks and can adjust production planning accordingly. Retailers are using production and processing data for intelligent pricing to steer customers demand according to the food availability.



Factor: Sustainability in the food sector | Assumption: Sustainability through regulation

Politics have realised that a sustainable way of agriculture is crucial to feeding the population in the long term. This results in more regulation especially regarding the use of land and water, treatment of soil, fishing quota and use of pesticides. There is a clear regulatory demand on national and EU level towards shorter value chains for certain products. Consumer trust more into the food they can buy, but they also pay higher prices because the government opts for taxes on less sustainable food, e.g. higher taxes on resource intensive meat.

The government decides on sustainability in relation to food production, the fraction of land to be used for agriculture (in relation to the fraction for e.g. houses, industry, nature) and the decision whether the production for export is based on sustainability and not profit. Law ensures that sustainable food will be available for everyone. Unsustainable operations like inefficiency and waste are punished by a fine, which will be reinvested in sustainability for water and land use, CO₂-sequestration and others. Governments have access to purchase data of every e-commerce food store. Purchase behaviour of people is smartly analysed taken into account household size and other factors. The nutritional content of the trolley is communicated with the health insurance of people and consumer get a bonus back if their food choice is a healthy choice. Bonuses can be shopping vouchers for very healthy food items with five per cent reduction on the next food purchase.

Factor: Growth paradigm in transition | Assumption: Economic green growth is aspired

Traditional meaning of growth is still strong, but policy generally focusses to limit growth to a sustainable level, in order to ensure a restricted exploitation of resources. Advanced technologies help to save some resources, but still support the paradigm of growth. Economic growth and the globalisation are not first and foremost driven by the food sector, but rather resulting from technological progress and business activities in other sectors.

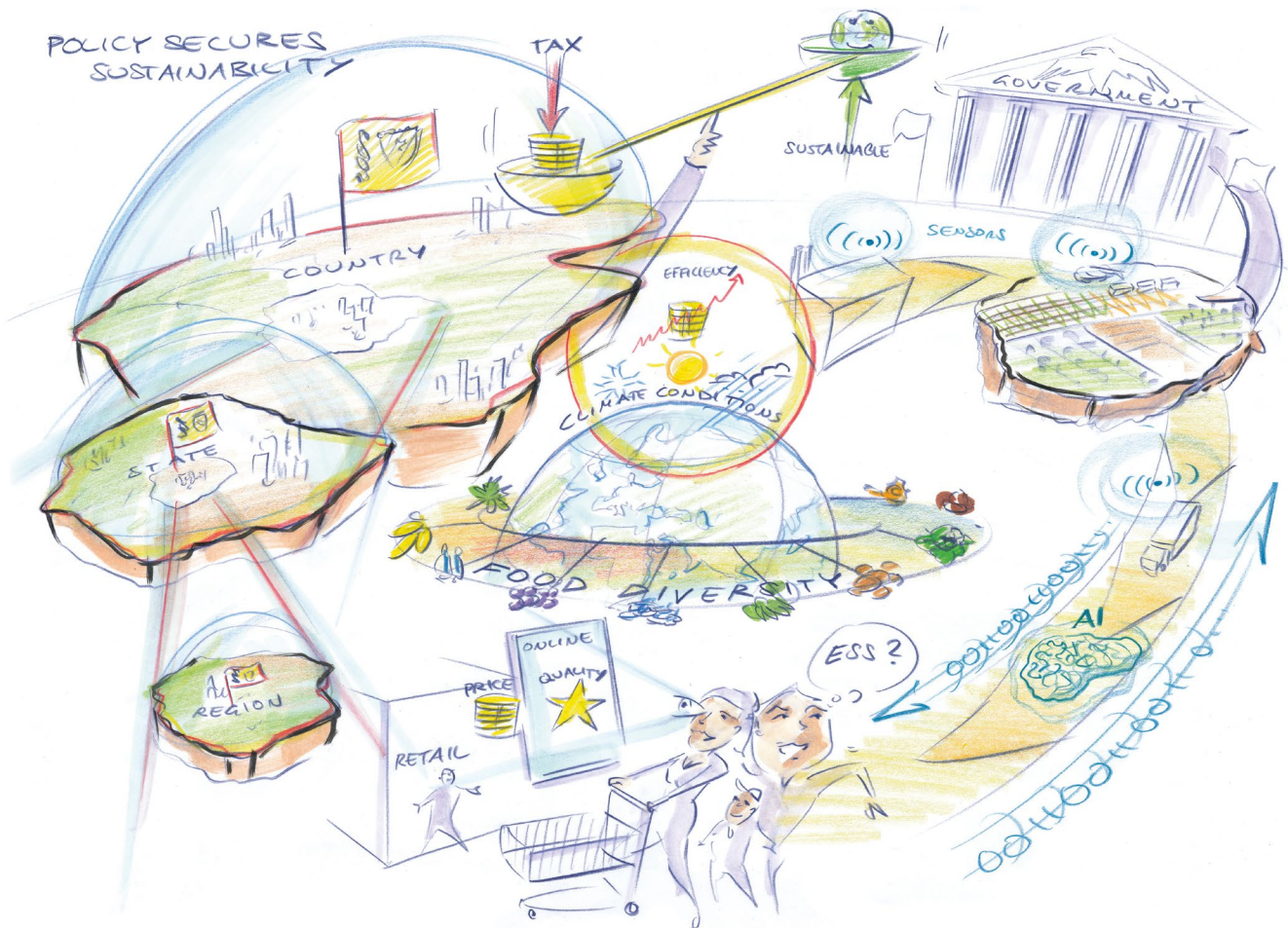
Factor: Food safety and security | Assumption: High level of policy regulation for food security and safety

Ensuring food security will lead to global tensions because many resources for production are scarce and not available in many parts of the world. Policy sets high standards for all actors in the food chain, including farmers. This implies that the total number of farmers will go down, as they are

not able to keep up with the standards. The choice of food is reduced, as the high standards also function as a trade barrier. Global food chains become rare. Citizens have little knowledge about the standards and trust the government. Therefore, food safety is not a problem in in this scenario.

Factor: Resource availability: land, water, energy | Assumption: Equitable distribution of resources by the state

The government manages all resources and decides how land, water and energy is used. They decide on the space for forest, grassland, environmental protection areas etc. and, in such a way, also stimulate or jeopardise biodiversity. Agricultural land is in public hand and is leased to farmers. The government takes care of soil health and this is as well part of the leasing contract. Hence, the contract might be terminated if the farmers leach soil. This has major consequences for global biodiversity, climate change and food production. Good governance in some countries can be counteracted by bad governance in large countries, which do not address sustainability. Policy uses state of the art technologies to make resources available: Depending on its climatic situation, every country has another strategy to optimise their use of available resources as water, land and energy to meet the demand for its own agriculture. Most countries in Europe suffer from long dry periods and heavy rainfalls: All kind of freshwater sources, even private wells, are monitored and digitally controlled (IoT) by regional or national governments; for drying periods governments control the availability of water for private and public sector by a water management plan. National water management plans are negotiated every two years in the CAP. As agricultural land is rare in many regions, vertical farming industries for vegetables, herbs and several fruits are standard. Energy supply is not an issue any more. Nuclear power is considered the safest and greenest energy since the aerospace sector got access to Mars. A space shuttle brings once a year hazardous waste to Mars. The waste is stored underground at the planet, because it has a very similar surface to the Earth.



Factor: Food losses and waste | Assumption: Regulations to avoid food losses and waste

Food loss and waste (FLW) are controlled through policies and governance on the level of the national government. FLW is a “non-topic” for the entire chain. It has never become a major social concern since it surfaced in 2010–25, as since then food is produced and delivered via short and regional value chains. The policy has introduced measures to reduce food losses. The actual amount of food losses shrunk to 1/10 compared to 1/3 in 2020. Governments do not allow waste anymore: the EU regulation banning the use of food for feeding animals is withdrawn, appropriate technologies guarantee that it is safe to be used as feed. A remaining challenge is the safety of food side streams to be used in human

food again. Production is highly specialised and streamlined. FLW in production (6–13% as we know it today) is nearly gone as the governments penalise any kind of spoiling food. A Lean Management approach to streamline production is common in any production facility. Big warehouses are no longer required anymore. Unplanned machine downtimes, which also produce waste, are gone, due to predictive maintenance. Behind the scenes, initiatives by retailers (e.g. through foundations) organise the re-use of FLW in food banks or as input to biorefineries just to avoid a potential hiccup of the media. Every household has an organic waste bin. A fee is charged according to weight of food waste, normal bins are checked with sensors to ensure that they are not misused for food waste and cities and regions are running modern composting plants or biogas plants. In addition, the supply chains are changing, resulting in less food loss.

Factor: Quality and quantity of labels | Assumption: Strict state regulation for fewer labels

The policy decides to reduce food labels to a minimum as only food quality and price is the decisive factor for purchase decision. The main part of food comes from regional agriculture – organic production is a quality label as well. The government rules the food sector and sets the scene for the standards and the level of the quality and quantities. It decides what and when to produce. Food labels are strictly controlled, specific quality schemes are in hands of government agencies. They are not prohibited, but have to pass an official test. Policy will implement labels curated by the state. Nameless currently existing labels will disappear from the market. Therefore, labels outside the foreseen box are considered as marketing. The consumer will always find approved labels in the same place on a product, in a highlighted box. The main goal would be the increase of consumption of healthier and local food products. Denomination of origin will be supported, more and more organic agriculture is established, naturalness outperforms over globalisation or local labels. However, labels play only an important role for the consumer, when the competing products have comparable prices.

Factor: Packaging of food | Assumption: Food packaging still in place

Most of the food products are still packaged in household sizes. However, the policy has installed strict rules on which materials for packaging are allowed. Hybrid materials like carton-polymer packs for drinks and liquids are more and more prohibited. Plastic packaging however is still available, as this is in this scenario the best way to control the shelf life of food, but all packaging have a deposit and are returned to supermarkets' return stations.

Factor: Online grocery shopping | Assumption: E-commerce on local or regional level implemented

National retailers jump into the e-platforms. Supermarkets become meeting points and pick-up stations for food that has been ordered before online. The policy use e-commerce to take care of sustainable food trade and consumer health. The government imposes restrictions to global e-companies and promotes local and direct selling. Farmers receive incentives and cooperation in direct selling.

Factor: Ownership of Data | Assumption: Data owned by the state

Governmental infrastructures provide a secured exchange and storage of all kinds of data. Therefore, the state owns some of the data and uses it. Public awareness is high and makes sure, that the data is not used in an unappropriated way. This means that the states are not using any data to observe people's behaviour or for any kind of social scoring.

Factor: Balance of power within the value chain | Assumption: Regulations ensure an equal distribution of power

Community organisations such as farmers' cooperatives, agricultural credit cooperatives and trade unions are well-established tools to promote a balance of power in agricultural value chains, as long as they are protected against abuse of power and unfair trading practices. In addition, there is a high degree of price transparency, i.e. price threshold, below which the affordability of products and, more globally, the sustainability of the entire value chain is at stake, are disclosed. Identifying products and regions where these costs are not recovered also provide useful information for areas where buyer power is particularly high and helps to take preventive measures against unfair trading practices. European competition policy is also based on the principle of

neutrality, i.e. that excessive buyer power is regulated to the same extent as excessive seller power, because of its expected negative effects on the general interest and consumer interests in Europe.

Factor: Society's attitude towards new technologies | Assumption: New government data platform, little information about technologies

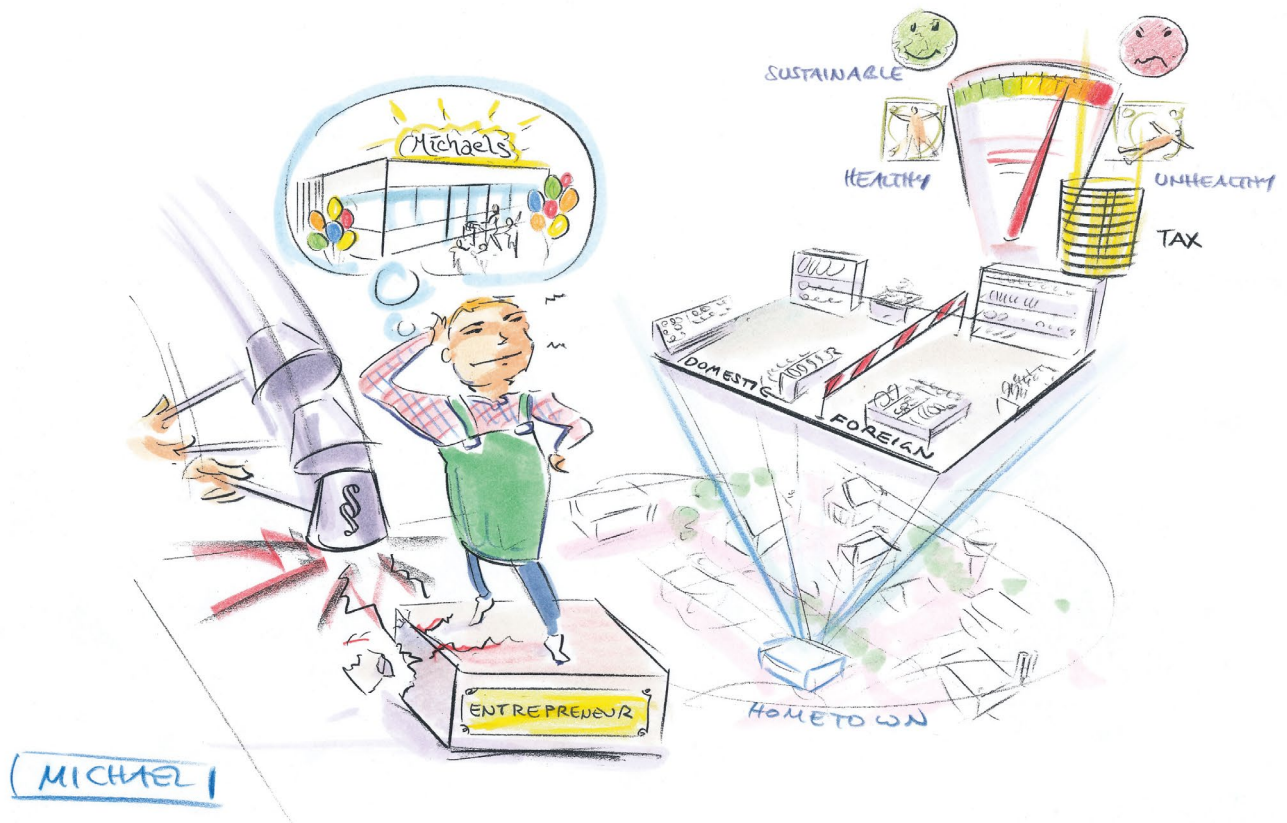
Since consumers generally trust in their government and people do not really understand food production structures and their effects, it is mainly the state that decides on the question of whether a particular new technology is supported or not. The quality and price of the product plays a role. If the process can be used to reduce the production costs, it is of high value.

Factor: Platforms and "Product as a service" in the food sector | Assumption: Governmental platforms to serve information on food and health

Citizens receive the instructions on their food consumption from the government, based on e-health data, which are also monitored by the government. This limits freedom in terms of food choice, but on the other hand also reduces the number of overweight citizens, which in turn has a positive impact on welfare diseases such as diabetes type II. An increased number of platforms offer food services, which are monitored by the government. Food safety has priority with an increasing number of inspections and data management.

Future story

Strong regulation puts the brakes on entrepreneurship



Michael (31) has been a loyal employee of a grocery store in a small village for many years. In 2020, he had completed his vocational training as a retail salesman in the same store. Unlike many of his work colleagues, he recently felt the urge to realise himself. There was a great demand for other grocery stores in his home village. Therefore, he decided to open his own grocery store. He submitted the construction project to the responsible state authority. The long audit process, which included checking whether Michael had the professional skills and the mental constitution for such a task, came to an end: Michael was officially allowed to start planning the market. What he was not aware of before was the strict state requirements for operating a food market.

For example, for reasons of food taxation in the market, there must be a strict spatial separation of domestic and foreign food: The taxation of domestic food is based on the criteria of healthy nutritional values and sustainability. Unhealthy foods and foods with a high negative environmental impact are taxed at a maximum of 30%, while staple

foods like potatoes and bread are tax-free. The taxation of food produced outside the state is also based on the criteria of healthy nutritional values and sustainability, but the criterion of distance also plays a major role. The minimum tax rate for foreign food is 20%. This applies, for example, to healthy foods from Europe, such as oranges from Spain. The maximum tax rate of 50% applies to overseas food such as Avocados. Food that is also produced domestically – like Argentinian, American or Brazilian beef – may no longer be offered.

Ultimately, Michael's plans failed due to the complicated state requirements. His story is exemplary for a lot of entrepreneurs and start-ups. The extensive governmental regulation makes it on the one hand very difficult for small enterprises and self-employed entrepreneurs, on the other hand, it ensures overall a certain degree of sustainability for example by an innovative change of the Common Agricultural Policy.

An illustration of two hands holding a dark blue tablet. The tablet screen is white and contains text. The background is a gradient of yellow and orange.

Germany has done it again – Recycling World Champion 2035 and setting the agenda for the EU recycling initiative.

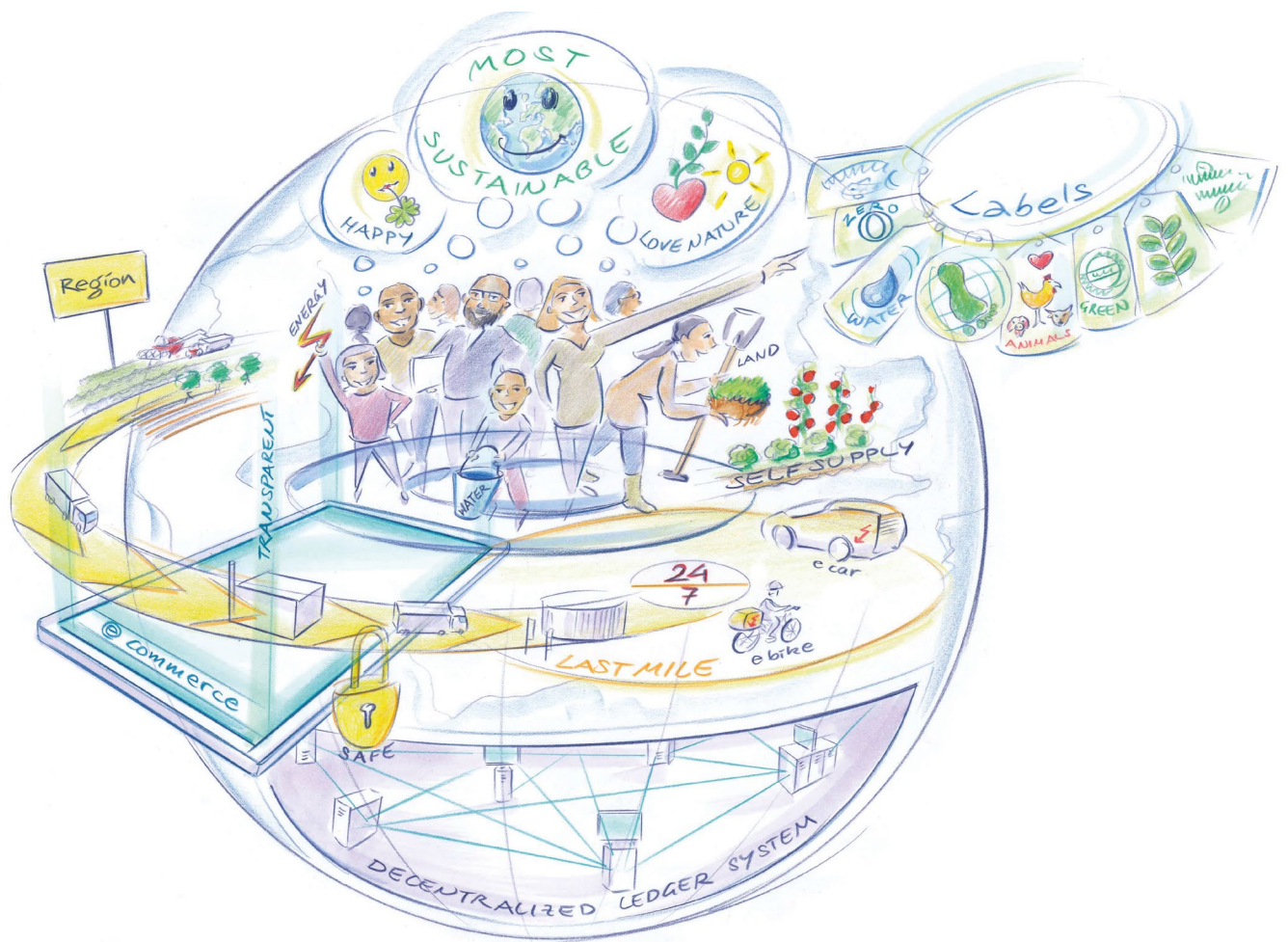
German government takes positive stock after five years of deposit system for plastic packaging and plastic traceability law

Due to the littering of the world's oceans, plastic has been badly discredited in the first two decades of this millennium. Nevertheless, plastic is indispensable in the food industry due to the excellent preservation of perishable food and the protection against pathogens in supermarkets. Many European governments had tackled the environmental problem and made great strides through strict plastic use regulations. Germany is considered a pioneer: on January 1, 2030, the German government introduced a nationwide deposit system for plastic packaging. Each plastic packaging was given a deposit of at least one euro and a substantial weight-based surcharge. In addition, the last owner of plastic packaging is clearly traceable through state-controlled tracking systems. The illegal disposal of plastic has serious criminal consequences. The European Commission announced to implement a similar system on an European level by the end of 2038.

Scenario 2

Society drives sustainability

Consumers enjoy a green and healthy lifestyle



People intrinsically live in harmony with nature and the environment and value a healthy lifestyle. They see the big picture and have learned to waive luxury. Sustainable behaviour and movements like “Fridays for Future” become a part of mainstream society.

Society has identified excessive economic growth as a key problem. The “post-growth society” is moving away from consumerism and prefers a sustainable and healthy lifestyle. Food consumption patterns correspond to the availability and requirements of a sustainable food value chain, which has a particularly positive effect on food security and safety. The role of the national government is limited, but there is still a well-organised government at the local level. The opinions and views of consumers and producers are taken very seriously. Consumers prefer regional products. They rate global food trade very critically due to the negative environmental impact for many products and the lack of information about the production conditions. Therefore, the import of exotic foods is largely avoided. Food diversity suffers as a result.

Society is happy with activities that do not require many resources because people are aware of their scarcity. Accordingly, local communities take good care of the use of natural resources such as land, water and energy. Tax benefits lead to an almost decentralised and privatised energy supply in the hands of municipalities, larger companies and private households. Consumers accept windmills and solar panels because most of them are shareholders.

People accept high food prices if food is produced in a sustainable and socially acceptable way. The demand for regional organic products is accordingly very high. They are also happy to grow their own fruits and vegetables in their own garden. Because of self-optimisation efforts, foods with healthy nutritional values are preferred. Thus, sustainability and health are crucial criteria for consumers when choosing their food.

Agricultural land is in the hand of many. Agriculture takes place in the immediate vicinity of consumers and therefore enjoys great trust in society. It is important to consumers that not only global but also in particular local biodiversity does

not suffer from food production. A high amount of food, especially fresh food, is produced within a 1-mile radius of the final customer or place of consumption. Staple foods, that can be not produced locally are still imported and where feasible replaced by regional alternatives.

The intensive contact between farmers and consumers and the local and decentralised production, which requires less storage and transport, leads to a minimal loss of food. As consumers themselves become producers, the subjective value of food also increases. Food waste is frowned upon in society. Technologies make an additional contribution to avoiding food waste. Methods that are used today in highly efficient industries such as the automotive industry are now widely used in the food industry. Data availability and AI technologies make it easy to predict demand. There are many innovative technologies and small devices that help people to optimally preserve their fresh food.

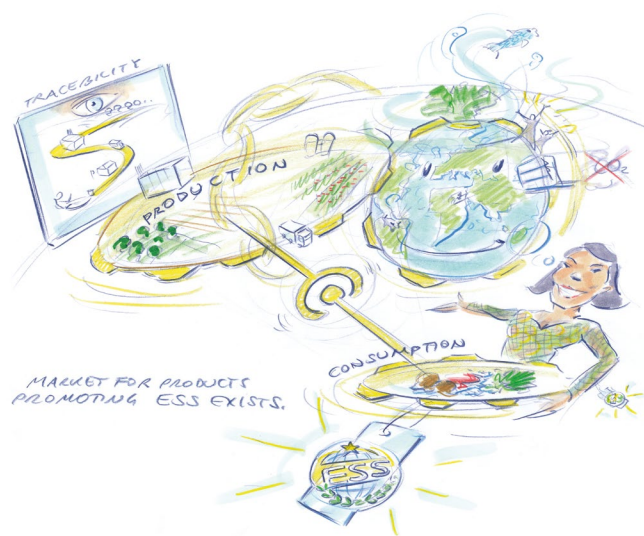
New digital technologies are used for smart decisions in single parts of the value chain. People are particularly curious about technologies that enable them to optimise their health or can pave the way for a considerate life. Therefore, new sustainable forms of food production, such as urban farming or cultivated meat, are becoming increasingly important. “Food as a Service” is integrated into the food policy of local communities. These well-organised food service systems, in which all citizens could play a role, can reduce the time spent preparing food. Decentralisation and interconnectivity are possible because data is publicly owned.

Through consistent sustainable consumption, society literally forces retailers to make their food assortment ever more sustainable. This also affects food packaging. They are reduced to a minimum, are largely biodegradable or even edible. Much of the food is bought in e-commerce stores or via e-commerce delivery. The prevailing opinion is that the food life cycle is most sustainable when all logistics are organised from one provider. Accordingly, the entire food logistics is organised by retailers. Conventional supermarkets no longer exist, they have become logistic centres. However, farmers’ markets are very popular because consumers like to buy fresh local food.

Detail description of all factors and their future assumptions in this scenario

Factor: Appreciation of products promoting ecosystem services | Assumption: Market for products promoting ecosystem services exists

Products promoting ecosystem services are in demand. Therefore, the coupling of production and consumption is working. The production of ESS friendly products follows a systemic and comprehensive approach. Direct promotion of sustainable production and the support of ESS is widespread. Ecosystem friendly products are as common as organic products. To ensure the reliability of these products, high traceability within the value chain is guaranteed. Ecosystem services are differently addressed by various products, but to simplify the communication, ESS are bundled onto one certification.



Factor: Degree of centralisation of food production | Assumption: 1-mile-rule

Almost all food is produced within a 1-mile radius of the final customer or place of consumption. Vertical surfaces and roof areas for urban gardening and farming enable cooperatives or neighbourhood associations to grow vegetables and fruits efficiently and locally. Consumers themselves are becoming producers, through 3D-printing and other new technologies; it is also conceivable that artificial meat or food can be produced in one's own cellar according to the personal, individual raw material composition. Staple foods that cannot be produced locally are replaced by regional alternatives. One example is rice, which is mostly substituted by grains (oat, wheat, rye, barley) in Europe.

Factor: Consumer decisions on food shopping | Assumption: Health and self-optimisation

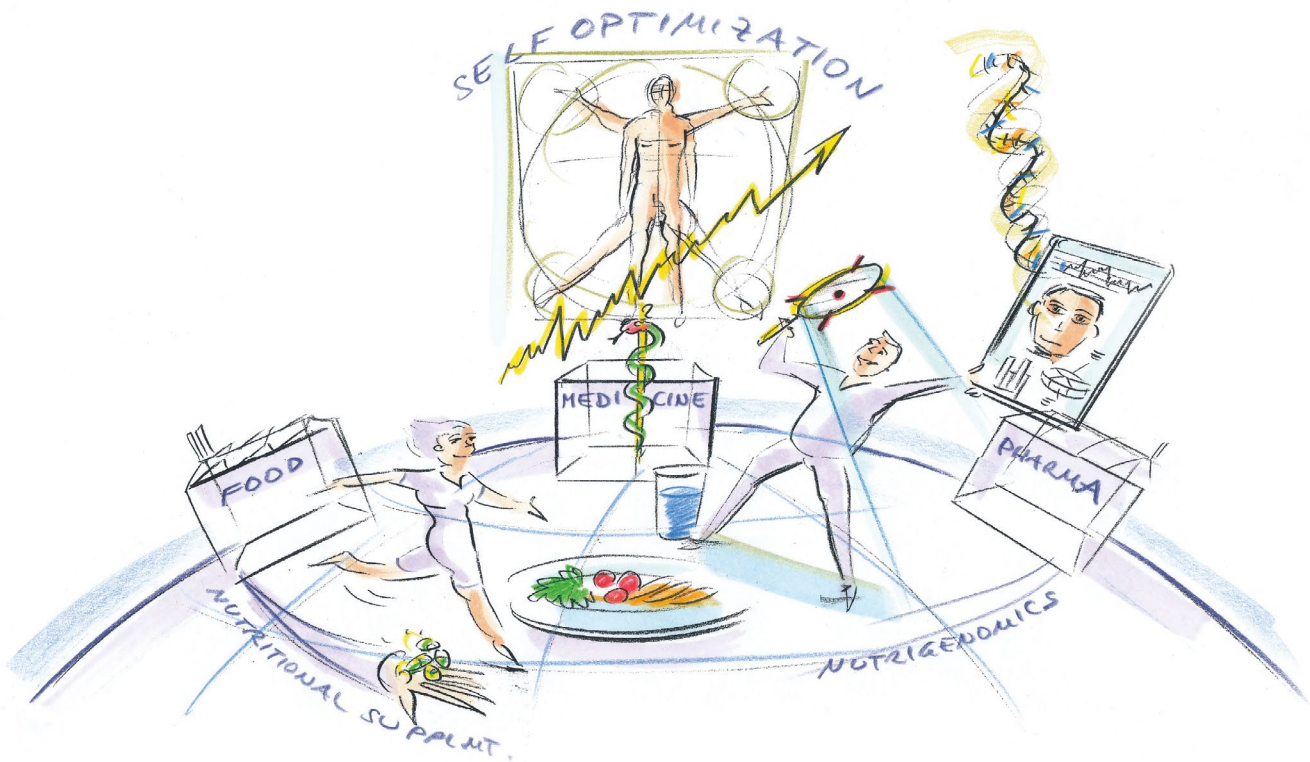
Health and self-optimisation is the key driver for consumer decisions. For the food sector, it means that functional food becomes more relevant. The food intake fulfils the purpose of self-optimisation. The food, pharma and medicine sectors are more and more merging. Nutritional supplements are in a part of almost every food product. Food and other parts of life, like sport or wellness are combined and aligned according to medical information. The pleasure of food or fine dining are no longer a selling point. Nutrigenomics, meaning personalised food according to the specific needs of the consumer have a huge market share.

Factor: Measures to reduce climate change in the food sector | Assumption: Society triggers production with low CO₂-emission

Movements like “Friday for future” have risen awareness within society. More and more people have a demand for sustainable products. This customer demand for climate-neutral food and food products is the main driving force for sustainable food production. Industry satisfies the market pull and offers sustainable food as mass product. This is working economically because customers are willing to pay a higher price for these products. The customer behaviour, however, strongly depended on income and overall welfare. Sustainable food products are therefore more in demand in highly industrialised countries.

Factor: Public and private investment in food and agriculture | Assumption: Sustainable mainly private investment

Investment in agriculture comes from diversified sources, e.g. small investment volumes are possible (crowdfunding), and various types of investors are active in the agricultural field. There is a high diversity of landowners and agricultural land is in the hands of many. Land allocation is related to the concept of societal needs. Agroforestry is attractive for farmers because they receive payments to guarantee economic viability.



**Factor: AI in the value chain | Assumption:
Use of AI at specific stages of the value chain**

Effective sensors are available and used for specific parts of the food value chain. The collected information is not shared along the different stages but remains within one-step of the value chain. Only this part (e.g. logistic) can make use of the data. This means only parts of the value chain are smart. The majority of farming processes are still analogue. Maybe there is some intelligence within the production chain but no connection in-between. This leads to some small smart islands within the entire production chain.

**Factor: Sustainability in the food sector |
Assumption: Sustainability through consumer
decision**

The consumers decide what is sustainable and what is not. The demand for organic products increases as there is a growing acceptance for higher prices. Also, self-supply by growing own fruits and vegetable increases. People are intrinsically motivated to choose the most sustainable option. Policy starts to internalise external costs making sustainable production as well as products more affordable in contrast to conventional ones.

**Factor: Growth paradigm in transition |
Assumption: Post-Growth Society**

The paradigm of excessive growth of the economy was understood as one of the core problems. Humans are now living more for happiness. They are happy with activities that do not need many resources. There is no more maximisation of money and goods. The result is a general change of society towards a sustainable and healthy lifestyle and a move away from consumerism.

**Factor: Food safety and security | Assumption:
High food safety and security through respon-
sible consumption**

The role of the government is limited in this scenario, this holds especially at the national level. At the local level, there is still a well-organised government, where the voice of consumers and producers plays a central role in deciding what to produce. This assures a variety of foods that can be grown within one mile. Local governments also organise a kind of safety plan to assure that sufficient food is available in the community during critical years. Food security is overcome because food consumption patterns follow the availability and requirements of a sustainable food value chain. Food safety is not a problem in this scenario.

**Factor: Resource availability: land, water,
energy | Assumption: Resource use as individual
responsibility**

All communities are aware of the need to be self-sufficient in food production. They take good care of the use of natural resources like land, water and energy. Some regions are disfavoured in terms of water availability or quality of the land. Solidarity between regions needs to be organised. Society is aware of resource scarcity. Tax benefits lead to an almost decentralised and privatised energy supply in the hands of municipalities, larger companies and private households. Consumers accept windmills and solar panels around as most of them are shareowners. Modern technology, very large supply networks and good policies ensure that water is always available. If private households exceed the average consumption, the unit price per litre increases considerably. Sustainability is more the main driver than resource efficiency. Therefore, a debate is on the use of land for food production, and for energy. The energy consumption decreases, as we travel less, and industries using a lot of energy are banned.

Factor: Food losses and waste | Assumption: Less food waste by consumers' conviction and technological improvement

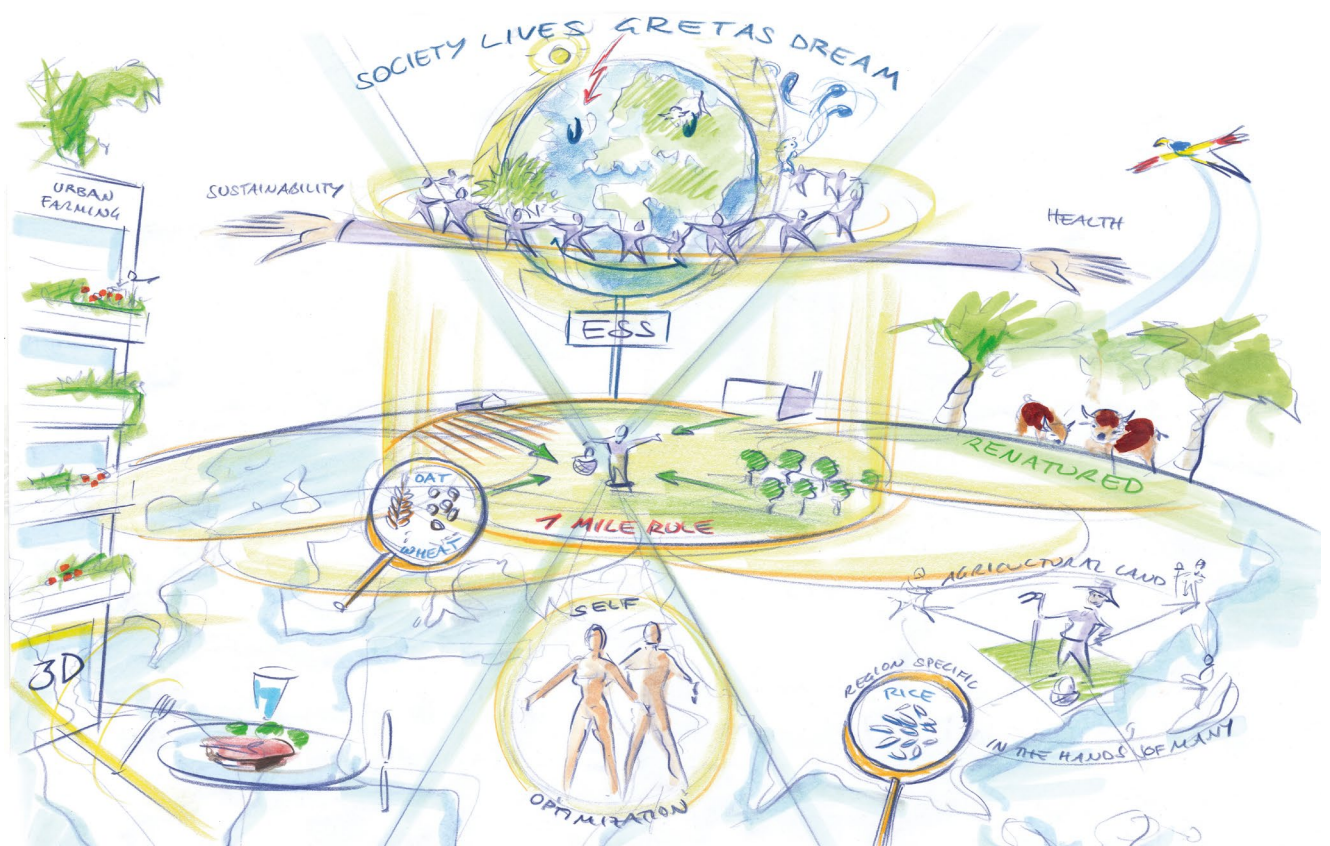
By intrinsic motivation, people will stop wasting food by themselves. It becomes very popular to consume also food that does not look perfect, such as twisted carrots or brown bananas. Food sharing becomes very popular. As a huge part of food production happens locally and therefore requires less storage and transport, food losses and waste are markedly reduced. As consumers are also becoming producers on their own, the subjective value of food increased. Citizens monitor their own food consumption and energy use. This may have a positive impact on over-consumption and contributes to waste reduction. Raw materials are expensive and valuable. Food loss and waste in production are gone, as the consumers and society do not accept spoiling food anymore. This pressure and the high price of raw materials makes the companies move: Methods used in highly efficient industries such as the automotive sector are now also widely applied in the food industry. A machine runs 100% during schedule due to data analytics. TPM (Total Productive Maintenance) assures the right level of care to have 100% availability. The lifestyle of health and sustainability (LOHAS) and the preference for highly personalised nutrition make FLW a topic of much bigger concern for the entire value chain and society. Food waste is a sin. The consumer is again moving very close to agriculture and production and identifies with it. People experienced after Corona some pandemics that have even be much worse and they understood that food and nutrition are elementary to survive. Every apartment, houses, even rented flats have access to urban farming, land shared with others or greenhouse-boxes in large cities. All children learn in school how to cook and preserve food, as well as how valuable food is. Plenty of innovative small-scale technologies and devices are around everywhere to help people to preserve their food that is not consumed freshly. Ideally, local production (within 1 mile) with a lot of contact between producer and consumer will result in minimum food loss and waste. Due to AI and data availability, the prediction of demand is quite simple. With digitalisation and tracking systems being well established, FLW information from farm to fork is readily available but is only used for efficiency management along the chain.

Factor: Quality and quantity of labels | Assumption: Sustainability labels on the rise

Given the increased importance of self-optimisation, health-related labels remain. NGOs implement labels curated such as WWF label for some retailer brands. There are new green labels and quality goes in the direction of sustainability (social, economic and environmental). Life Cycle Assessment is compulsory for many products and the environmental footprint is part of the information on products. Each community may have its own standards, depending on the local preferences and beliefs. This implies a lot of difference in food quality and quantities produced across regions. The consumers love labels and prefer those showing the food is coming from their neighbourhood or are produced in a very sustainable way. Farming and processing are under critical deep review. Large food producers can apply for a zero-waste and zero-emission logo that is awarded by an official body in each country. Without at least one of these labels, it is very difficult for large food producers to survive. The majority of the food is healthy and ecologically acceptable.

Factor: Packaging of food | Assumption: Bulk stores on- and offline

Consumer prefer to buy products with no or just few packaging. Bulk stores are very common and sell almost every food item unpackaged. The sale of unwrapped goods e.g. large containers are an ecological and resource-saving alternative to disposable packaging. Therefore, customers who want to shop at bulk stores bring their own containers. Another available option is for the store to let customers borrow their containers, which can be returned during the next transaction. This option usually requires the customers to pay a certain amount of deposit that will be reimbursed when the containers return.



Factor: Online grocery shopping | Assumption: E-commerce stores dominate the sale

Logistics innovate completely: LCA and footprint differentiate e-commerce, e-companies, food products and farming systems. All food is purchased in e-commerce stores or by e-commerce delivery or picked up as it has been figured out that food delivery is most sustainable if the logistic is organised completely from point of production to the household. This is especially interesting when combined with the factor of less packaging and bulk stores. Total food logistic is organised by the retailer, by the support of AI, by e-bikes and e-cars to deliver the last mile, by food lockers cooled if needed and accessible 24/7. Supermarkets do not exist anymore; they became logistic centres. However, farmers' markets are very popular as consumer love to buy fresh local food. New green labels managed by the e-companies are introduced.

Factor: Ownership of Data | Assumption: Data owned by the public (open data)

Public awareness for data allows the use and storage of big data on the one hand and ensures a responsible use on the other hand. Data like new green parameters are collected by satellites and drones. A high degree of interconnectivity along the value chain enables the intensive use of AI. Blockchain technology works by using a decentralised ledger system.

Factor: Balance of power within the value chain | Assumption: Digitalisation empowers consumers

With their purchasing decisions, people contribute to respecting human rights, conserving resources or protecting the climate. With their consumption and living habits, consumers can have a lasting influence on the range of goods on offer and thus on the market. Examples from the past show how consumers can exercise power through their purchasing decisions. For example, organic foods have made the leap from niche existence in health food stores to supermarkets and even discounters because of increasing demand. On the one hand, sustainable shopping means taking responsible care to ensure that ecologically and socially safe products end up in the shopping trolley. On the other hand, sustainable shopping also means buying from companies that take their social responsibility seriously – companies that treat their employees appropriately, pay attention to energy efficiency or ensure that their products are manufactured in an environmentally and socially responsible manner. At this point, transparency and traceability of supply chains are essential and are ensured by appropriate labels (see factor Quality and quantity of labels).

Factor: Society's attitude towards new technologies | Assumption: Technologies directly serve social demand and are therefore widely accepted

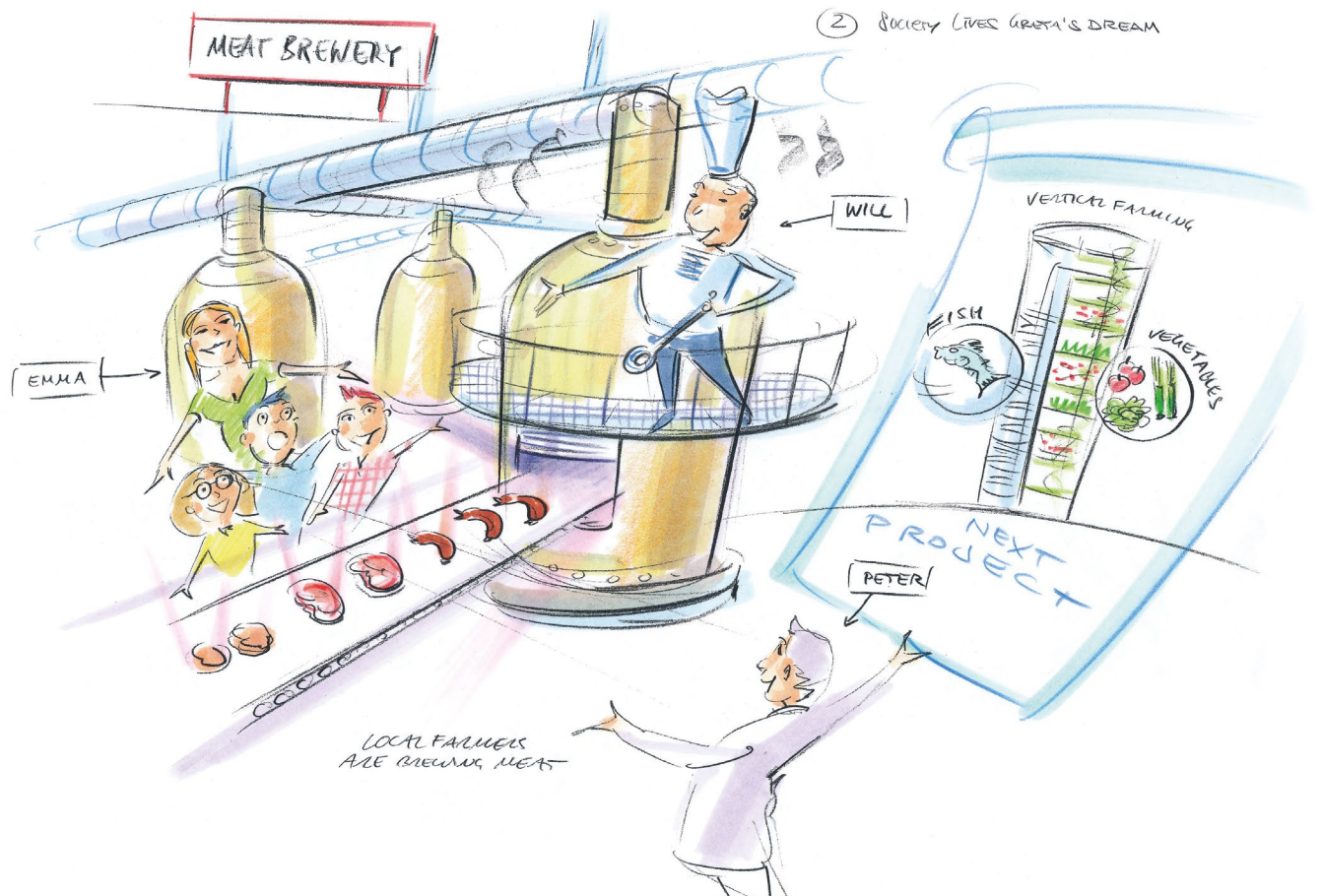
Consumers accept new technologies, but only if they meet their demands, e.g. a sustainable production and allowing for health- and self-optimisation. People are also willing to pay more for food products manufactured with such technologies. The driver is the argument about energy saving. A new technology becomes interesting the more energy it can save. Transparency is the key here. The use of new plants and new material for CO₂-sequestration increases. Genetics is only applied if it is in the interest of biodiversity. Farming and processing controls are centralised.

Factor: Platforms and "Product as a service" in the food sector | Assumption: Platforms to support sustainable and efficient food

Actors in the food chain are very well connected in order to make optimal use of the benefit that can be created by offering food services instead of just food products. Food actors also cooperate closely with local entrepreneurs for e-commerce and logistics. Food as a service is integrated into the communities' food policy. Citizens reduce the amount of time spent in preparing food by a well-organised food-service-system in which all citizens have a role to play. Exchanges of big and local data increase as well as mapping territorial green policies on reforestation. There are new green values in supply.

Future story

Local farmer brew meat



Emma (35) is a teacher at a primary school. Today, with her fourth class, there is an excursion to farmer Willi (60) who runs a high-tech farm on the outskirts of the city. The tram ride, which lasted only ten minutes, went smoothly. Willi welcomes the children to the heart of his farm, his meat brewery. The children look at four giant bioreactors and a conveyor system that transports the freshly brewed meat from the farm's hygiene area. They eagerly await what Farmer Willi has to tell: "Fortunately, ten years ago, I realised very early that my cattle breeding, which was geared for efficiency, had no future. The demand for meat from factory farming had decreased massively – yes, I was even outlawed for my work. So, I took a huge step forward at that time. I was the first farmer in Europe to invest in a meat brewery in 2025. Today, ten years later, I can supply my beef all over our city. I am lucky to be able to make a hugely positive contribution to our environment. Many farmers across Europe have taken me as an example.

My son Peter (30) also wants to continue on the path chosen. Together we plan to expand our business area. As you may have seen on your arrival, there is a large construction site next to my brewery. A 30-meter-high building will be built there to be used for vertical farming and aquaponics. In the future, fish and vegetables from Willi and Peter will also be available at the "Neighbourgoods Market", our weekly grocery market at the old slaughterhouse. We will successively renature our huge arable land, which I still needed a few years ago to produce animal feed. In a few years, we would like to settle bison on these areas, which can live almost independently in the newly emerging mixed forests. By doing so, our company could also be successful in the premium meat segment. Then, when you are in my age, you can go for a walk in our forest or at our pasture and with a little luck you can see our happy herd of bison.



Janne Korhonen



Helsinki

92 yo Finn trying to become the oldest person on earth

#followyourdreams
#healthyaging
#foodenthusiasm

Latest Tweet · August 25, 2035

Janne Korhonen · @Janne Korhonen · 1,4 Mio. Follower

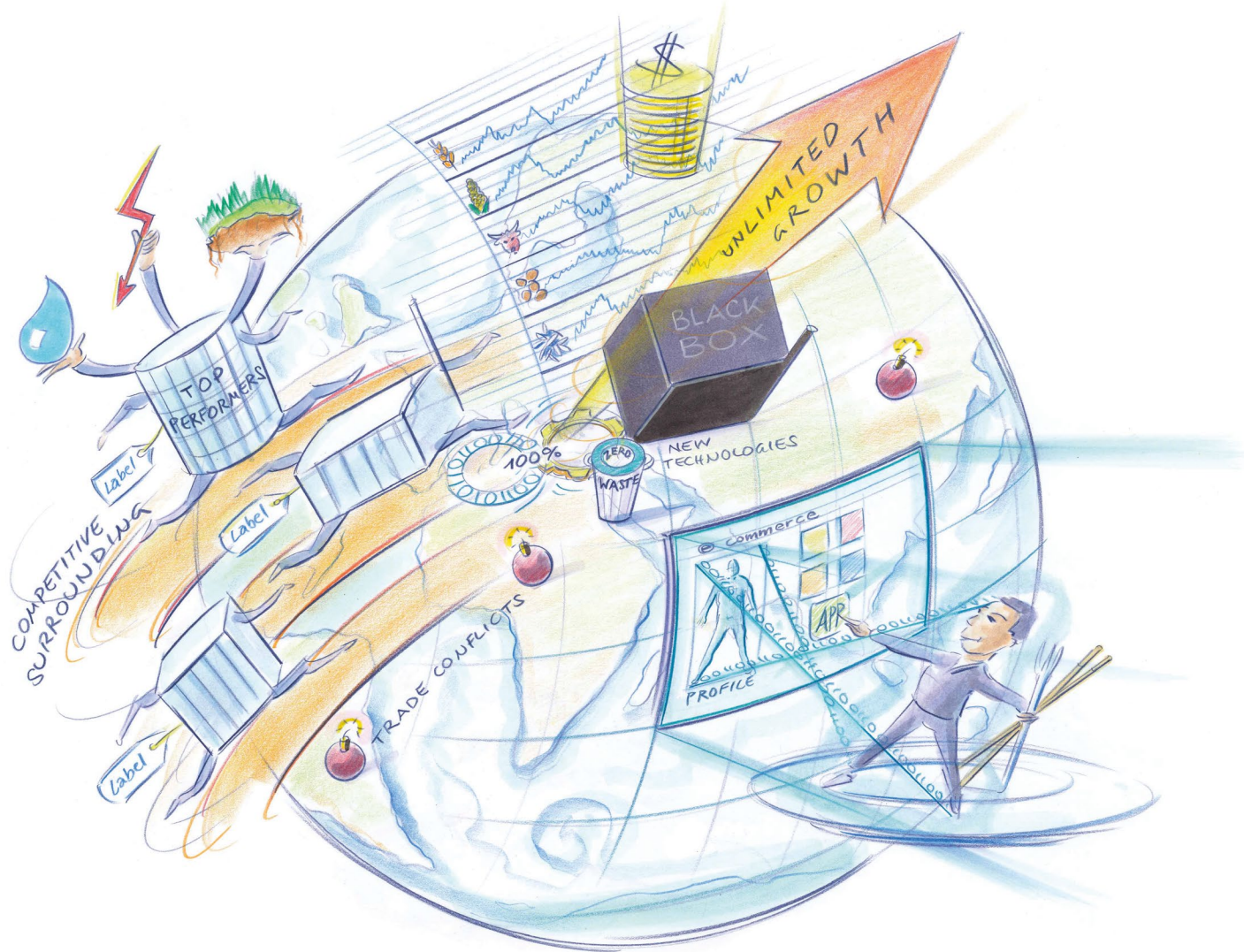
❤️ **Super happy** – today I did the **#HelsinkiMarathon** in less than 4:30h! I thank **#science** for the progress on the field of **#nutrigenomics**. Without the right **#individualnutrition** that would never have been possible. Looking forward to some relaxing days now! Take it easy, Janne

Social Media Post 2035

Scenario 3

A CO₂-currency and retailers dominate trade and consumption

In a globalised world, markets and technologies ensure prosperity for top performance



High-specialised global markets rule the world. The social attitude is: People acting in their self-interest also advance the common welfare. The key to overcoming global challenges is not social change but dynamic technological progress. The growth paradigm, deeply rooted in society, and the focus on new technologies lead to the very competitive surrounding. In the economy, unlimited growth is the main driver and profit maximisation is the overarching goal of most companies.

Large retail and sales groups dominate the food industry. Retail and sales, therefore, have the largest profit margin. E-commerce, which is mainly in the hands of the big box retailers, also increases the sales share of retailers. Since retailing via e-commerce has proven to be significantly less expensive than operating large supermarkets, the majority of groceries are sold online. The consumer's purchase decision is mostly made online anyway, because flexibility is the crucial criterion for consumers when choosing their food.

Retailers have sovereignty over information and can thus design the completely digitised value chains in their favour. The data sovereignty of retailers makes the customer transparent. As a result, retailers understand general buying behaviour, know all of their customers' preferences and expectations, and can make individual buying offers to each customer. The profiling of consumers is a core element of foodservice platforms. Food services are a booming business. On a global level, actors who develop food services inspire everyone else.

Agriculture has to become more and more efficient so that it remains economical. The resulting profit-oriented land use leads to soil degradation. Furthermore, biodiversity suffers greatly from the farming of huge, highly efficient monocultures and is only preserved in designated areas worldwide. There is general support for technologies that enable the efficient production of food. These technologies are validated by global e-retailers. Agricultural and processing technologies are therefore subject to global standardisation and harmonisation, which is often not transparent to consumers and additionally, reduces the rate of innovation. Due to the global food trade, consumers can enjoy a wide variety of foods. However, despite new technologies and high standards,

it is not possible to guarantee safe food because global trade focuses on very cheap food. The price pressure is so high that there are low-quality products or even unsafe products in the food chain. Food security is also a problem: global scarcity leads to trade conflicts. Some regions are being exploited. The power of national and local governments is limited and overruled by multinationals and supranational organisations. They are also the ones who decide on the use of land, water and energy. Politicians only set minimum standards that vary from state to state. Multinational companies are aware of the need for biodiversity and know the consequences of global warming. Therefore, they also see the need to invest in protected areas and to preserve natural habitats. Basically, companies are interested in good and sustainable developments as long as it serves the aim of guaranteeing profits.

Climate protection still takes place, but not out of intrinsic conviction, but rather to prevent personal disadvantages. A waiver does not matter to people – sustainability is priced in for all products in the form of a CO₂-price. Retailers use sustainability as a business model and have recognised that offering sustainable products can strengthen their core business. They, therefore, like to use the concept of sustainability as an advertising purpose. Labels are gradually disappearing from products as they become too complex and industry has found new digital solutions that help consumers choose the product they want or need. Food packaging can therefore also be reduced to a minimum.

The large-scale industrial processing of food helps to reduce food losses since processes for side streams can be applied very efficiently. Thus, food waste is also a valuable part of the circular economy because the resources required to produce a product are scarce and expensive. As a result, a circular economy is the new paradigm to follow. New technologies also make it much easier to reduce food waste. Methods that are used today in highly efficient industries such as the automotive industry are now widely used in the food industry. Regardless of what is produced, predicting demand is fairly simple due to AI and data availability. Intelligent technologies in households and communities have replaced the previous waste system.

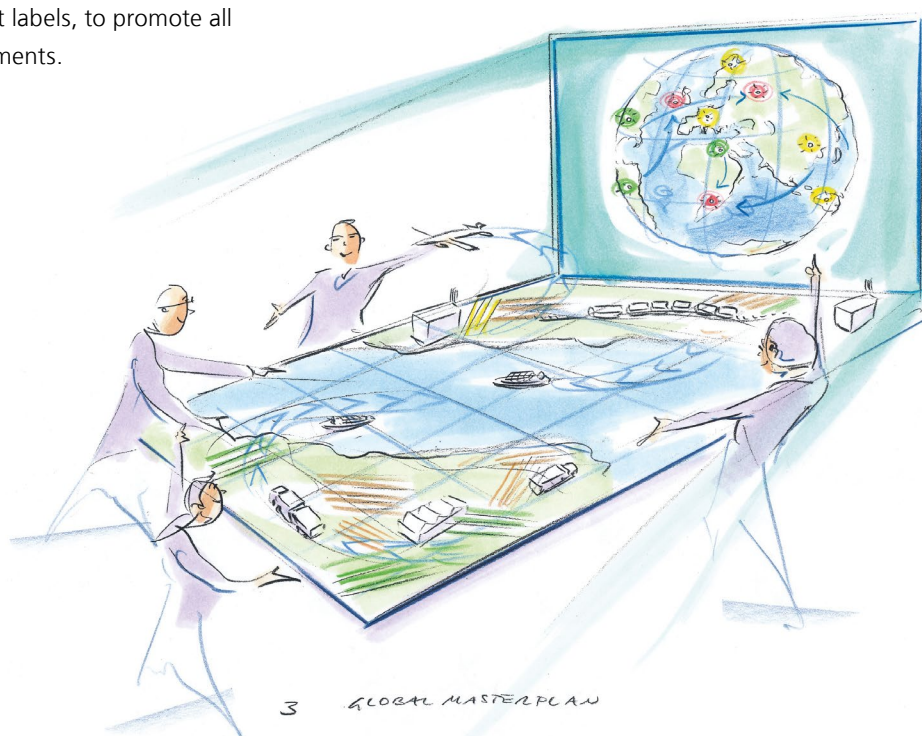
Detail description of all factors and their future assumptions in this scenario

Factor: Appreciation of products promoting ecosystem services | Assumption: Products promoting specific compensation payments preserving ESS

The production of food and the provision of ecosystem services does not occur at the same place. Although there is an awareness that ecosystem services need to be supported and consumers have a willingness to pay more for ESS friendly products, the production of food is not directly linked to the provision of ESS. Rather, money is spent on measures to promote ESS in other places. An example of this spatially decoupled approach is the willingness to pay more for certain products, which do not foster the provision of ESS on or close to production but spending the additional money on the preservation of forest in South America (remote protection of ESS). There are many different labels, to promote all different kinds of compensation payments.

Factor: Degree of centralisation of food production | Assumption: Centralisation and specialisation of agriculture

An international masterplan is organising and monitoring global food production. Every country is producing what it does best, not only for itself. This leads to huge “agricultural Mega-Factories” that fully exploit the specific cultivation conditions. Fresh goods (fruits, vegetables) are produced in highly efficient and highly specialised production sites. This worldwide division of production requires global trade and sophisticated logistics. Countries coordinate who produces which products at what time in order to be able to react to the changing global demand.



Factor: Consumer decisions on food shopping | Assumption: Food on the go

The traditional way of food consumption does not exist any longer. Classical habits like three or four meals a day at regular times are replaced by more and smaller in-between meals. This development is described with the term “snackification”. The rhythms of our everyday life are structuring the mealtimes and our eating habits. This means more flexibility, more mobility since work, education and spare time are increasingly merging. This influences where we eat and when. App-based delivery services, which provide very fast and highly varied meals are replacing traditional food retailers since viewer meals are prepared and eaten at home. Health and price arguments are not, or very few influencing consumer decisions.

Factor: Public and private investment in food and agriculture | Assumption: Profit driven private investments

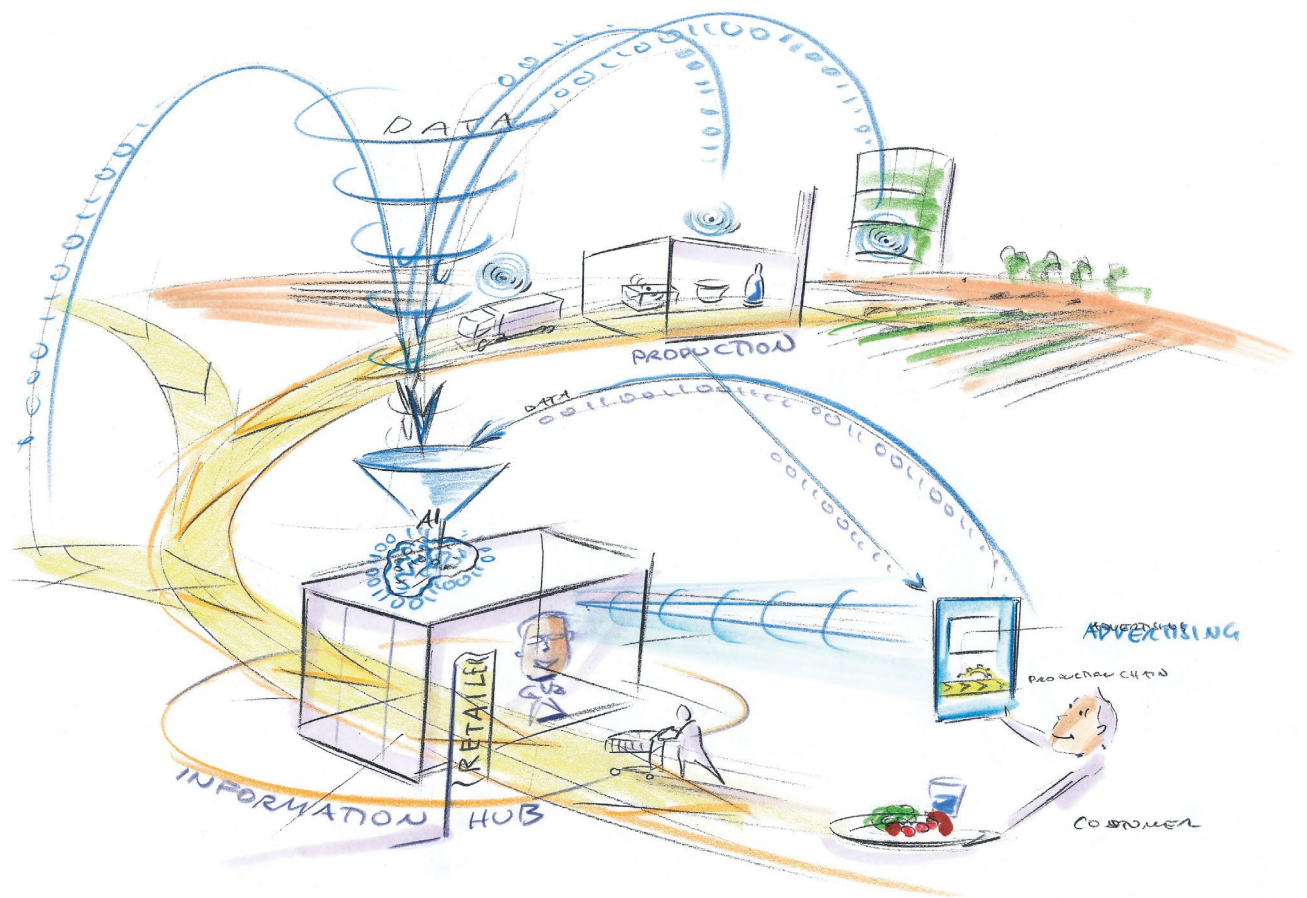
There is a conflict of interest between consumer and producer. There are no climate change mitigation measures in place. Biodiversity measures are neither taken nor would they be rewarded. “Land grabbing” expands dramatically, only a few players own the majority of agricultural areas. The profit-driven land management leads to desolation of the grounds (e.g. soils are not covered with vegetation layers for a significant time of the year); more and more products have to be imported. A significant amount of area is used for the bioeconomy and related biorefineries rather than food production. High yielding monocultures predominate, which leads to the loss of cultural landscape.

Factor: Measures to reduce climate change in the food sector | Assumption: CO₂-emission is new currency

The governments of all UN-countries agreed on a CO₂-emission currency. This currency gives every product and every service a second price, additional to the price expressed in monetary terms. Both prices, the usual one and the emission price have to be paid when purchasing a product or service. This “CO₂-price” is based on the CO₂-emission and calculated by a Life Cycle Assessment approach. Every citizen has a certain amount of CO₂-emission per year but can trade this contingent like money. Companies (seller) like food producers receive not only the money but also the CO₂-price from the customer and can spend it on food production. During food production, all resources like water, fertiliser or fuel, have required the payment of money and CO₂-price as well.

Factor: AI in the value chain | Assumption: Retailer is information hub

Retailers act as information hubs, meaning they collect data from the whole value chain as well as from the consumers. They have the most information and are the players that can use AI most efficiently. Sensors in every part of the production chain collect data about production, processing or packaging. This information is transferred seamlessly towards the retailer. In the other direction, however, no information is given (one-way flow of data). Retailers and sales become smart because they can use big data for intelligent pricing, smart stocks and customised advertising. From the customer perspective, there is access to most information throughout the production chain.



3 RETAILER IS INFORMATION HUB

Factor: Sustainability in the food sector | Assumption: Sustainability as business model for retailer

Retailers have realised that offering sustainable products will strengthen their core business. They use their power in pricing to promote sustainable products by making them affordable because they realised that destroying their basis of success (a stable and secure agricultural system) will cause massive problems in future and will harm their business. Some retailers see sustainability more as an advertisement and as a by-product. Their focus is on optimisation of profit and cheap food. Therefore, there is no real contribution to sustainable food for all.

Factor: Growth paradigm in transition | Assumption: Unlimited growth

Growth is still one of the main drivers and objectives of the economy. Consumers still may enjoy a variety of food products, which is the result of an equilibrium of different forces. There is a total focus on maximisation of profit and money, therefore a strong paradigm of growth that leads to the empowerment of the biggest. This results in a huge disparity among countries and humans in individual countries.

Factor: Food safety and security | Assumption: Low food safety and security

Due to global exchange and focus on very cheap food – despite new technologies and high standards – it is not possible to ensure safe food. The reason for this is that the price pressure is so huge, and the availability is low. Therefore, low-quality products or even unsafe products are in the food chain. Security is a problem as well. Global scarcity leads to trade conflicts (or even worse), exploitation in many regions has grown worse. The power of national and local governments is limited and overruled by multinationals and supranational organisations. Both supranational organisations (like the UN) and food multinationals set the scene for food production and food trade.

Factor: Resource availability: land, water, energy | Assumption: Resources managed by the industry

The multinationals and supranational organisations decide on the rules for the use of land, energy and water. Multinationals are aware of the need for biodiversity and know the consequences of global warming. Hence, they also see the need to invest in forestry and the need to stay away from natural habitats. They invest in clean water, precision farming and renewable energy. Retailers will push for technological solutions, e.g. reuse of water when growing vegetables or generating energy from food waste. Companies are global players and the shares of their companies are traded in the Global Eco Index, which is subject to special rules (e.g. forward contracts are not allowed, etc.). In principle, the companies are interested in good and sustainable developments, but profits are also important, and especially the population in countries with corrupt governments suffers. Policy and governments only set the minimum standard, which differs from state to state.

Factor: Food losses and waste | Assumption: No food losses due to specialisation and reuse

The entire recycling industry has grown extremely fast, food waste has now a price and each major food producer has its own business unit dealing with food preservation and recycling. Smaller producers have outsourced this part. By this, new business raise like re-food companies selling bioactive peptides or proteins extracted from food leftover. The large industrial processing of food in this scenario contributes to the reduction of food loss and waste, as with central production, you can also develop processes for side streams. From a societal impact, the retailers reduce food waste, but also see the importance of producers and consumers as other actors in the chain. Smart technologies in households and in communities replace the former waste system.

Factor: Quality and quantity of labels | Assumption: Labels made by retailers

Labels disappeared from products as they become too complex and the industry found new digital solutions to help the consumer choose the product they want or need. Retailers enforce their own sustainability labels. Especially for their own brands, there is increasing cooperation between retailers and agricultural associations (like Lidl & Bioland, Kaufland & Demeter). Labelling schemes go hand in hand with retailers and food producers, providing a competitive environment and enabling presentation where they are better than other companies. Consumers have limited information about the quality and background of foods. Actually, they do not need these, because food selection is based on the trust towards the selected supplier of food.

Factor: Packaging of food | Assumption: Packaging only where absolutely necessary

Retailers have replaced materials such as plastic by more sustainable alternatives and use more and more bulk assortments. They increased their engagement in recycling, maybe also by setting up their own business area such as Greencycle.

Factor: Online grocery shopping | Assumption: Pervasive e-commerce in the hands of the big box retailers

The turnover of retailers grows by e-commerce. Retailers understand the overall buying behaviour, know all the preferences and expectations of their customers and can make individual purchase offers to each customer. Since distribution by e-commerce has proven to be much more cost-efficient for retailers than running large supermarkets, the majority of food is sold online. Thanks to the transparent customer, retailers can optimally present their products, e.g. offers for specific groups in specific regions on different days to optimise their supply chain. With the biggest profit margins on their part, a very few remaining brands of big-box retailers dominate the distribution of foodstuff. They control the chains from field to fork by directly trading with the food production level in the chains. Global e-companies are market leaders and drivers of consumer choices on e-retailers branding and prices. The purchase decision is mainly done online, and several apps are available from a big retailer but also from independent brokers helping the consumer to make a choice; apps have sophisticated filter systems so that almost any product can be found according to consumer wishes. Depending on the consumer, some prefer retailers' apps (best prices in most cases) or apps from an independent broker (much broader product variety).

Factor: Ownership of Data | Assumption: Retailers own the data

Retailers and e-commerce platform invest many resources in gaining, storing and analysing data. The data is not coming only from consumer platforms but from all steps of the food value chain. Retailer have therefore the power to manage the whole food systems by the end. There is little regulation by policy, but industry associations impose certain rules on themselves to prevent data misuse that would harm the industry in the long term.

Factor: Balance of power within the value chain | Assumption: Market power of retailers

Large retail stores and discounters have mostly replaced the traditional offer structure of small food retailers. This led to a shift in power from consumer goods manufacturers to retailers, as retailers control the main distribution channels. This gatekeeper function enables them to influence prices, quality, range, and production conditions. The advent of e-commerce in the food sector is putting retailers under pressure to keep their power as new players like Amazon try to establish themselves in the food sector. E-commerce enables direct delivery to customers without retailers. While the rapid expansion has been temporarily halted, electronic food retailing will continue to play an important role in the food supply. New players and start-ups emerge and form partnerships with established companies.

Factor: Society's attitude towards new technologies | Assumption: General support for technologies managed by industry, but no knowledge about the technologies

There is general support for technologies allowing for efficient food and large-scale production in a particular country. Harmonisation and global standardisation of farming technologies and processing technologies increases. However, there is less transparency as there is barely information on food chain operators for consumers. Furthermore, there is price competition on tech inputs and a reduced innovation rate.

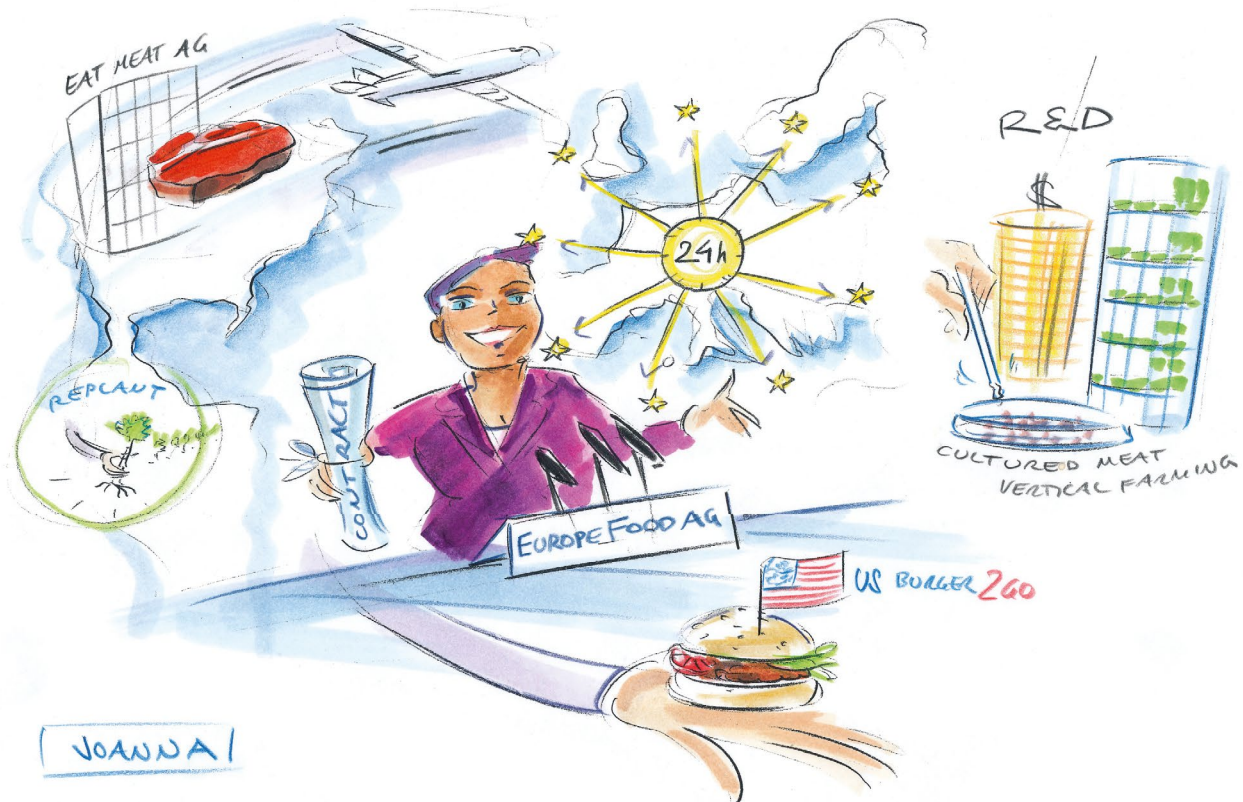
Factor: Platforms and "Product as a service" in the food sector | Assumption: Food service platforms as a booming business

Food services is a booming business at the global level and actors, developing food services inspire each other. In addition, monitoring systems, such as biomarkers, become popular. Global competition rules in data management. Accessibility and interconnectivity are a priority.



Future story

Globalisation offers huge food variety



Joanna (55) is the successful CEO of Europe's retail giant EuropeFood SE and is one of Europe's highest-paid managers. Now she is making public what has been going on over the past few weeks: The deal with the US-based EatMeat SE, the world's largest producer of beef. From now on, five cargo planes will land at Schiphol airport (Amsterdam) fully loaded with US beef every day. Her press statement:

"Today is an important day for all of Europe. Europe's population can now look forward to the world's best beef quality from the USA. Highly efficient logistics ensure that the meat is available in all shops of EuropeFood SE less than 24 hours after slaughter.

EuropeFood SE is aware that the logistics behind this achievement are associated with climate and environmental impacts. For this reason, the entire management team has spoken out in favour of setting up a climate protection program to replant the South American rainforest. In addition, further investments are made in R&D of sustainable alternative forms of food production like vertical farming or cultured meat technology.

This is a call to all European citizens: Look forward to our fresh "US-Burger2GO" for example on your next business trip! You can get it freshly prepared in all major European train stations in our fast food restaurants EatFix. And don't worry: We still guarantee the maximum waiting time of 3 minutes... because nobody wants you to miss your train! Enjoy!"

To: CEO@europapasta.it
CC: CEO@europefood.com

!!! Highly sensitive information !!!
SUN 5/24/2035 08:14 AM

Dear Francesca,

I received information from a subsidiary in Milano that the heat will have a firm grip on us in the days to come. The temperatures can rise up to 40 degrees; in any case, they will jump well above the 35-degree mark. Nevertheless, due to panic buying, our AI-based forecasting tool already predicts an up to 200% increase in demand for pasta for the next few weeks. People will fear repeated supply shortages. Please prepare your company urgently and make sure that raw goods are ordered from your producers at an early stage. As Europe's best retailer, we cannot afford the bottleneck on the supermarket shelves that we had 15 years ago. Our customers trust in our reliability and we trust in your ability to deliver!

Best,
George

Head of Supply Chain Management · EuropeFoodAG · Europe's No.1

E-Mail 2035

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External Experts

Assoc. Prof. (FH), DI, Dr.-Ing. Simon Berner

Sustainable food management, University of Applied Science
Graz

Prof. Dr. Fabian Christandl

Dean of study program business psychology, Hochschule
Fresenius – University of Applied Sciences Cologne

Dr. Mehmet Cicek

Managing Director, symvion Food Innovation Services GmbH

Axel Davila

Principal, Staufen AG

Prof. Dr. rer. nat. Markus Frank

Professor for Plant Health Management, Nuertingen-Geislingen
University

Prof. Dr. Vural Gökmen

Head of Food Quality & Safety Research Group, Hacettepe
University Ankara

Dr. Bruno Gransche

Research Associate, Institute of Advanced Studies FoKoS,
University Siegen

Prof. Dr. Tilo Hühn

Lead of the Centre for Food Composition and Process Design,
ZHAW Zurich University of Applied Sciences, Winterthur

Prof. Dr. Carolyn Hutter

Professor for Business Administration Food Management,
Baden-Wuerttemberg Cooperative State University Heilbronn

Dr. Daniel Rossi

Delegate in Research and Innovation, Confederation of
Farmers (Confagricoltura), Rome; Chairman Copa Cogeca
Research & Innovation Working Party

Prof. Dr. Stephan Rüschen

Director of Studies of Business Administration – Retailing,
Baden-Wuerttemberg Cooperative State University Heilbronn

Ass.Prof.i.R. Dipl.-Ing. Dr.nat.techn. Gerhard Schleining

Retired, University of Natural Resources and Life Science
Vienna

Declan Troy

Assistant Director of Research, Teagasc Food Research
Centre Dublin

Prof. Chibuike Udenigwe

University Research Chair, School of Nutrition Sciences,
University of Ottawa, Canada

Imprint

Contact

Dr. Björn Moller
Phone +49 721 6809-427
bjoern.moller@isi.fraunhofer.de

Fraunhofer Institute for
Systems and Innovation Research ISI
Breslauer Strasse 48 | 76139 Karlsruhe
Germany

www.isi.fraunhofer.de

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Authors

Björn Moller, Ariane Voglhuber-Slavinsky, Ewa Dönitz,
Fraunhofer Institute for
Systems and Innovation Research ISI

Coordination of the FOX-project

Kerstin Pasch, Project coordinator,
DIL Deutsches Institut für Lebensmitteltechnik e. V.

Ariette Matser, Scientific coordinator,
Wageningen University & Research

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