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Scoping study
Delivering on EU food safety and nutrition in 2050 - Scenarios of future change and policy responses

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Final Report

Submitted by:

Food Chain Evaluation Consortium (FCEC)

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Content

1. Executive summary

This scoping study on 'Delivering on EU Food safety and Nutrition in 2050 - Scenarios of future change and policy responses' was commissioned by the Directorate General for Health and Consumers (DG SANCO) of the European Commission. It was led by Civic Consulting of the Food Chain Evaluation Consortium (FCEC), and implemented with inputs from consortium partners Agra CEAS Consulting and Arcadia International. The objective of the study was to identify the critical challenges to the EU food safety and nutrition framework, their future evolution up to 2050, their impacts on its current structure and the potential critical changes to the current framework necessary to maintain the prevailing high standards. The intention was to provide insight and guidance for the development of future policy response scenarios and future analysis and research necessary for their development. The study is based on three stakeholder and expert workshops conducted between May and December 2013, a driver identification process, an extensive literature review, expert interviews, and a large-scale consultation of stakeholders and experts. This executive summary describes the key drivers of food safety and nutrition identified, presents the scenarios developed on the basis of an innovative and participative approach, summarises the results of the stakeholder consultation, draws conclusions on how high levels of food safety and nutrition can be safeguarded in the future, and finally indicates related research needs.

1.1. Scenario-building approach

In line with best practices, during the first stage of the study, key drivers of food safety and nutrition in 2050 were identified, as well as related uncertainties surrounding their future evolution. Briefings were produced for each of the drivers, detailing relevant trends, uncertainties and projections on their future evolution (see Section 3 for a detailed overview by driver), which were then refined and validated at the 1st workshop that took place in the context of this study. These drivers are outlined in the table below.

Table 1: Overview of drivers, trends and uncertainties identified

Main driver	Trends and uncertainties identified
Global economy and trade	• Globalisation of trade in food and feed • Increasing number of countries covered by free trade agreements • Emerging economies exporting more high added-value products & engaging in standard-setting • Global economic development • Increasing and more volatile food prices • Increasing pressure on public finances from financial and expenditure on health and pensions
Global cooperation and standard setting	• Increasing cooperation in setting standards for safe food • Increasing cooperation in international fora, information and early warning systems • Increased relevance of private food standards • Increased reliance upon multilateral structures, challenges from increasingly multipolar world

Main driver	Trends and uncertainties identified
EU governance	• Further EU enlargement, potentially coupled with further market integration • Continuing reform of the Common Agricultural Policy (CAP) • Continued consolidation of the food safety and nutrition legislative framework • Continuing challenge of ensuring enforcement • Rise in importance of communication concerning food safety and nutrition
Demography and social cohesion	• Increasing global population • Aging, more chronic illness-prone EU population • Increasing migration flows • Increasing inequality
Consumer attitudes and behaviour	• Increasing global demand for meat • Diversification and polarisation of diets and lifestyles • Increasing prevalence of obesity • Intensifying consumer values in relation to food • Increasing concern about risks related to food safety and food chain inputs • Stagnating levels of trust in public authorities in the EU
New food chain technologies	• Expected increase in the use of biotechnology and GMOs • Increase in productivity from other primary production technologies (e.g. aquaculture) • Expected increase in the use of nanotechnology • Increased medicalisation of food and new forms of food • Increased use of information and communication technologies (ICTs) • New processing and packaging technologies
Competition for key resources	• Increasing demand for non-renewable energy sources • Increasing scarcity of fertile soils • Increasing pressure on fresh water resources • Increasing scarcity of phosphorus for fertilisation • Diminishing biodiversity, genetic diversity, and ecosystem services • Increasing difficulty in supplying animal proteins sustainably
Climate change	• Rising temperatures • Changing precipitation patterns • Changing agricultural productivity according to species and regions • Emerging biological threats • Increasing 'environmental migration'
Emerging food chain risks and disasters	• Increasing risk of disease transmission from animals to humans • Environmental pollution and contaminants spreading through the food chain • Unintended consequences of food chain technologies • Wider possibilities for bioterrorism and sabotage • Continuing risk of neglect and failure of food safety mechanisms
New agri-food chain structures	• Industrialisation of agriculture, from small-scale and subsistence farming to large agri-businesses • Increasing concentration and integration of food chain industries to achieve economies of scale • Reduction in the agricultural labour force • Increase in organic farming • Increasing importance of regional, local and alternative food chains • Pressure for increased recycling and less waste all along the food chain

Source: Civic Consulting

On the basis of results of the 1st workshop a scenario-building approach was adopted, whereby each scenario focuses on one of the above described drivers, with the aim of capturing key disruptions or gradually developing stresses occurring between now and 2050 relating to the main trends of relevance in that driver. *A key requirement was that the scenarios challenge the current EU policy and legislative food safety and nutrition framework by exposing its vulnerabilities; more benign scenarios outlining futures with limited disruptions or gradual stresses, or scenarios depicting challenges that were not relevant in the context of this study were not considered.*

In order to clearly identify the vulnerabilities in the food safety and nutrition framework caused by gradually developing stresses or potential disruptions relating to a driver, each scenario was designed to explore a single driver-related stress/disruption and its related secondary effects resulting from the interrelationships between drivers. In this way, the scenarios allow for complex sets of inter-connected drivers and trends to be unpacked, without disregarding the most important interrelationships related to the driver under consideration.

Accordingly, the driver-specific scenarios outlined below were developed to depict a variety of the most challenging potential disruptions or critical developments to the EU legislative and policy framework from these drivers, with the principal aim of testing the current and future resilience of this framework until 2050 and thereby investigating which potential future policy measures may be necessary to increase its resilience.

The following table outlines the driver-specific scenarios that were developed and subsequently refined on the basis of results of the 2nd workshop, and the specific challenges to EU food safety and nutrition they aim to explore.[1]

[1] On the basis of the 2nd workshop results, initial scenarios for the drivers 'Global economy and trade' and 'New agri-food chain structures' were merged, bringing the number of scenarios to nine.

Table 2: Overview of driver-specific scenarios

Main driver	Scenario	Related challenges
Global economy and trade & New agri-food chain structures	Scenario 1 – Rapid surge in global trade in food and feed, with highly concentrated agri-food industries	Ensuring food safety and nutrition in the highly globalised and complex food supply chains of 2050
Global cooperation and standards	Scenario 2 – Break-down of global cooperation in a multipolar world	Ensuring food safety and nutrition in a multipolar world in 2050, and with highly fragmented and geographically dispersed food chains
EU governance	Scenario 3 – Long-term austerity and a shift to private food safety controls in the EU	Ensuring food safety and nutrition in an environment of tight budgetary restrictions
Demography and social cohesion	Scenario 4 – Severe inequality linked to food insecurity of vulnerable consumers and polarised diets	Safeguarding the food security of vulnerable consumer groups and addressing lifestyle-related problems affecting the health of large parts of the EU population
Consumer attitudes and behaviour	Scenario 5 – Strong shift in EU consumer preferences to food from alternative production systems	Ensuring food safety in EU food systems dominated by alternative food chains in 2050
New food chain technologies	Scenario 6 – Widespread consumption of high-tech functional foods	Ensuring high levels of food safety and nutrition for consumers of functional foods in 2050
Competition for key resources	Scenario 7 – Global resource depletion	Safeguarding food safety and nutrition when high quality resources are scarce
Climate change	Scenario 8 – Global disruptions of agriculture from climate change	Safeguarding food safety and nutrition under disruptive climatic conditions, affecting primary production, storage and transport of food in 2050
Emerging food chain risks and disasters	Scenario 9 – Breakdown in consumer trust in food following the emergence of food chain risks	Ensuring veterinary health and food safety under these circumstances, effectively communicating to the public in a situation of panic, and addressing a resulting loss in consumer trust in complex food chains

Source: Civic Consulting

The scenarios are described in more detail in the following section.

1.2. Scenarios for food safety and nutrition in 2050

Scenario 1: Rapid surge in global trade in food and feed, with highly concentrated agri-food industries

This scenario assumes rapid globalisation of trade leading to strong global economic development, including in the EU, with highly concentrated agro-food industries, and the end of

agricultural subsidies. The scenario explores the challenge of ensuring food safety and nutrition in the highly globalised and complex food supply chains of 2050.

In the 2020s and 2030s international trade in food and feed accelerated as the WTO's membership and free trade agreements gradually covered a significant part of the globe. As a consequence, by 2050 agricultural tariffs and subsidies have been all but eliminated, which has boosted competition across the globe, in particular between large transnational corporations, and has meant that while in some regions industry thrived thanks to low costs of production, in others it was forced to specialise and consolidate. In some regions agricultural production was abandoned altogether. In this strongly competitive environment, the higher cost efficiency offered by advanced genetically modified products – e.g. drought-resistant high yield crops for areas affected by climate change, livestock with immunity against certain diseases – caused many producers to take up these technologies, such that GM products constitute the lion's share of global trade in food and feed. This is also true for the EU, where GM products dominate consumers' tables. Technological progress, and the elimination of agricultural subsidies, have induced EU agri-food industries to become highly concentrated and specialised to compete on world markets – in particular with advanced GM technologies –, and wield considerable market power as well as influence on standard setting. They are complemented by a notable sector of small-scale producers in a variety of niche markets inside and outside the EU.

The very high levels of trade that ensued led to rapid global economic growth, with many of the emerging economies of 2013 now well developed, and carrying significant weight in the setting of global food standards. In 2050, 15 countries form the core of the global agri-food trade network, each trading with over 80% of all countries in the world, double the number of core countries at the turn of the century. The global agri-food trade network, in which major globalised food chains and niche regionalised food chains coexist, has therefore strongly gained in complexity, but is also exposed to systemic vulnerabilities as a result. In addition, in some regions there has been a significant increase in instability in food supplies and prices as a result of hastily liberalised agricultural markets, leading some countries to retain export restrictions – export regimes still being relatively less liberalised under WTO rules than imports – in order to safeguard food and resource security. The interconnected trade network has encouraged the rapid spread of new tastes and foods, often in convenient and pre-packed form. Because a typical pre-packed dinner is not only composed of ingredients and formulations originating from countries around the globe, but is often finalised and packaged in third countries, EU consumers have become largely ignorant of the origins of their meals, with notable impacts on consumer trust in food for those that care.

Scenario 2: Break-down of global cooperation in a multipolar world

This scenario assumes a break-down of global cooperation, including regarding setting standards for safe food and international early warning systems, in a world in which there is limited reliance upon multilateral structures. The scenario explores the challenges of ensuring food safety and nutrition in a multipolar world in 2050, and with highly fragmented and geographically dispersed food chains.

The WTO Doha round negotiations, EU-US free trade agreement negotiations and UN Framework Convention on Climate Change conferences continued through to the late 2010s and early 2020s, before finally failing to come to any concrete conclusions. This was the beginning of a gradual, but widespread loss of faith in global institutions, marked by persistent tensions over resources, emissions reduction and trade disputes, linked to the increasingly narrow focus of governments on national and regional economic and security interests, in a strongly multipolar world. Overall, international governance failed to broker any significant long-lasting agreements among the major countries and trade blocs, and a significant break-down in global cooperation occurred in the late 2020s, including regarding food safety and animal health. Many

international organisations from the UN system and other multilateral structures and agreements were thus weakened or abandoned and replaced by regional equivalents that served to further common interests of regional trade blocs. Strong tensions between major countries, marked by sporadic regional conflicts, as well as separate sets of standards in different regional trade blocs (including combinations of different degrees of public and private standards), induced a significant reduction in global trade volume in most goods (even if trade in some luxury goods available only in certain countries continued). Thus, the global economy has grown at a very slow pace in the last decades. Food chains have also gradually become fragmented and dispersed across regions, meaning that more food is sourced regionally, and there has been a reduction in food chain complexity, at least concerning its global dimension.

As a result of significantly reduced openness to trade, in 2050 consumers in the EU have a smaller range of foods to choose from and less diversified diets, although formerly exotic fruits or vegetables are now often grown in the EU to cater to the well-off. Decades-long anaemic growth has reduced EU consumers' purchasing power, which means expenditure on food has increased as a share of income, although severe food shortages have so far been avoided. However, global fragmentation has also had some unexpected advantages for the EU: first, EU institutions and the internal market have gained importance to counteract the break-down at the global level; second, the EU (as well as other major blocs) is forced to ensure the sustainability of their own food systems. Still, the exploitation of other natural resources as a result of the competing blocs has strongly increased due to the lack of international governance, and the protection of global public goods such as the control of livestock epidemics depends purely on national or regional initiatives.

Scenario 3: Long-term austerity and a shift to private food safety controls in the EU

This scenario assumes that overall, EU Member State governments continue with fiscal austerity policies over the next decades, inducing a significant reduction in public services in the EU, including in the area of official food safety controls. The scenario explores the challenge of ensuring food safety and nutrition in an environment of tight budgetary restrictions.

Throughout the 2010s and to the late 2020s, most EU Member States continued to pursue fiscal austerity policies – increased taxation and reduced spending – that had begun in the wake of the economic crisis, with the aim of rendering public debt levels more sustainable. The EU economy did not return to growth for several years, which further reinforced strain on public finances. Eventually, a range of fiscal adjustments needed to be implemented in order to bring Member States' debt ratios to the target level of 60% of GDP enshrined in the Treaty, involving entitlement reforms in particular. In the late 2020s, with the fear of another economic crisis in mind, coupled with the considerable influence of globalised markets on debt sustainability, many policy makers in the EU were reluctant to increase spending even once the economy had recovered. This heralded a further period of reduced spending, which affected many public services significantly, but also had an impact on social cohesion, and re-nationalisation movements are now strong in a number of Member States.

Public food safety and veterinary emergency preparedness and inspection capacities were among the areas most affected. The shortage in resources allocated to official controls led to an overall reorganisation of control systems in Member States (with some efficiency gains), including a prioritisation of EU border controls, but most importantly a strongly reduced frequency of public inspections. Nonetheless, private inspection services, combined with self-regulation and EU-level or global private standards and related certification, have appeared to fill the gap in most Member States. In addition, the market pressure to reduce costs associated with self-regulation has spurred on many operators to develop new technologies to control their products more efficiently, e.g. regarding traceability of food-stuffs and ingredients. Overall,

however, the risks associated with neglect in food safety mechanisms, bioterrorism, and fraud have increased, especially in the prevailing competitive global environment of very tight margins for producers, and consumer trust in food safety has decreased as a consequence.

Scenario 4: Severe inequality linked to food insecurity of vulnerable consumers and polarised diets

This scenario assumes a high level of socioeconomic inequality in the EU, accompanied by a very strong polarisation of diets and lifestyles. Specific vulnerable groups are affected by food insecurity as a result, while many others are now obese. The scenario explores the challenges of safeguarding the food security of vulnerable consumer groups and addressing lifestyle-related problems affecting the health of large parts of the EU population.

By 2050, the global divide between the rich and the poor has grown substantially. In the EU, as in the rest of the developed world, this is primarily a consequence of sustained reductions in social transfers as well as fiscal adjustments as a response to the ageing population and to the decline in competitiveness compared to the emerging economies. Socioeconomic inequalities in the EU in 2050 have reached levels comparable to those in the US in 2013. In the EU, two major vulnerable consumer groups are disproportionately affected: the elderly and migrants. The EU population has aged considerably: 30% of the EU population is over 60, which has led to a significant contraction of the labour supply, and has put considerable pressure on public finances. As a consequence of diverse labour-market induced migration programmes, as well as environmental disruptions and regional conflicts in other parts of the world, many EU consumers have an extra-EU background in 2050: cumulative net migration to the EU since 2010 stands at about 90 million, or slightly less than one fifth of the total EU population in 2010. The combined effect of the increased number of recipients of social transfers as well as tight budgetary restrictions has led to a substantial rise in poverty. While the extent of the problem differs by Member State, considerable numbers of the very poor now have serious difficulties in accessing sufficient and safe food of high nutritional quality (and, in particular for migrants, that is also culturally relevant) to meet their dietary needs and food preferences for an active and healthy life. The number of people that are at least partly dependent on charity, food-for-poor programmes or living off food waste is substantial.

For those rich enough to avoid food insecurity however, the increasing inequality in the EU, and ensuing differences in nutrition and health education, has led to highly polarised diets and lifestyles across the socioeconomic divide. The worse-off (the majority) predominantly eat cheap, often pre-prepared/convenience food, as in many parts of the EU fresh food is increasingly a luxury. They live on a largely animal protein and carbohydrate-rich diet – despite new food traditions brought by migrants and increasingly globalised food consumption patterns – and engage in little physical activity, while the expensive, healthy and fresh foods cater to the health-conscious, well-off minority. As a result, already by 2030, 70% of the EU population was overweight or obese (as in the US in 2010), and 40% was obese, and in 2050 this figure stands at 75%, with 45% being obese, leading to severe health problems and a reduction of the average number of healthy life years, and further putting strain on public finances as a result of increasing healthcare costs.

Scenario 5: Strong shift in EU consumer preferences to food from alternative production systems

This scenario assumes a strong shift in EU consumer preferences to either local, more sustainable, animal welfare-friendly, or organic food production systems. The scenario explores the challenge of ensuring food safety in EU food systems with strong alternative food chains in 2050.

While a number of technological innovations in food production occurred in the first quarter of the century, involving biotechnologies, nanotechnology, and new forms of food in general, many EU consumers remained sceptical of their benefits, especially due to a lack of substantial scientific underpinning as well as transparent risk communication. This, combined with several high-profile food scares, scandals and crises in the EU that involved food sourced from global food chains – relating variously to harmful effects of new technologies, inadequate treatment of animals, food contamination, fraud, environmental degradation and unfair terms of trade – gave rise to a strong shift in the preferences of many EU consumers to local, more sustainable, animal welfare-friendly/vegetarian, or organic food production systems throughout the 2020s and 2030s. As a result, various local and regional food systems and short supply chains emerged across the EU to meet this demand. Urban gardening also saw a significant boom to accommodate the alternative urban niche markets. The large scale agri-food industries connected to global food chains gradually adapted to the new demand and competed with independent producers for the significant value-driven proportion of the population with differentiated approaches, by establishing either specific brands, certified labels or production processes (in particular environmentally-friendly ones). Transparent food labelling and certification became paramount, as many EU consumers increasingly chose to only buy products satisfying a series of stringent conditions relating to the origin, method, and quality of production.

In 2050, the shift in demand entailed a significant increase in agricultural land use in the EU, combined with a stagnation of food imports from outside the EU, where global, integrated food chains incorporating new technologies (including GM products) thrive. The shift has had some clear benefits in avoiding the potential risks of technologically advanced global food chains, and improving nutrition thanks to the increased focus on food quality and diets, in addition to reviving rural communities, as some urban consumers return to the countryside. However, efficiency has declined in some regions. Less intensive, low-input agriculture in a number of areas has produced lower yields, exacerbated by climate change-related stress and the reluctance to use GM drought resistant crops due to consumer concerns. This has led to substantially higher food prices in some parts of the EU. Due to the significant price premiums of certified alternative products compared to food produced in mainstream production systems, labelling fraud has been persistent and has at times threatened to undermine consumer trust in food in general. In addition, the expansion of shorter chains and local production systems has posed new challenges for food safety controls and regulatory oversight of food systems due to their significant diversity, and niche providers often operate largely on a self-control basis. Consequently, some say that the risk of food safety events, while more contained thanks to shorter supply chains, has not decreased overall.

Scenario 6: Widespread consumption of high-tech functional foods

This scenario assumes that high-tech functional foods – defined as foods which affect functions in the body beyond adequate nutritional effects by improving health and well-being or reducing the risk of disease[2] – are regularly consumed by large parts of the EU population. The scenario explores the challenge of ensuring high levels of food safety and nutrition for consumers of these foods in 2050.

In the early 2020s, the variety of functional foods developed at a rapid pace in the EU. A substantial body of science underpinned the claimed health benefits such as better early development and growth, health maintenance, reduced risk of obesity, and reduced risk of chronic diet-related diseases. As a result, many functional foods were gradually given regulatory clearance, and while at first particularly health-conscious, active consumers adopted them, by

[2] European Commission, Functional Foods, November 14, 2010.p.7

the mid-2030s functional foods had become a key part of many EU consumers' diets. This came about as the result of several factors, including: new knowledge developed by nutrigenomics research; sustained advertising to consumers and the medical professions; a decrease in the cost of production of functional foods; higher prevalence of obesity-related diseases; increasingly risk-dependent contributions to health insurance; broader consumer understanding of the link between diet and health; and the high costs of healthcare overall. Where evidence existed, governments accepted the cost-saving benefits for public health, and supported further research. Detailed international standards for design and trade of functional foods were elaborated.

In 2050, the dividing line between traditional processed food and functional food has all but disappeared, and functional foods constitute a substantial part of foods on the EU market, facilitated by globalised food industries that are highly integrated with nutritional research institutions. Recent improvements in public health in a number of areas can be partly attributed to widespread functional food consumption. The development has its downsides, though: the variety of functional foods and competing health claims has made consumer choice more difficult, and sometimes even encouraged unhealthy lifestyles, as consumers perceive consumption of functional food as a sufficient precaution for an otherwise unhealthy animal protein and carbohydrate-rich diet. Consumption of fresh fruits and vegetables is steadily decreasing. Some health experts are worried by overconsumption and abuse of certain functional foods. While EU regulatory oversight has generally been effective in ensuring the safety of the new foods (which was essential for the high consumer take-up), it has become increasingly difficult to keep up with the fast pace of the global market. Several functional foods – some of them unauthorised and illegally imported through specialised online traders abroad – have turned out to induce serious side effects, while there have been several cases of conventional foods labelled as functional foods. As a result, in the EU calls for a return to food protectionism, as well as to conventional foods, have received greater attention in recent years.

Scenario 7: Global resource depletion

This scenario assumes increased depletion of the world's resources, leading to high and volatile food and energy prices. The scenario explores the challenges of safeguarding food safety and nutrition when high quality resources are scarce.

A number of forces, most notably the increased demand for food from the ever larger world population, the high energy consumption resulting from strong economic growth and rising per capita incomes, increased demand for biofuels, and the lack of global resource management strategies, have led to strong competition for and the substantial depletion of many of the world's resources in 2050. Global energy consumption has doubled, and the majority of the demand is still met from fossil sources; indeed while renewable sources continuously gained in importance, they did not become economically viable in many countries. World oil prices have skyrocketed at times to beyond $250 per barrel (while high prices have incentivised research into cheaper alternatives, price peaks continue to occur). Fertile soils have become considerably scarce: A 75% increase in agricultural production was needed to cope with the population increase and the much stronger than expected shift to meat-based diets in emerging economies, while efforts to reduce food waste largely failed. Much of the world's arable land has undergone soil degradation, in spite of widespread use of new GM crops with soil-enhancing properties. There has also been a strong shift in land use from crop production to other uses, including biofuel production. Overall, improvements in crop yields per area and sustainability were limited, and water consumption for agriculture has grown to an unsustainable level in many countries, causing severe regional freshwater shortages. There has also been a large increase in the incidence of environmental contaminants spreading through the food chain, due to the need to use lower quality water for irrigation and food production, which has mainly affected consumers where food control systems were deficient. While high uncertainty over the quantity

of remaining phosphorus reserves persists, the known reserves of cheap high-grade phosphate rock for fertilisation have been depleted. Methods to recover phosphorus from recycling on a large scale proved inefficient, contributing to increased prices of agricultural commodities. Finally, as a result of competition for land and conversion of natural land areas for intensive agricultural use, there has been a serious degradation of biodiversity and ecosystem services, globally and in the EU.

At a geopolitical level, regional resource scarcities have led to international conflicts, increased resource nationalism/protectionism, and the emergence of new strategic alliances, which have not always been in line with the EU's interests. The scarcity of resources has also induced high and volatile global energy and food prices, affecting EU consumer welfare significantly.

Scenario 8: Global disruptions of agriculture from climate change

This scenario assumes global temperatures increase in line with high projections, precipitation patterns change drastically, and global agricultural productivity suffers major disruption as a consequence. The scenario explores the challenge of safeguarding food safety and nutrition under disruptive climatic conditions, affecting primary production, storage and transport of food in 2050.

The world's fast growing economy, with its seemingly insatiable demand for energy, the continued dominance of fossil fuels, population growth, and importantly the lack of an international agreement on greenhouse gas emissions reduction led to a doubling of CO_2 emissions from energy use in 2050 compared to 2010 levels, the increase mostly originating from the major emerging economies. In 2050, in most countries energy is still largely sourced from fossil fuels, as renewable energy sources did not prove to be cost efficient due to a lack of appropriately designed incentives at the global level and the lower than expected fossil fuel prices due to new extraction technologies. Indeed, as a consequence of consistently diverging national interests and regional disputes, scant concrete climate change mitigation policy actions have been taken. Atmospheric concentration of greenhouse gases is now beyond 700 CO_2-equivalent parts per million. As a result, the world has warmed by 3 °C on average (compared to pre-industrial levels) and precipitation patterns have seen major changes across the globe. The combined effect of these has in turn led to considerable sea level rises and very frequent extreme weather events such as heat waves, droughts, and flooding, with drastic consequences, especially in terms of global agricultural productivity. While at higher latitudes crop productivity has increased slightly in some regions and decreased in others, depending on the crop, at lower latitudes, crop productivity has strongly decreased in all regions of the globe. Food security and agricultural incomes have been strongly impacted in many regions of Africa, Asia and Latin America, as well as on islands across the world (including overseas territories that have a special relationship with one of the EU Member States). In addition, the flooding, disease and in some regions even famine induced by climate change has displaced millions of people, many of whom depend on food aid, putting additional stress on those regions where agricultural productivity is still relatively unaffected.

In addition to changes in crop productivity, the warmer climate in Europe has also allowed new animal and plant diseases, pests and invasive alien species to regularly emerge, affecting food safety, while there has concurrently been a significant loss of biodiversity. The extreme weather patterns in turn have caused years of continual food price volatility, making food security of vulnerable populations in the EU more difficult to ensure. This has led to occasional food riots and social unrest, especially in the drought-affected southern Member States.

Scenario 9: Breakdown in consumer trust in food following the emergence of food chain risks

This scenario assumes a major loss in consumer trust in 2050 following the emergence of food risks, such as broad-scale antimicrobial resistance and outbreaks of a relevant zoonotic disease. The scenario explores the challenge of ensuring veterinary health and food safety under these circumstances, effectively communicating to the public in a situation of panic, and addressing a resulting loss in consumer trust in complex food chains.

In the 2020s and 2030s, while some continued to warn against the potentially disastrous consequences of antimicrobial resistance in pathogens, their calls did not lead to effective preventive measures, neither in the EU nor globally. Due to (mis)use of antimicrobials in livestock production, overuse by consumers and their doctors, pollution of the environment by residues, and other factors, broad-scale antimicrobial resistance developed, leading to the spread of resistant pathogens.

When outbreaks of an emerging, infectious zoonotic disease occurred in the EU owing to a highly resistant pathogen, they spread quickly throughout the EU. Diagnostic capacities of leading labs were quickly overwhelmed. Emergency response mechanisms were stretched to their limits and partly proved to be insufficient. The spread of the disease was strongly facilitated by the highly integrated nature of the EU food chain in 2050, frequent and large-scale live animal transports across Member States' borders and the ever increasing mobility of EU citizens, with the rate of travel between Member States having tripled since the turn of the century. Its impact on human health was further aggravated by the vulnerability of the aging EU population: the most affected population groups were the elderly and infants. While many Member States experienced outbreaks, some nonetheless managed to confine them within national borders thanks to effective, sometimes drastic control measures. In addition to the direct public health consequences, secondary effects of the disease on the supply of sufficient and safe food to EU consumers and on consumer trust in the food chain, proved to be very challenging. Following the outbreaks, many consumers have lost their trust in the control and response mechanisms in place, and of the safety of their food in general.

1.3. Results of stakeholder and expert consultation

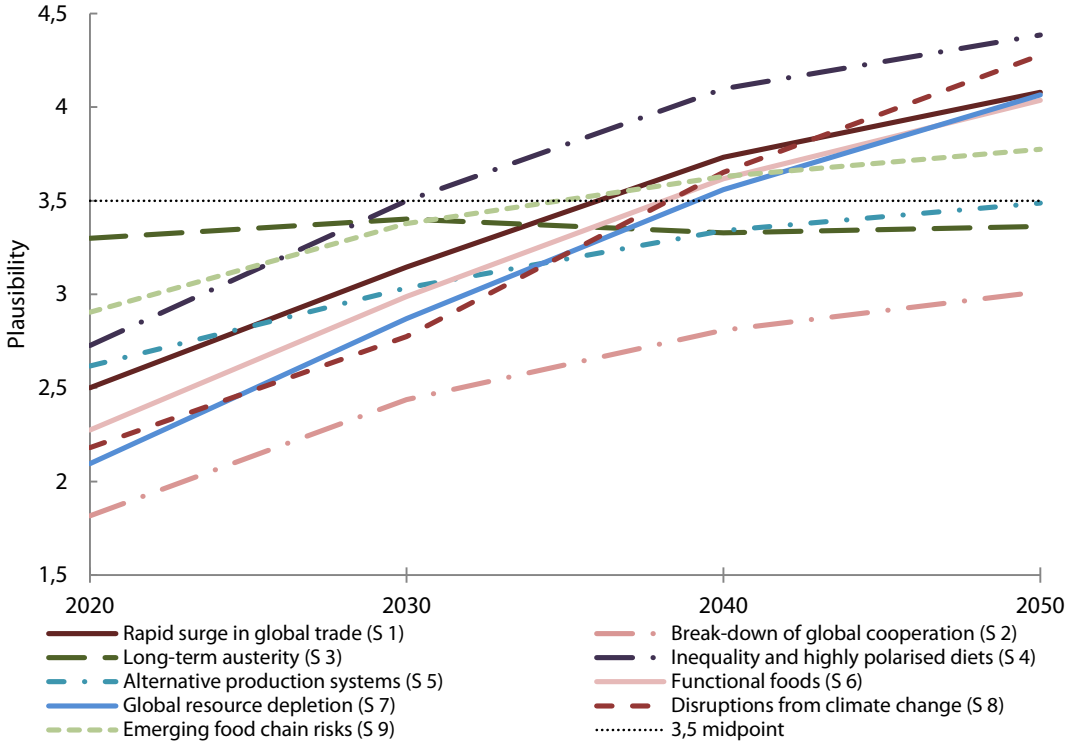
The stakeholder consultation consisted of an online survey developed on the basis of question themes discussed at the 2nd workshop. It was targeted at key stakeholders in the area of food safety and nutrition at the EU and Member State level, including competent authorities, industry associations, international organisations, consumer organisations, other non-government organisations, and independent experts. The main purpose of the survey was to assess the potential impacts on EU food safety and nutrition under the scenarios, and explore potential measures to face the challenges described and areas for future research. At the time the survey was closed, a total of 129 responses had been received.

1.3.1. Plausibility of scenarios

For each scenario selected for assessment, stakeholders were asked to provide their views as to the extent to which the scenario could plausibly occur within various timeframes – by 2020, 2030, 2040 or 2050 – on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe and for each scenario, where a scenario is characterised by a coloured line, as shown in the legend. In addition, a horizontal line has been drawn across all timeframes at 3.5, which characterises the midpoint between 1 and 6. An average assessment of a scenario's plausibility of a value of 3.5 could be understood as an assessment whereby the scenario is on average considered as

plausible as it is implausible. By extension, an average assessment of a scenario's plausibility *above* 3.5 is to be understood as an assessment whereby the scenario is on average considered more plausible than implausible. In contrast, an average assessment of a scenario's plausibility *below* 3.5 is to be understood as an assessment whereby the scenario is on average considered more implausible than plausible.

Figure 1: 'When could this scenario plausibly become reality?' – Comparison of scenarios



Source: Civic Consulting, based on stakeholder survey, questions 1.1, 2.1 etc. to 9.1.

Several key conclusions can be drawn from the graph:

- The plausibility of all scenarios is on average considered to increase for later timeframes, with the exception of Scenario 3 – 'Long-term austerity'.
- Six of the scenarios assessed reach the midpoint of 3.5 by 2050, and thus their becoming reality is considered more plausible than implausible by 2050. Of these, the scenario that is on average considered more plausible than implausible the soonest is Scenario 4 – 'Severe inequality and highly polarised diets', which reaches the midpoint by 2030, while the other five scenarios reach the midpoint by 2040.
- Of the three scenarios that do not reach the midpoint by 2050, Scenario 2 – 'Break-down of global cooperation' is on average considered to be least plausible.
- Scenario 7 – 'Global resource depletion' and Scenario 8 – 'Disruptions of agriculture from climate change' see the largest change in average assessments of plausibility across timeframes.

1.3.2. Impacts on food safety and nutrition policy – comparison of scenarios

For each scenario selected for assessment, stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of the scenario. Stakeholders were asked to assess impacts on various food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0. The following table displays, for each scenario, the assessments of positive (in blue) and negative (in red) impact on food safety and nutrition policy areas.

Table 3: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario? – Comparison of scenarios

Scenarios / Policy areas	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Novel foods & biotechnology	0,9	-0,2	-0,1	0,4	-0,3	1,5	0,3	0,7	0,2	*0,4*
Agents, additives & contact materials	0,6	-0,2	-0,4	0,3	-0,5	1,2	0,1	0,4	0,1	*0,2*
Labelling & informatio	-0,2	-0,1	-0,6	0,0	0,6	0,5	-0,2	0,0	0,4	*0,0*
Enforcement & controls	0,2	-0,1	-1,0	-0,2	0,2	0,5	-0,2	-0,3	0,6	*0,0*
Food & feed hygiene	0,1	-0,5	-0,7	-0,4	0,1	0,6	-0,5	-0,7	-0,2	*-0,2*
Plant health & plant protection products	-0,2	-0,4	-0,6	-0,3	0,7	0,1	-1,0	-1,0	-0,5	*-0,4*
Health & nutrition	-0,3	-0,5	-0,9	-0,8	0,8	0,6	-0,8	-0,8	-0,8	*-0,4*
Food contaminants	-0,3	-0,6	-0,7	-0,5	-0,1	0,3	-0,7	-0,8	-0,5	*-0,4*
Animal health & welfare	-0,6	-0,3	-0,7	-0,5	1,1	-0,1	-1,0	-1,1	-1,0	*-0,4*

Source: Civic Consulting, based on stakeholder survey, question 1.2b, 2.2b, etc. to 9.2b. Assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this table due to the small number of survey respondents for this item. Impacts that were assessed on average as positive are highlighted in blue, while those assessed on average as negative are highlighted in red. Policy areas are ranked by the average assessments across all scenarios (highest to lowest; see right-hand column).

As displayed in the table, average assessments of positive and negative impacts on policy areas broadly reflect assessments on food chain activities across scenarios: policy areas in Scenario 1 – 'Rapid surge in global trade', Scenario 5 – 'Shift to alternative production systems' and Scenario 6 – 'Widespread consumption of functional foods' scenarios are again considered to be relatively positively impacted. A key difference is that under Scenario 3 – 'Long-term austerity', assessments of negative impacts on food safety and nutrition policy areas are more significantly pronounced than for food chain activities. Nonetheless, Scenario 7 – 'Global

resource depletion', Scenario 8 – 'Disruptions of agriculture from climate change' and Scenario 9 – 'Emerging food chain risks' follow as the scenarios for which policy areas are assessed to be next most negatively impacted.

The table also shows that novel foods and biotechnology, food improvement agents, additives and contact materials are on average considered positively impacted across scenarios, while most other food safety and nutrition policy areas are considered on average negatively impacted across scenarios.

1.3.3. Impacts on other areas – comparison of scenarios

For each scenario selected for assessment, stakeholders were asked which other key areas would be impacted as a result of this scenario. Stakeholders were asked to assess impacts on various other areas on a scale of -2 to +2, where no impact is indicated by 0. The following table displays, for each scenario, the assessments of positive (in blue) and negative impact on food safety and other key areas (in red).

Table 4: 'In your view, what <u>other areas</u> would be impacted as a result of this scenario?' – Comparison of scenarios

Scenarios / Other areas	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Innovation	0,8	-0,3	-0,1	0,1	0,3	1,6	0,2	0,9	0,4	*0,4*
Competition	0,5	-0,6	0,1	0,0	0,5	1,0	0,0	0,0	0,0	*0,2*
Internal market	-0,1	0,6	-0,3	-0,2	0,7	0,4	-0,4	-0,4	-0,5	*0,0*
Trade	1,2	-1,2	-0,3	0,0	-0,4	0,8	-0,6	-0,3	-1,0	*-0,2*
Consumer choice	0,1	-1,2	-0,8	-0,7	0,7	0,6	-1,2	-0,9	-0,9	*-0,5*
Environmental sustainability	-0,8	-0,2	-0,8	-0,9	1,2	-0,2	-1,2	-1,1	-0,5	*-0,5*
Social stability, including equitable access to food	-0,4	-0,9	-1,0	-1,4	0,1	-0,5	-1,4	-1,4	-1,1	*-0,9*

Source: Civic Consulting, based on stakeholder survey, questions 1.2c, 2.2c, etc. to 9.2c. Assessments in relation to 'Other areas' (beyond those considered in the survey questions) are not shown in this table due to the small number of survey respondents for this item. Impacts that were assessed on average as positive are highlighted in blue, while those assessed on average as negative are highlighted in red. Areas are ranked by the average assessments across all scenarios (highest to lowest; see right-hand column).

The table indicates that innovation is the area considered to be most positively impacted across scenarios, on average, followed by competition, to a lesser extent. In contrast, social stability, including equitable access to food, is considered to be most negatively impacted across scenarios, followed by environmental sustainability.

1.3.4. Measures the EU should take to face the challenges posed by the scenarios

For each scenario selected for assessment, stakeholders were asked what measures/course of action the EU should take to face the challenges posed by the scenario. Stakeholders were asked to assess the extent to various measures/courses of action were needed, on a scale of 1 (Not at all needed) to 6 (Very much needed). The table below displays average assessments for various measures/courses of action, by scenario.

Table 5: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' – Comparison of scenarios

Scenarios / Measure/ Course of action	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Research	4,7	4,3	4,3	4,6	4,5	5,3	5,3	5,3	5,2	*4,8*
Education, awareness raising & training	4,6	4,2	4,5	5,1	4,8	4,6	4,5	4,7	5,0	*4,7*
Improving communication	4,7	4,3	4,3	4,6	4,6	4,7	4,3	4,4	5,0	*4,6*
Promoting international governance	4,9	4,7	4,4	3,8	3,4	4,2	5,1	4,8	5,0	*4,5*
Legislation	4,4	3,7	4,2	4,3	3,9	4,4	4,2	4,1	5,0	*4,2*
Economic incentives	3,7	3,8	3,8	4,4	3,8	3,3	4,1	4,0	4,0	*3,9*
Institutional changes	3,7	3,7	3,9	3,8	3,5	3,5	3,8	3,7	4,0	*3,7*
Promoting self-regulation	3,6	3,3	4,1	2,9	3,7	3,6	3,1	3,1	3,7	*3,4*

Source: Civic Consulting, based on stakeholder survey, question 1.3a, 2.3a, etc. to 9.3a. Assessments in relation to 'Other measures' are not shown in this table due to the small number of survey respondents for this item. A light to dark red colour grading applies, with the following grades: 0 to 3.5 (light red); 3.5 to 4.0 (medium red); and 4.0 and above (dark red). Measures/courses of action are ranked by the average assessments across all scenarios (highest to lowest; see right-hand column).

As shown in the table, research appears as the measure/course of action considered most necessary across scenarios, followed by education, awareness raising and training. Promoting self-regulation, on the other hand, is on average considered least necessary across scenarios.

1.3.5. Changes needed to adapt the current EU framework for food safety and nutrition

For each scenario selected for assessment, stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. Stakeholders were asked to assess the extent to which changes to various food safety and nutrition policy areas were needed on a scale

of 1 (Not at all needed) to 6 (Very much needed). The table below displays average assessments of the extent to which changes are considered necessary in various policy areas, by scenario.

Table 6: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.' – Comparison of scenarios

Scenarios / Policy areas	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Enforcement & controls	4,6	3,7	4,6	3,9	4,3	4,5	4,2	3,9	5,0	*4,3*
Health & nutrition	4,2	3,7	3,9	5,1	3,9	4,9	4,0	3,8	4,1	*4,2*
Cross-cutting measures	3,9	4,2	3,6	4,2	3,7	3,8	4,4	4,5	4,2	*4,1*
Labelling & information	4,6	3,5	3,7	4,4	4,2	5,0	3,5	3,6	4,0	*4,0*
Novel foods & biotechnology	4,4	3,5	3,3	3,9	3,3	4,9	4,2	4,1	3,5	*3,9*
Food & feed hygiene	4,1	3,3	4,0	3,9	3,9	3,5	3,7	3,6	4,6	*3,9*
Food contaminants	4,2	3,3	3,7	3,6	3,8	3,7	3,9	3,6	3,9	*3,7*
Plant health & plant protection products	4,0	3,2	3,5	3,4	3,7	3,0	4,0	4,0	3,9	*3,6*
Agents, additives & contact materials	4,0	3,1	3,4	3,5	3,1	4,6	3,6	3,3	3,5	*3,6*
Animal health & welfare	4,0	3,1	3,5	3,2	3,5	2,8	3,4	3,7	4,8	*3,6*

Source: Civic Consulting, based on stakeholder survey, question 1.3b, 2.3b, etc. to 9.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this table due to the small number of survey respondents for this item. A light to dark red colour grading applies, with the following grades: 0 to 3.5 (light red); 3.5 to 4.0 (medium red); and 4.0 and above (dark red). Policy areas are ranked by the average assessments across scenarios (highest to lowest; see right-hand column).

As shown in the table, enforcement and controls appears as the policy area for which changes are considered most necessary across scenarios on average, followed by health and nutrition, and cross-cutting inter-disciplinary measures. Animal health and welfare on the other hand appears as the policy area for which changes are on average considered least necessary across scenarios.

1.4. Conclusions

The analysis of drivers, the results of the expert workshops and of the stakeholder survey lead to a number of cross-cutting conclusions that apply to several or all scenarios. These cross-cutting conclusions in turn point to questions concerning the EU approach to guaranteeing high levels of food safety and nutrition in the near and distant future. In the following we present each of the main conclusions followed by the key question(s) for future research which they elicit:

1. **Cross-cutting policy measures are vital for the future of EU food safety and nutrition.** Such measures would need to be based on a diversified approach involving collaboration between different policy and research areas. This also relates to the need emphasised by stakeholders for a more holistic approach to the design of legislation and policy in the area of food safety and nutrition. At the level of the Commission, this means that it is critical for policy measures in relation to food safety and nutrition to be considered in the context of strengthened cross-cutting collaboration between DG SANCO and other relevant Directorates-General – e.g. DG Agriculture, DG Environment, DG Trade or DG Research – but also in view of international developments and collaboration. Existing cross-cutting EU policies, notably those involving financial instruments such as the Common Agricultural Policy (CAP), could also be harnessed.

   This conclusion leads to the following question for further research:

⇒ *How can cross-cutting collaboration and policy design in the EU be reinforced to achieve the best outcomes for food safety and nutrition? Concretely, how could relevant Commission DGs further pool their resources and develop integrated strategies in order to jointly address food safety and nutrition issues? Do other relevant DGs – e.g. DG AGRI and DG Research - sufficiently take food safety and nutrition into consideration in their policy agendas?*

2. **The area of food safety and the area of nutrition need distinct, separate approaches.** While important overlaps exist between the two areas, this scoping study has shown that in general future challenges to food safety are often distinct enough from those that concern nutrition to warrant distinct approaches. In particular, looking forward, results show that healthy and sustainable nutrition needs to be understood in a broad context through the analysis of a range of contributing social, political, economic and environmental factors; this is in contrast to the current specific topical approaches needed for food safety policy (e.g. relating to contaminants, biohazards, animal diseases, etc.). These findings are therefore indicative of a need for immediate and effective action and for more resources to be made available at EU level to combat nutritional problems, and to do so separately from – and without neglecting – food safety issues.

   This conclusion leads to the following question for further research:

⇒ *Which measures are needed and which resources need to be made available at EU level to address nutrition issues, and separately from food safety issues? Is there sufficient clarity concerning which EU service/institution should take the lead and implement and coordinate relevant actions across policy areas, in cooperation with Member States? In particular, is DG SANCO the right service to lead on these issues? If so, is it sufficiently equipped for taking on this role? If not, which other service should lead at EU level? Should a new nutrition task force or other structure be established?*

3. **Policy measures and research programmes and projects to address both consumer and producer behaviour jointly are needed, particularly education and communication.** This is of particular importance for nutrition, as the results of this scoping study reconfirm that a range of dynamic social, cultural, political, economic and environmental factors are

important determinants of healthy and sustainable nutrition. Stakeholders noted however that the critical determinants of healthy diets remain to be clearly identified, pointing to the need for further research in this area. It was in particular strongly emphasised by stakeholders that not only consumer behaviour is relevant for understanding nutrition habits, but also the behaviour of food producers. Product development, advertising and marketing influence consumers strongly in the choice of products, which if unhealthy may impact on obesity, disease and life expectancy. This means that a range of incentives to induce behavioural change can potentially be applied at all levels of the food chain, from primary production (e.g. concerning more sustainable production methods), to marketing and pricing of products (e.g. better nutrition labelling, possible fees, charges or taxes on unhealthy or unsustainable products) and on to consumption (e.g. measures to reduce meat consumption). These would need to be complemented by relevant education and communication measures (e.g. concerning nutrition-related knowledge, information and education to emphasise the advantages and lifestyle value of a more plant-based diet, but also cooking skills and elementary food safety rules, as a lack in these increases the need to consume processed foods).

This conclusion leads to the following questions for further research:

⇒ *What are the key determinants of healthy nutrition, and related household practices? Which measures can be targeted at key food chain stages to influence both consumer and producer behaviour to safeguard healthy nutrition with a reduced environmental footprint, and how effective are they in practice? What best practices should be promoted across the EU? Can public bodies, NGOs and the private sector be made to collaborate more effectively on healthy nutrition at local, regional, Member State and EU levels? Should more EU resources be allocated to promoting such collaboration?*

4. **Conducting and encouraging scientific research and innovation directed towards safer foods and healthier diets are key measures for dealing with the challenges under the different scenarios**. Stakeholder comments have revealed several areas that relate to all scenarios where research may need to focus, including:

    - *Information and communication technologies (ICTs) to improve traceability and labelling in the food chain*. This scoping study has emphasised the potential of ICTs to address future food safety challenges in relation to traceability in complex food chains and the provision of detailed product information at the ingredient level, (e.g. digital labelling – albeit with the caveat that widespread use of digital labelling/traceability may also lead to an increased risk of digital fraud);
    - *Advanced sensors/screening methods for testing of food products*. Such technology may be particularly relevant for effective enforcement and with the rapid advances in relevant technologies they have the potential to be low cost, user-friendly, quick, accurate, reliable, and selective, with resulting large benefits for producers, enforcement bodies, and food safety in general;
    - *Advanced modelling*. Modelling has been particularly emphasised throughout the scoping study in the context of understanding and mapping consumer behaviour and consumption patterns (in particular obesity), but also the spread of disease and other possible emerging risks (e.g. spread of contaminants through the food chain). While models to characterise specific aspects of the above list have been developed, so far no comprehensive modelling framework for food safety has been developed; or models that could integrate potential impacts on food safety and public health nutrition. Furthermore, for food safety it is important to base modelling on a holistic approach that takes into account the overall environment in which food is produced and consumed;

- *Sustainable food products.* Results of the scoping study emphasise the opportunity that new foods may offer – besides behavioural changes and a new focus on more plant-based nutrition – in delivering both greater levels of nutrition and a reduction in environmental footprint and food waste (e.g. meat replacement products, artificial meat, cheap and healthy processed food).

The key science and technology research areas above lead to the following questions for further research:

⇒ *How can ICTs that improve traceability and labelling of food products and integrate with food safety controls be promoted? How could the risk of digital fraud along the food chain be addressed? Which low-cost and reliable food safety testing methods are especially needed in the area of food safety controls, and how could their development be most effectively supported? Should new tools be developed to optimise risk-based monitoring/control, or can existing technologies be better harnessed? What aspects should be incorporated into a comprehensive food safety and public health nutrition modelling framework? Are there specific new foods on which research should be promoted to deliver both more healthy nutrition and a reduction in environmental footprint? Finally, what public-private partnerships could be fostered to kick-start research?*

5. **International food chain governance should be consistently advanced.** The future of EU food safety and nutrition in 2050 will depend increasingly on the actions of other global players (e.g. trade blocs, nation-states or multinational companies) and the extent to which cooperation can be achieved on a global scale, both regarding standards and their enforcement throughout the food chain. In this process of increasingly globalised standard setting and enforcement the EU will need to ensure that existing high standards on food safety are maintained or improved, rather than undermined through a 'race to the bottom'.

   This conclusion leads to the following questions for further research:

⇒ *Which areas are most in need of further harmonisation of standards? Which models for international governance constitute best practices, and which could be applied to specific food chain challenges? How could international information systems on food safety and nutrition be improved? Are there models for the enforcement of food safety standards that could be considered best practices? For example, could lessons be learned from the longstanding international cooperation in the field of animal health and related information systems?*

6. **Promoting diversity in the food system is critical to increase resilience to future shocks or disruptions.** In order to achieve a resilient EU food system that can withstand a diverse range of challenges, the results of this scoping study point to the importance of diversity. While increasing sustainability of the food chain,[3] EU policies therefore need to also ensure that diversity in the food system, including different primary production models that employ diverse plant and animal genetic resources, as well as different processing, distribution and consumption models, remain in place. Diversity in the food system should also be increased, by promoting diverse agricultural models, production sizes and technological processes, encouraging short and direct food chains, such as the provision of food from local markets/producers, organic or low-input agriculture, urban gardening, to complement the increasingly complex and long international food web. To accomplish this, the diversity of food production models may necessitate legislation that is adapted to those that are not considered 'mainstream'. Furthermore, maintaining diversity over the long term may

[3] Ongoing efforts include the EU Communication on Sustainable Food, which was not yet published at the time of finalisation of this report.

require innovative approaches, as it can be expected that the availability of support tools (such as direct support) will diminish through the increased liberalisation of agricultural markets.[4]

This conclusion leads to the following questions for further research:

⇒ *Where are the concrete possibilities for diversification of the food system? In particular, which specific food production and consumption models should be promoted as priorities to ensure sustainable diversity in the food system, and how can legislation be adapted to accommodate them? Which measures are needed to maintain and further develop diverse plant and animal genetic resources and diversity in the EU food system in general, especially in light of the increasing level of global trade and trade liberalisation? Which tools can be used to support relevant production models?*

7. **Enforcement and controls, and in extension consumer trust, are paramount for EU food safety and nutrition.** The study's findings reinforce the need for effective and efficient enforcement and controls in the context of all food safety and nutrition policy areas when looking to future challenges. This also points to the critical need to ensure sufficient resources are made available for public enforcement systems, where strong enforcement and controls was found essential for the management of emerging food chain risks. In addition, this scoping study has confirmed the importance of adequate enforcement and controls in safeguarding consumer trust, an issue which is prevalent in almost all scenarios (e.g. in relation to food origin and traceability, fraud, labelling and certification, disease outbreaks). As a result, to address specific challenges, research will be needed to investigate how existing enforcement systems can be made more effective and possibly integrated and harmonised, whether new partnerships for enforcement and control are needed, in which food business operators and public authorities develop complementary and coordinated approaches to increase food safety and maintain consumer trust. Relevant cost and responsibility sharing schemes between public and private institutions could in this regard also be explored.

   This conclusion leads to the following questions for further research:

⇒ *What are the determinants of effective enforcement in a diverse food system, with both short and alternative food chains, as well as long and globalised food chains being prevalent? Which institutional approaches - e.g. public, private, or a mix of both - are most effective and efficient? What best practices exist and how can they be promoted across the EU and internationally? What key tools are missing in current EU enforcement and control practices (which can be observed in third countries)? Is there a need for harmonisation of EU enforcement structures? How would public-private enforcement and controls in particular need to be designed to safeguard food safety under all foreseeable circumstances?*

[4] For example, workshop participants emphasised the need for effective price stabilisation mechanisms, as further liberalisation of markets may lead to increased price volatility of certain agricultural commodities.

2. Introduction

This scoping study on 'Delivering on EU Food safety and Nutrition in 2050 - Scenarios of future change and policy responses' was commissioned by the Directorate General for Health and Consumers (DG SANCO) of the European Commission. It was led by Civic Consulting of the Food Chain Evaluation Consortium (FCEC), and implemented with inputs from consortium partners Agra CEAS Consulting and Arcadia International. The objective of the study was to identify the critical challenges to the EU food safety and nutrition framework, their future evolution up to 2050, their impacts on its current structure and the potential critical changes to the current framework necessary to maintain the prevailing high standards. The intention was to provide insight and guidance for the development of future policy response scenarios and future analysis and research necessary for their development.

This scoping study is based on three stakeholder and expert workshops, a driver identification process, an extensive literature review, expert interviews, and a large-scale consultation of stakeholders and experts. The report is structured as follows:

- Section 3 presents the drivers of food safety and nutrition in 2050 identified;
- Section 4 presents the scenarios for food safety and nutrition in 2050, as well assessments from the stakeholder and expert consultation, by scenario;
- Section 5 presents the analysis across scenarios and cross-cutting conclusions, with questions for future research.

The annexes present:

- The study methodology;
- Stakeholders consulted;
- Additional stakeholder and experts comments from the consultation;
- A list of references.

3. Drivers of food safety and nutrition in 2050

In this section we present each of the drivers identified in this scoping study. For each driver, the introduction indicates the relevance of the driver for the EU food chain/food safety and nutrition, and provides an outline of the corresponding trends and uncertainties. The trends and uncertainties relating to the driver are then discussed; for each trend/uncertainty an overview is provided of the past and current situation, as well as expected future changes (with projections/forecasts if available and where appropriate).

3.1. Global economy and trade

3.1.1. Introduction

Global economic trends including trade flows strongly influence the extent to which enough safe, high quality and affordable food can be provided in the EU. Relevant trends and uncertainties relate to:

- Globalisation of trade in food and feed;
- Increasing number of countries covered by free trade agreements;
- Emerging economies exporting more high added-value products and actively engaging in setting standards;
- Global economic development;
- Increasing and more volatile food prices;
- Increasing pressure on public finances from the crisis and expenditure on health and pensions.

3.1.2. Trends and uncertainties

Globalisation of trade in food and feed is expected to increase, in volume, complexity and diversity. Industrialisation and globalisation of agriculture have increased the volume of food produced and the degree to which that production is traded between the EU and the world.[5] From 2000 to 2010, imports from developing countries to the EU grew at an average annual rate of 5.4%. Among developing countries, China was the most important trade partner.[6] In view of an expected 9.3 billion people inhabiting the planet by the year 2050,[7] international trade in food and feed is expected to rise significantly in order to nourish the global population.[8] Food and feed trade networks are also expected to become increasingly complex, as products and ingredients pass through a number of different countries at various stages of the food chain.[9]

[5] Flora, Cornelia Butler, "Foresight Project: SR17: The Social Structure of Food Production," Government Office for Science, 2011, p. 6.
[6] European Commission, Sustainable Development in the European Union 2011 Monitoring Report of the EU Sustainable Development Strategy, 2011th ed., European Commission, 2011.p.314.
[7] FAO, World Agriculture: Towards 2030/2050 Prospects for Food, Nutrition, Agriculture and Major Commodity Groups, Food and Agriculture Organization of the United Nations, Rome, 2006. p.1
[8] European Commission, New Challenges for Agricultural Research: Climate Change, Food Security, Rural Development, Agricultural Knowledge Systems, European Commission, 2009. p.18
[9] See figures in Ercsey-Ravasz M, Toroczkai Z, Lakner Z, Baranyi J (2012) Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety. PLoS ONE 7(5): e37810. doi:10.1371/journal.pone.0037810, p.2.

One study shows that seven countries – five EU countries, as well as the United States and China - formed the core of the international agro-food trade network in 2007, each trading with over 77% of all the countries in the world.[10] Expanding globalisation allows new food and feed to be traded, but with this comes a greater risk of food safety problems crossing borders and becoming global, rather than localised, crises. Globalisation also affects nutrition, as the availability of processed food such as meat and dairy products has risen in developing countries after foreign direct investment by multinational food companies.[11] In addition, it leads to more and more complex connections between food, feed, fibre, and fuel supply chains, with more suppliers from different safety regimes supplying products in new ways. This may pose challenges to sustainability and the overall food safety regime, for example in biofuel production.[12]

Projections show that overall, trade in food and feed will expand, but in different commodities[13,14] and especially from and to developing countries. Regarding livestock in particular, trade in meat has in recent decades been characterised by fairly rapid import growth in Japan and Russia, as well in some developing countries. In the future, meat trade expansion will likely continue, at least to 2050, but it is expected that meat imports by the major developed importers are likely to decline in the long term as their consumption slows down.[15,16,17]

The number of free trade agreements, as well as countries involved in setting standards, will increase. Recent globalisation has been characterized by a decline in the costs of cross-border trade in farm and other products.[18] A number of countries have reduced their agricultural subsidies and import barriers in response to the WTO's multilateral Uruguay Round Agreement on Agriculture.[19] In particular, between 2000 and 2009, the amount of EU agricultural subsidies qualified as trade-distorting according to the rules of the WTO declined annually by 16.7%.[20] In

[10] Ercsey-Ravasz M, Toroczkai Z, Lakner Z, Baranyi J (2012) Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety. PLoS ONE 7(5): e37810. doi:10.1371/journal.pone.0037810.

[11] Thow, A. M. & Hawkes, C. 2009, The implications of trade liberalization for diet and health: a case study from Central America. Global Health 28,5.(doi:10.1186/1744- 8603-5-5).

[12] See http://www.fao.org/fileadmin/user_upload/foodclimate/presentations/EM56/Flavell.pdf.

[13] See figure in OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011, p.38.

[14] OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011, p.38.

[15] Alexandratos, Nikos, and Jelle Bruinsma, World Agriculture Towards 2030/2050: The 2012 Revision., FAO, 2012.p.9.

[16] For details on projected changes in total trade until 2050, see figure in European Environment Agency (EEA), THE EUROPEAN ENVIRONMENT: State and Outlook 2010 - Assessment of Global Megatrends, 2010.p.56.

[17] For more details on projected changes in meat trade, see figure in Alexandratos, Nikos, and Jelle Bruinsma, World Agriculture Towards 2030/2050: The 2012 Revision., FAO, 2012.p.78.

[18] Anderson, Kym, "Foresight Project: DR10b: Globalization's Effects on World Agricultural Trade, 1960-2050.," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 3007–21. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2935114&tool=pmcentrez&rendertype=abstract. p.2.

[19] Anderson, Kym, "Foresight Project: DR10b: Globalization's Effects on World Agricultural Trade, 1960-2050.," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 3007–21. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2935114&tool=pmcentrez&rendertype=abstract. p.12.

[20] European Commission, Sustainable Development in the European Union 2011 Monitoring Report of the EU Sustainable Development Strategy, 2011th ed., European Commission, 2011.p.318.

addition, in the mid-2000s, as uncertainty about the progress of the Doha Round of WTO trade talks took hold, the number of regional trade agreements signed reached unprecedented levels. From 1990 to 2007, the number of such agreements notified to the WTO increased from 20 to 159. By the end of 2009, more than 30% of world trade was governed by over 250 regional and bilateral trade agreements.[21] Notable examples include the MERCOSUR, ASEAN, and NAFTA.[22] In early 2013, the EU had 28 trade agreements already in force, had finished negotiating 9 trade agreements that were yet to enter into force, had 9 trade negotiations under way and several more trade and development negotiations (EPAs) on going, and, importantly, had begun procedures to open trade negotiations with the US, Japan and African Mediterranean countries.[23]

Emerging economies will export more high added-value products and actively engage in setting standards. A shifting balance of power between the main world trading nations is likely to lead to a change not only in which goods are traded but also in the conditions and standards according to which they are traded. Europe's current trading patterns, described primarily by the import of raw materials and export of products with higher added value, are likely to change, while emerging economies will export increasing amounts of high added/value products. These economies, in Latin America, Africa, and China, are therefore likely to have a stronger voice in setting standards. The increasing complexity of trading networks indicates that EU standards may become less relevant on a global scale.

Global economic development, especially in emerging economies, will increase global demand for food commodities and animal protein/feed. The world economy grew by 3.2% annually on average in the period 1980–2010.[24] Developed economies grew 2.6 % annually on average, while China and India grew by 10.0% and 6.2% respectively in the same period. According to one estimate, the world's real gross domestic product (GDP, expressed in purchasing power parity terms) could rise by an average of 3.6% per year from 2010 to 2040. The fastest rates of growth are projected for the emerging, non-OECD regions, where combined GDP could increase by 4.7% per year.[25] According to a recent forecast, taking account of relative price variations, China could represent 28% of the world economy in 2050, dominating the US (14%), India (12%), the EU (11%) and Japan (3%). In particular, in 2025, China could overtake the US, and India could overtake Japan, if no major disruptions occur.[26,27] These developments have and may continue to have impact on demand for food and feed. On the one hand, the share of income spent on food in developing countries has been shrinking.[28] On the other hand, consumption of higher-value products, such as meat, fish, and poultry, has risen along with disposable income. Such changes in consumption patterns alter the net trade

[21] Brückner, G K, "Ensuring Safe International Trade: How Are the Roles and Responsibilities Evolving and What Will the Situation Be in Ten Years' Time?," Revue Scientifique et Technique (International Office of Epizootics), Vol. 30, No. 1, April 2011, pp. 317–24.
http://www.ncbi.nlm.nih.gov/pubmed/21809774.p.320.
[22] FAO, Safeguarding Food Security in Volatile Global Markets, 2011.p.47.
[23] European Commission, "The EU's Free Trade Agreements – Where Are We ?," 2013.
[24] IMF, 2010,'World Economic Outlook 2010 database'.
[25] U.S. Energy Information Administration, International Energy Outlook 2013, 2013.p.1-2.
[26] Fouré, Jean, Agnès Bénassy-Quéré, and Lionel Fontagné, The World Economy in 2050: a Tentative Picture, Vol. December, Vol. December, Paris, 2010.p.4.
[27] For more details, see figure in Fouré, Jean, Agnès Bénassy-Quéré, and Lionel Fontagné, The World Economy in 2050: a Tentative Picture, Vol. December, Vol. December, Paris, 2010.p.48.
[28] World Bank, Food Safety and Agricultural Health Standards: Challenges and Opportunities for Developing Country Exports, Poverty Reduction & Economic Management Trade Unit and Agriculture and Rural Development Department, 2005.

situation of countries.[29] Income changes in the short term may have relatively modest impacts on commodity consumption. However, a 1% increase in annual GDP growth has a considerably greater impact on the demand for animal protein, and higher value foods such as beef and dairy products are subject to the strongest reactions.[30,31]

Food prices are expected to increase over time and remain highly volatile. In recent years prices for agricultural commodities have become more volatile, both within the EU and internationally.[32] Volatile prices create uncertainty and risk for producers, traders, consumers and governments and can have extensive negative impacts on the agriculture sector, food security and the wider economy in both developed and developing countries.[33] Weather and climate change, stock levels of storable commodities, energy prices, exchange rates, rising energy-related production costs, resource pressures and general speculation are key drivers in determining price volatility.[34] Predicting volatility is challenging. From a general perspective, one or more of four factors determines volatility: an increase in the variance of demand shocks; an increase in the variance of supply shocks; a decline in the elasticity of demand; and a decline in the elasticity of supply.[35] Based on substantial volatility in wheat, maize and soybean prices in the past (1990-2010), these prices are likely to remain volatile in the future.[36,37]

Pressure on public finances in developed economies will continue to increase, most recently due to the crisis, but increasingly from spending on health and pensions. Public debt ratios have on average been on the rise in the G-7 countries for the past 35 years. Following World War II, the public debt burden in the average of the G-7 countries declined rapidly during the 1950s and 1960s. In 1974, the trough was reached with an average gross public debt-to-GDP ratio of 35%. By 2007, ahead of the crisis, the average debt ratio had more than doubled to over 80% of GDP. Thus, G-7 countries entered the crisis with a historically high level of public debt.[38] In the Euro area in 2011, the average debt-to-GDP ratio reached 88% of GDP – some 20 percentage points higher than at the start of the crisis in 2007. Further expected increases in debt in 2012 and 2013 pointed to a euro area debt to GDP ratio of 92.6% of GDP in 2013.[39] In the last three and a half decades, public debt has been the 'shock absorber' in advanced economies—increasing during recession without declining during periods of

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[29] Anderson, Kym, "Foresight Project: DR10b: Globalization's Effects on World Agricultural Trade, 1960-2050.," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 3007–21.

[30] OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011. p.42

[31] For more details, see figure in OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011. p.43.

[32] European Commission, High Level Forum for a Better Functioning Food Supply Chain, Vol. 2012, Vol. 2012, Brussels, 2012. p.6

[33] OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011. p.52.

[34] OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011. p.55-61.

[35] Gilbert, C L, and C W Morgan, "Foresight Project: DR18: Food Price Volatility," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 3023–34. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2935118&tool=pmcentrez&rendertype=abstract.p.3028.

[36] OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011. p.53.

[37] FAO, PRICE VOLATILITY FROM A GLOBAL PERSPECTIVE, Technical background document for the high-level event on: "Food price volatility and the role of speculation" FAO headquarters, Rome, 6 July 2012.

[38] IMF, Long-Term Trends in Public Finances in the G-7 Economies, IMF Staff position note, September 1, 2010.p.5.

[39] European Commission, Report on Public finances in EMU, European Economy 4-2012, 2012.p.2.

growth.[40] The last decades have also been characterised by an increase in the ratio of spending to potential GDP, with most of the increase taking place between 1965 and 1985, a trend which was present in all G-7 countries. The bulk of the increase in public spending (over 80%) is due to two items: health care and pensions. In particular, health care spending has surged in many G-7 countries (accounting for more than half of the increase in the primary spending ratio in Germany and the United Kingdom).[41] The revenue structure has also changed over time. In G-7 countries, the strongest increase in percentage points of GDP stems from social security contributions and personal income tax largely with a view to financing the expanding social entitlements. At the same time, consumption taxes have been assigned a greater role—more than doubling their share as a percentage of GDP over the past four decades.[42]

In all G-7 economies, public finances have deteriorated substantially due to the crisis. Overall fiscal balances widened on average by more than 7 percentage points between 2007 and 2010 to about 9.25% of GDP. As a result, in G-7 economies large adjustments may be needed to keep the debt-to-GDP ratio constant, with an even larger adjustment needed to lower public debt to below 60% of GDP by 2030 (about 8.75 percentage points of GDP). In the absence of fiscal adjustment, the high level of public debt is likely to have adverse macroeconomic effects.[43] In addition, major pressures on public finances are arising from pension and health care spending. Without reforms such as retirement age increases, pension spending was expected to increase from 7 to 10 percentage points of GDP in the G-7 economies by 2030 (although possibly only 1 point with the needed reforms), while projected increases in health care spending in Europe ranged between 0.8 and 3 percentage points until 2030.[44] Estimates indicate that under the current and future pressures on public finances—large primary gaps and rising health care and pension spending—public debt would spiral out of control in the absence of fiscal adjustment, with the net debt-to-GDP ratio of the G-7 economies reaching 200% by 2030 and exceeding 440% by 2050.[45, 46] These pressures on public finances are furthermore expected to have an impact on public services, including emergency preparedness and inspection capacities and resources.[47]

[40] IMF, Long-Term Trends in Public Finances in the G-7 Economies, IMF Staff position note, September 1, 2010.p.7.
[41] Ibid.p.8-9.
[42] Ibid.p.11.
[43] Ibid.p.11-12.
[44] Ibid.p.15-16.
[45] Ibid.p.17-18.
[46] See figure in IMF World Economic Outlook July 2010 Update, and IMF staff calculations and estimates.
[47] This is elaborated on in the 'EU governance' driver section (Section 3.3).

3.2. Global cooperation and standard setting

3.2.1. Introduction

Food safety issues can have an international and even a global dimension, as international trade increases and emerging countries assume an increasing share of global GDP. Global cooperation in food related issues and international standards are of crucial importance to ensure safe trade of food. Relevant trends and uncertainties relate to:

- Increasing cooperation in setting standards for safe food;
- Increasing cooperation in international fora, information and early warning systems;
- Increased relevance of private food standards;
- Increased reliance upon international organisations and multilateral structures, combined with challenges from an increasingly multipolar world.

3.2.2. Trends and uncertainties

Increasing cooperation in setting standards for safe international trade in the areas of animal health and products (OIE), plant health (IPPC) and food safety (Codex). International cooperation in the area of animal health, plant health, and food safety has existed for a long time. The World Organisation for Animal Health (OIE) was created already in 1924 and is the WTO reference organisation for standards relating to animal health and zoonoses. It is recognized in this function by the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS). Meanwhile, the International Plant Protection Convention (IPPC) entered into force in 1952. IPPC standards are recognized as the basis for phytosanitary measures applied by WTO members under the SPS Agreement. Similarly, the Codex Alimentarius Commission (established by FAO and WHO in 1963), develops harmonised international food standards, guidelines and codes of practice to protect the health of consumers and ensure fair practices in the food trade, including in the areas of nutrition labelling and health claims. Food labelling rules are expected to be tightened in the future, though whether these rules are proactive or reactive will depend on the overall international context, and some have suggested that stricter labelling requirements might come into conflict with WTO rules.[48]

Increasing global cooperation in terms of food safety, food security, international information and early warning systems. Although information exchange systems have existed in the EU for several decades, global cooperation in exchanging information and expertise about risks has developed significantly in the last ten years, complementing EU level systems. EU systems include the Rapid Alert System for Food and Feed (RASFF), launched in 1979, the TRACES (TRAde Control and Expert System), a trans-European network for veterinary health that notifies, certifies and monitors imports, exports and trade in animals and animal products, and the Animal Disease Notification System (ADNS) that has as its main purpose the registration and documentation of important infectious animal diseases. For plant health, the EUROPHYT network is a recent notification and rapid alert system dealing with interceptions for plant health reasons of consignments of plants and plant products imported into the EU or being traded within the EU itself. In terms of general food safety, the Information Exchange

[48] Brückner, G K, "Ensuring Safe International Trade: How Are the Roles and Responsibilities Evolving and What Will the Situation Be in Ten Years' Time?," *Revue Scientifique Et Technique (International Office of Epizootics)*, Vol. 30, No. 1, April 2011, pp. 317–24. http://www.ncbi.nlm.nih.gov/pubmed/21809774.

Platform (IEP) was launched in 2008 by EFSA to provide a platform to facilitate the exchange of risk assessment outputs undertaken by official bodies in different Member States.

These EU systems are complemented at international level. The World Animal Health Information System, better known as WAHIS, is an internet-based computer system that processes data on animal diseases in real-time and then informs the international community. It forms the basis for the World Animal Health Information Database (WAHID). The FAO, WHO, and the OIE jointly operate the Global Early Warning System for Major Animal Diseases, including Zoonoses (GLEWS), to combine and coordinate disease incident alert mechanisms, epidemiological analyses, and risk assessments from all three organisations, while linking international community networks and stakeholders, to contribute to early warning, prevention, and control of animal disease threats. Similarly, the WHO and FAO set up INFOSAN, the International Food Safety Authorities Network, which alerts national bodies on the occurrence of regional or global concerns for a food safety event. The WHO also launched FOSCOLLAB in early 2013, a global platform for food safety data and information enabling food safety professionals to access and exchange data on global food safety issues.

The EU itself plays a key role in international fora such as the UN, FAO, G8, and the G20, advancing international cooperation in the areas of food safety and security. Practical results to date of this cooperation include the Agricultural Market Information System (AMIS), a G20 initiative to enhance food market transparency and encourage coordination of policy action in response to market uncertainty, and the 2012 L'Aquila Food Security Initiative (AFSI), launched in 2009 at the G8 Summit in Italy. The long-standing Committee on World Food Security (CFS) was set up in 1974 as an intergovernmental body by the FAO to serve as a forum for review and follow up of food security policies, addressing short-term crises but also long-term structural issues. Other initiatives are newer: the formation of the UN High-Level Task Force on the Global Food Security Crisis (HLTF) was triggered by the dramatic rise of global food prices in early 2008, while the United Nations System Standing Committee on Nutrition (UNSCN) promotes cooperation among UN agencies and partner organizations in support efforts to end malnutrition.

Given the continued rapid advances in information systems and internet penetration globally, the exchange of information through such initiatives is expected to increase in the future, and is expected to contribute to further global initiatives addressing relevant risks, such as the 'One Health Initiative', which promotes a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment.

Increased relevance of private food standards. Furthermore, global liberalisation of trade has given impetus for new *private* food grades and standards (G&S), pertaining to quality, safety, authenticity (e.g. of origin or traditional process) and aspects of the production process such as worker health and safety. The number of private standards and their influence on trade has risen steadily since the early 1990s, driven by forces of globalization, liberalisation, and changing consumer preferences.[49] An example is the banana industry, where multinational companies increasingly used standards since the 1990s as they sold some of their plantations,[50] while a consortium of British retailers developed the Food Technical Standard in 1998, shortly after EurepGAP in 1997.[51] A more recent example is the ISO 22000 standard launched in 2005. This

[49] Liu, P., *Private standards in international trade: issues and opportunities,* Paper presented at WTO's Workshop on Environment-Related Private Standards, Certification and Labeling Requirements, 2009.
[50] Liu, P., *Certification in the value chain for fresh fruits*, FAO, Rome, 2009.
[51] http://www2.globalgap.org/about.html

(voluntary) standard is applicable to the entire food chain ranging from primary producers over processing businesses (i.e. dairies, meat processors and bakeries) to retailers.

Private standards have sometimes filled in for missing public standards, especially in developing countries, and also to differentiate products and maintain brand integrity. However, the impact and future of private food safety standards are complex and uncertain. The development of private standards is often criticised as being insufficiently participatory, transparent and science-based. Compliance with private standards can be expensive for smaller producers and suppliers in developing countries, who are less able to deal with high levels of bureaucratic controls, leading to de-facto trade barriers. However, they also offer increased market opportunities to those who comply with such standards.[52] They may also lead to a renewed focus on broader nutritional aspects of food, rather than just safety, if public standards are found to be lacking in this regard. Whether the growth of private standards will continue at the same rate in future is uncertain.

Increased reliance upon international organisations and multilateral structures, combined with challenges from an increasingly multipolar world. The density of international regulatory frameworks has increased, linked to globalisation processes. For example, the creation of the WTO in 1995 represented a new phase in the institutionalisation of international trade frameworks, by creating a formal process for adjudicating international trade disputes. Through the WTO, the relevant international standards such as Codex Alimentarius have acquired legal authority. This has led to a more international, multi-level system of governance and standard setting. However, at the same time world governance in an increasingly multipolar world no longer revolves around a few large nation states. In particular, the influence of global food trading corporations, major manufacturers and retail chains on standard setting has increased. Furthermore, over the last two decades, most trade liberalisation has taken place not at the WTO level but within regional and bilateral trade agreements such as NAFTA (1994), MERCOSUR (1995), and the ASEAN free trade agreement (2010). This may lead to a weakening of the international structure defined by the WTO order, with more focus given to bilateral trade agreements between different regional blocs, as well as private standards. Despite this, even within the EU agreement on standards in some cases may encounter difficulties, as shown by the disparity between Members States' approaches to the cultivation of GM crops. The different positions may be based on differences in political will, but also perceptions of acceptable standards of risk. The opposing trends above make predictions difficult, since many issues are uncertain, including the future of global and regional trade agreements, public discontent over trade globalization, disputes around the level of science-based risk assessments, the shifting balance between public and private standards, the continued existence of agricultural protectionism and a trend toward re-nationalisation of agricultural commodities during recent price peaks.[53]

[52] Lee, G., *Private Food Standards and their Impacts on Developing Countries*, European Commission DG Trade Unit G2, Brussels, 2006.
[53] See also Ansell, Christopher, and David Vogel, *What's the Beef: The Contested Governance of European Food Safety Regulation.*, 2006.

3.3. EU governance

3.3.1. Introduction

EU governance significantly affects the future of EU food safety and nutrition. Relevant trends and uncertainties relate to:

- Further EU enlargement, potentially coupled with further market integration;
- Continuing reform of the Common Agricultural Policy (CAP);
- Continued consolidation of the food safety and nutrition legislative framework;
- Continuing challenge of ensuring enforcement;
- Rise in importance of communication concerning food safety and nutrition.

3.3.2. Trends and uncertainties

The EU will continue to enlarge, while the extent of further harmonisation and internal market integration is uncertain. EU membership has grown from 6 members in 1951, to 15 in 1995, to 25 in 2004, 27 in 2007, and 28 in 2013. Further enlargement is foreseen in the near future: in 2013 there were 5 candidate countries, and 3 potential candidates. Concurrently with enlargement the internal market has developed, both in size and depth. However, this process has created tensions between intergovernmental and federal visions of Europe, as has been recently illustrated during the financial crisis. Market integration has often required either the harmonisation of pre-existing regulatory regimes or the creation of new European frameworks overriding pre-existing national policies. Food and food safety have been at the forefront of the debates over regulatory harmonisation, in light of the strategic importance of food production in national and EU policy making.[54] Diverging interests and fault lines have been shown to exist both in the economic field and in the food area more specifically (e.g. regarding GMOs), meaning that the question of subsidiarity as opposed to increased EU oversight, and related questions of multi-level governance, will continue to be of relevance in the foreseeable future.

The future changes to the CAP are likely to have an impact on trade, production levels, and innovation. Reforms to the Common Agricultural Policy have been made in recent years, notably in 2003 and during the CAP Health check in 2008, to modernise the sector and make it more market-oriented. The Commission Communication "The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future", which was presented in November 2010, launched an institutional debate on the future of the CAP,[55] leading to a set of legal proposals to further reform the CAP that were outlined by the Commission in 2011. The aims of the proposals were to reduce by about 12.5% in real terms the CAP budget, devote more resources to innovation, encourage convergence between Member States, and to reform direct payments with regionalisation and the introduction of 'green' payments to encourage crop diversification, more permanent grassland, and support smaller farmers.[56] Following a debate in the European Parliament and the Council, on 16 December 2013 the Council of EU Agriculture Ministers formally adopted the four Basic Regulations for the reformed CAP as well as the Transition Rules for 2014, with a view to having the CAP reform in place as from 1st January

[54] Ansell, Christopher, and David Vogel, The Contested Governance of European Food Safety, 2006.p.7.
[55] European Commission, 'The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future', COM (2010)672, Brussels, 18.11.2010.
[56] At the time of writing; see European Commission, 'Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, COM (2013)226, Brussels, 18.4.2013.

2014.[57] While the reforms are now in place, key uncertainties concerning long-term effects of the reforms on production levels, redistributive and environmental improvements, and effects on trade remain. The long-term role and structure of the CAP itself after 2020 is also uncertain.

The EU food safety and nutrition framework has undergone substantial revision, and further consolidation is expected to continue. Since the mid-1990s, changes to the EU food safety framework have been more far-reaching than in other areas, largely as a consequence of the BSE crisis.[58] The European food safety framework was substantially renewed based on the 2000 White Paper on Food Safety and the subsequent General Food Law (Regulation (EC) No 178/2002). Core transformations included institutional and legislative changes at the EU level (establishment of EFSA, and emphasis on comprehensive legislation covering all stages of the food chain), at national levels (harmonisation of standards with EU legislation; responsibilities for control), and within food supply chains (primary responsibility of food businesses for food safety, traceability requirements etc.). The precautionary principle was enshrined into EU food safety legislation and policy. Since then, the new framework for food safety as envisaged in the White Paper has to a large extent been implemented. Remaining horizontal legislation (e.g. the Animal Health law and Plant Health law) are in the process of being concluded. Further review and consolidation of the EU food legislative framework, with an emphasis on the use of regulations instead of directives is expected to continue towards 2020 – in line with the Commission's Smart Regulation agenda,[59] particularly as food safety and the food chain were recently priority areas for reducing administrative burden[60] and regulatory fitness checks[61] respectively. A further uncertainty is to what extent concerns about nutrition will be better accounted for in the regulatory framework, in a context where obesity and chronic disease are becoming more widespread.[62] The role of the continuing economic crisis in influencing future policy decisions is also uncertain and potentially threatens to limit the resources and capabilities of food safety systems already in place.

Enforcement remains a continuing challenge in ensuring that risks are dealt with adequately, especially in times of economic crisis. EU Member States have to put in place control systems to safeguard that food businesses operate in line with their primary responsibility for food safety. At EU level, the Food and Veterinary Office works to assure effective control systems and to evaluate compliance with EU standards within the EU, and in third countries in relation to their exports to the EU. The FVO does this mainly by carrying out inspections in Member States and in third countries exporting to the EU. In recent years the FVO has carried out around 250 audits each year, covering the whole food chain as well as animal health and welfare and plant health. Audits in the food safety area make up the main part of the programme (at least 70% of all audits).[63] EU enlargement, the increased trade with third countries and the wider context of increasingly complex food supply chains, mean enforcement is likely to continue to be of great significance in guaranteeing food safety, and essential for

[57] See http://ec.europa.eu/agriculture/cap-post-2013/

[58] van Zwanenberg, P. and Millstone, E. 2005. BSE: risk, science and governance. Oxford: Oxford University Press.

[59] European Commission, EC COMMUNICATION: Europe 2020 A European Strategy for Smart, Sustainable and Inclusive Growth, Brussels, 2010.p.19.

[60] European Commission, COMMISSION STAFF WORKING DOCUMENT. Action Programme for Reducing Administrative Burdens in the EU, 2012.

[61] European Commission, EC COMMUNICATION: EU Regulatory Fitness, 2012.

[62] European Commission, White Paper on A Strategy for Europe on Nutrition, Overweight and Obesity related health issues, COM(2007) 279, Brussels, 30.5.2007.

[63] COM(2012) 122 final, Report of the Commission to the European parliament and the Council on the overall operation of official controls in the Member States on food safety, animal health and animal welfare, and plant health.

safeguarding consumer trust, even when food safety is not affected (as the recent confidence crises caused by mislabelled horse meat illustrates). Furthermore, Member States are requested to ensure that adequate financial resources are available for official controls. However, current information from Member State and FVO audits indicates widespread difficulties in the Member States to appropriately resource control services. During the last 4 years, EU inspectors have reported that the reason for identified shortcomings in control activities or for unsatisfactory or insufficient level of controls is attributed to the lack or shortage of resources. Such difficulties are exacerbated by the on-going economic and financial crisis and there is a risk that further pressure on public finances and on funds made available for official controls might adversely affect Member States' capacity to deliver efficient official controls and, consequently, the level of protection offered by EU law.[64]

Communication of food chain and nutrition issues will remain a central element of EU food governance. The reform of food safety legislation following the food scares of the 1990s involved the creation of EFSA, which plays a key role in communicating on risks associated with the food chain. Since then, the Commission has placed key importance on communication on risk to stakeholders/consumers to avoid taking unjustified or disproportionate measures in the case of a crisis, in the event that consumers incorrectly perceive risk.[65] Progress has been made in gaining an appreciation for consumer perceptions to food risk, the importance of understanding food benefits, as well as specific communication strategies.[66] The rise of social media may in particular influence traditional approaches to risk communication. In the US, the Centers for Disease Control and Prevention (CDC) already use social media as part of their communication procedures.[67] In light of persistent food scares, increased awareness of consumers about food safety and specific food quality aspects, the use of new food technologies (e.g. GM foods, animal cloning, nutrigenomics, nanotechnology, 3D food printing), and the rise of social media, communication is likely to gain in importance as an essential element of food chain governance.

[64] European Commission, COMMISSION STAFF WORKING DOCUMENT. Executive Summary of the Impact Assessment accompanying the document 'Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, COM(2013)265 final, SWD(2013) 167 final, Brussels 6.5.2013.

[65] European Commission (EC) (2007) A new Animal Health Strategy for the European Union (2007-2013) where "Prevention is better than cure" (Luxembourg: Office for Official Publications of the European Communities) p.11.

[66] FOODRISC, Bridging Communication Divides on Food Risk and Benefit Issues, 2010.

[67] FOODRISC, "PRESS RELEASE: Evaluating new media as a means to communicate food risks & benefits to consumers across Europe", 20 December 2010.

3.4. Demography and social cohesion

3.4.1. Introduction

Demographic and social change may introduce several new challenges to ensuring the food supply chain is protected and distribution guaranteed to European citizens. Relevant trends and uncertainties relate to:

- Increasing global population;
- Aging, more chronic illness-prone EU population;
- Increasing migration flows;
- Increasing inequality.

3.4.2. Trends and uncertainties

The global population is expected to grow to 9.3 billion in 2050. The main global demographic and social trends that drive increasing food demand are population growth, increasing urbanisation and rising incomes. The world population was projected to grow by 34% from 6.9 billion in 2010 to 9.3 billion in 2050 according to the UN (medium projection).[68,69] Future population growth is highly dependent on the path that future fertility takes. According to this medium projection, global fertility declines from 2.52 children per woman in 2005-2010 to 2.17 children per woman in 2045-2050. Slow population growth brought about by reductions in fertility leads to population ageing: Globally, the number of persons aged 60 or over is expected to more than triple by 2100, increasing from 784 million in 2011 to 2 billion in 2050 and 2.8 billion in 2100. Furthermore, already 65 per cent of the world's older persons live in the less developed regions and by 2050, 79 per cent will do so. By 2100, this figure will reach 85 per cent.[70] The EU population is projected to increase (from 501 million in 2010) up to 2040 by almost 5%, when it will peak (at 526 million). Thereafter, a steady decline occurs and the population shrinks by nearly 2% by 2060. Nonetheless, according to the projections, the EU population in 2060 will be slightly higher than in 2010, at 517 million.[71] The level of urbanisation across the globe is also expected to rise from 52% in 2011 to 67% in 2050, though this is expected to remain stable in the EU.[72] At the same time, wealthier citizens may move to rural areas, enabled by remote working.

The EU population will continue to age, and thus be more prone to chronic disease. Europe combines the demographic extremes of very high life expectancy and very low fertility.[73] In most EU Member States, life expectancy, currently 75 years for men and 82 for women on average, is set to increase by an additional 15 to 20 years in the course of this century. Total fertility rates have declined sharply in the EU Member States since the post-war 'baby boom' peak above 2.5 in the second half of the 1960s, to below the natural replacement level of 2.1.

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[68] United Nations, *World Population Prospects, the 2010 Revision.* At: http://esa.un.org/unpd/wpp/index.htm

[69] For other projections, see figure in Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2011). World Population Prospects: The 2010 Revision. New York: United Nations.

[70] Ibid.

[71] European Commission, *The 2012 Ageing Report: Underlying Assumptions and Projection Methodologies*, 2011.p.19.

[72] United Nations, *World Urbanization Prospects The 2011 Revision*, 2012.

[73] Reflection Group on the Future of the EU 2030, *PROJECT EUROPE 2030 Challenges and Opportunities*, 2010.

Although the total fertility rate for the EU as a whole is projected to rise modestly from 1.59 in 2010 to 1.71 by 2060, Europe's population is still ageing and its native-born labour force declining. By 2050, life expectancy at birth is projected to rise from 83 (in 2010) to 88 years in the EU overall, while the labour supply (those aged between 20-64) is projected to decrease from around 232 million people in 2010 to 208 million in 2060.[74,75]. An aging EU population will also lead to an aging of workforces, which may be especially problematic in the agricultural sector, and could lead to a decline in output. Furthermore, as chronic diseases increase in prevalence,[76] the gap between average life expectancy and average healthy life years may increase, with serious implications for healthcare services' supply and cost.[77]

The share of the EU population with a migratory background will increase. As skills shortages threaten the EU due to a declining and aging population, skilled immigrants will increasingly be needed.[78] For the EU as a whole, annual net inflows of migrants to the EU are projected to increase from about 1,018,000 people in 2010 (equivalent to 0.21% of the EU population) to 1,332,500 by 2020 and thereafter declining to 945,000 people by 2060 (a slightly smaller part, 0.18% of the EU population), according to one projection[79], although this is inherently difficult to predict as it depends on future policies in this regard, but significantly also on other factors such as climate change. Over the entire period (2010-2060), the cumulative net migration to the EU is projected to be about 60 million, or approximately 12% of the entire population. Depending on the cultures of countries of origin and destination, acculturation can have varying effects on demographics, social cohesion, economic performance, nutrition, and diets. Rural to urban migration as well as migration to different countries and cultural contexts may lead to changes in life style, notably changing dietary habits and activity patterns. At the same time, preferences among immigrants for foods from home, along with spillovers of immigrants' preferences into the broader population, will alter overall consumption patterns to a degree related to the overall flow of migration. Uncertainty remains as to what extent competition for skills and political issues will determine the number and composition of immigrants to the EU.

Inequality in the EU has been increasing and may continue to rise. Over the past 25 years, household disposable income per capita rose on average by almost 70% in OECD countries (3.1% annually), with somewhat smaller annual growth over the past 15 years. In the EU, average annual growth was 2.5%.[80] Although global poverty in absolute terms has fallen in recent decades, the economic growth of recent decades has benefited the rich more than the poor.[81] In some developed countries the gap also increased between the rich and the middle

[74] All projections from EUROPOP2010. In: DG ECFIN, 'The 2012 Ageing Report: Underlying Assumptions and Projection Methodologies', European Commission, Directorate-General for Economic and Financial Affairs, 2011.
[75] For age group projections, see figure in UN Population statistics, European Foresight Platform, taken from Leis, Miriam, and Govert Gijsbers, Active and Healthy Ageing – A Long-term View up to 2050, European Foresight Platform, 2011.
[76] Dutch National Institute for Public Health and the Environment, Europeans of retirement age: chronic diseases and economic activity, 2012.
[77] European Observatory on Health Systems and Policies, Tackling Chronic Disease in Europe: Strategies, interventions and challenges, Observatory Studies Series No. 20, 2010, p.17.
[78] Kahanec, M., and Zimmermann, K., High skilled immigration policy in Europe, DIW Berlin Discussion Paper1096, 2011.
[79] For more projections, see figure in European Commission, The 2012 Ageing Report: Economic and Budgetary Projections for the 27 EU Member States (2010-2060), 2012.p.52.
[80] Fredriksen, K., *Income Inequality in the European Union*, OECD Economics Department Working Papers No. 952, OECD Publishing, 2012.
[81] OECD, 2009.

class.[82] The problem of the aging population is also aggravated by increasing inequality, as elderly citizens suffer from an increasing retirement age, with various proposals including extending working life in order to maintain the balance of not spending more than a third of adult life in retirement.[83] In the EU, since the mid-1980s, the top income deciles have captured an increasing part of the income generated in the economy, while the poorest 10% are losing ground.[84] However, predicting future trends is difficult. A slight reduction in global income inequality is forecast for 2050, but this is dependent on various other baseline predictions remaining stable; an increase is also possible.[85]

[82] European Commission, *New challenges for agricultural research: climate change ,food security, rural development, agricultural knowledge systems,* European Commission, 2009.
[83] European Commission, White Paper on an Agenda for Adequate, Safe and Sustainable Pensions, COM(2012) 55, Brussels, 16.2.2012.
[84] Fredriksen, K., supra.
[85] Hillebrand, E., *Poverty, growth, and inequality over the next 50 years*, Expert Meeting on How to feed the World in 2050, Food and Agriculture Organization of the United Nations, Economic and Social Development Department, 2009.

3.5. Consumer attitudes and behaviour

3.5.1. Introduction

As the main drivers of demand, the ways in which consumers interact with the food chain have profound effects on what is produced and how it is produced. In addition, consumers' behaviour is strongly influenced by market players (and sometimes policy makers), such that often new demand is created where it would otherwise not have existed. Some trends are predominantly extra-EU and will thus only affect the EU food chain indirectly. However, within the EU trends are broadly characterised by an increasing polarisation of consumers in their attitudes to food and the food chain. Relevant trends and uncertainties relate to:

- Increasing global demand for meat;
- Diversification and polarisation of diets and lifestyles;
- Increasing prevalence of obesity;
- Intensifying consumer values in relation to food;
- Increasing concern about risks related to food safety and food chain inputs;
- Stagnating levels of trust in public authorities in the EU.

3.5.2. Trends and uncertainties

Global demand for agricultural products is widely expected to increase, but grow more slowly in the next forty years than the previous forty. Specifically, demand is expected to grow at 1.1% per year from 2005/2007 to 2050, down from 2.2% per year since 1970. In 2050, much of the world population will reach per capita consumption levels that would constitute satiety. Developed countries have predominantly livestock-based diets, and while global demand for meat is likely to increase as countries develop, not all developing countries are likely to shift in the future to levels of meat consumption typical of western diets (e.g. India, due to religious reasons), and differences with the consumption levels of meat and milk of developed countries may remain substantial. The growth of world food production needed to meet the growth of demand will therefore be lower than in the past, even after accounting for increases in per capita consumption and changes in diets. In developed countries, changes in per capita consumption will eventually translate into falling aggregate consumption in the early 2040s.[86,87] The latest projections for the EU forecast per capita meat consumption in 2022 at 82.6 kg, approximately the same level as in 2009 and 1% lower than in 2011. Pig meat is expected to remain the preferred meat in the EU with 40.8 kg/capita consumption in 2022.[88]

In the EU, diets and consumption patterns are increasingly diversified and polarised, and follow the increasing diversity of lifestyles. In general, EU consumers buy more portioned, packaged, prepared/convenience food, and at multiple times throughout the day. They spend less time preparing and cooking meals, and increasingly consume food out of the home. Nonetheless, a majority of Europeans still associate food and eating with pleasure, such as selecting fresh and tasty foods (58%) and with enjoyment of meals with friends and family

[86] Alexandratos, Nikos, and Jelle Bruinsma, "World Agriculture Towards 2030/2050: The 2012 Revision.," FAO, No. ESA Working paper No. 12–03, 2012, p. 3.
[87] For more details, see figure in Alexandratos, Nikos, and Jelle Bruinsma, "World Agriculture Towards 2030/2050: The 2012 Revision.," FAO, No. ESA Working paper No. 12–03, 2012, p. 5.
[88] European Commission, Prospects for Agricultural Markets and Income in the EU 2012-2022, 2012.p.4.

(54%).[89] Europeans also increasingly seek diverse foods and demand availability regardless of the season. On the other hand, consumers increasingly desire uniform food that corresponds to their image of food quality (which may or may not be justified).[90] Finally, Europeans on average also engage less in physical activity: in 2005, 36% of Europeans declared that they do not perform any physical activity by way of sport, recreational or leisure activities,[91] while in 2010 39% of Europeans said they never exercised or played sport.[92] This polarisation in diets and lifestyles is likely to continue in the short term; trends highlighted below in obesity and intensifying values are emblematic of this.

Obesity in EU consumers is increasing at an alarming rate and is becoming a serious public health problem. In 2010, more than half (50.1%) of the adult population in the European Union was overweight or obese. The prevalence of overweight and obesity among adults exceeded 50% in 15 of 27 EU countries. There is little difference in the average obesity rate of men and women in the EU, with both at around 15%. The rate of obesity has more than doubled over the past two decades in most EU countries for which data are available. This increase occurred irrespective of obesity levels 20 years ago.[93] The groups causing greatest concern and for which the consequences may be particularly severe are children and adolescents. In 2007, on average 24% of children aged 6-9 years old in the EU were overweight or obese, associated with a dramatic rise in the incidence of type 2 diabetes in children and adolescents in recent years.[94,95] Furthermore, obesity is not only linked with diabetes, but also a broad spectrum of other chronic diseases such as cardiovascular disease and cancer. If these trends continue and no significant countervailing actions are taken from policymakers, obesity is likely to affect an increasingly larger share of the EU population in the next decades. According to one study, projections for England show that by 2025, 47% of men and 36% of women are estimated to be obese, and by 2050 these proportions could rise to 60% and 50% respectively.[96,97]

Some EU consumer groups increasingly demand food in line with specific values. These values can relate to, inter alia, animal welfare, religious values, methods of production and processing (e.g. organic, GMO-free), environmental and ecosystem impacts (e.g. carbon foot printing/labelling); health concerns (e.g. functional or dietetic foods, especially if prevalence of obesity and chronic diseases in general continues to rise); terms of trade (e.g. fair price for producers and suppliers); working conditions (e.g. labour standards); and the social capital of farmers' communities.[98] As examples, in 2012, 76% of respondents to a survey in the EU were concerned about global food security; 96% about food quality; 71% about food origin; and 67%

[89] European Commission, Special Eurobarometer 354 - Food-related Risks, 2010.
[90] The Government Office for Science, Foresight Project: C1: Trends in Food Demand and Production, London, 2011.p.13.
[91] European Commission, "Special Eurobarometer 246 - Health and Food," December 2005, 2006.p.65.
[92] European Commission, Special Eurobarometer 334 - Sport and Physical Activity, 2010.p.9.
[93] OECD/European Union (2010), "Overweight and Obesity among Adults", in Health at a Glance: Europe 2010, OECD Publishing.
[94] WHO European Childhood Obesity Surveillance Initiative 2008: weight, height and body mass index in 6–9-year-old children.
[95] D'Amario, Rosanna, and Isabelle de Froidmont-Görtz, The Fight Against Obesity Examples of EU Projects in the Field of Nutrition and Obesity, European Commission, Brussels, 2005.p.3.
[96] McPherson, Klim, Tim Marsh, and Martin Brown, Foresight: Tackling Obesities: Future Choices – Modelling Future Trends in Obesity and the Impact on Health, 2007.p.13.
[97] For more details, see figure in McPherson, Klim, Tim Marsh, and Martin Brown, Foresight: Tackling Obesities: Future Choices – Modelling Future Trends in Obesity and the Impact on Health, 2007, p.14.
[98] Transparent Food, Transparency in the Food Chain: Towards 2020, University of Bonn/ILB, 2011.p.30.

checked food purchases to see if they had quality labels.[99] Also, a majority (63%) of respondents to an EU survey in 2007 showed some willingness to change their usual place of shopping in order to be able to purchase more animal welfare-friendly products.[100] In addition, in 2011, 90% of EU survey respondents agreed that buying local food is beneficial and that the EU should promote their availability.[101] A strong indicator of the trend in concern for terms of trade is notable in the UK, where from 2001 to 2011, retail sales for Fairtrade-certified products saw a 26-fold increase, from £50.5 million to £1,319.3 million.[102] As for organic food, in 2009, the European turnover of the organic food market was 18.4 billion Euro, wherein Germany and France have the highest turnover of organic foods (in total 5.8 billion Euro and 3 billion Euro, respectively), while the highest market shares were reached in Denmark with 7.2% of the total food turnover, followed by Austria with 6%.[103] Nonetheless, price remains an important factor for almost all Europeans (91%), especially for the worse-off.[104] The way in which consumer values relating to food will evolve in the future is uncertain; new technologies such as nutrigenetic testing may change consumers' attitudes towards making healthy food choices and reduce potential genetic risks related to the intake of certain foods, for example.

Europeans are increasingly concerned about risks relating to food safety and food chain inputs. From 2005 to 2010s,[105] Europeans have become increasingly worried about a range of food-related risks, in particular chemical residues from pesticides, antibiotics, and pollutants like mercury and dioxins; however, concerns in relation to new viruses in animals or BSE decreased since 2005. Regarding genetically modified organisms (GMOs) in particular, support has fluctuated: a general decrease in European support for GMOs occurred between 1991 and 1999, followed by an increase from 1999 to 2005; in 2005 the level of 'optimism' about the technology was then about the same as it had been in 1991.[106] Also, a majority of EU consumers in 2010 did not feel confident in dealing with possible risks from animal infections or diseases (zoonoses) which could be transmitted to humans (52%); possible problems of chemical contamination (>60%) and new technologies (>70%).[107] In addition, evidence shows that food scares can considerably influence food safety perceptions and thus impact retail prices.[108] While the future development of these trends is difficult to forecast, it is possible that they continue in the short term; their long term development will depend, inter alia, on the transparency of communication of the nature of risks and the frequency of food scares.

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[99] European Commission, Special Eurobarometer 389 - Europeans' attitudes towards food security, food quality and the countryside, 2012.

[100] European Commission, Special Eurobarometer 270 - Attitudes of EU Citizens Towards Animal Welfare, 2007.p.49.

[101] European Commission, Special Eurobarometer 368 - The Common Agricultural Policy, 2011.

[102] See http://www.fairtrade.org.uk/what_is_fairtrade/facts_and_figures.aspx.

[103] See http://www.sippo.ch/internet/osec/en/home/import/publications/ food.-ContentSlot-98296-ItemList-61735-File.File.pdf/SIPPO_Manual_18.04.2011_final.pdf. See also Kahl, Johannes, Aneta Załęcka, Angelika Ploeger, Susanne Bügel, and Machteld Huber, "Functional Food and Organic Food Are Competing Rather Than Supporting Concepts in Europe," Agriculture, Vol. 2, No. 4, October 17, 2012, pp. 316–324. http://www.mdpi.com/2077-0472/2/4/316/. P.317.

[104] European Commission, Special Eurobarometer 389 - Europeans' attitudes towards food security, food quality and the countryside, 2012.p.4.

[105] See figure in European Commission, Special Eurobarometer 354 - Food-related Risks, 2010, p.23.

[106] Gaskell, G., Allansdottir, A., Allum, N., Corchero, C., Fischler, C., Hampel, J., Jackson, J., Kronberger, N., Mejlgaard, N., Revuelta, G., Schreiner, C., Stares, S., Torgersen, H. and Wagner, W. 2006. Europeans and Biotechnology in 2005: Patterns and Trends.

[107] European Commission, Special Eurobarometer 354 - Food-related Risks, 2010.

[108] Carter, Colin and Aaron Smith, Estimating the Market Effect of a Food Scare: The Case of Genetically Modified StarLink Corn, 2006.

Uncertainty in public authorities' ability to handle food risks is persisting. In 2010, Europeans responding to a survey had a relatively high level of confidence in national and European food safety agencies (EFSA) and European institutions concerning information on food-related risks, while this was less pronounced for national governments. Recent history has, however, shown that levels of public confidence in institutions responsible for controlling food standards and safety can show marked volatility. In 2010 there was a broad level of agreement – increased compared to 2005 – among EU consumers responding to a Eurobarometer survey, that public authorities in the EU do a lot to ensure that food is safe in Europe, are quick to act, base their decisions on scientific evidence and do a good job in informing people about food-related risks.[109] A majority of respondents also considered that possible risks from animal infections and bacterial contamination, and to health from particular diets are being adequately dealt with by public authorities in the EU. However, slightly more respondents across the EU worried about the news on food safety matters they heard in 2010 compared to five years ago (26% vs. 23% in 2005), and less than half of surveyed EU citizens thought that scientific advice on food-related risks is independent of commercial or political interests. Further, a majority of respondents did not see authorities in the EU as adequately dealing with possible risks from chemical contamination of foods (pesticide residues or environmental pollutants like mercury in fish) and new technologies (animal cloning and nanotechnology) (42%).[110] These opposing current trends indicate that trust in public authorities and as such in food quality may not increase in the short to medium term and will remain vulnerable to unanticipated food scares.

[109] European Commission, Special Eurobarometer 354 - Food-related Risks, 2010.
[110] Ibid.

3.6. New food chain technologies

3.6.1. Introduction

New food chain technologies may increase productivity of the food chain and quality of foods, and could help in addressing a number of societal challenges such as an ageing population, the effects of climate change, and the reduced availability of resources. Despite this, concerns remain about the safety and acceptability of these technologies in the food chain, and concurrent incremental innovations in conventional technologies can also be anticipated. Relevant trends and uncertainties relate to:

- Expected increase in the use of biotechnology and GMOs;
- Increase in productivity from other primary production technologies (e.g. management practices, aquaculture);
- Expected increase in the use of nanotechnology;
- Increased medicalisation of food and new forms of food;
- Increased use of information and communication technologies (ICTs);
- New processing and packaging technologies.

3.6.2. Trends and uncertainties

Biotechnology (e.g. GMO) use in the food chain is expected to increase, in an environment of growing competition for key resources. Biotechnology incorporates a number of different technologies; the main applications in agriculture encompass marker assisted selection (MAS), genetic modification, propagation, therapeutics and diagnostics. A prominent example is the application of MAS to animal breeding programmes.[111] Spurred on by the identification of DNA as a genetic material in 1953, genetics have transformed plant and animal breeding.[112] Biotechnologies offer the potential for greater efficiency for producers and processors, as well as additional benefits for consumers.[113] Still, the introduction of these into the food chain takes time and significant resources to deal with regulatory costs – as shown by the 12-15 years needed from the first DNA constructs to commercial introduction of GM crops.[114] In 2006, the countries that grew 97 per cent of the global transgenic crops were the United States (53%), Argentina (17%), Brazil (11%), Canada (6%), India (4%), China (3%), Paraguay (2%) and South Africa (1%). The majority of these crops were herbicide- and insect-resistant soya beans, corn, cotton, canola and alfalfa.[115] Within the OECD region, one estimate shows that in primary

[111] European Commission - Standing Committee on Agricultural Research, *Sustainable Food Consumption and Production in a Resource-constrained World. The 3rd SCAR Foresight Exercise*, *European Commission – Standing Committee on Agricultural Research (SCAR)*, 2011.
[112] The Government Office for Science, Foresight Project: C6: Raising the Limits of Sustainable Production, London, UK, 2011. p.3.
[113] The Government Office for Science, Foresight: Technology and Innovation Futures : UK Growth Opportunities for the 2020s – 2012 Refresh, London, 2012. p.21.
[114] The Government Office for Science, Foresight Project: C6: Raising the Limits of Sustainable Production, London, UK, 2011. p.20.
[115] Kearney, John, "Foresight Project: DR3: Food Consumption Trends and Drivers.," *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, Vol. 365, No. 1554, September 27, 2010, pp. 2793–807. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2935122&tool=pmcentrez&rendertype=abstract.p.2801.

production, while biotechnology will not be widely used in boreal forests, in 2030 it could contribute to half of agricultural production and almost all of aquaculture and plantation forestry, for a total contribution of approximately 50% of primary production output.[116] However, future consumer acceptance of GMOs and animal cloning remains uncertain,[117] while ethical and safety concerns will play a major role in the adoption of biotechnology.[118]

Other primary production technologies are expected to improve productivity. Beginning most markedly during the Green Revolution in the late 1960s but continuing until today, high-yielding varieties of cereal grains, expansion of irrigation infrastructure, modernization of management techniques, distribution of hybridized seeds, synthetic fertilizers, and pesticides have allowed for a dramatic increase in agricultural yields. While there is a high degree of uncertainty as to the adoption and success of new technology, this trend is expected to continue in the next decades. Regarding wheat for example, one forecast expects a 50% increase in average farm yields to about 13 tonnes/ha by 2050.[119] Despite this, the rate of yield improvement for cereal production has been slowing since the mid-1980s, and some say there will be need for alternative kinds of technological intensification that are less dependent on scarce resources.[120] Recent successes have in particular been recorded from making changes in the management of plants, soil, water and nutrients. These include agroecologically-based innovations that reduce farmers' dependence on external inputs, relying more on endogenous processes and existing potentials in plants and soil systems[121]. Other technological improvements on land may include further automation. Two types of autonomous robotic systems could potentially become more widespread within the near future (although uncertainty remains as to whether these will be introduced in practice): larger robots that can carry out various crop-related tasks independently and small robots that are able to carry out crop-related tasks very selectively and in particular patches.[122] These may help reduce labour costs per product unit; automation can also be further applied throughout the food chain, covering also distribution and processing industries.[123] Finally, highly productive technologies have also been developed in the context of marine resources. Over the last two decades, major improvements in aquaculture productivity have been achieved, through the provision of secure and inexpensive

[116] Organisation for Economic Co-operation and Development (OECD), The Bioeconomy to 2030: Designing a Policy Agenda, Paris, France, 2009. p.199.
[117] Nowicki, Peter, Chloé Weeger, Hans van Meijl, Martin Banse, John Helming, Ida Terluin, David Verhoog, et al., SCENAR 2020 Scenario Study on Agriculture and the Rural World, European Commission Directorate-General for Agriculture and Rural Development, Brussels, Belgium, 2006. p.93.
[118] Freibauer, Annette, Erik Mathijs, Gianluca Brunori, Zoya Damianova, Elie Faroult, Joan Girona i Gomis, Lance O´Brien, and Sébastien Treyer, Sustainable Food Consumption and Production in a Resource-constrained World, European Commission – Standing Committee on Agricultural Research (SCAR), 2011. p. 87.
[119] Food and Agriculture Organization (FAO), Looking Ahead in World Food and Agriculture: Perspectives to 2050, Edited by Piero Conforti, Food and Agriculture Organization of the United Nations, Rome, Italy, 2011.p.427.
[120] Uphoff, Norman, "Supporting Food Security in the 21st Century Through Resource-conserving Increases in Agricultural Production," Agriculture & Food Security, Vol. 1, No. 1, 2012, p. 18. http://agricultureandfoodsecurity.com.uat.test/content/1/1/18. p.1.
[121] Ibid.
[122] European Commission, SCENAR 2020 Scenario Study on Agriculture and the Rural World, 2006. p.66-67.
[123] Nowicki, Peter, Chloé Weeger, Hans van Meijl, Martin Banse, John Helming, Ida Terluin, David Verhoog, et al., *SCENAR 2020 Scenario Study on Agriculture and the Rural World*, Vol. 1, Vol. 1, European Commission Directorate-General for Agriculture and Rural Development, Brussels, Belgium, 2006.

holding facilities for fish stocks and the close management of rearing environments.[124] However, much of the feed currently provided to farmed fish derives from wild fish, so the extent to which aquaculture can alleviate pressure on fisheries is uncertain.[125] By 2015, aquaculture is projected to surpass capture fisheries as the most important source of fish for human consumption, and by 2020 could represent about 45% of total fishery production (including non-food uses).[126]

The use of nanotechnology in the food chain is increasing, but uncertainties over risks remain. While still at an early stage of development, spending on nanotechnology - technology associated with particles of 1-100 nm in size - is rapidly increasing and the number of nanotech patents is rising.[127] The global market for nanotechnology was valued at nearly $20.1 billion in 2011 and one forecast shows total sales reaching $48.9 billion in 2017.[128] The presence of nanomaterials in foods is not new – as shown by the example of ricotta cheese and certain chocolates -[129] while some food products containing nanoscale additives are already commercially available.[130] Out of 1000 nanotech commercial products, 50 were found to be directly related to food.[131] Nanotechnologies in the food industry have multiple functions: their first application is in food packaging, where they improve functionality. Other applications aim at improving taste, enhancing the bioavailability of certain ingredients, reducing the content of some elements such as sugar and salt, and slowing down microbial activity.[132] According to one forecast, by 2020, nanotechnology could bring about radical new approaches to assist crop production and storage.[133] Further applications include sensors and diagnostic devices, disease and pest control, and even agriculture as a potential for the production of nanomaterials.[134] However, uncertainty persists in the EU on how to accurately define nanotechnology in the EU (in relation to the importance of particle size).[135] This lack of an accurate definition compounds difficulty in regulating the technology. In addition, the unique features of nanomaterials are not fully explored and raise concerns about potential environmental, health and general safety hazards. For example, some new nanomaterials may have the potential to enter the human body

[124] The Government Office for Science, Foresight Project: C6: Raising the Limits of Sustainable Production, London, UK, 2011. p.3.
[125] FAO, FAO Technical Guidelines for Responsible Fisheries. Supplement 5. Aquaculture Development 5. Use of Wild Fish as Feed in Aquaculture, 2011.p.13.
[126] OECD, and FAO, OECD-FAO Agricultural Outlook 2011-2020, OECD/FAO, 2011. p.15.
[127] Institute for the Future, Science & Technology Outlook: 2005–2055, Palo Alto, CA, 2005. p.5.
[128] http://www.bccresearch.com/report/nanotechnology-market-applications-products-nan031e.html
[129] http://www.publications.parliament.uk/pa/ld200910/ldselect/ldsctech/22/2204.htm
[130] Thornton, Philip K, "Foresight Project: DR5b: Livestock Production: Recent Trends, Future Prospects.," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 2853–67. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2935116&tool=pmcentrez&rendertype=abstract. p.13.
[131] Freibauer, Annette, Erik Mathijs, Gianluca Brunori, Zoya Damianova, Elie Faroult, Joan Girona i Gomis, Lance O´Brien, and Sébastien Treyer, Sustainable Food Consumption and Production in a Resource-constrained World, European Commission – Standing Committee on Agricultural Research (SCAR), 2011. p.82.
[132] European Commission - Standing Committee on Agricultural Research, *Sustainable Food Consumption and Production in a Resource-constrained World. The 3rd SCAR Foresight Exercise*, *European Commission – Standing Committee on Agricultural Research (SCAR)*, 2011.
[133] Office, Government, and The Government Office for Science, Foresight: Technology and Innovation Futures: UK Growth Opportunities for the 2020s – 2012 Refresh, London, 2012. p.22.
[134] Robinson D. K. R. And Morrison M. J. Nanotechnology Developments for the Agrifood Sector - Report of the ObservatoryNANO, May 2009.
[135] European Commission, Second Regulatory Review on Nanomaterials, COM(2012) 572 final, 2012.

through mucous membranes or the skin and migrate via the blood stream to vital organs, or the brain, interacting with other cells in unpredictable ways, which may have potential cytotoxic or genotoxic effects.[136] If a major safety event involving nanotechnology took place, this would make the rate of adoption of nanotechnology highly uncertain and dependent on public acceptance. Moreover, the extent to which the presence of nano-ingredients is clearly labelled on products will determine consumers' awareness of the technology and thus overall demand.

Increased medicalisation of food and functional foods, and new forms of food. Developments in biotechnology and nutritional science allow food manufacturers to produce so-called 'functional foods', with alleged health-promoting or disease-preventing qualities. Current examples include yoghurts and fermented milk drinks containing probiotics (bacteria that are claimed to confer a health benefit), margarines containing phytochemicals to help lower cholesterol levels, as well as foods fortified with omega-3 polyunsaturated fatty acids, and vitamins. Given rapid developments in these areas, more products may be expected in the future, with the dividing line between food and medicine disappearing; one estimate expects the world market for functional foods and drinks to reach $130 billion by 2015.[137] It is envisaged that the development of functional foods will continue to grow in industrialized countries, fuelled by increasing life expectancy, higher prevalence of non-communicable diseases, increasing healthcare costs and the acceptance of the strong link between diet and health.[138]

A further development that may have a large impact over the coming decades is that of 'cultured meat', where meat is produced in vitro using tissue engineering techniques, usually by cultivating livestock muscle cells in a growth media. While this technology is still at the research stage, studies on the environmental impact of the adoption of such meat show that GHG emissions, land use and water use would be reduced significantly, compared to current meat production practices.[139] Indeed, one life cycle assessment found that in comparison to conventionally produced European meat, cultured meat involves approximately 7–45% lower energy use, 78–96% lower GHG emissions, 99% lower land use, and 82–96% lower water use depending on the product compared.[140] Should this technology become widespread, new approaches to food safety testing and consumer information provision will also be needed. And as the demand for protein rises globally, the exploitation of new food sources derived from insects, seaweeds, algae, and other previously unused sources will also increase. An increase in artificial flavourings may also pose challenges to regulation and risk assessment.

Improvements in ICTs (Information and communications technology) could be further integrated in the food chain. ICTs are increasing in importance for agriculture.[141] In the EU, a

[136] Monteiro-Riviere, N. A., et al. 'Multi-walled carbon nanotube interactions with human epidermal keratinocytes.', *Toxicology letters* 155.3, 2005, pp.377-384.
[137] See http://www.reportlinker.com/ci02036/Functional-Food.html.
[138] Kearney, John, "Foresight Project: DR3: Food Consumption Trends and Drivers.," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 2793–807. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2935122&tool=pmcentrez&rendertype=abstract.p.2800.
[139] Tuomisto, H.L. & Roy, A.G. (2012) Could cultured meat reduce environmental impact of agriculture in Europe? 8th International Conference on LCA in the Agri-Food Sector, Rennes, France, 2-4 October 2012
[140] Environmental Impacts of Cultured Meat Production, Hanna L. Tuomisto and M. Joost Teixeira de Mattos, Environmental Science & Technology 2011 45 (14), 6117-6123
[141] Freibauer, Annette, Erik Mathijs, Gianluca Brunori, Zoya Damianova, Elie Faroult, Joan Girona i Gomis, Lance O´Brien, and Sébastien Treyer, Sustainable Food Consumption and Production in a Resource-constrained World, European Commission – Standing Committee on Agricultural Research (SCAR), 2011. p.86.

primary purpose of ICTs is providing farmers with information through various services on market information, weather forecasts, crop and livestock disease, and dissemination of scientific advice and best practice. Certain recent developments in ICTs (e.g. GIS and GPS) allow for precision agriculture, i.e. accurate calculation of yields from land, based on rainfall and incidence of pests and disease, and thus optimisation of agricultural inputs (water and fertiliser).[142,143] Other ICTs allow for continuous automated real-time monitoring/controlling of production/reproduction, health and welfare of livestock and the environmental load.[144] However, ICTs have also led to 'just-in-time' practices across the food chain, which, while minimising costs relating to inventory storage and enhancing freshness, may make food chains more vulnerable to disruption. Lastly, current ICTs providing smart sensing, tracing, packaging, monitoring and reporting are likely to improve food safety processes.[145] Reducing food poverty and increasing food security by 2030 can be driven by improvements in ICTs in the areas of producing food, processing/packaging food, distributing/retailing food, and consuming food in the food system.[146] Together, information from these systems combined with advanced data management and analysis could be a tool to predict future food chain developments, including the spread of pathogens or pandemics (e.g. via network science). While the current implementation of these ICTs varies widely across Member States and individual food chains, given global drivers such as major reductions in technology costs, global investment in network infrastructures, and declining transaction costs for information exchange, it can be expected that the use of ICTs in the food chain will significantly increase in the coming years. In addition, it cannot be ruled out that new consumer ICTs unrelated to the food chain in particular have profound indirect effects relevant for the food chain, in the same way as the internet in the 1990s and smartphones in the 2000s have and are likely to continue to do so (e.g. internet food ordering, specific apps/internet services to meet consumer food choices and preferences.)[147]

Processing, packaging, and distribution/retail technology could make food chains more efficient and less wasteful. New technologies are also expected to have a major impact on processing, packaging, storage and consumption.[148] Traditional forms of processing and packaging food products have become increasingly innovative, and this trend is expected to continue.[149] It is projected that sensors, automation and low cost spectroscopy will enhance quality control in food processing. Low cost printing technologies will reduce packaging costs, while smart packaging will permit spoilage identification and sensors will measure freshness and nutritional content, thus helping to reduce food waste.[150] Radio frequency identification (RFID) tags are expected to improve logistics and value chain management in combination with ICTs. RFID technology can help detect the quality and origin of goods prior to entering a

[142] The Government Office for Science, Foresight Project: C5: Producing More Food Sustainably, Using Existing Knowledge and Technologies, London, UK, 2011. p.8.
[143] U.S. Grains Council, Food 2040 The Future of Food and Agriculture in East Asia, 2011. p.120.
[144] European Commission, "International Conference on: Empowering Consumers and Creating Market Opportunities for Animal Welfare," Brussels, Belgium, 2012, pp. 1–26. p.23.
[145] COST, Foresight 2030 Benefitting from the Digital Revolution Workshop on Food Security, 2009. p.8.
[146] COST, Foresight 2030 Benefitting from the Digital Revolution Workshop on Food Security, 2009. p.12.
[147] COST, Foresight 2030 Benefitting from the Digital Revolution Workshop on Food Security, 2009.p.12.
[148] Ulmann, Laurent, "Food Safety in Europe: Developments and Prospects," The European Files, Paris, France, December 2011. p.20.
[149] European Commission, "European Research on Traditional Foods," Brussels, Belgium, 2007. p.11.
[150] COST, Foresight 2030 Benefitting from the Digital Revolution Workshop on Food Security, 2009. p.12.

supermarket for sale much more efficiently and significantly increase transparency of the flow of goods.[151] RFID technology has an 80% likelihood of being fully implemented and having a relatively large impact on the food chain by 2025 according to one foresight study.[152] Another trend is the increasing use of so-called 'mild' processing techniques, where product quality, taste and freshness are preserved while microbiological safety is ensured through techniques such as mild heat treatments, high pressure, pulsed electric fields or intense light pulses or they are treated with organic acids and chlorine dioxide. However, such treatments may not always result in complete inactivation of pathogens, potentially leading to greater microbial resistance.[153]

[151] European Commission, and International Conference, INTERNATIONAL CONFERENCE PERSPECTIVES FOR FOOD 2030, Brussels, 2007. p.16.
[152] See tables in COST, Foresight 2030 Benefiting from the Digital Revolution Workshop on Food Security, 2009. p.15.
[153] Top Institute Food and Nutrition (TIFN), 'Safety and preservation issues with mildly processed foods', Food for thought, Issue no.2, December 2009.
http://www.nfia.com/fft/200912/article2.php

3.7. Competition for key resources

3.7.1. Introduction

Europe has the world's highest net imports of resource per person, and its open economy relies heavily on imported raw materials and energy. Research indicates that as demand increases, key resources required for agriculture and related infrastructure are likely to suffer from increasing shortages over the next decades. Several of these shortages may spark rising competition between a variety of actors and present critical challenges to EU food safety and nutrition. Relevant trends and uncertainties relate to:

- Increasing demand for non-renewable energy sources;
- Increasing scarcity of fertile soils;
- Increasing pressure on fresh water resources;
- Increasing scarcity of phosphorus for fertilisation;
- Diminishing biodiversity, genetic diversity, and ecosystem services;
- Increasing difficulty in supplying animal proteins sustainably.

3.7.2. Trends and uncertainties

Global demand for non-renewable energy sources like oil and gas will continue to increase; but future supply trends may be changed by new technologies such as hydraulic fracturing ('fracking'), or the exploration of marine methane hydrates. World energy consumption is expected to grow by 56% between 2010 and 2040. Total world energy use rises from 524 quadrillion British thermal units (Btu) in 2010 to 630 quadrillion Btu in 2020 and to 820 quadrillion Btu in 2040.[154,155] Much of the growth in energy consumption will occur in countries outside the OECD, where demand is driven by strong, long-term economic growth. Energy use in non-OECD countries is expected to increase by 90%; in OECD countries, the increase is expected to be 17%.[156] As a result, prices are expected to increase in the long term, with world oil price in real 2011 dollars reaching $106 per barrel in 2020 and $163 per barrel in 2040, in a reference scenario.[157,158]

Fossil fuels will remain the principal sources of energy; this is despite rapid projected growth in the renewable and nuclear energy sector, for which the total energy use could rise from 11% in 2010 to 15% in 2040, and from 5% to 7%, respectively.[159] In the EU, renewable energy is to reach a 20% share of EU energy consumption by 2020 according to the Renewable Energy Directive, up from 12.7% in 2010.[160] In terms of supply, gains may occur from new sources such as oil sands in Canada, deep-water production, and new technologies such as shale gas 'fracking'. Offshore methane hydrates are a further source of natural gas that may hold up to several times more natural gas than all global shale gas deposits combined. This makes reserve projections difficult. A strong possibility however, is that energy scarcities lead to international

[154] See figure in U.S. Energy Information Administration, International Energy Outlook 2013, 2013. 'Btu': British thermal unit. Source data : http://www.eia.gov/forecasts/ieo/index.cfm
[155] U.S. Energy Information Administration, International Energy Outlook 2013, 2013.p.1.
[156] Ibid.
[157] See figure in U.S. Energy Information Administration, International Energy Outlook 2013, 2013.p.25.
[158] U.S. Energy Information Administration, International Energy Outlook 2013, 2013. p.2.
[159] Ibid.p.2.
[160] http://ec.europa.eu/energy/renewables/reports/reports_en.htm

conflicts and realignments, and more strategic alliances to establish regional energy deals. The growing scarcity of conventional fossil fuel resources coupled with the potential emergence of unconventional resources may lead to a resurgence of resource nationalism, and political and physical threats to energy supply will persist in the medium term. In this context, unstable and conflict-prone relations between supplier, transit and EU consumer countries, for example in Eastern Europe and the Caspian/Central Asian region, will continue to pose problems for European energy security over the next 20 years. Furthermore, unconventional sources of fossil fuels may pose unpredictable environmental risks.[161]

Fertile soils will become scarcer in a global perspective. Though growth in demand over the next decades is expected to be slower than from the 1970s to now, a 60% increase in agricultural production by 2050 may be needed in order to cope with projected population increase and to raise average food consumption to 3,070 kcal per person per day.[162] Agriculture already occupies about 37% of the global land surface of which less than one third (9-10%) is cropland, while two thirds are used for animal production, mainly extensive grazing. This reflects the historical trend of bringing more land into agricultural production as the solution to growing demand for food.[163] However, 78% of the increase in global crop production between 1961 and 1999 was attributable to yield increases and only 22% to expansion of harvested area.[164] This growth in agricultural productivity has been accompanied by negative side-effects or externalities on land and water resources, both on-farm and downstream.[165] Of the 11.5 billion hectares of vegetated land on earth, 24% has undergone human-induced soil degradation, in particular through erosion.[166] In addition, crop production will need to compete with growing needs for land for other uses, including urbanisation. In the EU, more than 1,000 km^2 are subject to 'land take' every year for housing, industry, roads, or recreational purposes.[167] Considerable uncertainty exists over projections of intensity of competition for land in the future, and the regional distribution of this competition.[168] Future policy decisions in the agriculture, forestry, energy (in particular regarding biofuels) and conservation sectors could have profound effects, with different demands projected to intensify competition for land in the future.[169] In Europe, the importance of maintaining sufficient levels of production and ensuring sustainability is clear, but there are tensions in this relationship. For example, though organic agriculture often

[161] Broomfield, M, *Support to the Identification of Potential Risks for the Environment and Human Health Arising from Hydrocarbons Operations Involving Hydraulic Fracturing in Europe*, 2012.
[162] Alexandratos, Nikos, and Jelle Bruinsma, World Agriculture Towards 2030/2050: The 2012 Revision., FAO, 2012.p.19.
[163] FAO, *THE STATE OF THE WORLD ' S LAND AND WATER RESOURCES FOR FOOD AND AGRICULTURE Managing Systems at Risk*, Food and Agriculture Organization of the United Nations, Rome, 2011.
[164] Bruinsma J. ed. World Agriculture: Towards 2015/2030 An FAO Perspective, 2003.
[165] FAO, *THE STATE OF THE WORLD ' S LAND AND WATER RESOURCES FOR FOOD AND AGRICULTURE Managing Systems at Risk*, Food and Agriculture Organization of the United Nations, Rome, 2011, p.103.
[166] Bai ZG, Dent DL, Olsson L and Schaepman ME 2008. *Global assessment of land degradation and improvement. 1. Identification by remote sensing*. Report 2008/01, ISRIC – World Soil Information, Wageningen.
[167] Report on best practices for limiting soil sealing and mitigating its effects, Prokop et al, European Communities, 2011.
[168] For more details on the drivers and pressures of competition for land, see figure in Smith, Pete, Peter J Gregory, Detlef van Vuuren, Michael Obersteiner, Petr Havlík, Mark Rounsevell, Jeremy Woods, Elke Stehfest, and Jessica Bellarby, "Foresight Project: DR7b: Competition for Land," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 2941–57, adapted from Contreras-Hermosilla (2000).
[169] Foresight DR7b, competition for land, 2010.

has positive effects on biodiversity (in terms of species richness and abundance),[170] yields may be 20-30% lower than conventional agriculture, depending on crop, thus increasing pressure on land.[171] Climate change may also cause a significant loss of agricultural land and unpredictable changes in land use.

Globally, demand for fresh water is increasing. Current levels of demand for water at the global level may already exceed sustainable supply. Water demand by 2030 could be as much as 40% greater than supply.[172,173] The supply gap varies by geography: it is most severe in developing countries and countries in transition. By 2050, 75% of the global population could face freshwater shortages. Agriculture is the largest user of water: production of food and other agricultural products currently takes some 70% of the freshwater withdrawals from rivers and groundwater, or roughly 3,100 billion m^3.[174] Under current agricultural conditions, water demand for agriculture will rise by 70-90% by 2050 in order to cater to the needs of the world's population at that time.[175] This masks some regional variation. For example, overall water withdrawals for irrigation in the high-income countries are expected to decline by 17% in 2050.[176] By contrast, withdrawals in the low-income, food-deficit countries are expected to increase by 10% - often in areas already experiencing water stress. Climate change is expected to have disruptive and unpredictable effects, including widespread changes in the distribution of precipitation, and decreased flows in river basins.[177]

Phosphorus production may not be able to meet future demand. Both phosphorus and nitrogen underpin the ability of agriculture to produce food, and neither is substitutable. However, while reserves of atmospheric nitrogen which are essentially unlimited (even if substantial fossil fuel is required for fixation of the nitrogen),[178] phosphorus reserves are relatively very limited. It exists only in phosphate rock concentrated in certain countries (such as Morocco). While estimates of 'peak phosphorus' range from 30 to 300 years and are shrouded by a lack of publicly available data and considerable uncertainty, there is a general consensus that the quality and accessibility of remaining reserves are decreasing and extraction costs will increase.[179] However, while the supply of high-grade cheap phosphate rock is likely to be constrained in the future, the overall demand for phosphorus is anticipated to increase. This could increase food safety risks, as lower grade phosphate rock generally features a higher

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[170] Bengtsson J, Ahnström J, Weibull A-C. 2005. The effects of organic agriculture on biodiversity and abundance: a meta-analysis. Journal of Applied Ecology 42, 261–269

[171] Seufert, V., Navin R., and Jonathan A. F. "Comparing the yields of organic and conventional agriculture." *Nature* 485, no. 7397, 2012, pp. 229-232.

[172] See figure in 2030 Water Resources Group, 'Charting our Water Future: Economic frameworks to inform decision making', McKinsey, 2009. - Global Water Supply and Demand model; IFPRI; FAOSTAT.

[173] 2030 Water Resources Group, 'Charting our Water Future: Economic frameworks to inform decision making', McKinsey, 2009. - Global Water Supply and Demand model; IFPRI; FAOSTAT.

[174] Cosgrove, Catherine E, and William J Cosgrove, *The Dynamics of Global Water Futures Driving Forces 2011 – 2050*, Paris, 2012.

[175] Ibid.

[176] FAO, supra, p.103.

[177] UNESCO, World Water Assessment Programme, p.6.

[178] Dawson, C.J., and J. Hilton, "Foresight Project: SR31: Fertiliser Availability in a Resource-limited World: Production and Recycling of Nitrogen and Phosphorus," *Food Policy*, Vol. 36, January 2011, pp. S14–S22.

[179] Cordell, Dana, and Stuart White, "Peak Phosphorus: Clarifying the Key Issues of a Vigorous Debate About Long-Term Phosphorus Security," *Sustainability*, Vol. 3, No. 12, October 24, 2011, pp. 2027–2049.

level of cadmium, a toxic heavy metal.[180] Declining phosphorus reserves have also prompted increased focus on phosphorus recovery from recycling that closes the nutrient cycle,[181] which would thus reduce pressure on phosphorus reserves. Although fertiliser demand is stabilising in parts of Europe and North America, where decades of over-application means that soils are saturated and thus only require application to replace what is lost in harvest,[182] phosphorus consumption is expected to increase in developing countries and emerging economies.[183]

Declining biodiversity and genetic diversity is destabilising ecosystems; marine food and ecosystem services may face severe stress in the coming decades, causing a decline in fisheries. Food production takes up more land and has a greater impact on the sea and freshwater bodies than any other facet of human activity.[184] This activity affects biodiversity and ecosystem services. Ecosystems provide a range of benefits to mankind that are termed ecosystem services:[185] these are categorised into provisioning services (direct goods such as food, fibre, or timbers), regulating services (providing pollinators, natural enemies of pests, local climate conducive to growth), supporting services (processes producing fertile soils, recycling water or nutrients), and cultural services (less tangible goods such as valued landscapes). The positive impacts of genetic diversity have also been documented, for example where planting genetically diverse varieties of crops tends to produce greater yields as well as resistance to herbivores and disease.[186] But as global population density has risen, the pressure on natural environments has steadily increased. This has led to the depletion of the resources (fish, timber, water, fertile soils, clean air, biomass, biodiversity) and environmental systems of which they are part, and some resources are already beyond their global sustainable limits.[187] About 60% of the world's ecosystem goods and services have been degraded or used unsustainably.[188] In the absence of action, the rate of global biodiversity loss is not expected to slow; it may get worse as climate change increases pressures in some regions. In Europe, changing Mediterranean rain patterns will put more pressures on water resources and thus on biodiversity. By 2050, global agricultural land use intensification will be the direct cause of 4% of biodiversity loss (in terms of mean species abundance) from 2000 to 2050 – more than that caused by climate change. This in turn may exacerbate dangerous feedback loops.[189] Projections that marine resources could help reduce the pressure from food demand on fertile land are

[180] See: http://ec.europa.eu/research/agriculture/success_protector_en.htm
[181] James R. Mihelcic, Lauren M. Fry, Ryan Shaw, Global potential of phosphorus recovery from human urine and feces, Chemosphere, Volume 84, Issue 6, August 2011, Pages 832-839, ISSN 0045-6535, 10.1016/j.chemosphere.2011.02.046.
(http://www.sciencedirect.com/science/article/pii/S0045653511001925)
[182] DG Environment, *Conclusions of the Expert Seminar on the Sustainability of Phosphorus Resources*, Brussels, 2011. http://ec.europa.eu/environment/natres/pdf/conclusions_17_02_2011.pdf.
[183] For more details, see figure in IFA DATA, in Cordell, D., and White, S., "Peak Phosphorus: Clarifying the Key Issues of a Vigorous Debate About Long-Term Phosphorus Security," Sustainability, Vol. 3, No. 12, October 24, 2011, pp. 2027–2049.
[184] The Government Office for Science, *Foresight Project: C13: Maintaining Biodiversity and Ecosystem Services While Feeding the World*, 2011.
[185] Millennium Ecosystem Assessment Report, 'Current State & Trends Assessment', 2005. Available at: http://www.unep.org/maweb/en/Condition.aspx.
[186] FAO, The Second Report on the State of the World's Plant Genetic Resources, 2010. http://www.fao.org/agriculture/crops/core-themes/theme/seeds-pgr/sow/sow2/en/
[187] Ibid.
[188] Ibid.
[189] TEEB, *TEEB Interim Report*, The Economics of Ecosystems and Biodiversity (TEEB), Bonn, Germany, 2008.

uncertain. In the EU, 88% of fish stocks are fished beyond maximum sustainable yields.[190] More generally, without a drastic change in the governance of fisheries, drastically reduced pollution and a stabilization of the atmospheric CO_2 concentration at or below current level,[191] marine ecosystems face serious degradation (depending on the extent to which aquaculture can reduce pressure on marine resources).

The sustainable supply of animal proteins may become increasingly difficult. The global demand for animal protein (such as meat and milk proteins) is increasing rapidly. This is caused by the growing world population and reinforced by the increasing income per capita in developing countries. For example, from 1961/63 to 2005/7 the global consumption of meat increased from about 72 to 258 million tonnes.[192] Meat consumption may rise to a level of 455 million tonnes in 2050. The increase in the demand for animal protein will result in a significantly greater need for feed protein, which will be hard to meet in an ecologically sustainable way.[193]

[190] European Commission, *EC COMMUNICATION: Roadmap to a Resource Efficient Europe*, Brussels, 2011.
[191] Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., ... & Foley, J. A. A safe operating space for humanity. *Nature*, *461*(7263), 2009, pp.472-475.
[192] Alexandratos, Nikos, and Jelle Bruinsma, World Agriculture Towards 2030/2050: The 2012 Revision., FAO, 2012.p.94.
[193] COST, *Policy Brief on Sustainable Protein Supply*, Brussels, Belgium, 2012.

3.8. Climate change

3.8.1. Introduction

A substantial amount of existing research indicates that the world's climate is changing. Several climate change-related trends may present critical challenges to EU food safety and nutrition and warrant in-depth analysis. Relevant trends and uncertainties relate to:

- Rising temperatures;
- Changing precipitation patterns;
- Changing agricultural productivity according to species and regions;
- Emerging biological threats;
- Increasing 'environmental migration'.

3.8.2. Trends and uncertainties

Temperatures are projected to increase significantly. Compared to the preindustrial level (end of the 19th century), mean temperature and the frequency and length of heat waves have increased across Europe. The average temperature over land in Europe in the last decade was 1.3 °C warmer than the preindustrial level, which makes it the warmest decade ever. Land temperature in Europe is projected to increase between 2.5 °C and 4.0 °C by 2071–2100,[194] the largest temperature increases being projected over eastern and northern Europe in winter and over southern Europe in summer, while global temperatures are likely to increase by between 2.0 °C and 4.5°C.[195] Negative impacts on global food production are likely to occur when temperatures increase by 2-2.5°C and upwards compared to pre-industrial temperature levels (even if some impacts in Europe are likely to be positive – see below).[196] Projected long-term temperature changes are expected to lead to more frequent extreme weather events such as heat waves, droughts, and flooding, with drastic consequences.[197]

Precipitation patterns are expected to change starkly across regions. Precipitation changes across Europe show more spatial and temporal variability than temperature. Since the mid-20th century, annual precipitation has generally been increasing across most of northern Europe, most notably in winter, but decreasing in parts of southern Europe. In western Europe intense precipitation events have significantly contributed to the increase. In the future, precipitation is likely to increase in northern Europe (most notably during winter) and decrease in southern Europe (most notably during summer), while the number of days with high precipitation is projected to increase.[198] However, there is more uncertainty in rainfall projections than in temperature projections. Furthermore, changing precipitation patterns are also likely to be linked to an increase in extreme weather events.[199]

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[194] European Environment Agency, Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.19.
[195] IPCC, Climate Change 2007 : Synthesis Report, 2007.
[196] EU Climate Change Expert Group "EG Science", The 2 ° C Target. Background on Impacts, Emission Pathways, Mitigation Options and Costs, 2008.p.3.
[197] For more details, see figures in OECD Environmental Outlook Baseline projections; and European Environment Agency (EEA), Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.27.
[198] European Environment Agency, Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.19.
[199] For more details, see figures in OECD Environmental Outlook Baseline projections; and European Environment Agency (EEA), Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.27.

Agricultural productivity will strongly differ between regions. The thermal growing season of a number of agricultural crops in Europe has lengthened by 11.4 days on average from 1992 to 2008.[200] The growing season is projected to increase further throughout most of Europe, which would allow for a northward expansion of warm-season crops to areas that are currently not suitable. Crop growth phases have shortened for a number of crops in recent decades; this is expected to continue, with varying effects on yields. Some crops, mostly in central and southern Europe, will see reduced yield due to heat waves and droughts. However, other crops in northern Europe will benefit from increased yields,[201] while demand for water for irrigation will increase predominantly in southern and south-western Europe.[202] Furthermore, it is expected that in the future climate change will primarily affect livestock production directly via impacts on pasture and feed supplies, water, diseases, and genetic diversity.[203,204]

New biological threats are expected to emerge as a result of climate change.[205] More frequent and magnified climatic extremes, as well as higher temperatures, are conducive to the movement and emergence of animal and plant diseases, pest outbreaks and invasive alien species.[206] The net impact of climate change is likely to be a large increase in the burden of infectious diseases.[207] It is expected to improve habitat suitability in Europe for a wide range of disease vectors, and cause a loss of biodiversity, as many habitats of European interest (defined in the EU Habitats Directive) are potentially threatened by climate change over their natural range in Europe.[208] Animal diseases are set to become more prevalent: the emergence and spread of bluetongue, a viral disease of ruminants, is considered to be associated in Europe with climatic trends. Roughly a quarter of the global annual maize crop is already contaminated with mycotoxins - which are dangerous to health even at low doses - and in the long term, in colder tropical regions and temperate zones, this may increase.[209] It is not possible to assess whether climate change has already affected water- and food-borne diseases in Europe, but it is projected

[200] European Environment Agency, Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.160.
[201] Freibauer, Annette, Erik Mathijs, Gianluca Brunori, Zoya Damianova, Elie Faroult, Joan Girona i Gomis, Lance O´Brien, and Sébastien Treyer, Sustainable Food Consumption and Production in a Resource-constrained World, European Commission – Standing Committee on Agricultural Research (SCAR), 2011.
[202] European Environment Agency, Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.23.
[203] Vermeulen, Sonja J., Bruce M. Campbell, and John S.I. Ingram, "Climate Change and Food Systems," Annual Review of Environment and Resources, Vol. 37, No. 1, November 21, 2012, pp. 195–222. http://www.annualreviews.org/doi/abs/10.1146/annurev-environ-020411-130608.p.204.
[204] For projected impacts on crop yields in various EU regions, see figures in European Environment Agency (EEA), Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.27; and DG Agricultural and Rural development webpages, ENDURE Project (taken from Labussière, E, M Barzman, and P Ricci, European Crop Protection in 2030, ENDURE, 2010).
[205] Trends in emerging biological threats in general are further discussed in the driver briefing 'Emerging food chain risks and disasters'.
[206] Nellemann, Christian, Monika MacDevette, Ton Manders, Bas Eickhout, Birger Svihus, and Anne Gerdien Prins, The Environmental Food Crisis – The Environment's Role in Averting Future Food Crises. A UNEP Rapid Response Assessment., 2009. p.54.
[207] FAO, CLIMATE CHANGE: Implications for Food Safety, 2008.
[208] European Environment Agency, Climate Change, Impacts and Vulnerability in Europe 2012, 2012.
[209] Vermeulen, Sonja J., Bruce M. Campbell, and John S.I. Ingram, "Climate Change and Food Systems," Annual Review of Environment and Resources, Vol. 37, No. 1, November 21, 2012, pp. 195–222. http://www.annualreviews.org/doi/abs/10.1146/annurev-environ-020411-130608.

to increase the risk of these.[210] Finally, climate change will facilitate the propagation of pests: worldwide 67,000 pest species attacked crops in 2009: 9,000 insects and mites, 50,000 pathogens and 8,000 weeds.[211] Pests have significant detrimental effects on food production: for example, the loss in yields for eight of Africa's principal crops due to pests and diseases is estimated to be US$12.8 billion per year.[212]

Migrations to less affected regions of the globe will increase.[213] One of the most prominent drivers of migration is climate change.[214] In 2009, 17 million people were displaced by natural hazards and 42 million in 2010 (this number also includes those displaced by geophysical events).[215] These numbers are set to magnify as a consequence of flooding, disease and famine induced by climate change. This is also considered a major security threat. 'Environmental migration' may fuel existing conflicts and generate new ones, particularly in countries where resources are most scarce. Regions can become destabilised if large scale population movements occur due to increasing competition for diminishing resources (food and water).[216] Farmers in subtropical land regions for instance are particularly vulnerable to the impacts of climate change. Insecurity in these parts of the world may eventually lead to emigration to Europe.[217] Estimates for the number of people displaced from their homes by climate change by 2050 range between 150 and 300 million.[218]

[210] European Environment Agency, Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.24.
[211] Nellemann, Christian, Monika MacDevette, Ton Manders, Bas Eickhout, Birger Svihus, and Anne Gerdien Prins, The Environmental Food Crisis – The Environment's Role in Averting Future Food Crises. A UNEP Rapid Response Assessment., 2009. p.54.
[212] Nellemann, Christian, Monika MacDevette, Ton Manders, Bas Eickhout, Birger Svihus, and Anne Gerdien Prins, The Environmental Food Crisis – The Environment's Role in Averting Future Food Crises. A UNEP Rapid Response Assessment., 2009. p.54.
[213] Trends in migration in general are further discussed in the driver fact sheet 'Demography and social cohesion'.
[214] The Government Office for Science, Migration and Global Environmental Change Migration and Global Environmental Change Future Challenges and Opportunities, London, UK, 2011. p.38.
[215] The Government Office for Science, Migration and Global Environmental Change Migration and Global Environmental Change Future Challenges and Opportunities, London, UK, 2011. p.9.
[216] Christian Aid, Human Tide: The Real Migration Crisis, 2007. p.2.
[217] Christian Aid, Human Tide: The Real Migration Crisis, 2007. p.42.
[218] The Government Office for Science, "Foresight: Migration and Global Environmental Change Future Challenges and Opportunities," p.28.

3.9. Emerging food chain risks and disasters

3.9.1. Introduction

Over the last two decades the EU has experienced a number of food scares, leading to changes in regulation and the creation of new institutions such as the European Food and Safety Authority (EFSA). Future crises may significantly affect the EU agricultural sector, public health and lead to significant disruptions to markets and the wider economy. Several factors have increased the risk of such crises – including globalization and the resulting increase in trade and interdependence, climate change, and other factors. These pose challenges for risk assessment, management, and communication. Relevant trends and uncertainties relate to:

- Increasing risk of disease transmission from animals to humans;
- Environmental pollution and contaminants spreading through the food chain;
- Unintended consequences of food chain technologies;
- Wider possibilities for bioterrorism and sabotage.
- Continuing risk of neglect and failure of food safety mechanisms.

3.9.2. Trends and uncertainties

The risk of disease transmission from animals to humans (zoonoses) is forecast to increase in the future as a result of human and livestock population growth combined with more intensive farming practices, loss of diversity, increased mobility, and climate change displacing populations. Over two thirds of all human infectious diseases have their origins in animals,[219] and the rate with which these diseases have appeared has increased over the past 40 years. They are globally responsible for around 2.5 billion cases of human illness and 2.7 million human deaths a year.[220] The most frequently reported zoonotic disease in humans in the EU was by a wide margin *campylobacteriosis*, followed by *salmonellosis*.[221] For many diseases, the frequency of cases in the EU has been decreasing, reflecting success in detection and control measures. In 2005, a total of 177,963 cases of human *salmonellosis* were reported, while in 2010 this dropped to 99,020. However, human *campylobacteriosis* has seen a significant increasing five-year trend in the EU, since 2006.[222] Predicting disease emergence is inherently uncertain, and the food system is highly sensitive to small-scale unpredictable events. Globally, the rate of introduction of vector-borne pathogens to previously 'free' areas of the world is increasing, but the timing and severity of future events are uncertain. The spread of Bluetongue virus (BTV) into Northern Europe provides a disturbing example of how an 'exotic' vector-borne livestock pathogen can quickly become established within new geographical regions, with little understanding of its origin, to present new and significant risks to livestock production.[223] Diseases caused by the consumption of raw plant materials also present continuing risks, as recently seen with the outbreak of *E. coli* in Germany and France in 2011 due to the

[219] IDS, Zoonoses – From Panic to Planning, Rapid Response briefing, Institute of Development Studies, 2013.
[220] ILRI, Zoonoses Project 4: Mapping of poverty and likely zoonoses hotspots, International Livestock Research Institute, 2012.
[221] EFSA, *The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2010*, European Food Safety Authority, 2012.
[222] EFSA, *EFSA in focus FOOD*, European Food Safety Authority, Issue 10, September 2012.
[223] Jones K. E., Patel N. G., Levy M. A., Storeygard A., Balk D., Gittleman J. L., Daszak P., Global trends in emerging infectious diseases. Nature 451, 2008, pp.990–993.

consumption of raw sprouted seeds;[224] this event also demonstrated the difficulty in attributing a source to diseases from food comprising components sourced from a variety of producers. Finally, the worldwide trend in increasing international travel, in particular for tourism,[225] is likely to facilitate zoonosis outbreaks as pathogens are more likely to be transported by humans from disease-prone regions into the EU.

The risk of environmental pollution and contaminants spreading throughout the food chain persists. EU legislation stipulates that food containing a level of contaminant that is unacceptable from a public health viewpoint – in particular at a toxicological level – cannot be put on the market.[226] EFSA's Panel on Contaminants in the Food Chain (CONTAM) provides risk managers and policy makers with scientific advice to inform their decision-making on the setting of maximum levels of contaminants in food and feed. Recent contamination incidents include the discovery of semicarbazide in certain foodstuffs packed in glass jars sealed with metal lids,[227] dioxins in Irish pork meat in 2008,[228] and meat and egg products contaminated with dioxins in Germany in 2011/2012.[229] It is hard to predict how contaminants in food and feed will spread; one possibility is that increasing water scarcity in certain regions leads to higher pollution levels contaminating the food chain, as water is subject to increasing competition for agriculture, industry, and municipal uses.[230] Climate change may also increase the risk of contamination of food: according to one scenario, if average temperatures rose by 2°C, higher levels of aflatoxin contamination were predicted in the areas where maize is currently grown, whereas in a +5°C scenario, levels of contamination were predicted to be lower but more widespread.[231] Furthermore, the accumulation of chemical pollutants in the food chain leads to high risks and uncertainties regarding their impact on human health, particularly because of the so-called 'cocktail effect' of chemicals causing cumulative or interactive effects.

The scope for unintended consequences of food chain technologies remains large. A number of technologies used in the food chain introduced over time may have serious unintended consequences in terms of food safety. The inappropriate use of therapeutic antimicrobials in human and veterinary medicine, the use of antibiotics for non-therapeutic purposes as well as the pollution of the environment by antibiotics or antimicrobials is accelerating the emergence and spread of resistant microorganisms.[232] Pesticide resistance is also increasing in occurrence; estimates indicate that at least 10% of the world's harvest is destroyed while in storage, while at least 520 insects and mites, 150 plant diseases and 113 weeds have become resistant to pesticides meant to control them,[233] or about 1,000 species since

[224] European Food Safety Authority. Shiga toxin-producing E. coli (STEC) O104:H4 2011 outbreaks in Europe: Taking Stock. EFSA Journal 2011;9(10):2390.
[225] See figure in Friend M., Disease Emergence and Resurgence: The Wildlife-Human Connection, 2006, p.193.
[226] DG SANCO, Factsheet: Food contaminants, European Commission, 2008.
[227] EFSA, Risk Communication Annual Review, 2009.
[228] EFSA, Statement of EFSA on the risks for public health due to the presence of dioxins in pork from Ireland, The EFSA Journal 911, 2008.
[229] DG SANCO, 'Feed contamination – Dioxin in Germany', 2011.
At: http://ec.europa.eu/food/food/chemicalsafety/contaminants/dioxin_germany_en.htm
[230] DG Environment, The Fitness Check of EU Freshwater Policy, European Commission, 2012.
[231] Robinson T, Altieri A, Chiusolo A, Dorne J-L, Goumperis T, Rortais A, Deluyker H, Silano V, Liem D; Special issue: EFSA's approach to identifying emerging risks in food and feed: taking stock and looking forward. EFSA Journal 2012;10(10):s1015.
[232] WHO, Guideline for the conduct of food safety assessment of foods derived from recombinant-DNA plants, 2003.
[233] FAO, 'Controlling pests', Dimensions of need – An atlas of food and agriculture, FAO Corporate Document Repository, 1995.

1945 according to another study.[234] Genetically modified organisms (GMOs) constitute another key theme for food safety authorities: the authorisation process of GMOs for import or cultivation remains controversial and takes up a significant proportion of EFSA's workload.[235] Appropriate strategies to respond to resistant insect pests and herbicide-tolerant weeds will be needed. Other technologies which are discussed in the context of possible unintended consequences include animal cloning, and the use of nanomaterials in food packaging. For example, some nanomaterials may have the potential to enter the human body through mucous membranes or the skin and migrate via the blood stream to vital organs, or the brain, interacting with other cells in unpredictable ways, which may have cytotoxic or genotoxic effects.[236] Future risks and trends of unintended consequences from new food chain technologies are hard to predict given the fast pace of development and high levels of scientific uncertainty regarding long-term effects.

Bioterrorism remains a potential threat, especially in light of biotechnology developments. Bioterrorism can be defined as terrorism by intentional release of dissemination of biologic agents (bacteria, viruses, or toxins), in a natural or human-modified form. Biological weapons have existed for centuries, but their use was banned by the Geneva Convention, as well as in 1972, the Biological and Toxin Weapons Convention (BTWC). However, biological agents can be introduced by non-state actors all along the stages of the food chain, from crop growing to transportation. For example, *Coxiella burnetti*, a well-known zoonose affecting many animal species can cause potentially fatal chronic infection in humans and is considered a potential agent of bioterrorism because of its accessibility, low infectious dose, resistance to environmental degradation, and airborne transmission.[237] Bioterrorism is not only limited to agents targeting human health but also to those targeting animal and plant health; pathogens such as foot-and-mouth disease cause massive disruption to the meat and dairy industry, for example. Many biotechnologies that can be used to introduce pathogens are also dual-use, meaning that their legitimate scientific use may also be misused to pose a biological threat to public health.[238] This implies that the likelihood of future bioterrorist events will increase, given increasing development in biosciences and continuing geopolitical instability.

Continuing risk of neglect and failure of food safety mechanisms. Neglect in food safety is also an important aspect, and refers to neglect or non-compliance with food safety systems all along the food chain, for malicious or criminal intent, as with fraud. A clear recent example of this is with the 'horsemeat scandal', where EU-wide testing for horsemeat DNA and phenylbutazone showed that the entire internal market is affected by fraudulent labelling in the meat food chain.[239] A high average fraud rate (approximately 5 %) was found in the EU, while several Member States had even higher ones. Continued problems in this area may negatively

[234] Miller, G.T., *Sustaining the Earth*, 6th ed. Thompson Learning, Inc. Pacific Grove, California, 2004.
[235] Waigmann E, Paoletti C, Davies H, Perry J, Kärenlampi S, Kuiper H.; Special Issue. Risk assessment of Genetically Modified Organisms (GMOs); EFSA Journal 2012;10(10):s1008.
[236] Monteiro-Riviere, N. A., et al. 'Multi-walled carbon nanotube interactions with human epidermal keratinocytes.', *Toxicology letters* 155.3, 2005, pp.377-384.
[237] EFSA, Development of harmonised schemes for the monitoring and reporting of Q-fever in animals in the European Union, Report developed on the basis of the call for proposal CFP/EFSA/ZOON/2008/01, 2010.
[238] National Research Council (US) Committee on a New Government-University Partnership for Science and Security. Science and Security in a Post 9/11 World: A Report Based on Regional Discussions Between the Science and Security Communities. Washington (DC): National Academies Press (US), 2007.
[239] See http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+OQ+O-2013-000066+0+DOC+XML+V0//EN

affect consumer acceptance of food and heighten demands for more proactive control and legislation, especially as new technologies and foods enter the market.

3.10. New agri-food chain structures

3.10.1. Introduction

As the main drivers of supply, the ways in which the food chain will develop may have profound effects on what is produced and how it is produced. In some sectors, food chain market players have considerable influence on what is produced, including through their influence on consumer demand. Trends are broadly characterised by a rapid change of farming systems and markets. Relevant trends and uncertainties relate to:

- Industrialisation of agriculture, from small-scale and subsistence farming to large scale agri-businesses;
- Increasing concentration and integration of food chain industries to achieve economies of scale;
- Reduction in the agricultural labour force;
- Increase in organic farming;
- Increasing importance of regional, local and alternative food chains;
- Pressure for increased recycling and less waste along the food chain.

3.10.2. Trends and uncertainties

Industrialisation of agriculture, from small-scale and subsistence farming to large agri-businesses. The structure of agriculture in the EU Member States varies considerably, in terms of size and number of agricultural holdings, utilised agricultural area, average number of livestock, economic size, and composition of the labour force. There has been a general tendency for a decrease in the number of holdings in the last decades.[240] The total utilised agricultural area (UAA) of the EU27 has been relatively stable, but high increases are observed in some of the new Member States (such as the Baltic States and Poland), due to the new economic and political situation where the incentives of the Common Agricultural Policy (CAP) intensify the use of land for agriculture and drive industrialisation. Reflecting increasing consolidation, the average livestock units per holding have also increased, along with average size. This is consistent with the total number of small holdings, where in the EU there has been a gradual decrease (-10% in EU27 from 2003 to 2007) in the number of holdings with less than 1 European Size Unit (ESU) and an increase (10% in EU27 from 2003 to 2007) in the higher economic class (over 100 ESU). This trend is contradicted in some Member States where there is an opposite development, as is the case of the United Kingdom, Ireland, Sweden and Denmark. These countries have seen the number of their small farms (i.e. those with a lower number of ESUs) increase while the number of the larger ones has decreased. The impacts of changes in incentives as set out in the proposed CAP reforms may change these dynamics, however, predictions are uncertain.[241] The above trends reflect a general concentration of the more intensified agricultural production and food processing industries in highly productive farming regions and the withdrawal of agriculture from marginal farming areas in rural Europe. One forecast expects that this will lead to three types of agricultural land use: intensive farming areas where conflicts between competitiveness and sustainability may not easily be resolved; extensive farming areas, with predominantly part-time farmers, engaged in extensive beef/sheep and crop production, including farm-forestry; and marginal areas where the withdrawal of

[240] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Farm_structure_evolution#Agricultural_holdings
[241] http://capreform.eu/

agriculture will result in traditional rural landscapes being replaced by scrub encroachment and/or afforestation.[242]

Increasing concentration/integration of food chain industries and retailers to lower costs and achieve economies of scale, coupled with the entry into global markets of new companies from emerging economies. Competition in the global food economy and the need for economies of scale have driven efficiency and productivity and encouraged consolidation of many companies into a small number of large transnational corporations. Generally, this consolidation has been focused on the retail side, though land ownership in Europe has become increasingly concentrated over time.[243,244] In the EU, the food retail sector is highly concentrated: the market share of the top three retailers ranges from 30% to 50%. Significantly, it is above 70% in Ireland, Denmark and Sweden[245,246] while in Finland the share of the top two retailers alone is above 80%.[247] In addition, since 2004, food retail has been scrutinised by a number of EU national competition authorities: in total, 36 market monitoring actions have been reported, concerning the structure and functioning of the retail sector.[248] Concerns have been raised that such concentration has allowed major corporations to obtain considerable market power, against the interests of smaller producers, and consumers in general.[249] The next 40 years are likely to see the further consolidation of the major companies in the global food sector, but also the emergence of new and powerful enterprises from emerging economies who will have a major impact not only on the structure of the food systems in the countries from which they emerge, but also the global food system in general.[250]

Reduction in the formal agricultural labour force. Agriculture is still the world's main source of employment – it is estimated that 1.3 billion people work in agriculture, 450 million as waged labour.[251] But in European and OECD countries, labour has shifted away from primary production and expanded down supply chains. In regards the EU labour force, one survey shows that for the EU27 in 2007, 16.4 million persons worked regularly on the 7.3 million agricultural holdings in holdings above 1 ESU. There has been a clear reduction in the number of persons working in agriculture from 2003 to 2007 (-11.8%).[252] In contrast, overall employment in the food chain remains high: in 2010, almost 23 million people were employed

[242] Downey, Liam, Agri-Food Industries & Rural Economies, Competitiveness & Sustainability the Key Role of Knowledge, 2005.
[243] The Government Office for Science, Foresight Project: C3: State of Play and Trends: Governance and Globalisation, Government Office for Science, London, 2011.p.5.
[244] Transnational Institute (TNI) for European Coordination Via Campesina and Hands off the Land network, Land concentration, land grabbing and people's struggles in Europe, 2013.
[245] See figure in FoodDrinkEurope, Data and trends of the European food and drink industry, 2012, adapted from Europanel, 2012.
[246] FoodDrinkEurope, Data and trends of the European food and drink industry, 2012.p.13.
[247] See https://www.ifama.org/events/conferences/2011/cmsdocs/2011SymposiumDocs/365_Symposium%20Paper.pdf; Figures relate to 2010.
[248] FoodDrinkEurope, Data and trends of the European food and drink industry, 2012.p.13.
[249] The Government Office for Science, Foresight Project: C3: State of Play and Trends: Governance and Globalisation, Government Office for Science, London, 2011.p.6.
[250] The Government Office for Science, Foresight Project: C3: State of Play and Trends: Governance and Globalisation, Government Office for Science, London, 2011.p.14.
[251] ILO, Agricultural workers and their contribution to sustainable agriculture and rural development, 2007. http://www.fao-ilo.org/fileadmin/user_upload/fao_ilo/pdf/engl_agricultureC4163.pdf
[252] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Farm_structure_evolution#Labour_force

in the food chain, i.e. 10% of total EU employment.[253] Looking forward, the structure and interests of highly industrialised agriculture have driven skilled, permanent labour out of farming; yet there is an increasing demand for temporary, seasonal, unskilled, low wage labour in farming; a demand that city dwellers, even if unemployed, do not want to satisfy. In consequence, investments in automation, complex production processes and strict production regulations that require skilled labour to operate and maintain are expected to increase.[254]

Concurrent increase in organic agriculture. In contrast to conventional strategies of agricultural intensification, organic farming aims at producing food with minimal harm to ecosystems, animals or humans. One meta-analysis shows that overall, organic yields are typically 5 to 34% lower than conventional yields, while another shows that yields of individual crops are on average 80% of conventional yields, though these yield differences are highly contextual.[255,256] Under certain conditions (such as good management practices, particular crop types and growing conditions) organic systems can nearly match conventional yields,[257] and trials haven demonstrated that in some situations, organic agriculture can improve soil quality.[258] Other benefits of organic farming are reported, such as increased carbon sequestration in soils, and reduced nutrient leaching,[259] although there is considerable debate over the reliability of these claims. From 2005 to 2007, the total organic area (i.e. fully converted area plus area under conversion) as a percentage of the total utilised agricultural area (UAA) within the EU rose from 3.6 % to 4.1%.[260] This trend is expected to continue into the future.

Increasing importance of regional, local and alternative food chains. A countertendency to the trend toward concentration and homogenisation are alternative food chains based on more sustainable and/or regional patterns of production, distribution and consumption. High value markets, often linked with regional marketing projects, provide opportunities for farmers to use more sustainable production methods with fewer external inputs and lower dependency on dominant market actors (even if in some Member States large retailers also increasingly provide regional products). In recent years more direct links between consumers and farmers have been developed, e.g. with farmers markets and community supported agriculture, increasing the

[253] FoodDrinkEurope, Data and trends of the European food and drink industry, 2012.p.12. Note that persons employed in more than one economic sector are counted only in the sector of their main activity.
[254] European Commission, NEW CHALLENGES FOR AGRICULTURAL RESEARCH: CLIMATE CHANGE, FOOD SECURITY, RURAL DEVELOPMENT, AGRICULTURAL KNOWLEDGE SYSTEMS. 2nd SCAR FORESIGHT EXERCISE, European Commission, 2009.
[255] Seufert V, Ramankutty N, Foley J, 2012, Comparing the yields of organic and conventional agriculture.Nature.;485(7397):229-32. doi: 10.1038/nature11069.
[256] Tomek de Ponti, Bert Rijk, Martin K. van Ittersum, The crop yield gap between organic and conventional agriculture, Agricultural Systems, Volume 108, April 2012, Pages 1-9, ISSN 0308-521X, 10.1016/j.agsy.2011.12.004.(http://www.sciencedirect.com/science/article/pii/S0308521X1100182X)
[257] Ibid.
[258] Delate, K., Cambardella, C., Chase, C., Johanns, A., and Turnbull, R. 2013. The Long-Term Agroecological Research (LTAR) experiment supports organic yields, soil quality, and economic performance in Iowa. Online. Crop Management doi:10.1094/CM-2013-0429-02-RS.
[259] Kramer, SB; Reganold, JP; Glover, JD; Bohannan, BJ; Mooney, HA (2006-03-21). "Reduced nitrate leaching and enhanced dentrifier activity and efficiency in organically fertilized soils". Proceedings of the National Academy of Sciences (United States National Academy of Sciences) 103 (12): 4522–7.
[260] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Organic_farming_statistics

social resilience of food provisioning and leading to shorter food supply chains.[261] These kinds of supply chains are present in all member States in the EU, being more common and diverse in northwestern EU countries (UK, France, Belgium, etc.) than in other countries, where the focus is more towards farm-driven initiatives. They are often small or micro enterprises coupled with other quality certifications, such as organic production schemes or environmentally-sound agricultural practices.[262] These shorter chains are likely to focus on quality and intrinsic value, while the longer chains focus on bulk commodities, and where price is the key factor. However, local food and short supply chains have also been associated with specific food safety hazards and risks, relating to, inter alia, increased potential for cross contamination in case of combined or neighbouring activities, lack of food safety knowledge, and high relative costs of microbial testing for operators.[263] Other alternative chains may arrive in the form of ICTs enabling consumers to engage in more online shopping, which could lead to a decline in the importance of supermarkets.

Increasing pressure for recycling and waste reduction along the food chain. Around 90 million tonnes of food waste are generated in the EU each year.[264] Much of this food is still suitable for human consumption. All stages of the food chain are responsible for this waste, but the largest fraction of waste is produced by households (42%), followed by manufacturing food waste. Based on anticipated EU population growth and increasing affluence only, food waste is expected to rise to about 126 Mt in 2020 from about 89 Mt in 2006.[265] This is partially driven by the low price of food relative to disposable income, consumers' high expectations of food cosmetic standards and the increasing disconnection between consumers and how food is produced.[266] The Commission is currently analysing how to minimise food waste without compromising food safety through stakeholder platforms. A recent roadmap on resource efficiency in Europe features the food sector as key to improving resource efficiency and seeks incentives to halve the disposal of edible food waste in the EU by 2020.[267,268]

[261] IFOAM & ISOFAR (2008) Food, Fairness and Ecology. Vision for an Organic Food and Farming-Research Agenda to 2025, Report prepared by Urs Niggli, Anamarija Slabe, Otto Schmid, Niels Halberg and Marco Schlüter, IFOAM and ISOFAR, 2nd draft 26 march 2008. http://orgprints.org/13439/

[262] See http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&dt_code=NWS&obj_id=17030.

[263] Scientific Committee and the Staff Direction for Risk Assessment of the Belgian Federal Agency for the Safety of the Food Chain (FASFC), 'Food Safety of the Short Supply Chain', Symposium SciCom 2012, Brussels, Friday 9 November 2012.

[264] http://ec.europa.eu/food/food/sustainability/

[265] European Commission, P*reparatory study on food waste across EU27*, 2010.

[266] Parfitt, Julian, Mark Barthel, and Sarah Macnaughton, "Foresight Project: DR20: Food Waste Within Food Supply Chains: Quantification and Potential for Change to 2050.," Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 365, No. 1554, September 27, 2010, pp. 3065–81.
http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2935112&tool=pmcentrez&rendertype=abstract.

[267] European Commission, EC COMMUNICATION: Roadmap to a Resource Efficient Europe, 2011.

[268] For food waste trends in the EU27 from 2006 to 2020, see figure in Eurostat data; AEA.

4. Scenarios for food safety and nutrition in 2050

In this section we present the scenarios and the associated assessments provided by stakeholders and experts in the consultation. Each sub-section first provides key conclusions of the consultation, followed by the scenario description, and the detailed assessments of the consultation ordered by survey question.[269]

[269] For consistency reasons, the scenario descriptions, including the interrelationships discussed, are presented as they were originally presented in the stakeholder and expert consultation. For further details on the interpretation of the values assigned to the drivers as presented in the scenario diagrams, please refer to the table in Annex 7.2.

4.1. Scenario 1: Rapid surge in global trade in food and feed, with highly concentrated agri-food industries

1. This scenario assumes rapid globalisation of trade leading to strong global economic development, including in the EU, with highly concentrated agro-food industries, and the end of agricultural subsidies.
2. Key interrelationships in this scenario between the scenario driver (Global economy and trade) and other drivers include: *Global cooperation and standard setting:* Increasing levels of global cooperation in terms of trade agreements and reductions in agricultural subsidies were essential for the dramatic increase in global trade; and *New food chain technologies:* The end of agricultural subsidies induced many producers to produce more efficiently, by taking up increasingly advanced genetically modified crops – e.g. drought-resistant crops, disease-immune livestock , such that GM products constitute the lion's share of global trade in food and feed. Other new technologies have been adopted to address the increased complexity of the food chain and the consequent safety issues (e.g. advanced traceability).
3. Stakeholders assert that this scenario could plausibly become reality already by 2040 (based on average values).[270]
4. The most impacted food chain activities according to respondents are trade, storage, distribution, and retail, processing and packaging, and food waste. Novel foods and biotechnology, animal health and welfare, health and nutrition, food contaminants, labelling and information to consumers are considered to be the most strongly impacted food safety and nutrition policy areas. Other areas considered strongly impacted included trade, innovation and competition, as well as social stability, including equitable access to food, and environmental sustainability.
5. Promoting international governance, research, and education, awareness raising and training are considered to be the most needed measures/courses of action to face the challenges posed by this scenario.
6. Changes are considered necessary across all policy areas to adapt the EU food safety and nutrition framework to the challenges posed by this scenario, although changes in relation to labelling and information to consumers, enforcement and controls, and novel foods and biotechnology are considered slightly more needed.
7. Stakeholders found that research needed to be conducted in relation to disease transmission/prevention and related modelling, novel foods and biotechnology & new contaminants, labelling/self-regulation, trade law and regulation/international standards, or other issues such as improving food preservation processes.

4.1.1. Description of scenario

This scenario assumes rapid globalisation of trade leading to strong global economic development, including in the EU, with highly concentrated agro-food industries, and the end of agricultural subsidies. The scenario explores the challenge of ensuring food safety and nutrition in the highly globalised and complex food supply chains of 2050.

[270] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

In the 2020s and 2030s international trade in food and feed accelerated as the WTO's membership and free trade agreements gradually covered a significant part of the globe. As a consequence, by 2050 agricultural tariffs and subsidies have been all but eliminated, which has boosted competition across the globe, in particular between large transnational corporations, and has meant that while in some regions industry thrived thanks to low costs of production, in others it was forced to specialise and consolidate. In some regions agricultural production was abandoned altogether. In this strongly competitive environment, the higher cost efficiency offered by advanced genetically modified products – e.g. drought-resistant high yield crops for areas affected by climate change, livestock with immunity against certain diseases – caused many producers to take up these technologies, such that GM products constitute the lion's share of global trade in food and feed. This is also true for the EU, where GM products dominate consumers' tables. Technological progress, and the elimination of agricultural subsidies, have induced EU agri-food industries to become highly concentrated and specialised to compete on world markets – in particular with advanced GM technologies –, and wield considerable market power as well as influence on standard setting. They are complemented by a notable sector of small-scale producers in a variety of niche markets inside and outside the EU.

The very high levels of trade that ensued led to rapid global economic growth, with many of the emerging economies of 2013 now well developed, and carrying significant weight in the setting of global food standards. In 2050, 15 countries form the core of the global agri-food trade network, each trading with over 80% of all countries in the world, double the number of core countries at the turn of the century. The global agri-food trade network, in which major globalised food chains and niche regionalised food chains coexist, has therefore strongly gained in complexity, but is also exposed to systemic vulnerabilities as a result. In addition, in some regions there has been a significant increase in instability in food supplies and prices as a result of hastily liberalised agricultural markets, leading some countries to retain export restrictions – export regimes still being relatively less liberalised under WTO rules than imports – in order to safeguard food and resource security. The interconnected trade network has encouraged the rapid spread of new tastes and foods, often in convenient and pre-packed form. Because a typical pre-packed dinner is not only composed of ingredients and formulations originating from countries around the globe, but is often finalised and packaged in third countries, EU consumers have become largely ignorant of the origins of their meals, with notable impacts on consumer trust in food for those that care.

Looking back from 2050 to the world of today, forerunners of this future are…

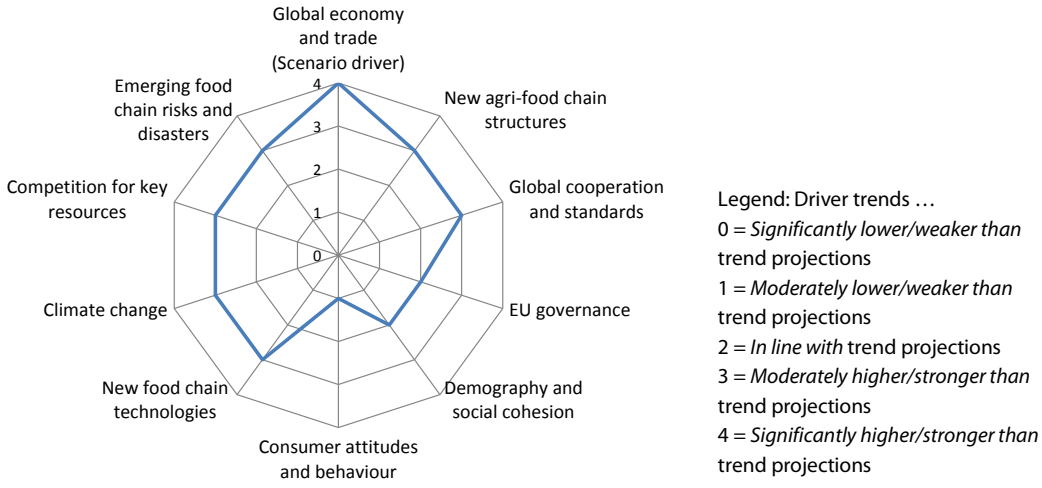
- The value of exports of food and live animals from the EU27 countries rose from 34 billion Euro in 2000 to 71 billion Euro in 2012, while the value of imports rose from 49 to 85 billion Euro.[271]
- Seven countries – five EU countries, the US and China – formed the core of the international agro-food trade network in 2007, each trading with over 77% of all countries in the world.[272]
- A large number of countries reduced their agricultural subsidies and import barriers in response to the WTO's multilateral Uruguay Round Agreement on Agriculture. Between 2000 and 2009, the amount of EU agricultural subsidies qualified as trade-distorting according to the rules of the WTO declined annually by 16.7%.[273] In early 2013, the EU had 28 trade agreements in force.[274]
- The food retail sector in the EU is highly concentrated: the market share of the top three retailers ranges from 30% to 50%. Significantly, it is above 70% in Ireland, Denmark and Sweden, while in Finland the share of the top two retailers alone is above 80%.[275,276]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (Global economy and trade) and the other drivers identified.

[271] Eurostat.
[272] Ercsey-Ravasz M, Toroczkai Z, Lakner Z, Baranyi J (2012) Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety. PLoS ONE 7(5): e37810. doi:10.1371/journal.pone.0037810
[273] European Commission, Sustainable Development in the European Union 2011 Monitoring Report of the EU Sustainable Development Strategy, 2011th ed., European Commission, 2011.p.318.
[274] European Commission, "The EU's Free Trade Agreements – Where Are We ?," 2013.
[275] FoodDrinkEurope, Data and trends of the European food and drink industry, 2012.p.13.
[276] See https://www.ifama.org/events/conferences/2011/cmsdocs/2011SymposiumDocs/365_Symposium%20Paper.pdf; Figures relate to 2010.

Figure 2: Scenario diagram for scenario 1



The following points describe in further detail the nature of the interrelationships identified.

- *Global cooperation and standard setting*: Increasing levels of global cooperation in terms of trade agreements and reductions in agricultural subsidies were essential for the dramatic increase in global trade.
- *New food chain technologies*: The end of agricultural subsidies induced many producers to produce more efficiently, by taking up increasingly advanced genetically modified crops – e.g. drought-resistant crops, disease-immune livestock , such that GM products constitute the lion's share of global trade in food and feed. Other new technologies have been adopted to address the increased complexity of the food chain and the consequent safety issues (e.g. advanced traceability).
- *New agri-food chain structures*: The major increase in global competition in food markets together with the end of agricultural subsidies have led to highly concentrated specialised EU agro-food industries to compete on world markets.
- *Competition for key resources:* The global agri-food trade network requires a significant amount of the world's resources to be sustained and has therefore significantly increased competition for key resources and as such resource depletion.
- *Climate change*: As a result of the focus on global trade increase and strong competition for key resources, climate change is more drastic.
- *Consumer attitudes and behaviour*: Due to the significant complexity of the global agri-food trade network, consumers have become largely ignorant of the origins of their meals, and distrust in food has increased.
- *Emerging food chain risks and disasters*: The increased complexity of the interconnected global and regional food chains has opened up systemic vulnerabilities to high-impact food safety events.

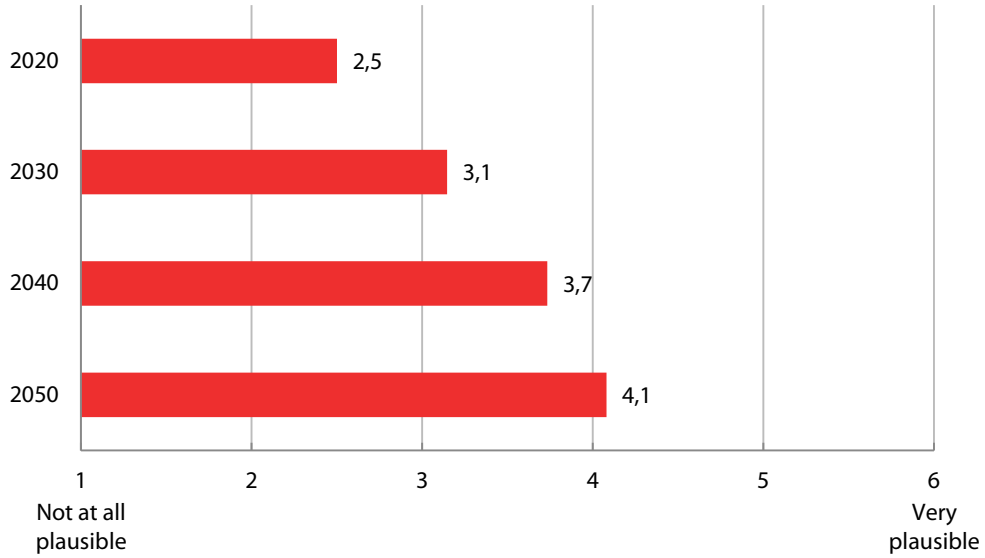
Other drivers not listed here were considered to develop in line with current trends and projections.

4.1.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the assessments of plausibility by stakeholders for each timeframe.

Figure 3: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 1.1.

As indicated in the graph, respondents find that it is increasingly likely for the scenario to become reality in later decades. Stakeholders assert that this scenario could plausibly become reality already by 2040, on the basis of the average assessment of plausibility for this year being higher than the midpoint (3.5). Stakeholder comments for this question broadly reflected this assessment, with a number of comments indicating that the scenario was found plausible in light of current and past trends, e.g. the rapid development of free trade and the global trade network in the last decades. Other comments indicated that while most elements of the scenario were considered plausible, there was less certainty regarding the extent to which specific issues, such as the elimination of agricultural subsidies and the broader impacts of free trade agreements, might occur by 2050.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 7: Key comments of stakeholders/experts regarding plausibility of scenario 1

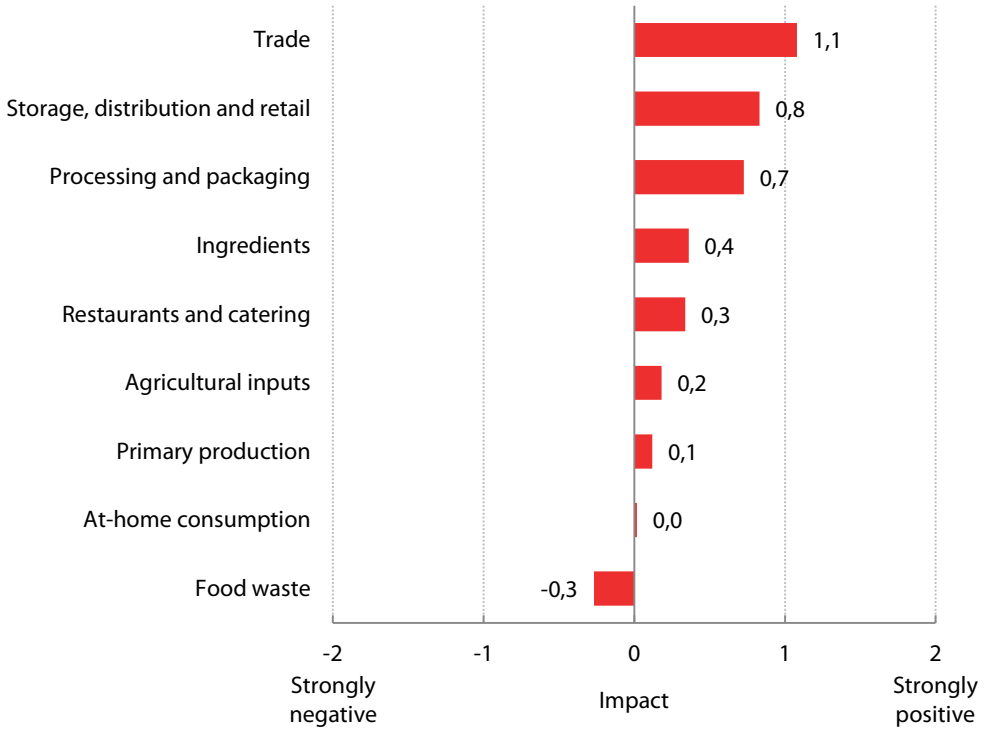
Judgement	Comments
Plausible scenario based on current and past trends	Having in mind the rapid development of the global food trade network of the last 20 years this scenario looks very reasonable within the next 30-40 years. (*Public authority)*
	This scenario is already on the way. *(Public authority)*
	Trade barriers have already dropped significantly and this is likely to increase. *(Food industry association/operator)*
	WTO membership already covers most of the glob[e], and [free trade agreements] have proliferated since 1995 and concentration is already high in some areas, so clearly a trend already well underway. *(Independent expert)*
	This scenario is highly plausible as an extension of what we are witnessing at the moment with the increase in globalisation and the consolidation/strengthening of the food industry in the hands of a few major players. *(Other stakeholder)*
	Increasing consumer concern and distrust on food safety and authenticity of materials from certain geographical areas likely to impact on free trade. Nationalistic tendencies contributing to continued maintenance of agricultural subsidies. *(Food industry association/operator)*
Scenario plausible except for some elements, which may not occur, or take longer than indicated	In the next 20 years, current situation will change, and subsidies will disappear slowly. However, in some regions such as Andalusia, it is difficult to finish with this situation and it will take longer time. However, in 2040-2050, this situation will be normalized and the scenario will become true. *(University/research organization)*
	Increase in trade is plausible, however, complete elimination of subsidies and shift to GMO production in the EU – not. *(University/research organization)*
	The impact of free trade agreements will take a longer time to have such a potential effect. The assumption that GM technology corresponds with market power consolidation of the agri food industries is unsubstantiated. *(Other stakeholder)*
	Until now, this scenario appears quite obvious, however, due to climate change and growing austerity, a breakdown of global cooperation could happen. *(University/research organization)*
	The complex WTO system is too reluctant to be quickly shifted into a complete free trade. *(Food industry association/operator)*

Source: Stakeholder survey, question 1.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 4: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



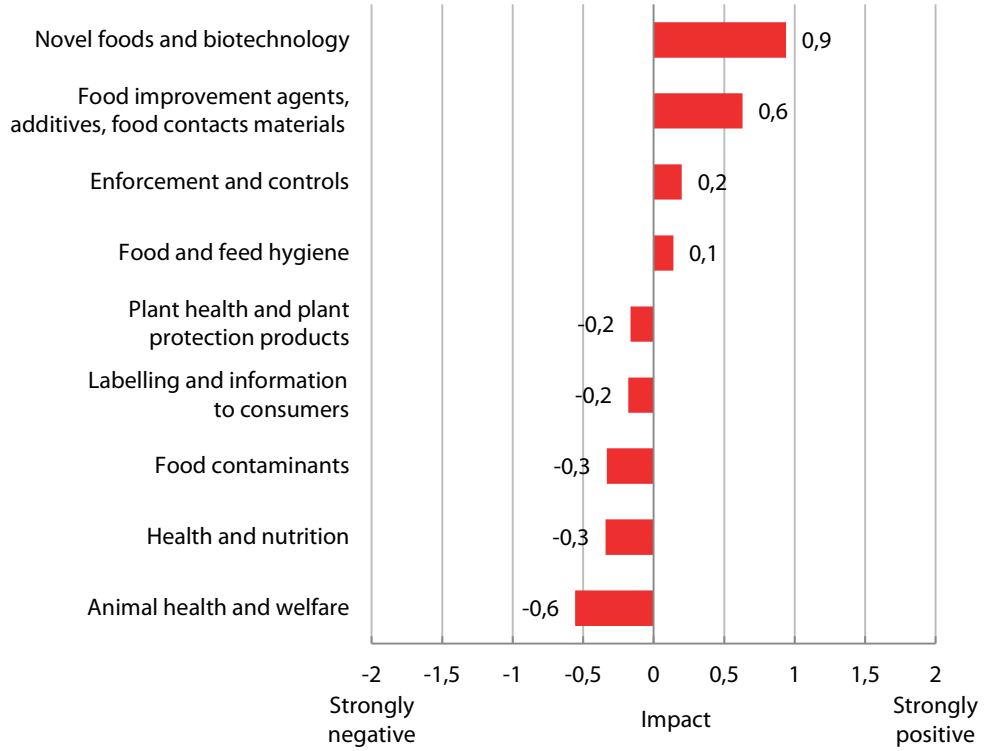
Source: Civic Consulting, based on stakeholder survey, question 1.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

As shown above, the most positively impacted food chain activity according to respondents by a clear margin is trade, i.e. imports and exports to and from the EU, while storage, distribution, and retail, as well as processing and packaging were also seen to be positively impacted under the scenario. On the other hand, food waste is considered to be negatively impacted as a result of the scenario. This is reflected in stakeholder comments, which indicated that processing, storage, distribution and retail, as well as agricultural inputs and primary production, would need to adapt to the consequences of the large increase in trade. However, some stakeholders indicated the probable increase in food waste as a result of the large increase in production accompanying the expansion in trade.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays stakeholder assessments for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 5: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



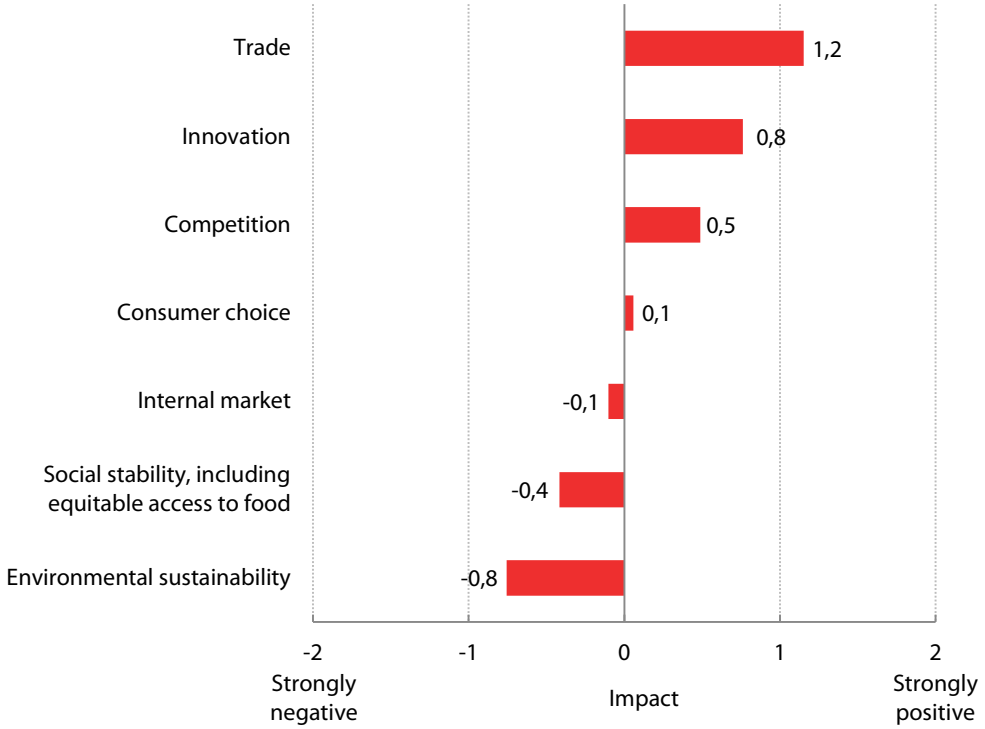
Source: Civic Consulting, based on stakeholder survey, question 1.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

As shown in the graph, novel foods and biotechnology are considered to be most positively impacted as a result of this scenario, while food improvement agents, additives and food contact materials are also seen to benefit from a positive impact. Areas considered to be negatively impacted included animal health and welfare, health and nutrition, food contaminants, plant health and labelling and information to consumers. This is reflected in stakeholder comments, which emphasised impacts on improved additives and agents to increase the shelf-life of foods/products and stronger food control mechanisms. Several stakeholders also noted that labelling, traceability and information provision would present challenges in this scenario due to the increased difficulty of assessing the origin of foods. Comments further indicated that animal health and welfare as well as human health are likely to be negatively impacted as a result of the increased risks of disease transmission and highly concentrated production processes described in the scenario.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other key areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 6: 'In your view, what other areas would be impacted as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



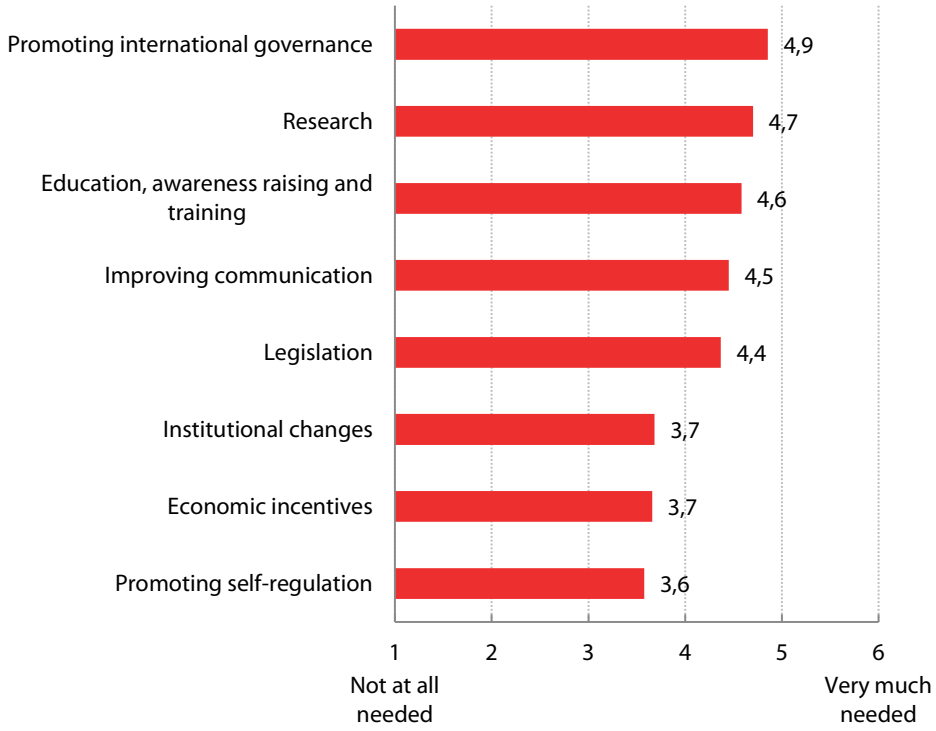
Source: Civic Consulting, based on stakeholder survey, question 1.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, trade is again considered to be most positively impacted by this scenario, followed by innovation and competition. On the other hand, social stability, including equitable access to food, and environmental sustainability in particular are considered to be negatively impacted. This is reflected in stakeholder comments, in that some stakeholders noted broadly positive impacts in terms of competition, innovation and consumer choice, linked to the increased pressure to compete and innovate on global markets and the increased diversity of goods. Others noted mixed impacts, due to risks posed to social stability and environmental sustainability. Several stakeholders however noted broadly negative impacts, associated with the market concentration of bigger producers and potential reduction of consumer choice as a result. Other points highlighted by stakeholders included in the increase in vulnerability of the system due to the heightened risk of interruption of global food supply chains.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 7: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 1.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, promoting international governance, research, and education, awareness raising and training are considered to be the most needed measures/courses of action to face the challenges posed by this scenario. On the other hand, measures such as economic incentives, institutional changes, and promoting self-regulation are seen as relatively less needed. Legislation is considered more/less needed than roughly half the measures/courses of action suggested. This is reflected by stakeholder comments, which on the whole indicated a greater need for research, education and awareness raising, coupled with key changes in international legislation and governance (e.g. trade legislation/regulation, novel foods legislation including GMOs, and food safety standards). Some stakeholders nonetheless also noted the increased need to promote self-regulation in the globalised context presented in the scenario.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 8: Key comments of stakeholders/experts regarding measures considered necessary under scenario 1

Main measures considered necessary	Comments
Research, Education & raising awareness, and Institutional changes	To deal with this scenario it is necessary to reinforce institutional and educational frames in order to regulate potential [un]equal developments. *(University/research organisation)*
	Research about threats to human health and environment posed by GMOs and other novel technologies. *(University/research organisation)*
	Raising awareness among stakeholders and consumers on Europe as a continent of tradition, diversity and taste. *(Food industry association/operator)*
Legislation & International governance	Worldwide legislation is critical in this scenario, and [the] EU should lead the development of legislation that should be applied worldwide in order to [en]sure food safety. (*University/research organisation)*
	Ensuring international harmonisation of food safety standards, measures and controls. (*Food industry association/operator)*
	Here legislation and international governance will be critical. (*University/research organisation)*
	New legislation, trade treaties, changes in patent law, research in detection of GM foods, environmental sustainability, effects on human health and the environ[me]nt of a wide spread adoption of the technology. (*University/research organisation)*
	Likely short term negative impact due to the necessity to revise legislation. With health impacts of GM foods still unknown and with issues related to the trade of such crops unresolved it is very likely that new legislation will be required to cover the new reality and provide confidence to the consumer.[277] (*University/research organisation*)
	Need for stronger legislation to control the availability and quality of food produce particularly on labelling etc. (*Consumer organisation/NGO*)
Self-regulation	Self-regulation as CSR can contribute to a more sustainable global trade. (*Public authority)*
	Self-regulation is essential in a globalization context and requires discipline for the operators. (*Other)*
	Improving self-regulation in a highly globalised context is important. Greater communication at the international level is important. (*Other)*
Economic incentives	Economic incentives: it is important to ensure that multinational companies pay tax. Promoting self-regulation: not as an alternative to official control. (*University/research organisation)*

Source: Stakeholder survey, question 1.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

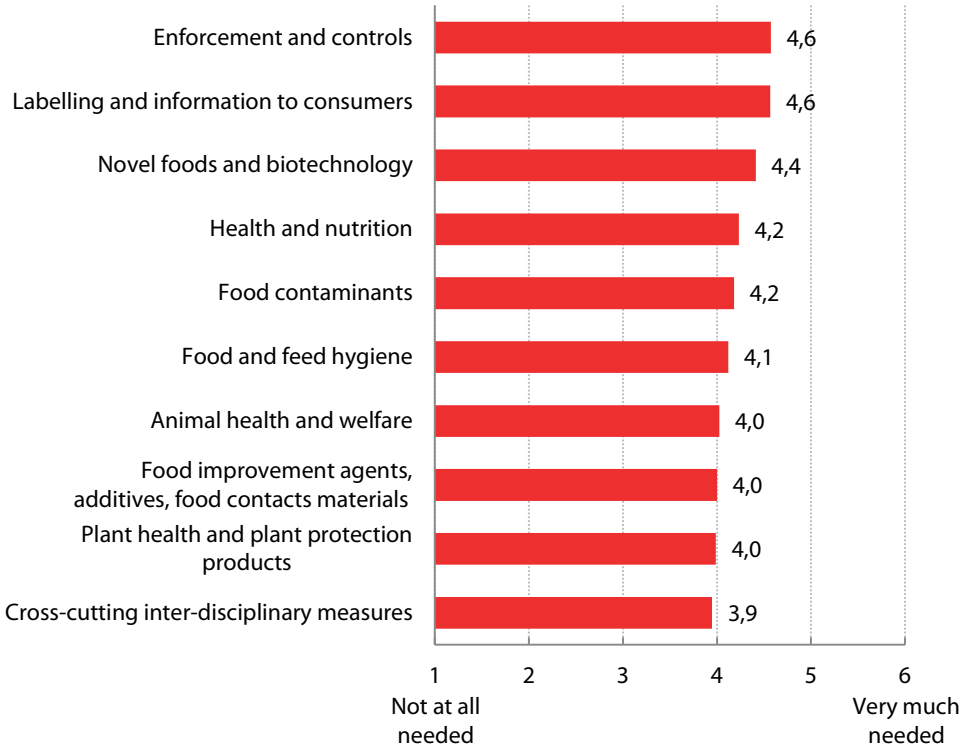
Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the

[277] This comment was originally provided in response to question 1.2b.

scenario. The graph below displays stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 8: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average stakeholders assessment on a scale from 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 1.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, in this scenario changes are considered necessary across all policy areas (on the basis of average assessments above the midpoint of 3.5). Nonetheless, changes in relation to labelling and information to consumers, enforcement and controls, and novel foods and biotechnology, are considered slightly more needed, whereas changes in relation to plant health and plant protection products, food improvement agents/additives or animal health and welfare are considered slightly less needed (but still considered more needed than not). This is broadly reflected by stakeholder comments, emphasising the need to improve labelling and transparency of information for consumers, while improving enforcement, controls and related warning mechanisms to avoid risks related to fraud and animal/plant diseases or threats, as well as harmonising EU standards with international standards.

The table below presents key stakeholder comments regarding potential changes needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario.

Table 9: Key comments of stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 1

Main area for which changes considered necessary	Comments
Labelling and information to consumers/traceability	Legislative frameworks cannot stop global developments, but information is needed. (*Food industry association/operator*)
	The more the production chain is fragmented, the more information is required about origin of products. (*Other stakeholder*)
	In contrast to the description in the scenario - labelling, transparency and traceability of food will become even more necessary. (*Food industry association/operator*)
Enforcement and controls	Controls - we see a direct link [to] the recent events on our [market] and [the] EU market with falsification and scandals. (e.g. meat of horse instead of beef meat). (*Public authority*)
	In this scenario the existing legislative framework can be expected to be adequate. Instead of wasting effort on legislation, focus on proper implementation to counter negatives associated with high-tech, large scale and geographically scattered production. (*Food industry association/operator*)
	The reinforcement of food control, health and nutrition, labelling will be necessary in particular, in order to create a very transparent and "clean" international market. (*University/research organisation*)
	With greater trade, better surveillance/early warning for animal/plant health threats may be required, alongside (possibly) strengthened enforcement/controls in the face of increased threats. (*Public authority*)
Contaminants	Updates will be needed in line with new knowledge that will become available. Legislation/standards on food contaminants may need to be revised for higher level of harmonization with international Codex standards, meanwhile ensuring appropriate level of protection of consumers in domestic and foreign markets. *(International organisation)*
Novel foods and biotechnology, plant protection products	With respect to plant protection products the scenario requires as a prerequisite a high level of convergence of regulatory requirements across the core countries involved in global trade, and or agreements between exporting and importing countries. [...] For a region expected to be open to trade as in the scenario, this would require that all EU legislation concerning GM would need to be amended. [...] Food and feed safety legislation in general would have to be up-dated and adjusted to keep up with international standards, and multi- or bi-lateral agreements hence reducing to the minimum gaps between the EU and third countries.[...]. *(Food industry association/operator)*
Cross-cutting measures	Much more rigorous accountability in the food chain and legislative powers to intervene. (*Consumer organisation/NGO*)
	This scenario would require better international structures for managing resources, global governance structures and institutions to ensure fair trading practices, food and feed hygiene with a strong emphasis on securing adequate diets for LMICs [low and middle income countries]. *(University/research organisation)*

Source: Stakeholder survey, question 1.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Harmonising standards on a global scale was considered the first priority in terms of improving food safety standards. It was noted that as a result of international standard harmonisation, there was a chance EU standards might see a decline. The EU may therefore need to prepare accordingly and foster agreement with global partners to ensure that standards are harmonised 'upwards';
- Harmonisation of enforcement and controls procedures was also regarded as necessary, as it was noted that mutual recognition of enforcement and control procedures may lead to more effective and more efficient controls overall;
- The current framework may need to ensure that small scale production can enter the market by protecting small scale production from large scale competition, in an environment with strong global trade. This may also allow for a more diversified market;
- The implementation of mechanisms to deal with price volatility via price stabilisation mechanisms was an additional suggested change needed;
- Lastly, it was suggested that labelling regarding the origin of products should also include the origin of ingredients in order to increase transparency.

Future research

Finally stakeholders were asked on which issues research should be conducted to better understand the challenges posed by scenario 1, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted in relation to disease transmission/prevention and related modelling; novel foods and biotechnology; new contaminants; traceability; labelling and self-regulation; trade law and regulation/international standards; or other issues such as improving food preservation processes.

The table below presents key stakeholder comments regarding issues for future research relating to this scenario.

Table 10: Key comments of stakeholders/experts regarding issues for future research under scenario 1

Main issue for research	Comments
Disease transmission/prevention and related modelling	Calculating and modelling the upcoming risk for the environment due to the increase of global trade and even bigger scale production units in some global player countries. (*Public authority*)
	International transmission of disease. (*Public authority*)
	Health, nutrition, prevention of diseases. (*University/research organisation*)
	More research needed on: understanding divergences in food standards; analytical methodologies to be used as standard; management of animal health and welfare. (*Food industry association/operator*)
Novel foods and biotechnology & new contaminants	Research on GMO crops and consumer research to understand how the benefits of GM can be made understandable to consumers. (*Food industry association/operator*)
	Contaminants, Biotechnology, Impact of Additives, Novel technologies. (*University/research organisation*)
	Novel foods/ingredients; other production method; HACCP and hygiene. Prioritisation on basis of consumer health. (*Public authority*)
	New contaminants (chemical or biological) should be controlled, and suitable tools to assure that imported products are safe should be developed. (*University/research organisation*)
	Promotion of innovation leading to novel foods (new protein sources for example) in the EU to maintain their market strength / leadership. (*Other*)
Traceability	[...] Some new technologies have been adopted to address the increased complexity of the food chain, i.e. advanced traceability and it should contribute to have information about the origin. Advantage of these developments should be taken under these conditions. (*Food industry association/operator*)
Food preservation	Improvements of food preservation processes reinforcing technological breakthroughs. (*University/research organisation*)
Labelling/self-regulation	Honest labelling is truly critical for this to work. (*University/research organisation*)
	Research on self-regulation and labelling effectiveness. (*Other stakeholder*)
Trade law and regulation/International standards	Trade law and patent law, market dynamics, specialised crops, population shifting, GM and the environment, GM and human health, disease resistance etc. (*University/research organisation*)
	Establishing control on contaminants that can be linked to international trade of foods. (*University/research organisation*)
	International trade regulation. (*International organisation*)

Source: Stakeholder survey, question 1.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Research into global governance systems of the food chain was suggested e.g. what type of supervisory structure would one need in order to arrive at mutual recognition of standards and enforcement and control procedures?;
- Further research could be undertaken regarding the quality of data used for monitoring and traceability, faced with the increasing risk of manipulation of digital data in a digitalised food chain (digital fraud);
- Research into the prevalence of fraudulent labelling of products (e.g. use of labels of major brands). Research may lead to quick and cheap testing methods of labels, via the use of ICTs adapted to this purpose;
- Finally, it was suggested that research into mechanisms for price stabilisation also be conducted to better understand ways in which price volatility can be mitigated.

4.2. Scenario 2: Break-down of global cooperation in a multipolar world

1. This scenario assumes a break-down of global cooperation, including regarding setting standards for safe food and international early warning systems, in a world in which there is limited reliance upon multilateral structures.
2. Key interrelationships in this scenario between the scenario driver (Global cooperation and standard setting) and other drivers include: *Global economy and trade*: Due to global fragmentation, many tariff barriers to trade have re-emerged, which has led to a strong decrease in global trade volume in most goods and slower growth, but trade remains high within regional blocs; and *Competition for key resources:* The strong decrease in global trade has somewhat reduced the global competition for some key resources, as now regions are forced to focus on ensuring the sustainability of their own resources. However, exploitation of some other natural resources as a result of the competing blocs has strongly increased due to the lack of international governance. In addition, the inward orientation in the EU has increased pressure on biodiversity, as agricultural land use intensified.
3. This scenario is seen as relatively less plausible than other scenarios; the scenario is considered more implausible than plausible for all timeframes assessed (based on average values).[278]
4. Trade, agricultural inputs and ingredients, as well as food waste and at-home consumption are considered to be strongly impacted beneficially under this scenario. Food contaminants, health and nutrition, and food and feed hygiene are considered most impacted food safety and nutrition policy areas. Trade, consumer choice and social stability, and the internal market are other key areas considered to be strongly impacted as a result of the scenario.
5. Promoting international governance is considered most needed of the measures/courses of action suggested, followed by improving communication and research.
6. Cross-cutting inter-disciplinary measures are considered most necessary to face the challenges posed by the scenario. Changes in relation to health and nutrition policy, enforcement and controls, labelling and information to consumers, and novel foods and biotechnology are also considered more necessary than not.
7. Stakeholders found that research needed to be conducted in relation to alternative, local agriculture that preserves resources, including biodiversity; internal market resilience, flexibility and sustainability; optimisation of productivity; alternative diets; novel foods/production methods and improved international governance.

4.2.1. Description of scenario

This scenario assumes a break-down of global cooperation, including regarding setting standards for safe food and international early warning systems, in a world in which there is limited reliance upon multilateral structures. The scenario explores the challenges of ensuring food safety and nutrition in a multipolar world in 2050, and with highly fragmented and geographically dispersed food chains.

[278] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

The WTO Doha round negotiations, EU-US free trade agreement negotiations and UN Framework Convention on Climate Change conferences continued through to the late 2010s and early 2020s, before finally failing to come to any concrete conclusions. This was the beginning of a gradual, but widespread loss of faith in global institutions, marked by persistent tensions over resources, emissions reduction and trade disputes, linked to the increasingly narrow focus of governments on national and regional economic and security interests, in a strongly multipolar world. Overall, international governance failed to broker any significant long-lasting agreements among the major countries and trade blocs, and a significant break-down in global cooperation occurred in the late 2020s, including regarding food safety and animal health. Many international organisations from the UN system and other multilateral structures and agreements were thus weakened or abandoned and replaced by regional equivalents that served to further common interests of regional trade blocs. Strong tensions between major countries, marked by sporadic regional conflicts, as well as separate sets of standards in different regional trade blocs (including combinations of different degrees of public and private standards), induced a significant reduction in global trade volume in most goods (even if trade in some luxury goods available only in certain countries continued). Thus, the global economy has grown at a very slow pace in the last decades. Food chains have also gradually become fragmented and dispersed across regions, meaning that more food is sourced regionally, and there has been a reduction in food chain complexity, at least concerning its global dimension.

As a result of significantly reduced openness to trade, in 2050 consumers in the EU have a smaller range of foods to choose from and less diversified diets, although formerly exotic fruits or vegetables are now often grown in the EU to cater to the well-off. Decades-long anaemic growth has reduced EU consumers' purchasing power, which means expenditure on food has increased as a share of income, although severe food shortages have so far been avoided. However, global fragmentation has also had some unexpected advantages for the EU: first, EU institutions and the internal market have gained importance to counteract the break-down at the global level; second, the EU (as well as other major blocs) is forced to ensure the sustainability of their own food systems. Still, the exploitation of other natural resources as a result of the competing blocs has strongly increased due to the lack of international governance, and the protection of global public goods such as the control of livestock epidemics depends purely on national or regional initiatives.

Looking back from 2050 to the world of today, forerunners of this future are…

- From 1990 to 2007, the number of bilateral and regional agreements notified to the WTO increased from 20 to 159. [279] By the end of 2008, more than 2670 bilateral investment treaties (BITs) had been signed,[280] and by the end of 2009, more than 30% of world trade was governed by over 250 regional and bilateral trade agreements.[281]
- A conclusive agreement to the Doha Development Round, the current trade-negotiation round of the World Trade Organization (WTO) that commenced in November 2001, has so far not been reached despite yearly negotiations, with a notable collapse in Geneva in 2008.[282]
- The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), was adopted in 1997 and entered into forced in 2005, however a successor agreement is still yet to be agreed upon despite yearly international negotiations, with a notable failure to reach a legally binding agreement in Copenhagen in 2009.[283]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (Global cooperation and standards) and the other drivers identified.

[279] Brückner, G K, "Ensuring Safe International Trade: How Are the Roles and Responsibilities Evolving and What Will the Situation Be in Ten Years' Time?," Revue Scientifique et Technique (International Office of Epizootics), Vol. 30, No. 1, April 2011, pp. 317–24. http://www.ncbi.nlm.nih.gov/pubmed/21809774.p.320.

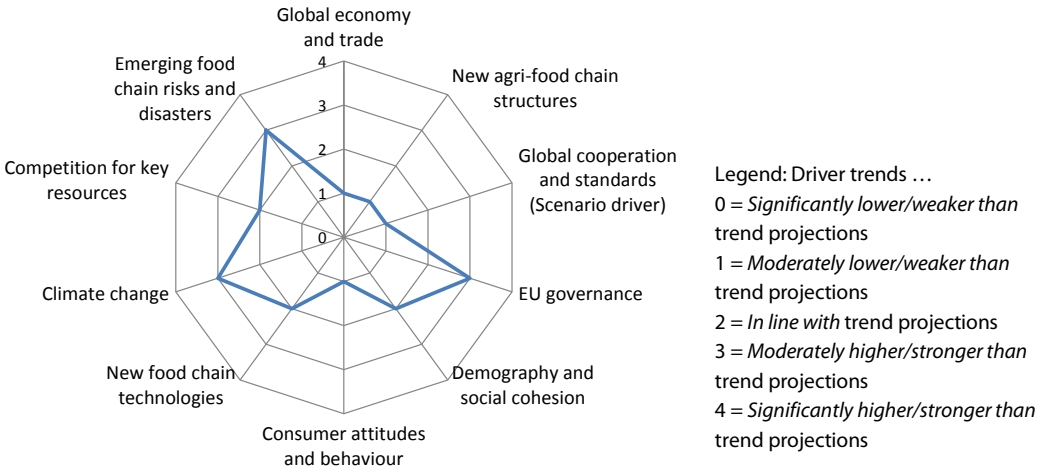
[280] UNCTAD, The Role of International Investment Agreements in Attracting Foreign Direct Investment to Developing Countries, UNCTAD Series on International Investment Policies fo, Development, 2009. p.2.

[281] Brückner, G K, "Ensuring Safe International Trade: How Are the Roles and Responsibilities Evolving and What Will the Situation Be in Ten Years' Time?," Revue Scientifique et Technique (International Office of Epizootics), Vol. 30, No. 1, April 2011, pp. 317–24. http://www.ncbi.nlm.nih.gov/pubmed/21809774.p.320.

[282] See http://www.wto.org/english/tratop_e/dda_e/update_e.htm. This is despite the adoption of the Bali Ministerial Declaration on 7 December 2013, which addressed bureautic barriers to commerce, a specific part of the Doha Round agenda.

[283] See http://unfccc.int/kyoto_protocol/items/2830.php.

Figure 9: Scenario diagram for scenario 2



The following points describe in further detail the nature of the interrelationships identified.

- *Global economy and trade*: Due to global fragmentation, many tariff barriers to trade have re-emerged, which has led to a strong decrease in global trade volume in most goods and slower growth, but trade remains high within regional blocs.
- *Competition for key resources:* The strong decrease in global trade has somewhat reduced the global competition for some key resources, as now regions are forced to focus on ensuring the sustainability of their own resources. However, exploitation of some other natural resources as a result of the competing blocs has strongly increased due to the lack of international governance. In addition, the inward orientation in the EU has increased pressure on biodiversity, as agricultural land use intensified.
- *Consumer attitudes and behaviour:* Due to the major reduction in food imports from outside the EU, most EU consumers are forced to switch to EU-sourced food, often from regional or local food chains.
- *New agri-food chain structures:* As a result of the break-down in international cooperation and trade, food chains are fragmented and dispersed across regions.
- *New food chain technologies:* Conflicting effects on technological progress in food chains have occurred as a result of global fragmentation: on the one hand, there has been a greater incentive to innovate due to the need to substitute for previously widely available inputs from global food chains; on the other, the ensuing low growth rates and protectionism have not been conducive to technological breakthroughs.
- *Climate change:* Owing to the overall break-down in global cooperation, less progress is made on addressing climate change, with climate change mitigation policies becoming increasingly subordinate to short-term economic interests.
- *Emerging food chain risks and disasters:* The lack in global cooperation has made it more difficult to combat global threats or threats affecting several trade blocs. In addition, although reduced global trade decreases the risks inherent in large trade flows

of food and feed, a parallel increase in illegal or informal trade of now scarce, high-priced goods has created new food safety risks.

- *EU governance:* EU institutions and the internal market have gained importance to counteract the break-down at the global level.

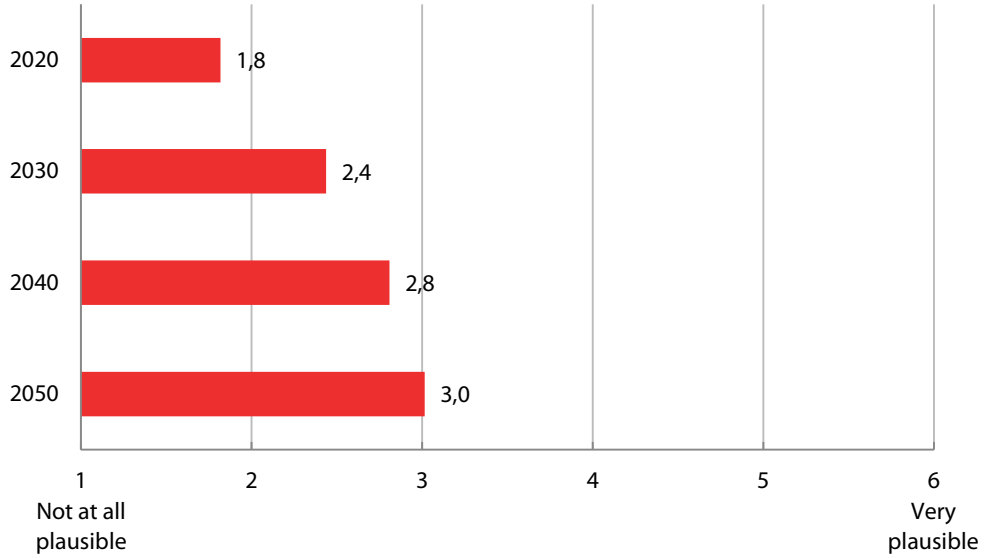
Other drivers not listed here were considered to develop in line with current trends and projections.

4.2.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 10: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 2.1.

As shown in the graph, this scenario is seen as relatively less plausible than other scenarios. Specifically, for each timeframe, the average assessment of plausibility does not reach the midpoint of 3.5, meaning that the scenario is considered more implausible than plausible for all timeframes assessed. Stakeholder comments broadly reflected this assessment, generally indicating either that the scenario was less plausible in the current globalised context, or that such a break-down in cooperation may only occur under specific circumstances or in certain regions. Other comments however noted that such a scenario could not be excluded, or that it is plausible only in a later timeframe.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 11: Key comments of stakeholders/experts regarding plausibility of scenario 2

Judgement	Comments
Implausible scenario; world too globalised	The scenario is overly pessimistic and seems to imply a rolling-back of international norms. *(Public authority)*
	Besides catastrophic events like wars or a huge outbreak of a pandemia there are not any hints that international collaboration should be suddenly interrupted, especially looking at the international share of labour. *(Food industry association/operator)*
	I believe that this scenario won't happen due to globalized trade, treaties and agreements between the countries. I also strongly believe that "bloc" mentalities belong to the past due to worldwide economic dependencies. *(Public authority)*
	This scenario is unlikely to happen. On the contrary, since many decades, the trend is to the contrary; and the bigger the global problems are, the stronger the global collaboration. It seems that "the global village" has not a point of return. *(International organisation)*
	The current degree of international integration and the dominance of multinationals will slow disintegration. (*University/research organisation)*
	Whilst global cooperation has in the past been put under serious pressure by some players, we do not believe that a scenario of total break-down is realistic. Of course, there will at all times be some players excluding themselves from international governance and not participating in standard setting activities or refusing to obey the rules commonly agreed. Similarly, some markets can be isolated, but the probability that a majority of markets are closed up and relying on local production only is rather low, considering the needs of emerging economies and the already existing imbalance between deficit areas and surplus areas. Although the scenario is unlikely to be mainstream, it can be expected that key agricultural raw material producing countries, with increased inter-regional differences in production volumes, could easily resort to trade distorting practices, such as differential export taxes, export subsidies and dumping. *(Food industry association/operator)*
	There are sufficient country or country blocs who are interested in maintaining links and communication. *(University/research organisation)*
Cannot be excluded	I do not expect this, but cannot exclude it either. My responses reflect the median of this thinking. But it is highly uncertain and the situation is far more unstable than many seem to be thinking. *(University/research organisation)*
	Whilst there are a multitude of regional trade agreements, these need to be in line with WTO. a total breakdown may happen but probably not in an irreversible manner. *(Other stakeholder)*
Only in specific circumstances or regions	The recent increase in globalisation has created greater dependence of most countries on each other. A complete breakdown in global cooperation is not likely in my view with the exception possibly of some regions in the world which would become isolated. *(Other stakeholder)*
	Only in case of war or major environmental disaster, e.g. another Krakatoa eruption or similar. *(Independent expert)*
Plausible but occurring later	With resources becoming limiting and replacement of fossil fuels still at its infancy this scenario might occur in the late future rather than sooner. *(University/research organisation)*
Plausible	Scenario 2 appears more realistic due to persistent austerity with more food sourced regionally. *(University/research organisation)*
	Plausible and therefore over time of increasing risk if not addressed. *(University/research organisation)*

Source: Stakeholder survey, question 2.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 11: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)

Source: Civic Consulting, based on stakeholder survey, question 2.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

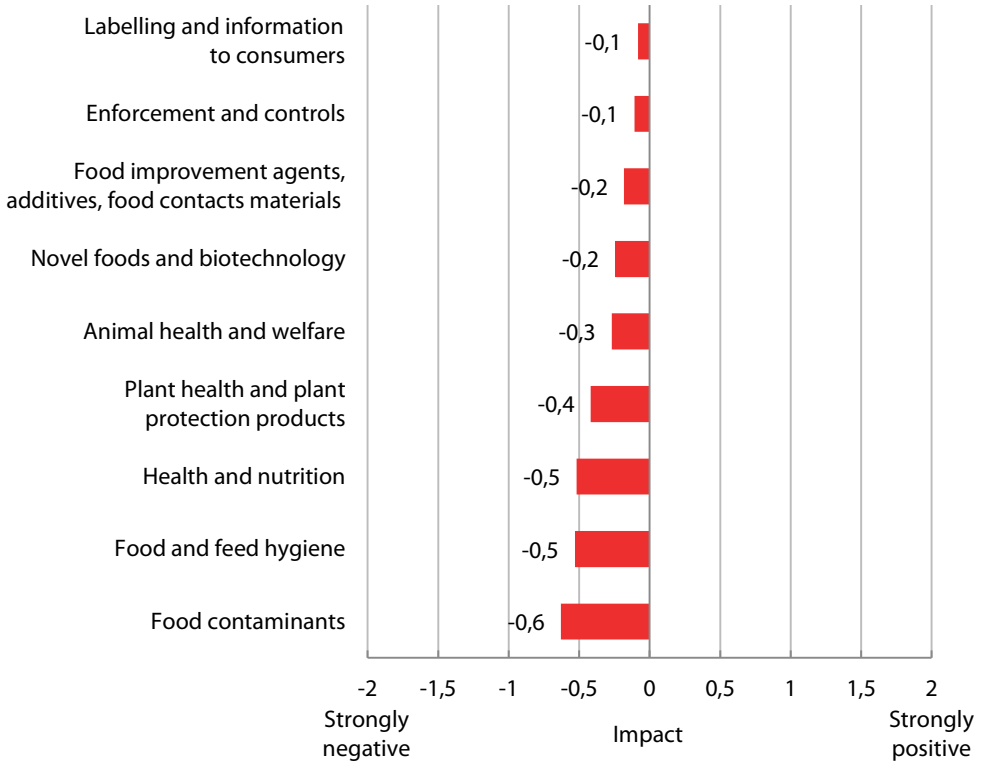
As shown above, most areas are seen to be negatively impacted under this scenario, including in particular trade, agricultural inputs and ingredients. Nonetheless, food waste and at-home consumption are considered to be impacted beneficially under this scenario. Stakeholder comments reflected these assessments, emphasising the increased incentives for low-carbon, low-input foods, the potential reduction in food waste, the loss of confidence in trade/third country products as a result of the cooperation break-down and risks of illegal trade, the increasingly locally oriented production along with the associated increased pressure on the environment and agricultural land use intensification. One stakeholder also noted that processing and packaging products on the whole would be less demanded by consumers due to their potentially reduced purchasing power.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments

for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 12: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



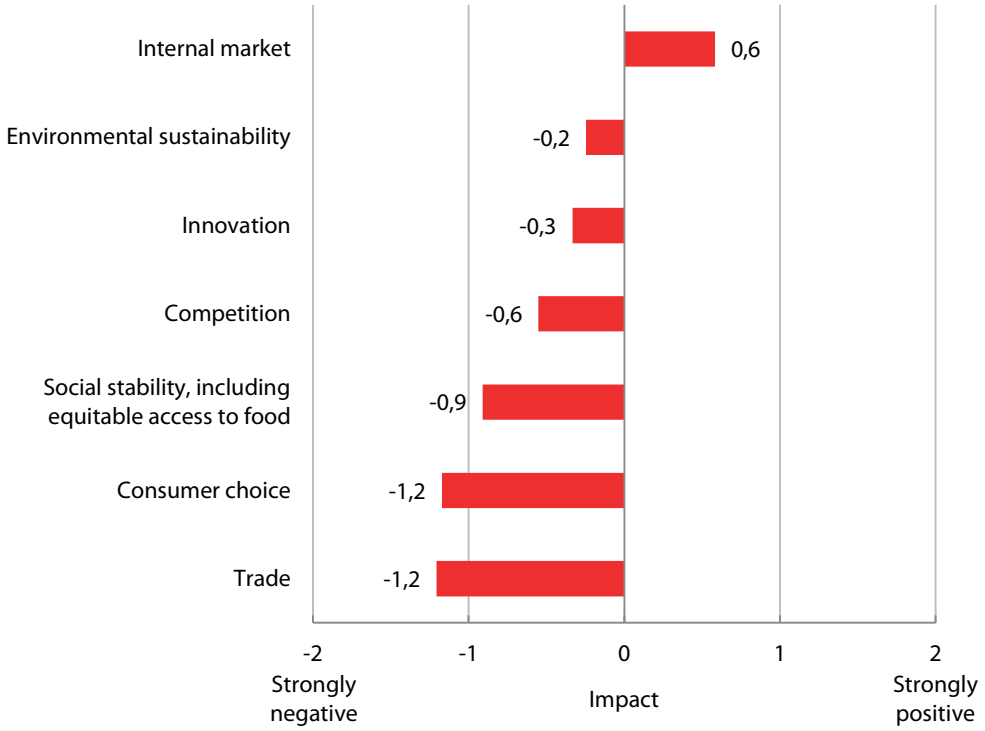
Source: Civic Consulting, based on stakeholder survey, question 2.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

As shown in the graph, all food safety and nutrition policy areas assessed are considered to be negatively impacted as a result of this scenario. Food contaminants, health and nutrition, and food and feed hygiene are considered most impacted, whereas food improvement agents, additives and contact materials, enforcement and controls, and labelling and information to consumers were considered least impacted. Stakeholder comments highlighted the negative impact on food contaminants related to the increased difficulty in combating global threats. However, some stakeholders noted the possibility of improved health and nutrition linked to the (potentially) increased focus on sustainability. Other comments indicated probable increased threats to animal health and welfare due to the lack of standards (although less trade may mitigate the transmission of diseases, it was noted), and the greater need to reinforce import controls, in contrast to official internal controls, which may benefit from greater harmonisation. Impacts on novel foods and biotechnology appeared ambiguous, as while it was noted that reduced trade may slow technological development, the need to substitute for previously available inputs may also stimulate innovation.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 13: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



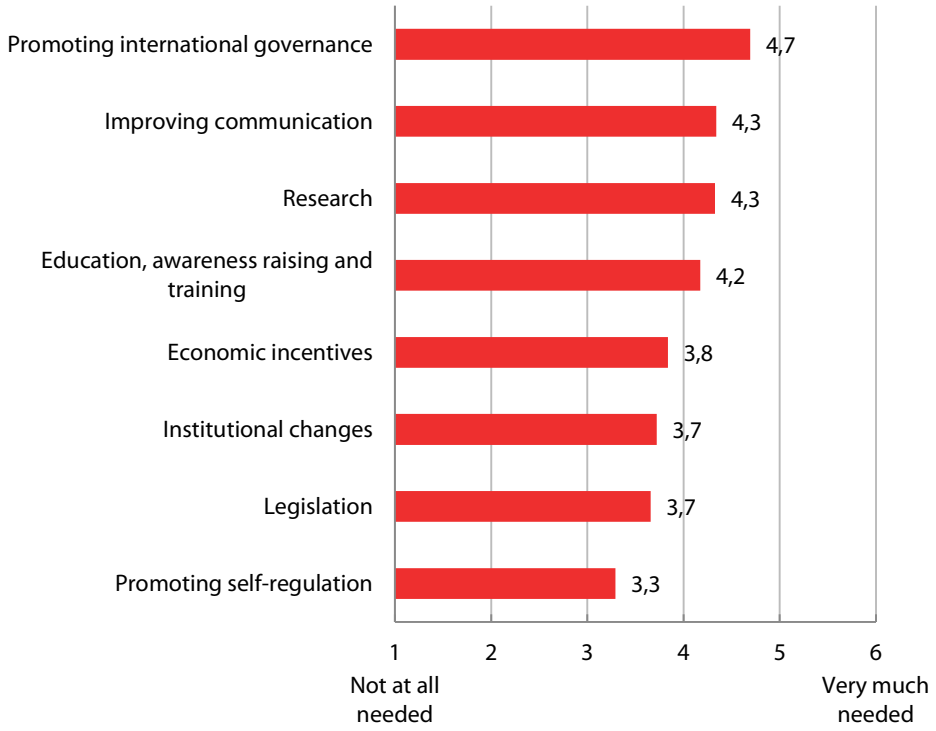
Source: Civic Consulting, based on stakeholder survey, question 2.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, trade, consumer choice and social stability are considered to be particularly negatively impacted under this scenario, whereas the internal market is seen as benefiting as a result of the scenario. This is broadly reflected in stakeholder comments, which indicated that the internal market is likely to expand under such a scenario, despite overall negative effects on trade, consumer choice, and equitable access to food. It was noted that access to food in particular could be restricted as a result of higher food prices, which would be the main negative impact on social stability. However, potential impacts on environmental sustainability were noted as both positive (related to the increased focus on self-sufficiency) and negative (related to the agricultural intensification described in the scenario).

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 14: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 2.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, promoting international governance is considered most needed of the measures/courses of action suggested, followed by improving communication and research. Promoting self-regulation, on the other hand, is considered least needed of the measures/courses of action suggested. Stakeholder comments echoed theses assessments, which revolved around promoting international governance and improving communication, especially with third countries, and fostering greater research on sustainable production. Some stakeholders also noted the need for measures to reinforce controls in light of the risk of illegal imports under the scenario.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 12: Key stakeholder comments regarding measures considered necessary under scenario 2

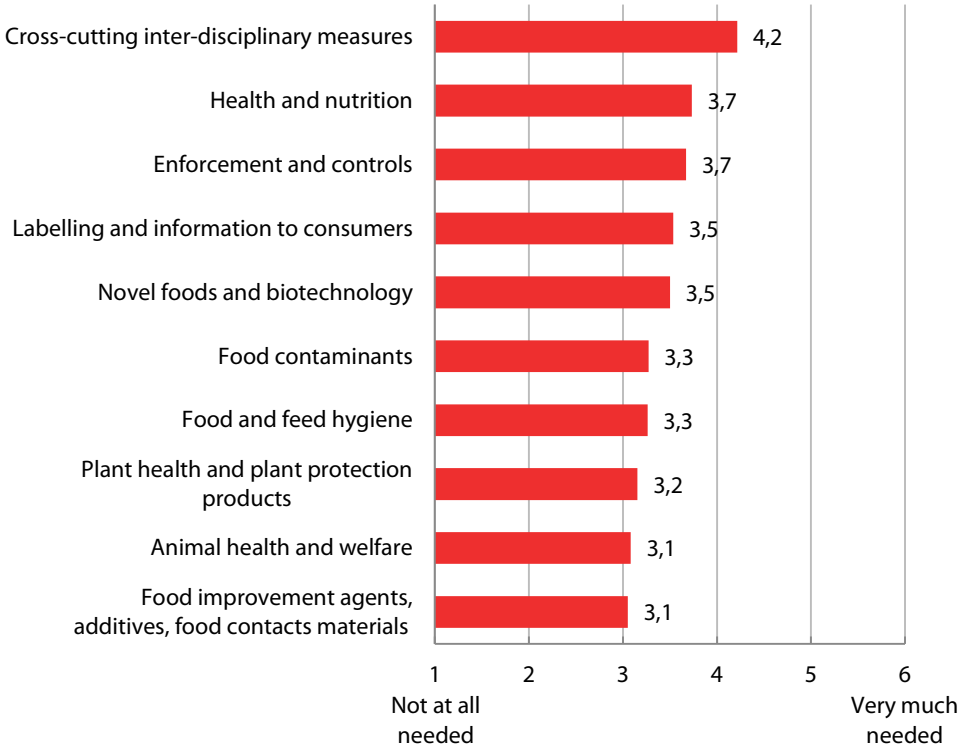
Main measures considered necessary	Comments
Promoting international governance & Improving communication	Improving communication - Resource efficiency in order to produce more with less will be key (land will continue to be a scarce resource), Promoting international governance - EU institutions and the internal market have gained importance to counteract the break-down at the global level. *(Food industry association/operator)*
	Promotion of international governance and encouraging education and communication in the emerging countries to lead to better understanding of each other's needs. *(Other stakeholder)*
	To face such a scenario, global and international governance is required. (*Other stakeholder)*
	Keep up the political dialogue and diplomatic ties with the given partners in the multipolar world. Make new alliances, if necessary. (Public authority)
	Education, awareness raising and training and Improving communication is very important, thus easy to share experiences and create conditions for cooperation. *(Independent expert)*
Research	Research: recycling, food waste reduction. *(University/research organisation)*
	Research needed to help sustainable production *(Other stakeholder)*
	Factors related to European self-sufficiency become more important. *(University/research organisation)*
Economic incentives to change diets	Incentives to promote crops such as whole grains fruit and vegetables. *(Consumer organisation/NGO)*
	Agriculture must be forced through incentives to produce more food for lower inputs (i.e. more plant foods with improved nutrition also resulting). (*University/research organisation)*
	[…] Consumption patterns probably need to be guided (e.g. through economic incentives). Assuming a break down in cooperation, a take up of it needs promoting. *(Other stakeholder)*
Measures to reinforce controls	In this difficult Scenario 2, active measures should be taken by the EU authorities which should be backed-up by national governments and municipalities, with the aim to keep the distribution channel as efficient as possible; to avoid black economy and trade of foodstuffs (with the always present problem of food safety, food alerts, etc. that are associated to this kind of trade) and to avoid fraudulent manipulation of food products. […] Enforcement and controls will be more needed that before. *(International organisation)*
	Reduction of food chain complexity will help to a better control and the risk management however illegal trade is a new menace and EU will have to reinforce border controls and to work with international organizations. *(University/research organisation)*
	Legislation: must ensure the relevant legislation are in place to control illegal imports. *(University/research organisation)*

Source: Stakeholder survey, question 2.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 15: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 2.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, in this scenario cross-cutting inter-disciplinary measures are considered most necessary to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. Changes in relation to health and nutrition policy, enforcement and controls, labelling and information to consumers, and novel foods and biotechnology are also considered more necessary than not (on the basis of average assessments above the midpoint of 3.5). However, changes relating to food contaminants, food and feed hygiene, plant health and plant protection products, food improvement agents, additives and food contact materials, and animal health and welfare, are considered relatively less necessary. Stakeholder comments regarding this question emphasised the need to improve enforcement and controls as a result of the decreased global cooperation, as well as cross-cutting measures to improve implementation of legislation, without necessarily making changes in specific topical

areas. Other comments indicated the need to improve labelling related to the origins of food, or improve education in relation to healthy diets.

The table below presents key stakeholder comments regarding potential changes needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario.

Table 13: Key comments of stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 2

Main area for which changes considered necessary	Comments
Cross-cutting measures & Enforcement and controls	Interdisciplinary measures and biotechnology are needed to optimise resource efficiency in fragmented setting. Legislative framework can remain largely intact, even though implementation may need to adapt to fragmented situation. Need to make the best out of a difficult situation, without legislation adding to burden. (*Food industry association/operator*)
	Key aspects are the capability of controls in a segmented environment. (*University/research organisation*)
	No one measure will cover what is needed. More inclusive enforcement and support. (*Independent expert*)
	Internal controls become more important. (*University/research organisation*)
	Important areas for international cooperation remain plant and animal health and enforcement/controls. In my view these need to be reinforced but no major changes are needed. (*Other stakeholder*)
	Communication is a matter of health and nutrition and controls for illegal trade will be very important in term[s] of food safety. (*University/research organisation*)
	Enforcements and controls are also needed to make sure that citizens have full confidence in food […]. Considering food safety issues can easily cross borders, mechanisms for early warning would need to be maintained. (*Food industry association/operator*)
	Regulations, controls are less (even no more) relevant if there is less trade. (*Other stakeholder*)
Health and nutrition & Education	Health and nutrition aspects need to be focused on since the European diet becomes less diversified and thus risk of inadequate intakes of nutrients increase. (*Public authority*)
	We do not believe that we need to change the labelling rules if the market is closed. Labelling is not impacted as much in the context of a closed market. We need to focus on other aspects of policy such as education in health, i.e. how consumers should eat a varied diet in conditions where the choice is limited rather than introducing changes in labelling. (*Food industry association/operator*)
Labelling and information to consumers	Participation in the international trade of food, but improving the quality of origin labelling. (*Food industry association/operator*)
	Labelling of origin will be important. (*University/research organisation*)
Other	European agriculture must become more efficient, producing much more protein per surface area of land. (*University/research organisation*)

Source: Stakeholder survey, question 2.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Stronger emphasis on changes to combat illegal trade of food products was needed according to workshop participants;
- Encouraging the production of more diversified food outputs was considered necessary to avoid the risk of only certain foods being available in the event of a cooperation break-down;
- It was noted that the potential trade-off/linkage between food sufficiency and food safety may result from the scenario and as a result an increased focus on linking food security to food safety was suggested;
- To face the eventuality of a break-down in cooperation, it was suggested that further consideration be placed on consumer education and awareness raising in relation to food culture and traditional food preparation practices.

Future research

Finally stakeholders were asked on which issues research should be conducted to better understand the challenges posed by scenario 2, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted in relation to either alternative, local agriculture that preserves resources, including biodiversity; internal market resilience, flexibility and sustainability; optimisation of productivity; alternative diets; or novel foods/production methods and improved international governance.

The table below presents key stakeholder comments regarding issues for future research relating to this scenario.

Table 14: Key comments of stakeholders/experts regarding issues for future research under scenario 2

Main issue for future research	Comments
Alternative, local agriculture that preserves resources, including biodiversity	Research on alternative non-food energy sources, promotion and preservation of local biodiversity and genetic resources. (*International organisation*)
	Into more efficient, low input agriculture, in all European agricultural environments. (*University/research organisation*)
	Research on sustainability and cycling of resources. Rapid methods for control of food. Development of local replacement foods, plant varieties, etc. (*Public authority*)
	Recycling, alternative feed products for the production [of] animals. (*University/research organisation*)
Internal market resilience, flexibility and sustainability	Resilience of the internal market including resources in combination with microclimate. (*University/research organisation*)
	Further research encouraging self-sustainability of the internal market. (*Other stakeholder*)
	Internal flexibility and appropriate legislation. (*University/research organisation*)
Optimisation of productivity	We think the research should concentrate on the production level, in order to maximize production without use of risky chemicals or methods for consumers: greenhouses, hydroponics, genetics, extending the period of life of a fruit or vegetable, etc. (*International organisation*)
	Optimise productivity of fragmented agriculture. (*Food industry association/operator*)
Alternative diets	[Research on] what would a European diet with little imp[or]ted food look like what would be its impact on health, what would be the internal market implications what regulation and support would be needed to meet needs. (*Consumer organisation/NGO*)
	[Research on] how to create healthy alternative diets. (*University/research organisation*)
Novel foods/production methods	Research in new food products and processing methods. Better lab testing methods. (*Independent expert*)
	[…] Research on innovations: use of nanotechnologies, active food packaging and food process with in parallel the risk assessment linked to these new technologies. (*University/research organisation*)
Improved international governance	Benefits and potential for increased international governance of global food markets. (*University/research organisation*)

Source: Stakeholder survey, question 2.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Broad consensus was achieved on the usefulness of research on what a European diet based on very little imported food would look like as well as the impact this could have on health. This could require the analysis of import statistics, as well as key dependencies on extra-EU food;
- Current meat production and a projected increasing amount of protein production are not considered to be sustainable. Research into the diversity of food consumption, resource efficiency proportional to land surface area, and long-term sustainable animal production was considered essential;
- Further research into high protein and novel foods that can provide new proteins and supply Europe was seen as needed;
- Research on how to safeguard food safety and a healthy diet in a situation where food security becomes key is essential;
- Considering the breakdown of international trade, access to primary commodities such as oil is likely to be more costly, and alternative food chains (e.g. local/short food chains) would therefore emerge. Therefore, further research on facilitating a potential switch towards smaller scale 'family' farm production was considered necessary;
- Research may need to focus on ways to avoid competition between biofuels and food needs, by safeguarding that biofuels are not made from crops intended for consumption and that there is as little competition as possible;
- Finally, research could be promoted regarding ICT technologies that may help in conducting effective and efficient border controls through quick and cheap tests, in an environment where the importance of border controls is increased.

4.3. Scenario 3: Long-term austerity and a shift to private food safety controls in the EU

1. This scenario assumes that overall, EU Member State governments continue with fiscal austerity policies over the next decades, inducing a significant reduction in public services in the EU, including in the area of official food safety controls.
2. Key interrelationships in this scenario between the scenario driver (EU governance) and other drivers include: *Global cooperation and standard setting*: While many food chain operators already made use of private standards to position themselves competitively on global markets, the lack of regular and thorough public controls due to a shortage of resources created further demand for private controls and standards as an alternative, which further spurred on the global increase in the use of private standards; and *Demography and social cohesion:* Long-term austerity has led to increased social unrest, with an increase in inequality, and re-nationalisation movements in a number of EU Member States.
3. While the assessment of plausibility is relatively higher than other scenarios for 2020, it remains below the midpoint of 3.5 for all timeframes, meaning that overall the scenario can be considered less plausible than it is plausible.[284]
4. Restaurants and catering are considered most strongly impacted under the scenario, followed by primary production, ingredients and agricultural inputs. Enforcement and controls are the policy areas considered most strongly impacted under the scenario, followed by health and nutrition and food contaminants. Social stability is considered most negatively impacted as a result of the scenario, followed by environmental sustainability and consumer choice, and to a lesser extent the internal market.
5. All measures/courses of action proposed are considered to be more needed than not needed, to a relatively similar extent, with promoting international governance, education and awareness raising, research, improving communication, and legislation considered most needed.
6. Changes to enforcement and controls are considered most needed, followed by food and feed hygiene, and health and nutrition policy and legislation. In contrast, changes in relation to novel foods and biotechnology and food improvement agents, additives and contact materials are considered least needed.
7. Stakeholders found that research needed to be conducted in relation to improving regulatory mechanisms via efficient, cost-effective control procedures; new technologies to improve control procedures, including traceability; and improving communication and public confidence in inspection services.

4.3.1. Description of scenario

This scenario assumes that overall, EU Member State governments continue with fiscal austerity policies over the next decades, inducing a significant reduction in public services in the EU, including in the area of official food safety controls. The scenario explores the challenge of ensuring food safety and nutrition in an environment of tight budgetary restrictions.

[284] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

Throughout the 2010s and to the late 2020s, most EU Member States continued to pursue fiscal austerity policies – increased taxation and reduced spending – that had begun in the wake of the economic crisis, with the aim of rendering public debt levels more sustainable. The EU economy did not return to growth for several years, which further reinforced strain on public finances. Eventually, a range of fiscal adjustments needed to be implemented in order to bring Member States' debt ratios to the target level of 60% of GDP enshrined in the Treaty, involving entitlement reforms in particular. In the late 2020s, with the fear of another economic crisis in mind, coupled with the considerable influence of globalised markets on debt sustainability, many policy makers in the EU were reluctant to increase spending even once the economy had recovered. This heralded a further period of reduced spending, which affected many public services significantly, but also had an impact on social cohesion, and re-nationalisation movements are now strong in a number of Member States.

Public food safety and veterinary emergency preparedness and inspection capacities were among the areas most affected. The shortage in resources allocated to official controls led to an overall reorganisation of control systems in Member States (with some efficiency gains), including a prioritisation of EU border controls, but most importantly a strongly reduced frequency of public inspections. Nonetheless, private inspection services, combined with self-regulation and EU-level or global private standards and related certification, have appeared to fill the gap in most Member States. In addition, the market pressure to reduce costs associated with self-regulation has spurred on many operators to develop new technologies to control their products more efficiently, e.g. regarding traceability of food-stuffs and ingredients. Overall, however, the risks associated with neglect in food safety mechanisms, bioterrorism, and fraud have increased, especially in the prevailing competitive global environment of very tight margins for producers, and consumer trust in food safety has decreased as a consequence.

Looking back from 2050 to the world of today, forerunners of this future are…

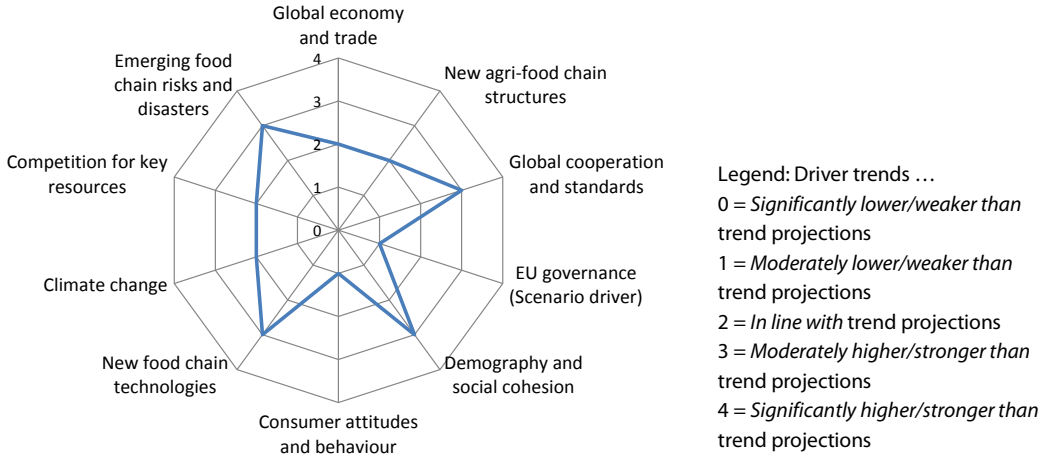
- In the Euro area in 2011, the average debt-to-GDP ratio reached 88% of GDP – some 20 percentage points higher than at the start of the crisis in 2007. Further expected increases in debt in 2012 and 2013 pointed to a euro area debt to GDP ratio of 92.6% of GDP in 2013.[285]
- Over 2007-2010, EU inspectors have reported that the reason for identified shortcomings in control activities or for unsatisfactory or insufficient level of controls is a lack or shortage of resources. FVO audit reports for 16 different Member States pointed to serious difficulties faced by competent authorities in maintaining an appropriate level of controls (e.g. of veterinary checks on imported goods at the border inspection posts, of farm level controls on the use of veterinary medicines).[286]
- Member States are allowed to collect a fee from operators to recover control costs (mandatory fees), however typically they recover between 20% and 80% of costs with respect to controls subject to mandatory fees, resulting in additional costs to the public of between 0.9 and 3.4 billion Euro per year across the Member States for official control activities.[287]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (EU governance) and the other drivers identified.

[285] European Commission, Report on Public finances in EMU, European Economy 4-2012, 2012.p.2.
[286] European Commission, Commission Staff Working Document. Executive Summary of the Impact Assessment accompanying the document 'Proposal for a Regulation Of The European Parliament And Of The Council, COM(2013)265 final, SWD(2013) 167 final, Brussels 6.5.2013.p.12.
[287] Ibid.p.13.

Figure 16: Scenario diagram for scenario 3



The following points describe in further detail the nature of the interrelationships identified.

- *Global cooperation and standard setting*: While many food chain operators already made use of private standards to position themselves competitively on global markets, the lack of regular and thorough public controls due to a shortage of resources created further demand for private controls and standards as an alternative, which further spurred on the global increase in the use of private standards.
- *Demography and social cohesion:* Long-term austerity has led to increased social unrest, with an increase in inequality, and re-nationalisation movements in a number of EU Member States.
- *Consumer attitudes and behaviour:* Reduced reliance on public inspection services has caused a decrease in consumer trust in food.
- *New food chain technologies:* The market pressure to reduce costs associated with self-regulation has spurred on many operators to develop new technologies to control their products more efficiently, e.g. regarding traceability of food-stuffs and ingredients.
- *Emerging food chain risks and disasters:* The risks associated with neglect in food safety mechanisms, bioterrorism, and fraud have increased as a result of the decrease in public controls, especially in the prevailing competitive global environment of very tight margins for producers.

Other drivers not listed here were considered to develop in line with current trends and projections.

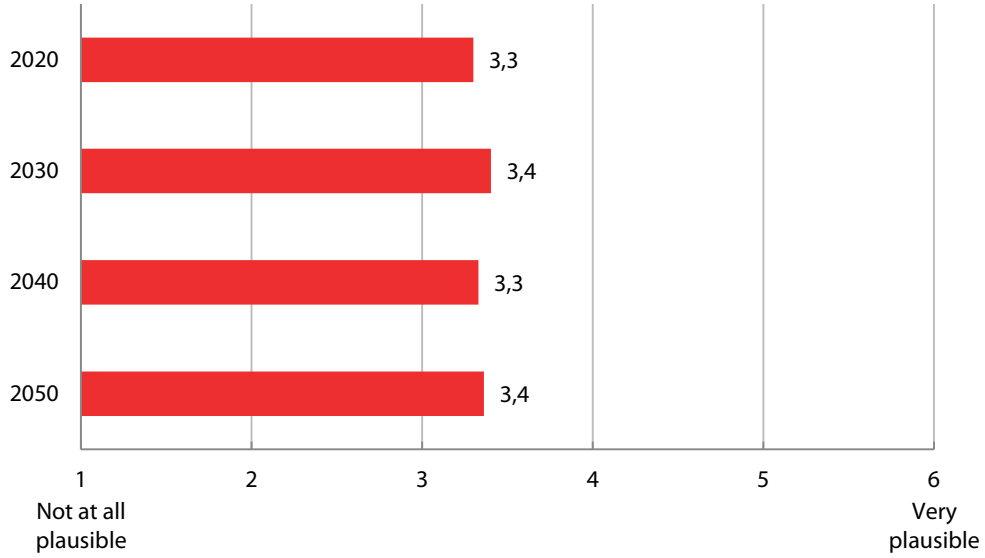
4.3.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at

all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 17: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 3.1.

As indicated in the graph, while the average assessment of plausibility is relatively higher than other scenarios for 2020, this assessment does not differ significantly across timeframes. Specifically, the average assessment of plausibility remains below the midpoint of 3.5 for all timeframes, meaning ´that overall the scenario can be considered less plausible than it is plausible. Stakeholder comments reflected this broadly, in that while some indicated that the scenario was broadly plausible given current trends, several noted that enduring austerity may not have such a negative effect on the shift to private controls, despite a partial move being seen as plausible.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 15: Key comments of stakeholders/experts regarding plausibility of scenario 3

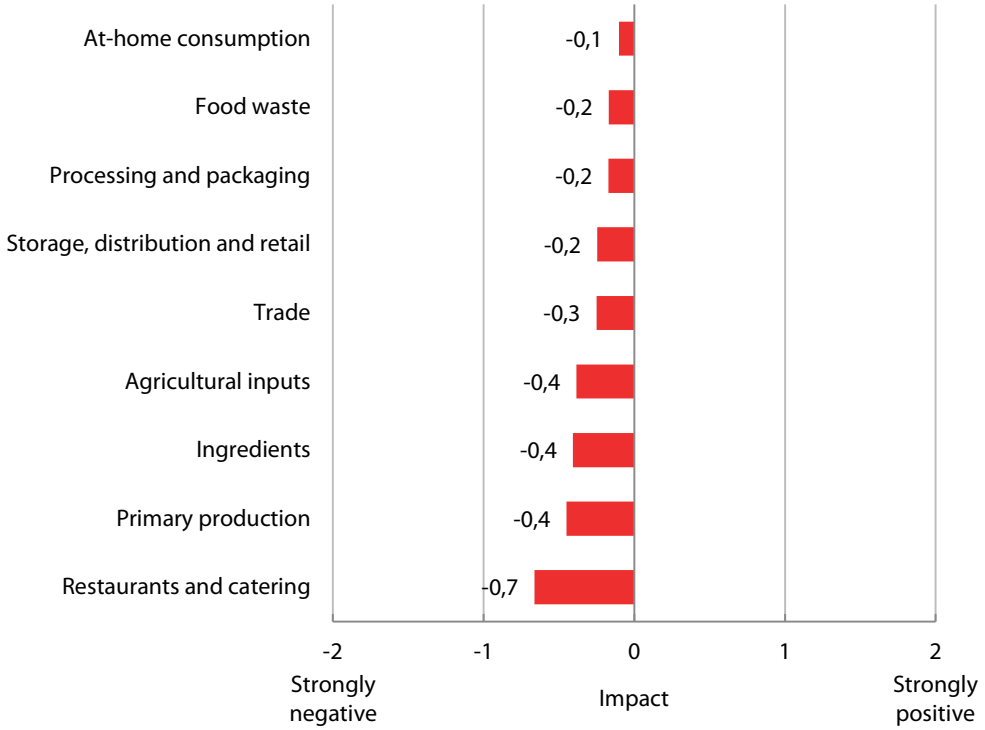
Judgment	Comments
Plausible given current trends	From my perspective the EC has already started to shift remaining responsibilities from official to private control due to fiscal austerity. *(Public authority)*
	A shift to self-regulation is already apparent in certain food sectors (more than others). *(University/research organisation)*
	There is, at least in Sweden, already a significant trend towards private standards covering the legislation, especially in primary production and process and packaging amongst small food business operators. Many food business operators will require/are already requiring certification according to specified standards from their suppliers. *(Public authority)*
	First developments of this scenario are already reported from Norway (new right wing government's act was to cut budget for food safety). *(Public authority)*
Partial move to private controls plausible, but austerity may not have such a significant effect	Despite the fiscal austerity prevailing at the moment, the likelihood that industry and public authorities are going to reduce vigilance as regards safety is highly unlikely, whether or not the private sector will be forced to contribute through inspection fees. Even in case the private sector had a more prominent role in safety controls, this should not necessarily be seen as a downgrading of the priority to ensuring safe food. Hence, although the trend for increased private certification can be verified in the market today at least in Europe, we do not consider the scenario of certification as mainstream option to be realistic. *(Food industry association/operator)*
	Two key assumptions made under this scenario are likely to happen: long-term fiscal austerity in the EU (very likely) and reduction of public food inspection services in the EU (likely), but I do not find plausible that private inspection services and self-regulation would fill the gap, as the Scenario describes. *(International organisation)*
	We expect that the initial reaction of competent authorities is to compensate the lack of public funding with a mechanism of fees charged to the operators. This fees system will increasingly come under pressure, which may ultimately result in the realisation of the above described scenario. *(Other stakeholder)*
	A move towards a balance between private self-control and public enforcement is quite probable although it is unlikely that official food safety control would disappear altogether. Areas such as border controls (customs) and veterinary health will remain under overall state control (even if outsourced to private contractors to reduce costs). *(Other stakeholder)*
	A number of technologies for the low-cost, automatic detection of contaminants are now appearing in the market. One such example is nucleic acid sequencing, that saw its price decrease more than 100 fold in the last years. Even with the long term fiscal austerity, public food inspection services will be able to do more with less. On the other hand, it is probable that food producers will be interested in implementing these cheaper and more efficient methodologies, meaning that public inspections will be less relevant. *(University/research organisation)*
	Possible, but with such a large population and with food supply being fundamental to human existance it is unlikely that the EU would reduce expenditure in the area of food safety control. *(University/research organisation)*
	Food safety is politically too important to foresee an almost total shift to private controls, even in an austerity scenario. *(Food industry association/operator)*
	Long term austerity, even if it happens, is unlikely to affect drastically the food-related industries, or consumption. *(University/research organisation)*

Source: Stakeholder survey, question 3.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 18: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



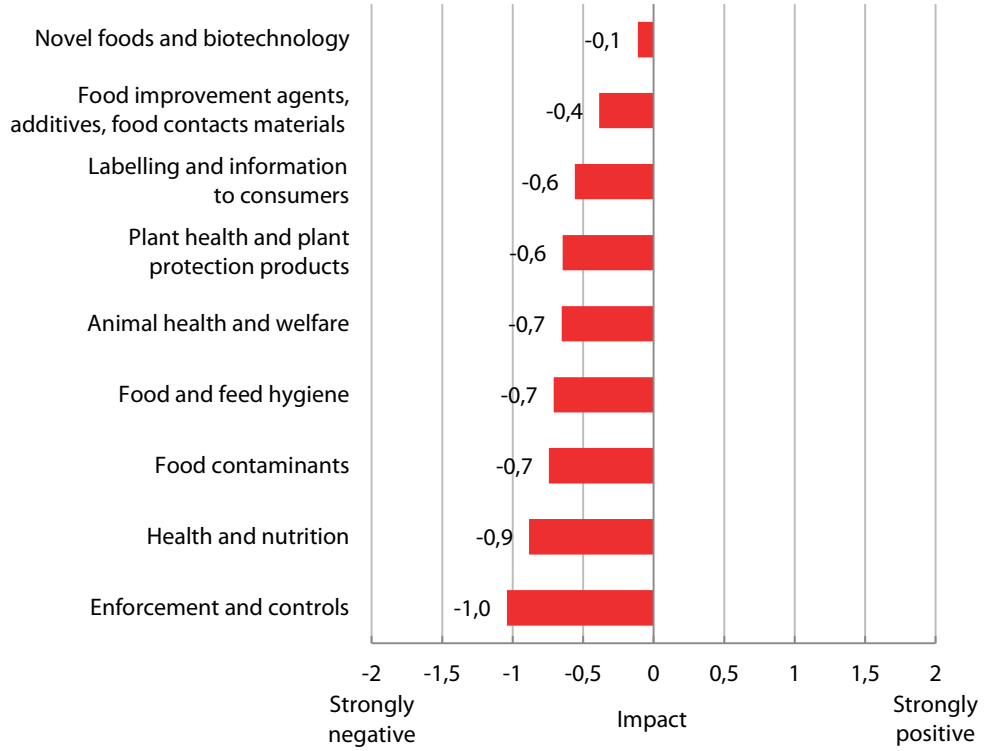
Source: Civic Consulting, based on stakeholder survey, question 3.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

As shown above, all food chain activities are considered to be negatively impacted under this scenario, with restaurants and catering suffering the most, followed by primary production, ingredients and agricultural inputs. At-home consumption, food waste, and processing and packaging are considered to be least impacted. Further detail was provided in stakeholder comments, indicating that restaurants and catering would mostly be negatively impacted by the increased proportion of consumers eating at home. Other comments emphasised negative impacts on food safety at the primary production stage, a potential reduction in food waste owing to the overall need for more careful consumption of food, as well as the potential for efficiency gains in the food chain as a result of the increased focus on savings. One stakeholder noted the potential for a clearer playing field and less administrative burden for operators as a result of the focus on reorganising controls to improve efficiency.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 19: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



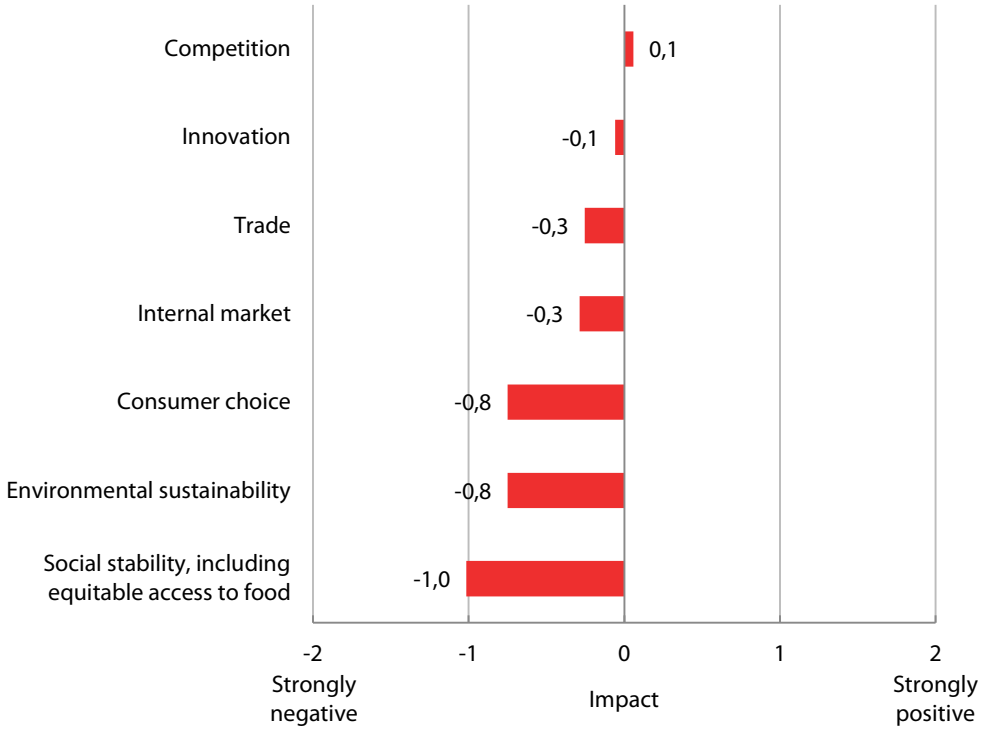
Source: Civic Consulting, based on stakeholder survey, question 3.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

As shown in the graph, all policy areas are considered to be negatively impacted under this scenario. Enforcement and controls are considered to be most negatively impacted, followed by health and nutrition and food contaminants. Novel foods and biotechnology, however, are by a clear margin considered to be least impacted. Stakeholder comments highlighted a potential decrease in product quality/lower standards as a result of the reduction in public inspection services, increased risk of contaminants and fraud in the food chain, increased importance of labelling as a signal for safe food, a negative impact on animal health and welfare and less acceptance of new technologies due to a potential higher aversion to risk. In addition, it was noted that a potentially significant price differential between safe, controlled food products and potentially unsafe food products could emerge as a result of the scenario. On the other hand, other stakeholders indicated no specific impact, as they found private controls could also be as effective and efficient as their public equivalents.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 20: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



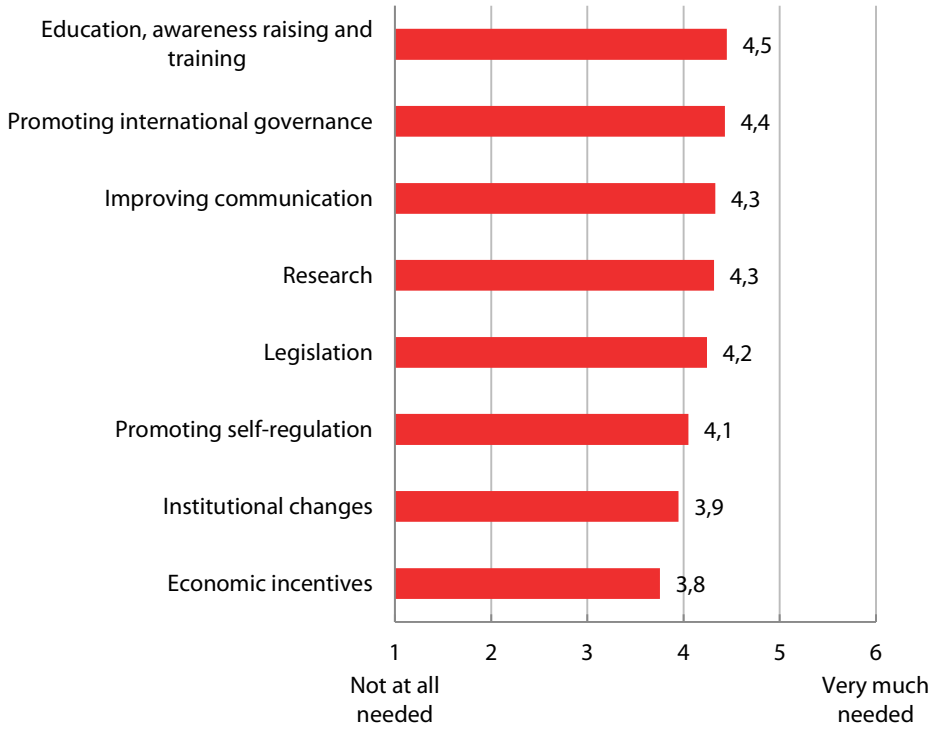
Source: Civic Consulting, based on stakeholder survey, question 3.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, social stability is considered most negatively impacted as a result of the scenario, followed by environmental sustainability and consumer choice, and to a lesser extent the internal market. Competition is on the other hand considered to be slightly positively impacted. This is reflected in stakeholder comments, which underlined the negative effects of austerity policies on inequality, and indicated a possible gain in competition and innovation from increased market pressure to ensure food safety. However, stakeholders noted that the internal market may be positively impacted thanks to a potentially increased focus on foods from local sources, even if it was noted that the internal market may still suffer from international competition, e.g. from imports from countries where food safety can be better guaranteed.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 21: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 3.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, all measures/courses of action proposed are considered to be more needed than not needed, to a relatively similar extent. Promoting international governance, education and awareness raising, research, improving communication, and legislation are considered most needed. Stakeholder comments highlighted a range of measures, including legislation and international governance to improve consumer trust, in particular in trade; supporting official controls, including through legislation, education and communication. Alternatively, some stakeholders found that self-regulation and related measures should be promoted to face a possible scenario of tight budgetary restrictions for controls.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 16: Key stakeholder comments regarding measures considered necessary under scenario 3

Main measures considered necessary	Comments
Legislation & International governance	The measures and courses of action must be at international levels in a global trade, legislation reinforced and improve traceability from farm to fork. *(University/research organisation)*
	Self-regulation will not be trusted by consumers. Strong legislation will be required to help increase consumer trust. *(Food industry association/operator)*
Promotion of trade	Promotion of food imports – provided the official quality standards are fulfilled- probably by means of tax & tariff reductions. *(Other stakeholder)*
	Support consumer confidence in international trade rather than protectionism. *(University/research organisation)*
Supporting official controls, including through legislation, education and communication	Fiscal austerity policies are a risk if applied to food security. There is a strong need for legislative framework which obliges governments to retain certain duties (such as controls) related to public health. Communication and Education is therefore a necessity in order to raise awareness among politicians about public health related [issues] such as food security […]. *(Public authority)*
	Public funding for official controls. *(Food industry association/operator)*
	Improvement of official controls [is] necessary . *(Food industry association/operator)*
Self-regulation and related measures	Since the resources for food control are limited it is not [justified] to maintain and develop new legislation. The private sector will handle these issues to a large extent and private controls and standards are the alternative. Hence the institutions would need to be adapted. To counteract the decreased consumer trust in food education and better communication are needed. *(Public authority)*
	Promotion of self-regulation should be a priority, although it could hardly fill the gap of less official controls. Institutional changes should be taken to improve the coordination and protocols of operation by those responsible in cases of food alerts. *(International organisation)*
	The EU could promote industry self-control schemes - and encourage these on an international scale through bodies such as Codex or the international trade associations. Further research for cheaper point-of-need testing for products before they enter the food chain would also be a key component of their policy. *(Other stakeholder)*
	Self-regulation: self-regulation should be the way forward to ensure the new control systems are effective, efficient, costly neither to the Member States, nor to the consumers, nor to the private sector.[…]; Education: Consumers should be educated about the efficiency of the self-regulation system aiming at ensuring controls are done properly. There is a role for public authorities to take part in these campaigns […] *(Food industry association/operator)*
Introduction of new technologies for control	New principles […] shall be established on the food chain safety controls: ICT based net control by national authorities with strong collaboration. Introduce automatic ICT controls instead of physical on-the-spot checks. Collect much more data, and mak[e] data warehouse at national and community level. *(Public authority)*

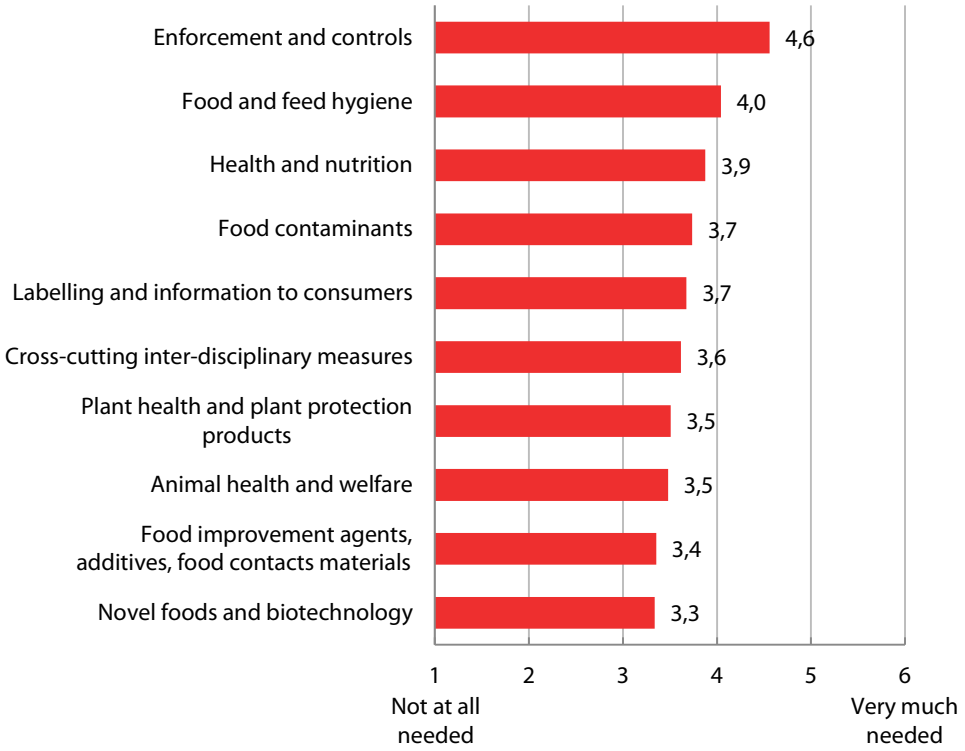
Source: Stakeholder survey, question 3.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the

scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 22: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 3.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, in this scenario changes are considered necessary across most policy areas (on the basis of average assessments above the midpoint of 3.5). Changes to enforcement and controls are considered most needed, followed by food and feed hygiene, and health and nutrition policy and legislation. In contrast, changes in relation to novel foods and biotechnology and food improvement agents, additives and contact materials are considered least needed. Areas for which changes are considered most needed therefore broadly reflect those considered to be most impacted shown in the previous graph.

These results reflect stakeholder comments, in that several stakeholders highlighted the need to make changes in relation to enforcement and controls, including legislation related to self-regulation, certifications and labelling, and to control procedures and technologies. However other stakeholders indicated specific changes to legislation may not be as needed as investment in existing control frameworks.

The table below presents key stakeholder comments regarding potential changes needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario.

Table 17: Key comments of stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 3

Main area for which changes considered necessary	Comments
Enforcement and controls, including legislation related to self-regulation, certifications and labelling	Since under this scenario enforcement and controls will be most affected preparation of how these will function under a severely reduced budget needs to be implemented. In particular greater collaboration with the trade associations to help with setting up efficient self-control schemes would be necessary. (*Other stakeholder*)
	Enforcement: the legislative framework will need to be adapted to allow and secure efficient self-regulation for control mechanisms. (*Food industry association/operator*)
	Self-controls at EU levels will be necessary, global private standards and related certifications, food safety will be very impacted [as] a whole especially food and feed hygiene (TIACS and food contaminants). (*University/research organisation*)
	As official controls become less important in favour of private control systems it is necessary to revise and adapt the current food control legislation and common food emergency systems. In order to ensure consumer trust and limit the risk of consumers being misled it is important to maintain good legislation in the area of food labelling, nutrition and health. (*Public authority*)
	With a self-regulated system supported by effective legislation and sanctions, the desired outcome can be achieved. (*Independent expert*)
... improving control procedures	Introduce new experts in official control, not only veterinarians but also food technologist and agricultural engineers. (*University/research organisation*)
	By developing other control and test mechanism it should be ensured to reach the same level of food safety with less official controls and a restricted budget. (*Public authority*)
	It is essential, in particular in case of such scenario to maintain official supervision and even enhance it. (*Independent expert*)
	Need to strengthen now so that food production systems are strengthened to withstand a period of reduced regulation. (*University/research organisation*)
	Preserve a good control of agro-food chain, transparency and restrictive legislation in restrictive budget scenario. (*University/research organisation*)
... and new technologies	The control methods [should] be improved in general, and then they [should] be adapted on the different fields. Lot of resources [should] be saved by using better technologies, methods. (*Public authority*)
	[…] Methods to evaluate the performance, compliance with legislation and efficiency of the controls carried out by the certifications bodies have to be developed. […]. *(Public authority)*
No specific changes necessary	The current EU legislative and policy framework is rather comprehensive and complete. Updates will be necessary from future lessons learnt from eventual food safety incidents caused by the reduction in public food inspection services. (*International organisation*)
	This scenario is essentially about the consequences of a prolonged fiscal crisis and absence of economic growth. More legislation would be of limited value if the issue is the extent to which member states can afford to invest in their control frameworks. (*Public authority*)

Source: Stakeholder survey, question 3.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- More severe consequences or higher fines for breaches to food safety laws were suggested (this may depend on the trade-off between the level of control and the value of the fine);
- Furthermore, changes to the efficiency of controls via technology (smarter controls) were also suggested.

Future research

Finally stakeholders were asked on which issues research should be conducted to better understand the challenges posed by scenario 3, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted in relation to improving regulatory mechanisms via efficient, cost-effective control procedures, new technologies to improve control procedures, including traceability, and improving communication and public confidence in inspection services.

The table below presents key stakeholder comments regarding issues for future research relating to this scenario.

Table 18: Key comments of stakeholders/experts regarding issues for future research under scenario 3

Main issue for future research	Comments
Regulatory mechanisms and efficient, cost-effective control procedures	Research should be dedicated to developing the most efficient self-regulatory mechanisms when it comes to control systems, involving the private sector which will have a crucial role in this. Also, research funding should be dedicated to product innovation, led by the industry, to ensure costs associated with the new control mechanisms, including new product development, are as reduced as possible for the industry and the consumers. (*Food industry association/operator*)
	Research on sustainable agriculture, food production and waste management. Tools for prioritization of control and management. Rapid and cost-effective methods for control. Research on efficient ways to educate and train people. (*Public authority*)
	The key areas of food safety control and improved systems of control (swifter / more pro-active, less reactive). (*University/research organisation*)
	Food safety decision making of FBOs [(fixed based operators)] from [a] psychological and sociological perspective (incentives, drivers, etc.); Research on cost-effectiveness of different controls (private vs. public) with regards to general health outcomes (i.e. economic burden of food-borne and nutrition diseases). (*Public authority*)
Technology to improve control procedures, including traceability	By developing test systems which give a comprehensive overview of a distinct part of the farm to fork chain (e.g. animal welfare marker or serum test for multiple diseases) conducting less controls should give the same level of safety. (*Public authority*)
	ICTs [information and communication technologies] in food chain: telemetry, remote sensors, intelligent process management, big data management, radio frequency identification, near field communication, biometric identification of animals; internet of things. Functioning of the food chain as a net. (*Public authority*)
	Fast, inexpensive screening methods. (*Food industry association/operator*)
	On line supervision of food production. Laboratory testing in real time. (*Independent expert*)
	Research for quick checks at the farm level for potential hazards (disease, or food borne contaminants, toxins, bacteria, etc...). (*International organisation*)
	Rapid quick tests to evaluate the presence of food contaminants. (*University/research organisation*)
	The main challenges posed will concern testing and traceability tools. Further research on rapid methods at point-of-need using new sophisticated Big Data collection systems which will ensure traceability and rapid access to data. (*Other stakeholder*)
Communication and maintaining public confidence	[Research on] [w]hat is the most effective means of communicating issues relating to food safety and food labelling (i.e. the information that the consumer needs to understand). (*Independent expert*)
	Public confidence in private food inspection services; competency level and effectiveness of private food inspection services. (*International organisation*)

Source: Stakeholder survey, question 3.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Research should be pursued into which risks can be handled by companies through more self-control, and which risks could not be handled and how these systems can be incentive structures/competitive;
- Participants noted that research in ICT in the food chain and high quality, effective and discriminating testing methods should be conducted;
- It was further noted that research into promoting domestic production/low input agriculture and improving nutrition is needed;
- Public confidence in the food chain was suggested as an area of further research;
- Scope for additional examination of the relationship between strict liability and due diligence in controlling the food chain (liability system) was highlighted;
- A need to conduct further research on methods to operate under austerity conditions and further improve the standards needed in food safety and nutrition was noted.

4.4. Scenario 4: Severe inequality linked to food insecurity of vulnerable consumers and polarised diets

1. This scenario assumes a high level of socioeconomic inequality in the EU, accompanied by a very strong polarisation of diets and lifestyles. Specific vulnerable groups are affected by food insecurity as a result, while many others are now obese.
2. Key interrelationships in this scenario between the scenario driver (Demography and social cohesion) and other drivers include: *EU governance*: As is the case in many parts of the world, EU public finances are put under considerable pressure from an increase in recipients of social transfers and increased healthcare costs due to obesity-related diseases, although governance remains stable overall; and *Consumer attitudes and behaviour:* For those consumers rich enough to avoid food insecurity, the strong inequality prevailing in the EU has driven an increased polarisation of diets and lifestyles across socioeconomic disparities, with the worse-off (the majority) now affected by very high obesity levels.
3. Already by 2030, stakeholders consider that the scenario is more plausible than implausible (based on average values).[288]
4. Most food chain activities are considered to only be slightly impacted by this scenario, in contrast with other scenarios. These include restaurants and catering, primary production, agricultural inputs, processing and packaging, and trade. Health and nutrition, animal health and welfare, food contaminants, novel foods and biotechnology, as well as food improvement agents, additives and food contact materials are the policy areas considered most impacted under this scenario. Social stability is considered by a clear margin to be the other key area most impacted; environmental sustainability, consumer choice, and innovation are also considered to be strongly impacted.
5. Education, awareness raising and training are seen as most needed measures/courses of action to respond to the challenges posed by the scenario, by a significant margin, followed by research, improving communication and economic incentives.
6. Changes in relation to health and nutrition policy are considered most needed under this scenario by a clear margin. This is followed by labelling and information to consumers, cross-cutting inter-disciplinary measures, and novel foods and biotechnology.
7. Stakeholders found that research needed to be conducted in relation to cheap and healthy foods, possibly incorporating new technologies; the determinants of the quality of nutrition across different consumer groups; education practices regarding nutrition and their impact; the current situation in the EU regarding nutrition levels across socio-economic groups; and economic modelling, e.g. regarding the impacts of obesity and related diseases.

4.4.1. Description of scenario

This scenario assumes a high level of socioeconomic inequality in the EU, accompanied by a very strong polarisation of diets and lifestyles. Specific vulnerable groups are affected by food insecurity as a result, while many others are now obese. The scenario explores the challenges of

[288] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

safeguarding the food security of vulnerable consumer groups and addressing lifestyle-related problems affecting the health of large parts of the EU population.

By 2050, the global divide between the rich and the poor has grown substantially. In the EU, as in the rest of the developed world, this is primarily a consequence of sustained reductions in social transfers as well as fiscal adjustments as a response to the ageing population and to the decline in competitiveness compared to the emerging economies. Socioeconomic inequalities in the EU in 2050 have reached levels comparable to those in the US in 2013. In the EU, two major vulnerable consumer groups are disproportionately affected: the elderly and migrants. The EU population has aged considerably: 30% of the EU population is over 60, which has led to a significant contraction of the labour supply, and has put considerable pressure on public finances. As a consequence of diverse labour-market induced migration programmes, as well as environmental disruptions and regional conflicts in other parts of the world, many EU consumers have an extra-EU background in 2050: cumulative net migration to the EU since 2010 stands at about 90 million, or slightly less than one fifth of the total EU population in 2010. The combined effect of the increased number of recipients of social transfers as well as tight budgetary restrictions has led to a substantial rise in poverty. While the extent of the problem differs by Member State, considerable numbers of the very poor now have serious difficulties in accessing sufficient and safe food of high nutritional quality (and, in particular for migrants, that is also culturally relevant) to meet their dietary needs and food preferences for an active and healthy life. The number of people that are at least partly dependent on charity, food-for-poor programmes or living off food waste is substantial.

For those rich enough to avoid food insecurity however, the increasing inequality in the EU, and ensuing differences in nutrition and health education, has led to highly polarised diets and lifestyles across the socioeconomic divide. The worse-off (the majority) predominantly eat cheap, often pre-prepared/convenience food, as in many parts of the EU fresh food is increasingly a luxury. They live on a largely animal protein and carbohydrate-rich diet – despite new food traditions brought by migrants and increasingly globalised food consumption patterns – and engage in little physical activity, while the expensive, healthy and fresh foods cater to the health-conscious, well-off minority. As a result, already by 2030, 70% of the EU population was overweight or obese (as in the US in 2010), and 40% was obese, and in 2050 this figure stands at 75%, with 45% being obese, leading to severe health problems and a reduction of the average number of healthy life years, and further putting strain on public finances as a result of increasing healthcare costs.

Looking back from 2050 to the world of today, forerunners of this future are…

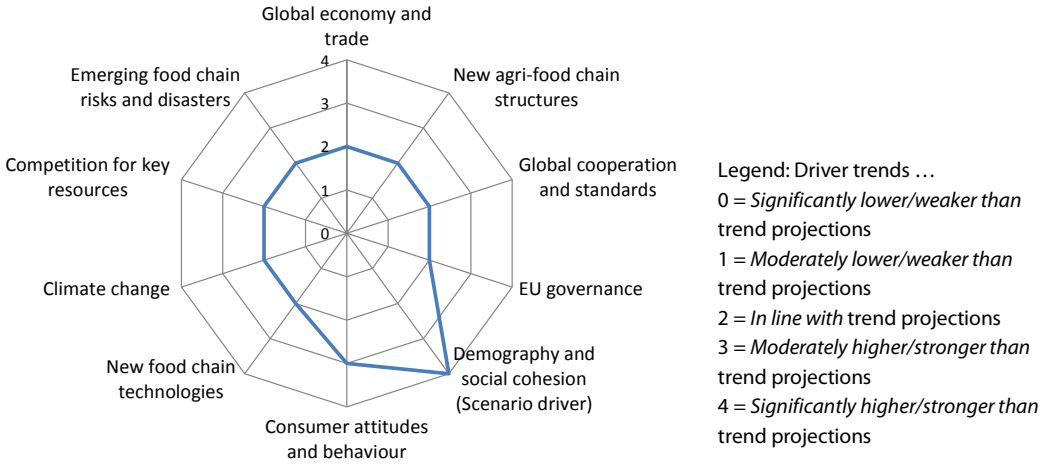
- In the EU, from the mid-1980s to 2008, people whose income was in the top 10% captured an increasing part of the income generated in the economy, while the poorest 10% lost ground.[289]
- 85 million people in the EU were aged 65 and above in 2010 (17% of the EU population).[290] In the EU as a whole, strictly-age-related spending (pensions, long-term care, and health care) was 25% of GDP and unemployment benefit spending was 1.1% of GDP in 2010, together accounting for about 50% of general government expenditure.[291]
- In 2008, risk-of-poverty levels for the elderly were approximately three percentage points higher than for the overall population in the EU-27.[292] In the EU15 as a whole, some 25% of migrants from outside the EU had disposable income below the poverty line in 2005.[293]
- In 2010, more than half (50.1%) of the adult population in the EU was overweight or obese.[294]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (Demography and social cohesion) and the other drivers identified.

[289] OECD, Income Inequality in the European Union, 2012.
[290] European Commission, The 2012 Ageing Report: Economic and Budgetary Projections for the 27 EU Member States (2010-2060), 2012.p.26.
[291] Ibid.p.23.
[292] Guerin, Benoit, Demography & Inequality - How Europe's Changing Population Will Impact on Income Inequality, 2013.p.6.
[293] Lelkes, O., Platt, L., and Ward, T. (2009), 'Vulnerable Groups: The Situation of People with Migrant Backgrounds', in Lelkes, O., Sutherland, H., and Tóth, I.G. (eds.), European Inequalities: Social Inclusion and Income Distribution in the European Union, Tárki: Budapest, pp.69–101.p.90.
[294] OECD/European Union (2010), "Overweight and Obesity among Adults", in Health at a Glance: Europe 2010, OECD Publishing.

Figure 23: Scenario diagram for scenario 4



The following points describe in further detail the nature of the interrelationships identified.

- *EU governance*: As is the case in many parts of the world, EU public finances are put under considerable pressure from an increase in recipients of social transfers and increased healthcare costs due to obesity-related diseases, although governance remains stable overall.
- *Consumer attitudes and behaviour:* For those consumers rich enough to avoid food insecurity, the strong inequality prevailing in the EU has driven an increased polarisation of diets and lifestyles across socioeconomic disparities, with the worse-off (the majority) now affected by very high obesity levels.
- *New food chain technologies:* The scale of obesity and the ensuing social costs have created some scope for the development of new technologies related to healthy or dietary foods and health care products in the EU. However, as increasing levels of inequality reduce innovation potential, the level of innovation is unchanged on balance.

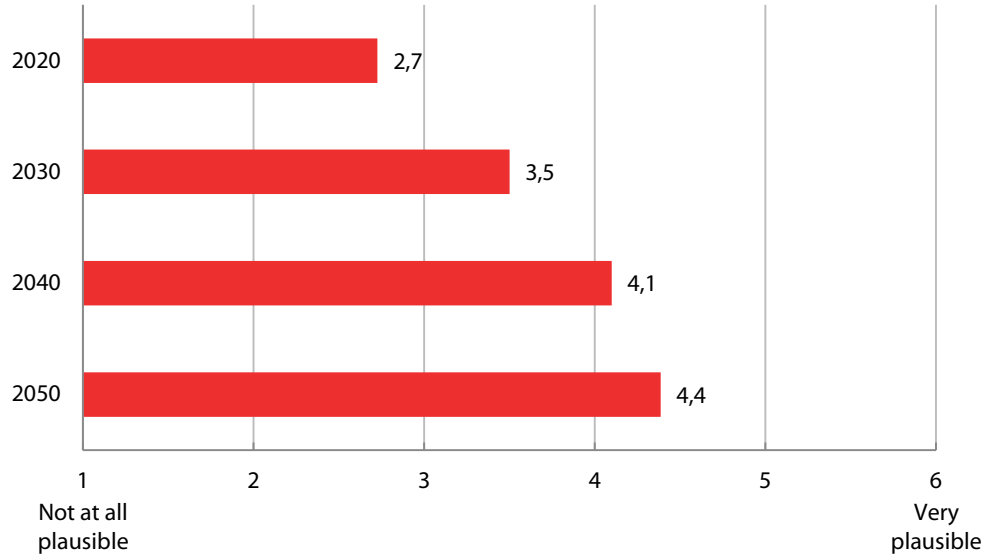
Other drivers not listed here were considered to develop in line with current trends and projections.

4.4.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 24: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 4.1.

As indicated in the graph, there is a significant increase in the average assessment of plausibility of the scenario through 2020-2050. Already by 2030, stakeholders consider that the scenario is more plausible than implausible, on the basis of the average assessment coinciding with the midpoint. This is strongly reflected by stakeholder comments for this question, many indicating that the origins of such a scenario are already very visible in current trends.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 19: Key comments of stakeholders/experts regarding plausibility of scenario 4

Judgement	Comments
Plausible based on current trends	Given the current trends, this is a likely scenario. Currently inequality is increasing between socioeconomic groups within most Member States. Although aging population is a factor the most pressing problem is the increasing gap between average life expectancy and average healthy life years. This means that people our living longer, but not healthier and this places increased pressure on health (care) systems. In addition, social inequalities are associated with lower health outcomes in lower socioeconomic groups and current austerity measures in many countries are exacerbating this problem. […]. Although many would believe that food insecurity would be not be associated with conditions normally associated with overconsumption, new evidence shows increased risk of overweight and obesity in individuals suffering from food insecurity. *(University/research organisation)*
	The described scenario seems very reasonable especially the change in consumer behaviour (getting more and more similar to the US) and the increasing percentage of old people in the EU.*(Public authority)*
	Given the current trend in levels of overweight, obesity and other NCDs, we can expect this scenario to occur rather quickly. *(Consumer organisation/NGO)*
	This is already happening and likely to increase unless drastic measures are taken. *(Independent expert)*
	If Europe fails to get out of the crisis in the medium term, the trend of higher social inequalities, accompanied by inequalities to access nutritious and healthy foods and the prevalence of unhealthy diets, that already arises here in European countries, could indeed widen. Further, we may expect to see the gap between the North and South to diminish and be replaced by inter-society gaps. *(Food industry association/operator)*
	Scenario 4 is likely to happen. Looking at the present situation in some EU Member States, the divide between social classes is growing. The number of "new poor" due to the economic crisis, unemployment and/or lowered salaries has increased, and the "middle class" is weaker and probably also narrower. We understand this process is not irreversible […]. There would appear to be something of a levelling-out/equalizing process underway between developed and developing countries. *(International organisation)*
	This is a scenario that is becoming increasingly plausible as the gap between the poor and the rich widens. This does not just affect the "rich" countries compared to the "poor" countries, but will become apparent inside the so-called "rich" countries as an increasing proportion of the population is living below the poverty level. The recent economic downturn in Europe, increase in immigration from poorer countries are all contributing factors. *(Other stakeholder)*
Plausible sooner rather than later	This scenario is more plausible early, rather than later, as the public becomes more aware of the previous generations health risk, they will take steps to mitigate for themselves and subsequent generations. *(Other stakeholder)*
Plausible except for some elements, or not as extreme	Although obesity and overweight will be a grand challenge for EU food policy and though inequality will become a major societal challenge, […] key assumptions will be likely correct, the extent will not be as extreme. Risk communication and food policy making will have impacted and softened the worst case scenario displayed […]. *(University/research organisation)*
	In terms of aging this is indeed a plausible scenario with demographic transition, however in terms of obesity levels it would take decades to reach the proposed levels and even then cannot be sure as in several countries it appears that obesity levels may be plateauing. *(University/research organisation)*

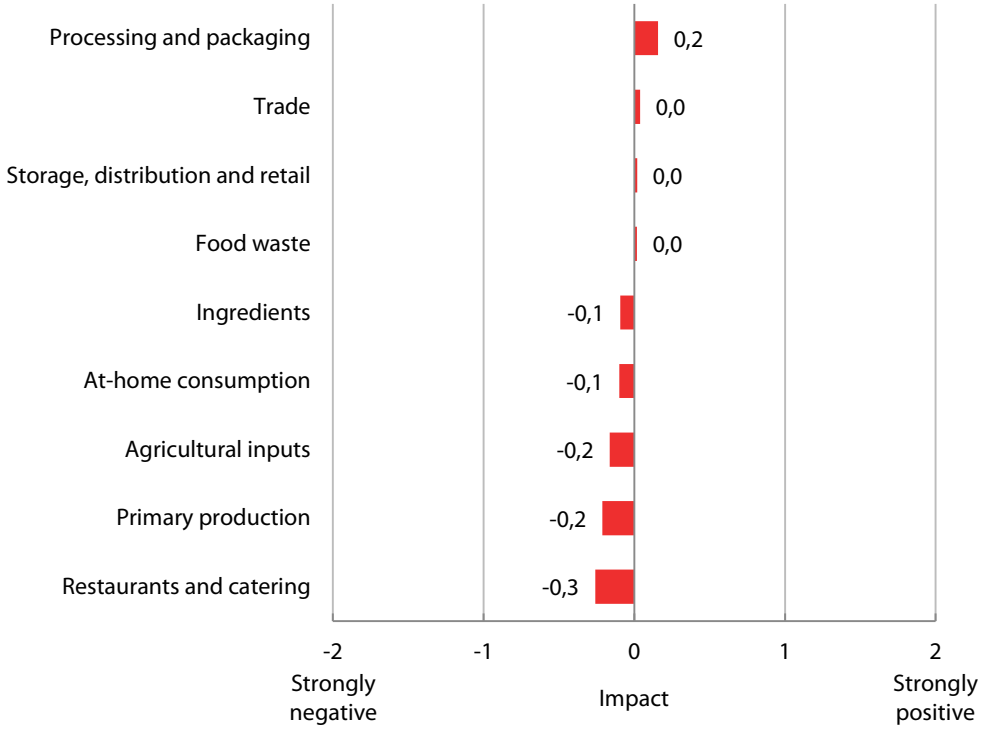
Source: Stakeholder survey, question 4.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average

stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 25: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



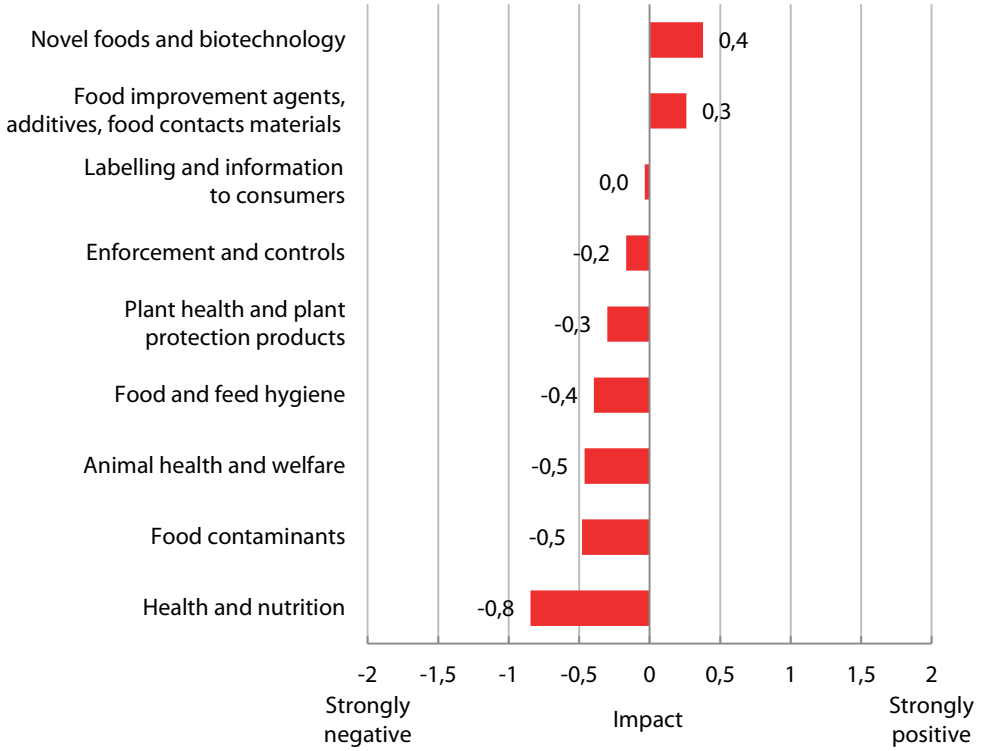
Source: Civic Consulting, based on stakeholder survey, question 4.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

As shown above, most food chain activities are considered to only be slightly impacted by this scenario, in contrast with other scenarios. Areas considered to be slightly negatively impacted included restaurants and catering, primary production and agricultural inputs, while those considered slightly positively impacted are processing and packaging, and trade. Stakeholder comments emphasised a possible shift away from at-home consumption for those at risk of obesity (e.g. increasing consumption of food at fast food restaurants), as well as a contrasting shift towards at-home consumption for the food insecure (restaurants being mostly too costly for low-income consumers in this scenario). Other comments highlighted impacts on agricultural inputs and ingredients as a result of a possible increased effort to maximise food production, a potential reduction in food waste due to the higher prices attached to food, as well as the emergence of different distribution and retail channels for rich and poor.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 26: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



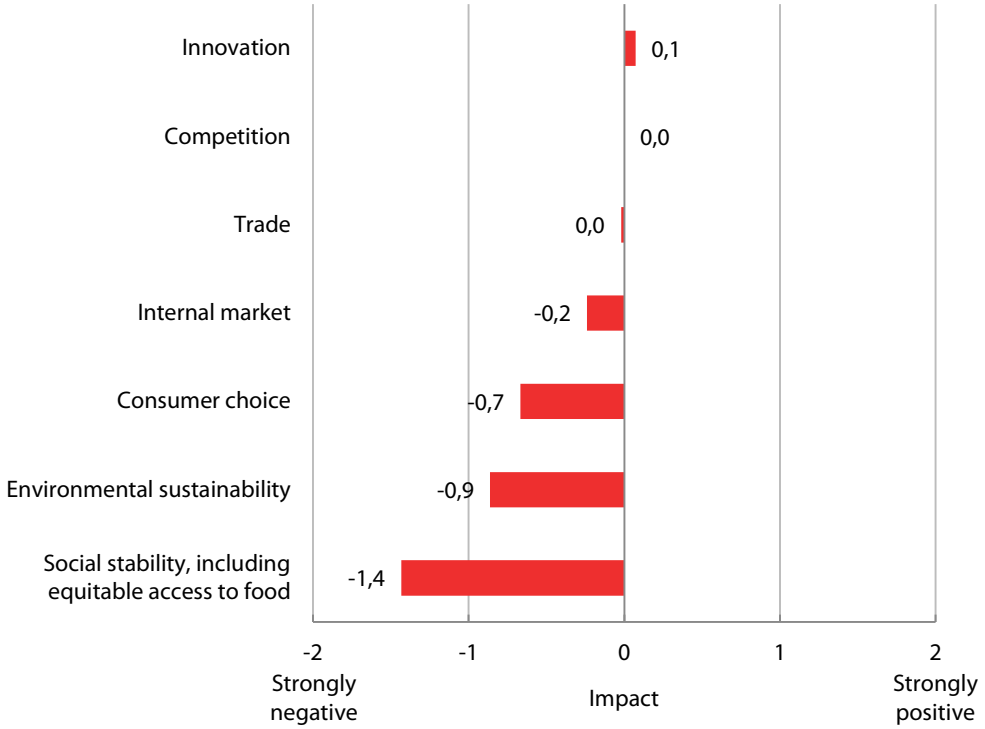
Source: Civic Consulting, based on stakeholder survey, question 4.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

As shown in the graph, differences in impacts across policy areas are considered to be more pronounced than for food chain activities: health and nutrition is considered to be most negatively impacted under the scenario, followed by animal health and welfare and food contaminants. Novel foods and biotechnology, as well as food improvement agents, additives and food contact materials, on the other hand, are considered to be positively impacted. This was broadly reflected in stakeholder comments, which mainly emphasised the negative impact on health and nutrition as a result of the unhealthy diets, as well as on animal health and welfare to a lesser extent. One stakeholder noted a potential reduction in the importance of labelling on foods due to focus on price as the sole purchase criterion for many, while other comments indicated the potential role for new technologies to play in combating both food insecurity and obesity.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 27: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



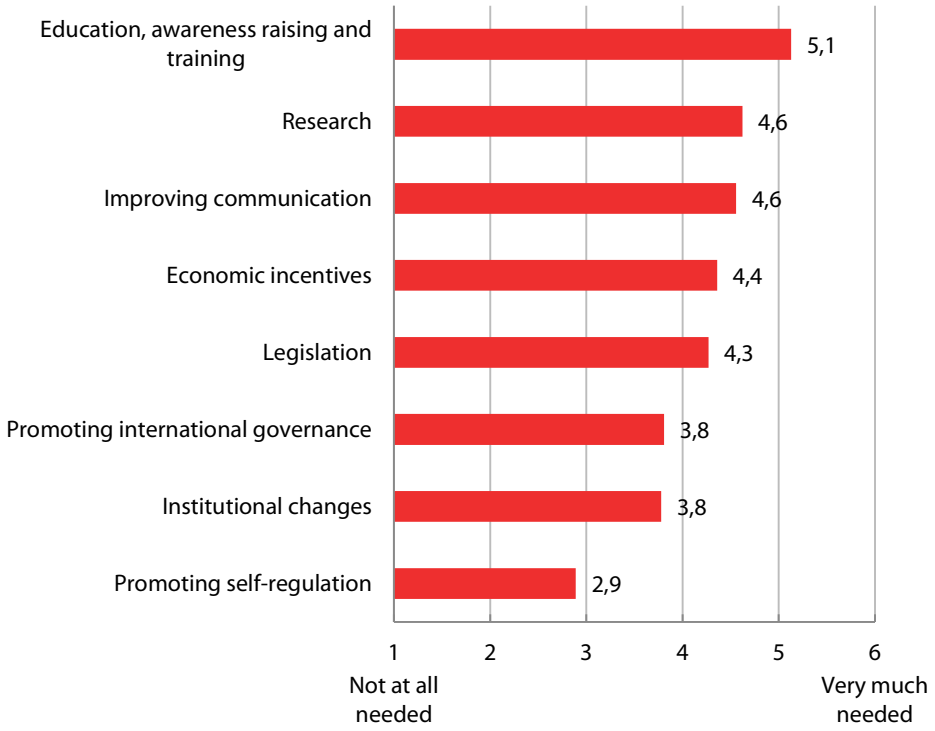
Source: Civic Consulting, based on stakeholder survey, question 4.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, social stability is considered by a clear margin to be the area most impacted, followed by environmental sustainability and consumer choice. However, innovation is seen to be benefit from a slightly positive impact. This is reflected in stakeholder comments, which strongly highlighted the negative impacts on social instability and consumer choice as a result of the increasing inequality and polarised diets, whereas it was suggested that innovation may be spurred on to attempt to tackle food insecurity and/or obesity, and to trade as well to a lesser extent, to cater to the large migrant population in the EU.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 28: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 4.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, education, awareness raising and training are seen as most needed measures/courses of action to respond to the challenges posed by the scenario, by a significant margin, followed by research, improving communication and economic incentives. Stakeholder comments indicated that underlined that mix of 'hard'- legislation and economic incentives - and 'soft' – education and awareness raising - measures may be needed to promote healthier nutrition. Cross-cutting measures to combat inequality and the associated food insecurity were also suggested.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 20: Key comments of stakeholders/experts regarding measures considered necessary under scenario 4

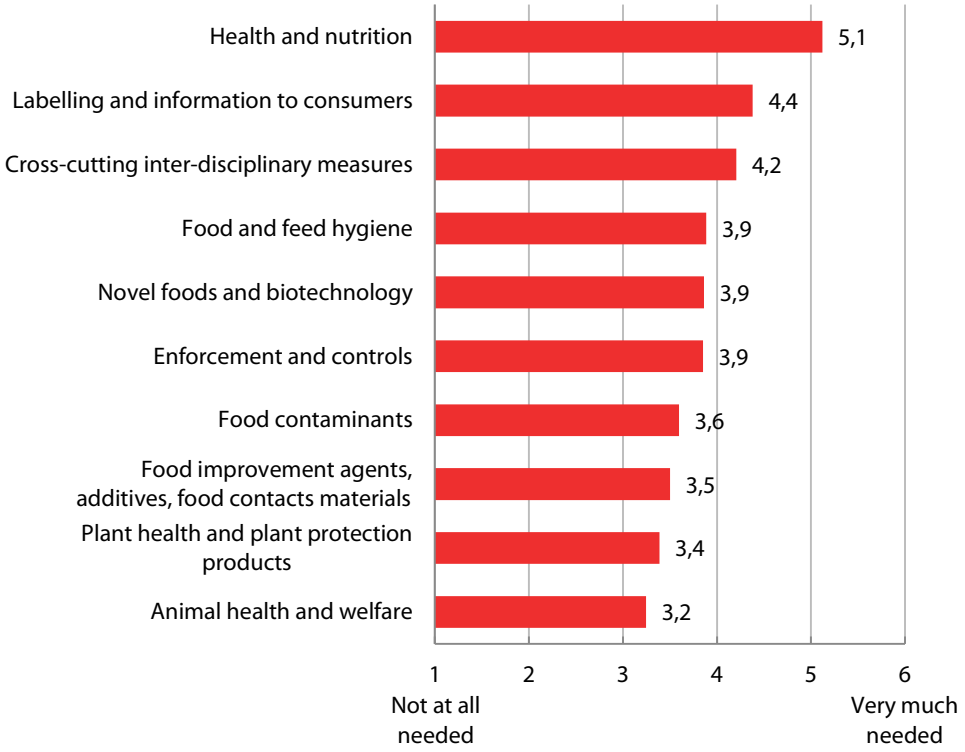
Main measures considered necessary	Comments
Mix of hard and soft measures	A number of 'hard' measures such as legislation or economic incentives could perhaps help minimise certain challenges (i.e. legislation to guarantee food safety; incentives for companies to keep prices down). Other softer measures like education and awareness and international governance could be useful in securing the supply of certain types of food while making people increasingly aware of good diets. *(University/research organisation)*
Education, awareness raising & Legislation	Nutritional education will be essential to try to limit the effects of NCDs and encourage low income consumers to eat healthy foods. (*Food industry association/operator)*
	Education re risk of excess/poor food intake and legislation to limit adulteration *(University/research organisation)*
	Creating awareness about food safety risks among different sub-groups of population would be most important. *[…] (University/research organisation)*
	Education in combination with legislative rules could reduce inequality. *(Food industry association/operator)*
Education, awareness raising and training & Economic incentives	In this scenario economic incentives [are needed], or perhaps more pertinent to the problem, measures to ensure low SES groups can afford and have access to foods necessary for a healthy diet. At the global level ensuring food and nutrition security is about cutting the pie more fairly and ensuring more equitable access to resources and infrastructure investments to get food to people who need it most, not producing more food. In this scenario economic incentives, or re-examining the way current incentives can play a substantial role in improving food and nutrition security. *(University/research organisation)*
	[…] It should become more expensive to make 'bad' stuff, and cheaper to make 'good' stuff (less calories, fat, sugar and salt, more fibres, micronutrients and variety). Keep developing alternatives, keep communicating the message, keep teaching children where the food comes from, what healthy foods are, how to cook, etc. *(University/research organisation)*
	If such a scenario were to happen education and economic incentives are the two solutions. Economic incentives such as taxes are very dangerous for the industry as the target is not always clear, hence option 1 remains the most important - to educate the consumers of how to spend the little money they have. *(Food industry association/operator)*
	Improvement in awareness raising of the factors predisposing to weight gain needed as well an improved means to communicate this. Underpinning this is the need for further research. The use of taxes/subsidies could positively influence improved dietary behaviours. *(University/research organisation)*
Legislation	If we are really going to address this crisis then the only way is to get it into legislation. Education awareness raising etc. doesn't work. self-regulation is not as effective as legislation and economic incentives - the change is not effective fast enough. *(University/research organisation)*
Redistribution of wealth	There should be a redistribution of wealth through taxes to assist the poor in obtaining good food. *(University/research organisation)*

Source: Stakeholder survey, question 4.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 29: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 4.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, in this scenario changes are considered necessary across most policy areas, (on the basis of average assessments above the midpoint of 3.5). In line with assessments of impacts on policy areas, changes in relation to health and nutrition policy are considered most needed under this scenario by a clear margin. This is followed by labelling and information to consumers, cross-cutting inter-disciplinary measures, and novel foods and biotechnology. Changes to animal health and welfare policy or legislation are considered to be least needed. This is broadly reflected by stakeholder comments, which revolved around cross-cutting measures related to health and nutrition; labelling and information to consumers, including education; novel foods and biotechnology and food improvement agents and additives; safeguarding food security via local production; and enforcement and controls in relation to food hygiene.

The table below presents key stakeholder comments regarding potential changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario.

Table 21: Key comments from stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 4

Main area for which changes considered necessary	Comments
Cross-cutting measures related to health and nutrition	The diverse nutritional problems seen in the population require major efforts to improve nutritional status and decrease burden of non-communicable diseases (e.g. cardiovascular disease, diabetes). (*Public authority*)
	[…] Healthy nutrition must simply be accorded higher priority overall within government. (*University/research organisation*)
	Especially to combat obesity and overweight a combination of incentives and prohibitions together with information and motivation [is needed]. (*Food industry association/operator*)
Labelling and information to consumers, including education	[…] More importance should be given to education, prevention and awareness raising campaigns aiming at informing the consumers. […] Here, the label is only one solution amongst many and not necessarily the most relevant as the information that would need to be passed to consumers are complex […]. (*Food industry association/operator*)
	Information to the consumer via clear labelling about risks involved in poor diet/no exercise combination. (*Other stakeholder*)
	Maintenance of food quality for less advantaged and early education re[garding] impacts of excess consumption. (*University/research organisation*)
Novel foods and biotechnology & Food improvement agents, additives	[A] need for new novel foods and a role for biotechnology to tackle the health consequences of this scenario - this needs appropriate changes in the way new foods are targeted to consumers as personalized nutrition. (*University/research organisation*)
	Here research is needed on novel foods, food improvement agents as well as hygiene. […]. (*University/research organisation*)
Food security and local production	The main issue should be guaranteeing minimum living standards during times of slower economic growth or zero growth. Health and nutrition policies would need to take into account improve[d] access to food through community development programmes without relying on food aid programmes. [...] Improved health and nutrition policies could scale up the successes at local level. (*University/research organisation*)
	In [this] environment like the one described in Scenario 4, with dual consumer social groups, one of the groups (the largest one in population terms) would need access to local production of primary fresh products (less logistical costs, transformation, packaging, storage, etc.). [...] Changes to legislative policy should be taken in order to recognize the strategic role of these traditional markets and to avoid them disappearing [...]. (*International organisation*)
Enforcement and controls, and food hygiene	Strengthening the legal framework for food safety, hygiene and controls could help ensure that the food which the majority of the population can access is still decent quality (i.e. using fewer chemicals, etc.). (*University/research organisation*)
No specific changes to legislation	Not necessarily. Rather than changing existing legislation, care should be taken that synergies are further developed between the public and private sector to find ways to improve availability of affordable food that can be combined in a nutritious and healthy diet by joint efforts (e.g. reformulation, waste reduction and prevention, education campaigns etc.). […]. (*Food industry association/operator*)

Source: Stakeholder survey, question 4.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Broad consensus was achieved among participants that cross-cutting measures to address the challenges described in the scenario were needed. This could involve making use of existing policy tools such as the Common Agricultural Policy, as a financial instrument to incentivise the consumption of fresh foods;
- It was highlighted that food insecurity and obesity can affect the same population, creating a 'double burden', and therefore policy measures that combat both issues simultaneously may be necessary. In this regard it was noted that often type 2 diabetes is linked to food insecurity;
- Beyond consumers, it was noted that more emphasis should be placed on the many actors and agents of the food chain and their role in consumers' dietary intake, e.g. through advertising, and the overall environment in which food is consumed. In this regard it was noted that addressing advertising of unhealthy foods may need stricter policy measures, while incentivising the production of diverse and fresh foods at the primary production level could also be further considered (also in relation to the CAP). It was also noted that greater emphasis could be placed on making healthy lifestyles fashionable and better promoted culturally;
- From a general perspective it was noted that pricing mechanisms, market structures, and the role of the Common Agricultural Policy may need to be better understood when formulating policy responses to the scenario;
- As it is likely that low-income groups may increasingly source food from food banks in such a scenario, a key concern is to ensure that healthy food is provided at such banks, as it was noted that in some countries the food provided through this channel does not meet high health standards;
- Actions at local level to both promote healthier diets and reduce socio-economic disparities, such as fostering 'garden communities', and urban environments conducive to healthy lifestyles e.g. more green areas, were also suggested;
- Finally, it was noted that the use of food stamps should be considered to tackle food insecurity when this relates to particularly low-income groups.

Future research

Finally stakeholders were asked on which issues research should be conducted to better understand the challenges posed by scenario 4, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted in relation to cheap and healthy foods, possibly incorporating new technologies; the determinants of the quality of nutrition across different consumer groups; education practices regarding nutrition and their impact; the current situation in the EU regarding nutrition levels across socio-economic groups; and economic modelling, e.g. regarding the impacts of obesity and related diseases.

The table below presents key stakeholder comments regarding key issues for future research relating to this scenario.

Table 22: Key comments of stakeholders/experts regarding issues for future research under scenario 4

Main issue for research	Comments
Cheap and healthy (novel) foods	Research is needed on many levels - for example the health consequences of obese elderly, development of novel foods to tackle the obesity epidemic that are targeted to this large subgroup and research into communication and education strategies for consumers. (*University/research organisation*)
	Research into cheap, novel, healthy, tasty, attractive foods. (*University/research organisation*)
	Diets, farm to fork products, new food (cheap and safe), packaging. (*University/research organisation*)
	Research into novel foods (new protein sources for example) to feed the increasing number of poorer consumers. (*Other stakeholder*)
Determinants of quality of nutrition	It could be useful to try and conduct research on the types of food which are 'at risk' of becoming increasingly socially polarised (i.e. rising in cost, which could mean only the well-off could afford them). (*University/research organisation*)
	Storage and consumption practices of different groups of population, especially emigrants, Roma and elderly. (*University/research organisation*)
	The interrelationship between lifestyle and good/bad nutrition. (*Food industry association/operator*)
	We need a better understanding of the consumer: how they select, prepare, avoid, use, feed their kids, their elderlies, etc. and what are the reasons for not going for the healthy food choice or for more exercise. (*University/research organisation*)
Education regarding nutrition	[Research] about impact of education (target, duration of the action, variety of the action, which age, etc.) on long-lasting changes in behaviour. Idem on public health information. For helping the consumer choice: improve the knowledge in cognitive sciences and use the current knowledge of private companies in marketing. (*University/research organisation*)
	How to educate the consumer on the importance of individual responsibility of nutrition. (*Other stakeholder*)
Current situation	Updated statistics on the level of de[privation] in [the] EU and capacity to meet daily dietary needs/requirements. (*International organisation*)
	Given the importance of the alternative supply chain, research should be carried out to verify what there is now, what the economic and social values are, understanding how they can be enhanced as opposed to squandered and knowing what needs to be done by public bodies to ensure this chain is functioning well. (*International organisation*)
Economic modelling	Research should focus on the factors that increase social inequality and how diets become polarized. […] Research design needs to include gathering disaggregated data relating to relative income, disposable income, gender, age and sex. Predictive modelling of trends towards less equality and its impact on food systems, health outcomes and associated costs could provide incentives and knowledge for policy development. […]. (*University/research organisation*)
	Research is needed to model the potential future economic and health impact of this scenario modelling levels of obesity etc., which are likely to reach unsustainable levels and have a significant impact on the health systems and labour participation. (*Consumer organisation/NGO*)

Source: Stakeholder survey, question 4.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Consensus was achieved that further research into consumer behaviour, and the key social, cultural, economic and environmental determinants of unhealthy diets was critical;
- It was noted in particular that not only consumers need to be better understood, but also the other relevant actors in the food chain and surrounding agents affecting what is consumed (including politicians);
- Research into underutilised, indigenous foods that could enrich and cheapen our diets was suggested;
- Research into the true cost of food was found necessary ('true cost accounting'), as it may reveal that cheaper foods for the consumer are in fact more costly in other respects (e.g. the environment);
- Research into ICTs and how to apply them in food chain to lower costs and reduce food waste was also suggested to tackle food insecurity.

4.5. Scenario 5: Strong shift in EU consumer preferences to food from alternative production systems

1. This scenario assumes a strong shift in EU consumer preferences to either local, more sustainable, animal welfare-friendly, or organic food production systems.
2. Key interrelationships in this scenario between the scenario driver (Consumer attitudes and behaviour) and other drivers include: *New agri-food chain structures:* Reflecting the consumer demand shift, many local and regional food chains have emerged in the EU, based on either sustainable, animal-welfare friendly or low-input production methods; and *Emerging food-chain risks and disasters:* New hazards and risks in terms of food safety controls and enforcement associated with short food chains have emerged.
3. This scenario is only considered more plausible than implausible in 2050 (based on average values).[295]
4. At-home consumption is considered to most impacted under the scenario by a clear margin, followed by primary production, food waste and restaurants and catering. Animal health and welfare is the policy area considered to be impacted most by a clear margin under this scenario. Health and nutrition, plant health and plant protection products, and labelling and information to consumers, food improvement agents, additives, and food contact materials, followed by novel foods and biotechnology, are also considered notably impacted. In addition, environmental sustainability is considered strongly impacted, followed by the internal market and consumer choice.
5. Education, awareness raising and training, followed by improving communication and research are considered most needed in this scenario.
6. In response to this scenario, changes are considered necessary across almost all policy areas, with changes in relation to enforcement and controls, labelling and information to consumers and food and feed hygiene considered most needed.
7. Stakeholders found that research needed to be conducted in relation to: the safety and consumer perception of new technologies; the feasibility and sustainability of alternative food chains; risk of contamination in alternative food chains; and the adequacy of safety and hygiene practices in SMEs.

4.5.1. Description of scenario

This scenario assumes a strong shift in EU consumer preferences to either local, more sustainable, animal welfare-friendly, or organic food production systems. The scenario explores the challenge of ensuring food safety in EU food systems with strong alternative food chains in 2050.

While a number of technological innovations in food production occurred in the first quarter of the century, involving biotechnologies, nanotechnology, and new forms of food in general, many EU consumers remained sceptical of their benefits, especially due to a lack of substantial scientific underpinning as well as transparent risk communication. This, combined with several high-profile food scares, scandals and crises in the EU that involved food sourced from global food chains – relating variously to harmful effects of new technologies, inadequate treatment of

[295] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

animals, food contamination, fraud, environmental degradation and unfair terms of trade – gave rise to a strong shift in the preferences of many EU consumers to local, more sustainable, animal welfare-friendly/vegetarian, or organic food production systems throughout the 2020s and 2030s. As a result, various local and regional food systems and short supply chains emerged across the EU to meet this demand. Urban gardening also saw a significant boom to accommodate the alternative urban niche markets. The large scale agri-food industries connected to global food chains gradually adapted to the new demand and competed with independent producers for the significant value-driven proportion of the population with differentiated approaches, by establishing either specific brands, certified labels or production processes (in particular environmentally-friendly ones). Transparent food labelling and certification became paramount, as many EU consumers increasingly chose to only buy products satisfying a series of stringent conditions relating to the origin, method, and quality of production.

In 2050, the shift in demand entailed a significant increase in agricultural land use in the EU, combined with a stagnation of food imports from outside the EU, where global, integrated food chains incorporating new technologies (including GM products) thrive. The shift has had some clear benefits in avoiding the potential risks of technologically advanced global food chains, and improving nutrition thanks to the increased focus on food quality and diets, in addition to reviving rural communities, as some urban consumers return to the countryside. However, efficiency has declined in some regions. Less intensive, low-input agriculture in a number of areas has produced lower yields, exacerbated by climate change-related stress and the reluctance to use GM drought resistant crops due to consumer concerns. This has led to substantially higher food prices in some parts of the EU. Due to the significant price premiums of certified alternative products compared to food produced in mainstream production systems, labelling fraud has been persistent and has at times threatened to undermine consumer trust in food in general. In addition, the expansion of shorter chains and local production systems has posed new challenges for food safety controls and regulatory oversight of food systems due to their significant diversity, and niche providers often operate largely on a self-control basis. Consequently, some say that the risk of food safety events, while more contained thanks to shorter supply chains, has not decreased overall.

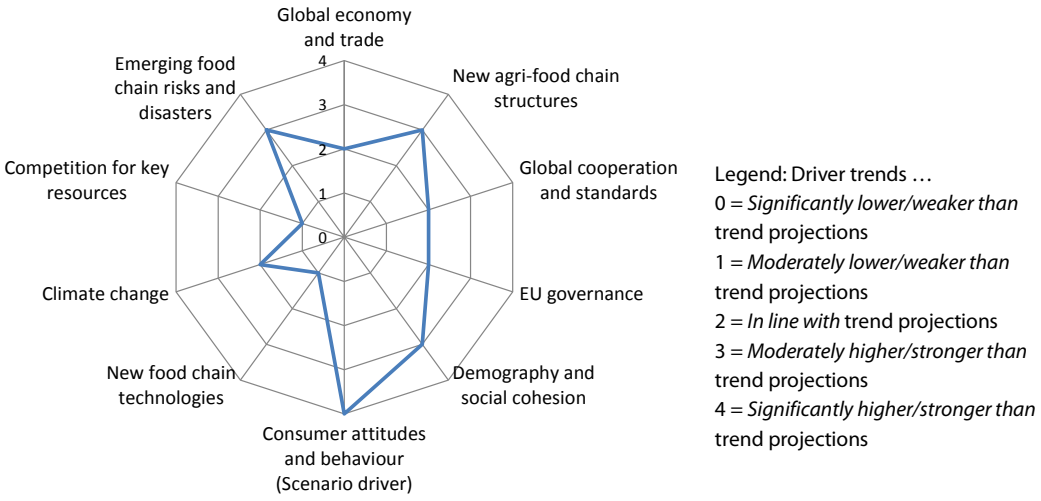
Looking back from 2050 to the world of today, forerunners of this future are…

- In 2012, 96% of respondents in an EU survey were concerned about food quality; 71% about food origin; and 67% checked food purchases to see if they had quality labels.[296]
- In 2009, the European turnover of the organic food market was 18.4 billion Euro, with Germany and France at 5.8 and 3 billion Euro respectively, while the highest market shares were reached in Denmark with 7.2% of the total food turnover, followed by Austria with 6%.[297]
- In 2011, 90% of EU survey respondents agreed that buying local food is beneficial and that the EU should promote their availability.[298]
- Over 70% of EU survey respondents in 2010 felt unconfident in dealing with new technologies.[299]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (Consumer attitudes and behaviour) and the other drivers identified.

Figure 30: Scenario diagram for scenario 5



[296] European Commission, Special Eurobarometer 389 - Europeans' attitudes towards food security, food quality and the countryside, 2012.

[297] See http://www.sippo.ch/internet/osec/en/home/import/publications/food.-ContentSlot-98296-ItemList-61735-File.File.pdf/SIPPO_Manual_18.04.2011_final.pdf. See also Kahl, Johannes, Aneta Załęcka, Angelika Ploeger, Susanne Bügel, and Machteld Huber, "Functional Food and Organic Food Are Competing Rather Than Supporting Concepts in Europe," Agriculture, Vol. 2, No. 4, October 17, 2012, pp. 316–324. http://www.mdpi.com/2077-0472/2/4/316/. P.317.

[298] European Commission, Special Eurobarometer 368 - The Common Agricultural Policy, 2011.

[299] European Commission, Special Eurobarometer 354 - Food-related Risks, 2010.

The following points describe in further detail the nature of the interrelationships identified.

- *Global economy and trade*: As a result of the large increase in demand for local and regional food, food imports from third countries have stagnated, even if global trade is largely unaffected.
- *Competition for key resources:* The (partial) shift to a focus on more sustainable food systems in the EU, while not followed in most other parts of the world, has induced some reduction in resource use for EU food production, and an improvement in environmental services, despite the required increase in agricultural land area in the EU.
- *New food chain technologies:* Broad scepticism among EU consumers as to the benefits of many new technologies in food chains was a key factor in the consumer demand shift.
- *New agri-food chain structures:* Reflecting the consumer demand shift, many local and regional food chains have emerged in the EU, based on either sustainable, animal-welfare friendly or low-input production methods.
- *Emerging food-chain risks and disasters:* New hazards and risks in terms of food safety controls and enforcement associated with short food chains have emerged.
- *Demography and social cohesion:* The higher prices of food from some alternative production systems have increased differences in diets between higher- and lower - income segments of the population, with consequences for nutrition and health, as well as social cohesion.

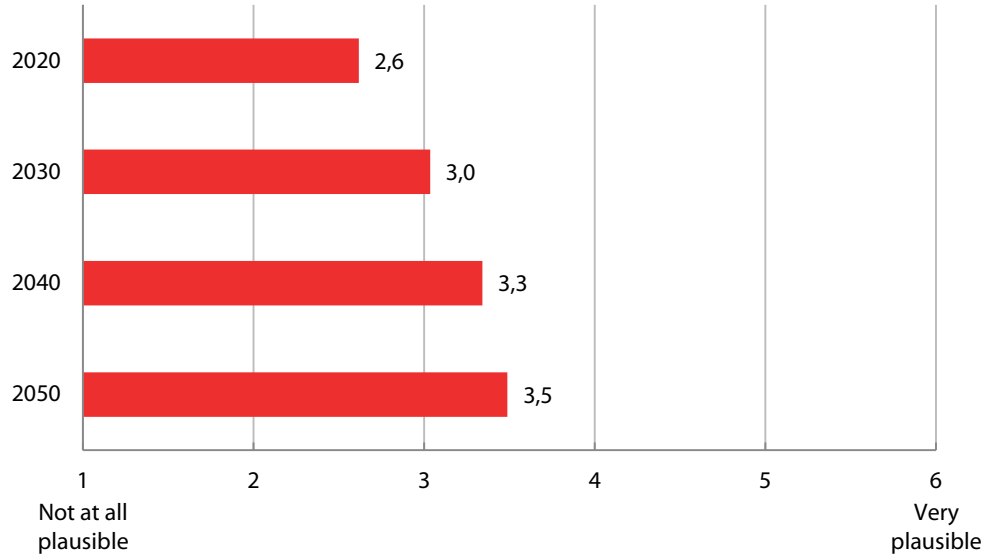
Other drivers not listed here were considered to develop in line with current trends and projections.

4.5.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 31: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 5.1.

As indicated in the graph, this scenario is only considered more plausible than implausible in 2050, on the basis of a midpoint of 3.5. Stakeholder comments broadly underlined this, as while some considered the scenario plausible based on current trends, several found that the extent of shift in consumer preferences described corresponded to an implausibly large part of the EU population, even if the shift described was considered plausible.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 23: Key comments of stakeholders/experts regarding plausibility of scenario 5

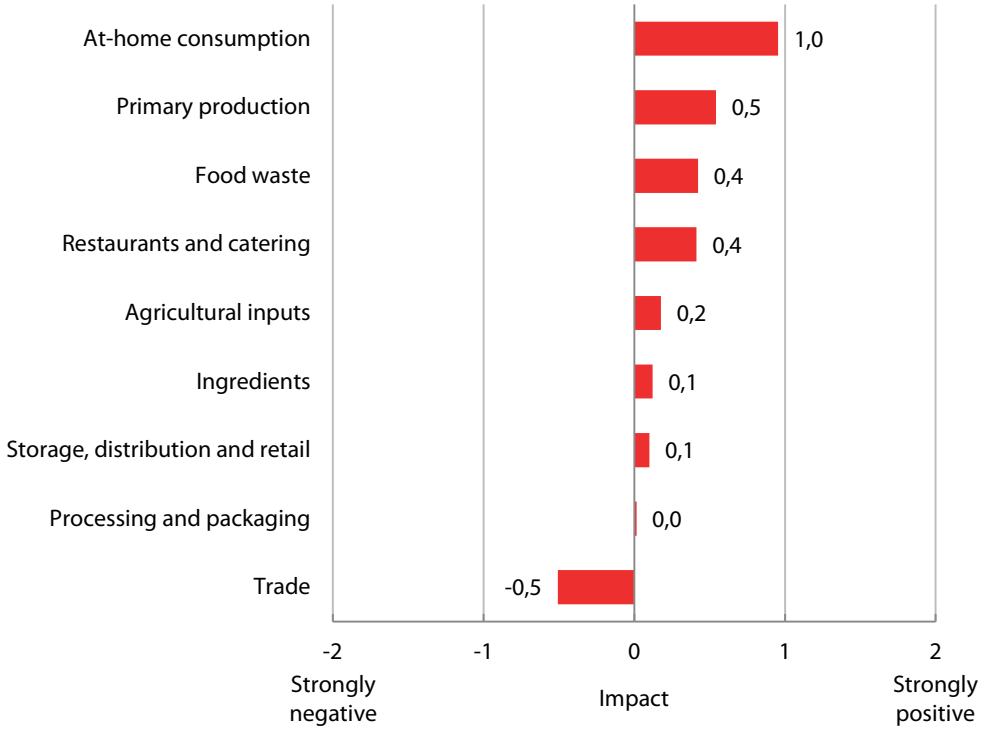
Judgement	Comments
Plausible based on current trends	The mix of social, ethical and technological factors is gradually becoming more favourable for this scenario. *(University/research organisation)*
	This scenario is already present in its early stages and appears to be accelerating in 2013. *(Food industry association/operator)*
	The scenario has already started at least in Germany. (*Public authority)*
Plausible but not to the extent described	I think this would take some major food scandal to happen in the immediate future or major geo-political event, or economic problem such as the collapse of the value of the euro. However as the impact of climate destabilisation hits and the ability of Europe to command land resources from other parts of the world to supply it as these will be taken up by other players it is more likely. *(Independent expert)*
	This scenario is quite plausible in the short term but the sustainability of small local production systems on the long term with fewer land resources, a larger population and increased urbanisation is unlikely.*(Other stakeholder)*
	Despite huge potential from 'alternative' food sources, short-food supply chains and their contribution to good health outcomes, we fear that the global multinationals who already own the majority of our food will be 'too big to be broken'. *(Consumer organisation/NGO)*
	In the developed European countries, there is a trend for consumers to want to feel good about the food they eat. This will contribute to this trend, even though the price will not compete with more mainstream systems. *(Other stakeholder)*
	[…] Moving towards more sustainable production systems that close nutrient cycles is plausible, if not a necessity moving towards more production systems that can adapt to climate change, resource constraints and are less dependent on fossil fuels. However this does not necessarily mean at total shift towards local food systems, but ideally a better balance between what is local, regional and global. […]. *(University/research organisation)*
	Indeed, this trend exists in the market and the expansion of organic production in certain countries and in certain sectors demonstrates this; but we do not consider that this up-market trend could give rise to a full mainstream scenario, given the cost. *(Food industry association/operator)*
	There will be a shift, but not a strong shift. The majority of the products will still be produced by larger, global companies to lower prices.*(Public authority)*
	Not likely in the short to medium term. May be plausible due to environmental factors in the longer term.*(University/research organisation)*
	We find Scenario 5 only partially plausible: it is quite plausible that the scepticism of new "technological" food will open opportunities to alternative (local, more sustainable, animal welfare-friendly, organic) production systems. But we do not find it plausible that this shift in consumer preferences will be a strong one. This change of consumer behaviour would be met only in those consumers whose first purchasing criteria is not price, but quality. Such groups of consumers have diminished all over the EU in the last years, even in the richest European countries. In the long run, this trend is not likely to change in the EU.[…] *(International organisation)*
Implausible	I cannot see the EU population at large acting in a manner that would make this scenario plausible. *(Food industry association/operator)*
	Such shift would result in seriously increasing the share of income dedicated to food, which is not the trend today (competition with high-tech, etc…) (*Food industry association/operator)*

Source: Stakeholder survey, question 5.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 32: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 5.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

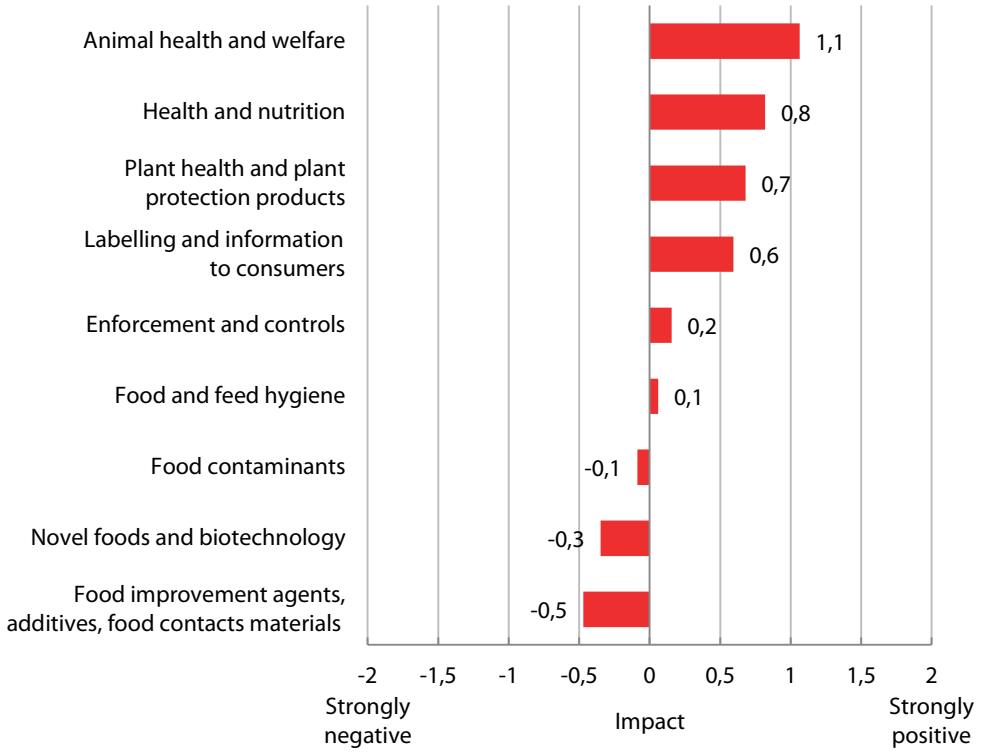
As shown above, all food chain activities are considered to be positively impacted area under this scenario, with the exception of trade. At-home consumption is considered to benefit most under the scenario by a clear margin, followed by primary production, food waste and restaurants and catering. Stakeholder comments also highlighted an increase in home consumption associated with a reduction in food waste. It was also noted that the shift in preferences would also entail impacts in relation to a change in agricultural inputs and ingredients, and less food imports to the EU. However, other comments underlined a potential increase in food waste, e.g. due to less use of preservatives, and noted the potential efficiency loss that could result from a shift to local production.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments

for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 33: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



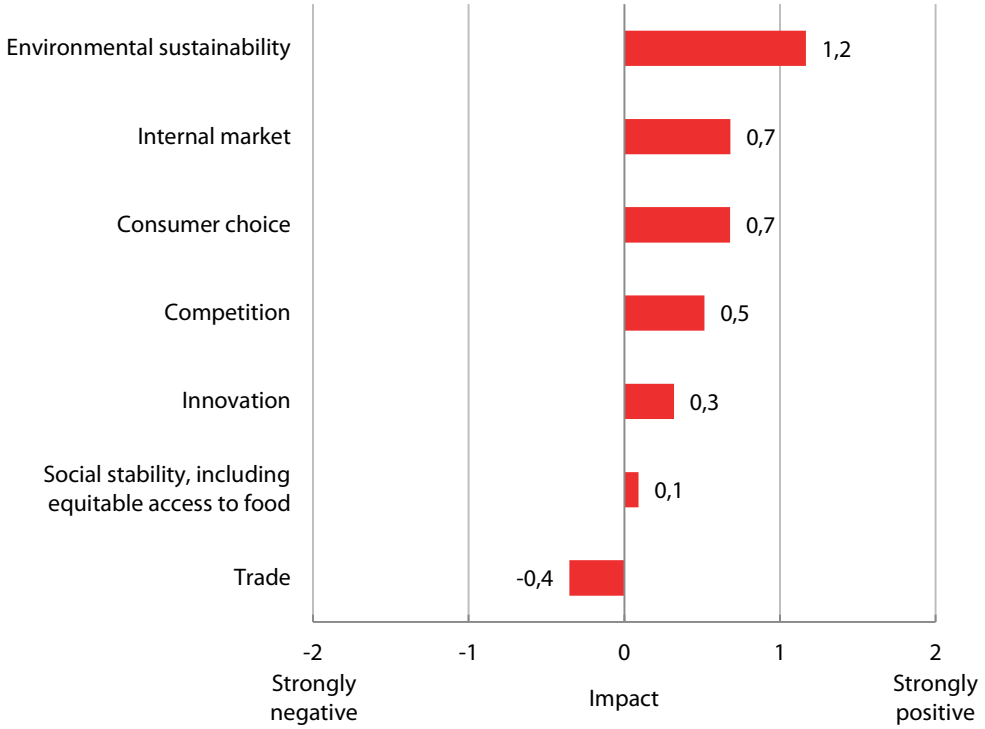
Source: Civic Consulting, based on stakeholder survey, question 5.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

As shown in the graph, animal health and welfare is the policy area considered to benefit most by a clear margin under this scenario, followed by health and nutrition, plant health and plant protection products, and labelling and information to consumers. However food improvement agents, additives, and food contact materials, followed by novel foods and biotechnology, are considered to be negatively impacted. Stakeholder comments echoed these assessments, with animal health and welfare being seen as positively affected, novel foods and biotechnology negatively so. Several comments also indicated broadly positive impacts on health and nutrition, and the increased importance of labelling in such a scenario, while the need to adapt enforcement and controls to the alternative chains was also emphasised.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 34: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



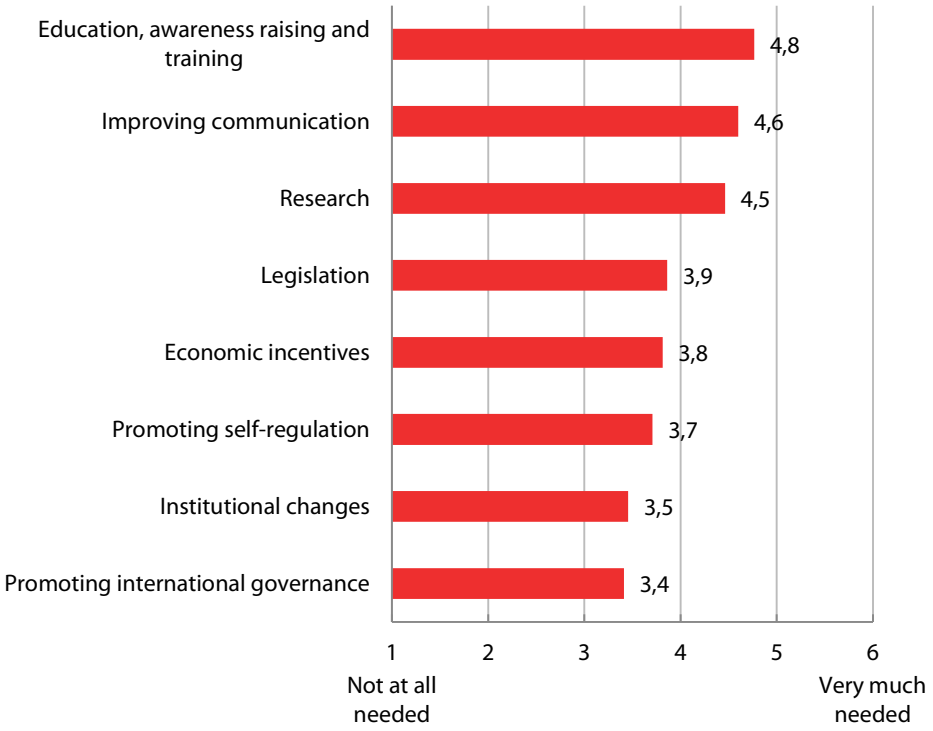
Source: Civic Consulting, based on stakeholder survey, question 5.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, environmental sustainability is considered most positively impacted in the scenario by a clear margin, followed by the internal market and consumer choice. Trade on the other hand is the only area considered to be negatively impacted. Several stakeholder comments added further detail by highlighting the heightened awareness of foods, and possibly greater consumer choice and environmental sustainability as positive impacts, at the expense of social stability and inequality.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 35: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 5.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, education, awareness raising and training, followed by improving communication and research are considered most needed in this scenario. Institutional changes, on the other hand, are considered least needed. Some stakeholder comments emphasised the need for education, and improved communication to regain trust, while also noting the need for appropriately adapted legislation, and economic incentives designed for the alternative food chains. On the other hand, some stakeholders promoted self-regulation combined with the appropriate legislation as a key measure, while others found that the need for EU involvement to respond to the challenges in the scenario was minimal.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 24: Key comments of stakeholders/experts regarding measures considered necessary under scenario 5

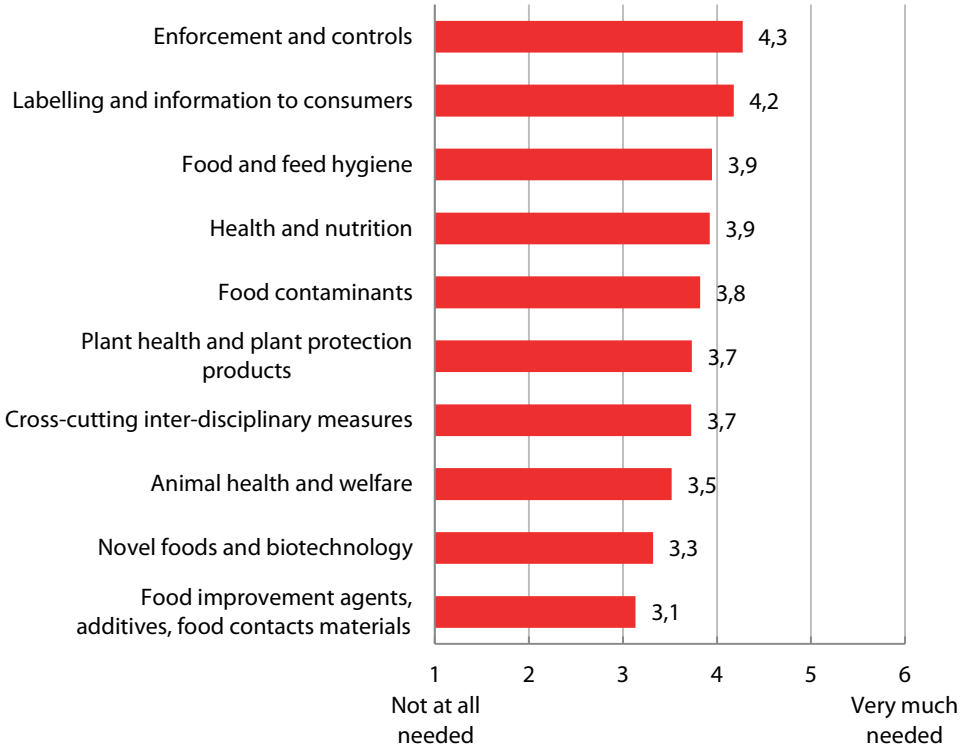
Main measures considered necessary	Comments
Education, improved communication to regain trust, adapted legislation, and economic incentives	This scenario would require substantial investment in education and training in new production practices, food safety and hygiene. Re-localization of food systems would require large scale adaptation of current food safety and plant protection rules and legislation and institutions. Moving towards more sustainable food production and consumption would require external costs to be internalized, and where the market cannot achieve this subsidies and taxes could be used to facilitate this. *(University/research organisation)*
	In order to regain consumer confidence in the food chain transparent risk communication as well as efforts to increase knowledge and awareness will be required. Promotion of self-regulation and economic incentives are important tools to encourage the alternative and niche producers, markets to ensure food safety and decrease the risk of food fraud. *(Public authority)*
	Education: A lot of emphasis should be put on educating consumers on what the new modes of production, coming either from the private sector (including the use of new technologies and/or biotechnology) or from the consumers (shorter chain, labelling schemes…), mean and that they can be trusted. (*Food industry association/operator*)
	Legislation as well as education should be reinforced and adapted to this scenario of food production for the quality and food safety. *(University/research organisation)*
	Clearer legislation to define the different production systems and better awareness among consumers of the products on offer in the market. *(Other stakeholder)*
	Education is essential as is improved communication to keep up with changing practices and to ensure better uptake *(University/research organisation)*
Self-regulation combined with the appropriate legislation	Self-regulation (auto-control) can be even more efficient than official regulation, provided there is an economic environment of competition, such as the one of Scenario 5; Legislation and Institutional changes: legislative and institutional changes should be made to guarantee the efficiency of the local/national channel of production and distribution, […]. Improving communication would be a must for consumers – being aware of the safety and health characteristics of the food products they buy. *(International organisation)*
	[…] Legislation: Legislation will need to be adapted to face the new consumers' expectations, and also the new modes of production of the private sector. It will need to consider self-regulation and provide for a clear framework for self-regulation. (*Food industry association/operator*)
Research	Measures to ensure more local food-along with research to ensure dietary balance and microbiological safety in inherently smaller and diverse production systems *(University/research organisation)*
Minimal EU involvement	Little scope for EU intervention other than to protect consumers excluded by price from participating in these markets. *(Consumer organisation/NGO)*
	Given that these changes will be consumer driven, the need for EU involvement will be minimal. *(Other stakeholder)*

Source: Stakeholder survey, question 5.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 36: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 5.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, in response to this scenario changes are considered necessary across almost all policy areas, (on the basis of average assessments above the midpoint of 3.5). Changes in relation to enforcement and controls, labelling and information to consumers and food and feed hygiene are considered more needed, whereas changes in relation to novel foods and biotechnology and food improvement agents, additives and food contact materials are considered less needed.

Stakeholder comments regarding this question revolved around cross-cutting measures to promote awareness regarding health and nutrition, adapting enforcement and controls and food hygiene legislation to small-scale production, improving labelling and information to consumers where needed, and incentivising transparent development of novel foods and new technologies.

The table below presents key stakeholder comments regarding potential changes needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario.

Table 25: Key comments of stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 5

Main area for which changes considered necessary	Comments
Cross-cutting measures to promote awareness regarding health and nutrition	[…] Health and nutrition- Could promote awareness and understanding between nutrition and health and the role of functional products. (*Food industry association/operator*)
	Cross-cutting approach to promotion of healthier nutrition required, in context of rapidly changing agriculture. (*University/research organisation*)
Enforcement and controls & Food hygiene legislation adapted to small-scale production	Legislation may need to adapt to the smaller scale and local production systems as consumer preferences have led to a shift to alternative production systems. Control legislation should be reviewed in order to ensure its efficacy to limit fraud. (*Public authority*)
	In small scale production, areas like innovation, hygiene and controls are more complex and may need to be adapted. (*Food industry association/operator*)
	This scenario would require rethinking current regulatory frameworks to increase the flexibility and applicability to local contexts. […] A strong system for food and feed hygiene and controls would also be necessary under this system. A better balance between local and global food systems and between processed and whole foods could potentially lead to gains in health and nutrition. (*University/research organisation*)
Labelling and information to consumers where needed	EU would need to strengthen its policy framework on health and nutrition and probably review labelling requirements. (*Other stakeholder*)
	[...]. Legislation and framed self-regulation will have a role to play in ensuring the labelling requirements make sense, are not misleading the consumers [...]. (*Food industry association/operator*)
	[…] Already have a significant amount of labelling and food information for consumers – the framework/legislative side is more than abundant. It is the implementation side that should be enhanced. (*Food industry association/operator*)
Novel foods and biotechnology	[…] Novel foods and food improvements would both increase consumer options and help to meet requirements. (*University/research organisation*)
	[…] A better framing of the use of novel foods and biotechnology will be needed, without jeopardizing innovation, research and the marketing of the new products deriving from novel foods and biotechnology. (*Food industry association/operator*)
	Competent authorities have to work on a balanced approach to avoid broad scepticism among EU consumers as to the benefits of many new technologies in food chain. (*Food industry association/operator*)
No specific changes needed	The current legislative framework is sound and comprehensive. Further updates will be required in view with new trends and developments. (*International organisation*)
Competition policy	The desire for traditional food from small scale production or processing structures is strong. Legislation has to guarantee, that true traditional food is not exposed to unfair competition by misleading information practices through big international structures. (*Food industry association/operator*)

Source: Stakeholder survey, question 5.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- It was noted that enforcement and control of food safety would need to be made more flexible for the various alternative food chains;
- Standards may need to be adapted to the scale of the food chain market players, as it was noted that larger food operators have less difficulty meeting higher standards than smaller operators;
- In this regard it was suggested that legislative exceptions could be needed for much smaller scale producers, where control might rather be based on 'social pressure' rather than on system controls;
- Smaller chains are also likely to have an impact on rural development, it was noted, and therefore policy development should take this into account;
- In addition, it was noted that in light of the large diversity, scale and type of food production across the EU, there may be potential for delegating control to individual small-scale producers or smaller collectives, as opposed to a more centralised approach;
- Rather than reframing technologies in a better light to improve consumer perception of them, participants found that emphasis should be placed on policies that deal with adapting to the alternative food chains (as opposed to attempting to prevent them);
- Promoting knowledge-intensive agriculture was also noted. In particular the existence of many local chains may entail the need for more locally-based knowledge.

Future research

Finally stakeholders were asked on which issues research should be conducted to better understand the challenges posed by scenario 5, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted in relation to the safety and consumer perception of new technologies; the feasibility and sustainability of alternative food chains; risk of contamination in alternative food chains; and the adequacy of safety and hygiene practices in SMEs.

The table below presents key stakeholder comments regarding issues for future research relating to this scenario.

Table 26: Key comments of stakeholders/experts regarding issues for future research under scenario 5

Main issue for research	Comments
Safety and perception of new technologies	Research will be important to find evidence of the safety of new modes of production (biotechnology…) and regain consumers' trust, but also in developing new ways of production that would fit consumers' new expectations. (*Food industry association/operator*)
	[…] R&D&I [Research, development and innovation] of new control techniques; Public risk perception in relation to new technologies (biotechnology, GMO, etc.). (*Public authority*)
	Consumer-friendly and transparent uses of new technology, biotechnology. (*University/research organisation*)
Feasibility and sustainability of alternative food chains	Although this scenario proposes a major shift towards local food, research should focus on transition to more sustainable food systems and creating more balance between local and global systems and how this can impact on livelihoods, resilience of production systems, what changes in behaviour are required to do this and how trade and competition factor into this transition from niche to larger scale change. […]. (*University/research organisation*)
	Whether and how "small" is compatible with quality standards, hygienic requirements. (*Food industry association/operator*)
	Basic feasibility of producing large volumes of high quality, safe, nutritious food in close proximity to population centres. (*Food industry association/operator*)
	Environmental impacts of a "healthy diet", as well as impacts of different food production pathways. (*University/research organisation*)
	Market resilience/Could organic approaches feed the world? […] Cost-benefit analysis of adopting policies that promote local produce. (*University/research organisation*)
	Research on increasing productivity of alternative food production methods. Research to ensure nutritional adequate diets needed in order to abandon conventional food production (reduce meat consumption, less waste). Research on alternative plant protection methods. […]. (*Public authority*)
	Relationship between health status of the population that consume more food issued from locally produced, short food chains. (*International organisation*)
Contaminants in alternative food chains	Contamination in small scale production, especially close to urban areas or industrial production. (*University/research organisation*)
	Risks of organic production (hygiene, contaminants). (*Public authority*)
	Microbiological implications of organic farming. (*Food industry association/operator*)
Safety and hygiene practices in SMEs	If local networks are going to be more important, then research [should be conducted] into how these currently function and how good food hygiene practices can be managed and monitored given the nature of the organisations [concerned,] i.e. SME and micro businesses, [which] will be needed in order that the regulatory framework is not made overly bureaucratic and costly to both implement and control. Production techniques would be the first priority. [...]. (*International organisation*)
	SME appropriate safety and quality research and product development. Local surveillance and testing. (*University/research organisation*)

Source: Stakeholder survey, question 5.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Several participants agreed that research should be conducted into the feasibility of efficient and safe small-scale production, while also investigating:
    - Impacts on rural development and rural livelihoods;
    - Related new forms of innovation;
    - New forms of urban gardening;
    - Dietary implications of more local production;
    - Climate change mitigation means for small scale producers;
    - Contaminants in urban gardening. In this context, participants also suggested research into cheap and easy methods for testing soils.
- Participants agreed that research into the safety and hygiene practices of SMEs was necessary;
- In contrast research into the safety and perception of new technologies was not seen as necessarily a high priority (as opposed to researching the feasibility of the alternative, less technologically intensive food chains).

4.6. Scenario 6: Widespread consumption of high-tech functional foods

1. This scenario assumes that high-tech functional foods – defined as foods which affect functions in the body beyond adequate nutritional effects by improving health and well-being or reducing the risk of disease[1] – are regularly consumed by large parts of the EU population
2. Key interrelationships in this scenario between the scenario driver (New food chain technologies) and other drivers include: *Consumer attitudes and behaviour*: The widespread consumption of functional foods crucially hinged on consumer acceptance and transparent risk assessment and communication. It contributed to a decline in obesity levels, although many consumers now use functional foods in the hope that this compensates for otherwise unhealthy lifestyles and diets; and *New agri-food chain structures:* The mainstream consumption of functional foods in the EU was driven by global food industries in line with their general increase in market power, which are now highly integrated with nutritional science research institutions.
3. Stakeholders assert that this scenario could plausibly become reality already by 2040 (based on average values), with several suggesting that this scenario is already under way.[300]
4. Processing/packaging and ingredients, trade, storage, distribution, and retail, are considered notably impacted under the scenario. Novel foods and biotechnology, food improvement agents, additives and food contact materials, food and feed hygiene, health and nutrition, labelling and consumer information, enforcement and controls, and food contaminants are the policy areas considered strongly impacted under this scenario. Other key areas considered to be significantly impacted are innovation and competition, as well as social stability and environmental sustainability.
5. Research, improving communication, education, awareness raising and training, legislation and promoting international governance, are considered to be the most needed measures/courses of action to face the challenges posed by this scenario.
6. Changes are considered necessary across most policy areas to adapt the EU food safety and nutrition framework to the challenges posed by this scenario, although changes in relation to novel foods and biotechnology, labelling and information to consumers, health and nutrition, food improvement agents, and enforcement and controls are considered to be the most needed.
7. Stakeholders found that research needed to be conducted in relation to: health and nutrition in general and the health impact of functional foods versus conventional food, in particular longer term; the nutrient content of foods – including ingredients obtained from natural sources; and improving risk assessment and the food safety implications of functional foods.

4.6.1. Description of scenario

This scenario assumes that high-tech functional foods – defined as foods which affect functions in the body beyond adequate nutritional effects by improving health and well-being or reducing the risk of disease[301] – are regularly consumed by large parts of the EU population. The

[300] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).
[301] European Commission, Functional Foods, November 14, 2010.p.7

scenario explores the challenge of ensuring high levels of food safety and nutrition for consumers of these foods in 2050.

In the early 2020s, the variety of functional foods developed at a rapid pace in the EU. A substantial body of science underpinned the claimed health benefits such as better early development and growth, health maintenance, reduced risk of obesity, and reduced risk of chronic diet-related diseases. As a result, many functional foods were gradually given regulatory clearance, and while at first particularly health-conscious, active consumers adopted them, by the mid-2030s functional foods had become a key part of many EU consumers' diets. This came about as the result of several factors, including: new knowledge developed by nutrigenomics research; sustained advertising to consumers and the medical professions; a decrease in the cost of production of functional foods; higher prevalence of obesity-related diseases; increasingly risk-dependent contributions to health insurance; broader consumer understanding of the link between diet and health; and the high costs of healthcare overall. Where evidence existed, governments accepted the cost-saving benefits for public health, and supported further research. Detailed international standards for design and trade of functional foods were elaborated.

In 2050, the dividing line between traditional processed food and functional food has all but disappeared, and functional foods constitute a substantial part of foods on the EU market, facilitated by globalised food industries that are highly integrated with nutritional research institutions. Recent improvements in public health in a number of areas can be partly attributed to widespread functional food consumption. The development has its downsides, though: the variety of functional foods and competing health claims has made consumer choice more difficult, and sometimes even encouraged unhealthy lifestyles, as consumers perceive consumption of functional food as a sufficient precaution for an otherwise unhealthy animal protein and carbohydrate-rich diet. Consumption of fresh fruits and vegetables is steadily decreasing. Some health experts are worried by overconsumption and abuse of certain functional foods. While EU regulatory oversight has generally been effective in ensuring the safety of the new foods (which was essential for the high consumer take-up), it has become increasingly difficult to keep up with the fast pace of the global market. Several functional foods – some of them unauthorised and illegally imported through specialised online traders abroad – have turned out to induce serious side effects, while there have been several cases of conventional foods labelled as functional foods. As a result, in the EU calls for a return to food protectionism, as well as to conventional foods, have received greater attention in recent years.

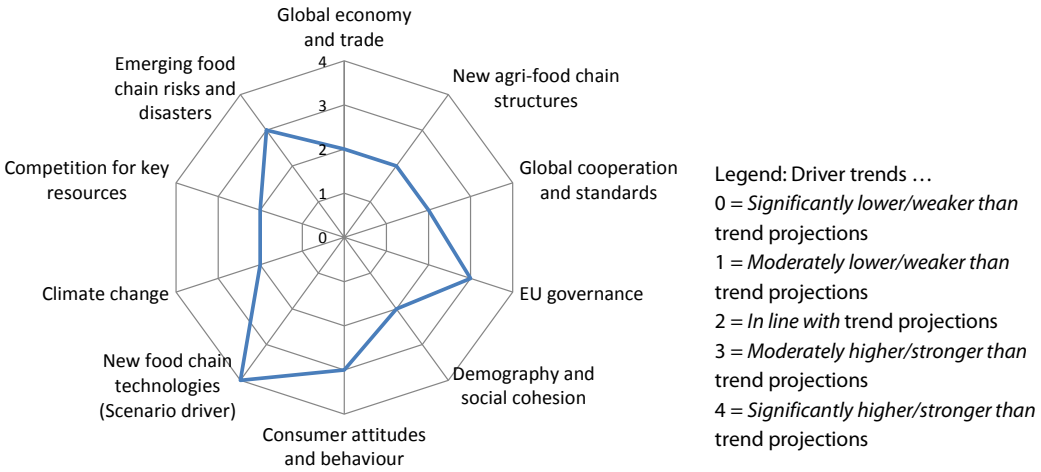
Looking back from 2050 to the world of today, forerunners of this future are…

- In 2008, estimates for the global market for functional foods fell into the range of 30-60 billion Euro, while the estimates for the EU market range from 6-20 billion Euro,[302] with one study identifying the 'big four' European markets in 2007 as the UK, Germany, France, and Italy.[303]
- Dairy products and beverages had the biggest market share in the EU in 2008, followed by cereals. In terms of bioactive ingredients, probiotic bacteria cultures clearly dominate, followed by dietary fibres and then plant extracts and other ingredients. Given available data, there were at least 168 EU companies active in the field of functional foods in 2008. [304]
- Japanese and US consumers already eat much more functional food than Europeans: in 2008 in Japan the per-capita expenditure on functional foods and beverages was four times as high as in the EU and in the US it was twice as high.[305]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (New food chain technologies) and the other drivers identified.

Figure 37: Scenario diagram for scenario 6



[302] Stein, Alexander J., and Emilio Rodríguez-Cerezo, Functional Food in the European Union, 2008.
[303] Bech-Larsen T., Scholderer J. 2007. Functional foods in Europe: consumer research, market experiences and regulatory aspects. Trends in Food Science & Technology 18:231-234.
[304] Stein, Alexander J., and Emilio Rodríguez-Cerezo, Functional Food in the European Union, 2008.
[305] Ibid.

The following points describe in further detail the nature of the interrelationships identified.

- *Global economy and trade*: The general increase in international trade, specifically cross-border business-to-consumer sales of functional food (e.g. over the Internet) from extra-EU countries, have made it more difficult to ensure that only authorised products are consumed in the EU.
- *Consumer attitudes and behaviour*: The widespread consumption of functional foods crucially hinged on consumer acceptance and transparent risk assessment and communication. It contributed to a decline in obesity levels, although many consumers now use functional foods in the hope that this compensates for otherwise unhealthy lifestyles and diets.
- *EU governance*: Increased EU regulatory oversight and risk assessment and communication were necessary for the high consumer take-up.
- *New agri-food chain structures:* The mainstream consumption of functional foods in the EU was driven by global food industries in line with their general increase in market power, which are now highly integrated with nutritional science research institutions.
- *Emerging food chain risks and disasters:* A few of the functional foods, while initially thought to be safe, have caused serious side effects for those who consumed them regularly over a long term.
- *Global cooperation and standards:* Detailed international standards were developed to facilitate the design and trade of functional foods, in line with the general expansion of standards.

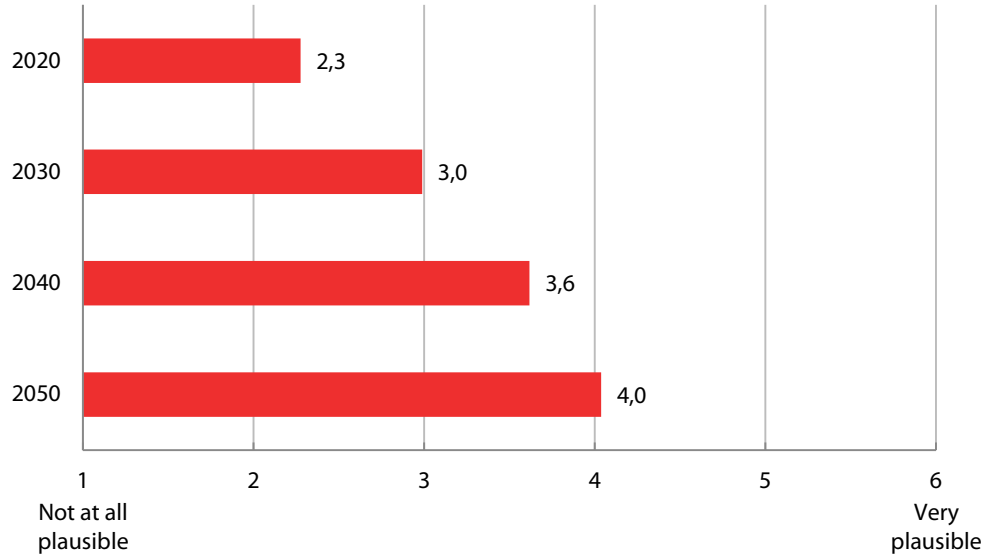
Other drivers not listed here were considered to develop in line with current trends and projections.

4.6.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 38: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 6.1.

As indicated in the graph, respondents find that it is increasingly likely for the scenario to become reality in later decades. Stakeholders assert that this scenario could plausibly become reality already by 2040, on the basis of the average assessment of plausibility for this year being higher than the midpoint (3.5). Stakeholder comments for this question broadly reflected this assessment, with a number of comments indicating that the scenario was found to become gradually plausible in light of current and past trends, e.g. the rapid development of functional foods by an increasingly globalised industry in the last decade and the fact that EU consumption of functional foods lags behind that of other developed countries (such as the US or Japan). Other comments indicated that while many elements of the scenario were considered plausible, there was less certainty regarding the extent to which EU consumers would endorse more fully functional foods, due to e.g. relatively high health and lifestyle awareness and strong traditional/cultural values of food in the EU, and relatively limited evidence that functional foods make a difference to health.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 27: Key comments of stakeholders/experts regarding plausibility of scenario 6

Judgement	Comments
Plausible scenario based on current and past trends	Functional food can improve our health, reducing costs for National Health Services. In addition they can be very profitable for the food industry, therefore their use will increase in the next years. *(University/research organisation)*
	Could be a desired solution to public health, sustainability, climate change and food security challenges. *(University/research organisation)*
	The scenario describes a trend that has already started and will most likely continue; examples could be 3d food printing and the development of personalised foods. *(Public authority)*
	Effective functional foods are available; they could be promoted more widely across the EU and more intensively. *(University/research organisation)*
	Plausible due to the power of advertising, combined with consumer desire for a magic solution by self-medication through food to resolve many negative lifestyle aspects. *(University/research organisation)*
	Production and consumption of functional food will increase over the years due to the constant development of new technologies. *(Other stakeholder)*
	Nowadays, the market related to functional food is increasing, and consumers have realized the positive benefits of these products. Therefore, this scenario would become true in less than 30 years. *(University/research organisation)*
	If food processing companies will gain influence compared to (primary) food producers and if food tech companies will continue to see ´food inputs´ as a commodity to serve them, rather than an intrinsic good in the supply chain, this may likely become the future. *(Food industry association/operator)*
Scenario plausible except for some elements, which may not occur, or take longer than indicated	The plausibility of this scenario depends on the legislative environment relating to both functional foods and health claims. There is currently very little evidence that functional foods can actually improve diets and health outcomes. In fact the evidence suggests that although micronutrients in isolation can provide solutions to micronutrient deficiencies, increased consumption of certain micronutrients can have a negative health impact especially in relation to non-communicable diseases (NCDs). At the same time, evidence shows that improving population diets can have a substantial positive impact on NCDs. Although there is some evidence of food/gene interaction leading to better understanding of how food and its constituents interact with human gene expression, it is difficult to ascertain how this personalized nutrition strategy can improve population diet and be implemented in population approaches. *(University/research organisation)*
	It is just not happening because there is no proof. There is no alternative to exercise and eating a varied diet in modest amounts. *(University/research organisation)*
	There is increasing scientific understanding that the link between a food and health is weak at best. *(Other stakeholder)*
	The majority of consumers within the EU are very concerned about maintaining healthy lifestyle, so I would not expect a dramatic shift in the next 10-20 years. *(University/research organisation)*
	Despite unquestionable huge interest and push from the industry to increase this market, we think the regular consumers will push back and will keep up with 'traditional' or 'current'-form foods. *(Consumer organisation/NGO)*
	This is a logical trend for the industry, however, due to reduction of public resources for education and research, this trend will decrease as research is necessary for innovation. *(University/research organisation)*

Source: Stakeholder survey, question 6.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 39: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)

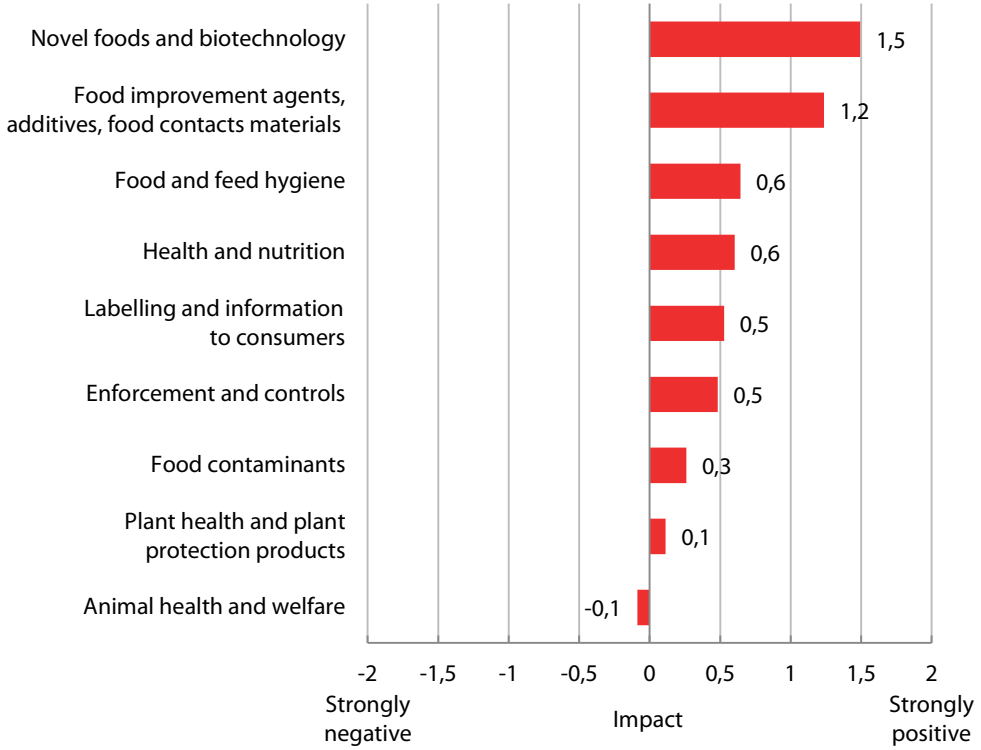
Source: Civic Consulting, based on stakeholder survey, question 6.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

As shown above, according to respondents, the most positively impacted food chain activities by a clear margin are processing/packaging and ingredients, while trade, i.e. imports and exports to and from the EU, as well as storage, distribution, and retail, were also seen to be positively impacted under the scenario. This is reflected in stakeholder comments, in which several stakeholders indicated that processing, as well as trade, storage, distribution and retail, would benefit under this scenario, while the comment was often made that this is expected to occur at the expense of primary (agricultural) producers. Although primary production was not indicated to be negatively impacted by this scenario (on the basis of average assessments), several of the comments in the survey as well as from the interviews suggest that primary producers may suffer further as a result of pressures from an increasingly industrialised and concentrated food processing sector seeking to procure mass, standard-quality raw materials at low (competitive) prices. The remaining areas were considered to be impacted only slightly positively as a result of the scenario.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 40: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 6.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

As shown in the graph, novel foods and biotechnology, as well as food improvement agents, additives and food contact materials are considered to be most positively impacted as a result of this scenario, in terms of receiving a stimulus for innovation. Other areas considered to be - generally positively - impacted were food and feed hygiene, health and nutrition, labelling and consumer information, enforcement and controls (less need for controls), and food contaminants (less risks).

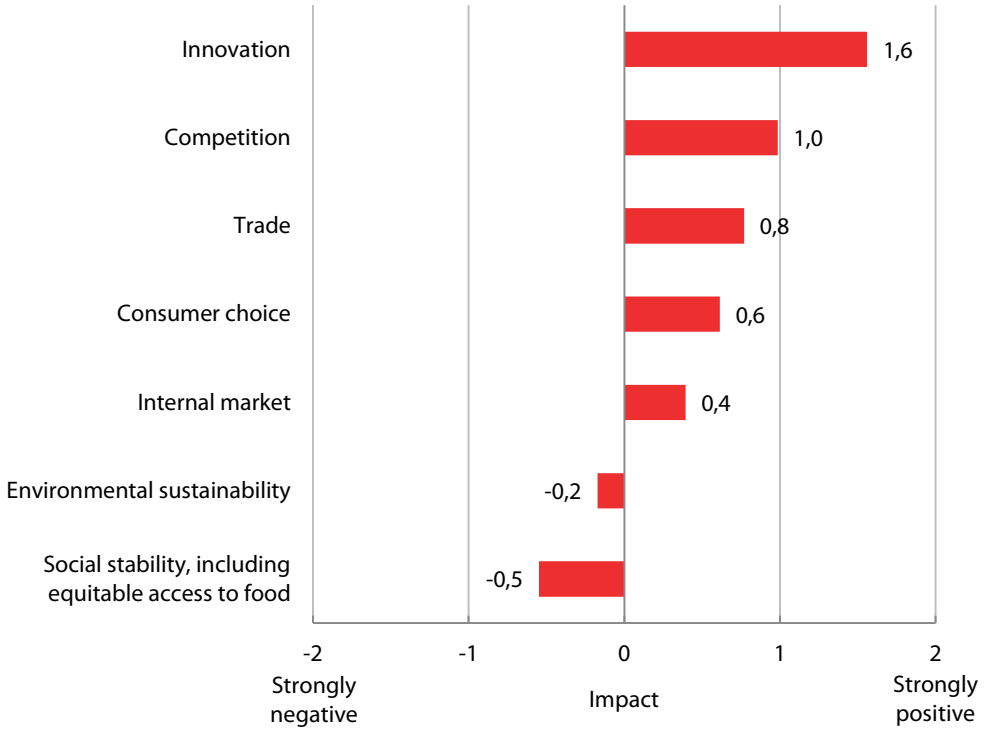
This is reflected in stakeholder comments, which emphasised that functional foods will rely on innovation in improved additives and agents, labelling to communicate the benefits of these foods, and stronger food control mechanisms. Several stakeholders also noted that labelling and information provision to consumers and - related to this - controls and enforcement would present challenges in this scenario due to the increased difficulty of assessing the claims made by functional foods. Several stakeholders commented that health and nutrition might be

negatively affected if labelling and health claims fail to inform consumers properly about the extent of the potential beneficial impact of these foods and/or if reliance on the claimed benefits of consuming functional foods leads consumers to adopt less diverse/healthy nutrition and lifestyles. Finally, in terms of the impact on food contaminants (to which some respondents added zoonotic diseases), some commented that risks might increase due to the introduction of new ingredients and new potential risks.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other key areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 41: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 6.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

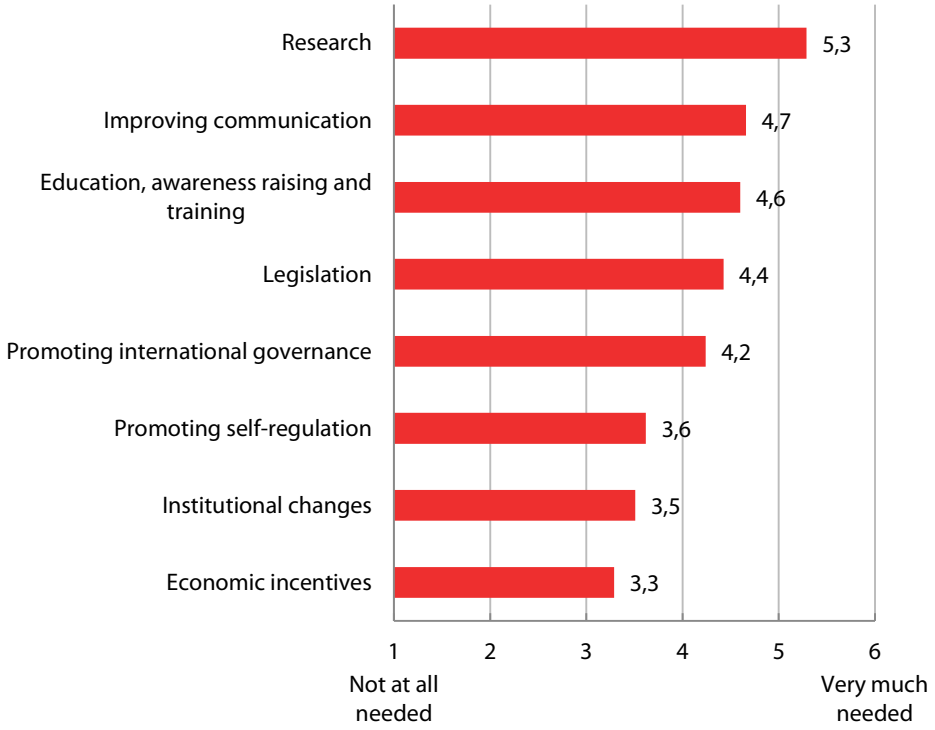
As shown in the graph, and consistently with previous responses, innovation and competition are again considered to be most positively impacted by this scenario, followed by trade. On the other hand, social stability, including equitable access to food, and environmental sustainability are considered to be negatively impacted. This is reflected in stakeholder comments, in that some stakeholders noted broadly positive impacts in terms of innovation in particular, linked to the increased pressure to compete and innovate on global markets. Others noted mixed impacts, in particular focusing on the more adverse effects of this scenario in terms of the potential for worsening consumer choice, access to nutritious good and balanced diets for lower income and/or not sufficiently informed consumers. The negative impacts on consumer choice and other

broadly negative impacts, such as the increasing risk for market concentration in the (generally bigger) companies of the food industry that can invest in the development of high-tech foods, were overall noted by the majority of stakeholders.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 42: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 6.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, research, improving communication, education, awareness raising and training, legislation and promoting international governance, are considered to be the most needed measures/courses of action to face the challenges posed by this scenario. Measures such as economic incentives, institutional changes, and promoting self-regulation are seen as relatively less needed. This is reflected in stakeholder comments, which on the whole indicated a greater need for research, although for most experts this was considered as going hand in hand with education and awareness raising amongst consumers, coupled with key changes in both EU and international legislation and governance (e.g. novel foods legislation including GMOs, and food safety standards). Some stakeholders noted that institutional changes might also be necessary, and particularly a very severe competition policy in the food sector, in view of the globalised context and implicit concentrated industry structures presented by this scenario.

Finally, economic incentives were considered by some as likely to be needed to improve the balance in the consumption of functional and conventionally produced foods of good nutritional value.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 28: Key comments of stakeholders/experts regarding measures considered necessary under scenario 6

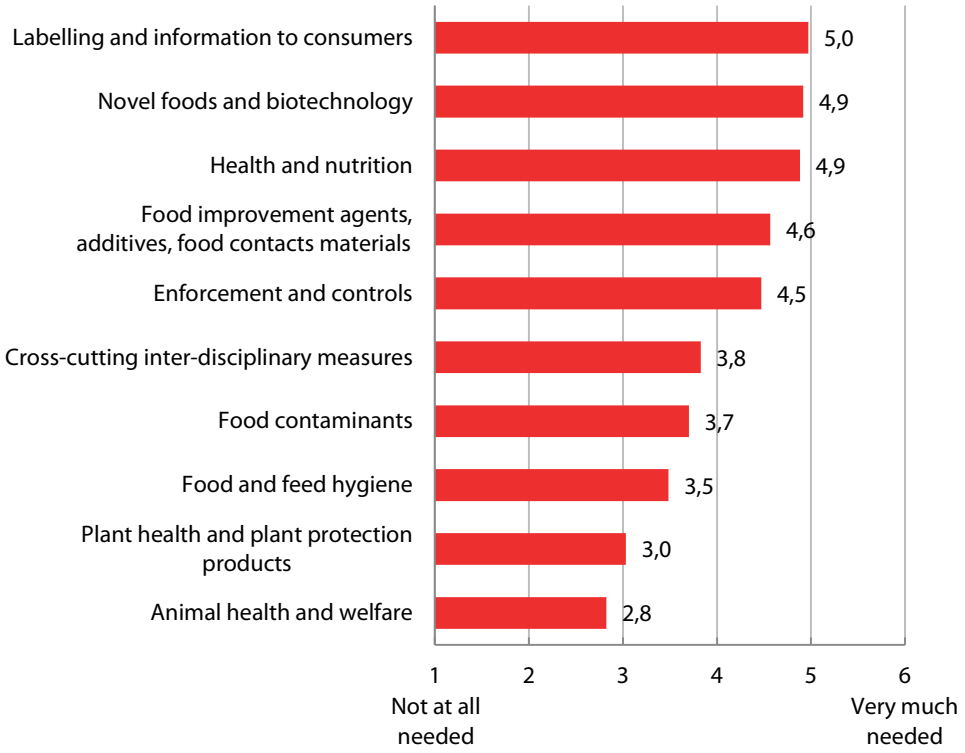
Main measures considered necessary	Comments
Research; Legislation; Education, awareness raising	In this scenario legislation is needed to ensure that consumers are not misled by false claims relating to the positive benefits of functional or novel foods. There is no evidence that self-regulation works, especially without any sanctions or penalties for providing false information to consumers. *(University/research organisation)*
	Education will be critical to ensuring positive impacts to this scenario. As with the development of any new food product communication of its real nutrient content and health associations are vital. *(University/research organisation)*
	Research is needed to confirm the health claims of functional foods; raising awareness will lead to increased demand and improved health. *(International organisation)*
	The EU should allocate more funds for research but also to educate European citizens to know more on new foods and on the effect of foods on human health. *(University/research organisation)*
	Research is really important, bearing in mind that new products would be developed. Furthermore, EU should set clear legislation related to these products, in order to ensure their safety and quality. *(University/research organisation)*
	Research will definitely be required and revised legislation for speedier approval of novel foods. Frameworks for self-regulation could be helpful. *(Food industry association/operator)*
	Stronger EFSA to regulate the new foods and health claims associated with them, need for strong penalties for misrepresenting claims. *(Consumer organisation/NGO)*
A broader mix of measures	Public research and innovation is badly needed to ensure that functional foods are not only analysed and understood by those who produce them. International governance is also a priority, to keep norms and standards as high as possible, in anticipation of a market of functional foods that would cross borders very easily. Legislating in the EU is also very important to ensure strong standards about nutritional and health claims, and organise also the format of communication to the consumer. Institutional changes might be necessary also and particularly an anti-cartel agency in the food sector, or at least a very severe competition policy in the sector. *(University/research organisation)*
	Improving communication, especially to consumer associations, but also to producers, traders, sanitary authorities, scientific community would be a priority in order to allow the use but not the abuse of such products. "Promoting international governance" would be important in order to enforce control, labelling and information measures all over EU and abroad. Promoting self-regulation could be an efficient way to make the private producers and traders take part in the transparency for consumers. New legislative measures, controls of the composition of the functional products, controls on unfair advertising, product responsibility, etc. should be taken. *(International organisation)*
Economic incentives	Same as scenario 4; rebalance the supply towards more nutritionally balanced food by incentives for food industry. *(University/research organisation)*
	In order to obtain a balanced lifestyle and consumption of both functional and conventionally produced foods of good nutritional value, conventional production should be encouraged by economic incentives. Global cooperation is crucial to address the problem of illegal market. *(Public authority)*

Source: Stakeholder survey, question 6.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 43: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average stakeholders assessment on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 6.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, in this scenario changes are considered necessary across most policy areas, with the exception of plant health and plant protection products, and animal health and welfare (on the basis of average assessments above the midpoint of 3.5). Nonetheless, changes in relation to novel foods and biotechnology, labelling and information to consumers, health and nutrition, food improvement agents, and enforcement and controls are considered to be the most needed, whereas changes in relation to cross-cutting measures, food contaminants and food/feed hygiene are considered slightly less needed (but still considered more needed than not). This is broadly reflected by stakeholder comments, emphasising the need to strengthen regulation of novel foods, biotech and food improvement agents, and to improve labelling and transparency of information for consumers, while addressing more specifically enforcement and controls to avoid risks related to potential misinformation, fraud and new/emerging threats.

In addition, cross-disciplinary measures were suggested such as improving the capacity of food safety agencies to conduct a systemic assessment of safety, health, nutrition, and environmental sustainability impacts, and multi-disciplinary research including basic research to identify the determinants of healthy diets.

Table 29: Key stakeholder comments regarding changes to EU food safety and nutrition framework considered necessary under scenario 6

Main area for which changes considered necessary	Comments
Labelling and information to consumers	Labelling too confusing at the moment. Needs changing in order to ensure a positive impact on people's health and to improve information provided to consumers. *(Food industry association/operator)*
	The positive link between the consumption of functional foods and health effects needs to be proven and reflected on food labelling. *(International organisation)*
	EU advice on nutritional claims, legislation to limit such claims and control advertising. Wider consumer education *(University/research organisation)*
	Prescribe stricter requirements for the placing on the market of functional food, and labelling of such foods. *(Other stakeholder)*
Health and nutrition	Develop nutrition policies that take into account the nutrient richness of some categories of foods and the overall food composition and nutritional contribution of whole foods such as dairy to the diet and that take focus away from negative nutrients and reformulations. *(University/research organisation)*
	Overconsumption and abuse of functional foods is a real threat, control of the benefits of functional food is a challenge, nutrition policies, labelling and information to consumers and enforcement and controls must be reinforced to avoid a misuse of functional foods. *(University/research organisation)*
Novel foods and biotechnology & Food improvement agents & Food contaminants	This scenario would mean that strong regulation of novel foods; biotech and food improvement agents would be needed. In addition, this scenario would put pressure on enforcement and control systems to ensure food safety and prevent fraudulent activities both in relation to food contaminants and misinformation to consumers. *(University/research organisation)*
	EU legislation should encourage biotech research and studies on novel foods. In addition consumers should be better informed on the opportunity given by novel foods. *(University/research organisation)*
Enforcement and controls	Enforcement and controls specific for these technological products should be adopted and implemented to ensure consumer trust. *(University/research organisation)*
	This scenario would put pressure on enforcement and control systems to ensure food safety and prevent fraudulent activities both in relation to food contaminants and misinformation to consumers. *(University/research organisation)*
Cross-cutting inter-disciplinary measures	Health effects of functional foods have to be proved scientifically. The capacity of the food safety agencies to conduct a systemic assessment of safety, health, nutrition, and environmental sustainability impacts is going to be key under this scenario. *(University/research organisation)*
	Research should also include consumer research, consumer science together with basic research to find determinants of healthy diets. *(Food industry association/operator)*

Source: Stakeholder survey, question 6.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Functional foods base their claims on the health and nutrition properties of each individual food; however, experts highlighted that the focus needs to be on consumers' overall dietary patterns.
- Participants noted that it remains extremely difficult to provide robust scientific evidence of the benefits of high tech functional foods. The effects of functional foods depend inter alia on an individual's diet and eating habits (e.g. bread consumed with butter or not has been proved to lead to different results), genetics, lifestyle, level of stress of individuals, etc. A mono-factor analysis approach may not be sufficient; as opposed to a more sophisticated multi-factor analysis approach.
- If the price of functional foods is higher than that of conventional food, given that technological innovation is generally costly, and the investment in research and administrative steps is needed within the current legislative framework to justify functional food product's claim, social inequalities regarding consumers' access to food are expected to increase; policy measures may therefore have to deal with this jointly.
- Communication to consumers will be an important policy response to improve awareness and knowledge about functional foods. Nutrition labelling was considered a complex and ineffective option, as studies have shown that only a proportion of consumers read food labels and a smaller proportion understand them fully. Instead, broad communication policies should be preferred according to participants, focusing on encouraging the promotion of healthy diets and lifestyles.
- While some experts indicated that, in their view, the policy regulating food products' claims should be improved and made stricter (including EFSA's role in assessing health claims under Article 13.1 of the EC Regulation on nutrition and health claims[306]), the majority of participants believed that the current legislative framework is already sufficiently stringent for business operators.
- On the other hand, experts agreed that the enforcement of the current policy framework on claims would need to be strengthened, with notably better controls on the market authorisations, in the EU and globally. Food safety agencies across the world need to harmonise their standards. Controls should also focus on the use of health claims on processed products, e.g. organic processed products should not be labelled with a nutritional claim if levels of sugar, fats or salt are high.

Future research

Finally stakeholders were asked on which research issues should be conducted to better understand the challenges posed by scenario 6, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted in relation to: health and nutrition in general and the health impact of functional foods versus conventional food, in particular longer term; the nutrient content of foods – including ingredients obtained from natural sources; and improving risk assessment and the food safety implications of functional foods. One respondent

[306] Regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods.

(university/research organisation) noted that developments in functional foods need to be backed by scientific evidence and be viewed as a longer term health initiative, not a commercial opportunity, as poorly founded short term exploitation "may destroy longer term consumer confidence in valuable forms of therapy".

The table below presents key stakeholder comments regarding key issues for future research relating to this scenario.

Table 30: Key stakeholder comments regarding issues for future research under scenario 6

Main issue for research	Comments
Nutrition, health impacts and diet	Especially important to evaluate the total impact of functional food through time, and the effects of the changes in traditional diet. *(University/research organisation)*
	Scientific evidence of the effect of the 'functional' products. *(University/research organisation)*.
	Clinical studies to prove scientific evidence. (University/research organisation)
	Research is needed in the field of health impact of functional food. (Public authority)
	Epidemiological studies on the effects of increased functional foods consumption on public health. *(International organisation)*
	Need to model effects of mitigating impacts - consumption of functional products versus consumption of other healthy and nutritional foods. *(University/research organisation)*
	Although more research on the functional qualities of food and its constituents is fascinating and provides potential for the food industry, this should be weighed against the benefits of more traditional and less costly dietary interventions. Currently there is very little evidence that functional foods can improve dietary diversity and health. Thus research should focus on changing diets and how to influence behaviour and not on quick technological fixes to a very complex problem. *(University/research organisation)*
Nutritional content foods	Improve nutrients content of foods (e.g., more Fe or folate; better amino acids profile); improve knowledge of EU citizen in human nutrition. *(University/research organisation)*
	Research is needed in the area of personalized nutrition as well as the link between nutrients and disease. (*University/research organisation).*
	Research on biomarkers and relation between food/ingredient intake and health during all stages of life. *(Public authority)*
	Examine the effect of new substances - e.g. animal experiments or in vitro or silico models. *(University/research organisation)*
Food safety	First research in innovation and in parallel the demonstration of the long term benefit in terms of health and nutrition, which is not always convincing, and secondly check the effect of process and new technologies in terms of food safety (by-products, side effects...) *(University/research organisation)*
	Research in the human 'microbiome'. Research to ensure safety levels for newly developed functional foods equivalent to pharmaceuticals having similar effects and risks. Research on developing concepts and methods for risk and benefit assessments. *(Public authority)*
	Strengthen risk assessment of novel techniques, like nanotechnology. *(Public authority)*
Other	Research on the future of personalized medicines and home/personal diagnostic possibilities. *(Public authority)*
	Research and development on new control techniques. *(Public authority)*
	Three main areas for research : 1) socioeconomic research to analyse the trends in concentration (oligopolisation, changes in business models) in the global food sector, 2) public research on functional foods to be able to assess the products and processes developed by private industries, 3) systemic assessments of new food products for their health and nutrition but also environment impact. (*University/research organisation)*

Source: Stakeholder survey, question 6.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Research is needed in order to take appropriate policy actions, notably to anticipate risks; mono-factor analysis studies exist but more complex multi-factor modelling of impacts on nutrition would be needed.
- Research on scientific evidence of claims could include the development of new methods to assess claims, studies on larger populations, etc. online community based forums on e.g. obesity, could provide valuable monitoring data on the effect of functional foods on larger samples of the EU population.
- It was noted that 3D-printed food supplements are a technical reality today and could become a commercial reality in 2-3 years – within the legal micronutrients limits.
- Personalised diets and genetics should be investigated (although consumers' eating habits and diets are the result of a mix of various decision factors).
- More research is needed into the nutritional properties of normal foods and balanced diets, rather than development of new foods as such.

4.7. Scenario 7: Global resource depletion

1. This scenario assumes increased depletion of the world's resources, leading to high and volatile food and energy prices. The scenario explores the challenges of safeguarding food safety and nutrition when high quality resources are scarce.
2. Key interrelationships in this scenario between the scenario driver (Competition for key resources) and other drivers include: *Global cooperation and standards:* International governance mechanisms proved ineffective in brokering sustainable management of the world's resources, and resource scarcities have led to international conflicts and realignments, resource nationalism, and a number of strategic alliances to establish regional resource and energy deals; and *Climate change:* The continued use of fossil energy to meet high energy demand due to insufficient alternative sources, and the lack of improvements in agricultural sustainability, have led to the aggravation of climate change.
3. Stakeholders assert that this scenario could plausibly become reality already by 2040 (based on average values).[307]
4. Primary production, agricultural inputs, ingredients, trade and restaurants and catering are considered significantly impacted under this scenario. Plant health, animal health and welfare, health and nutrition and food contaminants are policy areas considered to be notably impacted. Furthermore, social stability, including equitable access to food, environmental sustainability and consumer choice are considered to be significantly impacted.
5. A wide range of suggested measures/courses of action are considered necessary to face the challenges posed by this scenario, with research, and promoting international governance, considered to be the most needed. On the other hand, promoting self-regulation is seen as the least needed.
6. Changes are considered necessary across nearly all policy areas in this scenario. Nonetheless, changes in relation to cross-cutting interdisciplinary measures, novel foods and biotechnology, and enforcement and controls are considered slightly more needed, whereas changes in relation to animal health and welfare, and labelling and information to consumers are considered slightly less needed (but still considered more needed than not).
7. Stakeholders mostly found that research is needed in relation to optimising resource efficiency and environmentally sustainable food production methods, in particular through an integrated 'farm to fork' approach that spans from resource use to dealing with waste, but also improving the environmental and public health risk assessment of current and new production methods, and promoting health, nutrition and diet objectives.

4.7.1. Description of scenario

This scenario assumes increased depletion of the world's resources, leading to high and volatile food and energy prices. The scenario explores the challenges of safeguarding food safety and nutrition when high quality resources are scarce.

[307] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

A number of forces, most notably the increased demand for food from the ever larger world population, the high energy consumption resulting from strong economic growth and rising per capita incomes, increased demand for biofuels, and the lack of global resource management strategies, have led to strong competition for and the substantial depletion of many of the world's resources in 2050. Global energy consumption has doubled, and the majority of the demand is still met from fossil sources; indeed while renewable sources continuously gained in importance, they did not become economically viable in many countries. World oil prices have skyrocketed at times to beyond $250 per barrel (while high prices have incentivised research into cheaper alternatives, price peaks continue to occur). Fertile soils have become considerably scarce: A 75% increase in agricultural production was needed to cope with the population increase and the much stronger than expected shift to meat-based diets in emerging economies, while efforts to reduce food waste largely failed. Much of the world's arable land has undergone soil degradation, in spite of widespread use of new GM crops with soil-enhancing properties. There has also been a strong shift in land use from crop production to other uses, including biofuel production. Overall, improvements in crop yields per area and sustainability were limited, and water consumption for agriculture has grown to an unsustainable level in many countries, causing severe regional freshwater shortages. There has also been a large increase in the incidence of environmental contaminants spreading through the food chain, due to the need to use lower quality water for irrigation and food production, which has mainly affected consumers where food control systems were deficient. While high uncertainty over the quantity of remaining phosphorus reserves persists, the known reserves of cheap high-grade phosphate rock for fertilisation have been depleted. Methods to recover phosphorus from recycling on a large scale proved inefficient, contributing to increased prices of agricultural commodities. Finally, as a result of competition for land and conversion of natural land areas for intensive agricultural use, there has been a serious degradation of biodiversity and ecosystem services, globally and in the EU.

At a geopolitical level, regional resource scarcities have led to international conflicts, increased resource nationalism/protectionism, and the emergence of new strategic alliances, which have not always been in line with the EU's interests. The scarcity of resources has also induced high and volatile global energy and food prices, affecting EU consumer welfare significantly.

Looking back from 2050 to the world of today, forerunners of this future are…

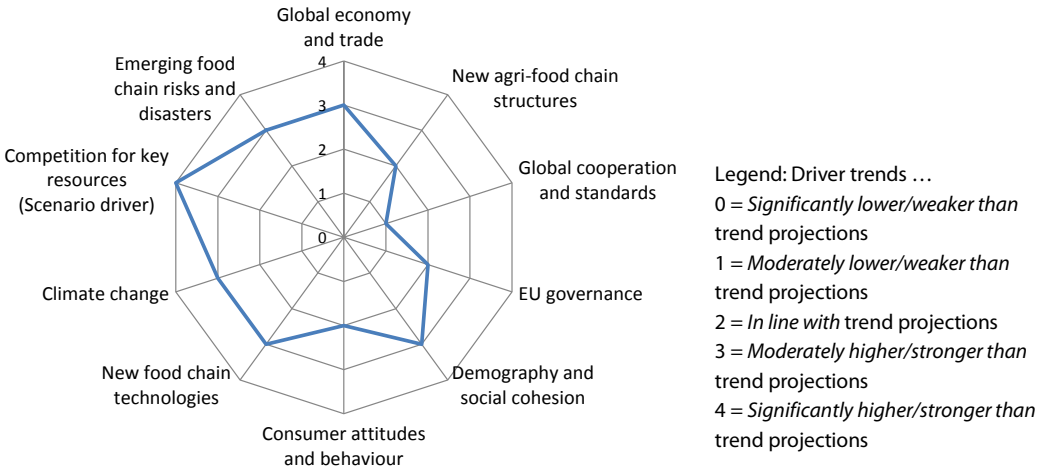
- Global energy consumption increased by 21% from 2000 to 2009.[308] Fossil fuels are the principal sources of energy, constituting 84% of world energy consumption in 2010.[309]
- Agriculture already occupied about 37% of the global land surface in 2007,[310] and while meat currently represents only 15% of the total global human diet, approximately 80% of the agricultural land is used for animal grazing or the production of feed and fodder for animals.[311] In the period 1963-2011 global meat consumption increased from about 72 to 297 million tonnes. [312]
- About 1.3 billion tonnes of food, or about one third of all food produced for human consumption, is lost and wasted globally every year, while produced but uneaten food occupies almost 1.4 billion hectares of land; i.e. close to 30% of the world's agricultural land area.[313]
- According to estimates in 2008, 24% of vegetated land on earth has undergone human-induced soil degradation, in particular through erosion,[314] while about 60% of the world's ecosystem goods and services have been degraded or used unsustainably.[315]
- The price of a barrel of crude oil has not returned to its level in September 2003 of 25 USD since then, and has generally been above 100 USD per barrel since early 2011. In addition, over 1990-2010, the implied volatility for major crops increased by over 20 percentage points. [316]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (Competition for key resources) and the other drivers identified.

[308] See http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/The_EU_in_the_world_-_energy.
[309] Ibid.p.2.
[310] FAO, *THE STATE OF THE WORLD ' S LAND AND WATER RESOURCES FOR FOOD AND AGRICULTURE Managing Systems at Risk*, Food and Agriculture Organization of the United Nations, Rome, 2011.
[311] The Government Office for Science, Foresight Project: C2: Changing Pressures on Food Production Systems, Government Office for Science, London, 2011.p.3.
[312] Alexandratos, Nikos, and Jelle Bruinsma, World Agriculture Towards 2030/2050: The 2012 Revision., FAO, 2012.p.94. See also http://www.worldwatch.org/global-meat-production-and-consumption-slow-down
[313] FAO, Food wastage footprint. Impacts on natural resources, Summary Report, 2013.p.6.
[314] Bai ZG, Dent DL, Olsson L and Schaepman ME 2008. *Global assessment of land degradation and improvement. 1. Identification by remote sensing*. Report 2008/01, ISRIC – World Soil Information, Wageningen.
[315] Ibid.
[316] FAO, IFAD, IMF, OECD, UNCTAD, WFP, the World Bank, The WTO, IFPRI, and the UN HLTF, Price Volatility in Food and Agricultural Markets: Policy Responses, 2011.p.8.

Figure 44: Scenario diagram for scenario 7



The following points describe in further detail the nature of the interrelationships identified.

- *Global economy and trade*: Resource depletion on a global scale, while initially fuelling economic growth in major emerging economies, has led to very high and volatile food and energy prices, as well as a gradual return of regional protectionism in an attempt to maintain key resources.
- *Global cooperation and standards:* International governance mechanisms proved ineffective in brokering sustainable management of the world's resources, and resource scarcities have led to international conflicts and realignments, resource nationalism, and a number of strategic alliances to establish regional resource and energy deals.
- *Climate change:* The continued use of fossil energy to meet high energy demand due to insufficient alternative sources, and the lack of improvements in agricultural sustainability, have led to the aggravation of climate change.
- *Emerging food chain risks and disasters:* The very high water scarcity in certain regions has led to a much higher potential of environmental pollution contaminating the food chain, as water is subject to intense competition for agriculture, industry, and municipal uses. In addition, in some cases greater fraudulent activity has emerged due to the increased pressure on scarce resources.
- *New food chain technologies:* The sustained resource depletion also incentivised technological innovation to reduce resource input or mitigate negative production effects, such as with the use of new GM crops with soil-enhancing properties.
- *Demography and social cohesion*: The scarcity of key resources has led to severe socio-economic and demographic imbalances in relation to available resources, resulting in decreased social cohesion in the EU.

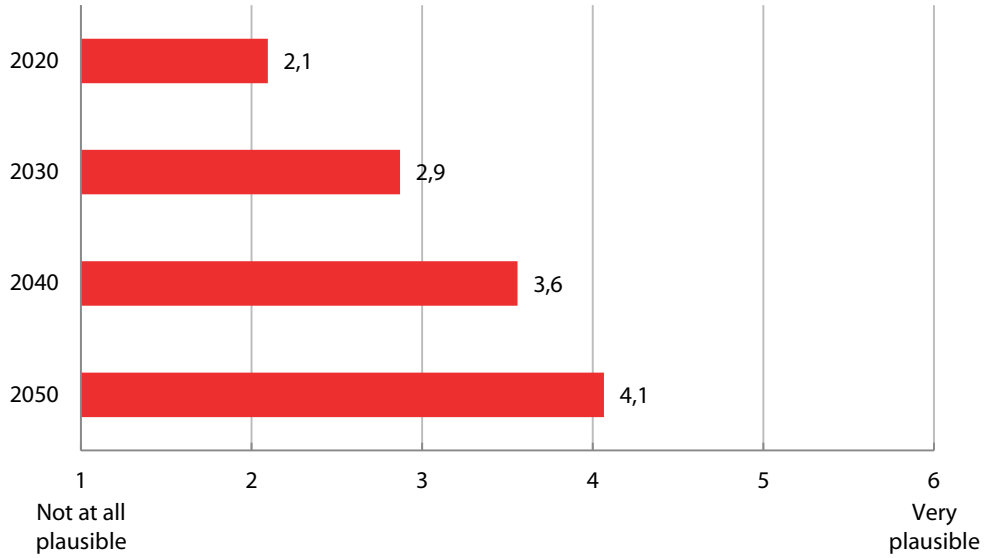
Other drivers not listed here were considered to develop in line with current trends and projections.

4.7.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 45: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 7.1.

As indicated in the graph, respondents find that this scenario is more plausible in later decades. Stakeholders assert that this scenario could plausibly become reality already by 2040, on the basis of the average assessment of plausibility for this year being higher than the midpoint (3.5). Stakeholder comments for this question broadly reflected this assessment, with a number of comments indicating that the scenario was found plausible in light of current and past trends, e.g. the depletion of key resources that has already initiated in the last decades, the lack of global resource management, and the expected growth of the global population. Other comments indicated that while most elements of the scenario were considered plausible, there was uncertainty about the timeframe in which the scenario could become a reality, as illustrated by the range of projections available on the time lap until depletion of the stock of resources, e.g. a 10-fold difference between optimistic and pessimistic scenarios for phosphorus. Finally, some stakeholders did not consider the scenario plausible as technology and resource management practices are and will be increasingly used to avoid the critical point of complete resource depletion, e.g. use of renewable sources of energy. Others did not agree on the underlying assumptions and current trends used to elaborate this scenario, e.g. there could be sufficient food production for 10 billion people by 2050 as growth rates in yields will continue to increase.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 31: Key comments of stakeholders/experts regarding plausibility of scenario 7

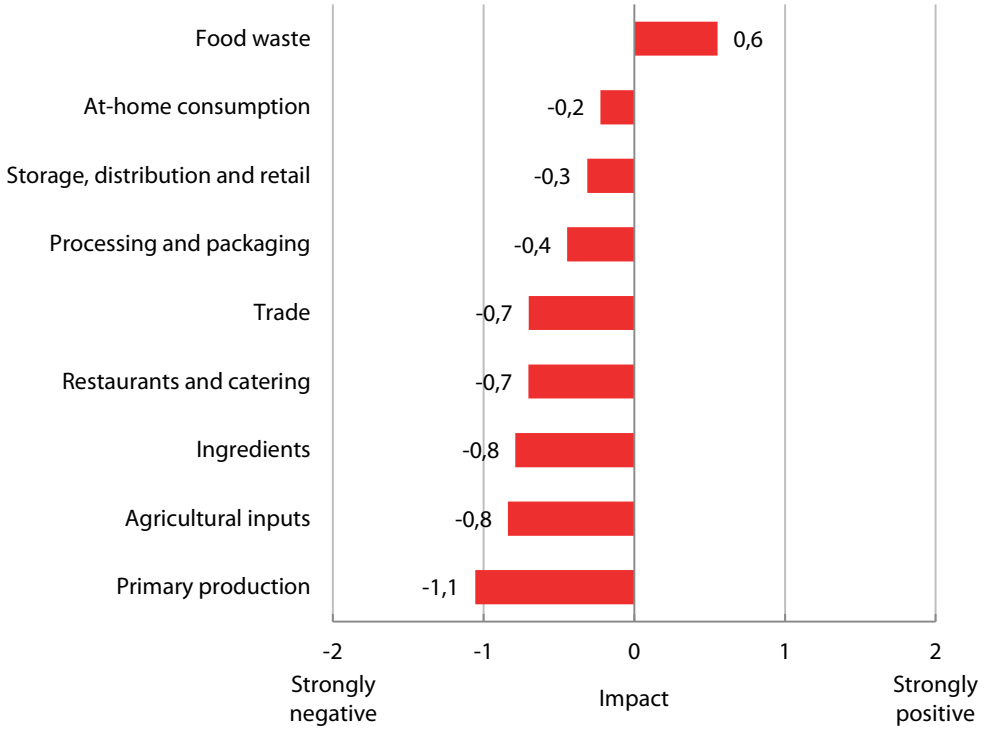
Judgement	Comments
Increasingly plausible in the long term	A very plausible business as usual scenario, as many of the sectors are in a lock-in situation. It is very probable that it could progressively develop. *(University/research organisation)*
	Attributable mainly to ever rising oil prices and increasing water shortage attributable to global warming effects in some areas, and to increasing demand for water. *(University/research organisation)*
	Answers based on 'forerunners' + the likelihood that a) global resource management will not be optimal and b) meat consumption in developing countries has increased beyond expectations. *(Other stakeholder)*
	Energy, nitrogen, phosphorous, clean soil, water and air: all can get depleted. Only solar power and derivatives (hydro-energy, wind) seem to be a given. *(University/research organisation)*
	The growth of the population makes this scenario more possible from the 2030. *(University/research organisation)*
	The scenario has already slowly started but will be become severe within the next decades. *(Public authority)*
	Fossil resources availability is currently estimated to last until 2040. Therefore, the impact of their scarcity will start after that. *(Food industry association/operator)*
Scenario plausible but uncertainty about the time frame	There is big uncertainty about the time period when oil and other natural resources will diminish critically. This is the reason to give higher plausibility for the distant future. *(University/research organisation)*
	While there will be challenges, after a period of higher risk of lack of resources, innovation will drive more efficiencies as the global food supply requirements are met. *(Other stakeholder)*
	Estimates for global rock phosphorous vary from stock depletion in 20 - 30 years to estimates that there is enough phosphorous for the next 200 - 300 years at current extraction rates. *(University/research organisation)*
Scenario not seen as plausible	Biodiversity is not endangered and petrol could be substituted for other energy sources (nuclear or renewable sources). Water for irrigation is continuously used in a more efficient way. *(University/research organisation)*
	Solar energy, gas reserves, renewable sources, construction of new nuclear power plants currently underway and, last but not least, technological innovations (as the controversial fracking, nowadays) could along the period until 2050 assure us an energy supply. *(International organisation)*
	Not a problem to produce enough food for 10 billion inhabitants - growth in food production over last 50 years shows this (FAO). *(University/research organisation)*
	So far, doom scenarios have always been overstated and the reality has always played out differently. Some of the assumptions presented in scenario 7 have already been proven to be inaccurate. *(Other stakeholder)*
	Identification of the problem has been done; research to this problem is on the way (but slowly). Therefore I think that we will face a problem which comes close to the scenario description but at the end innovation will decrease again the risk for full impact of the given scenario. *(Public authority)*

Source: Stakeholder survey, question 7.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 46: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 7.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

As shown above, according to respondents, only food waste is positively impacted under this scenario. All other food chain activities are considered to be impacted negatively as a result of the scenario, with primary production, agricultural inputs, ingredients, trade and restaurants and catering most negatively impacted. This is reflected in stakeholder comments, in which several stakeholders indicated that primary production, agricultural inputs, ingredients would face increasing pressure due to increased consumer demand and (to some extent) quality expectations on one hand, and on the other hand reduced availability of inputs of high quality (e.g. less fertile soils, phosphorous depletion, high costs). Resource depletion is foreseen by some to be exacerbated by an increased use of fertilizers to compensate for the likely decrease in yields. Trade and distribution would also be negatively impacted due to uneven supplies and protectionist measures.

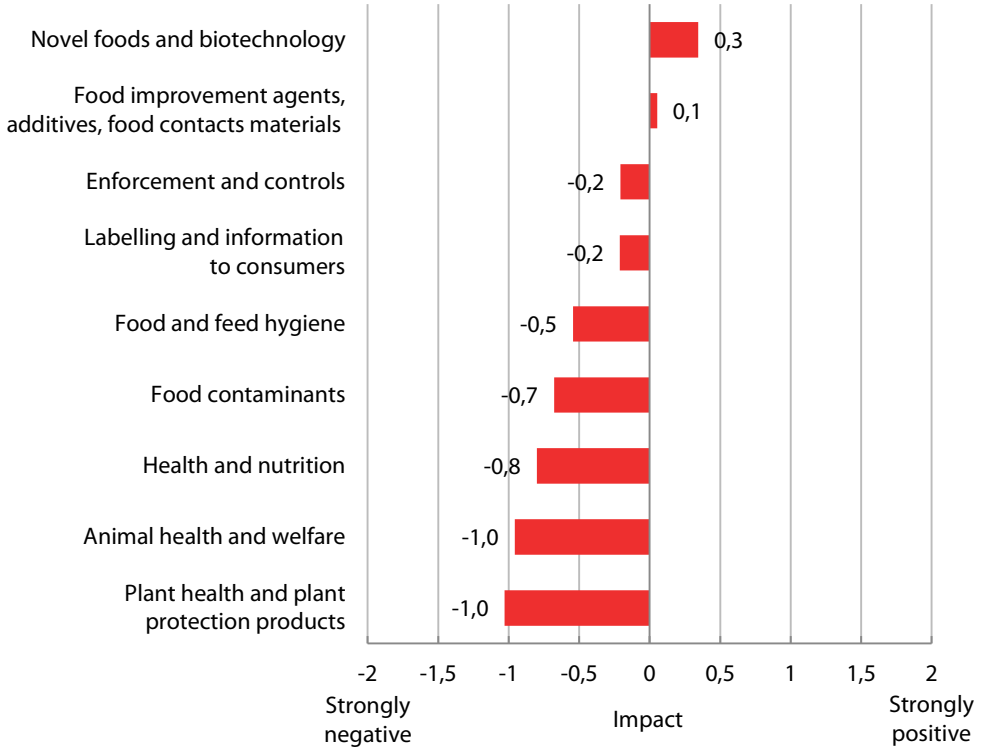
Most stakeholders indicate that the probable response to Scenario 7 will be a reduction in food waste as a result of the large increase in food prices. Positive outcomes of the scenario include the development of more efficient food producing systems and supply chains (in relation to food

waste) as well as of new innovations leading to more sustainable economic systems, to move away from the unviable economic systems that would have led to the realisation of Scenario 7.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 47: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 7.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

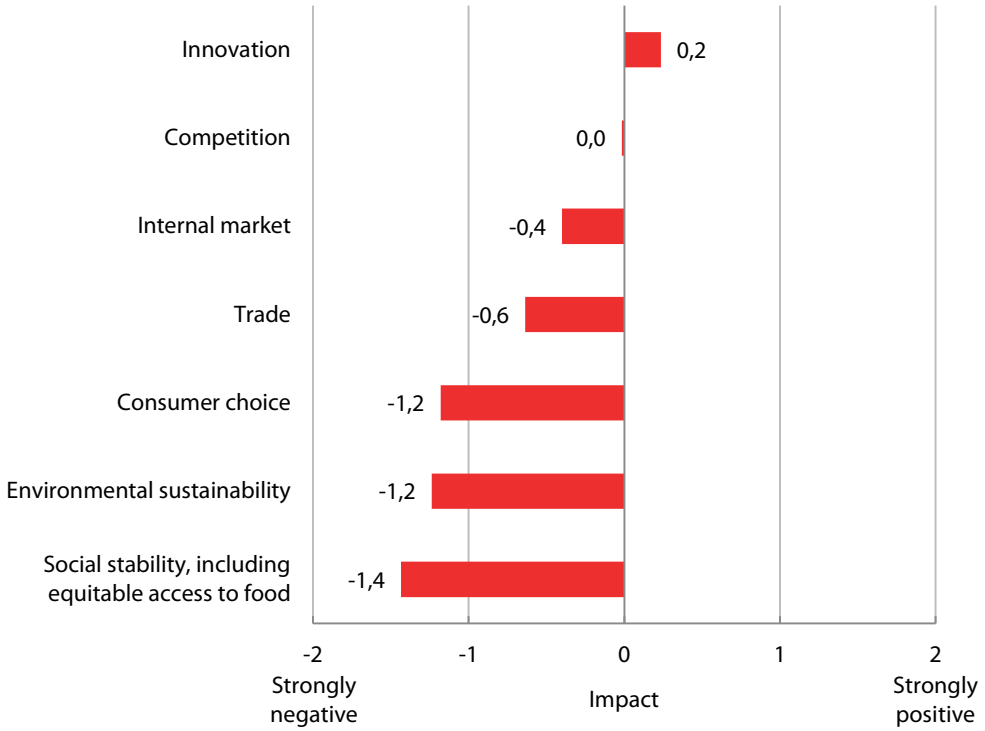
As shown in the graph, only novel foods and biotechnology are considered to be positively (although slightly) impacted as a result of this scenario, while for food improvement agents, additives and food contact materials the impact is expected to be negligible. All other policy areas are considered to be negatively impacted, with plant health, animal health and welfare, health and nutrition and food contaminants the most negatively impacted. This is reflected in stakeholder comments, which emphasised the likely deterioration of the quality level of production in the context of global resource depletion. This encompasses quality of foods as such (e.g. the increased presence of food and feed contaminants) but also the quality of production processes i.e. degradation of animal health, plant health and animal welfare to the benefit of productivity. Stakeholders believe that enforcement and controls will play an

important role in mitigating this while consumers' trust in food safety and nutrition would likely decrease. The only positive impact foreseen by stakeholders is on biotechnology and novel foods which would be encouraged to provide innovative solutions to mitigate the negative consequences of the global resource depletion.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other key areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 48: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 7.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, and consistently with previous responses, only innovation is considered to be positively (although slightly) impacted by this scenario. On the other hand, social stability, including equitable access to food, environmental sustainability and consumer choice are considered to be most significantly negatively impacted.

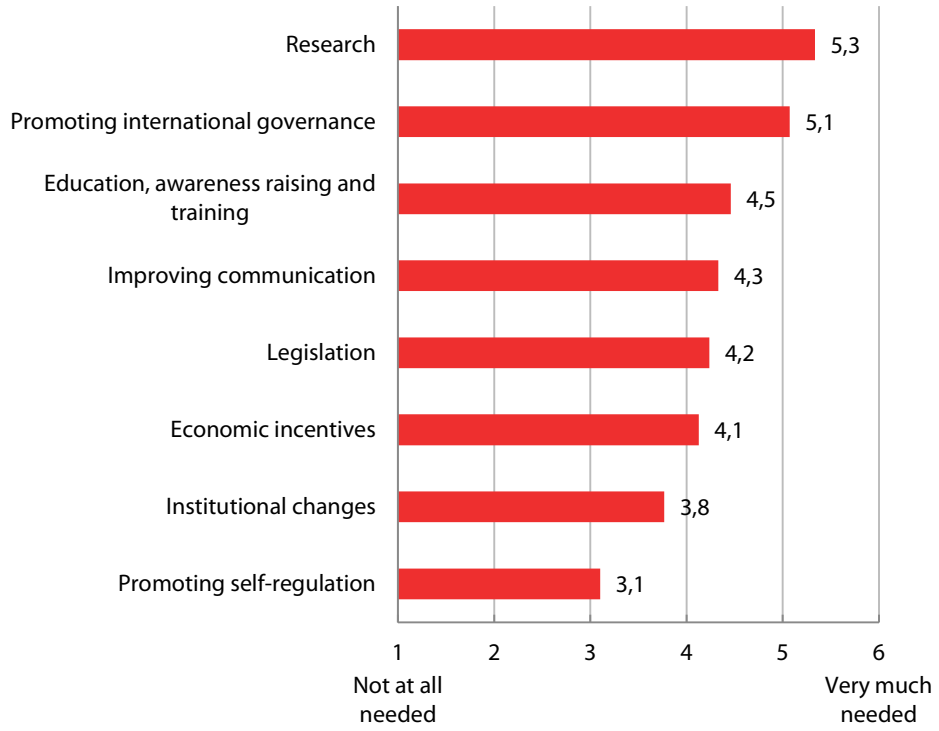
This is reflected in stakeholder comments, in that stakeholders broadly agreed on the negative impacts of the scenario on social stability, highlighting in particular less equitable access to nutritious food as food prices increase and the risk of less social cohesion in the EU. Environmental sustainability is likely to deteriorate in an attempt to compensate for the lack of

available natural resources. Consumer choice would also be negatively impacted as a result of both a reduced supply and an increase in food prices forcing consumers into cheap, unhealthy food diets. Some stakeholders noted the likely prevalence of protectionist measures and decreased trade. The scenario could however have some positive implications on innovation in view of the pressure applied to the food production and supply chains.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 49: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 7.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, a wide range of suggested measures/courses of action are considered necessary to face the challenges posed by this scenario, with research, and promoting international governance, considered to be the most needed. On the other hand, promoting self-regulation is seen as the least needed. This is reflected by stakeholder comments, which on the whole indicated a greater need for research to develop more efficient and alternative production systems (in the agriculture and energy sectors). International governance and legislation were also considered key measures to address this global challenge, in combination with economic incentives to business operators to encourage sustainable

production models (e.g. focus on resource efficiency, reduced food waste). Education, awareness raising and communication to consumers were also considered necessary to change consumer behaviour, demand and ultimately market signals to food business operators. Some stakeholders were sceptical that self-regulation alone could drive the necessary changes given the high economic interests at stake.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 32: Key comments of stakeholders/experts regarding measures considered necessary under scenario 7

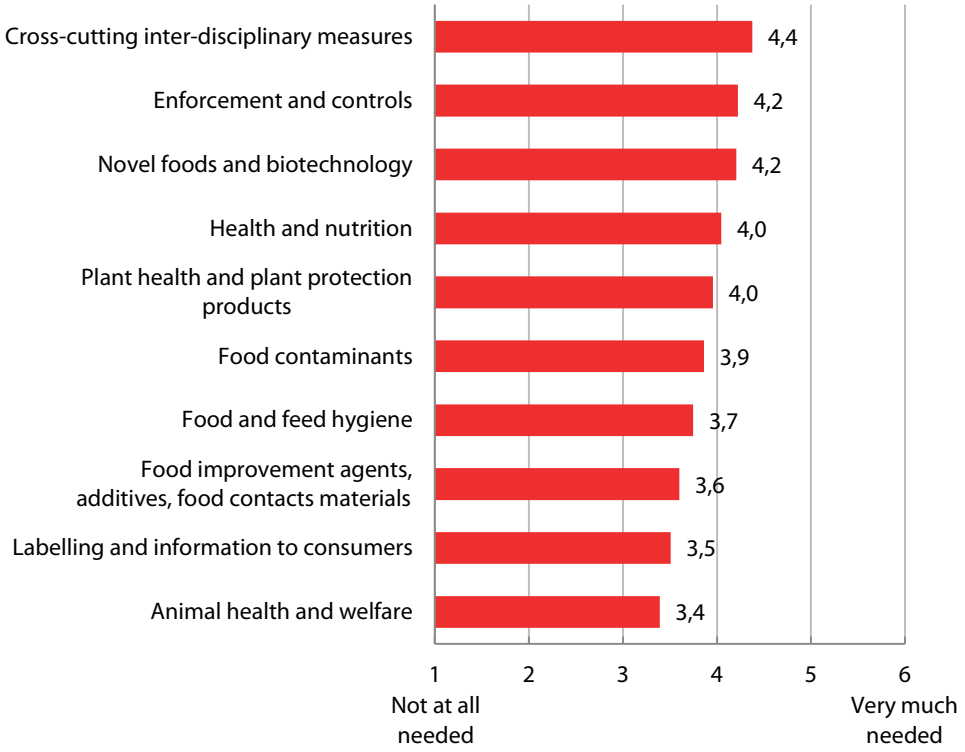
Main measures considered necessary	Comments
Research	Supporting research into novel foods or e.g. integrated pest management and agronomic methods that maximise use of available resources. *(Consumer organisation/NGO)*
	The possible lack of enough private investment in R&D should be compensated by public research at EU level. *(International organisation)*
	[Other areas of research include]: Research on recycling water, soil remediation and fortification, hydroponics and use of biotechnology, consumer behaviour. *(University/research organisation)*
	Research to develop alternative business models in the food industry would play a key role, to drastically reduce the dependency on resources. *(University/research organisation)*
Promoting international governance	This scenario demands efforts to re-establish international governance to tackle the common problems seen. *(Public authority)*
	Harmonization on quality and security between EU and extra-EU Countries. *(University/research organisation)*
	Global resource depletion is a global problem, therefore global action is necessary. *(Public authority)*
	WTO / FAO would benefit from governance of increasingly global food markets. *(University/research organisation)*
Economic incentives	Providing economic incentives for improving resource efficiency, changing consumption patterns and reducing food waste will be key to mitigating resource depletion. *(University/research organisation)*
	We need tax and subsidy incentives to promote production of healthy nutrition foods requiring low input of resources. *(University/research organisation)*
	Support sustainable production with subsidies, taxes on non-sustainable production systems, support research on sustainable production systems. *(University/research organisation)*
	Possible temporary measures could be taken to establish incentives for safe food, (which probably would be notably expensive) in order to allow the access to such food by wider parts of the population. *(International organisation)*
Education, awareness raising and training	Acting on supply and on demand together. The action on supply may have an impact more rapidly than that on the demand, because changing behaviours takes time. *(University/research organisation)*
	Education, raising awareness and improved governance in responsible use of natural resources is highly needed. *(International organisation)*
Institutional changes	Simplification of the framework needed for developing the conditions for proper water maintenance, food production and global cooperation. *(Food industry association/operator)*
Promoting self-regulation	Self-regulation given the economic interests of maintaining sufficient resource base is not realistic. *(University/research organisation)*
Mix of measures	All arsenals (legislation, non-legislation, incentive) will have to be used to avoid this catastrophe scenario. *(Other stakeholder)*

Source: Stakeholder survey, question 7.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 50: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 7.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, according to respondents, changes are considered necessary across nearly all policy areas in this scenario (on the basis of average assessments above the midpoint of 3.5). Nonetheless, changes in relation to cross-cutting interdisciplinary measures, novel foods and biotechnology, and enforcement and controls are considered slightly more needed, whereas changes in relation to animal health and welfare, and labelling and information to consumers are considered slightly less needed (but still considered more needed than not). This is broadly reflected by stakeholder comments, emphasising the need to improve enforcement and controls to address risks related to emerging threats particularly in relation to contaminants (due to the pressure on resources that forms the basis of this scenario), while also promoting inter-disciplinary research and stronger legislation not only to support innovation but also health and nutrition.

Table 33: Key comments of stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 7

Main area for which changes considered necessary	Comments
Cross-cutting measures	Interdisciplinary research to promote innovation in the food supply chain. (*University/research organisation)*
	Health and sustainable development must be part of trade and agricultural policies (and potentially other policies). (*University/research organisation)*
	More efficient systems with continuing effective legislation. Promote safety and confidence rather than novelty *(University/research organisation)*
	This scenario requires the research on novel and sustainable resources, on health, contaminants and respect of quality standards *(University/research organisation)*
	Treaties need strengthening to require EU to promote low input agriculture aiming to produce healthy nutritious foods. *(University/research organisation)*
Novel foods and biotechnology	Novel food and biotechnology legislation would have to adapt, be more effective in dealing with applications and offer simpler procedure for "lighter"/smaller company structures to deal with the administrative part of new developments. *(Food industry association/operator)*
	New foods and new processes will emerge as a result of this crisis. *(University/research organisation)*
	The demand for new or improved production methods, crops etc. will require appropriate legislation related to those areas. *(Public authority)*
Enforcement and controls	According to the scenario description, most of the health and nutrition problems originate at the first stages of production: at the farm, due to bad quality water and soil contaminants. The new situation would probably require new and more comprehensive protocols, regulation, controls on production. *(International organisation)*
	More attention is needed to actual enforcement of e.g. welfare measures to avoid fraudulent activity and to find ways to provide reliable/truthful information to the consumers. *(University/research organisation)*
	Need to protect trust in the food chain. *(Consumer organisation/NGO)*
Food contaminants	The environmental situation requires the contaminant legislation to closely follow the developments. *(Public authority)*
	As the scenario unfolds, greater controls in particular to detect food contaminants will be required. *(Other stakeholder)*
Health and nutrition	Health and nutrition will become the biggest challenge, lack of good food. *(University/research organisation)*
Labelling and information to consumers	Changes to labelling may be needed in order to face future resource depletion. This can be by agreeing on a common methodology to measure the carbon footprint or other. *(Food industry association/operator)*

Source: Stakeholder survey, question 7.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Participants stressed the need to have a more integrated approach by placing food safety in the context of the global food security, with food safety integrated with other policy frameworks e.g. CAP (first pillar: CMOs/price stability and second pillar: rural development measures), or environment policy. Emphasis on overall legislation and better international governance of key resources is required;
- The food safety and nutrition areas may gain from being considered separately. In particular, the current situation shows that nutritional issues exist in a rather secure food safety environment; therefore analysis of the appropriate policy responses may be improved if the two areas are considered separately in many cases.
- It was noted that in stakeholder comments too much emphasis was placed on the supply side and too little on the demand side. It was recognised that it is much more challenging to understand how consumers act and behave; it was also highlighted that more efforts should be dedicated to integrate cultural, ethical, social aspects into the regulatory framework (see research needs).
- It was noted that changes to the regulatory framework should place more emphasis on creating incentives for behaviour that improve food safety and nutrition rather than further increasing penalties.
- The food safety regulatory framework should further integrate consumers' behaviour and expectations, and should therefore put more emphasis on communication and education.
- One participant noted that many of the comments points suggested more regulation, as opposed to innovation to deal with the challenges described in the scenario.
- Participants highlighted that the food safety legislation, if linked to food security policy, should put more emphasis on creating raw material and food stocks to limit food price volatility.
- Some participants noted that social and ethical dimensions needed to be further integrated into the potential policy responses to the scenario, as opposed to technological solutions.

Future research

Finally stakeholders were asked on which research issues should be conducted to better understand the challenges posed by scenario 7, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted in relation to optimising resource efficiency and environmentally sustainable food production methods, in particular through an integrated 'farm to fork' approach that spans from resource use (energy; water; minerals) to dealing with waste, but also improving the environmental and public health risk assessment of current and new production methods, and promoting health, nutrition and diet objectives.

The table below presents key stakeholder comments regarding key issues for future research relating to this scenario.

Table 34: Key comments of stakeholders/experts regarding issues for future research under scenario 7

Main issue for research	Comments
Health and nutrition	How to promote a healthy diet, ensure food security [from a nutrition point of view]. *(University/research organisation)*
	Environment and health dimension of diets. Considering diets as a whole in the research process and not focusing studies on single food products. (*University/research organisation)*
Diseases and contaminants related to resource depletion	Research should focus on developing a capacity to detect in advance the systemic safety risks posed by the conjunction of pesticides, antibiotics and other contaminants of food, in order to prevent a crisis and have food systems change pathways rather than wait for a major safety crisis to occur. *(University/research organisation)*
	Increase research on diseases, plant and animal, epizootology, food contaminants. *(Independent expert)*
Renewable energy and resources; Resource efficiency	The main research focus should be developing integrated approaches to more efficient resource use in production systems (closing nutrient cycles, more efficient water use, maximizing nitrogen efficiency, no-till production systems, integrated soil management) while at the same time ensuring consumer safety and public health. A systematic analysis of food waste (e.g. not just placing responsibility on the consumer, but a systematic analysis of the key drivers) and using inedible food waste for soil improvement (closed nutrient cycles). In addition, predictive modelling to analyse how changes in consumption will affect demand for land and water resources and resource depletion. To complement this research into changing consumer behaviour (not just awareness building) including how taxes and financial instruments can be used to facilitate this change. *(University/research organisation)*
	Research should focus on 1) developing and supporting alternative systems based on drastically reduced dependency on resources, 2) analysing the barriers to transitions that keep the agri-food system in a locked in situation although it does not seem sustainable even from a purely economic point of view. *(University/research organisation)*
	Research on the future of energy sources; research on recycling resources and effective utilization (e.g. phosphorus). *(Public authority)*
	Research needed to develop alternative energies. *(Public authority)*
	Plants and systems of production wasting fewer resources. *(Other stakeholder)*
	Integrated production, waste reduction, collective management of resources and value chains. *(University/research organisation)*
	Research on sustainability and reduction of food waste, recycling. Research to increase productivity and yield, e.g. in terms of new varieties, nitrogen fixation. (*Public authority)*
	Developing water-sparing technologies; water preservation techniques in all areas of human activity. (International organisation)
	Biotechnology of crops resistant to poor soils. Food waste reduction and agricultural by-products utilisation. *(University/research organisation)*
	Research on environmentally sustainable food production methods. *(University/research organisation)*
	Research for sustainable development with low resource input. *(Public authority)*

Source: Stakeholder survey, question 7.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Research into the optimisation of resource usage was suggested; research could focus on how to adopt a more qualitative approach as opposed to focusing on increases in productivity;
- More research should be focused on the food prices facing the consumer as a result of resource depletion;
- Further research could investigate the balance between food security and food safety;
- Further investigation of the ethical and cultural dimensions of resource depletion was seen as needed, as opposed to the technical one;
- Finally, research to add flexibility to the current regulatory system was suggested.

4.8. Scenario 8: Global disruptions of agriculture from climate change

1. This scenario assumes global temperatures increase in line with high projections, precipitation patterns change drastically, and global agricultural productivity suffers major disruption as a consequence.
2. Key interrelationships in this scenario between the scenario driver (Climate change) and other drivers include: *Global economy and trade*: Increasing world fossil-fuel based economic growth was one of the key drivers of severe climate change, while the extreme weather patterns significantly affected trade patterns and therefore global food supplies/prices and their volatility. Protectionism and specific bilateral agreements aimed at safeguarding food supplies ('food nationalism') have gained in importance and thereby aggravated food scarcity in some parts of the world; and *Global cooperation and standards*: The international deadlock on global climate change policy was a key reason for the absence of any significant mitigation actions.
3. Stakeholders assert that this scenario could plausibly become reality already by 2040 (based on average values).[317]
4. Primary production, agricultural inputs, ingredients, restaurants/catering and trade are considered to be significantly impacted under this scenario. Plant health, animal health and welfare, health and nutrition, food contaminants and food/feed hygiene are the policy areas considered to most impacted as a result of the scenario. In addition, social stability, including equitable access to food, environmental sustainability and consumer choice, and innovation are considered to be most significantly impacted other areas under the scenario.
5. A wide range of suggested measures/courses of action are considered necessary to face the challenges posed by this scenario, with research coming top priority, followed by promoting international governance, as well as education, awareness and training, improving communication and legislation. These 'top-down' types of interventions are considered more necessary that 'bottom-up' approaches such as promoting self-regulation, which is seen as the least needed.
6. Changes are considered necessary across nearly all policy areas in this scenario. Nonetheless, changes in relation to cross-cutting interdisciplinary measures, novel foods and biotechnology, plant health, as well as enforcement and controls are considered slightly more needed, than in the other areas.
7. Stakeholders found that research needed to be conducted for the adaptation of the current agricultural production model, as well as diet and nutrition, towards more resilient systems, rather than mitigation strategies to reduce the impacts of the current systems.

4.8.1. Description of scenario

This scenario assumes global temperatures increase in line with high projections, precipitation patterns change drastically, and global agricultural productivity suffers major disruption as a consequence. The scenario explores the challenge of safeguarding food safety and nutrition under disruptive climatic conditions, affecting primary production, storage and transport of food in 2050.

[317] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

The world's fast growing economy, with its seemingly insatiable demand for energy, the continued dominance of fossil fuels, population growth, and importantly the lack of an international agreement on greenhouse gas emissions reduction led to a doubling of CO_2 emissions from energy use in 2050 compared to 2010 levels, the increase mostly originating from the major emerging economies. In 2050, in most countries energy is still largely sourced from fossil fuels, as renewable energy sources did not prove to be cost efficient due to a lack of appropriately designed incentives at the global level and the lower than expected fossil fuel prices due to new extraction technologies. Indeed, as a consequence of consistently diverging national interests and regional disputes, scant concrete climate change mitigation policy actions have been taken. Atmospheric concentration of greenhouse gases is now beyond 700 CO_2-equivalent parts per million. As a result, the world has warmed by 3 °C on average (compared to pre-industrial levels) and precipitation patterns have seen major changes across the globe. The combined effect of these has in turn led to considerable sea level rises and very frequent extreme weather events such as heat waves, droughts, and flooding, with drastic consequences, especially in terms of global agricultural productivity. While at higher latitudes crop productivity has increased slightly in some regions and decreased in others, depending on the crop, at lower latitudes, crop productivity has strongly decreased in all regions of the globe. Food security and agricultural incomes have been strongly impacted in many regions of Africa, Asia and Latin America, as well as on islands across the world (including overseas territories that have a special relationship with one of the EU Member States). In addition, the flooding, disease and in some regions even famine induced by climate change has displaced millions of people, many of whom depend on food aid, putting additional stress on those regions where agricultural productivity is still relatively unaffected.

In addition to changes in crop productivity, the warmer climate in Europe has also allowed new animal and plant diseases, pests and invasive alien species to regularly emerge, affecting food safety, while there has concurrently been a significant loss of biodiversity. The extreme weather patterns in turn have caused years of continual food price volatility, making food security of vulnerable populations in the EU more difficult to ensure. This has led to occasional food riots and social unrest, especially in the drought-affected southern Member States.

Looking back from 2050 to the world of today, forerunners of this future are…

- Global greenhouse gas (GHG) emissions doubled over the 1970-2005 period. Historically, OECD countries emitted the bulk of global GHG emissions, but the share of Brazil, Russia, India, Indonesia, China and South Africa in these increased to 40% by 2005, from 30% in the 1970s.[318]
- The emergence and spread of bluetongue in Europe, a vector-borne viral disease of ruminants, is considered to be associated with climatic trends, in particular its outbreak in northwest Europe in 2006, as recently explained by a climate-driven model in both space and time.[319]
- In 2010 global energy-related CO2 emissions reached an all-time high of 30.6 gigatonnes despite the economic downturn in the aftermath of the financial crises.[320]
- Historical statistical data indicate that six major crops have experienced significant climate-associated yield reductions of 40 million tonnes per year between 1981 and 2002 at the global level, but these losses have been out-stripped by technological improvements.[321]
- Estimates from 2009 indicated that 19% of habitats and 12% of species of European interest are potentially threatened by climate change in regions where they are naturally present.[322]

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (Climate change) and the other drivers identified.

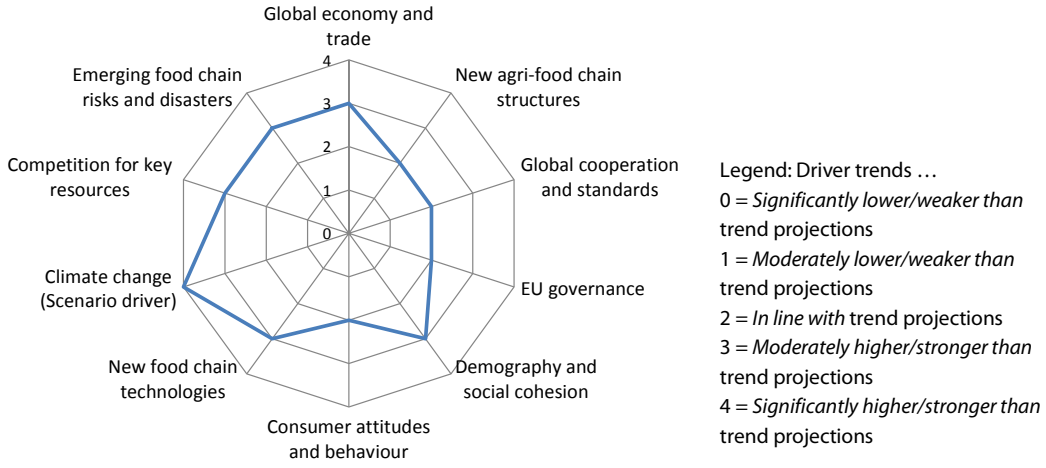
[318] Marchal, Virginie, Rob Dellink, Detlef van Vuuren, Christa Clapp, Jean Château, Eliza Lanzi, Bertrand Magné, and Jasper van Vliet, OECD Environmental Outlook to 2050 Chapter 3: Climate Change, 2011.p.10.

[319] Guis H, Caminade C, Calvete C, Morse AP, Tran A, et al., Modelling the effects of past and future climate on the risk of Bluetongue emergence in Europe, J R Soc Interface 9: 339–35010.1098/rsif.2011.0255, 2012.
Marchal, Virginie, Rob Dellink, Detlef van Vuuren, Christa Clapp, Jean Château, Eliza Lanzi, Bertrand Magné, and Jasper van Vliet, OECD Environmental Outlook to 2050 Chapter 3: Climate Change, 2011.p.5.

[321] Vermeulen, Sonja J., Bruce M. Campbell, and John S.I. Ingram, "Climate Change and Food Systems," Annual Review of Environment and Resources, Vol. 37, No. 1, November 21, 2012, pp. 195–222. http://www.annualreviews.org/doi/abs/10.1146/annurev-environ-020411-130608.p.203.

[322] European Environment Agency, Climate Change, Impacts and Vulnerability in Europe 2012, 2012.p.127.

Figure 51: Scenario diagram for scenario 8



The following points describe in further detail the nature of the interrelationships identified.

- *Global economy and trade*: Increasing world fossil-fuel based economic growth was one of the key drivers of severe climate change, while the extreme weather patterns significantly affected trade patterns and therefore global food supplies/prices and their volatility. Protectionism and specific bilateral agreements aimed at safeguarding food supplies ('food nationalism') have gained in importance and thereby aggravated food scarcity in some parts of the world.
- *Global cooperation and standards*: The international deadlock on global climate change policy was a key reason for the absence of any significant mitigation actions.
- *Competition for key resources:* The high energy demand from emerging economies has increased the use of still comparatively cheap fossil fuels across the globe, significantly contributing to GHG emissions. At the same time, most developed economies have not succeeded in reducing their energy consumption, and per-capita consumption is still highest in the US.
- *New food chain technologies:* The disruptive effects of climate change on agriculture have strongly induced many producers to resort to adaptive technologies, including drought-resistant genetically modified crops.
- *Emerging food chain risks and disasters:* The highly frequent and magnified climatic extremes, as well as higher temperatures, have led to a high incidence of movement and emergence of animal and plant diseases, pest outbreaks and invasive alien species in the EU.
- *Demography and social cohesion:* The large-scale flooding, disease and famine caused by climate change have induced migrations to less affected areas; this, and increased food volatility due to extreme weather patterns, have increased social unrest in the EU.
- *Consumer attitudes and behaviour:* A largely meat-based diet and the consumption of other foods with a high carbon footprint by a significant proportion of EU consumers and around the globe (including in emerging economies), contributed significantly to climate change.

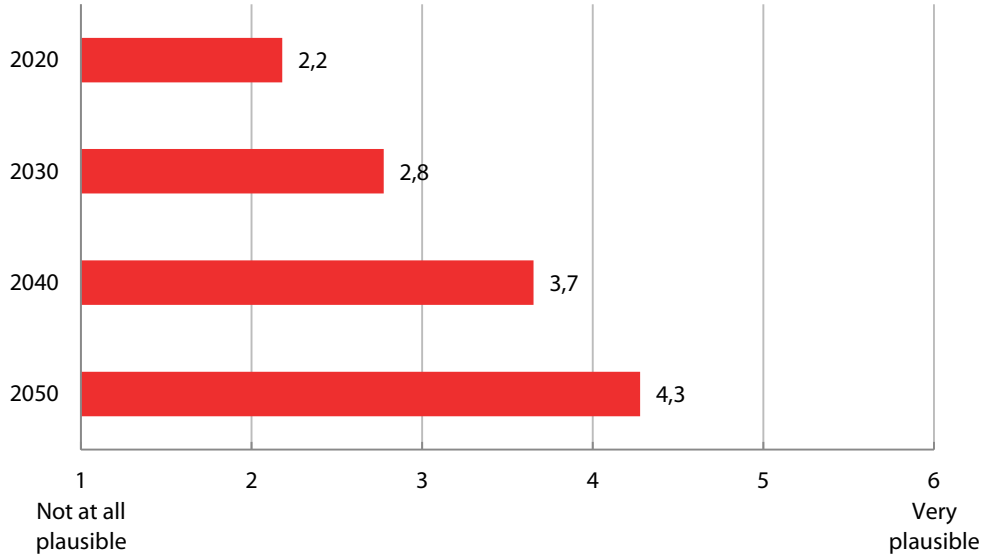
Other drivers not listed here were considered to develop in line with current trends and projections.

4.8.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 52: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 8.1.

As indicated in the graph, respondents find that it is increasingly likely for the scenario to become reality in later decades. Stakeholders assert that this scenario could plausibly become reality by 2040, on the basis of the average assessment of plausibility for this year being higher than the midpoint (3.5).

Stakeholder comments for this question broadly reflected this assessment, with a number of comments indicating that the scenario was found plausible in light of current and past trends, e.g. the continuation of extreme climatic events which are already visible, the development of industries, and the failure to address climate change at international level. Other comments indicated that while most elements of the scenario were considered plausible, there was less certainty regarding the time needed to reach the dramatic situation depicted in Scenario 8, or that by then mitigation measures would have been implemented. Finally a minority of stakeholders did not find the scenario plausible, arguing climate change has proved in the past to develop less rapidly than forecasted.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 35: Key comments of stakeholders/experts regarding plausibility of scenario 8

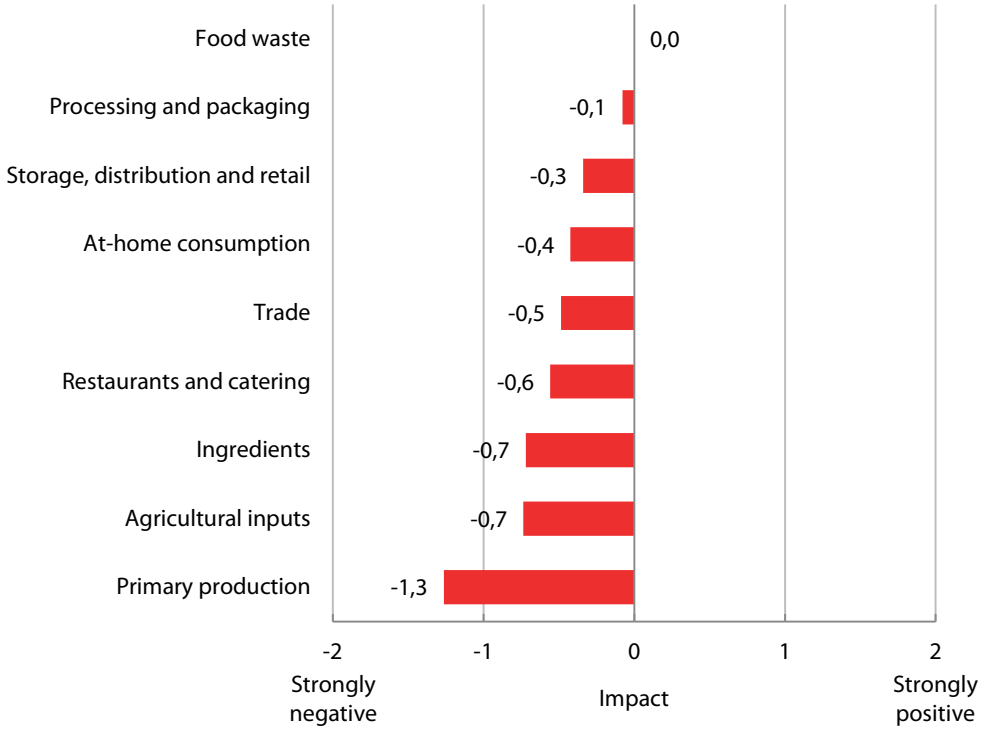
Judgement	Comments
Scenario plausible	Many of these climate events are already happening and affecting food production. *(University/research organisation)*
	It is happening, probably because of mankind's exploding ecological footprint. *(University/research organisation)*
	Severe global warming by 2050 now seems unavoidable, and its consequences for food production will be enormous. *(University/research organisation)*
	Over the coming years, we expect an increasing development of the industry, and therefore increased emissions of greenhouse gases, which remains a very long time in the atmosphere. *(Other stakeholder)*
	The scenario is plausible in the mid-term but unlikely before 2020. Climate change is not being taken seriously. The only part of the above scenario that I do not agree with is the lack of development of renewable energy - I think this will develop and will be cost effective. However, the climate change effects will still be seen - it would require a massive shift NOW to halt the effects of climate change. *(Food industry association/operator)*
	Severe disruption of agriculture and food production due to climate change is very plausible in the midterm and even more probable in the long term as increasing population and income in LMICs will drive increased demand for food. Increasing average temperature will change production patterns, and is likely to impact hardest on the Southern hemisphere and low income countries. Increased price volatility, regional food shortages and resource constraints will likely lead to increasing level of conflict further disrupting both primary production and trade patterns. *(University/research organisation)*
	The majority of research and indicators suggest this is a very likely scenario. *(University/research organisation)*
Plausible in the long term	More plausible circa 2100. *(Independent expert)*
	A plausible long term change. *(University/research organisation)*
	Climate change is a very long term trend. *(Other stakeholderer)*
Scenario not plausible	Climate change will not be so dramatic and in addition agricultural productivity will be increased by research. *(University/research organisation)*
	As you have assumed the high projections then the probability is lower. Some of the predictions are not very plausible. *(University/research organisation)*
Others	Timing for impact of the scenario depends upon the time it takes for governments to take mitigation and prevention actions. *(Food industry association/operator)*
	Efforts made by the international organizations and their members' governments may slow down the increase of CO_2 emissions which may reduce the risk of this happening. *(Public authority)*
	At the medium term, climate changes may appear, but solutions (e.g. resistant and robust animals and plants, new technological means to manage changing situations) will be found through science and positive entrepreneurships. *(Food industry association/operator)*
	There are many scientific opinions with different views; it is still unclear if global warming is a dramatic issue as it is promoted in the press. Nevertheless precautions need to be thought about. *(Public authority)*

Source: Stakeholder survey question 8.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 53: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 8.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

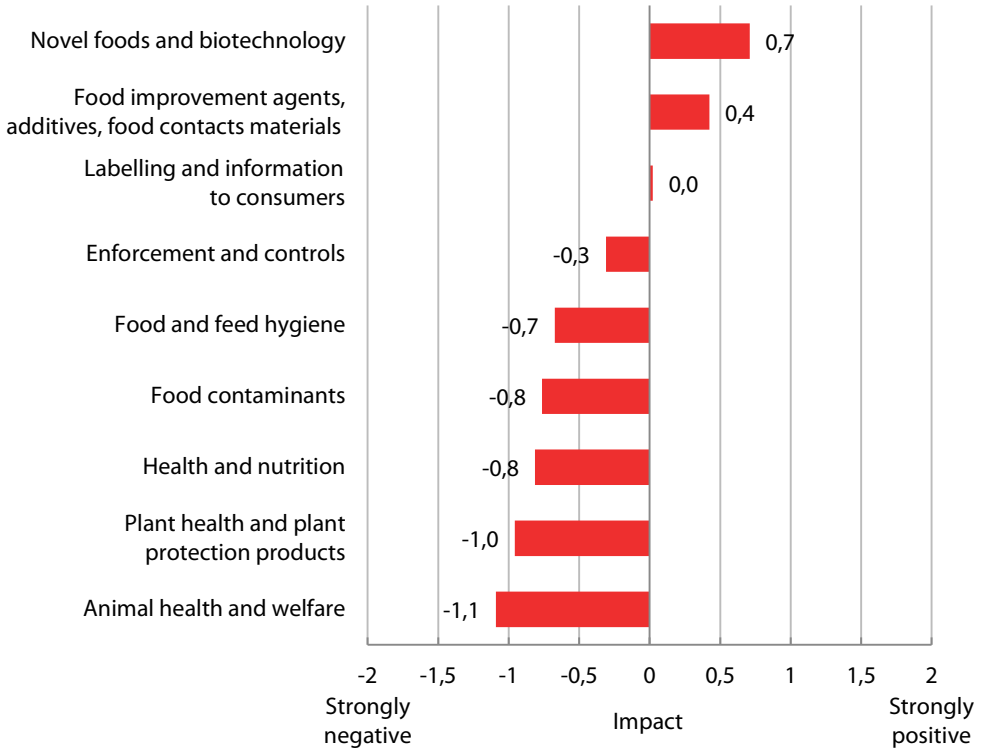
As shown above, according to respondents, all food chain activities are considered to be impacted negatively as a result of the scenario, with primary production, agricultural inputs, ingredients, restaurants/catering and trade most negatively impacted. This is reflected in stakeholder comments, in which several stakeholders indicated that primary production, agricultural inputs and ingredients would need to adapt to the consequences of a dramatic climate change. Other negatively impacted areas cited by stakeholders included all downstream stages of the food supply chain, e.g. restaurants and catering, trade, at-home consumption and storage, distribution and retail.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments

for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 54: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 8.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

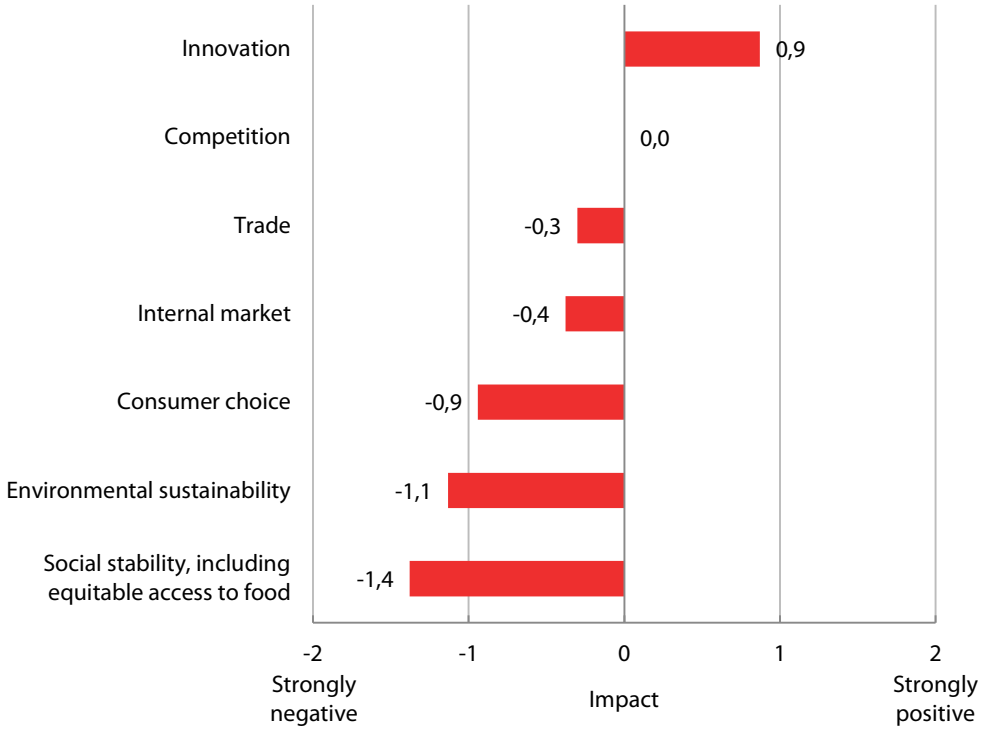
As shown in the graph, only novel foods and biotechnology, as well as food improvement agents, additives and food contact materials are considered to be positively impacted as a result of this scenario. All other policy areas are considered to be negatively impacted, with plant health, animal health and welfare, health and nutrition, food contaminants and food/feed hygiene the most negatively impacted. This is reflected in stakeholder comments, which emphasised the likely development of new harmful organisms to animals and plants as a result notably of the temperature increase. Food contaminants and food and feed hygiene would also be negatively impacted due to increasing pressure put on scare resources and possible fraudulent activities. Comments further indicated that in such a context, enforcement and controls would become essential albeit increasingly difficult.

Several stakeholders finally noted that sectors such as novel foods and biotechnology or food improvement agents may be positively impacted and promoted to develop new solutions in order to adapt and/or to mitigate the impacts of climate change.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other key areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 55: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



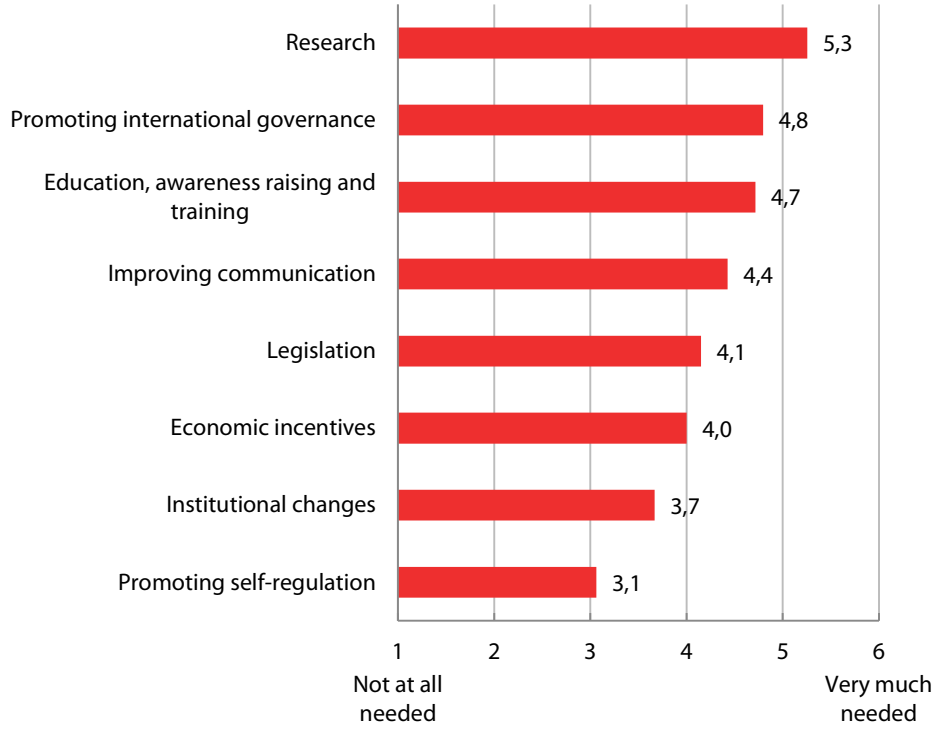
Source: Civic Consulting, based on stakeholder survey, question 8.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, and consistently with previous responses, only innovation is considered to be positively (and significantly) impacted by this scenario. On the other hand, social stability, including equitable access to food, environmental sustainability and consumer choice are considered to be most significantly negatively impacted. This is reflected in stakeholder comments, in that most stakeholders foresee broadly negative impacts in terms of social stability due to disruption or shortages in food supplies. As previously seen, in a resource-constrained world, little attention would be given to environmental sustainability while protectionist measures are likely to be implemented, thereby hindering trade. There was broad agreement among most stakeholders that consumer choice would be negatively impacted as a result of disruptions in food production and trade, in particular as regards access to healthy foods. Another point highlighted by stakeholders included the expected development of innovative technologies and sustainable solutions to adapt to climate change.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 56: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 8.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, a wide range of suggested measures/courses of action are considered necessary to face the challenges posed by this scenario, with research coming top priority, followed by promoting international governance, as well as education, awareness and training, improving communication and legislation. These 'top-down' types of interventions are considered more necessary that 'bottom-up' approaches such as promoting self-regulation, which is seen as the least needed. This is reflected by stakeholder comments, which indicated a greater need for research, and improved communication, education, awareness raising and training. Further to this, emphasis was made by stakeholders on 'top-down' measures included the need for promoting international governance and to legislate, offering e.g. economic incentives, to promote sustainable practices along the food chain, highlighting in this regard the lack of power or awareness of consumers.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 36: Key comments of stakeholders/experts regarding measures considered necessary under scenario 8

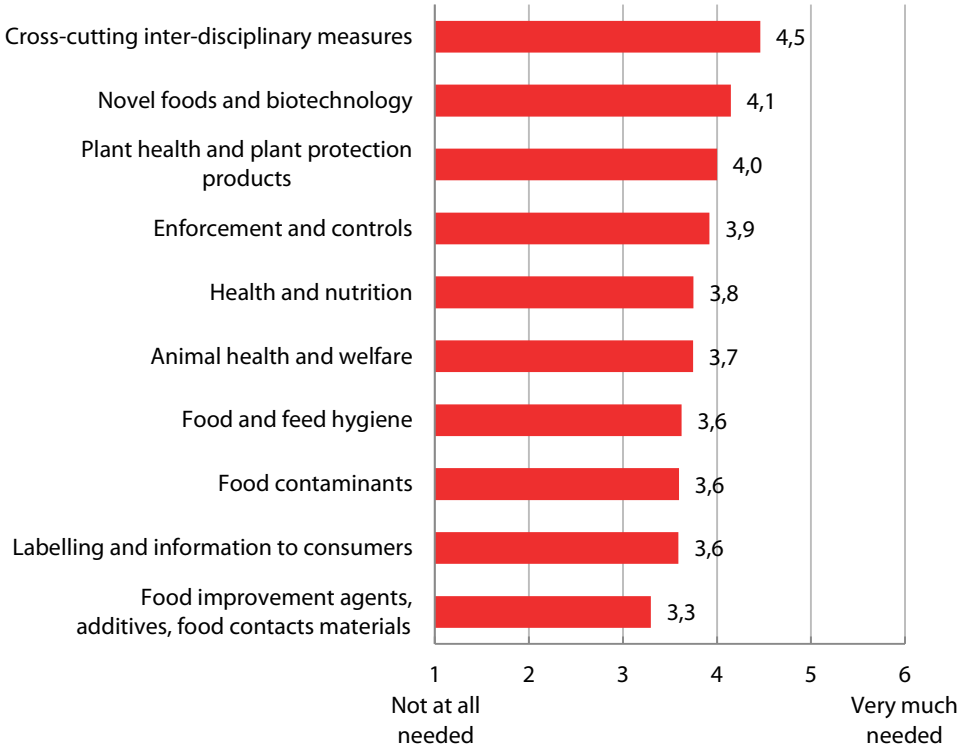
Main measures considered necessary	Comments
Research	If this happens research will need to examine the new realities of nature, new conditions for the production of various foods. *(Independent expert)*
	Research on the interaction between weather/yields and disease. New ways of growing fresh produce. Cooperation in trade and stockpiling. *(University/research organisation)*
	Research about effect of climate change on agriculture, agricultural methods and on food safety. *(University/research organisation)*
	For still unknown threats, a quick reaction in terms of investigation should be a priority. *(International organisation)*
Economic incentives	Averting this scenario will require economic incentives to change production and consumption towards more sustainable methods and patterns. *(University/research organisation)*
Education, awareness raising and training; Improving communication	Communication and awareness raising is where the EU could have maximum impact. *(Food industry association/operator)*
	It is necessary to prescribe the permissible levels of contaminants in food that has not yet been covered and thus require constant education on emerging risks. *(Other stakeholder)*
Improving communication	Communication channels among all implicated operators (producers, the food chemical industry, traceability, retailers, local, national and supranational authorities etc.) should share common news, communication and alert network. *(International organisation)*
Promoting international governance	Collaboration among EU Member States and between the EU and other countries would be a must. *(International organisation)*
	International governance, given climate changes international perspective will be essential for providing solutions to ensure equitable access to food and resources under this scenario (Self-regulation will not be sufficient). *(Food industry association/operator)*
	An international and world institution is needed to address this issue. *(Other stakeholder)*
Legislation	A closer collaboration among countries and agents, the controls at external frontiers of the EU, import requirements, etc. would need an improved and upgraded legal framework. *(International organisation)*
	Legislation is necessary but should not become so complex as to stifle innovation and market growth. *(Food industry association/operator)*
	Farming should be brought into the European carbon trading system, to incentivise them towards more environmental-friendly and healthier agriculture. *(University/research organisation)*
	The consumers have limited power to mitigate the climate change, if companies are not forced into action. *(University/research organisation)*

Source: Stakeholder survey, question 1.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 57: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 8.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, according to respondents, changes are considered necessary across nearly all policy areas in this scenario (on the basis of average assessments above the midpoint of 3.5). Nonetheless, changes in relation to cross-cutting interdisciplinary measures, novel foods and biotechnology, plant health, as well as enforcement and controls are considered slightly more needed, whereas changes in relation to health and nutrition, food/feed hygiene, food contaminants, and labelling and information to consumers are considered less needed (but still considered more needed than not). This is broadly reflected by stakeholder comments, emphasising the need to improve cross-cutting and integrating policy responses (e.g. by considering jointly environmental, agricultural, trade and food safety policies, and how these impact one another), enforcement and controls to address also risks related to emerging threats (as climate change is expected to generate new animal health, plant health and contaminants issues), while also promoting stronger legislation not only to support innovation, but also health and nutrition for the wider population and equitable access to food.

Table 37: Key comments of stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 8

Main area for which changes considered necessary	Comments
Cross-cutting measures	Cross-cutting approach to carbon use reduction, including in agriculture. *(University/research organisation)*
	Agriculture should no longer be excluded from carbon trading. *(University/research organisation)*
	Environmental and food safety policies should be considered together, how they impact each other. *(University/research organisation)*
	We can only prevent this scenario if international agreement on environmental and sustainable development measures is achieved; we need to be aware of potential negative impacts by bi-lateral and regional trade agreements. *(Other stakeholder)*
Novel foods and biotechnology;	Novel food and biotechnology legislation would have to adapt, be more effective in dealing with applications and offer simpler procedure for "lighter"/smaller company structures to deal with the administrative part of new developments. Production of safe and nutritious food in sufficient quantities will be the main challenge under this scenario. For that, EU agriculture policy should be geared towards increased productivity. Limiting factors and constraints on the farming sector would need to be lifted and where deemed necessary, agricultural production should be supported. *(Food industry association/operator)*
	The scenario will probably lead to innovations in primary production which need to be captured in legislation and regulated. *(University/research organisation)*
	Research into biotech novel foods which provide pest/disease/drought resistance to cope with climate change consequences. *(Other stakeholder)*
Enforcement and controls	The response to the crisis that climate change could cause […] would only be possible with flexible mechanisms for intervention, control, enforcement and international collaboration. The worse the [threat], the stronger the remedy must be. *(International organisation)*
Food and feed hygiene	Greater awareness of impact on food and feed hygiene to deal with appearance of lesser known/unknown pathogens and evolving legislation to take into account emerging risks. (Other stakeholder)
Emerging risks	This scenario will require rethinking the policy framework to deal with the challenges that it will create in animal health and welfare, plant health and preventing the emergence of new "pests". *(University/research organisation)*
	There will also be a need to handle new diseases and alien species. (*Public authority)*
Food contaminants	It is necessary to strictly prescribe the permissible level of contaminants that could arise as a result of climate change. *(Other stakeholder)*
Health and nutrition	We need novel foods and alternatives in nutrition to become more resilient for crises. *(University/research organisation)*
	[…] Pressure on public health systems, impacts on population nutrition and inequitable access to food will require new method, policies and financial instruments. *(University/research organisation)*

Source: Stakeholder survey, question 8.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Participants noted that greater consideration of extreme weather situations may be needed in the policy response to the scenario, including policies to adapt to the extreme weather situations. Increased biodiversity may also allow for greater scope for dealing with unpredictable weather changes.
- More emphasis may need to be put on forward- rather than backward-looking policy actions i.e. aimed more at adaptation than prevention.
- Some participants mentioned that the scenario elicits the need for more incentive systems (e.g. carbon trading scheme provides incentives to change dietary habits).
- In general, it was noted that more resilient and diverse systems are needed to deal with adverse and unpredictable climate change effects.

Future research

Finally stakeholders were asked on which research issues should be conducted to better understand the challenges posed by scenario 8, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, several found that research needed to be conducted for the adaptation of the current agricultural production model, as well as diet and nutrition, towards more resilient systems, rather than mitigation strategies to reduce the impacts of the current systems. Such research would be in relation to environmentally sustainable food production methods that deliver healthier food choices for the general population, and – related to this - improving the environmental and public health risk assessment of current and new production methods, to promote health, nutrition and diet objectives.

The table below presents key stakeholder comments regarding key issues for future research relating to this scenario.

Table 38: Key comments of stakeholders/experts regarding issues for future research under scenario 8

Main issue for research	Comments
Production systems	Work is required on how climate change will affect crops in EU. Which regions will grow new crops needs understanding. Will tropical crops be able to grow in EU? What happens to previous tropical countries? How will poor quality food affect the population of EU? How bad will climate change be for southern EU states? *(University/research organisation)*
	Drought resistance, heat tolerance. *(University/research organisation)*
	New methods of primary production/weather control/ prediction/ novel processing and preservation techniques. *(University/research organisation)*
	Development of a holistic view of the interrelation of drivers of change (including climate, social behaviour, trade etc.) on food security and food safety. Developing prediction model for such analysis. *(University/research organisation)*
	Agro-ecology and human ecology frameworks for research to examine how food systems can move towards sufficiency instead of the current paradigm of producing more to feed a growing population. Current investment in research is skewed towards biotech and gene modification, and has shown little promise compared to traditional breeding practices. Research efforts should focus on primary production's potential to have a positive balance on GHG emissions. This will require going beyond the current modelling tendency of forecasting i.e. extrapolating current trends into the future, towards systems based analysis, modelling changes in consumption together with models for changing production systems including economic incentives and predictive modelling. *(University/research organisation)*
Health and nutrition	Need to understand what a future climate-proof food system for Europe might look like - less meat production more whole grains and fruit and vegetables - to conserve resources and what would be the economic and health benefit of the different possibilities. *(Consumer organisation/NGO)*
	Need a more resilient food chain use of GMO, identify diets that are sustainable even in crises while being healthy and nutritious *(University/research organisation)*
	Research on plant health and plant protection is essential to mitigate the effects of climate change on available nutrients. Consumers will need to decrease their consumption of animal protein - there will be extreme pressure on animal feed. (*Food industry association/operator)*
Diseases & Contaminants	Outbreak investigations of emerging diseases, selection of seeds/animals resistant to emerging diseases. *(University/research organisation)*
	It is necessary to base research on monitoring temperature through the next period, and the incidence of certain contaminants. *(Other stakeholder)*
	The main priority is the collection and analysis of data showing the evolving effects of climate change. This includes continued efforts such as those carried out by OIE with regularly updated disease distribution maps for animal health. Similar exercises in emerging contaminants/pathogens in the food supply chain. *(Other stakeholder)*
Resource efficiency	Making better and full use of the food around the world; minimizing food waste. *(University/research organisation)*
	Research and identification of economically viable and preferred alternatives for clean energy *(Food industry association/operator)*

Source: Stakeholder survey, question 8.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Research into communication policy regarding the impacts of climate change should be furthered;
- Investigation should be undertaken regarding how the research activities outlined by stakeholders will be performed (e.g. role of public research vs private research, level of Private-Public Partnership, etc.)

4.9. Scenario 9: Breakdown in consumer trust in food following the emergence of food chain risks

1. This scenario assumes a major loss in consumer trust in 2050 following the emergence of food risks, such as broad-scale antimicrobial resistance and outbreaks of a zoonotic disease owing to a highly resistant pathogen.
2. Key interrelationships in this scenario between the scenario driver (Emerging food chain risks and disasters) and other drivers include: *Consumer attitudes and behaviour*: As a result of the food scares and zoonotic disease outbreaks, consumer trust in food and in public authorities' ability to handle food risks has strongly decreased; and *Global cooperation and standards*: A lack of an effective long-term global strategy against antimicrobial resistance contributed to the emergence of the resistant pathogen. However, existing global cooperation mechanisms facilitated support in e.g. disease diagnostics once the outbreaks occurred and in preventing the spread of the disease beyond the EU.
3. Stakeholders assert that this scenario could plausibly become reality already by 2040 (based on average values).[323]
4. Trade, primary production, restaurants/catering, ingredients and agricultural inputs are the food chain activities considered most impacted as a result of the scenario. Enforcement and controls, animal health and welfare, and health and nutrition are the policy areas considered to be most notably impacted. In addition, social stability, trade and consumer choice are considered significantly impacted.
5. A wide range of suggested measures/courses of action are considered necessary to face the challenges posed by this scenario, with research coming top priority, followed by improving communication, promoting international governance, as well as education, awareness and training, and legislation.
6. Changes are considered necessary across all policy areas in this scenario. In particular, changes in relation to enforcement and controls, animal health and welfare, food/feed hygiene, cross-cutting interdisciplinary measures, health and nutrition, labelling and information to consumers, food contaminants and plant health are considered most needed.
7. Stakeholders found that research needed to be conducted in relation to emerging risks/diseases (e.g. pathogen development and survival; control strategies), transmission/prevention of antimicrobial resistance (AMR) in the food chain and from animals to humans, and other factors affecting AMR patterns in the wider environment.

4.9.1. Description of scenario

This scenario assumes a major loss in consumer trust in 2050 following the emergence of food risks, such as broad-scale antimicrobial resistance and outbreaks of a relevant zoonotic disease. The scenario explores the challenge of ensuring veterinary health and food safety under these circumstances, effectively communicating to the public in a situation of panic, and addressing a resulting loss in consumer trust in complex food chains.

[323] All assessments quoted in this section are on the basis of average values, as stakeholders were asked to provide their assessment either on a scale of -2 to +2 (when assessing impacts on various areas in a scenario) or on a scale of 1 to 6 (when assessing the extent to which measures/courses of action or changes to the EU food safety and nutrition framework are necessary in a scenario).

In the 2020s and 2030s, while some continued to warn against the potentially disastrous consequences of antimicrobial resistance in pathogens, their calls did not lead to effective preventive measures, neither in the EU nor globally. Due to (mis)use of antimicrobials in livestock production, overuse by consumers and their doctors, pollution of the environment by residues, and other factors, broad-scale antimicrobial resistance developed, leading to the spread of resistant pathogens.

When outbreaks of an emerging, infectious zoonotic disease occurred in the EU owing to a highly resistant pathogen, they spread quickly throughout the EU. Diagnostic capacities of leading labs were quickly overwhelmed. Emergency response mechanisms were stretched to their limits and partly proved to be insufficient. The spread of the disease was strongly facilitated by the highly integrated nature of the EU food chain in 2050, frequent and large-scale live animal transports across Member States' borders and the ever increasing mobility of EU citizens, with the rate of travel between Member States having tripled since the turn of the century. Its impact on human health was further aggravated by the vulnerability of the aging EU population: the most affected population groups were the elderly and infants. While many Member States experienced outbreaks, some nonetheless managed to confine them within national borders thanks to effective, sometimes drastic control measures. In addition to the direct public health consequences, secondary effects of the disease on the supply of sufficient and safe food to EU consumers and on consumer trust in the food chain, proved to be very challenging. Following the outbreaks, many consumers have lost their trust in the control and response mechanisms in place, and of the safety of their food in general.

Looking back from 2050 to the world of today, forerunners of this future are…

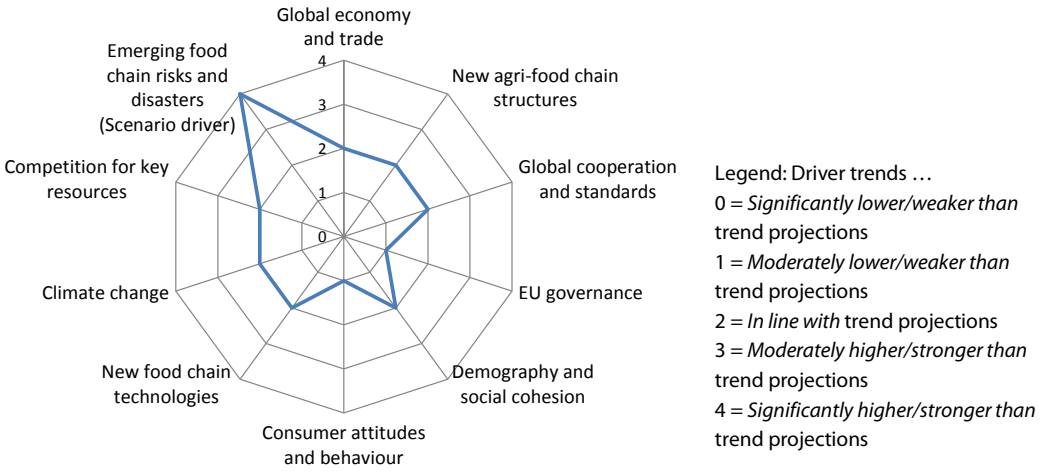
- From 2005 to 2010, according to an EU survey, Europeans have become increasingly worried about a range of food-related risks, in particular chemical residues from pesticides, antibiotics, and pollutants like mercury and dioxins.[324]
- A majority of EU survey respondents in 2010 did not feel confident in dealing with possible risks from animal infections or diseases which could be transmitted to humans (52%) or possible problems of chemical contamination (>60%).[325]
- Despite this, a majority of EU survey respondents considered that possible risks from animal infections and bacterial contamination and to health from particular diets are being adequately dealt with by public authorities in the EU.[326]
- Over two thirds of all human infectious diseases have their origins in animals,[327] and the rate with which these diseases have appeared has increased over the past 40 years.
- The prevalence in the EU of campylobacteriosis, a zoonotic disease, has significantly increased since 2006.[328]

[324] European Commission, Special Eurobarometer 354 - Food-related Risks, 2010.p.23.
[325] Ibid.
[326] Ibid.
[327] IDS, Zoonoses – From Panic to Planning, Rapid Response briefing, Institute of Development Studies, 2013.
[328] EFSA, *EFSA in focus FOOD*, European Food Safety Authority, Issue 10, September 2012.

Interrelationships with other drivers under this scenario

The scenario diagram below presents the key interrelationships between the scenario driver (Emerging food chain risks and disasters) and the other drivers identified.

Figure 58: Scenario diagram for scenario 9



The following points describe in further detail the nature of the interrelationships identified.

- *Consumer attitudes and behaviour*: As a result of the food scares and zoonotic disease outbreaks, consumer trust in food and in public authorities' ability to handle food risks has strongly decreased.
- *Global cooperation and standards*: A lack of an effective long-term global strategy against antimicrobial resistance contributed to the emergence of the resistant pathogen. However, existing global cooperation mechanisms facilitated support in e.g. disease diagnostics once the outbreaks occurred and in preventing the spread of the disease beyond the EU.
- *EU governance*: Existing EU response mechanisms and communication channels proved partly insufficient to contain the outbreaks quickly enough and keep consumer trust at bay.
- *Global economy and trade:* The food scares and zoonotic outbreak led to a halt of trade in food and feed between the EU and the rest of the world, with the ensuing consequences on EU food operators and the broader economy.

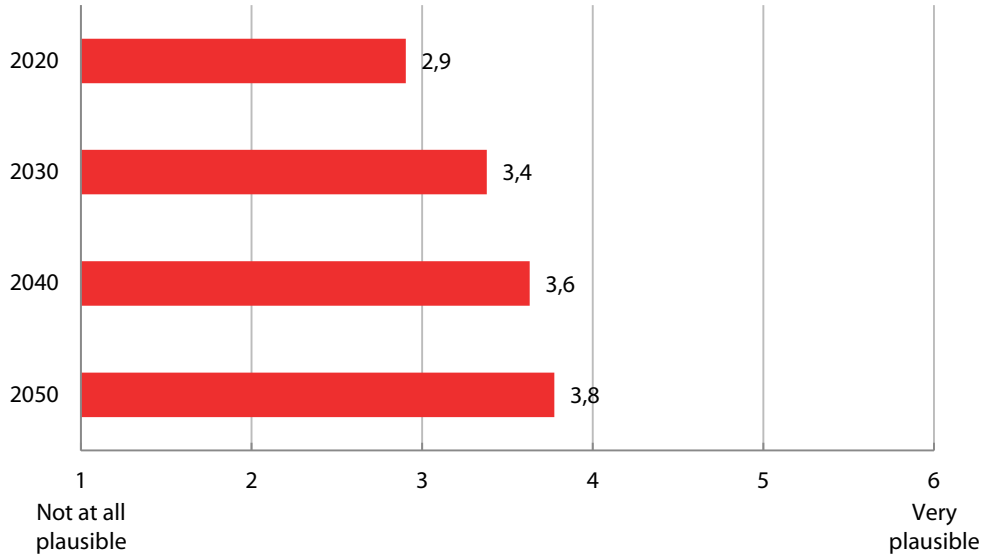
Other drivers not listed here were considered to develop in line with current trends and projections.

4.9.2. Assessment of stakeholders/experts

Plausibility of scenario

Stakeholders were asked to provide their views as to the extent to which this scenario could plausibly occur within various timeframes (by 2020, 2030, 2040 or 2050) on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe.

Figure 59: 'When could this scenario plausibly become reality?'
(Average assessment of stakeholders on a scale of 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 9.1.

As indicated in the graph, respondents find that it is increasingly likely for the scenario to become reality in later decades. Stakeholders assert that this scenario could plausibly become reality already by 2040, on the basis of the average assessment of plausibility for this year being higher than the midpoint (3.5).

Stakeholder comments for this question broadly reflected this assessment, with a number of comments indicating that the scenario was found plausible in light of current and past trends, e.g. the increase in antimicrobial resistance in both food producing animals and humans, the adaptation patterns of pathogens as microorganisms/viruses are constantly developing and the emergence of 'superbugs' such as MRSA and ESBL,[329] and the continuing misuse of antibiotics both in veterinary and human medicine around the world, while sustaining the effectiveness of current antimicrobials remains a key challenge as there are no new developments in this field. Other comments indicated that while most elements of the scenario were considered plausible, there was less certainty regarding the extent to which mitigation measures taken by governments and the industry to enforce responsible use of antibiotics in intensive livestock production systems could limit the spread of antimicrobial resistance and slow down occurrence

[329] Methicillin resistant Staphylococcus aureus (MRSA) and Extended-spectrum β-lactamase (ESBL)

of this scenario. At the same time, it was noted that significant adaptation of current production practices would be needed to prevent altogether this scenario from occurring.

The table below presents key comments from survey respondents regarding the plausibility of this scenario.

Table 39: Key comments of stakeholders/experts regarding plausibility of scenario 9

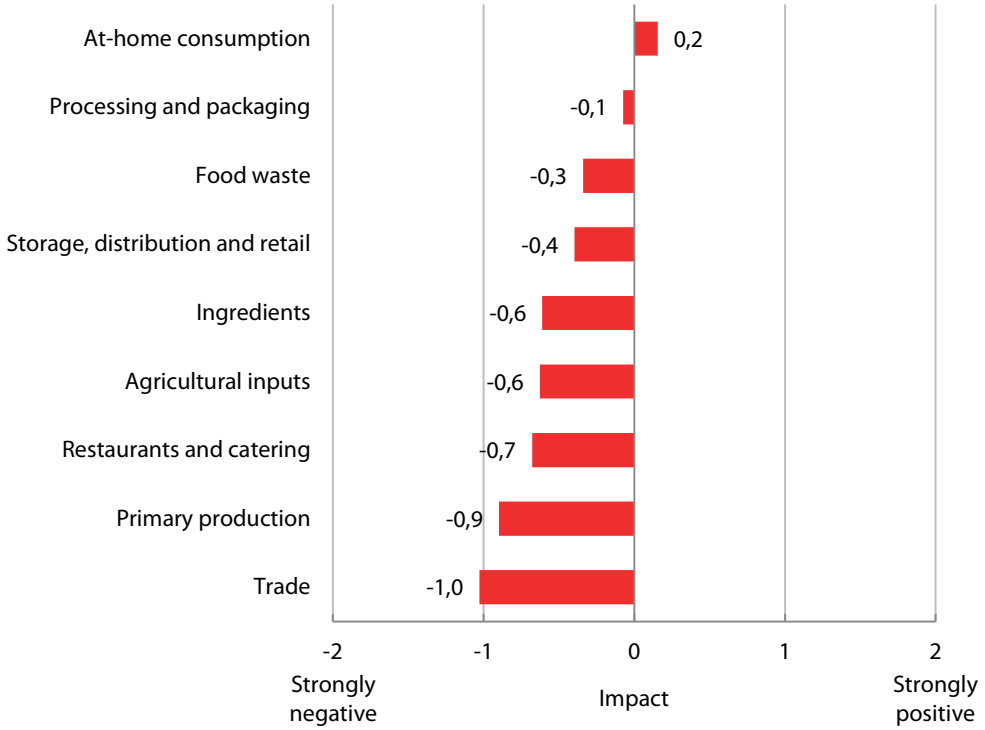
Judgement	Comments
Plausible scenario based on current and past trends	An increase in antimicrobial resistance is indeed happening and there appears to be little awareness of that. In addition, as the amount of antibiotics and other chemicals accumulate in the environment and promote resistance transfer, the number of new antibiotics available is decreasing. It is possible that, if nothing happens in the meantime, this scenario will hold true. *(University/research organisation)*
	This is already under way, with antibiotic bacteria entering the food chain (ESBL is 50% amongst broilers). *(University/research organisation)*
	The development of broad-scale antimicrobial resistance is a fact and it will be one of the biggest challenges within the next 20 years. *(Public authority)*
	The development of broad-scale antimicrobial resistance is accelerating because significant reduction of use of antibiotics will not be achieved. *(Public authority)*
	Given the amount and pace of likewise worrisome developments on European and global scale, we fear this scenario is very likely to happen in 2050. *(Consumer organisation/NGO)*
	If indiscriminate use of antimicrobials continues all over the world we are bound to see more and more resistance. *(University/research organisation)*
	Over time this scenario becomes more plausible, more so because medical professionals and their patients continue to resort too easily to antibiotics, adding to the risk of resistant pathogens. *(Food industry association/operator)*
	A scenario which is definitely plausible - antimicrobial resistance is already being seen and illegal prophylactic use of antibiotics continues. As more intensive farming becomes important to feed the world (aquaculture, poultry farming) the widespread use of antibiotics to avoid disease in animals/fish kept in small spaces will be necessary. In addition, globalisation means that disease can spread more quickly. *(Other stakeholder)*
Scenario plausible except for some elements, which may not occur, or take longer than indicated	This scenario is very plausible in the short term given current trends in antimicrobial use in animal production, increasing length of pipeline for developing antimicrobials and lack of financial incentive for medicinal industry to develop new antimicrobials. This combined with changing vectors of disease associated with climate change would have substantial impact on human health and production systems. Efforts to enforce responsible use of antibiotics in intensive livestock production systems could limit the spread of AMR, but would not be enough. Changing to livestock production systems that are not dependent on therapeutic doses of antibiotics could substantially mitigate the threat of widespread AMR. *(University/research organisation)*
	Prevalence of resistant veterinary pathogens will increase, but a growing emphasis on biosecurity/good husbandry should help mitigate the impact of outbreaks. *(Public authority)*
	Due to consumer, animal keeper and veterinary awareness technical and scientific developments will decrease the key assumptions in the next 30 years. *(Public authority)*
	Without changes in agricultural practices and intensive farming systems, with a successful (from a US perspective) EU-N Am trade deal, more and more likely. *(Independent expert)*
	Luckily, this is currently under study by international public and private entities (European Food Safety Authority, World Medical Association, etc.) in order to take preventive measures, making Scenario 9 less plausible, even though the risk described is a real one. *(International organisation)*

Source: Stakeholder survey, question 9.1, 'When could this scenario plausibly become reality?' – 'Please explain'.

Impacts on food chain activities

Stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario. The graph below displays average stakeholder assessments for food chain activities on a scale of -2 to +2, where no impact is indicated by 0.

Figure 60: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?'
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 9.2a. Average assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item.

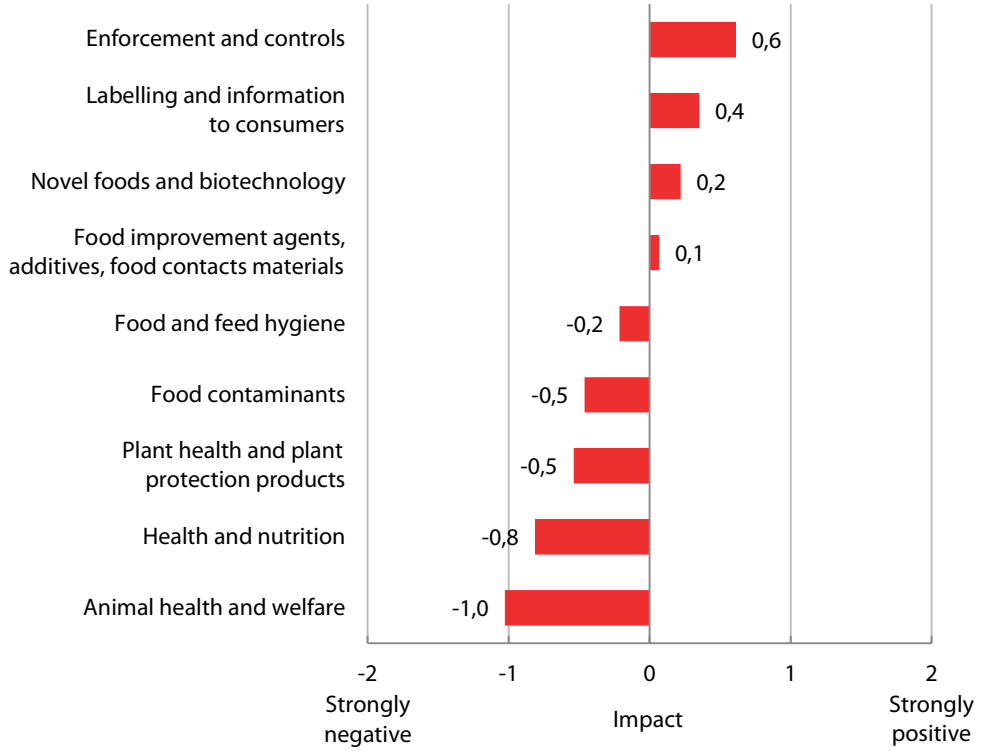
As shown above, according to respondents, all food chain activities (with the exception of at home consumption) are considered to be impacted negatively as a result of the scenario, with trade, primary production, restaurants/catering, ingredients and agricultural inputs most negatively impacted.

This is reflected in stakeholder comments, in which several stakeholders indicated that trade and primary production, along with the rest of the supply chain suffering the ramifications of a fall in consumer trust, would need to adapt to the adverse consequences of this scenario. Furthermore, some stakeholders indicate the probable increase in food waste both at household level and from potential product recalls and rejections in trade.

Impacts on food safety and nutrition policy areas

Stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 61: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?
(Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



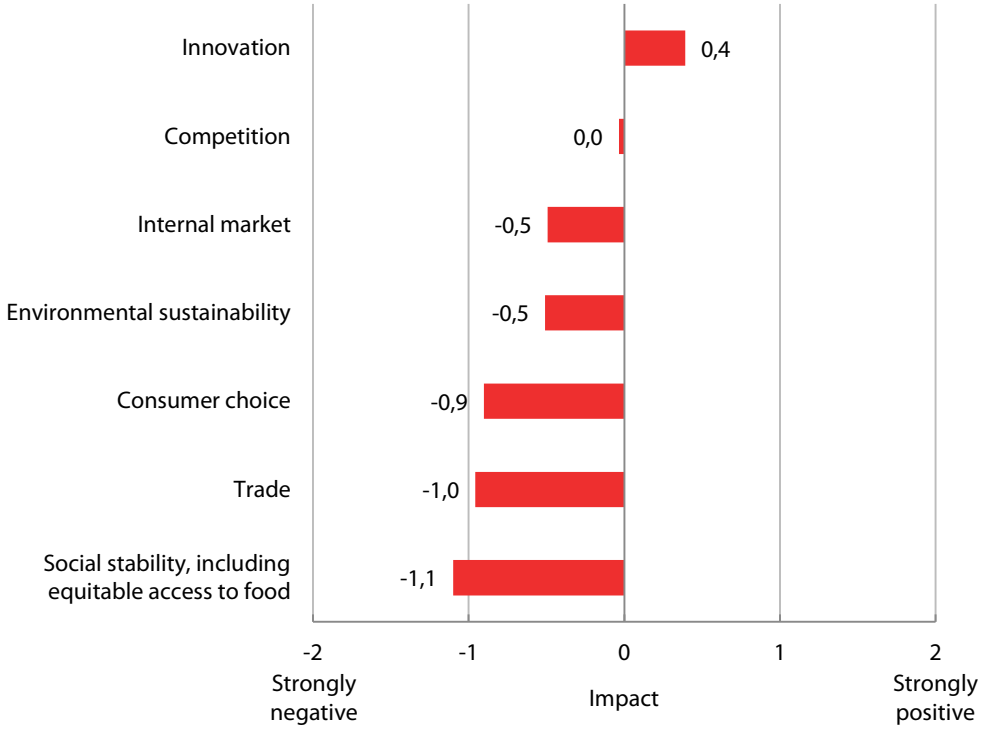
Source: Civic Consulting, based on stakeholder survey, question 9.2b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown here due to the small number of survey respondents for this item.

As shown in the graph, enforcement and controls is the policy area considered to be most positively impacted as a result of this scenario. In addition, some slight positive impact is expected in the area of labelling and food information to consumers, as well as novel foods and biotechnology. Areas considered to be negatively impacted were animal health and welfare, and health and nutrition. This is reflected in stakeholder comments, which emphasised the potential ramifications of this scenario on strengthening enforcement and controls, hence the generally expected positive impact that this would exert in policy implementation in this area. Several stakeholders also noted that labelling, traceability and information provision would present challenges in this scenario due to the increased difficulty of assessing the origin of foods. Comments further indicated that animal health and welfare are likely to be negatively impacted as a result of the increased risks of disease transmission described in the scenario, while health and nutrition would suffer from the food supply disruptions likely to be caused.

Impacts on other areas

Stakeholders were asked which other key areas would be impacted as a result of this scenario. The graph below displays average stakeholder assessments for various other key areas on a scale of -2 to +2, where no impact is indicated by 0.

Figure 62: 'In your view, what other areas would be impacted as a result of this scenario?' (Average stakeholders assessment on a scale from -2 to +2, no impact indicated by 0)



Source: Civic Consulting, based on stakeholder survey, question 9.2c. Average assessments in relation to 'Other areas' are not shown in this graph due to the small number of survey respondents for this item.

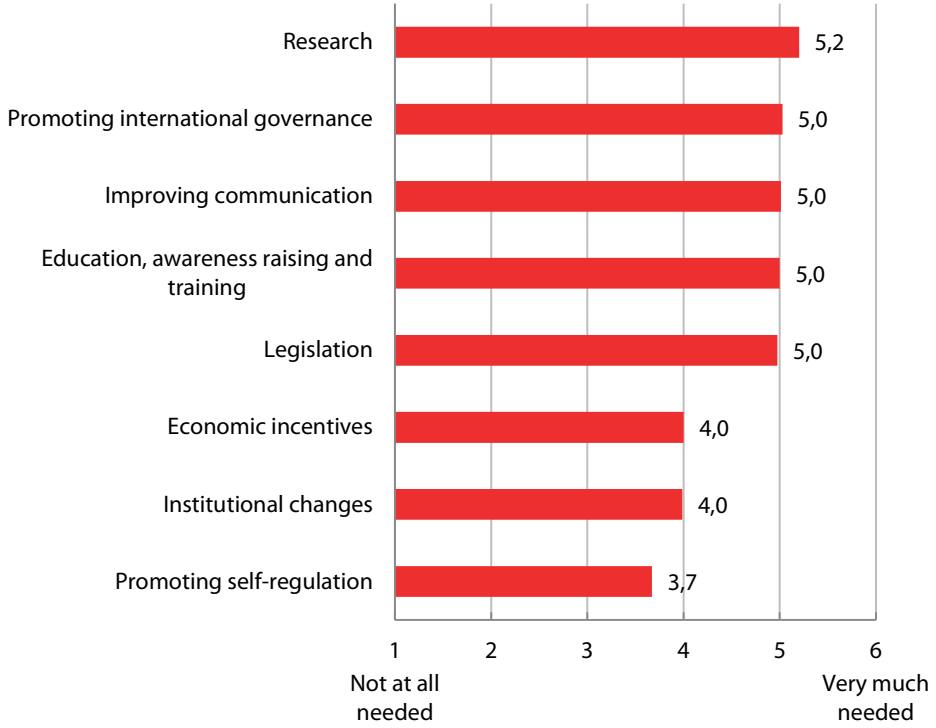
As shown in the graph, only innovation is considered to be positively (although slightly) impacted by this scenario. On the other hand, social stability, including equitable access to food, trade and consumer choice are considered to be most significantly negatively impacted.

Nonetheless, some stakeholder comments indicated broadly positive impacts in terms of innovation, environmental sustainability, and consumer choice, linked to the increased pressure to compete and innovate. Others noted mixed impacts, due to risks posed to social stability and environmental sustainability, but also higher expected product prices affecting consumer choice and equitable access to food. Several stakeholders however noted broadly negative impacts, associated with the potential impacts on trade, price increases and reduction of consumer choice as a result.

Measures/course of action for the EU

Stakeholders were asked what measures/course of action the EU should take to face the challenges posed by this scenario. The graph below displays average stakeholder assessments for various measures/courses of action on a scale of 1 to 6.

Figure 63: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?'
(Average stakeholders assessment on a scale from 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 9.3a. Average assessments in relation to 'Other measures' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph above, a wide range of suggested measures/courses of action are considered necessary to face the challenges posed by this scenario, with research coming top priority, followed by improving communication, promoting international governance, as well as education, awareness and training, and legislation. These 'top-down' types of interventions are considered more necessary that 'bottom-up' approaches such as promoting self-regulation, which is seen as the least needed (although, still, more considered than not).

This is reflected in stakeholder comments, which on the whole indicated a greater need for research, education and awareness raising, coupled with key changes in international legislation and governance for a more harmonised approach on this, with several stakeholders noting that the EU provides a paradigm for addressing antimicrobial resistance issues more globally. Some of the food industry stakeholders in particular also noted the increased need to promote self-regulation in the globalised context presented in the scenario, although other stakeholders stressed that this should complement and not replace legislation.

The table below presents key stakeholder comments regarding measures considered necessary to face the challenges posed by this scenario.

Table 40: Key comments of stakeholders/experts regarding measures considered necessary under scenario 9

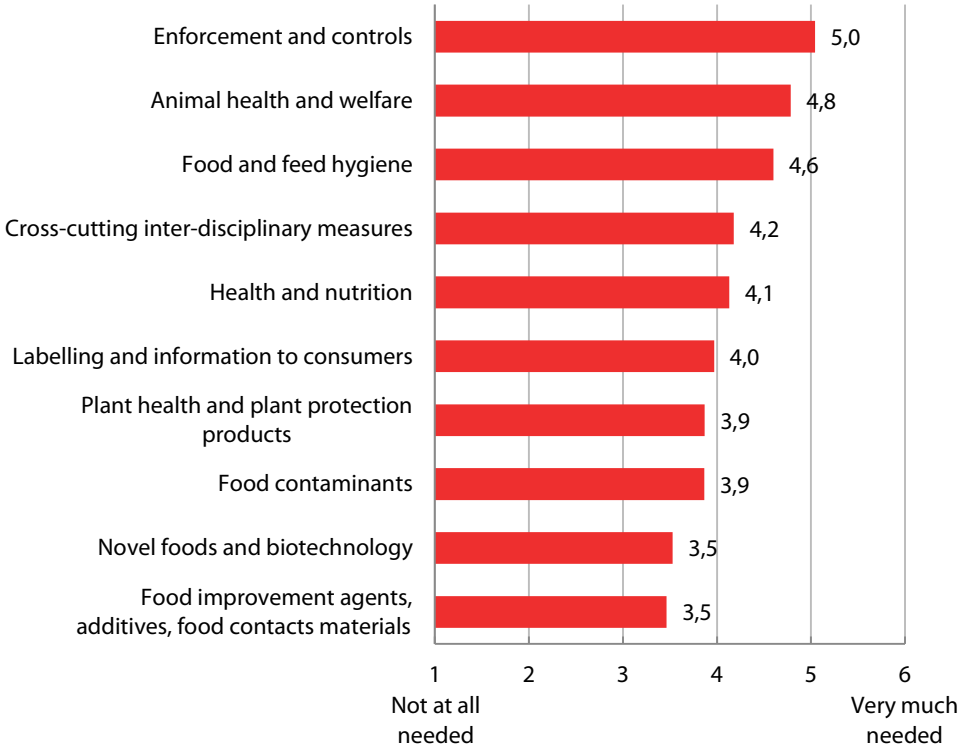
Main measures considered necessary	Comments
A mix of measures	Because AMR and zoonosis cannot be contained by borders, promoting international governance of both livestock production systems and trade would become essential. Self-regulation would not be able to adequately contain the risk of AMR and strong international regulation and legislation would be required. Economic incentives for transition to production systems not reliant on therapeutic antibiotic use would be essential for a transition to sustainable livestock production systems. *(University/research organisation)*
	Legislation to control use of antimicrobials in livestock; communication about new outbreaks; education about (mis)use of antibiotics. *(Other stakeholder)*
	A broad spectrum of measures is needed to address the challenges in this scenario. Efforts should be put into research in order to find solutions to antimicrobial resistance. Antimicrobial resistance is a global concern and its management should be facilitated through global measures. Guidelines and code of practice will be of major importance to facilitate diagnostics and prevent disease outbreaks etc. *(Public authority)*
	Self-regulation supported by legislation could be very effective. Research is needed into effective new anti-microbials. *(Independent expert)*
	To prevent this scenario (being proactive) requires a complex set of measures that form a coherent approach, using all instruments that the EU may have. In this case more specifically it may take considerable effort in legislation regarding the use of antibiotics and investing in early warning type of tools. *(University/research organisation)*
	It is important to reduce the use of antibiotics in human and animal population by good information, legislation, change in the practices by doctors and veterinarians. *(Public authority)*
Promoting international governance	Clearly the best management traditions in this area presently are in Europe - these should be spread globally. *(University/research organisation)*
	WTO & FAO required to provide international governance as these are global food markets. *(University/research organisation)*
	There is a need for international consensus and harmonised action. Otherwise this risks to be used as an excuse for inappropriate trade barriers. *(Food industry association/operator)*
	Legislation is a 'null' concept. Taxes and subsidies tend to result in misallocation of resources. Use existing international structures (WHO). *(Food industry association/operator)*
Research	The use of antibiotics has to be reduced as far as possible. Therefore the husbandry systems have to be evaluated and improved to improve livestock health, animal welfare and decrease the pressure of infections. *(Public authority)*
	It is important to better understand pathogens and their development, evolution and impact on our life and health. Based on this knowledge, new strategies to fight and control pathogens and to prevent their development have to be developed. Behaviour that is restrictive for pathogens should be financially stimulated, behaviour that is stimulating for pathogens should be discouraged. *(University/research organisation)*

Source: Stakeholder survey, question 9.3a, 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' - 'Please explain the measures you consider necessary, if any. In case you think that measures should be taken by other actors in addition to/instead of the EU, please specify'.

Changes needed to adapt the current EU food safety and nutrition framework

Stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. The graph below displays average stakeholder assessments of the extent to which changes are considered necessary in various policy areas, on a scale of 1 to 6.

Figure 64: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.'
(Average stakeholder assessment on a scale from 1 to 6)



Source: Civic Consulting, based on stakeholder survey, question 9.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this graph due to the small number of survey respondents for this item.

As shown in the graph, according to respondents, changes are considered necessary across all policy areas in this scenario (on the basis of average assessments above the midpoint of 3.5). In particular, changes in relation to enforcement and controls, animal health and welfare, food/feed hygiene, cross-cutting interdisciplinary measures, health and nutrition, labelling and information to consumers, food contaminants and plant health are considered most needed. This is broadly reflected in stakeholder comments, emphasising the need to improve enforcement and controls to ensure compliance to the current regulatory framework, and better address risks related to emerging animal/plant diseases or threats. In addition, addressing antibiotic use and antimicrobial resistance on a global scale is considered necessary as the EU on its own is not considered to be in a position to provide solutions to this issue.

Table 41: Key comments of stakeholders/experts regarding changes to EU food safety and nutrition framework considered necessary under scenario 9

Main area for which changes considered necessary	Comments
Enforcement and controls	Legislation should change from strict standards to general rules, with strict interpretation but also some flexibility in enforcement and control, also in public-private cooperation, and with clear responsibilities. *(University/research organisation)*
	More controls will be required on food contaminants, hygiene and conditions for raising livestock. *(Food industry association/operator)*
	Enforcement and controls are necessary because the system will never be perfect. But to what extent? Do we need a more flexible system that can be scaled up in case of an emerging risk or an emergency? *(University/research organisation)*
	Improvements in surveillance systems and their coordination to mitigate the threats from this scenario. (*Public authority)*
	Primary producers need to be stopped from using remedies and crop protection products irresponsibly. To start this, some products should not be permitted for use in primary production. *(Independent expert)*
	Animal health and welfare should remain high on the food safety agenda with greater controls to detect illegal use of veterinary products. *(Other stakeholder)*
Animal health and welfare	To improve animal welfare and health with fewer antibiotics the husbandry systems have to be changed. Food of animal origin should be regarded as a valuable good which has its price. Producing food of animal origin like the EU has done in the last decades will result in tremendous environmental problems and an on-going rise in antimicrobial resistance. *(Public authority)*
	To prevent wide-scale emergence of AMR [anti-microbial resistance] strong animal health and welfare legislation (i.e. reducing animal density, changing weaning practice) is needed to provide incentive for decreasing antibiotic use. In addition a moratorium on using antibiotics as growth promoters and therapeutic antibiotic use should be negotiated internationally. EU legislation would not be sufficient given the global scale of the problems, also due to changing vectors of zoonoses with climate change. *(University/research organisation)*
	Legal restrictions to the use of antimicrobial agents as feed additives for animals and controls to improve the global network of antimicrobial resistance surveillance; and to guarantee the observance of the new more strict rules. *(International organisation)*
	Need clear focus on where the disease specifically comes from - in future this will be much easier because of new methodology in lab and epidemiological studies, including DNA sequencing. *(University/research organisation)*
Cross-cutting measures	For years food had to be cheap, resulting in food production methods (especially in animal sector) with inherent risks. Innovation, return to GMP [good manufacturing practice] plus associated enforcement will be important plus consumer acceptance that safe and sound food production has a price. *(Food industry association/operator)*
Labelling and information for consumers	Systematic updates are necessary to policies and legislation framework as new knowledge will become available with special focus for labelling and information for consumers. *(International organisation)*
Other: self-regulation	Cannot rely on self-regulation in an increasingly competitive market. *(University/research organisation)*

Source: Stakeholder survey, question 9.3b, 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario?' - 'For those areas where you consider changes are necessary, please explain in what way and why'.

Feedback from 3rd workshop regarding potential changes to EU food safety and nutrition framework

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- It was noted that a break-down in consumer trust also entails a rapid reaction to new threats in the food chain (e.g. E coli outbreaks), implying excellent surveillance, early warnings and traceability systems. While prevention is important, the rapid response capacity should not be overlooked.
- Participants noted that many consumers prefer 'zero risk' in food as well as the lowest possible price. This puts large constraints on the supply chains, and can consequently create an unsustainable situation that provides opportunity for fraud. As a result the development of private standards, complementary to legislation, could also be a solution to counter this, and in the future even a comparative advantage for the EU quality food industry rather than just a cost.
- Consumers' attitudes and low level of awareness also pertain to a lack of understanding of the complexity of food supply chains by the general public. The understanding that zero risk is not achievable is very important in this context. As a result, improving awareness, thereby empowering consumers, would be a key response to this. An improved communication policy needs to explain that providing a tasty, healthy, safe food at a low price is a challenge and needs to be taken into account in informing consumer choice and purchase decisions, as the market ultimately responds to the signals provided by consumer purchase patterns.
- Enforcement and controls should be flexible as it is not possible to control *all* food production at a reasonable cost for society. New forms of regulation should be promoted such as improving cost and responsibility sharing between different actors, and, for some experts, more efficient and cost-effective control systems such as risk-based measures. Self-regulation on the other hand was not considered a feasible option by some participants. In addition, traceability should be reinforced to identify the origin and appropriate response to threats (whether coming from within or outside the EU) and also to contain them if they occur.
- Some threats, such as antimicrobial resistance, require a global response and cannot be addressed at EU level only. International governance and the development of harmonised standards will therefore be increasingly needed to address poor practices along the food chain especially where the response needs to be global, e.g. where animal husbandry practices put pressure on disease transmission to humans and the development of 'super bugs' such as MRSA and ESBLs.

Future research

Finally stakeholders were asked on which research issues should be conducted to better understand the challenges posed by scenario 9, and to mitigate potential negative impacts on food safety and nutrition. Of those stakeholders who provided comments, many found that research needed to be conducted in relation to emerging risks/diseases (e.g. pathogen development and survival; control strategies), transmission/prevention of antimicrobial resistance (AMR) in the food chain and from animals to humans, and other factors affecting AMR patterns in the wider environment.

The table below presents key stakeholder comments regarding key issues for future research relating to this scenario.

Table 42: Key comments of stakeholders/experts regarding issues for future research under scenario 9

Main area for which changes considered necessary	Comments
Emerging risks & Diseases	Pathogen development and survival. Impact of pathogens on long-term health chronic diseases. Intervention strategies. *(University/research organisation)*
	Contaminants, Microbiology, Bacteriology. *(University/research organisation)*
	Rapid microbiological screening techniques. *(Food industry association/operator)*
	Research especially on how microorganisms evolve and develop, and how this can be predicted and monitored. Rapid methods for analysis and characterisation are needed. These are priorities for prediction and rapid reaction.*(University/research organisation)*
	Research to identify alternative means of controlling pathogens and to develop tools for early detection of anti-microbial resistance. (*Food industry association/operator)*
Antibiotic use in production systems	The system of animal production has to be changed. To prioritize the cost of production at the top (not to produce healthy animals who don`t need antibiotics to grow up) has made it nearly impossible to stay on the market with smaller businesses, smaller groups of animals and smaller emissions. *(Public authority)*
	Need research in the development of innovative antimicrobial agents and vaccines and their appropriate use. (*International organisation)*
	Research into new antibiotics is key. *(Food industry association/operator)*
	Research into antimicrobial resistance and new antibiotics to treat disease due to resistant pathogens. Priority should be cutting edge research into the microbiome. *(Other stakeholder)*
	Primary research on genomics and antimicrobial resistance including mode of administration and synergistic effects. *(University/research organisation)*
	Whole genome sequencing - global database - Global Microbial Identifier. *(University/research organisation)*
	Clarify the current level of anti-microbial usage in food production sector; identify the level of non-compliance with good veterinary practices; study the contamination of phreatic water and impact on plant origin food safety and public health. *(International organisation)*
Relation of risks to human health	Document the relation between antimicrobial use in animals and human infections with resistant bacteria. *(University/research organisation)*
	Alternatives to antibiotics both in veterinary and human medicine, to build resilience into the food chain. *(University/research organisation)*
	Prevention and mitigation of AMR due to human and veterinary medicine; development of new key antibiotics but not to continue current consumption levels. *(Consumer organisation/NGO)*
	Persistence and dissemination of AMR in the food chain. Factors stimulating/ suppressing AMR gene development and exchange in human and animal populations. (University/research organisation)
Novel foods and biotechnology	Research on potential effects of biotechnologies, nanotechnologies, novel foods. *(Other stakeholder)*

Source: Stakeholder survey, question 9.4, 'On which issues should research be conducted to better understand the challenges posed by this scenario, and to mitigate potential negative impacts on food safety and nutrition? Please consider prioritising these according to your perspective and please share your criteria for prioritisation'.

Feedback from 3rd workshop regarding areas for future research

Participants at the 3rd workshop reviewed the table of comments on the previous page and raised the following key points:

- Research on enhancing more generally the reaction and response mechanisms to more effectively address emerging risks and threats will be needed in the future.
- Research on rapid detection methods in the event of crises was suggested.
- It was suggested to further investigate how cross-cutting policy areas, such as the CAP, could encourage food safety and nutrition in general, while some current practices, e.g. importing soybeans to feed the EU intensive livestock sector, may bear risks.
- Research into small scale, local, food production was highlighted. Local production chains can carry more risks and if a crisis occurs, it is likely to be less publicised. On the other hand, they may also contribute to fewer risks.
- Finally, research on consumer behaviour (e.g. interest and understanding of various labelling options) and risk-based analysis (e.g. GM-free policy is very costly but the level of risk associated is being questioned) was advanced.

5. Analysis and conclusions

In this section we first provide an overview of the scenario-building approach used and the methodology for the stakeholder consultation. We then present comparisons of stakeholder assessments across scenarios for selected questions, either in the form of a graph or a table. This is followed by a discussion on cross-cutting conclusions and related key questions for future research.

5.1. Overview of scenario building and consultation approach

5.1.1. Aims of workshops

The first of three workshops in the context of this scoping study took place on 31 May 2013, bringing together a diverse range of experts to discuss the critical drivers of change and their implications for EU food safety and nutrition in 2050, in an interdisciplinary context and from a forward-looking perspective. The workshop validated a set of ten key drivers of food safety and nutrition, and provided essential feedback on the study's content and methodology. The main aim of the second expert workshop, which took place on 18 September 2013, was to explore and refine draft scenarios, and assess the importance of the scenarios for EU food safety and nutrition in 2050. An additional aim was to explore survey themes concerning the implications for food safety and nutrition under these scenarios, which then formed the basis of a stakeholder/expert survey. The aim of the third and final workshop, which took place on 10 December 2013, was to present and discuss results of the stakeholder/expert survey with a view to formulating conclusions and recommendations as to potential future policy measures necessary to face the challenges described in the scenarios and supporting future research.

5.1.2. Scenario-building approach

Scenarios can be seen as plausible alternative futures, i.e. futures that could occur under certain assumptions. They are used both as an exploratory method or a tool for decision-making, mainly to highlight the discontinuities from the present and to reveal the available choices and their potential consequences.[330] In this context a scenario represents a pathway defined by a set of assumptions regarding the future developments of drivers. The aim of the scenario-building approach was to develop a set of complementary plausible futures, while excluding those futures that could be considered implausible (without making any judgment concerning the likelihood of the selected scenarios). In other words, scenarios are not predictions, nor should they be taken as the most likely or desirable of the myriad of possible futures. At most, they paint pictures of a limited number of plausible futures, and the real future is likely to include elements of several of the scenarios.

In line with best practices, during the first stage of the study, key drivers of food safety and nutrition in 2050 were identified, as well as related uncertainties surrounding their future evolution. Briefings were produced for each of the drivers, detailing relevant trends, uncertainties and projections on their future evolution (see Section 3 for the driver briefings), which were then refined and validated at the 1st workshop that took place in the context of this study. These drivers are outlined in the table below.

On the basis of results of the 1st workshop, a driver-specific approach for scenario-building was adopted, whereby each scenario focuses on one driver, with the aim of capturing key disruptions or gradually developing stresses occurring between now and 2050 relating to the main trends of

[330] European Commission, JRC (IPTS), Online Foresight Guide.

relevance in that driver. *A key requirement was that the scenarios challenge the current EU policy and legislative food safety and nutrition framework by exposing its vulnerabilities; more benign scenarios outlining futures with limited disruptions or gradual stresses, or scenarios depicting challenges that were not relevant in the context of this study were not considered.*

In order to clearly identify the vulnerabilities in the framework caused by gradually developing stresses or potential disruptions relating to a driver, each scenario was designed to explore a single driver-related stress/disruption and its related secondary effects resulting from the interrelationships between drivers. In this way, the scenarios allow for complex sets of inter-connected drivers and trends to be unpacked, without disregarding the most important interrelationships related to the driver under consideration.

Accordingly, the driver-specific scenarios outlined below were developed to depict a variety of the most challenging potential disruptions or critical developments to the EU legislative and policy framework from these drivers, with the principal aim of testing the current and future resilience of this framework until 2050 and thereby investigating which potential future policy measures may be necessary to increase its resilience.

The following table outlines main drivers of food safety and nutrition identified, the associated scenarios that were developed and subsequently refined on the basis of results of the 2nd workshop, and the specific challenges to EU food safety and nutrition they aim to explore (see Section 4 for a description of each scenario and associated stakeholder and expert assessments).[331]

[331] On the basis of the 2nd workshop results, initial scenarios for the drivers 'Global economy and trade' and 'New agri-food chain structures' were merged, bringing the number of scenarios to nine.

Table 43: Overview of driver-specific scenarios

Main driver	Scenario	Related challenges
Global economy and trade & New agri-food chain structures	Scenario 1 – Rapid surge in global trade in food and feed, with highly concentrated agri-food industries	Ensuring food safety and nutrition in the highly globalised and complex food supply chains of 2050
Global cooperation and standards	Scenario 2 – Break-down of global cooperation in a multipolar world	Ensuring food safety and nutrition in a multipolar world in 2050, and with highly fragmented and geographically dispersed food chains
EU governance	Scenario 3 – Long-term austerity and a shift to private food safety controls in the EU	Ensuring food safety and nutrition in an environment of tight budgetary restrictions
Demography and social cohesion	Scenario 4 – Severe inequality linked to food insecurity of vulnerable consumers and polarised diets	Safeguarding the food security of vulnerable consumer groups and addressing lifestyle-related problems affecting the health of large parts of the EU population
Consumer attitudes and behaviour	Scenario 5 – Strong shift in EU consumer preferences to food from alternative production systems	Ensuring food safety in EU food systems dominated by alternative food chains in 2050
New food chain technologies	Scenario 6 – Widespread consumption of high-tech functional foods	Ensuring high levels of food safety and nutrition for consumers of functional foods in 2050
Competition for key resources	Scenario 7 – Global resource depletion	Safeguarding food safety and nutrition when high quality resources are scarce
Climate change	Scenario 8 – Global disruptions of agriculture from climate change	Safeguarding food safety and nutrition under disruptive climatic conditions, affecting primary production, storage and transport of food in 2050
Emerging food chain risks and disasters	Scenario 9 – Breakdown in consumer trust in food following the emergence of food chain risks	Ensuring veterinary health and food safety under these circumstances, effectively communicating to the public in a situation of panic, and addressing a resulting loss in consumer trust in complex food chains

Source: Civic Consulting

5.1.3. Stakeholder and expert consultation

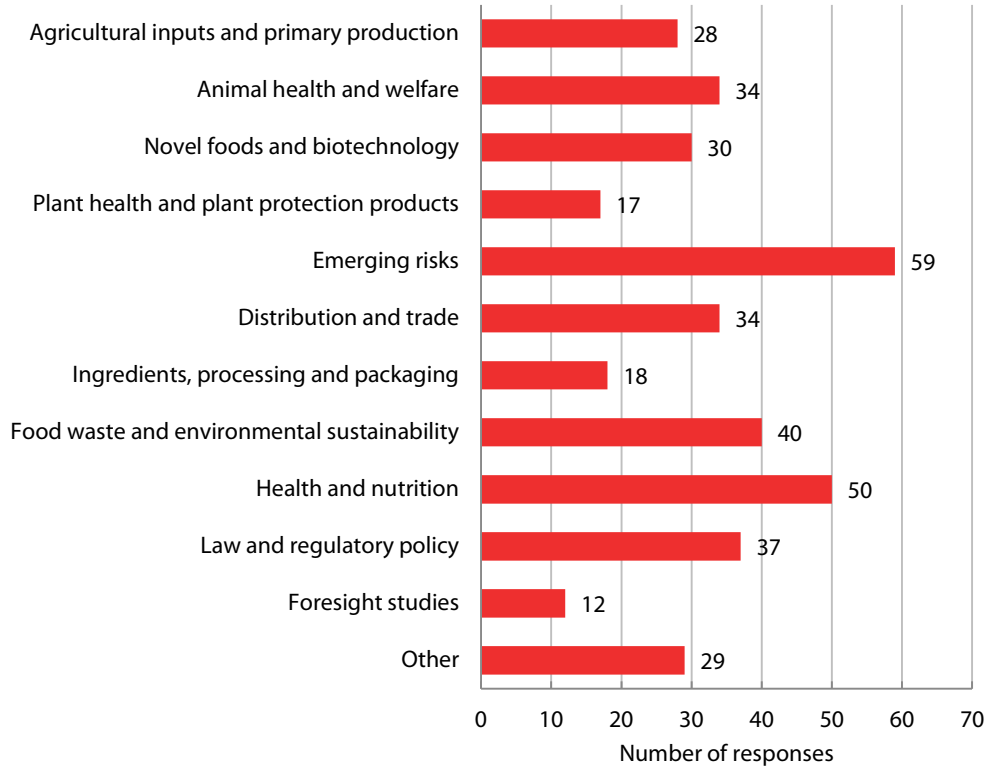
The stakeholder consultation consisted of an online survey developed on the basis of question themes discussed at the 2nd workshop. It was targeted at key stakeholders in the area of food safety and nutrition at the EU and Member State level, including competent authorities, industry associations, international organisations, consumer organisations, other non-government organisations, and independent experts. The main purpose of the survey was to assess the potential impacts on EU food safety and nutrition under the scenarios, and explore potential measures to face the challenges described and areas for future research. At the time the survey was closed, a total of 129 responses had been received. The graph below presents the break-down of responses by stakeholder type.

Figure 65: Break-down of responses by stakeholder type

Source: Civic Consulting, based on stakeholder survey.

Furthermore, the following graph displays the break-down of responses by area of expertise (respondents could select more than one area of expertise):

Figure 66: Break-down of responses by area of expertise

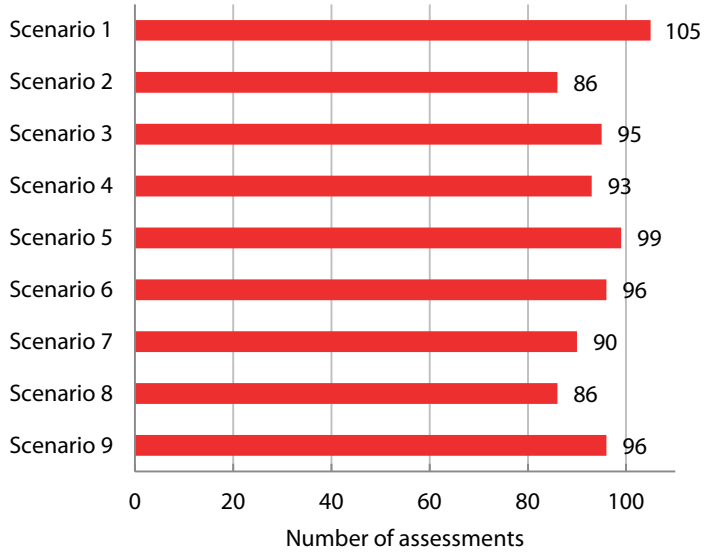


Source: Civic Consulting, based on stakeholder survey.

Stakeholders and experts consulted were presented with an overview of the scenarios and the related challenges (as in the table on the previous page) and were requested to select the scenarios they wished to assess. Each scenario assessment then consisted of a description illustrating the disruption or gradual stress related to the scenario driver and the key changes having occurred by 2050 as a result, followed by a list of key assumptions for each scenario, and a series of seven questions relating to the scenario's plausibility and impacts, potential policy measures to counter the challenges described, and areas for future research.

The figure below presents the total number of scenario assessments by each scenario.

Figure 67: Number of scenario assessments by each scenario



Source: Civic Consulting, based on stakeholder survey.

More specifically, the questions presented to respondents as part of each scenario assessment related to:

1. The plausibility of the scenario, according to various timeframes;
2. Impacts on food chain activities as a result of the scenario;
3. Impacts on food safety and nutrition policy areas as a result of the scenario;
4. Impacts on other areas as a result of this scenario;
5. Measures/course of action the EU should take to face the challenges posed by the scenario;
6. Potential changes needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario; and
7. Issues for future research.

As with any survey, inherent limitations to the methodology and associated caveats need to be kept in mind when interpreting the responses received. First, despite the considerable expertise mobilised in the large survey sample, responses nonetheless reflect subjective assessments as opposed to scientific measurement, and therefore any quantification of responses needs to be understood on this basis. In particular, as shown in the previous section, most of the questions

posed to respondents in the context of the scenario assessments are closed-ended, in that they elicit a response from a restricted set of options, which in this case have each been assigned a numerical value to allow for an assessment of magnitude or degree, e.g. of impact. While this quantification of closed-ended questions has the significant advantage of allowing comparisons to be made across respondents (and across scenarios, as questions were uniform across scenarios) with the aid of descriptive statistics, it risks masking complexity, which in this context is significant, given the broad and in-depth nature of the issues explored in each of the scenarios.

A prime goal of the 3rd workshop was therefore to explore this complexity in further detail, particularly as it provided an opportunity for stakeholders to nuance and qualify their responses to the survey, as well as expand on the comments provided by stakeholders in the survey in relation to key questions for each scenario (potential changes to the EU food safety and nutrition framework and areas for future research), and draw cross-cutting conclusions relevant for all scenarios.

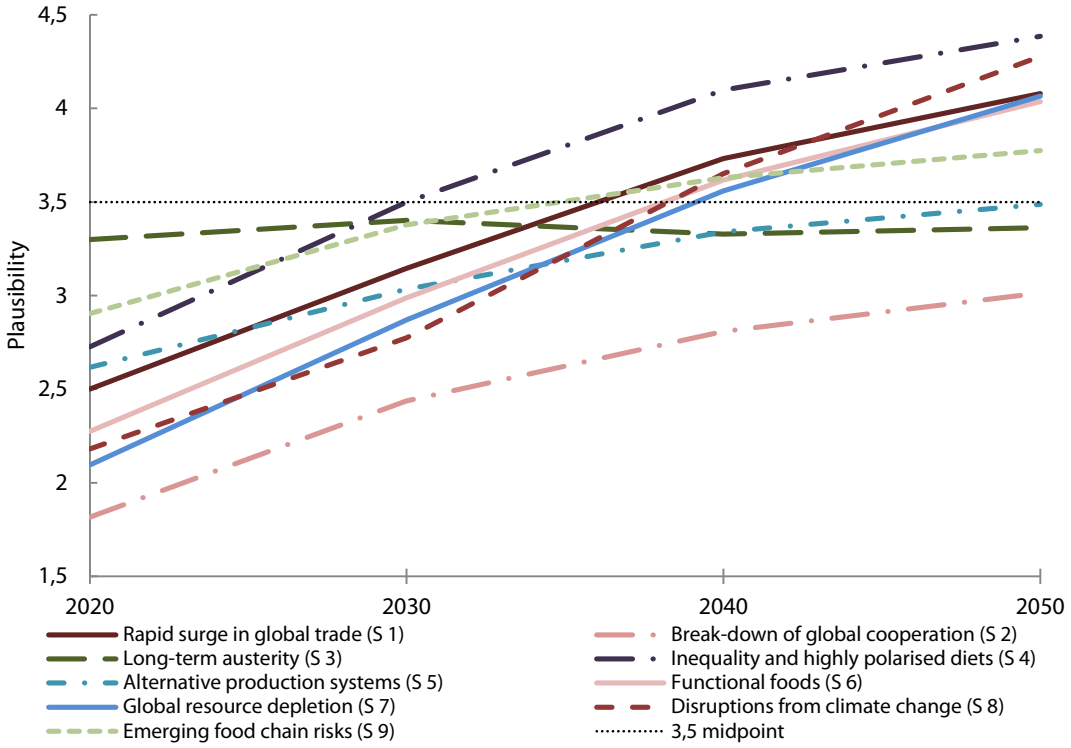
In the following, results across scenarios are presented in a summary format; a detailed discussion of each scenario and the associated stakeholder and experts comments is provided in Section 4.

5.2. Comparison of assessments of stakeholders/experts across scenarios

5.2.1. Plausibility of scenarios

For each scenario selected for assessment, stakeholders were asked to provide their views as to the extent to which the scenario could plausibly occur within various timeframes – by 2020, 2030, 2040 or 2050 – on a scale of 1 (Not at all plausible) to 6 (Very plausible). The following graph displays the average assessments of plausibility by stakeholders for each timeframe and for each scenario, where a scenario is characterised by a coloured line, as shown in the legend. In addition, a horizontal line has been drawn across all timeframes at 3.5, which characterises the midpoint between 1 and 6. An average assessment of a scenario's plausibility of a value of 3.5 could be understood as an assessment whereby the scenario is on average considered as plausible as it is implausible. By extension, an average assessment of a scenario's plausibility *above* 3.5 is to be understood as an assessment whereby the scenario is on average considered more plausible than implausible. In contrast, an average assessment of a scenario's plausibility *below* 3.5 is to be understood as an assessment whereby the scenario is on average considered more implausible than plausible.

Figure 68: 'When could this scenario plausibly become reality?' – Comparison of scenarios



Source: Civic Consulting, based on stakeholder survey, questions 1.1, 2.1 etc. to 9.1.

Several key conclusions can be drawn from the graph:

- The plausibility of all scenarios is on average considered to increase for later timeframes, with the exception of Scenario 3 – 'Long-term austerity'.
- Six of the scenarios assessed reach the midpoint of 3.5 by 2050, and thus their becoming reality is considered more plausible than implausible by 2050. Of these, the scenario that is on average considered more plausible than implausible the soonest is Scenario 4 – 'Severe inequality and highly polarised diets', which reaches the midpoint by 2030, while the other five scenarios reach the midpoint by 2040.
- Of the three scenarios that do not reach the midpoint by 2050, Scenario 2 – 'Break-down of global cooperation' is on average considered to be least plausible.
- Scenario 7 – 'Global resource depletion' and Scenario 8 – 'Disruptions of agriculture from climate change' see the largest change in average assessments of plausibility across timeframes.

5.2.2. Impacts on food chain activities – comparison of scenarios

For each scenario selected for assessment, stakeholders were asked which specific food chain activities would be impacted in terms of food safety and nutrition as a result of the scenario. Stakeholders were asked to assess impacts on various food chain activities on a scale of -2 to +2, where no impact is indicated by 0. The following table displays, for each scenario, the assessments of positive (in blue) and negative (in red) impact on food chain activities.

Table 44: 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' – Comparison of scenarios

Scenarios / Food chain activities	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Processing and packaging	0,7	-0,3	-0,2	0,2	0,0	1,1	-0,4	-0,1	-0,1	*0,1*
At-home consumption	0,0	0,1	-0,1	-0,1	1,0	0,2	-0,2	-0,4	0,2	*0,1*
Food waste	-0,3	0,3	-0,2	0,0	0,4	0,1	0,6	0,0	-0,3	*0,1*
Storage, distribution and retail	0,8	-0,2	-0,2	0,0	0,1	0,7	-0,3	-0,3	-0,4	*0,0*
Ingredients	0,4	-0,6	-0,4	-0,1	0,1	1,0	-0,8	-0,7	-0,6	*-0,2*
Restaurants and catering	0,3	-0,3	-0,7	-0,3	0,4	0,1	-0,7	-0,6	-0,7	*-0,3*
Trade	1,1	-1,3	-0,3	0,0	-0,5	0,8	-0,7	-0,5	-1,0	*-0,3*
Agricultural inputs	0,2	-0,7	-0,4	-0,2	0,2	0,2	-0,8	-0,7	-0,6	*-0,3*
Primary production	0,1	-0,3	-0,4	-0,2	0,5	0,0	-1,1	-1,3	-0,9	*-0,4*

Source: Civic Consulting, based on stakeholder survey, question 1.2a, 2.2a etc. to 9.2a. Assessments in relation to 'Other food chain activities' are not shown here due to the small number of survey respondents for this item. Impacts that were assessed on average as positive are highlighted in blue, while those assessed on average as negative are highlighted in red. Food chain activities are ranked by the average assessments across all scenarios (highest to lowest; see right-hand column).

The table shows that mostly positive impacts on food chain activities can be expected in Scenario 1 – 'Rapid surge in global trade', Scenario 5 – 'Shift to alternative production systems' and Scenario 6 – 'Widespread consumption of functional foods'. In contrast, Scenario 7 – 'Global resource depletion', Scenario 8 – 'Disruptions of agriculture from climate change' and Scenario 9 – 'Emerging food chain risks' are considered to have the most negative impacts on food chain activities. The table also shows that impacts on specific food chain activities depend on the scenario, with all activities being impacted negatively in at least four scenarios. Across all scenarios, the most affected activity is primary production.

5.2.3. Impacts on food safety and nutrition policy – comparison of scenarios

For each scenario selected for assessment, stakeholders were asked which specific food safety and nutrition policy areas would be impacted as a result of the scenario. Stakeholders were asked to assess impacts on various food safety and nutrition policy areas on a scale of -2 to +2, where no impact is indicated by 0. The following table displays, for each scenario, the

assessments of positive (in blue) and negative (in red) impact on food safety and nutrition policy areas.

Table 45: In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario? – Comparison of scenarios

Scenarios / Policy areas	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Novel foods & biotechnology	0,9	-0,2	-0,1	0,4	-0,3	1,5	0,3	0,7	0,2	*0,4*
Agents, additives & contact materials	0,6	-0,2	-0,4	0,3	-0,5	1,2	0,1	0,4	0,1	*0,2*
Labelling & informatio	-0,2	-0,1	-0,6	0,0	0,6	0,5	-0,2	0,0	0,4	*0,0*
Enforcement & controls	0,2	-0,1	-1,0	-0,2	0,2	0,5	-0,2	-0,3	0,6	*0,0*
Food & feed hygiene	0,1	-0,5	-0,7	-0,4	0,1	0,6	-0,5	-0,7	-0,2	*-0,2*
Plant health & plant protection products	-0,2	-0,4	-0,6	-0,3	0,7	0,1	-1,0	-1,0	-0,5	*-0,4*
Health & nutrition	-0,3	-0,5	-0,9	-0,8	0,8	0,6	-0,8	-0,8	-0,8	*-0,4*
Food contaminants	-0,3	-0,6	-0,7	-0,5	-0,1	0,3	-0,7	-0,8	-0,5	*-0,4*
Animal health & welfare	-0,6	-0,3	-0,7	-0,5	1,1	-0,1	-1,0	-1,1	-1,0	*-0,4*

Source: Civic Consulting, based on stakeholder survey, question 1.2b, 2.2b, etc. to 9.2b. Assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this table due to the small number of survey respondents for this item. Impacts that were assessed on average as positive are highlighted in blue, while those assessed on average as negative are highlighted in red. Policy areas are ranked by the average assessments across all scenarios (highest to lowest; see right-hand column).

As displayed in the table, average assessments of positive and negative impacts on policy areas broadly reflect assessments on food chain activities across scenarios: policy areas in Scenario 1 – 'Rapid surge in global trade', Scenario 5 – 'Shift to alternative production systems' and Scenario 6 – 'Widespread consumption of functional foods' scenarios are again considered to be relatively positively impacted. A key difference is that under Scenario 3 – 'Long-term austerity', assessments of negative impacts on food safety and nutrition policy areas are more significantly pronounced than for food chain activities. Nonetheless, Scenario 7 – 'Global resource depletion', Scenario 8 – 'Disruptions of agriculture from climate change' and Scenario 9 – 'Emerging food chain risks' follow as the scenarios for which policy areas are assessed to be next most negatively impacted, as in the previous table.

The table also shows that novel foods and biotechnology, food improvement agents, additives and contact materials are on average considered positively impacted across scenarios, while

most other food safety and nutrition policy areas are considered on average negatively impacted across scenarios.

5.2.4. Impacts on other areas – comparison of scenarios

For each scenario selected for assessment, stakeholders were asked which other key areas would be impacted as a result of this scenario. Stakeholders were asked to assess impacts on various other areas on a scale of -2 to +2, where no impact is indicated by 0. The following table displays, for each scenario, the assessments of positive (in blue) and negative impact on food safety and other key areas (in red).

Table 46: 'In your view, what other areas would be impacted as a result of this scenario?' – Comparison of scenarios

Scenarios / Other areas	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Innovation	0,8	-0,3	-0,1	0,1	0,3	1,6	0,2	0,9	0,4	*0,4*
Competition	0,5	-0,6	0,1	0,0	0,5	1,0	0,0	0,0	0,0	*0,2*
Internal market	-0,1	0,6	-0,3	-0,2	0,7	0,4	-0,4	-0,4	-0,5	*0,0*
Trade	1,2	-1,2	-0,3	0,0	-0,4	0,8	-0,6	-0,3	-1,0	*-0,2*
Consumer choice	0,1	-1,2	-0,8	-0,7	0,7	0,6	-1,2	-0,9	-0,9	*-0,5*
Environmental sustainability	-0,8	-0,2	-0,8	-0,9	1,2	-0,2	-1,2	-1,1	-0,5	*-0,5*
Social stability, including equitable access to food	-0,4	-0,9	-1,0	-1,4	0,1	-0,5	-1,4	-1,4	-1,1	*-0,9*

Source: Civic Consulting, based on stakeholder survey, questions 1.2c, 2.2c, etc. to 9.2c. Assessments in relation to 'Other areas' (beyond those considered in the survey questions) are not shown in this table due to the small number of survey respondents for this item. Impacts that were assessed on average as positive are highlighted in blue, while those assessed on average as negative are highlighted in red. Areas are ranked by the average assessments across all scenarios (highest to lowest; see right-hand column).

The table indicates that innovation is the area considered to be most positively impacted across scenarios, on average, followed by competition, to a lesser extent. In contrast, social stability, including equitable access to food, is considered to be most negatively impacted across scenarios, followed by environmental sustainability.

5.2.5. Measures/course of action the EU should take to face the challenges posed by the scenarios

For each scenario selected for assessment, stakeholders were asked what measures/course of action the EU should take to face the challenges posed by the scenario. Stakeholders were asked

to assess the extent to various measures/courses of action were needed, on a scale of 1 (Not at all needed) to 6 (Very much needed). The table below displays average assessments for various measures/courses of action, by scenario.

Table 47: 'In your view, what measures/course of action should the EU take to face the challenges posed by this scenario?' – Comparison of scenarios

Scenarios / Measure/ Course of action	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Research	4,7	4,3	4,3	4,6	4,5	5,3	5,3	5,3	5,2	*4,8*
Education, awareness raising & training	4,6	4,2	4,5	5,1	4,8	4,6	4,5	4,7	5,0	*4,7*
Improving communication	4,7	4,3	4,3	4,6	4,6	4,7	4,3	4,4	5,0	*4,6*
Promoting international governance	4,9	4,7	4,4	3,8	3,4	4,2	5,1	4,8	5,0	*4,5*
Legislation	4,4	3,7	4,2	4,3	3,9	4,4	4,2	4,1	5,0	*4,2*
Economic incentives	3,7	3,8	3,8	4,4	3,8	3,3	4,1	4,0	4,0	*3,9*
Institutional changes	3,7	3,7	3,9	3,8	3,5	3,5	3,8	3,7	4,0	*3,7*
Promoting self-regulation	3,6	3,3	4,1	2,9	3,7	3,6	3,1	3,1	3,7	*3,4*

Source: Civic Consulting, based on stakeholder survey, question 1.3a, 2.3a, etc. to 9.3a. Assessments in relation to 'Other measures' are not shown in this table due to the small number of survey respondents for this item. A light to dark red colour grading applies, with the following grades: 0 to 3.5 (light red); 3.5 to 4.0 (medium red); and 4.0 and above (dark red). Measures/courses of action are ranked by the average assessments across all scenarios (highest to lowest; see right-hand column).

As shown in the table, research appears as the measure/course of action considered most necessary across scenarios, followed by education, awareness raising and training. Promoting self-regulation, on the other hand, is on average considered least necessary across scenarios.

5.2.6. Changes needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges reflected in the scenarios

For each scenario selected for assessment, stakeholders were asked whether they thought changes were needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario. Stakeholders were asked to assess the extent to which changes to various food safety and nutrition policy areas were needed on a scale of 1 (Not at all needed) to 6 (Very much needed). The table below displays average assessments of the extent to which changes are considered necessary in various policy areas, by scenario.

Table 48: 'Do you think changes are needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario? Please consider the following areas.' – Comparison of scenarios

Scenarios / Policy areas	1. Rapid surge in global trade	2. Break-down of global cooper-ation	3. Long-term austerity	4. Inequa-lity and highly polarised diets	5. Altern-ative produc-tion systems	6. Fun-ctional foods	7. Global resource deple-tion	8. Dis-ruptions from climate change	9. Emer-ging food chain risks	*Average*
Enforcement & controls	4,6	3,7	4,6	3,9	4,3	4,5	4,2	3,9	5,0	*4,3*
Health & nutrition	4,2	3,7	3,9	5,1	3,9	4,9	4,0	3,8	4,1	*4,2*
Cross-cutting measures	3,9	4,2	3,6	4,2	3,7	3,8	4,4	4,5	4,2	*4,1*
Labelling & information	4,6	3,5	3,7	4,4	4,2	5,0	3,5	3,6	4,0	*4,0*
Novel foods & biotechnology	4,4	3,5	3,3	3,9	3,3	4,9	4,2	4,1	3,5	*3,9*
Food & feed hygiene	4,1	3,3	4,0	3,9	3,9	3,5	3,7	3,6	4,6	*3,9*
Food contaminants	4,2	3,3	3,7	3,6	3,8	3,7	3,9	3,6	3,9	*3,7*
Plant health & plant protection products	4,0	3,2	3,5	3,4	3,7	3,0	4,0	4,0	3,9	*3,6*
Agents, additives & contact materials	4,0	3,1	3,4	3,5	3,1	4,6	3,6	3,3	3,5	*3,6*
Animal health & welfare	4,0	3,1	3,5	3,2	3,5	2,8	3,4	3,7	4,8	*3,6*

Source: Civic Consulting, based on stakeholder survey, question 1.3b, 2.3b, etc. to 9.3b. Average assessments in relation to 'Other food safety and nutrition policy areas' are not shown in this table due to the small number of survey respondents for this item. A light to dark red colour grading applies, with the following grades: 0 to 3.5 (light red); 3.5 to 4.0 (medium red); and 4.0 and above (dark red). Policy areas are ranked by the average assessments across scenarios (highest to lowest; see right-hand column).

As shown in the table, enforcement and controls appears as the policy area for which changes are considered most necessary across scenarios on average, followed by health and nutrition, and cross-cutting inter-disciplinary measures. Animal health and welfare on the other hand appears as the policy area for which changes are on average considered least necessary across scenarios.

5.3. Conclusions

The analysis of drivers, the results of the expert workshops and of the stakeholder survey lead to a number of cross-cutting conclusions that apply to several or all scenarios, in addition to the conclusions in relation to specific scenarios that are discussed in Section 4. These cross-cutting conclusions in turn point to questions concerning the EU approach to guaranteeing high levels

of food safety and nutrition in the near and distant future. In the following we present each of the main conclusions followed by the key question(s) for future research which they elicit:

1. **Cross-cutting policy measures are vital for the future of EU food safety and nutrition.** The importance of potential changes to the EU food safety and nutrition framework via cross-cutting policy measures is highlighted in the consultation results with the high assessments (based on average values) of the extent to which such measures are considered necessary across scenarios, as shown in Table 48 in the previous sub-section. Such measures would need to be based on a diversified approach involving collaboration between different policy and research areas. This also relates to the need emphasised by stakeholders for a more holistic approach to the design of legislation and policy in the area of food safety and nutrition. Scenarios in which it was found cross-cutting/inter-disciplinary policy measures were of particular importance were: Scenario 8 – 'Disruptions of agriculture from climate change', where jointly considering environmental, agricultural, trade and food safety policies, and how these impact on each other was considered to be critical; Scenario 4 – 'Severe inequality and highly polarised diets', where cross-cutting measures to combat the diverse determinants of unhealthy nutrition were emphasised (regarding the need for measures in this field see conclusion 6 below); and Scenario 7 – 'Global resource depletion', where an integrated farm-to-fork approach spanning resource use to waste was proposed, and the importance of viewing healthy diets and resource systems jointly was underlined. At the level of the Commission, this means that it is critical for policy measures in relation to food safety and nutrition to be considered in the context of strengthened cross-cutting collaboration between DG SANCO and other relevant Directorates-General – e.g. DG Agriculture, DG Environment, DG Trade or DG Research – but also in view of international developments and collaboration. Existing cross-cutting EU policies, notably those involving financial instruments such as the Common Agricultural Policy (CAP), could also be harnessed.

   This conclusion leads to the following question for further research:

   How can cross-cutting collaboration and policy design in the EU be reinforced to achieve the best outcomes for food safety and nutrition? Concretely, how could relevant Commission DGs further pool their resources and develop integrated strategies in order to jointly address food safety and nutrition issues? Do other relevant DGs – e.g. DG AGRI and DG Research - sufficiently take food safety and nutrition into consideration in their policy agendas?

2. **The area of food safety and the area of nutrition need distinct, separate approaches.** While important overlaps exist between the two areas (e.g. regarding the challenges of providing access to sufficient safe and nutritious food for vulnerable consumers, as highlighted in Scenario 4 – 'Severe inequality and highly polarised diets'), this scoping study has shown that in general future challenges to food safety are often distinct enough from those that concern nutrition to warrant distinct approaches. In particular, looking forward, results show that healthy and sustainable nutrition needs to be understood in a broad context through the analysis of a range of contributing social, political, economic and environmental factors; this is in contrast to the current specific topical approaches needed for food safety policy (e.g. relating to contaminants, biohazards, animal diseases, etc.). The pressing importance of nutrition to be strengthened as a distinct policy area of its own, but also as an area where policy action is urgently needed, is underscored by the fact that stakeholders considered Scenario 4 – 'Severe inequality and highly polarised diets' to be more plausible than implausible already by 2030 (based on average values). In addition, the extent to which stakeholders considered changes to policy and legislation relating to health

and nutrition as necessary across scenarios is notable (see Table 48). These findings are therefore indicative of a need for immediate and effective action and for more resources to be made available at EU level to combat nutritional problems, and to do so separately from – and without neglecting – food safety issues.

This conclusion leads to the following question for further research:

Which measures are needed and which resources need to be made available at EU level to address nutrition issues, and separately from food safety issues? Is there sufficient clarity concerning which EU service/institution should take the lead and implement and coordinate relevant actions across policy areas, in cooperation with Member States? In particular, is DG SANCO the right service to deal with these issues? If so, is it sufficiently equipped for taking on this role? If not, which other service should lead at EU level? Should a new nutrition task force or other structure be established?

3. **Policy measures and research programmes and projects to address both consumer and producer behaviour jointly are needed, particularly education and communication.** This is of particular importance for nutrition, as the results of this scoping study reconfirm that a range of dynamic social, cultural, political, economic and environmental factors are important determinants of healthy and sustainable nutrition. Stakeholders noted however that the critical determinants of healthy diets remain to be clearly identified, pointing to the need for further research in this area. It was in particular strongly emphasised by stakeholders that not only consumer behaviour is relevant for understanding nutrition habits, but also the behaviour of food producers. Product development, advertising and marketing influence consumers strongly in the choice of products, which if unhealthy may impact on obesity, disease and life expectancy. This means that a range of incentives to induce behavioural change can potentially be applied at all levels of the food chain, from primary production (e.g. concerning more sustainable production methods), to marketing and pricing of products (e.g. better nutrition labelling, possible fees, charges or taxes on unhealthy or unsustainable products) and on to consumption (e.g. measures to reduce meat consumption). These would need to be complemented by relevant education and communication measures (e.g. concerning nutrition-related knowledge, information and education to emphasise the advantages and lifestyle value of a more plant-based diet, but also cooking skills and elementary food safety rules, as a lack in these increases the need to consume processed foods). The high assessments across scenarios of the extent to which education and awareness raising, as well as improving communication are considered necessary (see Table 47) further support the notion that such measures are of key importance to the future of EU food safety and nutrition.

   This conclusion leads to the following questions for further research:

   What are the key determinants of healthy nutrition, and related household practices? Which measures can be targeted at key food chain stages to influence both consumer and producer behaviour to safeguard healthy nutrition with a reduced environmental footprint, and how effective are they in practice? What best practices should be promoted across the EU? Can public bodies, NGOs and the private sector be made to collaborate more effectively on healthy nutrition at local, regional, Member State and EU levels? Should more EU resources be allocated to promoting such collaboration?

4. **Conducting and encouraging scientific research and innovation directed towards safer foods and healthier diets are key measures for dealing with the challenges under the different scenarios**. The importance of both research and innovation to better understand and deal with the challenges described in the scenarios was underlined in the survey, as

research was considered the most important measure/course of action the EU should take across all scenarios (see Table 47), while innovation was considered the most positively impacted area across scenarios from a list of various key areas (see Table 46). Indeed, the latter can be interpreted as an indication of the positive outcomes that could emerge from the increasing pressure to innovate in order to tackle the challenges described in the scenarios. Stakeholder comments have revealed several areas that relate to all scenarios where research may need to focus, including:

- *Information and communication technologies (ICTs) to improve traceability and labelling in the food chain*. This scoping study has emphasised, particularly in Scenario 1 – 'Rapid surge in global trade', the potential of ICTs to address future food safety challenges in relation to traceability in complex food chains and the provision of detailed product information at the ingredient level, (e.g. digital labelling – albeit with the caveat that widespread use of digital labelling/traceability may also lead to an increased risk of digital fraud);
- *Advanced sensors/screening methods for testing of food products*. Such technology may be particularly relevant for effective enforcement – as was highlighted in Scenario 3 – 'Long-term austerity' – and with the rapid advances in relevant technologies they have the potential to be low cost, user-friendly, quick, accurate, reliable, and selective, with resulting large benefits for producers, enforcement bodies, and food safety in general;
- *Advanced modelling*. Modelling has been particularly emphasised throughout the scoping study in the context of understanding and mapping consumer behaviour and consumption patterns (in particular obesity), but also the spread of disease and other possible emerging risks (e.g. spread of contaminants through the food chain). While models to characterise specific aspects of the above list have been developed, so far no comprehensive modelling framework for food safety has been developed; or models that could integrate potential impacts on food safety and public health nutrition. Furthermore, for food safety it is important to base modelling on a holistic approach that takes into account the overall environment in which food is produced and consumed;
- *Sustainable food products.* Results of the scoping study emphasise the opportunity that new foods may offer – besides behavioural changes and a new focus on more plant based nutrition – in delivering both greater levels of nutrition and a reduction in environmental footprint and food waste (e.g. meat replacement products, artificial meat, cheap and healthy processed food).

The above key science and technology research areas lead to the following questions for further research:

How can ICTs that improve traceability and labelling of food products and integrate with food safety controls be promoted? How could the risk of digital fraud along the food chain be addressed? Which low-cost and reliable food safety testing methods are especially needed in the area of food safety controls, and how could their development be most effectively supported? Should new tools be developed to optimise risk-based monitoring/control, or can existing technologies be better harnessed? What aspects should be incorporated into a comprehensive food safety and public health nutrition modelling framework? Are there specific new foods on which research should be promoted to deliver both more healthy nutrition and a reduction in environmental footprint? Finally, what public-private partnerships could be fostered to kick-start research?

5. **International food chain governance should be consistently advanced.** The significance of international governance was highlighted by stakeholders with 'promoting international governance' considered most needed of the measures/courses of action suggested for all scenarios dealing with global challenges, i.e. Scenario 1 – 'Rapid surge in global trade', Scenario 2 – 'Break-down of global cooperation', Scenario 7 – 'Global resource depletion', Scenario 8 – 'Disruptions of agriculture from climate change' and Scenario 9 – 'Emerging food chain risks'. The relatively high assessments of plausibility of such scenarios (based on average values) coupled with their broad mutual compatibility – with the exception of Scenario 2 – 'Break-down of global cooperation', which was found least plausible – supports the notion that the future of EU food safety and nutrition in 2050 will depend increasingly on the actions of other global players (e.g. trade blocs, nation-states or multinational companies) and the extent to which cooperation can be achieved on a global scale, both regarding standards and their enforcement throughout the food chain. In this process of increasingly globalised standard setting and enforcement the EU will need to ensure that existing high standards on food safety are maintained or improved, rather than undermined through a 'race to the bottom'.

   This conclusion leads to the following questions for further research:

   Which areas are most in need of further harmonisation of standards? Which models for international governance constitute best practices, and which could be applied to specific food chain challenges? How could international information systems on food safety and nutrition be improved? Are there models for the enforcement of food safety standards that could be considered best practices? For example, could lessons be learned from the longstanding international cooperation in the field of animal health and related information systems?

6. **Promoting diversity in the food system is critical to increase resilience to future shocks or disruptions.** In order to achieve a resilient EU food system that can withstand a diverse range of challenges, the results of this scoping study point to the importance of diversity. While increasing sustainability of the food chain,[332] EU policies therefore need to also ensure that diversity in the food system, including different primary production models that employ diverse plant and animal genetic resources, as well as different processing, distribution and consumption models, remain in place. Diversity in the food system should also be increased, by promoting diverse agricultural models, production sizes and technological processes, encouraging short and direct food chains, such as the provision of food from local markets/producers, organic or low-input agriculture, urban gardening, to complement the increasingly complex and long international food web. To accomplish this, the diversity of food production models may necessitate legislation that is adapted to those that are not considered 'mainstream' (as was in particular emphasised in response to Scenario 5 – 'Shift to alternative production systems'). Furthermore, maintaining diversity over the long term may require innovative approaches, as it can be expected that the availability of support tools (such as direct support) will diminish through the increased liberalisation of agricultural markets.[333]

   This conclusion leads to the following questions for further research:

[332] Ongoing efforts include the EU Communication on Sustainable Food, which was not yet published at the time of finalisation of this report.

[333] For example, workshop participants emphasised the need for effective price stabilisation mechanisms, as further liberalisation of markets may lead to increased price volatility of certain agricultural commodities.

Where are the concrete possibilities for diversification of the food system? In particular, which specific food production and consumption models should be promoted as priorities to ensure sustainable diversity in the food system, and how can legislation be adapted to accommodate them? Which measures are needed to maintain and further develop diverse plant and animal genetic resources and diversity in the EU food system in general, especially in light of the increasing level of global trade and trade liberalisation? Which tools can be used to support relevant production models?

7. **Enforcement and controls, and in extension consumer trust, are paramount for EU food safety and nutrition.** As shown in Table 48, 'Enforcement and controls' is considered to be the policy area for which changes are most needed across all scenarios (based on average values). Another key indication of the importance attributed to controls by stakeholders is the result shown in Table 45, where Scenario 3 – 'Long-term austerity' (in which there is a reduction in official inspection services) is considered to induce significant negative impacts on food safety and nutrition policy areas. These findings reinforce the need for effective and efficient enforcement and controls in the context of all food safety and nutrition policy areas when looking to future challenges. This also points to the critical need to ensure sufficient resources are made available for public enforcement systems, as was also highlighted in response to Scenario 9 – 'Emerging food chain risks', where strong enforcement and controls was found to be essential for the management of emerging food chain risks. In addition, this scoping study has confirmed the importance of adequate enforcement and controls in safeguarding consumer trust, an issue which is prevalent in almost all scenarios (e.g. in relation to food origin and traceability, fraud, labelling and certification, disease outbreaks). As a result, to address specific challenges, research will be needed to investigate how existing enforcement systems can be made more effective and possibly integrated and harmonised, whether new partnerships for enforcement and control are needed, in which food business operators and public authorities develop complementary and coordinated approaches to increase food safety and maintain consumer trust. Relevant cost and responsibility sharing schemes between public and private institutions could in this regard also be explored.

   This conclusion leads to the following questions for further research:

   What are the determinants of effective enforcement in a diverse food system, with both short and alternative food chains, as well as long and globalised food chains being prevalent? Which institutional approaches - e.g. public, private, or a mix of both - are most effective and efficient? What best practices exist and how can they be promoted across the EU and internationally? What key tools are missing in current EU enforcement and control practices (which can be observed in third countries)? Is there a need for harmonisation of EU enforcement structures? How would public-private enforcement and controls in particular need to be designed to safeguard food safety under all foreseeable circumstances?

Annex I: Study methodology

This Annex presents the methodology used throughout the study, in particular the approach used for the design of the various methodological tools, from the inception phase to the conclusions and recommendations.

Inception phase

Initial literature review to establish drivers

An initial literature review was conducted focusing on the main challenges/driving forces (or drivers) for EU food safety and nutrition identified in the TOR – resource adequacy/efficiency, climate change, global governance, sustainability of energy and waste, consumer behaviour, malnutrition, obesity and healthy diets, and economic sustainability. Literature proposed by the Commission during the kick-off meeting was also included.

The literature reviewed for the purposes of outlining drivers included a series of foresight studies/prognostic documents from recognised international organisations (FAO, OECD, UN World Water Assessment Programme, UN Environment Programme); European organisations (European Environment Agency, European Commission - including the Standing Committee on Agricultural Research, and DG AGRI - European Cooperation in Science and Technology - COST, European Science Foundation - ESF); Member State organisations (French National Institute for Agricultural Research – INRA; Centre de cooperation internationale en recherche agronomique pour le développement – CIRAD); Member State governments (UK Government Office for Science); and European universities (Swedish University of Agricultural Sciences).

Following this review, the scoping of literature has continued throughout the study in accordance with methodological needs (see section below on scoping of literature for more details). A list of references is shown in Annex IV.

Selected key foresight studies/prognostic documents were then further reviewed in order to establish an initial list of drivers. Emphasis was placed on ensuring a wide coverage of potential drivers, with a selection of studies covering a range of focuses. The table below presents the selected studies, their main focus, and the abbreviation used in the following pages.

Table 49: Selected studies reviewed to establish initial drivers

Institution, year of study	Study name	Main focus	Abbreviation
European Commission – SCAR, 2007	2nd SCAR foresight exercise	Sustainable agriculture	SCAR 2
European Commission – SCAR, 2011	3rd SCAR foresight exercise	Sustainable agriculture	SCAR 3
UK Government Office for Science, Foresight, 2011.	The Future of Food and Farming: Challenges and Choices for Global Sustainability	Sustainable food systems	UK Foresight
United Nations World Water Assessment Programme, 2012	The Dynamics of Global Water Futures Driving Forces 2011 – 2050	Sustainable water supply	UN Water 2050
United Nations Environment Programme, 2012	GEO5 Global Environment Outlook. Environment for the future we want	The global environment	UN GEO 5
OECD, 2009	The Bioeconomy to 2030: Designing a Policy Agenda	The bioeconomy	OECD Bio 2030
Swedish University of Agricultural Sciences, 2011	Five Scenarios for 2050 – Conditions for Agriculture and Land Use, Uppsala	Agriculture and land use	SLU 2050
European Environment Agency, 2007	Land-use scenarios for Europe: qualitative and quantitative analysis on a European scale.	Land use	EEA PRELUDE

Source: Civic Consulting

Each study selected considered several drivers or challenges,[334] which were first categorised according to five main driver categories: policy/governance; economic; social; technological; and environmental. The table on the next pages shows this categorisation of drivers identified from each study reviewed.

[334] Note that some of the studies reviewed also used other terms to describe drivers/challenges (e.g. trends, pathways, pressures, factors, etc.).

Table 50: Review of drivers/challenges considered in relevant studies

Driver categories	SCAR 2	SCAR 3	UK Foresight	UN Water 2050	UN GEO 5	OECD Bio 2030	SLU 2050	EEA PRELUDE
Economic	- Global economy trends - Income distribution, inequality - Energy prices - Agri-food patterns: production, trade, distribution, consumption, waste; - Alternative agri-food visions; - Food prices (global demand for food, structure of the food system) - Fertiliser market and prices; - Farm labour market; - Food waste - Alternative food chains; - High value market segments - New form of service provision: co-production, local economies	- New socio-ecological production model - Agricultural knowledge systems - Economic development - Organisational innovations in food supply chains, - Social conditions of food production and transformation of farming systems	.	- Demand for water in developing countries - New economic polarities from water scarcity Infrastructure, including: - Access to potable water and to appropriate sanitation facilities - Inspection of all dams and dykes	- Economic development (consumption and production, markets and trade)	- Globalisation of trade in services (investments in R&D) - Higher incomes (demand for healthcare, meat, fish and specialty foods, consumer durables, automobiles, higher education, and travel)	- Economic development	- Economic growth - Agricultural optimisation - Self-sufficiency
Technological	- Genomics/ genetics - Functional food - Innovative developments by the agricultural machine industry - Nutri-genomics - Systems biology - Minimal and careful processing technologies - Farmer-based participatory breeding concepts - Nanotechnology	- Biotechnology - GMOs - Nanotechnology - ICTs - Agro-ecology		- Technology (products to conserve water, desalination technology)	- Scientific and technological innovation	- Computing and nanotech-nologies - Integrated pest management - Agro-ecology - Solar energy - Disease prevention	- Development and dissem-ination of new technology (e.g. biotechnology, resource cycle technology)	- Techno-logical growth

Driver categories	SCAR 2	SCAR 3	UK Foresight	UN Water 2050	UN GEO 5	OECD Bio 2030	SLU 2050	EEA PRELUDE
Social	- World population - Changing dominant values - Migration flows - Consumption quantities and patterns (nutritional transitions, obesity) - Social concerns over new technologies (e.g. over animal cloning, agricultural GMOs, nanotechnologies) - Diversity in lifestyles - Human and social capital in rural areas - Demographic trends in rural areas - Non-agricultural economic activity	- Urban transition and the new territorial dynamics - Demographic transition and active ageing. - Urbanization - Increasing variety of food consumption, habits are changing, divergence in diet between the rich and poor	- Global population increases - Urbanisation - Issues of national interest and 'food sovereignty' - Acceptability of modern technology - Importance accorded to particular regulated and highly specified production methods - Value placed on animal welfare - Importance of environmental sustainability and biodiversity protection - Issues of equity and fair trade - Demand for meat; - Demand for fish	- Demography (World population size) Ethics, society and culture (+equity), including: -Intergener-ational equity, - Inequalities in access to water	- Population (demography, migration) - Distribution pattern processes – (inter- and intra-generational) - Cultural, social and political institutional processes (including production and service sectors)	- Population growth (Increase of food demand) - Ageing (Increase of the prevalence of neurodegenera tive and other diseases of old age)	- Human population growth (migration flows included) - Consumption patterns	- Population growth - Ageing - Settlement density - Internal migration - Immigration - Daily mobility - Social equity - Quality of life - Human behaviour - Health concerns
Policy/gov-ernance	- Kyoto protocol; - MDG; - Doha round agreements - CAP reform - Rural policies (diversification of rural economies) - Agri-energy policies - Sustainable consumption and production;	- Multi-polar world and world governance - Politico-cultural transition towards a new universalism - Large integrated Europe and a global Europe - Global governance	- Globalisation of markets - Emergence of new food superpowers - Trend for consolidation in the private sector - Trade (subsidies, restrictions, etc.) - Multi- or uni-lateralism - International institutional architecture	- Governance and institutions (+right to water) - Politics - Transparency and participation procedures - Centralised decision-making	-	-	Distribution of power, including: - Role of strong states, - Role of intergovernmen tal organisations, - Role of private companies, - Role of NGOs	- Policy intervention - Subsidiarity - International trade

Driver categories	SCAR 2	SCAR 3	UK Foresight	UN Water 2050	UN GEO 5	OECD Bio 2030	SLU 2050	EEA PRELUDE
Environmental	- Climate change - Reactive nitrogen depositions - Water - Soils - Biodiversity - Oil reserves - Agriculture and greenhouse emissions/soil degradation/water quality/biodiversity - Pesticide use - Pandemic pests and diseases in animal and plant production - Agriculture and environmental services - New agricultural visions - Resource-efficient agriculture (LEISA) - Local biodiversity programmes - Herbicide resistance in major crops - Widespread pandemic diseases and resistance against antibiotics - Phosphorus peak	- Fertile land - Water - Energy - Nitrogen - Phosphorus - Climate change - Biodiversity - Forestry - Fishery and aquaculture - Bioenergy	- Climate change (Rising temperatures and changing patterns of precipitation) - Climate change mitigation policies - Competition for key resources, including: - Land for food production, - Global energy demand, - Global water demand.	- Agriculture (Increasing water withdrawals, increasing water productivity, fertiliser prices) - Climate change and variability (Risk from water stress, delta land vulnerable to serious flooding) - Water resources, including groundwater and ecosystems (water productivity in agriculture, droughts) - Severe freshwater scarcity	- Land use - Resource extraction - External inputs (fertilisers, chemicals, irrigation) - Emissions (pollutants and waste) -Modification and movement of organisms - Solar radiation, volcanoes and earthquakes	- Climate change (Spread of new diseases, reducing yields, stress on crops)	- Climate change - Access to water - Availability of wild fish and aquaculture - Access to energy sources Natural resources, including: - Area of agricultural land - Fertility of arable land - Potential for production and ecosystem services - Availability of agricultural inputs (e.g. phosphorus)	- Climate change - Environ-mental awareness - Renewable energy

Source: Civic Consulting.

This review of relevant studies provided the conceptual basis for the identification of drivers which would potentially be relevant from a food chain/food safety and nutrition perspective. On the basis of the drivers identified in each of the studies, we established 20 initial drivers with a selection of four most relevant drivers for each of the five driver categories. This list, which served as a basis to be refined following exploratory interviews, is presented below.

Table 51: Initial list of drivers used for exploratory interviews

Driver category	Trends identified
Policy/governance	Trade orientation and globalisation of food and related commodity markets (e.g. volume of trade, trade agreements, existence of free trade zones involving EU)
	International food chain governance and cooperation (e.g. extent to which governments act collectively or individually in addressing threats and opportunities)
	EU and Member State government intervention levels (level of centralisation in the EU, public vs. private sector responsibilities, size of government, control systems)
	Other policy/governance drivers (e.g. level of transparency/participation)
Economic	Global food and related commodity prices (economic sustainability)
	Global economic development (including emerging economies, income distribution)
	Intensification and integration level of EU agriculture and food chain industries (including transformation of farming systems/agriculture, role of multinational companies, alternative food chains, regional and local markets)
	Other economic drivers (e.g. transfer of agricultural and food chain knowledge, food waste and recycling)
Social	Consumption patterns and demand (e.g. diets/lifestyle, in particular meat consumption, demand for high value food and high-tech food products)
	Consumer trust and food-related values/acceptance of technologies (e.g. values placed on animal welfare, organic food, protection of biodiversity/environment, fair trade, acceptance of innovations such as artificial meat, animal cloning, GMOs)
	Population growth, demography (ageing) and migration flows (including urbanisation/de-urbanisation)
	Other social drivers (e.g. bioterrorism)
Technological	Nanotechnology
	Biotechnology and GMOs
	Information and communications technologies (ICTs)
	Other technological drivers (e.g. functional food, and new agricultural, processing and packaging technologies etc.)
Environmental	Climate change (e.g. increased/decreased agricultural production)
	Emerging diseases/threats (including those caused by movements of humans, animals, pathogens, and pests; disasters impacting the food chain)
	Competition for key resources - particularly: fossil energy, phosphorus, water, nitrogen, fertile land, marine resources - and biodiversity
	Other environmental drivers (e.g. other emissions relevant for the food chain, volcanoes, earthquakes and changes in solar radiation)

Exploratory interviews

Following the identification of initial drivers, on 20 February 2013 the FCEC conducted seven individual interviews with DG SANCO policy officers. The interviews consisted of semi-structured discussions with the main objective of identifying perceived current and possible future main challenges in the units' respective policy areas, as well as refining the initial list of drivers presented above. The exercise proved useful in particular in identifying the perceived future relevance of possible drivers for various DG SANCO policy areas. Following this first round of interviews, relevant modifications to the driver list were made in preparation for the scoping of literature (see next section). Subsequently, during the month of March 2013, we conducted 12 interviews with selected experts. All interviewees are listed in Annex II.

Scoping of literature

Process for identification of literature and cataloguing using Mendeley

Several software applications were considered to facilitate the organisation of relevant literature for the study in a database. In light of the ease of cataloguing, annotating, citing, and linking documents, inter alia, the reference management application Mendeley was chosen to streamline the review process. The programme allows users to read and annotate PDFs, back up and synchronise files across computers, and easily create academic referencing.

A total of 559 relevant documents were initially identified and catalogued for the purposes of drafting the driver briefings (see next section). Initial literature was gathered from desk research, in particular from the databases of relevant international organisations. Additional literature was found from the bibliographies of relevant literature as well as from recommendations by interviewees. All documents were downloaded, filed and imported into Mendeley. The software aided in efficiently and clearly organising research, particularly as it allowed full-text search across all documents. The literature was then listed in the software according to author, title and year of publication. Missing information was retrieved from studying the literature of the relevant document. Documenting the abstracts and appropriate bibliographic references of documents using Mendeley allowed for an organised overview of the literature.

The full list of documents reviewed in the inception phase is provided in Annex IV.

Categorisation of documents according to initial drivers

After all documents were catalogued, the documents were further reviewed in order to accurately tag each document according to the initial drivers identified. Each document was tagged in the database with one or more drivers depending on the breadth and depth of the document. After the initial drivers were revised (see next section for more details), the tags were also subsequently revised.

Selection of key documents for review

In order to draft driver briefings, key documents for review needed to be identified. To this end, criteria for identifying key documents were established. Documents tagged as key documents needed to:

- Be published after the year 2005; and

- Contain prognostic elements (minimum 2020) for at least one initial driver identified; and
- Be relevant to a EU Member State; and
- Be relevant for the food chain; *or* feature reference scenarios for the driver produced by a relevant organisation (e.g. UN World population programme, FAO, IPCC, IEA, IMF, World Bank, OIE, OECD, USDA, WFP, IFAD, etc.);

Compilation of driver briefings

The scoping of literature according to initial drivers, as well as the exploratory interviews, served to achieve the following objectives:

- Locate key sources of information regarding each driver;
- Confirm or infirm the relevance of drivers for the EU food chain/food safety and nutrition;
- Identify individual trends in each of the drivers;
- Highlight quantitative and qualitative (textual and graphical) information on these trends, as well as projections/forecasts on future trends;
- Provide examples of implications of trends for the EU food chain/food safety and nutrition; and
- Indicate interrelationships between drivers, via examples.

On the basis of information collected regarding the above points, we systematically revised the initial list of drivers. In particular, it was deemed of key importance – for the drafting of complete and coherent briefings, and for the further process in general – that each revised driver:

- Be sufficiently examined in publicly available literature from academic or policy making institutions such that a wide range of information is available;
- Be of clear relevance to the EU food chain/food safety nutrition;
- Feature at least three clearly identifiable current trends, each with one or more future projections or forecasts from recognised and credible sources, if possible;
- Could not reasonably be considered to be a 'sub-driver' or trend within another driver.

The above conditions allowed for the initial list of 20 drivers to be consolidated into a list of 10 main drivers, each with four-to-six trends and (sub-)drivers, and grouped by four main driver categories. These trends then served as a basis for the driver briefings.

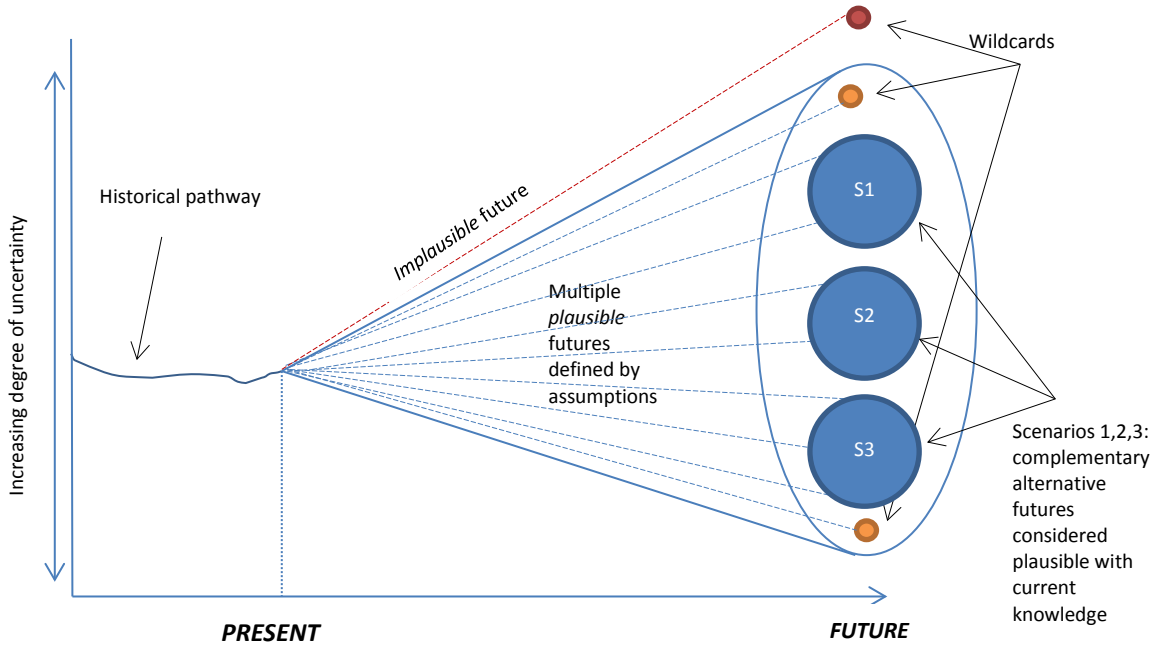
Following the revision of drivers described in the previous section, work began on the drafting of the corresponding briefings. In line with the initial information collected from the literature review and interviews, we produced a general template to be followed for all briefings. As each key document had already been tagged in the database with the initial driver identified, driver tags were first updated in line with the revised driver list. Then, at the time of drafting of each driver briefing, the corresponding tagged key documents identified in the scoping phase were accessed to obtain the relevant information. Finally,

after the drafting of briefings was completed, they were given a layout to bring them in a format suitable for support material at the 1st workshop.

Scenario-building methodology and initial scenarios

Scenarios can be seen as plausible alternative futures, i.e. futures that could occur under certain assumptions. They are used both as an exploratory method or a tool for decision-making, mainly to highlight the discontinuities from the present and to reveal the available choices and their potential consequences.[335] In this context a scenario represents a pathway defined by a set of assumptions regarding the future developments of drivers. The aim of our scenario-building approach was to develop a set of complementary plausible futures, while excluding those futures that could be considered implausible (without making any judgment concerning the likelihood of the selected scenarios). In other words, scenarios are not predictions, nor should they be taken as the most likely or desirable of the myriad of possible futures. At most, they paint pictures of a limited number of plausible futures, and the real future is likely to include elements of several of the scenarios. This is represented more explicitly in the graph below, which depicts scenarios as groupings of plausible alternative futures.

Figure 69: Scenarios as complementary plausible futures



Source: Civic Consulting.

This initial understanding of scenarios served as a guiding principle throughout the scenario-building process.

[335] European Commission, JRC (IPTS), Online Foresight Guide.

We first conducted an extensive review of the literature on scenario-building in the area of the food chain and related areas, and focused in particular on recent scenario studies that were relevant in the context of the study (for more details regarding literature reviewed, see the section on scoping of literature above). This review aimed at producing an overview of the main methods used, both in terms of the methodology for scenario building and specific aspects related to food systems scenarios. Concurrently, we interviewed foresight experts and participants of previous foresight studies.

Following the literature review and interviews, the initial scenario-building approach derived consisted of a classical scenario matrix complemented by the morphological analysis of driver states.[336] As shown below however, the initial approach was subsequently refined on the basis of results of the 1st workshop.

1st workshop

The main aims of the 1st workshop, which took place in Brussels on 31 May 2013, were to present and discuss the suggested methodology for the exercise at expert level and bring together a diverse range of expertise to discuss the critical drivers of change and their implications for EU food safety and nutrition in 2050, in an interdisciplinary context and from a forward-looking perspective. Experts were invited to attend on the basis of the relevance of their expertise for the key drivers identified. Prior to the workshop, participants received preparatory materials – the driver briefings – to facilitate discussion on the day of the workshop. A full list of workshop participants is provided in Annex II.

A key result of the workshop was the validation and refinement of the set of ten key drivers of food safety and nutrition. The workshop also provided essential feedback on the initial scenario-building methodology. In particular, in the aftermath of the workshop it was concluded that the scenario building approach needed to be refined, in light of the comments provided by participants, in order to avoid some of the limitations posed by the 'classical' scenario matrix.

Updated approach: scenarios and survey

Updated approach to scenario-building

On the basis of results of the 1st workshop, a *driver-specific* approach for scenario-building was adopted. According to this approach, each scenario focuses on one driver, with the aim of capturing key *disruptions* or gradually developing *stresses* occurring between now and 2050 relating to the main trends of relevance in that driver. *A key requirement was that the scenarios challenge the current EU policy and legislative food safety and nutrition framework by exposing its vulnerabilities; more benign scenarios outlining futures with limited disruptions or gradual stresses, or scenarios depicting challenges that were not relevant in the context of this study were not considered.*

[336] A scenario matrix involves the selection of two, relatively independent, high impact and highly uncertain dimensions of the system, in order to generate four distinct complementary scenarios on the basis of these dimensions. Morphological analysis involves the definition of discrete 'states' for each of the drivers (i.e. plausible future developments), in order to produce scenarios based on plausible combinations of driver states.

For each of the ten drivers validated during the 1st workshop, we therefore identified key trends and uncertainties most suited to define a driver-specific scenario, taking into account relevant interrelationships between the scenario driver and other drivers. Criteria for the identification of key trends and uncertainties most suited to define a driver-specific scenario were as follows:

a) Potential to challenge the EU food safety and nutrition framework, either as gradually developing stresses or as potential disruptions;

b) Relevance to the EU food safety and nutrition framework;

c) Outcomes of the 1st workshop.

When identifying key trends and uncertainties for each of the ten drivers that have the potential to challenge the EU food safety and nutrition framework, potential 'stresses' or 'disruptions' are not to be understood as necessarily negative or catastrophic events. Gradually developing stresses may result from trends such as increasing obesity and polarization of diets. However, they may also result from rapid globalization of food chains and related complexities, for example. Similarly, potential disruptions, which signify ruptures or sudden breaks in the projected trends in the drivers, may prove detrimental or beneficial, or a mix of both. An example of a catastrophic disruption is a major pandemic, a more beneficial disruption, however, could result from major food chain technological breakthroughs.

In order to clearly identify the vulnerabilities in the framework caused by gradually developing stresses or potential disruptions relating to a driver, each scenario was designed to explore a single driver-related stress/disruption and its related secondary effects resulting from the interrelationships between drivers. In this way, the scenarios allow for complex sets of inter-connected drivers and trends to be unpacked, without disregarding the most important interrelationships related to the driver under consideration.

Accordingly, 10 initial driver-specific scenarios were developed to depict a variety of the most challenging potential disruptions or critical developments to the EU food safety and nutrition legislative and policy framework from the 10 drivers identified, with the principal aim of testing the current and future resilience of this framework until 2050, and thereby investigating which potential future policy measures may be necessary to increase its resilience.

Stakeholder/expert consultation

Following the 1st workshop, it was concluded that a targeted consultation of selected experts and stakeholders, consisting of a survey to be followed up by the 3rd workshop, constituted the optimal tool to ensure that relevant stakeholders participated in the study at the appropriate stage.[337] The main purpose of the survey would be to collect stakeholders' and experts' views on potential impacts on EU food safety and nutrition under the scenarios, and explore potential measures to face the challenges described and areas for future research.

2nd workshop

The main aims of the 2nd expert workshop, which took place in Brussels on 18 September 2013, were to explore and refine the draft scenarios prepared, and assess the importance of

[337] This replaced the modelling exercise that was initially planned for as part of the study's Terms of Reference, for which the CAPRI modelling framework had been foreseen.

the scenarios for EU food safety and nutrition in 2050. As with the 1st workshop, experts were invited to attend on the basis of the relevance of their expertise for the scenarios to be discussed, and were provided with preparatory materials (the draft scenarios) prior to the workshop to facilitate discussion on the day of the workshop. A full list of workshop participants is provided in Annex II

Broad consensus among participants was achieved on largely maintaining the original number of scenarios, to more readily allow for the distinct challenges posed to the EU food safety and nutrition framework to be assessed separately. Ultimately however, a total of nine scenarios were maintained for the further analysis.[338] An additional aim of the workshop was to explore survey themes concerning the implications for food safety and nutrition under these scenarios. The themes discussed then formed the basis of the stakeholder/expert survey to be conducted.

Survey design and implementation, including additional interviews

Based on the results of the 2nd workshop, the FCEC produced a draft questionnaire for the stakeholder/expert consultation. A pilot survey was then implemented online via the use of tailor-made survey software (Qualtrics). The questionnaire was subsequently piloted with several organisations - a consumer organisation, a food operator, and a public authority. Based on the feedback received during interviews with these organisations, a final version of the survey was produced for broad-scale implementation online using the Qualtrics platform on 18 October 2013.

The survey was targeted at key stakeholders in the area of food safety and nutrition at the EU and Member State level, including competent authorities, industry associations, international organisations, consumer organisations, other non-government organisations, and independent experts. Contact lists were retrieved from a variety of sources, including Commission suggestions, workshop participants, relevant stakeholder databases,[339] and the FCEC's own research. In addition, in parallel to the survey, additional in-depth interviews were conducted with selected experts having participated in the workshops, which served to elaborate on the responses provided. A full list of interviewees is provided in Annex II.

As mentioned above, the main purpose of the survey was to assess the potential impacts on EU food safety and nutrition under the scenarios, and explore potential measures to face the challenges described and areas for future research. Stakeholders and experts consulted were presented with an overview of the scenarios and the related challenges and were requested to deselect the scenarios they did not wish to assess. Each scenario assessment then consisted of a description illustrating the disruption or gradual stress related to the scenario driver and the key changes having occurred by 2050 as a result, followed by a list of key assumptions for each scenario, and a series of seven questions relating to the scenario's plausibility and impacts, potential policy measures to counter the challenges described, and areas for future

[338] Initial scenarios for the drivers 'Global economy and trade' and 'New agri-food chain structures' were merged.

[339] In particular stakeholders participating in the High Level Forum for a Better Functioning Food Supply Chain set up by the European Commission, as well as the Collab4safety stakeholder database (http://web.spi.pt/collab4safety/), a global database of stakeholders whose profession or research relates to food safety.

research. More specifically, the questions presented to respondents as part of each scenario assessment related to:[340]

1. The plausibility of the scenario, according to various timeframes;
2. Impacts on food chain activities as a result of the scenario;
3. Impacts on food safety and nutrition policy areas as a result of the scenario;
4. Impacts on other areas as a result of this scenario;
5. Measures/course of action the EU should take to face the challenges posed by the scenario;
6. Potential changes needed to adapt the current EU legislative and policy framework for food safety and nutrition to the challenges posed by the scenario; and
7. Issues for future research.

3rd workshop, survey closure and conclusions and recommendations

The aim of the 3rd and final workshop, which took place on 10 December 2013, was to present and discuss results of the stakeholder/expert survey with a view to formulating conclusions and recommendations as to potential future policy measures necessary to face the challenges described in the scenarios and supporting future research. To this end, only all those responses received a few days prior to the workshop were taken into consideration for the workshop, to allow sufficient time for an analysis of the assessments obtained.[341] Key stakeholders and experts were invited to attend the workshop on the basis of their participation in the survey (a full list of participants is provided in Annex II). As with previous workshops, prior to the workshop participants were provided with preparatory materials. These consisted of a summary by scenario of the assessments received, highlighting in particular stakeholder and expert comments in response to key questions regarding potential changes to the EU food safety and nutrition framework as a result of the scenarios, and areas for future research.

Overall, the final workshop served to add to, clarify, and refine comments made by stakeholders and experts in the consultation with regard to potential changes to the EU food safety and nutrition framework and areas for future research, by scenario, as well as highlight key cross-cutting aspects for these two points applying to all scenarios. Conclusions of the workshop are incorporated into Section 5 on the study's overall conclusions.

Following the final workshop, the survey was definitively closed on 13 December 2013, at which time a total of 129 responses had been received (a full list of organisations that participated in the survey is provided in Annex II). Finally, on the basis of the results from each of methodological tools used over the course of the study– the three stakeholder and expert workshops, the driver identification process and briefings produced on the basis of a literature review, expert interviews, and the large-scale consultation of stakeholders and experts – key conclusions and recommendations were elaborated (see Section 5).

[340] More details on the survey methodology are provided in Section 5.1.3.

[341] Although the definitive assessments differed only marginally, as subsequent to the workshop only an additional 9 responses were received.

Annex II: Stakeholders consulted

Interviewees

Table 52: Interviewees[342]

Last name	First name	Organisation
Baayen	Robert	DG SANCO - Plant health (E2)
Bodenbach	Stephanie	DG SANCO - Nutrition, food composition and information (E4)
Bregeon	Thomas	DG SANCO - Biotechnology (E1)
Cornelia	Flora	Iowa State University
de Smet	Kris	DG SANCO - Food hygiene (G4)
Frewer	Lynn	Newcastle University
Kalk	Christiaan	Wageningen University
Kurppa	Sirpa	MTT Agrifood Research Finland, Finnish Association of the Club of Rome
Laddomada	Alberto	DG SANCO - Animal health (G2)
Lang	Tim	City University London
Marvin	Hans	RIKILT Institute of Food Safety, Wageningen University
Mathijs	Erik	University of Leuven
Millstone	Erik	University of Sussex
Öborn	Ingrid	Swedish University of Agriculture Sciences
Pitton	Patrizia	DG SANCO - Chemicals, contaminants, pesticides (E3)
Robinson	Tobin	European Food Safety Authority (EFSA)
Ronzon	Tévécia	Independent researcher, formerly INRA
Rowe	Gene	Gene Rowe evaluations
Russel	Marie	National Institute for Agricultural Research (INRA)
Scannell	Michael	Food and Veterinary Office - European Commission
Schlundt	Jørgen	National Food Institute, Technical University of Denmark
Simonin	Denis	DG SANCO - Animal welfare (G3)
Tait	Joyce	UK Department for Environment, Food and Rural Affairs (DEFRA)
Timmermans	Toine	Wageningen University

[342] Note that selected interviewees were interviewed on several occasions throughout the course of the study

Treyer	Sébastien	Institute for sustainable development and international relations (IDDRI)
Vereijken	Johan	Wageningen (ESF/COST study)
von Witzke	Harald	Humboldt-Universität zu Berlin
Wittmer	Heidi	Helmholtz Centre for Environmental Research
Witzke	Heinz-Peter	Eurocare – University of Bonn

Workshop participants

Table 53: Participants at 1st workshop

Last name	First name	Organisation	Position
Brennan	Mary	University of Newcastle	Senior Lecturer in Food Marketing
Cogill	Bruce	Bioversity International	Programme Leader, Nutrition and Marketing Diversity Programme
Davies	Sue	Which?/EFSA Management Board	Chief Policy Adviser
Havelaar	Arie	Utrecht University, Institute for Risk Assessment Sciences	Deputy Head
James	Philip	International Association for the Study of Obesity (IASO)	President
Jozwiak	Ákos	National Food Chain Safety Office System Management and Supervision Directorate	Vice-director
Kalk	Christiaan	Food and biobased research UR, University of Wageningen	Business Development Manager, Healthy Foods
Leeson	George	Oxford Institute of Population Ageing/ Department of Sociology, Oxford Martin Programme on the Future of Food, Oxford University	Co-Director/Senior Research Fellow
Marvin	Hans	RIKILT - Institute of Food Safety, University of Wageningen	DLO Researcher
Millstone	Erik	STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre, Sussex University	Professor of Science Policy
Pederson	Robert	University of Aalborg, Foodscapes Innovation and Networks	Research Assistant
Pfeiffer	Dirk	Department of Production and Population Health, Royal Veterinary College (RVC)	Professor of Veterinary Epidemiology, Head of the Veterinary Epidemiology, Economics and Public Health Group
Robinson	Tobin	European Food Safety Authority (EFSA)	Head of Scientific Committee and Emerging risks Unit
Ronzon	Tevecia	INRA – Foresight Unit (formerly)	Independent researcher
Schlundt	Jørgen	National Food Institute, Technical University of Denmark	Director of Institute
Shepherd	Richard	Food, Consumer Behaviour and Health Research Centre, Department of Psychology, University of Surrey	Emeritus Professor of Psychology
Smith	Fiona	University College London	Senior Lecturer
Tait	Joyce	ESRC (UK Economic and Social Research Council) Centre for Social and Economic Research on Innovation in Genomics (INNOGEN), University of Edinburgh	Professor
ten Brink	Patrick	Institute for European Environmental Policy	Senior Fellow and Head of Brussels

		(IEEP)	office
Vereijken	Johan	University of Wageningen	External employee
Wittmer	Heidi	Helmholtz Centre for Environmental Research	Deputy head of the Department of Environmental Politics and senior researcher

Source: Civic Consulting. Note that European Commission participants at the workshop are not listed in the table.

Table 54: Participants at 2nd workshop

Last name	First name	Organisation	Position
Davies	Sue	Which?/EFSA Management Board	Chief Policy Adviser
Fino	Michele	Università degli Studi di Scienze Gastronomiche	Associate Professor of Fundamentals of European Law
Guerin	Benoit	RAND Europe	Associate Analyst
Jozwiak	Ákos	National Food Chain Safety Office System Management and Supervision Directorate	Vice-director
Kalk	Christiaan	Food and biobased research UR, University of Wageningen	Business Development Manager, Healthy Foods
Kearney	John	Department of Biological Sciences, Dublin Institute of Technology (DIT)	Lecturer, Epidemiology
Leboucq	Nadège	World Animal Health Organisation (OIE)	OIE Sub-Regional Representation in Brussels
Marsh	Tim	Micro Health Simulations (MHS)	Executive Director
Marvin	Hans	RIKILT - Institute of Food Safety, University of Wageningen	DLO Researcher
Pederson	Robert	University of Aalborg, Foodscapes Innovation and Networks	Research Assistant
Pezzana	Andrea	Università degli Studi di Scienze Gastronomiche	Head of Hospital Dietetics and Clinical Nutrition Unit - Coordinator of Piedmont Clinical Nutrition Network
Robinson	Tobin	European Food Safety Authority (EFSA)	Head of Scientific Committee and Emerging risks Unit
Rowe	Gene	Gene Rowe Evaluations	
Russel	Marie	National Institute for Agricultural Research (INRA)	SUSFOOD ERA-Net Coordinator
Smith	Fiona	University College London	Senior Lecturer
Stewart-Knox	Barbara	University of Bradford	Professor of Psychology
ten Brink	Patrick	Institute for European Environmental Policy (IEEP)	Senior Fellow and Head of Brussels office
Treyer	Sebastien	Institute for sustainable development and international relations (IDDRI)	Director of Programmes
von Lampe	Martin	Organisation for Economic Cooperation and Development (OECD)	Senior Agricultural Policy Analyst

Source: Civic Consulting. Note that European Commission participants at the workshop are not listed in the table.

Table 55: Participants at 3rd workshop

Last name	First name	Organisation	Position
Bhatiani	Ravi	Independent Retailers of Europe (UGAL)	Director Legal Affairs
Bourgeois	Robin	The Global Forum on Agriculture research (GFAR)	Senior Foresight and Development Policies Expert
Castenmiller	Jacqueline	Netherlands Food and Consumer Product Safety Authority	Advisor Food Safety/Nutrition
Eversheim	Franz	BAYER	Director of public affaires
Frison	Emile	Biodiversity International (CGIAR)	ex-Director General
Gerritsen	Eric	WWF	Policy officer
Guerin	Benoit	RAND Europe	Associate Analyst
Huggett	Anthony	Nestlé	Corporate head of quality
Jacobs	Dirk	FoodDrinkEurope	Director Consumer Information, Diet and Health
Kalk	Christiaan	Food and biobased research UR, University of Wageningen	Business Development Manager, Healthy Foods
Leeson	George	Oxford Institute of Population Ageing/ Department of Sociology, Oxford Martin Programme on the Future of Food, Oxford University	Co-Director/Senior Research Fellow
Marsh	Tim	Micro Health Simulations	Executive Director
Messa	Marta	Slow Food	Policy officer
Millstone	Erik	STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre, Sussex University	Professor of Science Policy
O'Brien	John	Nestlé	Head of food safety & quality department, Nestlé Research Centre
Pezzana	Andrea	Università degli Studi di Scienze Gastronomiche	Head of Hospital Dietetics and Clinical Nutrition Unit - Coordinator of Piedmont Clinical Nutrition Network
Pfeiffer	Dirk	Department of Production and Population Health, Royal Veterinary College (RVC)	Professor of Veterinary Epidemiology, Head of the Veterinary Epidemiology, Economics and Public Health Group
Rokka	Susanna	MTT Agrifood Research Finland, Finnish Association of the Club of Rome	Researcher
Russel	Marie	National Institute for Agricultural Research (INRA)	SUSFOOD ERA-Net Coordinator
Tansey	Geoff		Independent expert
Veale	Ruth	Bureau Européen des Consommateurs (BEUC)	Head of Food, Health, Environment and Safety Department

Wittmer	Heidi	Helmholtz Centre for Environmental Research	Deputy head of the Department of Environmental Politics and senior researcher

Source: Civic Consulting. Note that European Commission participants at the workshop are not listed in the table.

Survey participants

Table 56: Organisations of survey participants

Organisation	Type of institution	Country
A.G.O.N. consulting	Independent expert	Italy
AGES - Austrian Agency for Health and Food Safety	Public authority	Austria
Agricultural University of Athens	University/ research organisation	Greece
Analiza Calidad	Other - Laboratory analysis and accessory in food safety	Spain
Anses - Food Safety Laboratory, Maisons-Alfort (FR)	Public authority	France
AquaGen AS	Food industry association/ operator	
Aristotle University of Thessaloniki	University/ research organisation	Greece
Austrian Agency for Health and Food Safety (AGES)	Other - Public Authority and Research Organisation	
Aviagen Group	Other - Breeding industry	
Bayer CropScience	Other - Company	
Belgium Federal Food Safety Agency	Public authority	Belgium
BelOrta	Other - Producer organisation	Belgium
BGA - Bundesverband, Großhandel, Außenhandel, Dienstleistungen e.V.	Food industry association/ operator	
Biodiversity International (CGIAR)	International organization	
BOKU - University of Natural Resources and Life Sciences, Vienna	University/ research organisation	Austria
Bulgarian Food Safety Agency, Regional Food Safety Directorate - Sofia	Independent expert	Bulgaria
Centro de Investigacion y Tecnologia Agroalimentaria de Aragon	University/ research organisation	Spain
CFA	Food industry association/ operator	United Kingdom
CIRAD	University/ research organisation	Reunion
CIRAD (Centre de coopération internationale en recherche agronomique	University/ research organisation	France
Committee of Professional Agricultural Organisations - General Confeeratin of Agricultural Cooperatives (COPA-COGECA)	Food industry association/ operator	
Croatian Food Agency	Other - Governmental institution	Croatia
Department of Biological Sciences, Dublin Institute of Technology (DIT)	University/ research organisation	

Department of Production and Population Health, Royal Veterinary College (RVC)	University/ research organisation	
Department of Public Health and Policy, University of Liverpool	University/research organisation	
Dublin Institute of Technology	University/ research organisation	Ireland
EUCOLAIT - Euro pean Association of Dairy Trade	Other - Trade association	
Eurofins Analytics France	Other - Contract laboratory food testing	France
Eurogroup for animals	Other - NGO	
European Association of Bioindustries (EUROPABIO)	Food industry association/ operator	
European Coffee Federation (ECF)	Food industry association/operator	
European Community of Consumer Cooperatives (Euro Coop)	Other - Consumer cooperatives	
European Dairy Association (EDA)	Food industry association/ operator	
European Heart Network (EHN)	Other - Public Health NGO	
European Livestock And Meat Trading Union (UECBV)	Food industry association/ operator	
European Public Health Alliance (EPHA)	Consumer organisation/NGO	
Faculty of Engineering University of Porto	University/ research organisation	Portugal
Federal Institute for Risk Assessment	Public authority	Germany
Federation of European Specialty Food Ingredients Industies (ELC)	Food industry association/ operator	
Federation of the Food and Drink Industries of the Czech Republic	Food industry association/ operator	
FEDIOL	Food industry association/operator	
Food and Agriculture Organization of the United Nations, FAO - Regional Office for Europe and Central Asia	International Organisation	
Food Control Consultants Ltd	Independent expert	United Kingdom
FoodDrinkEurope	Food industry association/ operator	
Frank Judge & Company	Independent expert	Ireland
German Federal Ministry of Food, Agriculture and Consumer Protection	Public authority	
Gesco	Food industry association/ operator	Italy
GLOBAL 2000	Consumer organisation/NGO	Austria
IFAH-EUROPE- International Federation for Animal Health-	International organisation	

Europe		
INIAV, Instituto Nacional de Investigação Agrária e Veterinária	University/ research organisation	
INRA – Foresight Unit (formerly)	Independent expert	
Institut Symlog de France	Independent expert	France
Institute for sustainable development and international relations (Iddri)	University/ research organisation	
Institute of Feed and Food Science and Nutrition, Catholic University	University/ research organisation	Italy
Instituto de Ciencia y Tecnología de Alimentos y Nutrición, ICTAN	University/ research organisation	Spain
Instituto de Investigacion y Formacion Agraria y Pesquera (IFAPA)	University/ research organisation	Spain
Instituto Politécnico de Viana do Castelo - Escola Superior Agraria	University/ research organisation	Portugal
Jaen University	University/ research organisation	Spain
Laboratório Regional de Veterinária e Segurança Alimentar - Funchal	Public authority	Portugal
LK, Landwirtschaftskammer Österreich. Chamber of Agriculture	Food industry association/ operator	
Ministry of Agriculture and Rural Development	Public authority	
Ministry of Food, Agriculture and Fisheries of Denmark	Public authority	
Ministry of Rural Development	Public authority	Hungary
Mountain Research Centre (CIMO), Institute of Bragança	University/ research organisation	Portugal
MTT Agrifood Research Finland, Finnish Association of the Club of Rome	Public authority	
N.C.S.R. DEMOKRITOS	Independent expert	Greece
National Food Agency	Public authority	Sweden
National Food Agency	Public authority	
National Food Chain Safety Office	Public authority	
National Food Chain Safety Office	Public authority	Hungary
National Food Institute, Technical University of Denmark	University/ research organisation	Denmark
National Food Institute, Technical University of Denmark	University/ research organisation	
National Foodchain Safety Office	Public authority	Hungary
National Institute for Agricultural Research (INRA)	University/ research organisation	
National Technical University of Athens	University/ research organisation	Greece

National Veterinary Institute	Public authority	
NEIKER-Tecanlia	University/ research organisation	Spain
Nestlé	Food industry association/operator	
Nestlé SA	Food industry association/operator	
Netherlands Food and Consumer Product Safety Authority, Office for Risk Assessment and Research	Public authority	Netherlands
Northumbria Univeristy	University/ research organisation	United Kingdom
Observa Science in Society	University/ research organisation	Italy
Oxford Institute of Population Ageing/ Department of Sociology, Oxford Martin Programme on the Future of Food, Oxford University	University/ research organisation	
Permanent Representation of Spain to the European Union	Public authority	
Public Health Laboratory of Valencia. Conselleria de Sanitat	Public authority	Spain
RAND Europe	University/ research organisation	
Regulatory, Science and Health Division Food and Drink Federation	Food industry association/operator	
RIKILT - Institute of Food Safety, University of Wageningen	University/ research organisation	
Sine-Institut gGmbH	University/ research organisation	Germany
Slovak University of Technology	University/ research organisation	Slovakia
Société des agriculteurs de France	Other - Think Tank	
Soremartec- Ferrero group	Food industry association/ operator	
Spanish National Research Council	University/ research organisation	Spain
Swedish University of Agricultural Sciences	University/ research organisation	Sweden
Swedish university of agricultural sciences	University/research organisation	Sweden
Swiss association of cantonal Veterinarians/ Swiss veterinary association for food safety	Public authority	
The Brewers of Europe	Food industry association/ operator	
The Swedish Food retailers Federation	Other - National retailer federation	
TNO NL	University/ research organisation	Netherlands

UEVP	International organisation	Belgium
UK Health Forum	Consumer organisation/NGO	
Universidad Autonoma de Madrid	University/ research organisation	Spain
Universidad Miguel Hernández de Elche	University/ research organisation	Spain
Universidade de Trás-os-Montes e Alto Douro (UTAD)	University/ research organisation	Portugal
Università degli Studi di Scienze Gastronomiche and Turin University	University/ research organisation	
Universitatea SH	University/ research organisation	
University Dunarea de Jos Galati	University/ research organisation	Romania
University of Aalborg, Foodscapes Innovation and Networks, also EPHAC	University/ research organisation	
University of Almeria	University/ research organisation	Spain
University of Bareclona	University/ research organisation	Spain
University of Bologna	University/ research organisation	Italy
University of Burgundy	University/ research organisation	France
University of Leuven	University/ research organisation	
University of Lincoln	University/ research organisation	United Kingdom
University of Liverpool (also North of England EU Health Partnership)	University/ research organisation	
University of Minho	University/ research organisation	Portugal
University of Natural Resources and Life Sciences, Vienna (BOKU	University/ research organisation	
University of Sussex	University/ research organisation	
University of Ulster	University/ research organisation	United Kingdom
University of Wageningen	University/ research organisation	
Utrecht University	University/ research organisation	Netherlands
Veterinary Medicines Directorate, defra	Public authority	
Wageningen University	University/ research organisation	Netherlands

Wageningen University	University/ research organisation	
Wageningen UR, Food and Biobased Research	University/ research organisation	
Warsawa University of Life Scinces	University/ research organisation	Poland
World Union of Wholesale Markets (WUWM)	International organisation	
	Independent expert	

Source: Civic Consulting. Information concerning organisations is self-reported by survey participants.

Annex III: Additional comments from stakeholder consultation

The following tables present additional key comments of stakeholders/experts having responded to the consultation, in the order of the scenarios. These refer to impacts on food chain activities, impacts on food safety and nutrition policy areas, and impacts on other areas. Key comments from stakeholders/experts in relation to the plausibility of the scenarios, potential policy measures to counter the challenges described, and areas for future research are presented in Section 4, by scenario.

Table 57: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 1

Main food chain activities impacted	Comments
Trade	Free trade means positive impacts on trade activities as a whole and all system based structures like retail. *(Food industry association/operator)*
Processing, storage, distribution and retail	This scenario heavily impacts on high-tech and geographically diversified food production and therefore on processing, distribution and trade. *(Food industry association/operator)*
	Processing and packaging will be essential with the concentration of food production. This scenario would only be feasible through attention to storage and distribution. *(Food industry association/operator)*
	The primary processing area will be mostly impacted but also the final consumption. *(University/research organisation)*
	Retail sector - more uniform food from great producers. *(Public authority)*
Agricultural inputs and primary production	New technologies may allow reduced use of pesticides, fertilizers, veterinary drugs with improved animal and plant health. Potentially no improved choice for consumers as smaller industries would be eliminated or driven into niche areas. *(Food industry association/operator)*
	Primary production - limitations in arable land acreage, access to the water. (*Public authority)*
	Scenario may lead to mono cultures of food production with negative impact on soil, food security and income of farmers. *(Public authority)*
	Highly concentrated industries need highly concentrated production sites (farm). An increase in farm specialization is expected also. *(University/research organisation)*
	GMO introduction of seeds, and GMO ingredients in complex foods, [would lead] to different food production approaches. *(University/research organisation)*
	Agricultural input: due to increased use of pesticides we consider this negative. *(University/research organisation)*
	Improved crops (nutritional, social and environmental benefits) lead to more sustainable agriculture; economic benefits for farming communities. *(Other stakeholder)*
Food waste/cross-cutting	The development of wide spread GM foods will probably meet with some resistance as currently the all-natural trend is strong. Primary production could be increased significantly but possibly with a negative impact on food waste. *(University/research organisation)*
	Globalisation will have a positive impact on the distribution and packaging industries - more consumers will be encourage eat out of the home which would further restaurant and catering. A negative impact on food waste is likely. *(Other stakeholder)*
	Food waste: larger companies will be better at reducing food waste. *(University/research organisation)*

Source: Stakeholder survey, question 1.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 58: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 1

Main policy areas impacted	Comments
Novel foods and biotechnology & Food improvement agents, additives and contact materials	This scenario relies on expansion of GMO and other biotechnologies. Controls will need to be increased but food contamination and adultering could get worse. *(Food industry association/operator)*
	Positive [impact] for the development of novels foods and contact materials [for] longer shelf-life, microbial stability, etc. *(Other stakeholder)*
	In order to increase the lifetime of the products, maybe it will be necessary to develop new additives and agents […]. *(University/research organization)*
Enforcement and controls & Food and feed hygiene	The free trade in feed and food and the concentration of the production will increase the necessity of strongly food control. *(University/research organization)*
	High-tech and large scale production tends to be more innovative with strictly monitored processes, hence favourable for hygiene and easier to control. *(Food industry association/operator)*
Labelling and information to consumers, and traceability	More information to consumers is required to inform them about the origin of their food. Stimulation of growing GM crops and possibly developing novel foods. *(Public authority)*
	Getting relevant and reliable information about the food chain will [get] more difficult for the consumer than today. *(Public authority)*
	If this scenario implies consumers' mistrust in foods, that would impact the information [provision] as well. The legislator would have to adapt the legislation […] to increase consumers' trust, hence labelling is impacted by this scenario. *(Food industry association/operator)*
	Globalisation means anonymity to the consumer and negative impacts on traceability and diversity. *(Food industry association/operator)*
	Less traceability and more risks, reduced possibility of control, growing allergenic risks with industrialization. *(University/research organisation)*
Health and nutrition	Production in bulk quantities for retailers linked with pressure on prices can lead to decreased quality and less nutritious product[s] on market *(Public authority)*
	Negative impact on health and nutrition if choice is limited, and among those who cannot afford the niche products. *(Other stakeholder)*
Animal health and welfare and food contaminants	Higher production rates are in a negative correlation with animal health *(Public authority)*
	Animal welfare is critical in large scale livestock [production]. Highly concentrate[d] industries can support research better than small scale enterprise. *(University/research organization)*
	Animal welfare: lob[bying]/pressure from the large food producing companies. *(University/research organisation)*
	Positive impacts are trade related. But more trade means more risk of trading animal disease and contaminants. *(Public authority)*

Source: Stakeholder survey, question 1.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 59: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 1

Main subject of comment	Comments
Broadly positive impacts for competition, innovation and consumer choice for some…	Consumers will take advantage of this scenario, and there will be more products in the market. More competitors will be [on the market], and innovation will be a key point for the competitiveness of the companies. *(University/research organization)*
	Innovation and competition are stimulated by concentration and aggregation process. *(University/research organization)*
	Competition based on price and not quality will be the main influencer. *(Food industry association/operator)*
	Positive for innovation, higher pressure for competition. *(University/research organization)*
	Improved crops (nutritional, social and environmental benefits) lead to more sustainable agriculture; economic benefits for farming communities. *(Other stakeholder)*
… but mixed impacts for some	Good for the innovation and choice of the foods, but risk for equal access to food because of instability of the market. *(University/research organization)*
	Environmental sustainability could get better or could get worse - it depends on how the agriculture is conducted. Consumers should have more choices due to the global supply. *(Food industry association/operator)*
	More trade and boost of agri-food sector, but threats to human health and environment due to use of GMO and other technologies with uncertain effect. *(University/research organisation)*
	Trade and competition will increase but social inequality may further increase. *(Public authority)*
... and broadly negative impacts for others, e.g. on consumer choice, social stability/equitable access to food.	The concentration of the agro-food industry would reduce consumer choice, may be detrimental to the environment if more packaging is used. Could also negatively impact social stability if part of the population does not have access to the niche markets of fresher, healthier foods. *(Other stakeholder)*
	The large scale makes the system less robust and makes it volatile and less secure, especially if the food chain is vertically integrated. *(University/research organisation)*
	Generally detrimental impact on consumer choice and quality of foods on offer, little accountability *(Consumer organisation/NGO)*
	I consider that the competitiveness will decrease because of the monopoly of the global producers & traders and the inequitable access to food will became a crude reality. *(University/research organisation)*

Source: Stakeholder survey, question 1.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 60: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 2

Main food chain activity impacted	Comments
Low-carbon, low-input foods	Increased incentives for efficiently-produced, low input, low carbon, home-produced foods in Europe. *(University/research organisation)*
	The ecological footprint within the EU may become smaller, but it will increase elsewhere (BRIC & others, non -EU and non-North America *(University/research organisation)*
Reduction in food waste	Food waste will reduce with increasing associated costs / scarcity. *(University/research organisation)*
	Food waste- Improved in line with increased awareness, conscientiousness and being more frugal and efficient with resources *(Food industry association/operator)*
	Food waste would become an unaffordable luxury (in contrast to present throwing away of food in rich countries). *(Food industry association/operator)*
Loss of confidence/increased risk of fraud	Loss of confidence in all products – and probably loss of confidence from third country trade partners for EU products. *(Food industry association/operator)*
	This scenario could lead to increased fraud and adulteration due to increase food costs. *(Food industry association/operator)*
Trade & primary production; including more locally oriented production, increased pressure on environment, and risk of illegal trade	Agricultural inputs - Competition for key resources: exploitation of some natural resources would strongly increase. Increased pressure on environment, as agricultural land use intensified Primary Production - More food sourced regionally, but increased pressure on environment, as agricultural land use intensified, *(Food industry association/operator)*
	If international cooperation diminishes, there would seem to be an inevitable impact on trade with a consequential impact on primary production and inputs. *(Public authority)*
	The production of primary products will increase and import of primary products and process products will decrease due to trade blocs and tolls. *(Public authority)*
	Obviously makes trade more complicated but could lead to greater local production and less waste in the EU. *(Consumer organisation/NGO)*
	Primary production would became an interesting business itself (not requiring much more added value (logistics, prepared fresh product, technological foodstuffs, etc.) to be attractive to buyers, (in contrast with the present reality). *(International organisation)*
	Strong reduction in food trade would lead to less scale economies, less Research+Development+innovation. Local production would hardly reach (at reasonable prices) international markets and even other distant consumption points within the same nation. *(International organisation)*
Processing and packaging	[...] "Processing and packaging" would be not as appreciated and demanded by consumers, who have already a much reduced purchasing power and would not be ready to pay for it. *(International organisation)*

Source: Stakeholder survey, question 2.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 61: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 2

Main policy area impacted	Comments
Food contaminants	Negative impact will be more on food contaminants due to intensified agriculture. Due to a decrease of purchasing power an impact of health will be possible. *(University/research organisation)*
	Food contaminants - lack in global cooperation should make it difficult to combat global threats. *(Food industry association/operator)*
Health and nutrition	When agriculture is forced to produce more low input, low carbon output food, the result could be much healthier nutrition in Europe. *(University/research organisation)*
	Health and nutrition - Less emphasis on convenient food leading to a healthier nutritional status. However, the lack of food choices in the supermarket could result in micronutrient deficiencies and malnutrition. *(*Food industry association/operator)
Plant health and protection products	Plant health and plant protection products -New MRL [maximum residue limits] for intensive farming will be needed. *(Food industry association/operator)*
Animal health and welfare	Negative impact on animal health and welfare particularly if there are no longer international agreements in use of veterinary products, how animals are kept, slaughtered, before entering the food chain *(Other stakeholder)*
	Increasing shortage will lead to intensified agricultural systems which in turn may impact negatively on animal welfare and the environment. Biotech will be increasingly relied upon. *(University/research organisation)*
	Decreased international trade may increase the consumer confidence, restrict the transmission of serious animal and plant diseases, and actually improve food quality in EU. *(University/research organisation)*
	Animal health and welfare- New standards for intensive farming will be needed. *(Food industry association/operator)*
Enforcement and controls	The increase protectionism and focus on local production will lead to increase costs, increased controls (of origin) but also to the production of varieties in non-traditional geographies, with potential impact on the type of contaminants present. *(Food industry association/operator)*
	The needs of controls of imported products are increased since there are no harmonized standards. The need of increased controls is relevant for all areas above except health and nutrition. On the other hand, it will be easier to harmonize the rules within EU and thus less official control is needed. (It is hard to say if the impact is positive or negative, but it is high.). *(Public authority)*
Novel foods and biotechnology	The impacts would be a result of reduced trade leading to a reduction in innovation and consequently slowing the advancement of new technology. *(Public authority)*
	[…] Greater incentive to innovate due to the need to substitute for previously widely available inputs from global food chains. *(Food industry association/operator)*
Regulatory harmonisation	Smaller food chains could lead to greater harmonisation. *(Consumer organisation/NGO)*

Source: Stakeholder survey, question 2.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 62: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 2

Main other areas impacted	Comments
Internal market may expand, in spite of negative effects on trade, consumer choice, and equitable access to food	Less international cooperation, and less trade, will undoubtedly have a negative impact on access to food in certain parts of the world. On the other hand the internal market could benefit by having to adjust to the lack of raw materials available from the international market, which would encourage innovation to cope with this penury. *(Other stakeholder)*
	[...] Due to the reduction in international move[ment] of foods, the internal market will expand along with environmental sustainability. *(International organisation)*
	Consumer choice would diminish; in many countries, we would get back to the times where fresh products are only available in the season of production. Trade, would decrease, mainly internationally (as is assumed in the Scenario 2). In compensation to that, local trade would spontaneously highly increase: farmers markets, wholesale assembly markets, and wholesale markets at the cities and retail markets and traditional shops would increase as important points of trade. Social stability would rely mainly in the national production and the right functioning of the national and local markets (farmers, wholesale, retail). *(International organisation)*
	Consumer choice and trade will be severely impacted due to the fragmented market. Internal market likely to advance to bridge the gap. Innovation is also likely to accompany this crisis. *(University/research organisation)*
	It will affect strongly the equality to access to food as the purchasing power decreases, but internal market will gain importance and innovation will be necessary. *(University/research organisation)*
Ambiguous effects on environmental sustainability	[…] I have forecast a positive impact on environmental stability; this is in the light of a strong focus on EU self-sufficiency. […]. *(Other stakeholder)*
	Environment protection and healthy nutrition should become more highly valued. *(University/research organisation)*
	Environmental and social sustainability will suffer from sub-optimal allocation of resources in fragmented setting. *(Food industry association/operator)*
	Intensification of farming practice is likely to negatively impact on the environment. *(University/research organisation)*
Social stability, including equitable access to food	[…] Locally produced goods are often more expensive than imported products. This is strongly linked to personnel costs and socio-economic structures in a particular country. Social stability and equitable access to food might therefore become a problem if employment and products prices are unbalanced. *(Public authority)*
	Social instability due to lack of access to less expensive food sources. *(Food industry association/operator)*
Trust and common principles	Consumers will have more trust in products produces within EU and locally produced products. Increased need to agree on common principles for quality systems (MANCP) and reporting of the effectiveness of the control, especially the control of imported products, further development of systems for early warning and cooperation between MS when needed. *(Public authority)*

Source: Stakeholder survey, question 2.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 63: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 3

Main food chain activity impacted	Comments
Restaurants and catering, and distribution affected, with more people eating at home	If no inspections occurred, then distribution would be affected as the number of recalls would likely increase. Low consumer confidence would negatively impact restaurants at the expense of a higher at-home consumption. *(University/research organisation)*
	[…] I have emphasised restaurants [in the assessment] because if food is not handled hygienically and properly cooked, food poisoning will result. I believe that this is the weakest point in the supply chain. *(Independent expert)*
	Reduction in standards leads to less trust in external food providers so restaurants etc. suffer. *(Consumer organisation/NGO)*
	In virtue of high taxes applied and in order to save money, people started eating at home and cultivating their own products. *(Public authority)*
Primary production	The hypothetical decrease in the level of public food inspection services may have negative impact on the food safety in primary production and uncontrolled use of agricultural inputs. *(International organisation)*
	The decrease of cost and margin will have a negative impact at the primary production level, because farmers will not have the financial opportunity to call experts as vets for example. *(International organisation)*
	I have emphasised primary production because if the food is not produced safely, this cannot be rectified (i.e. this is a critical control point). *(Independent expert)*
	It is possible that there might less controls in agricultural field and primary production, which might require more private controls at the next stages in the supply chain, but not very different from today. *(Food industry association/operator)*
Reduction in food waste	An austerity scenario can be expected to emphasise prevention of food waste which in turn will require a lower volume of primary production […]). *(Food industry association/operator)*
	Most would be negatively affected but there could be a reduction in waste because of pressure. *(University/research organisation)*
	Food waste - Austerity policies may also result in more careful consumption of food. *(Food industry association/operator)*
Clearer playing field and lower prices	The controls of the food chain will have to be reinvented, which could clarify the situation (clearer rules, less administrative burden, better organisation, more implication of the food supply chain) for the private sector whilst providing improvements to the consumers (i.e. less costly procedures for the private sector which might lead to price decrease to consumers). *(Food industry association/operator)*
Trade	[…] Imports could slightly increase as the EU market would be more accessible to foreign countries but, exports could slightly decrease as some EU companies would probably reduce their standards. […].*(International organisation)*
Increase in local production	Retrenchment to safer (local/known) supply and reduced confidence in more distant sources. *(University/research organisation)*

Source: Stakeholder survey, question 3.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 64: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 3

Main policy area impacted	Comments
Animal health and welfare	Negative impact on animal health and welfare because of fewer vets involved in primary production. *(International organisation)*
Decrease in product quality/lower standards	In virtue of strict fiscal authority and in order to diminish expenditure and increase profit, enforcement and controls are reduced and people and companies decrease the quality of their products and services. *(Public authority)*
	It is unlikely that a private self-regulatory system would be as effective as a statutory system the market could become populated with unscrupulous operators looking for quick profits leading to a general decline in food safety and production standards. *(Consumer organisation/NGO)*
Increase in price of safer products	We think austerity-imposed restriction on public food safety inspections would lead to a situation that we could witness recently under the US government shutdown - less inspections->increase in e.coli infections in humans. Diverting public funding for safety controls would probably lead to increase in private controls - to a probable increase in final product price, leading to a situation when safer products cost more and therefore might be a luxury and difficult to afford by lower SES [(socioeconomic status)] population groups. The price-sensitive consumers would be faced with a reality of either spending a higher proportion of their disposable income on safe products or not but putting their health at significant risk. *(Consumer organisation/NGO)*
All policy areas affected, with higher risk of fraud	The indicated policy areas would be negatively affected because any legislative step forward to improve in those fields would not be implemented and assumed by the food industry, knowing that official controls are reduced (at present, case of some developing countries). On the contrary, relaxed controls open the door to food fraud. *(International organisation)*
New procedures established	Food chain (net) control systems and information centres (as reference points) shall be established. *(Public authority)*
More contaminants, with consequences for health and nutrition	Of course, very negative impacts for food safety (from farm to fork with food contaminants) and consumers trusts, that means a decrease in confidence in industrial food and in the market. *(University/research organisation)*
	[...] Austerity measures means that people will buy cheaper, junk food less healthy/nutritious food leading to malnutrition fuelling chronic diseases. *(Food industry association/operator)*
Less acceptance of new technologies	A lower number of inspections might make public authorities less willing to take risks and accept novel products or novel food improvement agents. […]. *(University/research organisation)*
Labelling becomes more important	In this scenario the labelling will be critical as trademarks will be the main tool for consumers to ensure safe food. *(University/research organisation)*
No specific impact/efficiency gain	Combining public food safety controls and private quality assurance schemes improves the overall outcome, reduces red tape, saves costs. *(Food industry association/operator)*
	My assumption is that private controls could be as efficient and effective as public ones, hence no change. *(Food industry association/operator)*

Source: Stakeholder survey, question 3.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 65: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 3

Main area impacted	Comments
Social stability and inequality	Decreasing of social stability and negative impact on good consumer behaviour with a relative increasing on competitiveness on food market. *(University/research organisation)*
	Austerity tends to put a wet blanket on many areas. Again: 'haves' and 'have nots' will put pressure on social stability. *(Food industry association/operator)*
	Increase in health outcome inequalities; disproportionate risk due to unsafe products for lower SES groups, vulnerable consumers etc. *(Consumer organisation/NGO)*
Competition & Consumer choice	Reduced official food safety controls might influence consumers choice and preference for certain food products. Trade could be affected by higher product prices due to alternative control processes in the food business (prices might be influenced by expensive international control standards carried out by FBO [(fixed based operators)] and which will be consequently allocated in the product costs). *(Public authority)*
	Competition will be stimulated to maintain market shares. *(University/research organisation)*
	Competitive pressure will be high, while the need for information on food quality and safety will be trademark oriented. *(University/research organisation)*
	Different labels linked the different standards will make it easier for customer choice if the symbol is well known but also more difficult if the symbol is unknown. *(Public authority)*
Innovation may be stimulated	With such issues innovation is likely to be encouraged to find solutions. *(University/research organisation)*
	Probably the decrease of official controls may have a positive impact on innovation, internal trade also. *(Public authority)*
Internal market may gain at expense of environment	Lessening of controls would lead to greater trade and competition, with a possible negative effect on the environment. The internal market could see itself strengthened if the only controls were at the borders. *(Other stakeholder)*
	Fewer controls could negatively impact environmental sustainability. Internal markets will be favoured as trust in imported food will be low. *(Food industry association/operator)*
	If the EU imposes itself as a "guarantor" the internal market could be positively affected. The negative impacts: neglect in public control mechanisms, etc. *(Other stakeholder)*
But international groups may gain at expense of internal market	The internal market of food products would lose competitiveness in comparison to the rest of the world. Food products could probably be produced in a cheaper way, and therefore be more accessible to the population, but at the cost of health, nutrition quality for consumers. *(International organisation)*
	Internal market will be impacted, gap and disparities between small industries and international groups weakening the small food industries. *(University/research organisation)*
	Possible disruption to the single market if certain member states' control systems break down, leading to erection of internal trade barriers in response to public health threats. *(Public authority)*

Source: Stakeholder survey, question 3.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 66: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 4

Main food chain activity impacted	Comments
At-home consumption vs. restaurants and catering	Potential increase in the risks from consumption at-home: low-grade food, poor cooking habits, more instances of food poisoning and safety lapses. Also the restaurant trade will become polarised increasing risk there. *(International organisation)*
	Restaurants and catering- People will have less money to eat out- this will be a luxury for the more affluent. *(Food industry association/operator)*
	At home consumption would be negatively impacted (following the pattern seen in North America where a large number of families never eat at home). *(Other stakeholder)*
	There will be more out of home consumption and therefore a greater role for restaurants and catering. In addition the at home consumption patterns will be impacted on account of an aging population. *(University/research organisation)*
Higher prices and decrease in food waste	Processing and packaging will be even more important - food waste will be likely to decrease due to high food prices. *(Food industry association/operator)*
	Farms / primary producers will be more in demand and therefore likely to benefit from higher pricing. With higher costs / scarcity of foods, wastage is likely to decrease. *(University/research organisation)*
	Regarding waste: more food will be captured for food banks, soup kitchens, etc. so waste should reduce. *(International organisation)*
Cross-cutting impacts	An increase in consumption or poor quality food for the majority is likely to have an impact on agricultural inputs (to maximise yield), ingredients (perhaps chemically produced alternatives to naturally occurring ingredients), catering (fewer people being able to eat out, depending on the level of inequality), at home consumption (increasing for the poorer section of the population), and food waste (reduced if large swathes of the population strive to find food). *(University/research organisation)*
Distribution and retail channels for rich and poor	Impacts on retail and trade could be related to the increased difficulty to balance supply and demand and the increased dependence on charities and forms of collective supplies, which have been popping up over the last years already as a means to source nutritious food at reasonable cost. […]. *(Food industry association/operator)*
	This scenario may lead to problems with distribution of food among different groups at risk and risky food consumed at home. *(University/research organisation)*
	[…] in Scenario 4 food safety and nutrition would not be a problem for the "well-off": there would be good products (imported if needed) from good producers, following a good and healthy balanced diet and the products would come to the end consumer along a transparent and traceable distribution chain. […] For the rest (the "worse-off" as Scenario 4 calls them) a different production and distribution channel will operate, with much less care in food hygiene and nutritional standards: lower quality products (especially in the case of fresh produce: fruit & veg, fish, meat), transportation of food in bad conditions, storage, conservation, unbalanced diets, black economy). We may find a similarity in some Asian or Latin American countries where this dual economy, dual food marketing channels exists. […]. *(International organisation)*
Trade	[…] Trade: trade could be fostered to develop new products and to import/export products expected by the many migrants leaving in the European Union. *(Food industry association/operator)*

Source: Stakeholder survey, question 4.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 67: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 4

Main policy area impacted	Comments
Health and nutrition	A substantial increase in poverty would lead to demand for cheap foods which will lead to inevitable cuts in quality and healthiness, new foods may be developed to meet this need and the needs of the growing "rich " market as population ages a greater proportion will be in a "looked after" environment as procurement policies will be important to ensure adequate nutritional quality. *(Consumer organisation/NGO)*
	Health and nutrition would be negatively affected for a significant proportion of the population, leading to higher obesity rates and associated diseases such as diabetes, ... *(Other stakeholder)*
	[…] Health and nutritional outcomes will suffer. The industry will probably follow so as to embark on 'health-washing' activities by increasing their involvement in anti-NCDs policy making, funding and informing the consumers - to a counter-productive effect. *(Consumer organisation/NGO)*
	[…] The main impact of this scenario would be on health and nutrition - increasing inequality and polarised diets would increase the burden of chronic disease on health care systems and ultimately productivity. *(University/research organisation)*
	Health and nutrition: the health and nutrition patterns would be considerably and negatively affected by the scenario. Healthy eating patterns would be shared by fewer and fewer consumers, whilst a minority of consumers would have access to very sophisticate and healthy eating patterns and very healthy products. *(Food industry association/operator)*
	Health and nutrition for a large part of the population could decrease as a result of poor quality diets. The need to produce pre-packaged food could in turn affect the way plants and animals are used for production, but also lead to looser controls. On the other hand, the pressure may cause a boom in biotechnology but also growing reliance on additives to meet demand. *(University/research organisation)*
	The lack of safe, high-quality food products will have a significant and severe impact on the consumers' health (like it is for poor people in the US today. *(Public authority)*
Animal health and welfare	With increasing scarcity agricultural systems are likely to become more intense with consequential impacts to animal welfare and crop processes, which in turn will lead to an increasing need for technological solutions. *(University/research organisation)*
Enforcement and controls	Increased needs of official control in several areas […] to ensure that only approved and safe products are sold, policies for the controls are needed including internet distribution. Difficult for consumers to make good choices of healthy food. High risk for import of cheap unsafe products. *(Public authority)*
Labelling and information to consumers	[…] Labelling and information to consumers - Consumers would lose interest, price is more important in determining their choices. *(Food industry association/operator)*
Cross-cutting	There will be an ever increasing role for novel foods and biotechnology as well as an increase in packaging materials for convenience. This will result in an ever increasing role for appropriate labelling and information to consumers to keep them informed and to maintain consumer trust. As a result of this scenario there will be a significant impact of aging and obesity and (most of all that combination) on the health of the population making nutrition policy critical to improvement of outcomes. *(University/research organisation)*

Source: Stakeholder survey, question 4.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 68: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 4

Main area impacted	Comments
Social instability and reduction in consumer choice, with impacts on environmental sustainability	It may be that with rising prices or decreasing wages, food choice becomes restricted for a larger proportion of people. It may be that growing demand for food hinders the environmental sustainability of the methods used for production. In this scenario, unequal access to food may lead to social tensions (although it may be that people are happy to have poor quality, pre-prepared food as opposed to fresh vegetables - on the other hand, the rising cost of meats or fish or vegetables could be a source of concern for many). *(University/research organisation)*
	Social stability could be very negatively impacted. *(University/research organisation)*
	Social stability will be the key issue. There will be soaring health care costs due to the ageing population and the high incidence of non-communicable diseases. *(Food industry association/operator)*
	Shortage will reduce consumer choice. Likely consequence is to then encourage innovative solutions. *(University/research organisation)*
	Confusion in consumer choice; unsustainable levels of overconsumption and production will lead to social, environmental instability and collapse. The current double burden of malnutrition - overconsumption co-existing with hunger, 'obesity paradox', widespread food and nutrition poverty among poor, disadvantaged consumers, children, the elderly etc. *(Consumer organisation/NGO)*
	Increasing inequality and polarised diets can be characterized by less choice in these groups. Current models of behaviour change and consumer choice are less applicable in low income countries and in low SES populations in more affluent regions. This ultimately has the most profound impact on social stability including these populations ability to access foods for sufficient and nutritious diets. *(University/research organisation)*
	Less social stability as markets become increasingly heterogeneous and demand for cheaper foods will lead to short cuts in production [and] more intensive production with detrimental impacts on the environment. *(Consumer organisation/NGO)*
Innovation to tackle food insecurity	Innovation will be important to provide enough food for all the EU population (native or not). *(University/research organisation)*
	Increased use of pesticides, veterinary drugs, GM in third countries for production of cheap primary products for the EU market. Innovation – production of new functional foods with new ingredients or health "declarations". *(Public authority)*
	Improvements in food innovation and production should result in greater consumer choice. *(University/research organisation)*
	Innovation: according to the scenario, the innovation could be reduced: as the majority of consumers will have access to a limited choice, there would not be enough incentive to develop new products. However, if a clear and positive legislative and financial framework is developed to ensure that a wide choice of products can be offered to all consumers, then, this might trigger innovation from the private sector. […]*(Food industry association/operator)*
Trade	[…] Trade: trade could be fostered to develop new products and to import/export products expected by the many migrants living in the European Union. *(Food industry association/operator)*

Source: Stakeholder survey, question 4.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 69: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 5

Main food chain activity impacted	Comments
More at home consumption, less food waste	A greater shift to local, shorter supply chains would encourage more at-home consumption, less food waste. It would also lead to better animal health and welfare and a lower use of agricultural inputs. *(Other stakeholder)*
	This scenario may lead to increase of consumption of fresh products, and reduction of food waste, due to consumer attention to environment and health. *(University/research organisation)*
	The new food of a higher ecological, ethical and possibly also nutritional quality will also become an interesting export article. The higher value perception of food will help to diminish waste. […]. People would be more actively engaged in their food. *(University/research organisation)*
Change in agricultural inputs and ingredients, less global trade and a reduction in food waste	Agricultural inputs: the production mode of agricultural raw materials will be impacted. New ways of production should be developed (i.e. "green" pesticides…) which will have an impact on production costs (through product development) and on productivity.; […] Ingredients: the way ingredients are produced and marketed will be impacted and that may have an impact on production cost, on productivity and supply (less goods available) and on choice (decrease of imported ingredients/raw materials) which could impact negatively the whole production chain and, in the end, the consumers (restricted choice without guaranteed improvement of the quality). […] *(Food industry association/operator)*
	Processing and ingredients might see their activity seriously reduced but no connection with safety or nutrition. *(Food industry association/operator)*
	The primary producers will use less antibiotics, fertilisers and pesticides. In processed products less different ingredients and additives will be used. Locally produces products will be promoted in restaurants and for consumption at home in some groups, but not by the growing group of poor people within EU. *(Public authority)*
	A very good impact for less use of pesticides and fertilisers but primary production , storage and distribution could be negatively affected (no protection, loss of cultures), innovation in ingredients and packaging to protect the short shelf life will increase , in parallel this scenario permits less food waste due to intensified agriculture and food industries.[…]. *(University/research organisation)*
	Trade: trade will obviously be negatively impacted as short chains are favoured. Imports will decrease and exports, due to the new modes of production, may also decrease (conservation problems of food items). *(Food industry association/operator)*
	This scenario would mean moving from current inputs to other inputs, but generally less reliance on inputs such as pesticides and fertilizers based on fossil fuels. […] A shift towards more local food systems would have a negative impact on global trade, but because of focus on resource efficiency and increased consumer prices could lead to substantial gains in reducing food waste. *(University/research organisation)*
Potential inefficiency	This scenario is poised to create many inefficiencies in the food supply chain. Local is absolutely not the equivalent of sustainable. *(Other stakeholder)*
Potential increase in food waste	Food waste might increase due to reduced use of preservatives in organic food. *(Public authority)*

Source: Stakeholder survey, question 5.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 70: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 5

Main policy area impacted	Comments
Animal health and welfare positively affected, novel foods negatively	More sustainable production systems, changes in dietary patterns could reduce the need for intensive livestock systems and stock densities leading to substantial gains in animal welfare. However moving in this direction would have negative impacts on biotech and novel foods. […]. *(University/research organisation)*
	Animal production systems would need to meet new specifications to comply with controls and information required by consumers. *(University/research organisation)*
Health and nutrition	This scenario implies that consumers are more health and nutrition conscious. As a consequence, it means that there is a positive impact on health and nutrition; if the consumer is oriented towards new positive schemes, these are associated with positive certification and communication, hence the proposal for strong positive impact. *(Food industry association/operator)*
	We would expect positive health and nutrition effects. We would be concerned, however, with accessibility and affordability of such alternative production systems for all layers of society. What we would not want would be poor and lower SES consumers left behind to use the mainstream highly intensive production systems (cheaper but low quality), be blamed for continuing environmental degradation with no real opportunity to choose due to their underprivileged situation and inability to truly contribute. *(Consumer organisation/NGO)*
Labelling and information to consumers, including awareness	Due to the fact that food will have a higher price and the made assumptions the consumer will expect more information. The type of husbandry or production system will become a major prerequisite for his purchasing decision. *(Public authority)*
	"Labelling and information to consumers": a more conscientious consumer would demand more detailed and reliable information on the characteristics of the products. *(International organisation)*
	A greater awareness by the consumer of where food is coming from along with improved animal husbandry and environmental awareness in terms of sustainability. *(University/research organisation)*
	Greater interest in wider aspects of more localised food production processing and distribution systems. *(University/research organisation)*
Enforcement and controls; risk of fraud and contamination	An increased number of small FBO [fixed based operators] producing premium products will increase the need of policies for official controls, especially on labelling and fraud. *(Public authority)*
	[…] Enforcement and controls" should be upgraded by official authorities in order to cope with public demand and avoid fraud with the demand for more expensive products. *(International organisation)*
	Smaller urban production may need different approach to control and enforcement, considering shift to other types of contaminants (e.g. due to air and road pollution in urban production settings). *(University/research organisation)*
	Enforcement: enforcement and control procedures will be severely impacted due to the huge variety of the production chains, ranging from global actors to very short local chains which may escape scrutiny and attention of control authorities. The costs associated with control and enforcement might increase considerably. *(Food industry association/operator)*

Source: Stakeholder survey, question 5.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 71: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 5

Main area impacted	Comments
Heightened awareness of foods, and possibly greater choice and environmental sustainability, at the expense of social stability / inequality	Consumer choice will become more exigent in matter of taste and price, innovation will be necessary to adapt to this scenario to maintain a high level of quality and safety and this scenario appears very helpful in term of environmental sustainability, however access to food will be more difficult and unequal between consumers due to the price. *(University/research organisation)*
	Most important impact will be on the cost of food and the consequences of this. *(Food industry association/operator)*
	Positive impacts reflecting more interest/care about food (not just "fuel") but negative re availability of cheaper foods to lower income groups. *(University/research organisation)*
	Could be problems for poor people with possibility to gain access to wholesome food, less trade, while consumer choice improved. *(University/research organisation)*
	The benefits will be largely beneficial for the customer, giving more choices and satisfying growing, but nonetheless smaller markets. *(Other stakeholder)*
	Though generally public nutrition-related health is likely to improve, inequalities may increase if food prices are higher. *(Other stakeholder)*
	More pronounced difference between 'haves' and 'have not's likely to reduce social stability. *(Food industry association/operator)*
	Consumer choice: consumer choice will be impacted somehow positively (i.e. a little bit more choice would be, in general, offered to consumers). However, due to the scarcity of certain "new" choices (restricted and limited), not all consumers will benefit from the new choice and could even see the range of options offered to them reduced. […]. *(Food industry association/operator)*
	Improved environmental sustainability but increased costs could have detrimental impacts on sections of society unable to afford them leading to greater polarisation in the food chain. *(Consumer organisation/NGO)*
	Could potentially have a strong impact on environmental sustainability by virtue of a wider array of food production possibilities. *(University/research organisation)*
	Alternative production systems can be expensive and lead to social instability if a proportion of the EU population cannot afford these products. On the other hand, the greater care involved in such production systems would lead to improved environmental sustainability. *(Other stakeholder)*
Innovation	Innovation will be impacted negatively as society looks to a mythical past & the poor will have less access to food. *(International organisation)*
Competition	Competition: competition would increase not only amongst national producers but also between national and international producers and traders. […]. *(International organisation)*

Source: Stakeholder survey, question 5.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 72: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 6

Main food chain activities impacted	Comments
Ingredients	Ingredients/food processing industry is radically changing, with significant innovation in new products and processes. *(Food industry association/operator)*
	The development of functional foods stimulates innovation. *(Other stakeholder)*
	This scenario may lead to difficulties with traceability of ingredients, which may pose risk to human health. *(University/research organisation)*
Processing and packaging; Ingredients; Trade; Storage, distribution and retail; Primary production	The main impacts of this scenario would be on the ingredients, processing and packaging sectors. This could further exacerbate the current problem of squeezing primary producers as a provider of cheap inputs in an even more industrialized food system. *(University/research organisation)*
	The design and production of functional food could be both a pre-harvest or post-harvest issue. *(University/research organisation)*
	The disconnection between consumers and users and the concentration of added value downstream from the food chain would only put more pressure on primary production to produce massive primary products with lots of inputs damaging the environment, and at a low price. *(University/research organisation)*
	Primary production could benefit, in that new products could be cultivated and current crops could be changed. *(University/research organisation)*
	The money will be earned by food processing, retail and restaurant/catering, at the expense of primary production and agricultural inputs. *(Food industry association/operator)*
Trade; Storage, distribution and retail; Processing and packaging;	These functional foods will require new processing technologies, hence high research and investment. Trade is likely to increase as these high-tech foods will probably only be produced in certain parts of the world. *(Food industry association/operator)*
At-home consumption	Concerning at home consumption, there is a contradictory effect; it will have a direct positive impact on public health but it will induce unhealthy lifestyles. *(University/research organisation)*
Restaurants and catering	Stratified nutrition makes bespoke provision more important than food. Restaurants will be the new "health clinic." *(University/research organisation)*
Food waste	There may be beneficial implications of the increased demand in functional foods on the safety of food supply in terms of more responsible use of inputs, and reduced waste *(International organisation)*
	In order for the food and drink industry to remain competitive, it is essential to reduce waste and make better use of foods and ingredients available. *(Public authority)*
	Functional foods will remain relatively expensive and this should have a positive impact on food waste. *(Food industry association/operator)*

Source: Stakeholder survey, question 6.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 73: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 6

Main policy areas impacted	Comments
Novel foods and biotechnology	Functional foods will rely on the use of biotechnology to a large extent. *(University/research organisation)*
	Growing demand for functional foods will require policies to be revised to deal with the issues relating to novel foods and biotechnology. *(Food industry association/operator)*
Enforcement and controls; Labelling and information to consumers	The development of novel foods and ingredients and the increased use of health claims are difficult to monitor or control, both for products produced within EU and for imported products. In general, this scenario should lead to improved health of consumers. Whether that will imply the increased use of additives etc. and increased prevalence of food contaminants, is difficult to foresee but should be prevented. *(Public authority)*
	Labelling will be a key parameter in this scenario. Consumers will look for products that could help them, and labelling should provide suitable information to the consumers in order to select the right product. *(University/research organisation)*
	The diversity of foods and claims would require strong enforcement and regulation of claims as well as better labelling to reflect ingredients. *(Consumer organisation/NGO)*
	Enforcement and controls are less required when the quality is high, but is this the case in poor countries? *(University/research organisation)*
	A new kind, probably more sophisticated instruments of enforcement and controls should be implemented. Labelling requirements should be revised to avoid fraud and unclear information from the producer. Information to consumers from independent or state entities would be crucial to avoid unfair advertising. *(International organisation)*
	Very importantly, nutritional claims would make information for consumers completely blurred by the overload of information, particularly concerning other information like environmental impact. *(University/research organisation)*
Food and feed hygiene; Food contaminants	Lots of issues related to the traditional production systems (e.g. hygiene, zoonosis as well as contaminants) will be affected positively, i.e. less contaminants, less zoonosis etc.). *(University/research organisation)*
	Public concern around food "quasi medical" qualities will increase emphasis on food quality and safety - among those who can afford these nutritional medicines. *(University/research organisation)*
	Primary production would be under pressure of producing more for less value, and therefore production conditions would deteriorate. *(University/research organisation)* New ingredients can cause new emerging risks. *(Public authority)*
Health and nutrition	Functional and fortified foods will have a positive impact on nutrition: e.g. cholesterol/glucose lowering action. *(University/research organisation)*
	Health could be improved by appropriate use of such new foods that have been developed with specific subgroups of the population in mind. Vital that consumers be informed of nutrient content and not misinformed by false nutrition or health claims. *(University/research organisation)*
	While recognising the potential for 'functional foods' to support certain deficiencies in short-term, emergency type of interventions, it would not be of long-term benefit for health at population level to widely consume such foods on a daily basis. This could lead to a 'compensation' effect whereby people tend to undertake unhealthy lifestyles to an even greater degree when thinking they already did some 'healthy'

	activities to counterbalance. Furthermore, consumers would not comprehend a variety of competing labels, health claims, scientific information assigned to 'functional foods'. *(Consumer organisation/NGO)*

Source: Stakeholder survey, question 6.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 74: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 6

Main subject of comment	Comments
Broadly positive impacts for some…	There will be a lot of products, and consumers will have a lot of possibilities to choose. Moreover, for the development of new functional food, innovation will have an important role in order to satisfy consumers' requirements. *(University/research organisation)*
	Less inputs into agriculture, higher yields, better and safer products through high tech, more environmental sustainability. *(Food industry association/operator)*
	These type of products mainly will be globalised products. The global competition is growing, so the global companies will support innovation. *(Public authority)*
… but mixed impacts for some	Consumer choice will be limited (personalised health will dictate the development of a small number of foods); competitiveness of highly specialised industry will improve. *(Public authority)*
	This scenario will stimulate innovation - social stability may be worsened since lower income consumers will probably be unable to afford these products. *(Food industry association/operator)*
	The innovation will be increased by research on novel foods, but food prices will be higher and for this reason people with low-income will have a limited access to high-tech foods. *(University/research organisation)*
	A lot of innovation possibilities for food industry and retail, but risk of growing social inequalities (access to a safe food). People less/badly informed will eat unbalanced food. *(University/research organisation)*
	The need for innovation will contribute to stimulate the market , could have a positive impact on environmental sustainability but the negative side effect could be less use of fresh products and growing social inequalities in consumers' choice. *(University/research organisation)*
	This scenario may lead to more food and packaging innovation, more products and choice for the consumers, more trade and competition. Negative effect to the environment due to more food and packaging waste. *(University/research organisation)*
... and broadly negative impacts for others, e.g. on consumer choice, social stability/ equitable access to food.	Likewise, social inequalities are likely to hamper poor and low income consumers' choices as a rather high level of food literacy is required to comply with the understanding and navigation of 'functional foods'. We also think that a number of 'functional foods' would promote unsustainable, health-damaging behaviours such as a recent development around 'hangover-free' alcohol. *(Consumer organisation/NGO)*
	There would be an impact on equity as these foods are likely to be more expensive than conventional foods. *(Consumer organisation/NGO)*
	The scenario has potential negative impacts on consumer choice because marketing of functional foods and related health claims could mislead consumers. *(University/research organisation).*
	Given the overload of information, consumer choice will become impossible. Also competition would be degraded due to a probable concentration in the part of the agrifood industry capable of producing such functional foods. Exports and imports would probably increase, but the internal market and its specific standards would probably be completely eroded by competition with international firms with safety and environmental standards lowered down, leading to degrading environmental conditions within the EU. The duality of foods would make inequalities among the

	population (access to food) wider (fresh primary products reserved for an elite). *(University/research organisation)*
	The increased number of functional food will require better information about health and nutrition in order to help people make good choices. *(Public authority)*
	If most products on the market are for example fortified that gives the consumer less choice for other kind of products, without claims, not function. Thus, it is not a positive development for the consumer, in the end. *(Food industry association/operator)*
	Fresh produce consumption: consumers could easily wrongly believe that the industrialized product can substitute eating fresh fruits and vegetables. Taking an example today of the uninformed consumer drinking fruit juice made from concentrate and forgetting to eating fresh fruit; or eating dairy products, yogurts as a substitute for fruits. *(International organisation)*

Source: Stakeholder survey, question 6.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 75: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 7

Main themes	Comments
Food waste	Limitation of resources will have a negative impact on all activities but minimise waste. *(University/research organisation)*
	With the food becoming scarce (hence more costly), people would pay more attention). *(Food industry association/operator)*
Primary production	An increasing scarcity of agricultural land will impact primary production and lead to excessive use of fertilizers. *(Other stakeholder)*
	[...] and more resistant seeds. *(University/research organisation)*
	Higher use of fertilisers and pesticides may [affect] the soil. *(Food industry association/operator)*
	Europe is relatively well placed compared to other regions that might be more susceptible to resource depletion, existing structures such as CAP could be utilised to modify food systems to meet changing demand, but negatively might lead to a drive to high yield intensive produced foods which may have detrimental health impacts (Consumer organisation/NGO) and contribute to nutritional poverty. *(University/research organisation)*
Ingredients	Poor water quality and fraud (in particular for products to substitute protein) will drive the negative impact for ingredients. *(University/research organisation)*
Agricultural inputs	Increasing costs of agricultural inputs (fertilisers, etc.) and loss of high quality soils. The primary production will have to cope with a higher demand for the same quality and lacks in supply of inputs. (*University/research organisation*)
	e.g. fertile soils, water and phosphorus. *(Public authority)*
	Agricultural inputs could have implications at production level on yields, on safety, shelf life and possibly safety of certain commodities. Resource depletion both relating to phosphorous and fossil fuels will have major impacts on inputs such as fertilizers and pesticides, and in turn have a major impact on production and trade. *(University/research organisation)*
Storage, distribution and retail; Primary production	The modalities of distribution, the overall conception of the supply chain may be impacted, due to the increase of oil price and the need to reconsider how to lower the cost of distribution and to reorganise for a better income and a better environmental impact. *(University/research organisation)*
Trade	Higher uncertainty as to resource availability and uneven supplies, are likely to put food manufacturing, retail and trade under pressure, although the key responsibility of trade to balance off areas of over-supply with areas of under-supply will continue playing its role. *(Food industry association/operator)*
	Variable availability might lead to difficulties in the trade flow. *(Food industry association/operator)*
	The main feature of this scenario is that agrifood systems are locked in in a situation of impossibility to reduce their dependency on resources, which degrades the environment to an extent that also endangers their own economic viability. Trade would be impacted by protectionist measures. The EU would be particularly badly hit due to its dependency to many resources (soybeans from the Americas that would go directly to China, oil,

	phosphorus). The example of Brittany shows that such economically very fragile situations can nevertheless last a very long time with a lot of negative side effects, without causing the system to really change pathways. *(University/research organisation)*
Restaurants and catering	Restaurants: Potentially lower offer and possibilities for this sector. *(Food industry association/operator)*
Other	Resource economy will increase. (*University/research organisation)*
	Survival economy. *(Other stakeholder)*
	A shortage of resource will boost studies to improve efficiency of animal/crop production. *(University/research organisation)*
	With strong demand and high prices, in principle this could have a positive impact on the agricultural production side, provided, water and land can be managed efficiently. *(Food industry association/operator)*

Source: Stakeholder survey, question 7.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 76: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 7

Main themes	Comments
Animal health and welfare	As land becomes scarcer, traditional farming systems will give way to more intensive operations leading to poorer animal welfare. *(Other stakeholder)*
	Animal & plant health is a cost to be easily disregarded at production stage in scenario 7. *(International organisation)*
Plant health and protection products; Animal health and welfare	Plant health and animal health will worsen due to soil degradation etc. and the effect on plants and animal feed. *(Food industry association/operator)*
Enforcement and controls	More care will be taken in the supply chain to reduce waste and this will require more controls. *(Food industry association/operator)*
Food and feed hygiene; Food contaminants	Scenario 7 is terrifying from the food safety point of view: soil degradation of arable land, environmental contaminants [e.g. mycotoxins] spreading through the food chain, low quality water *(International organisation)*
	Use of land that may previously been utilised for landfill or other polluting activity (necessary because of lack of agricultural land) will give rise to more contaminants entering the food chain. *(Other stakeholder)*
	Lower food and feed quality due for example to lower quality fertilizers, increased presence of heavy metals or toxic substances following use of degraded or contaminated land. Fraudulent activity might arise as a result of pressure on scarce resources. *(Food industry association/operator)*
Health and nutrition	A large part of the population would care more about the price of food than about the healthy and good characteristics of the food they buy. *(International organisation)*
	Healthy nutrition might improve, as less animal protein and more plant-origin protein is consumed world-wide. *(University/research organisation)*
	Increases in food prices will lead to more inequity in regions and nations ability to access resources necessary for food production. It is estimated that the cumulative effect of resource depletion and climate change will mean an increase of people at risk of hunger from 881 M in 2005 to 1,031 M in 2050 (this estimate is for chronic hunger only). *(University/research organisation)*
Novel foods and biotechnology	Scarcity will lead to increased research and look for alternatives in the food production techniques. *(Food industry association/operator)*
Other	Primary production is highly negative affected because it depends on resource-intensive inputs such as fertilizers and pesticides. *(Public authority)*
	Policy areas are likely to develop to include sources of foods that we are not exploiting at the moment. *(University/research organisation)*
	Understanding of links between agri production, and especially animal products, and human health will grow. *(University/research organisation)*
	Water quality in the EU would be in a very bad state, and the cost to agrifood industry to decontaminate water (for the many processes that necessitate purified water) would grow rapidly, linked to the energy costs. Consumers would be very sceptical about the safety quality of the products they buy, and very suspicious about any information given. *(University/research organisation)*

Source: Stakeholder survey, question 7.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 77: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 7

Main theme	Comments
Social stability	Major disruptions in social stability and ensuring equitable access to food. *(University/research organisation)*
	The price of food will increase and the less equitable access to food. *(Public authority)*
	The scarcity of key resources has led to severe socio-economic and demographic imbalances in relation to available resources, resulting in decreased social cohesion in the EU. *(Food industry association/operator)*
	In the present world we have many examples of the increase of basic food prices causing social instability (Mexico and the tortillas crisis; the beginning of the so-called Arab Spring in Tunisia, which began at a food market). *(International organisation)*
	Some parts of the population disproportionately more affected by diminishing safety standards, worse nutrition, and lower access to foods. *(Consumer organisation/NGO)*
Environmental sustainability	Biodiversity and environmental sustainability could possible also be impacted because of attempts to compensate for lack of resources through land use expansion. *(Food industry association/operator)*
	High risk of not having enough healthy arable land for the world population' needs. *(International organisation)*
Social stability; Environmental sustainability	Decreased consumption will increase awareness and long term sustainability, but trading and social stability will be damaged. *(University/research organisation)*
Consumer choice	Resource depletion would diminish the choice the consumers have (Food industry association/operator) This may lead to less choice for the consumer (less e.g. organic, free range, GMO-free options). *(University/research organisation)*
	At a time of rising cost consumer choice and environmental sustainability is likely to be negatively impacted. *(University/research organisation)*
	Consumer choice - Selection of products has decreased and higher cost of food has resulted in consumers being drawn to unhealthy, cheaper food. *(Food industry association/operator)*
Innovation	Greater need for innovation to maximise use of resources but potential overuse to meet increasing demands. *(Consumer organisation/NGO)*
	Innovation in food production might be stimulated. *(University/research organisation)*
Innovation; Competition	Any challenge improves innovation and makes competition harder. *(University/research organisation)*
	Obvious negative effects but maybe force new thinking in some areas such as new food development. *(University/research organisation)*
Trade	More regionalisation would lead to focus on EU's Internal market. *(Food industry association/operator)*
	There is likely to be more protectionism and decreased trade. Social unrest will increase. *(Food industry association/operator)*
Other	The impacts will be worldwide. *(Public authority)*
	Reduction in internal choice and inability to externally compete. *(University/research organisation)*

Trade; Competition; Internal market; Environmental sustainability	Competition with outside EU would be made more difficult due to EU being particularly dependent on resources from other continents, particularly for feeding its animal production that would probably disappear due to competition with others. Member states would begin to sign specific bilateral agreements with countries owning crucial resources. *(University/research organisation)*

Source: Stakeholder survey, question 7.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 78: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 8

Main themes	Comments
Primary production	Climate change due to the development of various diseases will impact largely on primary production because of animal and plant diseases, and the consequence will be proportional visible in other food chain activities. *(Other stakeholder)*
	Most affected will be way of production, and the use of pesticides and fertilizers. *(University/research organisation)*
	Greatest impact of climate change will be primary production influencing yields and also quality safety. We have already seen the increase in mycotoxin contamination of crops in areas and in pests, fungal diseases will lead to a greater necessity for plant protection products and use of veterinary products. *(Other stakeholder)*
	Effects of climate change will be more catastrophic in low income regions of the world. *(University/research organisation)*
	Negative impact due to decrease in production, however difficult to project. *(Independent expert)*
	Risks of flooding of fields for crops (pathogens, heavy metals, chemicals), sewage in cities, drinking water contaminated with pathogens, chemical contaminants, draught. *(University/research organisation)*
Primary production; Ingredients	Primary production and hence ingredients will be significantly affected - due to yield, crops will need to be grown in different places. Food prices will increase. *(Food industry association/operator)*
Agricultural input; Ingredients	Climate change will raise new challenges to food safety negatively affecting the need in agricultural inputs [such as seeds, fertilisers and pesticides], availability of a range of ingredients, higher food losses. *(International organisation)*
	Agricultural inputs (such as seeds, fertilizers and pesticides) will turn out to be inefficient against some future new diseases or invasive alien species *(International organisation)*
Food waste	Disruptions due to climate change, all areas of the food chain would be negatively impacted. But food waste would face […] regained attention. *(Food industry association/operator)*
Other; innovation	New sources of Energy and mainly protein will be available on long term basis. *(Food industry association/operator)*
	Innovation from plant biotechnology needed to address climate change/change in weather patterns. *(Other stakeholder)*
	climate change creates need for more resilient seeds to address new conditions *(Food industry association/operator)*
Storage, distribution and retail	Storage, distribution and retail: these stages of the distribution chain should be as transparent and efficient as possible in order to enable effective reaction protocols in face of food hygiene alarms. *(International organisation)*
Trade	Disruption of growth and trade of primary agricultural products *(University/research organisation)*
Trade; Restaurants and catering	Protectionism and specific bilateral agreements aimed at safeguarding food supplies ('food nationalism') have gained in importance and thereby aggravated food scarcity in some parts of the world. Restaurants and catering - Nutrition has been negatively impacted as environmental conditions have resulted in a decrease in the choice of food, higher prices due to food volatility. *(Food industry association/operator)*

Source: Stakeholder survey, question 8.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 79: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 8

Main themes	Comments
Animal health and welfare	Increasing temperature will change the vectors of disease transmission, and as already seen zoonosis not seen in regions will emerge as the result of increasing temperature. *(University/research organisation)*
Health and nutrition	Nutrition has been negatively impacted as environmental conditions have resulted in a decrease in the choice of food, higher prices due to food volatility. *(Food industry association/operator)*
Food contaminants	Higher level of food contaminants as a result of the use of lower quality water in food production and fraudulent activity as a result of pressure on scarce resources. *(Food industry association/operator)*
Enforcement and controls; Food contaminants;	Emerging risks from environmental contaminants (mycotoxins, other plant toxins) will increase (see also answer to a), increasing pressure on resources for enforcement and controls. *(Other stakeholder)*
Enforcement and controls	New polices for official controls need to be developed. New risks will be introduces, which need to be included in the control system. The systems for early warning and cooperation between the MS also need to be improved. *(Public authority)*
	Food safety might be compromised due to economic and enforcement breakdown. *(Independent expert)*
	Risk of fraud also might increase. *(Public authority)*
	Food safety scares will lead to decreased trust in food by consumers and require more stringent enforcement of controls. *(University/research organisation)*
Food and feed hygiene	Changed pattern of temperature and weather will induce changes in food safety hazards, will affect the level of food contamination, food hygiene, spread of animal and plant pests and diseases. *(International organisation)*
	Risks in this [food and feed hygiene] would be much higher than at present and with risk of more lethal consequences. *(International organisation)*
Food improvement agents, additives, food contacts materials	There could be new foods developed, new additives, new controls developed. *(University/research organisation)*
	Improvement policies in these areas would be required in the EU to face the assumed loss of productivity at higher latitudes. *(International organisation)*
Novel foods and biotechnology	The need to overcome problems related to climate change will boost the agro-food research. Strategic will be the use of biotechnology. *(University/research organisation)*
Novel foods and biotechnology; Health and nutrition; Food contaminants	The scenario would require more pragmatic approach in these policy areas. In particular the biotechnology area, with increased need for developing products that meet certain agronomic and nutritional objectives would be under pressure for a fundamental review. *(Food industry association/operator)*
Other	In Europe health might benefit from the enforced changes in agriculture, away from meat and dairy production. *(University/research organisation)*
	Dislocation of efficient production trade and distribution systems. *(University/research organisation)*

Source: Stakeholder survey, question 8.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 80: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 8

Main themes	Comments
Social stability	Disruption in food supplies will impact social stability. *(Food industry association/operator)*
	Worldwide, social stability would become an enormous problem (less so within Europe, where the population could get healthier). *(University/research organisation)*
	High food prices alone are already a factor for social instability. *(International organisation)*
	Social instability due to climate refugees will have negative effect on price and consumption. *(University/research organisation)*
Environmental sustainability	The damage caused by possible contaminating agents as a result of climate change (either agents coming from other world latitudes or endogenous of EU) could be very considerable, just taking the present example of some fish and algae species of the Mediterranean sea. *(International organisation)*
Consumer choice	Consumer choice would be affected making it more difficult to opt for healthy options in the diet, notably due to price increase, limited access to choice and food. *(Food industry association/operator)*
Consumer choice	Because of disruptions in primary production and trade, consumer choice will be negatively impacted by this scenario. In this context, it is worth noting that currently there is a trend towards more food products available at retail level, but these products are increasingly based on 8 major commodities. *(University/research organisation)*
	A largely meat-based diet and the consumption of other foods with a high carbon footprint contributed significantly to climate change. *(Food industry association/operator)*
Internal market	Protectionism and specific bilateral agreements aimed at safeguarding food supplies "food nationalism" have gained in importance and thereby aggravated food scarcity in some parts of the world. *(Food industry association/operator)*
	Greater internal market as transport costs rise. *(Consumer organisation/NGO)*
Trade	Unstable weather conditions = unstable supply = unstable trade activities. *(Food industry association/operator)*
	Trade would be affected due to availability and also price [of food]. This could result in countries to increase their agricultural stock levels and deploy more trade restrictive measures, which could further exacerbate the situation. *(Food industry association/operator)*
Innovation	The disruptive effects of climate change on agriculture have strongly induced many producers to resort to adaptive technologies, including drought-resistant genetically modified crops. *(Food industry association/operator)*
	It is hoped that innovation would find mitigating solutions. However, the competition, trade, environmental stability will be negatively affected due to food security concerns. *(International organisation)*
	Possible positive impacts could be associated to new policy and governance e.g. towards increased sustainable [production systems]. *(Independent expert)*
Innovation; Competition; Internal market	Innovation will increase [due to the] need of new sources of nutrition. That will possibly be managed by multinational companies (among those companies competition might raise but […] local food producing businesses will face hard times). *(Public authority)*

Source: Stakeholder survey, question 8.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 81: Key comments of stakeholders/experts regarding most important impacts on food chain activities under scenario 9

Main food chain activities impacted	Comments
Trade	In order to delimit outbreaks of highly infectious zoonotic disease global trade will have to be minimized. *(Public authority)*
	Outbreaks would have an inevitable impact on primary livestock production and on trade as third countries act to close their borders to EU livestock products. *(Public authority)*
	Trade will be seriously affected as consumer trust declines and scientific documentation of [the origin] the problem increases. *(University/research organisation)*
	Food waste will be increased as contaminated food will need to be destroyed. Trade barriers will emerge due to protectionism. The importance of storage and distribution will increase. *(Food industry association/operator)*
	Trade (and food waste) may be affected by rejections, recalls. *(International organisation)*
Primary production	Contamination routes with zoonotic agents come from primary production, and such a scenario may lead to more use of chemical alternatives, and less organic farming. *(University/research organisation)*
	Antimicrobial resistance will have major impacts on the production of food of animal origin. The use of antibiotics has to be reduced but at the same time treatment of diseased livestock has to be ensured. *(Public authority)*
	The main impact of this scenario would be on inputs for animal production and on primary production. Major shocks to livestock production systems reliant on antibiotics as AMR becomes widespread and lack of consumer trust will lead to substantial impact. *(University/research organisation)*
Processing and packaging	This will hit farmers hard and necessitate processing approaches to eliminate AMR from food (irradiation, heat treatments) and more of value addition will be here. *(University/research organisation)*
Storage, distribution and retail	Storage, distribution and retail would be affected more from an economic point of view than from a food safety and nutrition point of view. However the role that these stages of the food chain should play, in order to have an effective reaction to the food alerts, is of great relevance. *(International organisation)*
Ingredients	General loss of confidence in foods manufactured or prepared with ingredients from undefined origins. *(Food industry association/operator)*
At-home consumption	Primary production will be impacted as a default from the scenario, but they will be held responsible also. People will divert from anything coming from the 'outside', hence more at home consumption. *(University/research organisation)*
	Breakdown in consumer trust in food will negatively influence out-of-home consumption and encourage consumers to grown own food, buy from local producers, increase in organic systems of agriculture. *(Other stakeholder)*
Other	The whole chain would be affected. None is exempt. *(Independent expert)*
	Awareness raising for private homes and within canteens might influence the food choice towards avoiding too much intake of animal products. *(University/research organisation)*

Source: Stakeholder survey, question 9.2a, 'In your view, which of the following food chain activities would be impacted in terms of food safety and nutrition as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 82: Key comments of stakeholders/experts regarding most important impacts on food safety and nutrition policy areas under scenario 9

Main policy areas impacted	Comments
Animal health and welfare	Wide use of antimicrobial substances for production purposes affect negatively animal health and welfare. At the same time, the enforcement and control activities will be intensified, hence this is a positive development. *(International organisation)*
Health and nutrition	We think that widespread AMR from human and veterinary medicine, overconsumption of poor quality and hampered access to healthy and nutritious foods for all, are likely to very negatively affect health and nutritional outcomes at population level. Due to vast inequalities in access to food, imbalances in power and resources in the food supply chain poor-diet related NCDs are to grow to disastrous levels. *(Consumer organisation/NGO)*
	A crisis for industry might cause food supply disruption, and more expensive food, but longer term nutrition in food might improve. *(University/research organisation)*
All areas	A catastrophic or major event would undoubtedly lead to addressing some current weaknesses, but depending upon the severity of the event it can also lead to disproportionate politically motivated policy decisions based upon an over conservative precautionary approach. *(Food industry association/operator)*
Enforcement and controls	Although the loss of efficient antimicrobial treatment is serious for animal production, the main impact is on public health. Need for stricter enforcement of controls. *(University/research organisation)*
	A zoonotic disease will reduce animal health and welfare. A change in animal health and welfare towards less use of antibiotics will substantially improve the situation. Antibiotics should be forbidden as growth promoters within animal production and the legislation rigorously enforced. *(University/research organisation)*
	This scenario will boost innovation to address antimicrobial resistance and/or to improve hygiene conditions. Good manufacturing practices will require better enforcement. *(Food industry association/operator)*
	The experience of past food crises in European countries shows that right after the origin of the problems have been identified and the security measures have been taken, the concerned food product (cucumber, poultry, milk, etc) becomes a much safer product than before the food crisis occurred. It is true that this happens even while consumer trust is broken, and the consumption of the product has sharply declined. In other words, one consequence of a food crisis is that the control, enforcement and alert protocols assure a better food safety for the concerned product for the future. *(International organisation)*
	Widespread AMR would have a devastating impact on public health and nutrition and current production systems, and a large negative impact on trade. However countries or trading blocs enforcing adequate legislation to control AMR could gain a competitive advantage. *(University/research organisation)*
Food and feed hygiene	In order to delimit outbreaks of highly infectious zoonotic disease, measures of food and feed hygiene are indispensable. *(Public authority)*
Other	Dramatic impact on entire agro-food chain. *(University/research organisation)*
	Food scandals in the EU have always increased the consumer power and strengthened the legislation. *(University/research organisation)*
	Customers will become more demanding of animal health and welfare, plant health and plant protection products, more critical to novel foods and biotechnology, more conservative to food improvement agents, additives, food contacts materials, food contaminants, more keen on health and nutrition and more demanding of labelling and information to consumers. *(Independent expert)*

	The industry (producers, manufacturers and legislators) always react energetically AFTER a serious problem has arisen. *(Independent expert)*

Source: Stakeholder survey, question 9.2b, 'In your view, which of the following food safety and nutrition policy areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'.

Table 83: Key comments of stakeholders/experts regarding most important impacts on other areas under scenario 9

Main subject of comment	Comments
Broadly positive impacts for competition, innovation and consumer choice for some…	Consumers' choice may become more production oriented which means that the type of husbandry (i.e. organic versus intensive) becomes more important. Perhaps environmental sustainability too. *(Public authority)*
	People will understand that environmental sustainability is really needed. *(Independent expert)*
	The will drive the need for innovation and build resistance and resilience into the food chain. *(University/research organisation)*
… but mixed impacts for some	If there are less of us and if we learn how we impact our environment and how we can diminish our footprint, this is likely to impact positively on innovation and on the environment. But at what price? *(University/research organisation)*
	Local marketing/production may benefit, but prices will increase. *(University/research organisation)*
	Consumers will avoid buying animal source food due to the fear of cumulative effect of anti-microbial residues. Innovation will be on rise to search alternative ways to increase food production and ways of health care. *(International organisation)*
	I expect a very mixed set of impacts: reduced consumer choice as products considered 'risky' are avoided, more innovation and competition (especially to deliver 'safe' products), more nationalism and a 'blame game' that negatively impacts on social stability. *(Food industry association/operator)*
	A zoonosis will boost research on drugs and/or vaccines but will reduce international trade. *(University/research organisation)*
	Zoonosis and antimicrobial resistance will have large economic impacts for the EU, trade will suffer as products cannot be sold on the world market. Innovation on feed and animal production might help to mitigate the problem. *(University/research organisation)*
... and broadly negative impacts for others, e.g. on consumer choice, social stability/equitable access to food.	Under this scenario, widespread breakdown in consumer confidence would lead to less consumer choice and potentially negative impacts on social stability and equitable access to food. Environmental sustainability would be impacted by soil acting as a reservoir for resistant microbes. *(University/research organisation)*
	Such an event could precipitate protectionism and creation of trade barriers. *(Food industry association/operator)*
	Increase in unequal access to good quality healthy and nutritious foods would lead to social instability, widespread violence and potentially even wars over control of food. *(Consumer organisation/NGO)*
	Outbreaks lead to trade restrictions, lower consumer choice, re-imposition of internal market controls (unilaterally or otherwise), and food price rises. *(Public authority)*
	Consumer loss of trust would collapse the market of the concerned product, and even other non-risky food products perceived by consumers as non-safe due to misinformation or lack of it. Protest and also political crisis would be connected. *(International organisation)*

Source: Stakeholder survey, question 9.2c, 'In your view, what other areas would be impacted as a result of this scenario?' - 'Please explain the most important impacts you have indicated above'

Annex IV: References

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