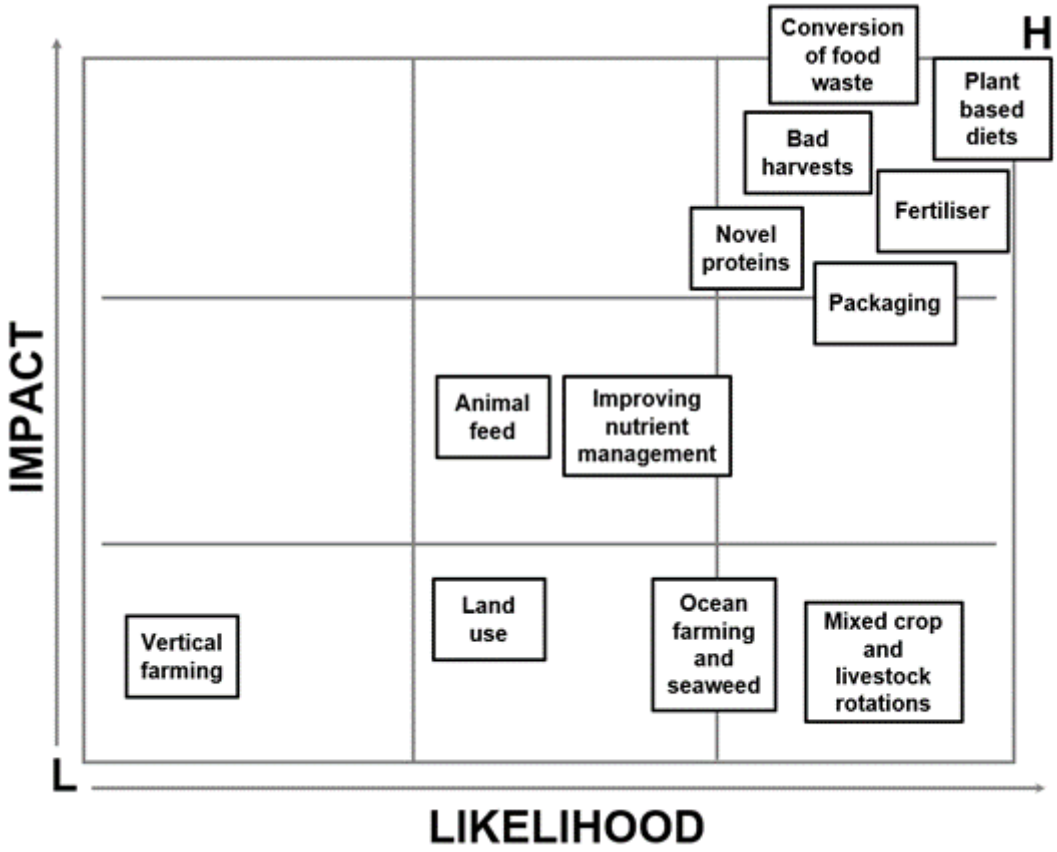
Workshop findings

In this guide

1. Overview

Throughout the workshop, participants reflected on the interconnectivity of the topics explored, highlighting the complexities around establishing which food safety risks should be prioritised in future. Much discussion focused on elements of the circular economy, as well as changes to land use and future consumer habits. The extent of uncertainty around climate change and future activities related to achieving Net Zero was also highlighted, particularly in terms of the implications related to more extreme weather events. For many activities, it is still unclear the extent to which they will be implemented in future or the extent of the impact on food safety that may be seen, given the multiple dependencies at play. Figure 1 shows the final positions of the activities discussed in breakout groups, illustrating the diversity in the potential impact of different activities. It is worth noting that many of these activities were seen as likely to happen – or already happening – by the group. This may reflect the fact these activities were easier for participants to discuss as they are aware of investments already being made and may already see changes taking place today.

Figure 1. Workshop prioritisation exercise: Net-zero activities with potential impact on food safety, placed against the impact-likelihood matrix by participants



Source: Ipsos

A number of activities were identified as more likely to have an impact on food safety, notably the reuse of food waste, more plant-based diets and novel proteins in human diets, changing fertiliser practices and reduced plastic packaging. These activities were linked to several food safety risks including:

- **Allergen** risks associated with reworking materials and novel foods including new ingredients, risks around cross-contamination, consumer awareness and labelling.
- **Antimicrobial resistance** and cross-resistance issues from disinfectants associated with the conversion and reuse of food waste.
- Reduced and novel packaging may result in **chemical contamination** and product cross-contamination, as well as having implications on product shelf-life.
- New (and old) **pathogens** due to changes in fertiliser practices, instability in pathogen populations and mixed land uses.
- **Nutritional risks** to consumers due to:
    - Highly processed plant-based foods and a move towards a fully plant-based diet.
    - Changed inputs (feed / fertilisers/ soil) to livestock and crop production potentially affecting the nutritional profile of foods.

- **Drastic food shortages** with knock-on effects on supply chains and impacts on the availability of both animal and human food products.

The following section includes detailed notes for each activity based on Miro board contributions, plenary and breakout group discussions. Given the 'funnel' approach taken during the workshop, some activities include more detail than others. We have highlighted where there are connections between activities and/or combined certain activities where discussions took place together. The activities and relevant findings have been grouped thematically into those associated with:

1. Changes in farming practices
2. Changes in diets
3. Development of the circular economy
4. Changes to the environment and resources

1. **Changing farming practices**

Activity 1 – Changed fertiliser practices including new formulations and more organic systems of production

Food safety risk(s)

New (and old) pathogens

- Changing fertiliser practices could lead to the appearance of new (super) pathogens as a result of instability in pathogen populations. Examples were given of recent recalls in California and there was acknowledgement that this could be a global issue. Botulism risks from the use of poultry litter spread on fields as a fertiliser was specifically mentioned.
- It was also emphasised that anaerobic digestion is unlikely to lead to more stable outputs as pathogen digestates are likely to be more challenging and are not necessarily a benign product. For example, if super bugs survive the anaerobic digestion process they are likely to be more resilient and thus a higher risk.

Lack of/not enough food

- Making greater use of organic fertilisers was seen as positive. However, concerns were raised around the ability to completely replace synthetic fertilisers with organic ones. Some participants' views were that yield levels

could be reduced with organic fertilisers.
- CO_2 is a by-product of synthetic fertilizer manufacture. Less nitrogen use will lead to potential shortages in CO_2 with knock on effects for food and beverage production.

Environmental contamination

- It was felt that organic fertilisers will be part of the solution, but the extent of use is unclear. Trading in muck/slurry is important and likely to get more important, as it may have implications for farm boundaries and biocontainment. For example, if muck/slurry is being transported and used across different farms it could increase the risk of pathogens spreading, as well as making it more difficult to trace these pathogens.
- Absorption issues may be critical when it comes to soil health. If the focus is only on manure/fertilisers in terms of crop yields, the need to rebuild depleted soils may be missed. However, there is also an economic opportunity arising from the benefits of organic manures.

Activity 17 – Changing/mixed crop and livestock rotations

Food safety risk(s)

Increased reliance on heavy pesticides and chemicals for monocultures

- It was felt there were opportunities to reduce chemical inputs including pesticides, fertilisers and antimicrobials by effective circular economy and livestock grassland rotation integrated to crops.

Crop co-mingling and cross-contamination

- Mixed crop and animal rotations seem important to both crop sizes and soil health, but disease breaks are likely to be necessary. The “dung factor” means worm health also improves.
- Farmers can graze cattle for shorter periods e.g. one to two months, and get these benefits. There is lots of existing research on cattle and sheep that shows how livestock grazing helps land recover.
- But there were questions about how to create more space for livestock in a sustainable way and the impact of ruminants.
- There are potential risks associated with faecal contamination and E.coli.

Speed to market

- Existing approaches are familiar but there are scaling issues. New funding models are emerging and there are international efforts towards innovation taking place, for example in New Zealand.

Activity 20 – Ocean farming and harvesting of seaweed

- Participants linked this with activities 8 (reduction of inputs (e.g. water, biocides) that affect food safety) and 19 (Multi-stream culture systems (e.g., fish plus water plants such as watercress).

Food safety risk(s)

Contamination

- There are a large number of contaminants in the sea and this has a regional component. For example, organic pollutants and heavy metals would require routine surveillance of contaminants and would potentially fall into the industry's remit with responsibilities to ensure safe products. Nuclear radiation and dioxins were also mentioned.
- Seaweed's ability to absorb radionuclides, particularly TC99 is something that has been looked at in the past, particularly from the west coast of England related to releases from Sellafield. Participants felt radioactive contamination was likely a low risk and isolated to particular locations, for example in areas where nuclear power stations are in operation. However, the next generation of nuclear power stations have dramatically reduced their discharges. Furthermore, participants explained that this is a process that is already monitored in food and other materials. There was a sense that there should be efforts to ensure legislative procedures are in place to control the quality of products.

Utilising seaweed as a resource

- There is a mature industry of consuming seaweed (particularly in China and Japan) and more recently in Scandinavia and Benelux where there are efforts going into utilising seaweed as a potential new resource.
- Seaweed strains are used as a replacement for salt in foods, for example the kombu strain. They are packed with fibre, cellulose and other structuring materials that have been used in foods for many years.
- There is potential not only for seaweed as a fibre protein but also as a good lipid. Depending on the fermentation conditions, you can get algae to switch

from being high fibre, high protein or high lipid producers. The lipids that are produced can be polyunsaturated rather than saturated fatty acids with nutritional benefits.
- Seaweed can also be cultivated sustainably, for example utilising inoculated ropes. This has already been done in Cornwall and there are more lessons to be learned from other countries that have been doing this for a while.

Ocean farming

- Participants recognised emerging developments related to ocean farming and changing fish species that may result from ocean warming.
- There was uncertainty about the food safety risks associated with changing fish species and ocean warming, but it was felt there could be barriers related to consumer acceptance.
- Concerns were also raised around ocean farming and plastics (particularly microplastics and nano-plastics) entering the marine food and the food chain. Participants linked this to Activity 19.
- Participants considered the issues surrounding 'ownership' of marine 'space' used for farming and hence implications for control/responsibility regarding the integrity of food and food safety.

Speed to market

- Medium to high given this is already happening around the world and is therefore an opportunity for the UK.

Activity 34 – Vertical farming systems

Participants noted a number of positive effects of vertical farming systems including:

- Reduced reliance on conventional pesticides, resulting in reduced residues on crops
- Removing environmental risks including birds, soil, physical contaminants
- Less handling of crops through hand harvesting reducing the risk of norovirus being spread to products.
- Automation of systems and use of existing infrastructure (e.g. disused underground lines, mineshafts) could increase productivity.
- Improved flavour profile with LED lights using different wavelengths.

Food safety risk(s)

Contamination

- Participants discussed the slightly higher risk of contamination through pathogens in vertical farming systems. An example was given from the US with Salmonella spreading through re-circulated water to the whole crop.
- It was suggested that often products are ready to eat such as leafy salads, removing the need to wash food before it is consumed. This is potentially beneficial in terms of quality but does raise safety risks.

New, atypical environments with limited understanding of associated risks

- Participants considered the relatively young age of vertical farming systems and raised concerns about potential future environmental risks as a result of these systems ageing. For example, dust accumulation over time inside the structures, and viruses.
- Vertical farming systems were typically associated with start-ups, which might not have a food industry background raising concerns around potential risks associated with lack of experience/awareness.

- Participants reflected on the 'niche' character of vertical food systems, the limited number of crops the technology applies to and limited return of investment. They felt this could have implications for food security if it takes resources away from areas that may do more to feed the population.

Speed to market

- Participants felt the speed to market for this activity would be in the medium to long-term (4-9 years). They described how we are seeing more legacy industries, such as established horticultural producers and food companies, enter the sector with increasing investments. It was felt the retail link is slowly establishing, whereas previously the market was focused on high-end restaurants.
- There are commonalities between vertical farms and high-tech glasshouse systems, with the potential for approaches used for glasshouses being applied to vertical farms.
- One participant advocated for increasing the scope of the discussion to cover wider controlled environment farming, beyond vertical farms. They suggested that high tech growing conditions are likely to expand in response to changing weather conditions that farmers are no longer able to afford given the implications for crops. This could include glasshouses and mushroom farms, which are not new innovations and will therefore be faster

to market compared to vertical farming systems, which may be more of a “slow burn”.

2. Changes to diets

Activity 9 – Improving nutrient management

Food safety risk(s)

Participants agreed this was a broad and complex topic with a range of food safety implications. Discussions expanded from allergens and food/nutrition security to the importance of standardised labelling to avoid misunderstandings and potential impacts to consumer health. However, it was recognised that there are likely to be positive implications of improved nutrient management; both to human nutrition, and reducing contamination with fewer nutrients ending in the wrong place in the environment (e.g. waterways contaminated with phosphorus or nitrogen).

Food security, nutrition and allergens

- There was a recognition that continued growth in the human population could result in a lack of food, with implications such as a greater need for alternative sources of proteins for both humans and animals.
- Improving and manging nutrients was seen as also being dependent on where food is produced and imported from and shortages resulting from climate change were identified as a risk. For example, selenium levels in Canadian wheat (a major import product for the EU), compared with Ukrainian wheat which have different levels of selenium. They emphasised the level of complexity in this. As climate change changes where products are grown, this may lead to higher risk factors throughout the food chain.
- It was emphasised that the nutritional risks do not just relate to proteins, but also micronutrients including iron, calcium or zinc, and secondary metabolites which are provided by plants.
- One participant described how their team had been working with the Royal Botanic Gardens Kew on different varieties of apples. They were looking at fluorescein which is a compound which reduces the risk of type-2 diabetes. In different varieties, they found a difference of up to tenfold in the natural variation of fluorescein between plants.

- Participants also described a need for digestibility and the bio-availability of amino acids in animal proteins that they felt plants would not be able to deliver. This was identified as a challenge resulting from a move towards a more plant-based diet.
- An emphasis was placed on the importance of accurate and standardised labelling for specific nutrients or sustainability attributes. This could reduce the risk of misunderstandings around safe or sensible ingestion levels and was linked to attitudes to supplements, for example, that more is often automatically seen as better.
- One participant felt that nutrient management should also be looked at from the perspective of capturing nutrient losses in the food production system. For example, there are significant nutrient losses in manure resulting from livestock production. If manure is applied to crops, nutrient losses may occur because they are not absorbed by the crops. Better nutrient management could lead to fewer nutrients in the wrong place in the environment.
- Another participant emphasised the need for a thorough risk-benefit assessment which also captures the benefits as well as risks of future changes.

Speed to market

- Participants emphasised the difficulty around identifying the speed to market, because certain elements of nutrient management could take place at different times. For example, starting with a new GM crop will make for a longer process due to the required regulatory and safety clearances to produce this type of crop. However, if farmers were being encouraged to select new varieties on the basis of nutrient content rather than yield per mass, they can do so as soon as the varieties are available. One participant hypothesised that a potential tax incentive for farming practices to adapt on the basis of nutrition rather than yield, could increase the speed to market.
- There are also already known steps to improving nutrient management which could take place rapidly. However, this could trigger longer-term issues such as those resulting from breeding for certain varieties.
- The speed to market could also be dependent on demand, which participants did not feel was currently there in terms of consumers seeking food with improved nutrient content. Legislation could increase the speed to market by creating incentives to improve nutrient content without consumer demand.

- Some of the more immediate, subtle changes that can happen are those which won’t affect the flavour profile of foods and are not going to cause any

major changes for the consumer. It was felt this could happen fairly quickly on a voluntary basis without much impact.
- Conversely, any kind of legal intervention to push farmers or producers in certain directions probably would require time to develop and would not be in place for at least three years or more. This could have a more significant longer-term impact.
- One participant felt these changes were highly likely either due to environmental factors that may lead individuals to change their sources of protein, with an effect on nutritional profiles, or due to cost. They suggested it might become cheaper to use certain ingredients as replacements for those traditionally used, which would drive the likelihood of changes becoming widespread.

Activity 21 – Novel animal feed: insect protein, soy replacement, new proteins

Food safety risk(s)

Nutrition

- Risks associated with anti-nutritional factors (in particular compounds that could interact and inhibit digestive enzymes during the digestive process, rather than high levels of chitin in insect larvae and exoskeletons) from both insects and emerging crop sources should be considered and mitigated against. Referencing work from the University of Nottingham, one participant explained there are certain processing steps that could eliminate some of the risk but warned these risks should not be underestimated.
- Participants reflected on the risk of changing the nutritional profile of human consumed meat as a result of feeding insect protein to animals. For example, meat could become leaner or increase its fat content.
- When assessing the potential risk, participants also highlighted the importance of being aware of how these compounds are being used and how they reach the market. For example, whether they are being used as protein replacement for soya and fish meal, and the differing nutritional needs of different species. Using insect larvae as a protein source or as white powder extract which may be purified to different degrees as the market moves away from intensive refining.

- Participants agreed that novel animal feed, and in particular alternative protein sources, provide an opportunity to enhance aquaculture and the nutritional levels of fish. A study from the University of Nottingham in partnership with their Malaysia campus was mentioned as exploring plant alternatives to fish feed.
- Discussions also covered research looking into replacing the importation of soy into animal feed by increasing the number of pulses and legumes that are being produced in Europe, with potential benefits in nitrogen fixing from crop rotations.

Speed to market

- Medium to long-term (4-9 years). Although some of this is already happening, it will take some time to reach the scale of tonnage of new protein sources where it will have a significant impact.
- One participant predicted the insect feed market developing through the agricultural market first, monogastric animals, reaching ruminants last, as a reflection of the post-BSE legislation being stricter for ruminants and the enhanced risk. It was also noted that this could lead to high demand and therefore a need to have the infrastructure in place (more bioreactors) to produce hundreds of millions of tonnes of insect protein.

Activity 31 – More plant-based diets

Participants mentioned the potential for plant-based diets to have more nutritional benefits with positive impacts on public health due to being lower in saturated fatty acids. They discussed the reduced microbiological risk in plant-based diets, as this type of risk is usually more present in animal-based foods. There was an expectation that antimicrobial resistance will decrease, as human diets drift away from animal-based products. Plant-based foods were also perceived to be more environmentally friendly.

Food safety risk(s)

Allergens and new pathogens

- Participants highlighted the importance of ensuring a good understanding of what ingredients are going into novel plant-based foods and ultra-processed plant-based foods to mitigate against potential allergens. This included looking at how the products are being produced.

- They also acknowledged the potential for the development of new microorganisms in plant-based diets. Listeria was named as an example of a human pathogen that was not known 40 years ago.

Nutrition

- Participants explained that there is an anti-nutrient angle associated with plant-based diets. For example, if a consumer requires more iron and calcium, they may find it more difficult to source these nutrients in a plant-based diet.
- Similarly, there was acknowledgement that some plant oils are not necessarily healthier than animal oils. This is the case for coconut oil and PKO (palm kernel oil), which are higher in saturated in fatty acids.

Suppliers and regulation

- Participants raised concerns around the need to better grasp small suppliers' understanding of and capability to meet safety requirements when seeking approval for novel foods.
- They also highlighted the importance of having up to date food intake data for the UK as an important part of the food safety risk assessment.

Speed to market

- Because a lot of these products are already on the market participants felt the likelihood was high. However, they were less certain about the extent to which these diets will be adopted in future.
- Younger generations were perceived as being early adopters of the more convenience-type plant-based foods, which are heavily processed and could present risks in future. Participants felt this was the direction the market might move in future.
- Whilst recognising the complexity of the issues associated with this activity and considering the current market trends, participants hypothesised this will have a medium to long term impact (4-9 years).

Activity 32 – Novel proteins in consumer diet: insects, cultured meat, meat and dairy substitutes

Food safety risk(s)

The FSA is aware of the term ‘novel proteins’ being used loosely, and it is currently thinking about this in three ways:

- Products that are clearly protein, are already being consumed, but are now being used differently – for example, a pea-based burger as an option
- Proteins which exist in nature but have not traditionally been consumed in large quantities in the UK – insect protein is the primary example here, crickets, either in its native form or as a kind of processed end-product
- Novel to the planet in the context of lab-grown meat, cell line-based meats, even artificial proteins that you could create synthetically from amino acids

Allergens

- During discussions, participants emphasised the need to differentiate between ‘novel proteins’ and ‘novel uses’ – for example, seeing an increase in pea protein, might mean it’s a novel use rather than a novel protein. They explained how changing the exposure levels to something that is already in the supply chain could shift the risk profiles for some allergic consumers.
- Novel food risk assessments were seen as a good tool to mitigate against some of these risks. However, challenges were raised around the quality of intake data used for risk assessments.
- Allergen risks were also discussed in the context of traditional foods used in other places around the world that are not commonly sold or consumed here. In these cases, there may be a lack of common knowledge about allergenicity or information about how to prepare, cook and eat these products.

Labelling

- Consumer confusion can lead to safety issues related to novel proteins (e.g., lab-grown meat). For example, if a product is labelled as vegan, someone with a milk allergy may not expect to find an exact copy of a milk protein.

Suppliers and regulation

- There was concern about small companies lacking understanding of the level of regulation, veracity and rigour of information required when submitting materials for approval to the Advisory Committee on Novel Foods and Processes (ACNFP).

- There was also concern about small suppliers who might not have the in-house ability or expertise to complete a full characterisation. There was a sense that better access to testing facilities was needed. There were concerns about the ACNFP and Contact Research Organisations (CROs) being overwhelmed by the large numbers of submissions in addition to what they're currently experiencing.
- It was highlighted there are also risks in this space from the illegal market.

Speed to market

- Participants noted the challenges around processing and responding to the large number of applications for approving the use of new and diverse foods. They highlighted the importance of taking a precautionary approach with appropriate processes in place to ensure novel foods are dealt with in the most suitable way.

3. Development of the circular economy

Activity 7 – Development of circular economy principles to utilise waste streams

- This activity was linked in discussions with Activity 28 (Conversion of and reuse of food waste).

Food safety risk(s)

Allergens and toxin issues

- Participants discussed using waste streams to create novel foods e.g. removing sugar as the primary product and reusing the fibre and protein as a new product. This could have implications for allergies as well as toxicological issues with the new food and would require a normal novel food risk assessment.
- There is also a risk of increasing concentrations of toxins through reuse.
- Changes to feedstock, for example, the change in waste streams used within a standard process to create a carbohydrate feedstock for fermentation can vary dramatically, particularly if your fermentation products are selective about their carbohydrate substrate. This creates potential unknown risks – for example, micro-content risks (on a long shelf-life product when breakdown happens very quickly during the fermentation process) and

transference to other products. This was also associated with the lack of experience of start-ups that may benefit from access to a knowledge-sharing network.

Allergens linked to food contact materials

- There were concerns about the use of food waste products as food packaging materials. For example, chitin exoskeletons of shellfish being used in packaging which allergic consumers may not be aware of.
- The need for assessing these allergy risks was highlighted as the risk in practice could be low given the extent of processing. However, there were concerns about new producers and their understanding of these kinds of assessments and their responsibilities related to allergens.
- There was also uncertainty about the risks of packaging on international products entering the UK and how we screen what’s coming in from other countries in relation to packaging.
- It was recognised that there will be an increase in the number of materials using recycled content, particularly recycled plastic. The FSA is currently setting up an application and authorisation system for recycled plastic processes. Any output that comes from those processes is going to be safe to be used in food contact material applications. This will be a good example for referencing to the circular economy.
- If packaging breaks down more quickly but it's on a long shelf-life product, there is a risk both of the micro-content as well as the transference of other things between products. There was concern about the lack of requirements for the labelling of contact materials (compared to the requirements for food labels).
- Participants discussed side stream valorisation, linked to agile biorefineries.
- The potential for unintended consequences associated with the intense commercial pressure linked to Science Based Target Initiatives and Net Zero, was also discussed.
- It was felt there is a need for awareness raising initiatives, particularly among new and/or small producers, to ensure they develop risk assessment procedures. A knowledge-sharing network was suggested. This could embrace small high-tech, host academic float-offs, invest in educational or awareness-raising programmes about some of the basics that major suppliers appreciate but new start-ups may not.
- There is also a need to improve guidance and regulation. For example, engagement with the finance sector that finances such expansions of pilot

projects or academic investment projects, to enable them to ask the right questions before they loan money to new start-ups in this space.
- It may be useful to engage some of the circular economy organisations such as WRAP and the Ellen MacArthur Foundation to give them some guidance on what some of the basic food safety elements should be looked at. It was suggested that this guidance could be shared as an open-source access public document on relevant websites.

Nutrition / food content risks

- Some concerns were raised about feeding livestock new foods which could change the nutritional profile of the meat.
- In rare events, feeding livestock new foods has been the cause of new transmission of diseases. This has the potential to accidentally cause an incident such as BSE.

Speed to market

- There was acknowledgement that there is currently significant interest and development in food contact materials triggered by the Blue Planet 2 effect. Businesses have started to look at alternatives to conventional plastic. The FSA's Committee on Toxicity is also looking at a number of these materials, including chitin-based and potentially wheat-based products. This was seen as something that the FSA needs to take a close interest in as we move forward.
- It was felt that these developments are already happening so the speed to market will be fast.
- Medium risk associated with allergens as a result of contact materials and novel foods although a sense that more risk assessments are required. It was felt that products developed by smaller companies or without extensive market reach could slip through existing food safety risk assessments and requirements. For example, wheat-based straws were mentioned as already being on the market, but there was uncertainty about the safety processes these products had been through.
- There was an expectation of more novel food submissions. A higher risk was associated with the capacity of committees such as the ACNFP to handle the large volume of requests they are receiving.

Activity 27 – Reduced plastic packaging

This activity was linked to Activity 28 – Conversion of and reuse of food waste.

Allergens and cross-contamination

- Participants discussed the potential risks of allergens and chemicals getting into food products as a result of reduced packaging. This was distinguished from novel packaging which has distinct risks attached to the potential allergic content of the packaging itself (as discussed in Activity 7 and 26).
- Using less packaging due to increased consumer demand, was emphasised by participants as increasing the risk of cross-contamination between products both in storage and when products reach the consumer.
- Participants reflected on consumer attitudes towards plastic packaging, the impact this has on the integrity and safety of food content as less packaging is used, and associated food safety risks. This was seen as having a potential knock-on effect on consumer trust in regulatory procedures and legislation.
- Furthermore, group discussions highlighted important trade-offs to consider in the context of using less packaging and the implications of this on food waste. One example given by participants was the plastic-wrapped cucumber, which has twice the shelf life when wrapped, therefore reducing food waste.
- Participants described the risks associated with consumers removing products from their packaging and distributing them in reusable containers. This increases certain risks linked to hygiene, cross-contamination, lack of labelling and safe shelf life.
- There is a need to mitigate against risks associated with the use of recycled packaging coming from real circular use. For example, there may be an increased the need for more robust cleaning and protective layering.
- Participants also discussed the use of packaging for animal feed products. One participant described their experience of using different materials for different animals. For example, the use of paper for poultry food if kept in the right conditions, or plastic for bird food with a long shelf-life. They also described how they use plastic packaging for sheep food as the packaging needs to maintain its shape to avoid breaking under more adverse conditions while out in the fields. They reflected on potential Net Zero impacts of using these materials in relation to shelf life and carbon footprints. In this case, the participant explained how they tended to avoid using cardboard as it could have a higher carbon footprint than plastic.

Speed to market

- Participants felt reducing packaging had been happening for some time but they had not noticed a significant impact of this on food safety. Questions were raised as to whether the FSA would pick up on this through their incident reporting. This could pick up on impacts to human health but would not highlight if more people are throwing food away as a result of shorter shelf lives.

Activity 28 – Conversion of and reuse of food waste

- Commercial pressures to address the conversion and reuse of food waste were linked to the cost and achievement of science-based targets and Net Zero. Participants felt there could be unintended consequences from these activities. It was also felt that there could be variation in the quality of outputs due to the ingredients, which could have an impact on the final product.
- It was suggested that industry is trying to upcycle waste not downcycle waste, particularly where waste inputs are being used in factory settings and other processes. It was felt this could potentially create new areas of risk due to a lack of training, misunderstanding allergen risks and not managing these risks appropriately.
- Participants questioned whether allergen management risks associated with reworking and upcycling are manageable through well applied existing practices or needs new practices and processes. It was pointed out that Foot and Mouth Disease and BSE both started with feeding waste to animals.
- Participants mentioned anti-microbial resistance issues and cross-resistance from disinfectants e.g. waste milk residues, cropping, sanitized water (e.g. bleaching chemicals, sanitizers). There were also concerns about the bioaccumulation of chemical contaminants.
- Microbiocidal safety and the use of chitin as a soil additive promotes activity that reduces potential carbon mineralisation (PCM) levels.
- The principles industry is following are to upgrade to higher value and better use, not just to address waste. There is a need to ensure risks are addressed in by-product handling and processing.

- This activity was linked with Activities 7 (development of circular economy principles to utilise waste streams), 8 (reduction of inputs (e.g. water, biocides) that affect food safety) and 27 (reduced plastic packaging).

4. Changes to the environment and resources

Activity 8 – Reduction of inputs (e.g., water, biocides) that affect food safety

Food safety risk(s)

Contamination

- Water scarcity could have a potential impact on cleaning during food production. This could have a subsequent impact on the management of a range of risks including contamination of food products.
- The increased use of brown and grey water in agriculture was seen as a potential problem, which could lead to more risks in future. The current use of highly treated water in agriculture was seen as not sustainable, due to the high financial costs associate with this type of practice.

Foodborne diseases and nutrition

- A shift to more plant-based diets could result in the UK having to import more plant commodities. The pressure to increase plant production in this way could lead to a range of plant safety risks.

Likelihood of impact

- Medium risk due to high awareness of what the risks associated with the reduction of inputs are. These risks were already accounted for by risk managers and were unlikely to worsen.

Activity 16 – Land use change: balance between use for agriculture and use for carbon storage

Food safety risk(s)

Contaminants and pathogens transmission

- Diversifying land use through mixed agriculture, might lead some farmers to have multiple animals on the farm, which could bring risks associated with

pathogen transmission – for example between poultry and pigs. Having livestock on cropland, will also require careful management of contamination from animal faeces into food products.
- Similarly, in the context of circular economy, more farms are now capturing their waste and making biogas to support themselves. It's possible that in the future, stubble waste will be fed to insects which will then be fed to animals as animal feed which could have resulting risks.
- Using manures could be beneficial from the perspective of moving to a lower carbon-use environment, although it will need appropriate risk assessments in place. Participants reflected on this while drawing parallels with sewage solids in the UK that go onto the land rather than into the sea. This is a carefully monitored process to ensure no harm is caused, which could be learnt from.
- Participants also discussed the restoration of peatlands and afforestation as a positive impact. They felt this could be a means to help cleaner water go into primary produce and agriculture, mentioning how it could help with attenuation and storage. One participant mentioned how it also has the potential to prevent rivers flooding with store overflow into field crops, arguing there may be wider positive benefits to be investigated.
- Mixed agriculture as a way of increasing environmental and crop diversity was also seen in a positive light.

Allergens and toxins

- Discussed in relation to mixed crop rotations and co-mingling/growing agriproducts which have a regulatory allergen.
- Alkaloid containing weeds – different plants getting in with the crops may have toxic risks. There are technically challenging ways of sifting these crops out.

Speed to market and impact

- Low to fast, and dependent on second phases of ELMs and the finance incentives for farmers to change at scale. There are a few farmers who are doing it now, however, participants felt it will take quite a long time for it to become standard practice. Despite some of it being already on the market under the label 'organic', participants concluded it was a very small part of the total food market.
- Participants emphasised the importance of thorough risk assessments but did not feel there was necessarily a risk to these changes in relation to a

move towards a lower carbon-use environment.

New activity – Impact of bad harvests causing price and supply volatility

Food safety risk(s)

Economic and climate challenges with potential impact on the UK food system

- Participants discussed an increased move towards a ‘design to value’ approach, which is adding pressure on cost base structures. This was seen as impacting the resilience of the UK food system. As well as economic pressures, participants emphasised how current climate issues could lead to shortcuts with potential food safety implications.
- It was also felt there could be an impact in a potential decrease in affordable and accessible healthy foods. This could, in turn, lead to a number of health and social problems and potentially further pressure on the NHS.
- Participants recognised that changes in price could affect consumer choice and increase the risk of fraud or food authenticity risks. This could present further challenges and give rise to potential food safety consequences.
- There was a sense of uncertainty around post-Brexit funding models for primary production and in particular farming. Participants expressed concern about the dependency of many producers on subsidies and the potential risks associated with having funding models that deprioritise food production. This could increase risks for countries reliant on imports.

Labelling

- Participants reflected on the rapid need to change ingredients and suppliers, which in turn can present challenges with specification handling in the food chain. They emphasised the need for labelling changes to accurately reflect the ingredient content.

Food security/shortages

- Whilst acknowledging the uncertainty around these issues, participants reflected on the 2008 food crisis when Russia and the USA were affected by a partial drought. China’s increased use of maize for biofuel led to major disruption to the supply of cornflour and maize products with knock-on effects throughout the food supply system. Drastic shortages lead to a lack

of food and significant food shortages for animal and human food products.

Speed to market

- Participants reflected on the complexity of the issues discussed and agreed this is something that could reach the market at any point in time. They felt the potential impact was likely to be high.