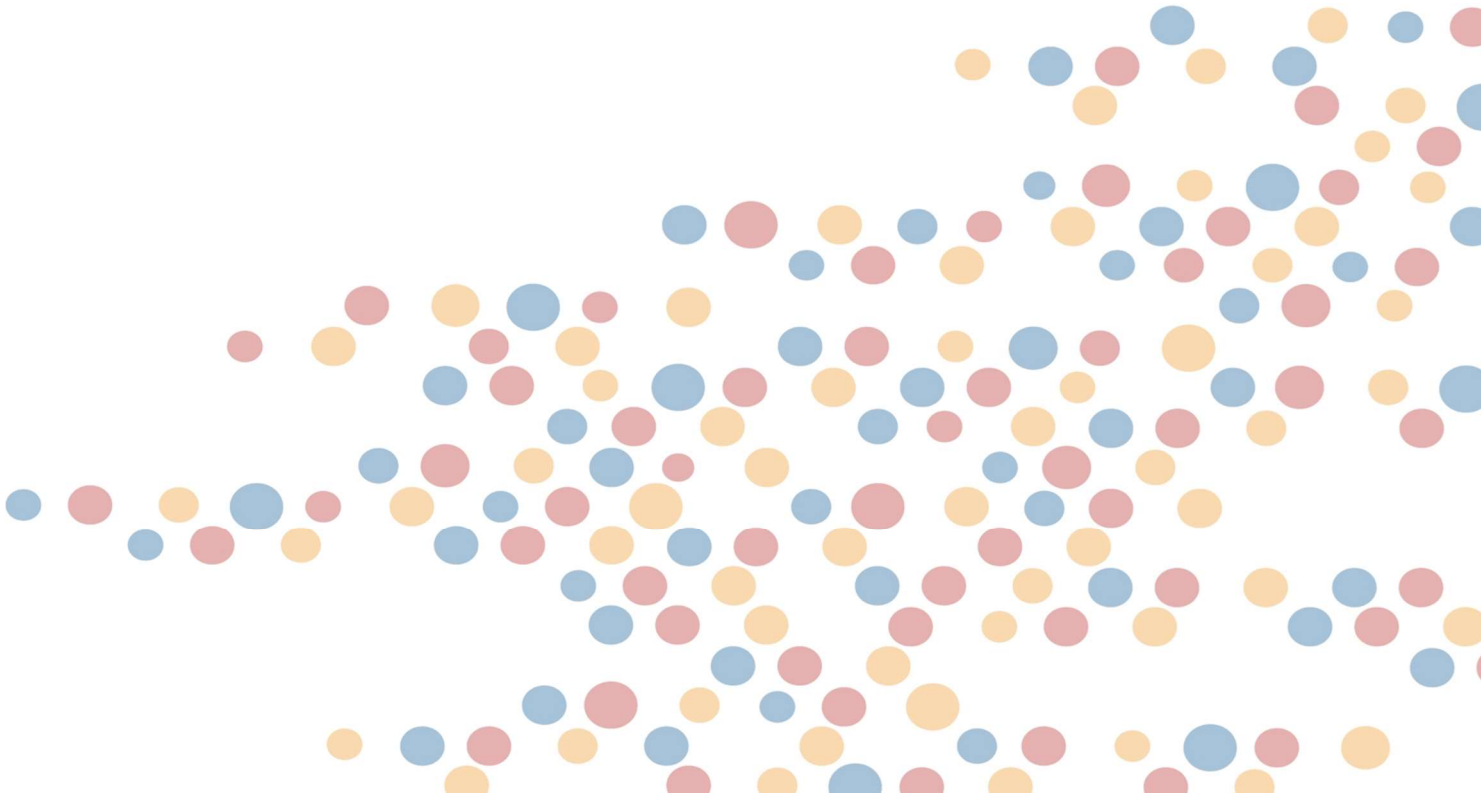
jrs the research consortium

New Breeding Techniques (NBTs) Consumer Research

Final Report

June 2023



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1. Key Terms and Working Definitions

Key Terms	
FSS	Food Standards Scotland is the independent food regulator responsible for regulating food and feed products in Scotland
FSA	Food Standards Agency is the independent food regulator responsible for regulating food and feed products in England, Wales, and Northern Ireland
'New' or 'Novel' foods	Foods that have not been consumed by people within the UK or EU. These must be risk assessed by the food regulator before being authorised for sale to consumers.
Tiered Systems	Tiered systems are systems that have different regulations for different types of NBTs. For instance, a tiered system based on potential risk might have a tier for small NBT changes where the risk is well understood (Tier 1) and another tier for larger changes where additional risk assessments are required (Tier 2).
Expert Committee	Expert committees are dedicated bodies that provide expert oversight and opinion on food and feed products containing NBTs.
Online register	An online register would require producers to register foods using NBTs with the food regulator which would then be available online to the public.
Labelling	Labelling of all ingredients contained within a food product is a legal requirement. Mandated labelling of NBTs would require products that include ingredients from NBTs to be stated on a product food label.

Working Definitions of Key Technical Terms *Note that many technical terms can be defined in different ways - for the purposes of the research these terms have been defined as follows[1].*	
Classical Breeding Techniques	Sometimes also known as conventional or traditional breeding, this refers to breeding techniques which were commonly used before the definition of a GM was adopted in 2001.
New Breeding Techniques (NBTs)	Techniques that can alter the genetic material of an organism that have emerged or been developed since the definition of a GMO was established in 2001.
Genetically Modified Organism (GMO)	Organisms produced using genetic modification, typically with the addition of DNA from another species.
Radiation	The application of radiation is a technique used to generate new genetic variation. Often referred to as random mutagenesis, this technique is considered part of conventional or traditional breeding.
Gene Editing	Techniques that alter the genome by editing the DNA to produce site specific modifications.
CRISPR (Clustered Regulatory Interspersed Short Palindromic Repeats)	A prominent technique of gene or genome editing which can produce targeted changes to the target genome.
DNA	(Deoxyribonucleic acid) the genetic information contained in every cell.
Targeted Mutagenesis	A breeding tool where one or more specific change(s) to DNA letter(s) in target locations of the genome. No DNA is inserted. These changes could occur by classical plant breeding.
Cisgenesis	A breeding tool where a gene from the same species is introduced as an exact copy. No transgenes are inserted. In many cases, these changes could occur by classical plant breeding.
Transgenesis	A breeding tool where a gene from another species is inserted. Techniques of transgenesis are often referred to as genetic modification (GM). These changes could not be achieved by classical breeding.

[1] These terms are not necessarily officially endorsed by FSS.

2. Executive Summary

Background

JRS was commissioned by Food Standards Scotland (FSS) to carry out research into consumer attitudes towards New Breeding Techniques (NBTs). The research was commissioned to help inform FSS's understanding of consumer perceptions around terminology and the future regulation of food containing products of NBTs. Research objectives were to explore: consumers' views and attitudes to different terminology; perceived risks and benefits; and the level of regulation that consumers want. The research aimed to build on previous joint survey research carried out by the Food Standards Agency (FSA), in association with FSS, which examined consumer attitudes to Precision Breeding[2], by providing further in-depth insights from qualitative research with consumers in Scotland.

Methodology

The research was conducted across a series of eight, three hour-long, focus groups designed to familiarise participants with NBTs in food production and for them to give their opinions. A total of 43 consumers participated, reflecting a broad mix of the Scottish population. Participants were shown an introductory video on plant breeding, and presentations on terminology and regulation. A few days after the focus groups, participants were asked to reflect on a number of questions in a short online questionnaire (38 of the 43 focus group participants completed the questionnaire). The materials largely drew upon examples from NBTs in plants, but NBTs in animals were also touched upon.

Findings

Consumer understanding and views on NBTs

The vast majority of participants started from a very low base of awareness and understanding of NBTs. At the outset, spontaneous awareness of new plant breeding techniques was very limited. A few people tentatively mentioned they were aware of "something" around this, but in most cases without the backing of any real knowledge of the topic.

Many were open to the idea of learning more about the science of how plants are bred, but it was not high on their agenda or front of mind in their day to day lives.

[2] https://doi.org/10.46756/sci.fsa.ouv127. FSA carried out separate qualitative research with consumers in England, Wales and Northern Ireland - Consumer perceptions of precision breeding: Executive summary | Food Standards Agency.

Indeed, some did not want to know more, because they felt they might start to worry about what is in their food.

When prompted with a range of terms relating to plant breeding (precision breeding, new plant breeding methods, Genetic modification/GMOs, new breeding techniques and targeted breeding), there was slightly more recognition, with the term GMO triggering a response from a number of participants.

Following a brief initial discussion, participants were shown an introductory video explaining NBTs in plants. The video was presented by an independent academic in the field of plant breeding and covered the historical context of plant breeding techniques including classical breeding techniques, genetically modified organisms (GMOs) and new breeding techniques (NBTs). Many found the video difficult to follow and difficult to recall shortly afterwards. Some were impressed by the volume and intricacy of the scientific work that is going on behind the scenes. A few were immediately suspicious, questioning why these new developments were necessary and the motives and drivers behind change. Two particular types of plant breeding triggered a very negative response. The first was mention of the use of high energy radiation to make seedless oranges. The second, was making a GMO by taking genes from another organism.

Both radiation and GM had been mentioned in the video before the presenter talked about the new techniques of gene editing and the CRISPR tool. Consequently, some people had been distracted by negative views to radiation and GM which made it difficult for them to fully engage with the content on NBTs. A reflection of this is that CRISPR gene editing was discussed less by participants than both the use of radiation in classical breeding and the use of GMO over the last 40 years.

Even so, there was still a fairly strong view, held by many, that consumers had to trust the science and accept that change is inevitable. A sizeable number of participants trusted science and scientists, accepted that things move on, and that scientific advancements are, in general, good for society.

Terminology

A short PowerPoint presentation was given about some of the terminology used around the technologies, including explaining the distinctions between techniques of mutagenesis, cisgenesis and transgenesis. As with the video, many participants found it difficult to recall what they had just listened to in the terminology presentation. Most found the content difficult to understand, and few were able (even with prompting) to appreciate the distinctions between targeted mutagenesis, cisgenesis, and transgenesis. They were not familiar with the terminology, and found the language off-putting, over-scientific, and even “a bit scary”.

On further discussion, and on probing each of the three types of change, some participants began to highlight differences that were important to them, which

indicated some recognition that NBTs were different from other plant breeding methods. Distinctions most frequently focused on NBTs and GMOs, though some still found it difficult to fully disentangle the two.

A good number of the participants made a distinction between transgenesis and everything else; frequently driven by having a strongly held negative view about the idea of using DNA from another species.

The grouping that most were comfortable with was distinguishing change that could occur naturally from change that could not occur naturally: i.e., essentially keeping transgenesis (involving GM) separate from everything else.

Partly due to concerns around some of the processes (e.g., irradiating plants) involved in 'classical' breeding practice, and, because in many peoples' minds 'classical' should actually mean 'natural' with no tampering at all, making a distinction based on classical versus modern/new was not particularly meaningful to a considerable number of participants.

When probed on their views on whether or not the distinction between editing existing DNA versus adding DNA from the same or another species was important, many felt that it was. However, it was only important if the DNA being added was from another species. If the DNA was from the same species, then people did not generally feel this distinction was important.

Some participants could see the case for using a technical/scientific term (for example targeted mutagenesis and cisgenesis) to describe the topic area, but only if the audience was well informed.

A clear preference was expressed for using an umbrella term (for example "new breeding techniques" or "precision breeding"), because it felt more straightforward, easier to understand and remember, and better suited to an audience unfamiliar with the topic.

Some favoured a more descriptive term (for example genome or gene editing), because it offered consumers more information than an umbrella one, while staying clear of the disadvantages of using highly technical language.

Participants offered a few of their own suggestions for terminology to communicate NBTs. These were added to the follow-up questionnaire which asked people to assess the suitability of some twelve terms (using a 5-point Likert scale). Five of the twelve terms were deemed as suitable or very suitable by at least 22 of the 38 respondents:

- New growing techniques
- New plant cultivation techniques
- New cultivation techniques

- Precision plant breeding
- New plant breeding techniques

The three terms that specifically referred to ‘genes’, i.e.: Genome editing; Gene editing; and New genomic techniques, were felt to be suitable by only a few participants.

For the most popular of the twelve terms set out in the follow-up questionnaire – i.e., New growing techniques - the main positives were:

- it was simple, self-explanatory, and uncomplicated
- clear and easy to understand
- it made the association between growing and plants
- growing felt more natural than breeding.

On the downside, some negatives were that it: does not say what the techniques or the processes involved are; is a bit vague and possibly over simplistic; and it retains an association with traditional farming.

The term currently being used in Scotland by FSS (i.e., New breeding techniques) was felt to be suitable by 14 of the 42 respondents, for whom positive associations were that it was:

- clear, informative, straight to the point, and easy to understand
- communicating something new and innovative
- generalised and could be used to cover animals or plants
- less scientific than some other terms would not alienate the general public.
- different from terms that people may associate with GMO.

Negative associations mentioned in relation to the term NBTs included:

- the word ‘breeding’ may confuse some because it is associated with animals. The association with plants is weak
- a degree of vagueness which weakens its descriptive impact
- the word ‘new’ may raise concerns and questions about what is involved, particularly if people make associations with their food having been modified and tampered with.

Perceived Benefits and Risks of NBTs

Perceived benefits

In the focus groups, the most frequently mentioned benefits that consumers could see as possibly flowing from the use of NBTs related to: food economy (e.g., lowering the cost of food); positive impact on health; and more consumer choice. Slightly less frequently mentioned were: impact on food security and sustainability; producing crops more resistant to disease and pathogens, and possible positive impacts on animal welfare.

Perceived risks

Perceived risks often mirrored the reverse of the benefits: unknown things being added to food with negative impacts on health; concern about how consumers would know what had been done to the food they are eating; and risks of 'messing with nature'. There was also a suggestion that the quality of food might suffer due to faster mass production, with some foods losing their nutritional value.

Potential benefits for crop producers were balanced by worries that some farmers (i.e., those not in a financial position to invest in and use NBTs) could get left behind and go out of business, thus leaving consumers with less choice.

Some participants who were living with a food allergy (or who were living with a family member with a food allergy) were very concerned that NBT might lead to potential additional allergy issues for them.

At the root of a lot of peoples' worries was uncertainty about how NBTs would be regulated. It is important to note that when benefits and risks were discussed, this was before regulation of NBTs had been considered in the focus groups, and prior to participants hearing the FSS presentation.

At the end of the research process, most people were fairly comfortable about NBTs. Of the 38 respondents completing the follow-up questionnaire, only 9 were negative about the prospect of NBTs being used in food, with 3 of these people being 'very negative'. Almost two-thirds (24 out of 38) were positive, with 9 of these respondents reporting that they were 'very positive'.

Regulating NBTs

The final presentation was a PowerPoint presentation covering some potential options for regulating NBTs in foods given by FSS. Participants were invited to comment on whether they thought NBTs should be treated like GM food of which none are currently authorised to be grown in Scotland and imports must follow strict

rules about labelling, or whether they should be regulated the same as other new and novel foods which are subject to safety checks and environmental impact assessments and must be traceable through the supply chain. Once hearing the FSS presentation on regulatory options, many concerns were assuaged. People were reassured that the 'system' had (or would have) measures in place to carry out the necessary checks on food containing NBTs.

Those participants who remained less confident, tended to either misunderstand important aspects of NBTs, be more cynical and suspicious that the use of NBTs is a 'done deal', or had particular concerns about using NBTs in animals.

Some participants felt that NBTs should be treated the same as GM food. Others were less concerned and felt that the existing system was adequate and that NBTs should be regulated the same as other 'new' or 'novel' foods. Most people were somewhere in the middle of the spectrum, and valued the range of additional regulatory options that could potentially be introduced on top of what FSS currently does. These included:

Tiered system

A tiered system is one that has different regulations for different types of NBTs, based on risk. Most participants were in favour of a two-tiered system until NBTs are more well established and understood.

Expert committee

An expert committee is a dedicated body providing expert oversight and opinion about NBTs. The majority of participants were in favour of an expert committee. There were some concerns about possible partiality of members, with independence and impartiality seen as important for consumer confidence.

Online register

An Online register would require producers to register foods using NBTs on publicly available forum. Although an online register did not excite participants (they did not envisage using it), it is something that people felt needs to be in place to ensure transparency and traceability.

Labelling

Labelling involves providing information on the origin of ingredients contained within a product. Labelling was an area of huge importance to consumers (and in particular for people with food allergies and intolerances). Consumers expected that foods produced using NBTs would be readily identifiable by information on labels.

Communications

Other forms of communications in addition to labelling (e.g., posters in stores) were supported, but did not replace NBT information on labelling. The research findings indicated that, if consumers are to understand NBTs, there is a need for communications to educate them about the topic. There was also support for using QR codes to make it easy for consumers who need more detailed information to quickly access it.

Animals

There was broad agreement among respondents that regulations needed to be much tighter if NBTs are used in animals. Many felt that NBTs should not be allowed at all in animals for ethical reasons.

Summing up

The research uncovered a very uninformed population of consumers, with a wide spectrum of views from the very negative to the broadly accepting, and with an appetite (among some) to know more. Most people lean towards the more accepting end of the scale, mainly due to a belief that systems and checks are in place to ensure that NBT produced foods will be safe to eat. However, a great deal of education and information will need to be provided if consumers are to understand NBTs. Communications would need to be clear, simple, use non-technical language, avoid too much detail about the science, and, crucially, be presented in an impartial way which talks about cons as well as pros from a consumer perspective.

3. Background

JRS was commissioned by Food Standards Scotland (FSS) to carry out research into consumer attitudes towards New Breeding Techniques (NBTs). NBTs describe a range of breeding techniques, including gene editing, that enable DNA to be edited more efficiently and precisely than current breeding methods. In England, the term that is currently being used for NBTs with outcomes comparable genetically to traditional/conventional breeding is Precision Breeding (PB).

These new techniques can make targeted genetic changes to produce traits that could also occur through traditional breeding and natural processes (but faster). They differ from genetic modification (GM) which involves inserting functional DNA from an unrelated species into another species[3].

A survey of public attitudes towards PB carried out for FSS and the Food Standards Agency (FSA) was reported in September 2022[4]. The survey covered 4,177 people from across the UK, with 1,005 of these respondents being from Scotland. Key findings from the Scottish sample found that, while awareness was low (with three in four respondents not having heard of it), close to half felt that PB foods should be available for sale, with fewer than one in three feeling that they should not be. However, views were not generally strongly held. A large majority of consumers were confident that the food they bought was safe to eat, though this majority was reduced when consumers were asked specifically about the safety of precision bred food if it became available to buy in the UK.

Overall, if foods bred in this way became available to purchase, then consumers felt they would be more likely to have a positive than a negative impact on: affordability of food; how nutritious foods are; and on health. For most it would be important to know if a food item has been precision bred. The majority claimed that they would be willing to eat precision bred cereals, grains or flour, fruit and vegetables, processed foods, and dairy products, but views were more divided when it came to meat.

The Genetic Technology (Precision Breeding) Act 2023 was recently passed and became law in England only[5]. The Bill changes the legal definition of Genetically Modified Organisms (GMOs) to remove certain organisms produced by precision bred techniques from the scope of GMOs[6]. This allows the FSA to create a proportionate framework for regulating Precision Bred Organisms (PBOs) to enable precision bred food and feed products to be authorised and placed on the market in England.

This issue is devolved, meaning that the Scottish Government, if it chooses to do so, can make different decisions about the use of these techniques in Scotland. Currently, the language that will be used to describe and communicate these new

[3] https://publications.parliament.uk/pa/bills/cbill/58-03/0011/FactsheetGenetic.pdf
[4] https://doi.org/10.46756/sci.fsa.ouv127
[5] Genetic Technology (Precision Breeding) Act 2023 - Parliamentary Bills - UK Parliament
[6] The Food Standards Agency and the Genetic Technology (Precision Breeding) Bill

technological advances in plant breeding to the general public, and about the nature of the regulatory framework that will be put in place are being considered by agencies in Scotland, including FSS. After consideration, Scotland has the option to follow a slightly different path than that being followed in England including using different terminology, e.g., 'NBTs' as opposed to 'PB'.

Requirement and research objectives

The research was commissioned to help inform FSS's understanding of consumer perceptions around terminology and future regulation of food containing NBTs. It builds on the joint survey research carried out with FSA on attitudes to PB (summarised above), and separate qualitative research with consumers in England, Wales and Northern Ireland[7]. It has sought to provide insights from qualitative research with consumers to inform a way forward that will enable innovation in the agri-food system that has the confidence of the Scottish public and that will maintain a high level of protection for health and the environment.

Key research objectives identified were to explore:

1. Consumers' response to, and views on NBTs
2. Consumer attitudes to different terminology around NBTs
3. Perceived risks and benefits associated with NBTs
4. The level of regulation that consumers want, e.g., prohibited, heavily regulated, lightly regulated, and their views on labelling and communications.

The materials largely drew upon examples from NBTs in plants, but NBTs in animals were also touched upon.

[7] Consumer perceptions of precision breeding: Executive summary | Food Standards Agency, 9th March 2023 https://www.food.gov.uk/research/consumer-perceptions-of-precision-breeding-executive-summary

4. Methodology

The research was conducted across a series of eight, three hour-long, focus group discussions with members of the public in Scotland. Each group had between four and six participants, with a total of 43 being engaged across the research. The focus groups took place between 20th February and 1st March, 2023.

Participants were paid an incentive to participate in the focus group, and a further incentive to complete a short online questionnaire a few days after the focus group.

All research was undertaken in strict accordance with UK GDPR legislation and the Market Research Society's Code of Conduct.

Research design

In the design phase of this research, the research team consulted and reviewed the tools used by FSA in the qualitative research carried out with consumers in other UK nations (as mentioned above). These tools informed the design of the research in Scotland. However, the Scotland research has more focus on understanding the terminology and has a different regulatory environment (i.e., the Precision Breeding (PB) Bill only applies in England). Hence, a fresh set of research tools were designed to reflect these differences.

The research process was designed to be "deliberative" in that: a range of people who potentially held very different views were brought together; they were provided with expert information on the topic of NBTs; they were able to consider, discuss and reflect on the information that had been shared; and they were given time to do so, not being rushed to offer only immediate 'top-of-mind' responses. In addition, participants were given the opportunity to reflect further on the discussions and provide additional feedback post group session. However, it became clear during the course of the research that the topic was too complex for participants to be able to completely understand and to offer fully considered opinions over the course of one three-hour workshop. In effect, the research was able to show the range of potential responses when participants are given basic information about NBTs, but the extent to which it was fully able to be "deliberative" was limited.

Recruitment of participants

A sample plan was drawn up and agreed with the FSS client team which aimed to achieve a spread of demographic characteristics including gender, age group, socio-demographic group and area. Also, it was proposed that two of the eight groups be focussed on people with a specific diet or health condition that impacts food information needs, including people with food allergens or intolerances (as consumers with these characteristics may have some particular concerns or information needs relating to NBT foods). Participants were recruited by an

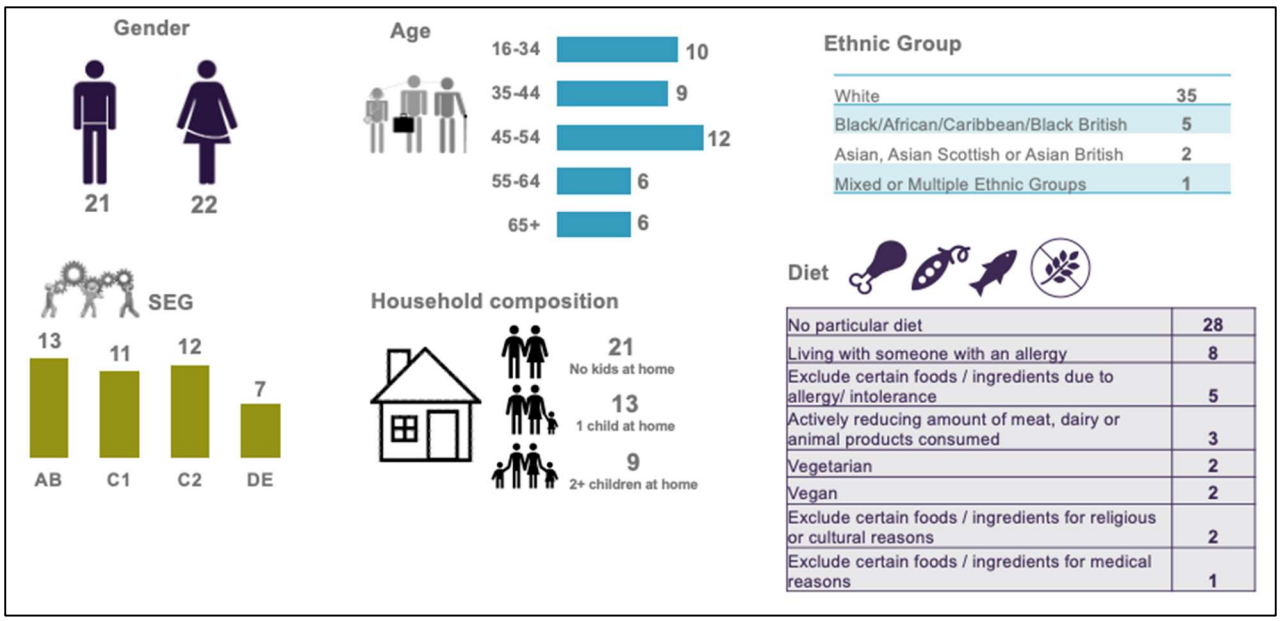
experienced recruitment team at JRS, using a detailed screening questionnaire based on the agreed sample specification.

Recruiters used several methods to identify participants for the groups, including using existing networks and databases as well as 'cold' in-street recruitment approaches. Recruiters identified participants from across Scotland to participate in the online group sessions. Copies of recruitment materials are included in the Appendices – Supporting Materials.

Research sample

Participants were recruited to meet the requirements of the specification agreed with FSS. This achieved a broad mix of the Scottish population, with key characteristics of the forty-three participants in the sample being[8]:

Figure 1: Characteristics of the sample



Base: 43

Focus group planning and structure

Focus groups were carried out online using Zoom, with participants gathered from different geographical locations around Scotland.

Each focus group was broken down into four discrete parts, each section dealing with one of the key research objectives above.

A detailed discussion guide was prepared, structured to reflect each of the research objectives, and with guidance to the moderator on how much time should be

[8] Participants were offered an incentive to participate in the group sessions and to complete the follow-up questionnaire

allocated. Moderators stuck very closely to the guide as they delivered the focus groups. A copy of the discussion guide is in the Appendices – Supporting Materials.

In each of the four sections of the focus group sessions, sufficient time was allocated for participants to be introduced to information on NBTs and/or to give some initial thoughts and feelings, and then to consider their responses (and the responses of others) in open discussion facilitated by the moderator. The discussion guide highlighted where the moderator could probe or prompt, and where it was appropriate to take a poll: all of which were devices which supported the deliberative process.

Stimulus material used in the focus groups

A range of stimulus material (supplied by FSS) was used to set up to support discussion in each of the four sections of the session. Further details are in the Appendices – Supporting Materials. The four main pieces of stimulus used were:

Video on NBTs

FSS commissioned a bespoke video presentation given by an independent academic expert in the field of plant breeding and genetics. This video placed NBTs in their historical context of plant breeding techniques[9] and set out: how, up to 40 years ago, society relied on traditional breeding which included random (radiation and chemical) mutagenesis; in the late 1980s, there was the development of genetically modified organisms (working in a lab and using genes from another species); and, more recently, new breeding techniques have become available which allow targeted and precise genetic changes. The presenter talked about how the UK and the EU are on the cusp of new breeding techniques which cannot be distinguished from traditional plant breeding and GMOs. One of the tools for gene editing is CRISPR (Clustered Regulatory Interspersed Short Palindromic Repeats).

Presentation on Terminology

A short PowerPoint presentation was re-recorded by a Scientist employed by FSS. This presentation covered terminology and introduced a number of tools available to breeders to achieve one of the following three outcomes:

- Targeted mutagenesis – i.e., a specific change(s) to DNA letter(s) in target locations of the genome. No DNA is inserted. These changes could occur by classical plant breeding.
- Cisgenesis – i.e., gene from the same species is introduced as an exact copy. No transgenes are inserted. In many cases, these changes could occur by classical plant breeding.
- Transgenesis – i.e., a gene from another species is inserted. Techniques of transgenesis are often referred to as genetic modification (GM). These changes could not be achieved by classical breeding.

[9] Presentation by Huw D Jones, Professor of Translational Genomics for Plant Breeding, IBERS, Aberystwyth University.

Both targeted mutagenesis and cisgenesis may be considered as NBTs.

In terms of 'how' these changes can be brought about, the presenter summed up that:

- Targeted mutagenesis and Cisgenesis are equivalent to changes that could occur through conventional breeding processes (i.e., no insertion of DNA from a different species)
- Cisgenesis and Transgenesis can be achieved by random insertion of DNA (from the same or a different species)
- Gene editing (i.e., precision changes) can achieve all three of the above outcomes.

Showcards on Benefits and Risks

Based on advice provided by FSS about the possible benefits and risks that might be associated with NBTs, two showcards (one on benefits, one on risks) were used to support the discussion.

Presentation on Regulatory Options

A PowerPoint presentation was pre-recorded by a Social Scientist employed by FSS and covered potential regulatory options. This presentation built on a point made in the video that because NBTs are new, there is some uncertainty about how they should be regulated. The presentation covered how foods using NBTs are currently regulated around the world (ranging from regulating them as GM foods to regulating them the same as other new or novel foods). It then set out a range of options and possibilities, i.e., treating NBTs in plants the same or differently from NBTs in animals; the option of introducing a tiered system (with different rules and regulations for NBTs at different tiers); an Expert Committee to provide expert oversight and opinion); and labelling and communication about foods that contain NBTs.

Conducting the focus groups

Two JRS researchers attended each online focus group. One researcher moderated the session, while the second took notes and checked that all the issues/questions in the discussion guide were being adequately covered.

Five of the groups were viewed by an FSS member of staff, with observers turning off their cameras and on mute for the duration of the main session, then given an opportunity to ask questions during the final few minutes.

Each group began with a welcome and an opportunity for participants to introduce themselves. Permission to video record the session was checked, and reassurances were given with respect to confidentiality, GDPR, and following the MRS Code of Conduct.

At the outset, the moderator reminded participants about the key issues that would be covered, how the session would be structured, and (importantly) that some of the information that they would be hearing from experts might be new to them and feel quite complex. This included impressing upon the participants that, even if they did not fully understand everything being presented, what was important was to hear and share their impressions, thoughts, and any concerns and worries.

The planned follow-up questionnaire was also brought to the attention of the participants at this stage, and their engagement encouraged.

Data collection and analysis

Each focus group session was video recorded using Fathom. Fathom generates a script of the discussion, with each participant interjection time marked. Fathom also allows for sections of the discussion to be tagged by the researcher in real time, thus making it easy to go back and watch or read the content gathered around that point in the session.

After each focus group, the second researcher (consulting both the video and transcript as appropriate) prepared a full write-up of the salient findings (including illustrative/supportive verbatims), structuring these under the main sections of the discussion guide. These write-ups were then shared with the moderator of the session, who (in some instances) requested some further information or revisions to the write-up.

Therefore, for preparing the draft final report, the lead author had a set of high-quality research write-ups to consult and work from. The author was able to read across these structured documents, look for consistencies and differences on specific questions, and synthesise findings emerging across the groups. To support the report author, the research team convened an internal workshop to reflect on and discuss the findings relating to each of the research objectives.

Follow-up questionnaire

A few days after the focus groups, participants were invited to complete an online questionnaire. Some 38 of the 43 focus group participants completed the questionnaire. The data was gathered and analysed using Snap Surveys. A copy of the tool is available in the Appendices – Supporting Materials.

This questionnaire was not designed until the focus groups had been completed. Indeed, findings from the groups informed the design of the questionnaire. For example, some of the terms in a list of terminology that participants were asked to respond to in the questionnaire had been suggested by participants during the

groups. The follow-up questionnaire, therefore, allowed a comprehensive list of terms for consideration to be presented.

The follow-up questionnaire gathered feedback on:

- The main things that people had taken out of the focus group sessions
- How positive or negative they now felt about NBTs being used within Scotland
- The main positives (if any) and negatives (if any) associated with NBTs
- The suitability of a range of terms that could potentially be used to describe NBTs
- Their agreement or disagreement with a range of options for regulating NBTs
- Any comments, or any questions they need answered, on NBTs.

Presentation of data

The research findings are presented in an analytical narrative that flows across each of the four main sections of the discussion guide in turn (and reflects the main research objectives). The narrative is supported by a mix of figures and verbatims/quotations. The figures draw both from the online polls that were taken during the focus groups, and the responses in the follow-up questionnaire.

Quotations are used throughout this report and are anonymised to protect the identity of participants. Reference is made to participant characteristics using the following abbreviation conventions:

Gender	M (Male) F (Female)
Age	16-34 35-54 55+
Socio-economic group (SEG)	A - Higher managerial, professional or administrative B - Intermediate managerial, professional or administrative C1 - Supervisory or clerical, junior managerial, professional or administrator, student living away from home C2- Skilled manual worker D - Semi or unskilled manual worker E - Unemployed or retired and living on state pension only

Other information is provided where appropriate.

Strengths and limitations of the research

Reflecting on the research experience, particular strengths of the research method were:

- The use of an online research method made it possible to bring together the desired sample mix in a relatively short period of time and within a modest

budget: people from different geographical locations were able to participate in each online session
- Pre-recorded material (e.g., video and PowerPoint presentations) allowed for the same information to be shared in every focus group, thus giving consistency to the expert knowledge that was made available for the participants to consider
- The use of the above as stimulus material provided all participants with a basic knowledge base that enabled a relatively uninformed audience to engage with the research questions
- Having a second facilitator dedicated to producing high-quality research write-ups to a common format was a valuable and efficient interim step in the analysis-report preparation process
- The follow-up questionnaire proved to be a useful supplement to the focus group work, allowing people some time to digest and feedback from a more considered position.

While, overall, the research process can be deemed to have been generally satisfactory, a few limitations are worth mentioning:

- Low awareness and limited knowledge about the topic area meant that the issues researchers sought to discuss were not front of mind among the participants. It might have helped if participants had been given the opportunity to engage with some introductory material in advance of the sessions
- Some of the expert material shared as stimulus (particularly the video introducing NBTs and the presentation on terminology) was complex and (for many) hard to fully digest in the time available
- The scope of the enquiry in each focus group (ranging across four discrete and substantial sections) was broad and (across a 3-hour session) somewhat tiring for the participants. However, that said, group energy was generally maintained, and the full 3 hours was fully used in each case.

5. Findings – Consumer understanding and views on NBTs

A striking, if unsurprising, observation is that most participants started from a very low base of awareness and understanding of new developments in plant breeding and the science involved. This was expected given that in the FSA/FSS survey on attitudes to PB found that only 6% of respondents in Scotland had heard of PB and claimed to know what it was – a further 17% had heard of PB but didn't know what it was. Furthermore, very few had even a basic understanding of the historical picture of how plants have been historically bred. The group discussions, therefore, while difficult and challenging for many to follow, proved to be a steep learning curve for most.

Spontaneous awareness and understanding of topic area

At the outset, spontaneous awareness of new plant breeding techniques was very limited. A few participants tentatively mentioned that they had heard "something" about this, but in most cases did not show any real knowledge of the topic.

> *"The difficulty is not having the technical ability to understand all these things"* (M, 65+, C2)

> *"It is the difference between mass produced and organically produced."* (F, 35-44, C2)

Some who felt they did know "something", tended to be negative towards the idea, and suspected it related to modern farming techniques, which are complex and not something that a lay audience tends to think much about.

> *"On Countryfile they are always talking about farmers not making money and going bust. They have to look at new techniques."* (M, 65 +, C2)

When further probed, a few participants were quite cynical about the motives behind modern farming approaches, on the basis that they did not necessarily benefit them as consumers, but rather profit-driven corporations. Some also feared that modern techniques used in food production could be detrimental in terms of, for example, peoples' health, and the cost and quality of food.

> *"I'm aware that they're trying to cut down on water usage…so trying to factory manage plants."* (M, 35-54, C1)

Many consumers were open to the idea of learning more about the science of how plants are bred, but it is not something that is high on their agenda, or front of mind.

"It's a thing that doesn't come up in conversation with friends….so that's why I'm not aware of the topic…" (F, 45-50, C2)

Some people did not want to know more, because it might lead them to worry about what is in their food.

*"All I know is GMO is somehow connected to America and to avoid it" (*M, 35-44, C1)

"I find it a bit scary – I think Dolly the Sheep. It's probably related to a lack of knowledge." (F, 65+, C1)

Following the opening discussion (which underlined the very low awareness and knowledge base), participants were given some gentle prompting, with the facilitator reading out a few terms to see if they sparked further thoughts and associations. The terms mentioned were: precision breeding; new plant breeding methods; genetic modification (GMO); new breeding techniques; and targeted breeding.

There was some recognition when prompted with these terms, with GMO triggering recognition in several participants, although it was only a few that demonstrated any real knowledge of the topic.

"I've heard the term genetic modification, but I'm a bit ashamed to say that I just kind of switched off…. science and things, it's not something that's really my bag." (F, 35-54, B)

Some related GMOs specifically to animals (e.g., chickens growing faster; bigger animals being bred for more meat). Several were quite surprised that GM could also relate to plants. A few made an association with America only, having heard something about GM being used in US crops and livestock, and a few believed that GM foods were not allowed in the UK. Those who felt they knew more about GM foods, tended (overall), to be cynical about them.

"I've heard about GM crops before – the minute I hear that, I think they're not for me – I'd rather pay a bit extra and have something that's more natural. I just think they're playing with nature and to be honest if I could stay away from ever consuming these items I definitely would do so." (M, 45-50, C2)

"The term genetic modification sounds like it would put me off. I like the idea of something being natural rather than being modified." (M, 35-44, C2)

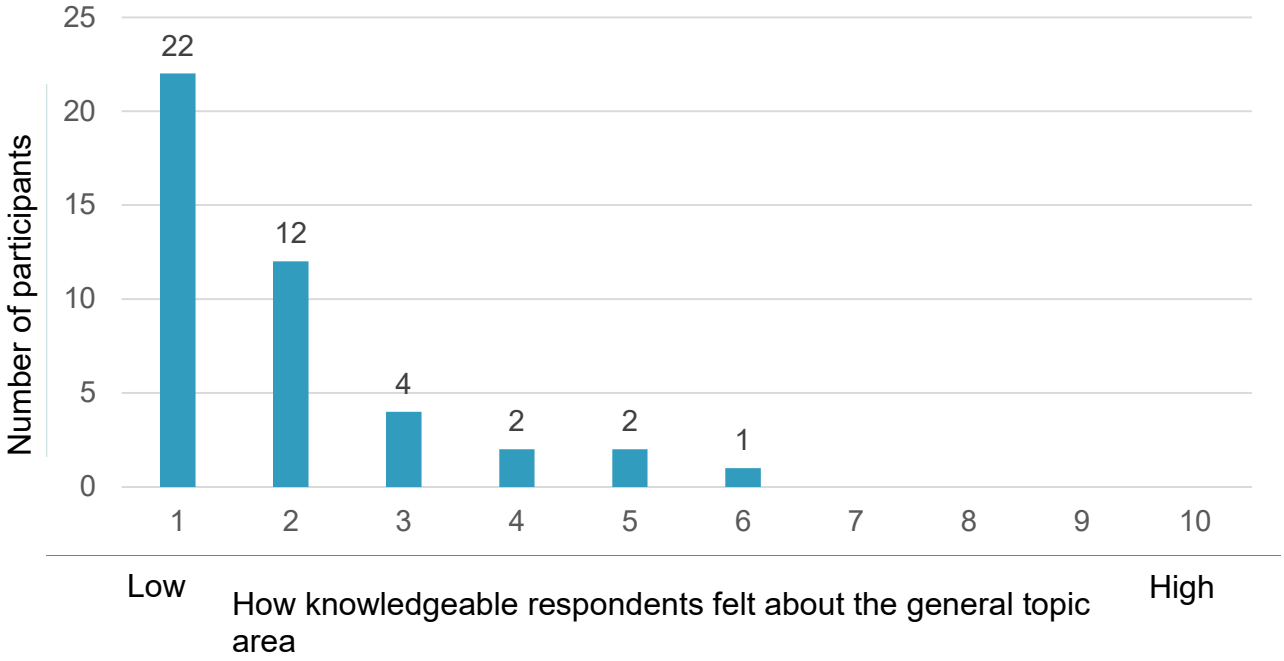
A small number of respondents also recognised the term 'targeted breeding' but did not know much about it.

Although not mentioned by the facilitator when prompting, several consumers brought up 'organic' as a term they felt as fitting within the topic area being

discussed. There were some signs that this was coming to mind because it was *not* GM food, and generally seen to be preferrable.

During the focus groups, participants were asked to score (with 10 being high / 1 being low) how knowledgeable they felt they were about the general topic area (i.e., new developments and technologies relating to plant breeding). Not surprisingly, the great majority (34 out of 43) gave themselves a score of only 1 or 2 out of 10, as shown in Figure 2, indicating the low levels of knowledge about the topic, and highlighting that it is not something that is on their radar.

Figure 2: Participants' existing knowledge of the topic area



Base n= 43

To sum up, before any detail about NBTs was shared with the participants, across the sample the picture was very much one of there being:

- General lack of knowledge about plant breeding
- Acute lack of awareness of new breeding techniques
- Lack of understanding of how or why this is relevant to them
- Some openness to learning more about NBTs, although the topic was not front of mind.

Participant's response to the NBTs video

All participants then watched the 13 minute-long video, with the presenter talking about new breeding techniques, including gene editing, and placing them in the

historical context of the development of plant breeding methods over time. A link to the video is available in the accompanying Appendices – Supporting Materials.

Many people's first reactions to the video demonstrated that they had found it (or at least significant parts of it) difficult to follow, fully digest and recall shortly afterwards. A lot of material had been covered in a short space of time, terminology new to them had been used, and the general subject matter felt scientific and complex.

All of this made it challenging (to varying degrees) for participants to engage with the topic.

> *"I find it quite hard to follow, to be honest. I know he's always talking to people who are more interested in that kind of thing, but from a neutral point of view, I find it quite difficult to follow, quite technical."* (M, 35-44, B, Living with someone with food allergies)

A lot of participants had never really thought about plant breeding as having a 'history' in terms of moving through different phases and using evolving technologies. For them, thinking and talking about the history of plant breeding was new and, for some, somewhat confusing. They were coming to the topic completely cold, never having thought about how, for example, a seedless orange was 'made'.

Regarding the general themes covered in the video, while few respondents stated that they were able to fully understand what was being presented, respondents were often surprised, some were even impressed, by the volume and intricacy of the scientific work that is going on 'behind the scenes' in food production.

For more than half of the participants, however, their initial response was suspicious, or even more negative. Early concerns raised included questions about why these new developments were necessary. What was wrong, for example, with the way things had always been done? Several people challenged either the reasons and/or the motives behind these new scientific developments. Some simply assumed that plants (crops, fruit, and vegetables) just grow, needing only soil, water, and sunshine, and, other than some pesticide use, they do not require any further 'interference' in the natural process. Others were, for example, cynical and suggested that the drivers were the commercial self-interests of big farming and large food corporations.

> *"Targeted breeding seems to be more efficient, a more consistent way to breed plants…. But I do wonder why we need to do this. Are fruit and plants not better in their natural form?"* (F, 45-50, B)

> *"My question is why do we need to evolve so much? Why can't we stick with natural growing…. what's the need?"* (F, 45-50, C2)

"My big concern – will it be like thalidomide in the 60s which didn't have enough testing – I don't think there are too many bad food shortages in the world so why do we need this? I'm worried it's just big companies trying to eke out as much profit as they can." (M, 45-50, C2)

Two types of plant breeding covered in the video triggered a very negative response among several of the participants. The first was mention of the use of high energy radiation (Cobalt 60) to make seedless oranges. The second, which was introduced immediately after the piece on seedless oranges, was making a GMO by taking one or a few genes from any organism, then cutting and splicing them into the host plant.

Certainly, a stand-out concern for some was hearing about radiation being used to manipulate the food they eat. Also, the mention of radiation as a term associated with 'classical' plant breeding felt (for some) to be somewhat incongruous as they assumed that classical breeding was essentially just "mother nature" and did not involve this type of intervention in the breeding process.

"I was almost warming to it when I heard about them creating seedless oranges, but when I heard about the idea of subjecting it to radiation that worried me. I hadn't thought about it before but hearing that would make me think twice about picking up the seedless grapes." (M, 35-44, C2)

A similar level of concern was expressed over GM foods, which reflected the broad-based negativity towards such foods that had been expressed earlier in the discussion.

"It's a bit worrying, why is there so much money being spent on this science to produce GMOs? I'm not really comfortable… if I went into a shop to buy something and saw a label saying GMO, I'd steer clear of it." (F, 45-50, C2)

"There's only so many GMOs in the UK because there's a problem with them....so I think these things are Frankensteins once they're released into the wild, it's hard to take them back…. So, I would be very, very anti using stuff like this. If the system works just now, it doesn't need messing about with." (M, 35-44, C1)

"GM – putting one species into another species, that's the big thing that puts me off – that's too far – I don't want to know about it. You're crossing too many lines. You want to keep it as what it is, the natural formation." (F, 35-44, C2)

It is important to note that both radiation and GM had been mentioned in the video *before* the presenter talked about new breeding techniques, gene editing, and the use of the CRISPR tool. Consequently, some people had been distracted by negative thoughts and reactions to radiation and GM and were not fully engaging with the content on NBTs. This was evidenced by, for example, CRISPR gene

editing being discussed *less* by participants than both the use of radiation in classical breeding and the use of GMO over the last 40 years.

Even so, there was still a strong view, expressed by some, but that appeared to echo the feeling of others, that consumers had to trust the science and accept that change is inevitable. While it was not quantified in the sessions, numerous participants indicated at different points in the discussion that they trusted science and scientists, accepted that science and technology inevitably moves on, and that scientific advancements are, in general, good for society.

While not all participants fully grasped what was involved in NBTs, for those better able to understand, there was a recognition that new science would allow for very targeted changes to be made in plant breeding - changes that could also theoretically happen in the natural world. And a few people were positive – even excited - about NBT in general, and CRISPR in particular.

> *"It never struck me you could edit the DNA in a plant like that. CRISPR is amazing."* (M, 35-44, B)
>
> *"What I got was the main difference between new breeding techniques, GMOs and classical breeding is that when the genes are edited it's more targeted changes you can make."* (F, 35-44, B)
>
> *"Targeted breeding seems to be more efficient, a more consistent way to breed plants "* (F, 45-50, B)
>
> *"I think it's actually quite exciting to see what can be produced in a targeted way for the benefit of society and in terms of health and wellbeing"* (F, 35-44, B)

The above voices were, however, in a minority. Most had difficulty articulating the crucial difference between NBTs and GM. Indeed, most participants were not able to clearly distinguish between classical or traditional methods, GM, and NBTs. Thus, they remained confused about what NBTs are, the difference from what had gone before, and the potential for the future. Confusion heightened concerns around GM and radiation, which in turn fed into quite negative views about the whole idea of NBTs.

However, confusion did not equate with outright rejection. While expressing many concerns, respondents were often also curious about NBTs and what they could be used for. Many were open to learning more about potential benefits of using NBTs, such as mitigating the impacts of climate change or enhancing the nutritional value of foods.

During the discussion it was also mentioned spontaneously that they were okay with the idea of NBTs in plants but would be worried about this in animals (largely due to ethical concerns, for instance, around animal welfare).

To sum up, the video, and the follow-on discussion on the topic, did give rise to quite a lot of questions and some concerns, such as:

- Why do we need this?
- How can we trust what we're buying in the supermarkets?
- Is it safe?
- What's been done to the food before it gets on to the shelves?
- How do we know whether food has been genetically modified / if NBTs have been used?

There was, therefore, an appetite for more information. Essentially, people want to be able to find a simple, not over-scientific, explanation which is balanced and impartial. When asked what they would do if they were to look for this themselves, many participants said they would turn to the webpages of an 'official' or government body (FSS was mentioned by a few), or to information supported by academic study.

Some respondents did indicate that they would approach official sources with a degree of scepticism as government funding could be invested in scientific advancement but felt that at least the government is accountable. Some would also not be wholly comfortable turning to scientists working for commercial organisations, who they felt could be biased or/and possibly compromised.

A clear message emerging from consumers in relation to public information is that it is important not to try too hard to 'sell' the idea of NBTs to the public. People want to be able to trust the information they get and to make up their own minds.

6. Findings – Terminology

The FSS presentation on terminology built on the introductory video, clarifying and naming three different types of change (or outcome) that the plant breeding methods described in the video can bring about, i.e.,: targeted mutagenesis; cisgenesis; and transgenesis.

Facilitators sought – initially without prompting, then with prompting - to evoke what participants were taking out of the presentation, with a particular interest in spotting if people were recognising distinctions between:

- changes that are a result of natural processes versus changes that cannot occur naturally
- changes that are a result of classical/traditional breeding practice versus changes that require modern scientific gene editing techniques
- changes that come from editing the existing DNA versus changes that involve adding DNA from other species.

As was the case with the video, many found it difficult to recall all that they had just listened to. Most found the content difficult to understand, and very few were able (even with prompting) to recognise the three distinctions above. As a lay audience, they were not familiar with the terminology. They were hearing most of it for the first time, and some found the language off-putting, over-scientific, and (for some) even "a bit scary". The following verbatims are indicative of many peoples' initial reaction:

> *"It's complicated."* (F, 45-50, C2)

> *"I am totally confused…. I don't understand any of it.."* (F, 35-44+, C1, Living with someone with food allergies)

On further discussion, and on probing each of the above distinctions, some respondents began to highlight differences that were important to them, and indicated some recognition that NBTs were different from other plant breeding methods. The distinctions that participants made most frequently focused on NBTs and GMOs, though some still found it difficult to disentangle the two.

While not always able to articulate using the correct terminology, for a good number of the participants, a distinction was made between transgenesis and everything else. This was frequently driven by people having a strongly held negative view about the idea of DNA from another species being inserted. Most participants had some issue with GM and, at its most extreme, a few felt strongly negative about the idea of transgenesis:

> *"I am comfortable with targeted mutagenesis – because no DNA is inserted. I'm not in support of the transgenesis at all. Cisgenesis, I don't have a problem with that – it's comfortable."* (M, 35-44, C2)

"For me it was transgenesis – people who are doing this are playing God – targeted mutagenesis and cisgenesis could be achieved through natural breeding. The latter two I'd be uncomfortable with - I don't think they should be doing these either, but transgenesis is totally outrageous – you shouldn't be able to do this – where will it stop – designer babies? Alien to me. I think they're playing God. They're messing with things where they couldn't know the outcomes without decades of research." (M, 45-50, C2)

Participants were asked about how the different methods of bringing about change might be helpfully grouped. Those who had struggled to understand the three types of change understandably also struggled with this question:

"I don't really know how to categorise them because I don't fully understand what the difference is – what the techniques really are." (M, 35-44, C2)

However, a good number of participants were able to offer thoughts. The grouping that most people were comfortable with was change that could occur naturally versus change that could not occur naturally, i.e., essentially keeping transgenesis (involving GM) separate from everything else.

"I think the terminology (of natural versus not natural) is quite clear, quite simple, more black and white." (F, 45-50, C2)

Partly due to concerns around some of the processes (e.g., irradiating plants) involved in 'classical' breeding practice, and, because in many peoples' minds 'classical' should mean natural with no tampering at all, making a distinction based on classical versus modern/new was not particularly meaningful to a considerable number of participants.

"Classical should be how we've grown crops for thousands of years. I wouldn't class from the 50s to the 80s as classical – they're all unnatural approaches, using chemicals and x-rays. Classical should be using actual natural breeding techniques." (M, 45-50, C2)

When probed on their views on whether the distinction between editing existing DNA versus adding DNA from the same or another species was important, many felt that it was. However, it was only important if the DNA being added was from another species. If the DNA was from the same species, then people did not generally feel this distinction was important.

This suggests that, as long as species are not mixed, gene editing is not perceived as especially problematic. It also echoes the point already made that a key grouping for many participants is the distinction between transgenesis and other types of change (i.e., change that could occur naturally being distinguished from change that cannot occur naturally).

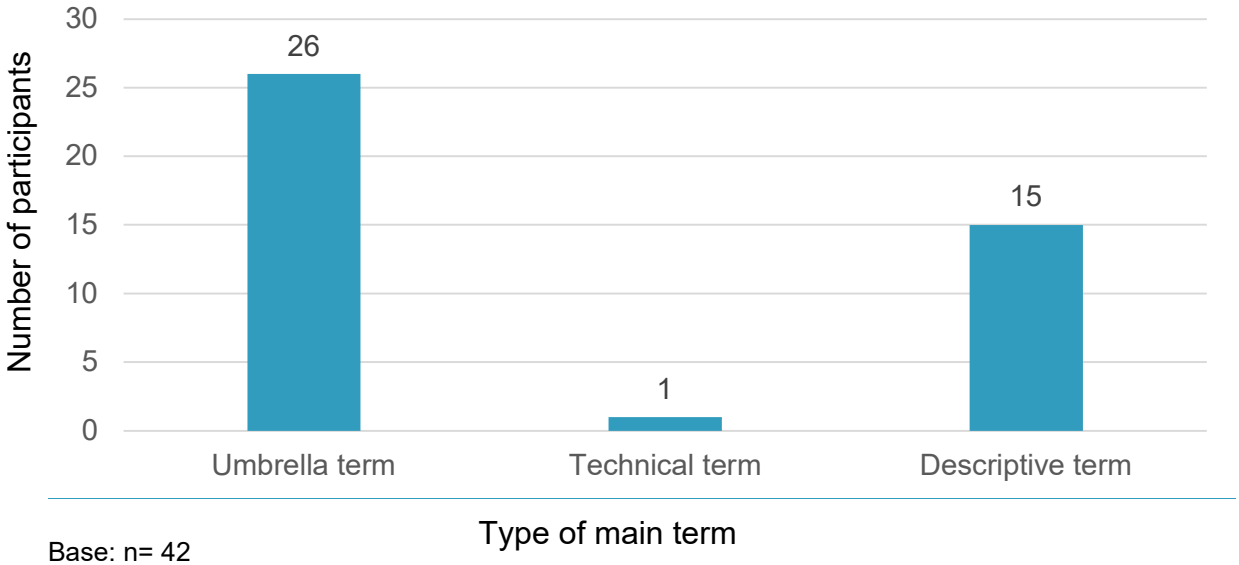
Participants were shown three broad options for the type of terminology that could be used to communicate NBTs to consumers. These were:

- An *umbrella* term (e.g., New Breeding Techniques or Precision Breeding) – easy to say/remember, but might not fully describe the science involved
- A *technical* term that gives a very accurate, correct description of the science involved, that is not possible with an umbrella term (e.g., targeted mutagenesis, cisgenesis, transgenesis)
- A *descriptive* term that makes it very clear what a technique is doing (e.g., Genome Editing or Gene Editing).

There was at least some support each of the three options, as shown in Figure 3, with people highlighting advantages and disadvantages of each.

"Each one has a place, depending on who your audience is." (M, 65+, C2)

Figure 3: Participants' preference for type of main term



Base: n= 42

Technical term

Some participants could see the case for a more technical term if the audience was well informed or was a scientific one. However, the prospect of a technical term also led some to quickly make associations with lab-based, unnatural intervention in what they eat, which often made them uncomfortable, hence just 1 out of 42 participants preferred this term (Figure 3).

Umbrella term

With a consumer audience in mind, a clear preference was expressed for using an umbrella term because it felt more straightforward, easier to understand and remember, and better suited to an audience unfamiliar with the topic area.

> *"Easy to remember, not too technical, but defines what it is".* (F, 25-34, B)

> *"Plain English, easy to understand, the general population won't understand the technical terms".* (F, 55-60, B)

> *"Makes it a little bit more accessible for people that may not be able to remember a technical or descriptive term."* (F, 25-34, D)

Although the majority favoured an umbrella option (26 out of 42, Figure 3), some pointed out that it did lack detail. That said, because they would be able to remember an umbrella term, this would allow them to look up further information if they wanted to.

Overall, participants were not hungry for a lot of detail. The topic did not excite, and food labels were already considered to be very detailed. At this point, several pointed out that adding a QR code to a food product was an easy way to enable consumers who wanted more information to access it.

> *"With a QR code you could get as much information as you wish to read. You don't want to have to read reams and reams of info. With a QR code you have a choice, if you wish, to find out what it is all about."* (M, 55 - 60, C2)

Descriptive term

While not as popular as the umbrella option, there was still solid support for using a descriptive term with 15 out of 42 respondents preferring it (Figure 3).

For those favouring a descriptive term, the main benefits related to it being transparent, honest, giving enough detail without being too technical. Several people, who by this point in the focus groups (halfway through) understood what NBTs involve, recognised the accuracy of the phrase 'gene editing' and saw the appropriateness of using such a descriptive term such as this.

> *"['Gene editing'] would be more eye-catching and would actually describe what it is."* (M, 25-34, C1, Child with a food allergy)

> *"Umbrella is not enough, technical is too sciency, the descriptive is best."* (F, 51-54, B)

> *"['Gene editing' is] a little bit more direct without being too technical."* (F, 25-34, C2)

> *"['Gene editing' is] giving a bit more of an idea of what's behind the process."* (M, 45-50, C2)

Other terms

During group discussions, participants were asked if any other specific terms came to mind that could be used to describe the NBTs that they had been discussing. A few suggestions were offered, such as introducing words like “growing”, “plant”, “cultivation”, and “propagation” to the terms that might be used. This enabled the research team to set out a list of twelve specific terms in the follow-up questionnaire. In the questionnaire, people were asked to assess the suitability of each of these twelve terms (using a 5-point Likert scale).

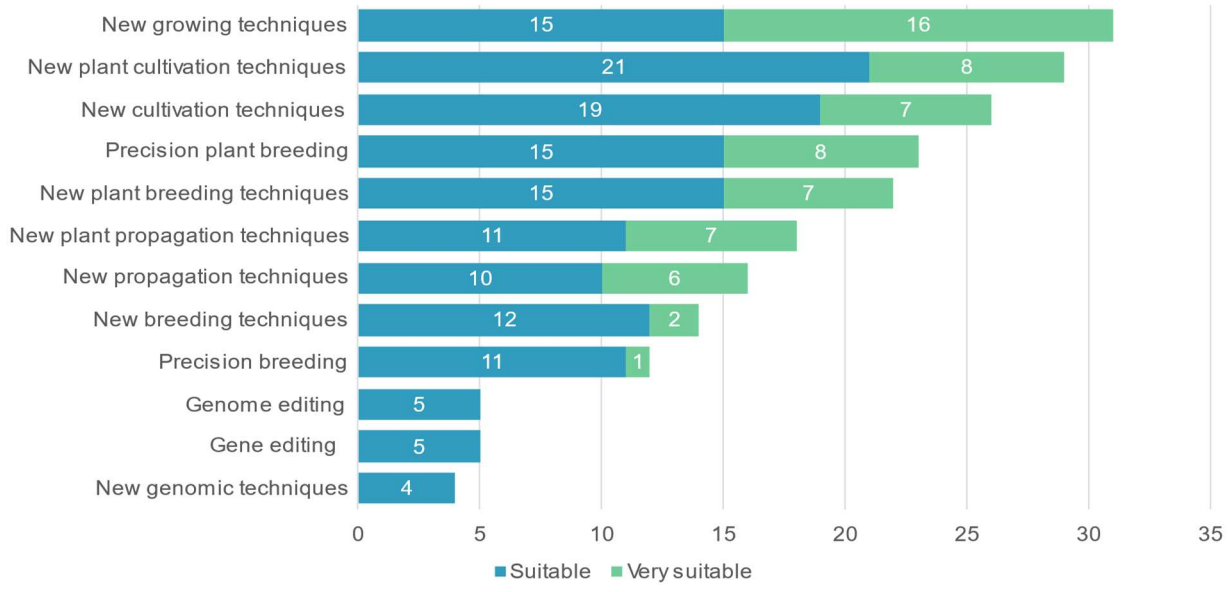
Figures 4 and 5 show the results of this exercise. While we need to be cautious given the relatively small sample size (Base n= 38), these results are illuminating and reinforce the insight from the focus groups. They underline the strong preference among consumers to use a term that provides a degree of description in accessible language and avoids terms that many see as over-scientific.

Five of the twelve terms were deemed as *suitable or very suitable* by at least 22 of the 38 questionnaire respondents (Figure 4):

- New growing techniques (31 respondents)
- New plant cultivation techniques (29 respondents)
- New cultivation techniques (26 respondents)
- Precision plant breeding (22 respondents)
- New plant breeding techniques (22 respondents)

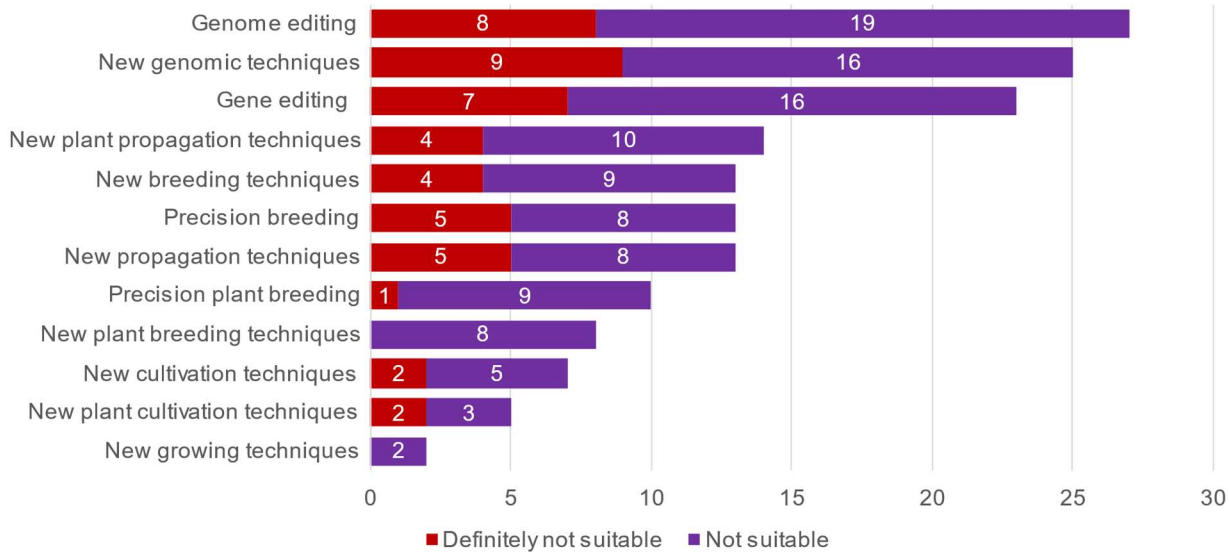
The three terms that specifically refer to ‘genes’, i.e., Genome editing; Gene editing; and New genomic techniques, were felt to be suitable by only 5, 5 and 4 respondents respectively. Indeed, as shown in Figure 5, of the 38 respondents to the follow-up questionnaire, these three terms were considered unsuitable by 27, 25 and 23 respondents respectively.

Figure 4: How suitable respondents felt specific terms are for communicating with the general public



Base: n=38
Source: Follow-up questionnaire

Figure 5: How unsuitable respondents felt specific terms are for communicating with the general public.



Base: n=38
Source: Follow-up questionnaire

In the follow-up questionnaire, respondents were asked to comment on any specific positives and/or negatives they associated with each term.

New growing techniques

For the most popular of the twelve, i.e., New growing techniques, the main positives were: it is simple, self-explanatory, and uncomplicated; clear and easy to understand; made the association between growing and plants; and growing felt more natural than breeding.

On the downside, some negatives were that it: does not say what the techniques are or what the process involved is; it is a bit vague and possibly over simplistic; and it retains an association with traditional farming.

New breeding techniques

In terms of how respondents assessed their suitability, the term used for this research (New breeding techniques) and the term currently being used in England by the FSA (Precision breeding) performed very similarly. Some 14 of the 42 respondents assessed New breeding techniques (NBTs) as suitable, with 13 assessing the term as unsuitable.

The positive associations associated with the term NBTs were that it was:

- Clear, informative, straight to the point, and easy to understand
- Communicating something new and innovative
- Generalised and could be used to cover animals or plants
- Less scientific than other terms and will not alienate the general public
- Different from terms that people may associate with GMO.

Negative associations mentioned when respondents assessed suitability of the term NBTs included:

- The word 'breeding' may confuse some because it is associated with animals. The association with plants is weak
- A degree of vagueness in the term weakened its descriptive impact
- The word 'new' may raise concerns and questions about what is involved, particularly if people make associations with their food having been modified and tampered with.

To sum up, while NBTs is not high on the list of what consumers felt to be a suitable term, neither is it at the bottom. It is important to bear in mind that people had come to this research with very little awareness and knowledge about the topic area. Also, in the group sessions they had watched and listened to content which reinforced this, and which in turn generated numerous concerns and questions. As such, it is understandable that they are currently likely to favour language that they are familiar and feel safe with.

7. Findings – Perceived Benefits and Risks of NBTs

Having been given quite a lot of new information, participants were then invited to open up about what they felt might be the possible benefits and risks associated with NBTs. Some prompting was also done by facilitators, with reference to advice provided by FSS. What was immediately clear, was that many people were able to quickly point to a wide range of issues relevant to them as consumers, without needing to be prompted.

Overall, participants were slightly more vocal about possible benefits than they were potential risks. However, when they did talk about potential risks, these were certainly significant considerations for them. Key issues related to the impact on health and the cost of food, as well as wider impacts on community and society. Participants articulated both possible benefits *and* risks across most of these issues.

Perceived benefits

The most frequently mentioned benefits that consumers could see as possibly flowing from the use of NBTs in food related to:

Food economy

For instance, lowering the cost of food to consumers because it is easier and cheaper for farmers to produce, achieve higher yields, and produce foods with longer shelf-lives (which in turn will also reduce food waste). Current concerns with the rising cost of living served to place a particularly high value on this area of potential benefit.

> *"Cheaper, longer shelf life for foods."* (M, 65 +, C2)

> *"Thinking of the cost of living crisis, if they could reduce the prices that's got to be a good thing. Most people do shop on price."* (M, 65 +, C2)

Positive impact on health

For instance, increasing the nutritional value in food, decreasing allergens, and producing food that could lead to other health benefits, like reducing cancer.

> *"Modifying crops could bring better health benefits"* (F, 25-34, C2)

> *"Remove the unhealthy aspects of foods"* (M, 25-34, C1, Child with a food allergy)

> *"It would eliminate the need for pesticides that are potentially harmful"* (M, 25-24, C2)

More consumer choice

For instance, a greater variety of food being available throughout the year, because there would be fewer foods not being sold because they were 'out of season'.

> *"Certain fruits and vegetables that would only be available at certain times of year would now be available throughout the year."* (M, 55 - 60, C2)

> *"New varieties like purple sprouting, broccoli or cauliflower, and different tastes and colours…. more choice for consumers."* (F, 65 +, C2)

Slightly less frequently mentioned, but also perceived to be possible benefits of NBTs were:

- Impact on food security and sustainability - e.g., enabling more food to be produced locally, thus reducing the carbon footprint, making the UK more self-sufficient and less reliant on imported food from overseas (which also reduces food miles)

- Producing crops that are more resistant to disease and pathogens, that do not require the same use of pesticides, and that are more environmentally versatile – in turn participants could see how this could mean that crops that can be grown in a wider variety of environments, with positive impacts on issues relating to international food poverty and famine in poorer parts of the World.
- While mentioned infrequently, a few participants were attracted by the possible positive impacts that might be seen in relation to animal welfare, although this was not something mentioned spontaneously by participants.

Perceived risks

Perceived risks often mirrored the reverse of what people had suggested might be benefits. For example, potential positive health impacts were countered by concern about unknown things being added to food, negative impacts of which may not be visible in the short-term, a general concern about how consumers would know what had been done to the food they are eating and the longer-term risks of 'messing with nature'. For a few people, this started to paint a frightening picture:

> *"They could end up creating an absolute monster here even by doing research… some kind of catastrophe…. before you know it, everything could be out of control…. like new diseases. They need to test it to death before release."* (M, 45-50, C2)

There was also a suggestion that the quality of food might suffer due to faster mass production, with some foods losing their nutritional value.

> *"Would it affect the taste of our food? Would it impact on the cost if it has to be DNA modified…. would it drive up the cost?"* (M, 45-50, E, Living with someone with food allergies)

> *"If your body is designed to take nutrition from certain foods…, would it impact on that if the food was modified."* (M, 35-44, B, Living with someone with food allergies)

Potential benefits for crop producers were balanced by worries that some farmers (i.e., those not in a financial position to invest in and use NBTs) could get left behind. There was also concern that some farmers could go out of business, thus leaving consumers with less choice and more dependent on big food conglomerates that control the market. There were also questions about the impact of NBTs on organic farming and products, e.g., might consumer choice in these areas be negatively impacted?

A few respondents who were living with a food allergy (or who were living with a family member with a food allergy) were very concerned that NBT might lead to

potential additional allergy issues for them. In these cases, this concern, it appeared, outweighed the possible benefits that could come from having new foods developed by using NBTs to reduce their allergen levels.

> *"Additives…. what are they going to be adding to our food."* (F, 35-44+, C1, Living with someone with food allergies)

> *"Allergies…. I'm wondering if having modified vegetables would I come out with more allergies?"* (F, 45-50yrs, C2, Food allergies)

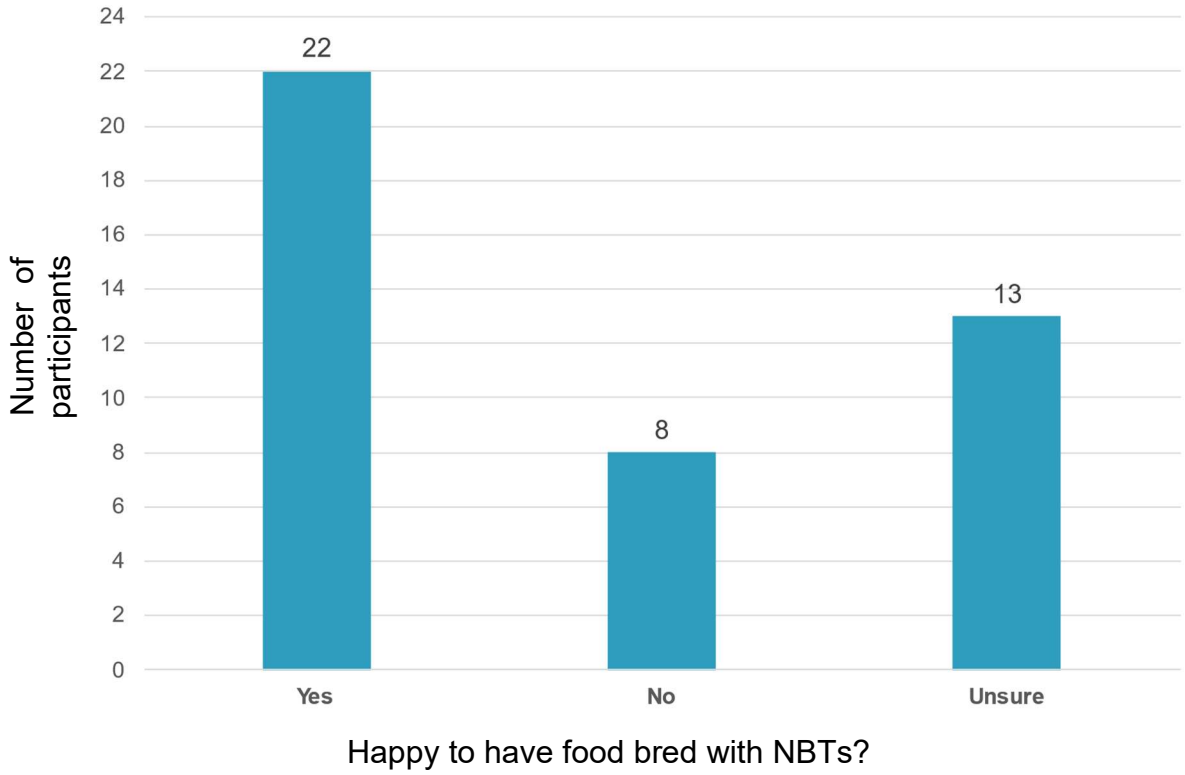
At the root of a lot of peoples' worries was uncertainty about how NBTs would be governed and regulated. For some, these concerns pointed to a potential lack of trust among consumers that is tied to current low levels of awareness and understanding.

> *"I am worried about consumer acceptance… we're all lacking trust in this. Because it's new to us and we don't understand it."* (M, 35-44, C2)

It is important to note that when we discussed benefits and risks in the focus groups, this was *before we had considered regulation*, and prior to participants hearing FSS's presentation on regulating NBTs. Even so, and despite the numerous perceived risks that participants had articulated, in a straw poll carried out in the focus groups, around half (22 out of 43 in the focus groups) said that they would be happy to have foods bred using NBTs (Figure 6).

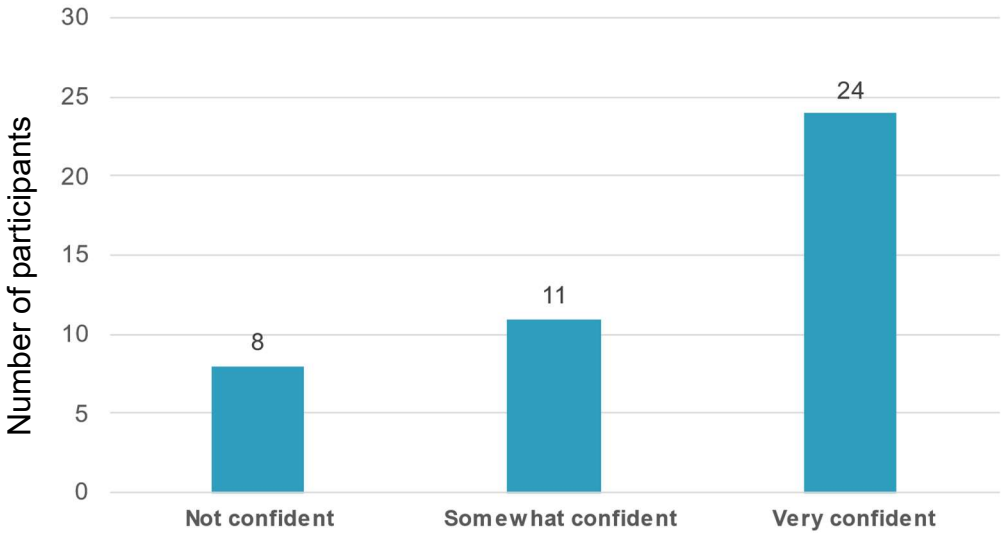
Also, most (35 out of 43 in the focus groups) were confident/somewhat confident that foods containing NBTs would be safe to eat (Figure 6). Underpinning this confidence appears to be a widespread trust among most consumers that there are sufficient controls in place within the system (even if they were not aware of what these controls are) to keep them safe.

Figure 6: Number of participants happy to have food bred with NBTs



Base – n= 43
Note: this data was collected *before* participants had heard the FSS presentation on Regulation of NBT

Figure 7: Number of participants confident that the food produced by NBTs will be safe to eat

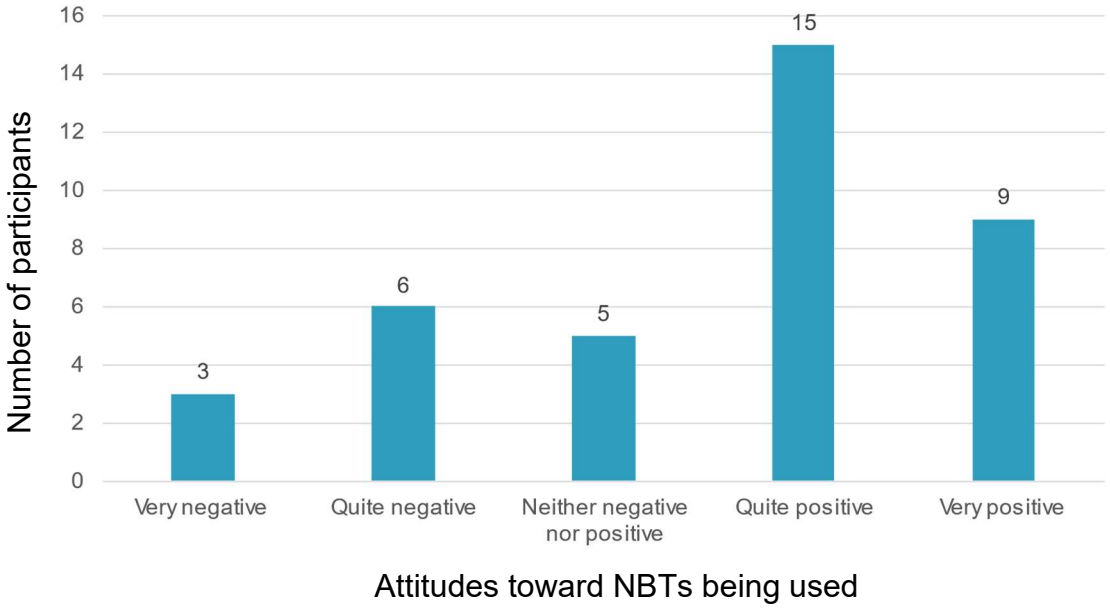


Base – n=43
Note: this data was collected *before* participants had heard the FSS presentation on Regulation of NBTs

After involvement in the focus groups, participants had a few days to reflect on what had been covered before completing the follow-up questionnaire. Whereas in the focus groups (and before they had heard the FSS presentation on regulation), participants were asked about their confidence in relation to food produced by NBTs, it was only in the follow-up questionnaire that they were asked how positive or negative they felt about NBTs being used within Scotland.

While we need to be cautious given the relatively small sample size (Base 38), these results are illuminating and reinforce the insight from the focus groups. Of the 38 respondents completing the follow-up questionnaire, only 9 were negative about the prospect of NBTs being used in food, with 3 people being 'very negative' (Figure 8). Almost two-thirds (24 out of 38) were positive, with 9 of these respondents reporting that they were 'very positive'. This indicates that participants' views had not shifted to any great extent from what was discussed during the focus groups.

Figure 8: How positive or negative respondents are about NBTs being used



Base – n= 38
Source: follow-up questionnaire

Appendix 1 (at the end of this document) presents (in the respondents' own words) positives and negatives associated with NBTs a few days after participating in the focus groups. Because there was a little time between the groups and the questionnaire, this can be regarded as a slightly more considered position across the sample. It is worth noting that some of the negative feedback reflects a continued misunderstanding that NBTs can involve DNA from difference species coming together.

8. Findings – Regulating NBTs

During the focus groups, once participants had viewed the FSS presentation on regulatory options for NBTs, many of their general concerns about NBTs were assuaged. This presentation outlined some of the regulatory options that could be used to regulate NBTs in future, including treating NBTs the same as GMOs (subject to strict rules and restrictions), or the same as other 'new' or 'novel' foods (which undergo risk assessments but generally with less strict rules than GMO). Many felt reassured that the 'system' had (or would have) measures in place that would carry out the necessary checks on food containing NBTs before they were made available to sale.

Indeed, there was a good deal of positive surprise in response to what FSS currently does to ensure consumers are safe when new and novel foods come onto the market. This had not been front of mind for most consumers, and it appeared to boost peoples' confidence in the FSS brand.

Those participants who remained less confident after watching the video, tended to be those who either continued to misunderstand important aspects of NBTs (e.g., perceiving that NBT food could involve DNA from another species), were cynical and suspected that the future use of NBTs is a 'done deal', or were particularly concerned about the use of NBTs in animals.

Participants expressed a range of views on what sort of regulatory regime would be appropriate for NBTs. At one end of the spectrum, some felt that NBTs should be treated the same as GM food. Participants taking this position tended to be those more concerned or/and with a poorer understanding of NBTs, and a few who had been impacted by negative media coverage of GMOs.

> *"Depends on what they really mean by new breeding techniques. Playing on words here just to confuse people. Should be banned in my opinion, but definitely be regulated the same as GM."* (M, 45-50, C2)

> *"Should go through a strict process because of the involvement of the genes…. should be the highest level of going through the risk assessment. Like GM."* (F, 45-50, C2)

At the other end of the spectrum, some participants, particularly in light of the FSS presentation, demonstrated little remaining concern. They felt that the existing system was fine. These participants tended to be people who did not really want to know too much detail, and few had any real interest in the science behind plant breeding. They were comfortable trusting that 'the system' would ensure that the food on supermarket shelves would be safe.

> *"If all safety checks are in place, it should just be treated more like a new food."* (F, 35-44, B)

"I am quite reassured that there is a lot going on behind the scenes." (M, 35-44, B, Living with someone with food allergies)

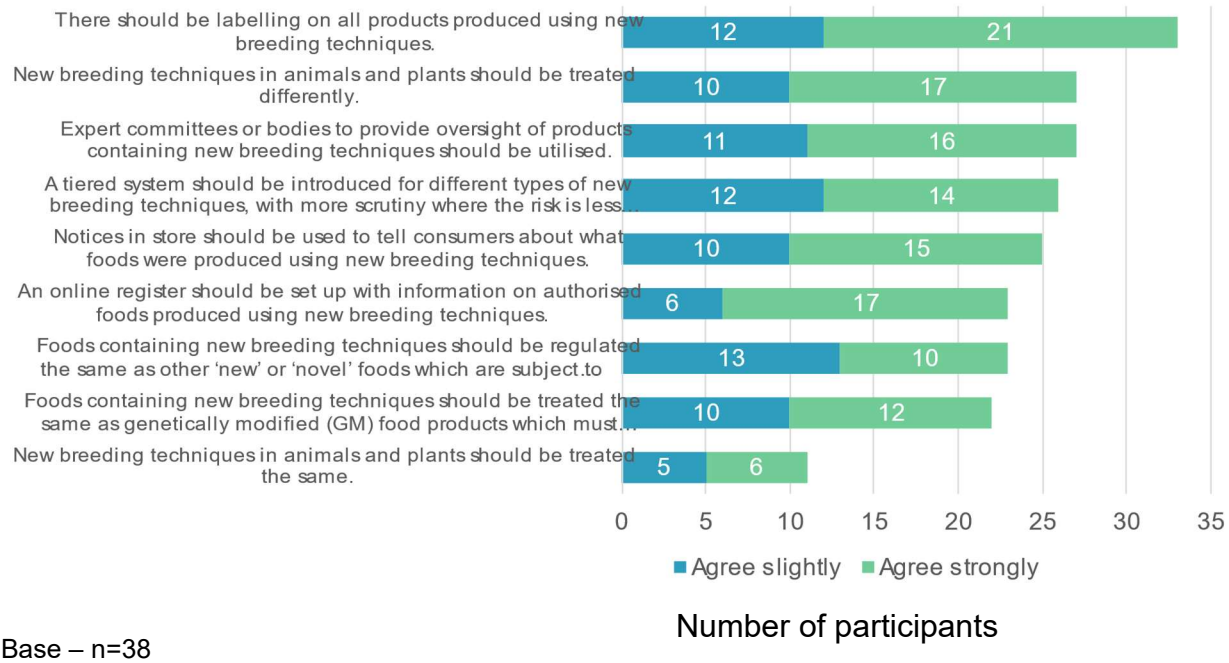
"I don't think it needs to be as rigid as GM because … the risks for new techniques are not the same." (F, 51-54, C1)

Considering the discussion at the focus groups, most people appeared to be somewhere in the middle, and valued the range of additional options (such as tiered regulatory systems, expert committees, information around labelling and communication) that could potentially be introduced on top of what FSS currently does to regulate new or novel foods. There was broad support for each of the possible options mentioned in the FSS presentation. Most people would welcome some or all of these measures being introduced, and indeed it was common to hear participants say that they would have thought such a measure would already have been in place.

"You would want the committee and the tier system….and the labelling has to be clear…. but it is time for it (NBT) to come….so it does not need a ban like GM." (F, 51-54, B)

In the follow-up questionnaire, the range of options that were discussed in the focus groups were brought together in a list for respondents to consider. Figure 9 shows how far they agreed with each of the options. For each option participant support ranged between from between 11 to 33 individuals. The five most popular regulatory options concerned labelling products containing NBTs, treating NBTs in animals and plants differently, the use of expert committees or similar bodies, using a tiered system, and using notices in stores to inform consumers. All five of these options were supported by 25 or more of the 38 respondents. The least popular option was treating NBTs in animals and plants the same.

Figure 9: Numbers of respondents agreeing with suggested regulatory options



Base – n=38
Source: Follow-up questionnaire

Before considering each of the specific options, it is notable that people frequently indicated their support for a number of options, which perhaps underlines their general lack of knowledge and a desire to have things tightly controlled in order to feel NBT foods are safe.

Tiered system

Tiered systems are systems that have different regulations for different types of NBTs. For instance, a tiered system based on potential risk might have a tier for small changes made by NBTs where the risk is well understood (Tier 1) and another tier for larger changes where additional risk assessments are required (Tier 2).

Most participants in the focus groups were in favour of a tiered system. Support leaned towards having a two-tiered system (for the time being at least) as being appropriate to deal with NBT foods where there may be greater uncertainty about their safety, and until they were more established and understood. Some 26 of the 38 respondents to the follow-up questionnaire (Figure 9) agreed that the option should be introduced.

> *"(The tier system)….this is about safety….I would put my weight behind this, it needs regulated for safety."* (M, 35-44, C1)

> *"The tier system is useful because it is all new to the breeder and the consumer….initially it would be good to have the tier system."* (F, 51-54, B)

> *"I expect this to be in place anyway."* (M, 35-44, B, Living with someone with food allergies)

Expert committee

Expert committees are distinct bodies that could provide expert oversight and opinion on food and feed products containing NBTs.

Broad support was expressed for this option. Some 27 of the 38 respondents to the online questionnaire (Figure 9) favoured the idea of an expert committee, echoing how participants had responded during the focus groups. However, despite the majority being in favour, a few questioned whether its impartiality could be guaranteed. Subject to it being independent of powerful food business interests, and impartial, most participants felt that a body like this would be an expected and vital component to the regulatory and safety process.

> *"The governing body needs to be impartial….most folk have an agenda…as long as that is taken into account."* (M, 51-54, C1)

> *"They can ask the questions… they're there as the checks and balances."* (M, 51-54, C1)

> *"Yes, I think that Food Standards would head it….they can bring in people like the professor."* (F, 51-54, B)

Online register

An online register could require producers to register foods using NBTs with the food regulator which would then be available online to the public.

Of the various regulatory options discussed, the online register was the one that excited participants the least. That said, there was still a lot of support for a register, to enable transparency and traceability, and this reassured them. However, they did not readily see themselves consulting it as consumers.

Most participants suspected that the register would only be used by, and be of value to, government and corporate audiences. They could not imagine a situation where they would seek to look up a food producer on a register to check if they are credible - this would be the job of FSS, or other bodies entrusted with ensuring that food for sale is safe.

> *"It is pointless from a consumer point of view…. that is the last thing I would be look at."* (M, 35-44, B, Living with someone with food allergies)

> *"That would be for the companies."* (F, 35-44, C1, Living with someone with food allergies)

"If it's made it on to the shelves you know it's had some level of testing. If the price is right, most people would just buy it." (M, 35-44, B)

Labelling and communications

Labelling requires products that include ingredients produced with NBTs to be stated on a product food label. Other communications could include notices that must be displayed somewhere in store stating if particular products contain ingredients produced with NBTs.

This was an area of huge importance to consumers. And this was echoed in the follow-up questionnaire where 33 out of 38 agreed that there should be labelling on all products produced using NBTs.

Generally, focus group participants were aware that information on food labels has greatly improved recently, and that consumer choice has been enhanced as a result. With the expectation that food labelling will now carry information on the ingredients in food, they expected that foods using NBTs would be readily identifiable by the information provided on food labels. People would be shocked if they felt this would not be the case.

"Because they are bred in a different way, they should be labelled so people know what they are getting." (M, 45-50, B)

"If there's no mandatory labelling, that's an absolute outrage. The consumer needs to be able to make a real choice." (M, 45-50, C2)

Focus group participants felt that labelling *and* other forms of consumer communications (e.g., posters in stores where NBTs are starting to be sold) were both important. It was felt, however, food labelling is primary, with the use of notices and in-store posters being used to complement the information on package labelling, not to replace it.

"It is important to have it marked on the package…. not on the wall of supermarkets. (F, 51 - 54, B)

Importantly, participants were clear that for labelling to be of value to consumers more broadly, there would need to be significant communications to educate the public about NBTs and what the benefits and risks are.

"It is about getting buy-in from the public. The labelling means nothing if nobody knows what it is about. It is good that this (communications to the public) is being looked at. The rest (e.g., regulation and registration) is just checks and balances." (M, 51-54, C1)

Labelling and allergens

The discussion around labelling was the main area where those who had an allergy (or had a person at home with an allergy) made most reference to their situation with food issues. Being able to check food labels is a hugely important part of the shopping process for this group. It can soak up a fair amount of time, and some frustration was often expressed about struggling to read information because of small print size. Nevertheless, people with more severe food allergies and intolerances are committed to finding and checking information to stay safe and invest a lot of effort in doing so.

> *"You need to have labels to have confidence."* (M, 35-44, B, Living with someone with food allergies)

> *"I think it would be a good idea if stores have posters or something saying this item contains slightly dangerous things. I know, because I've been a Coeliac all my years and I've been eating cornflakes for many, many years. Then, all of a sudden Kellogg's decided to change and put barley in it. Now 600,000 Coeliacs are not allowed to eat cornflakes."* (M, 45-50, E, Food allergies)

> *"There could be a QR code on the label" …. (to find out more about NBT and what their impact is for people with allergies).* (F, 35-44, C1, Living with someone with food allergies)

NBTs and animals

Almost all focus group participants agreed that there should be a difference in regulation of NBTs food between plants and animals. In short, regulations needed to be much stricter if NBTs were to be used in animals compared to plants. Indeed, many people had strong views about this issue, and thought that NBTs should not be allowed at all in animals for ethical reasons.

> *"I don't mind if somebody tampers about with a vegetable; selective breeding in animals is enough, but as soon as you start tampering with that it brings in an ethical thing that I'm not comfortable with."* (M, 35-44, B)

> *"It is different for animals, they are living beings, welfare is key."* (M, 55 - 60, C2)

> *"People think animals are like pets and things, so there is a difference between them and plants. It's a kind of moral question more than food that grows, it doesn't feel like it's alive. Animals feel like you could be messing with nature a bit more, even though you probably aren't. It just feels a bit more emotive*." (M, 35-44, B, Living with someone with food allergies)

Confirming the ethical concerns about NBTs with animals voiced in the focus groups, 27 out of the 38 respondents to the follow-up questionnaire agreed that NBTs in

animals and plants should be treated differently (Figure 9). This is mirrored by the least agreement with the statement that NBTs in animals and plants should be treated the same (11 out of 38).

9. Key Findings - Summary

This research was commissioned to help inform FSS's understanding of consumer perceptions around terminology and future regulation of food containing New Breeding Techniques (NBTs). It has sought to build on the joint survey research carried out with FSA on attitudes to Precision Breeding (PB)[10] by providing insights from qualitative research with consumers.

Consumer understanding and views on NBTs

Mirroring the findings from the previous FSA/FSS PB survey, awareness of new breeding techniques in foods was very low. Participants had come to the research largely unaware and uninformed about NBTs. After hearing about NBTs for the first time in the sessions, many remained uncertain, and some were confused and anxious, about what their introduction might mean. Participants also found it a challenging area to understand.

Participants generally had trust in science and scientists and a sense that change was inevitable. However, there was a minority who remained deeply sceptical about the new technologies and their use.

Terminology

Participants found the terminology around the techniques challenging - they were not familiar with it and found the language off-putting and over-scientific.

However, most were able to make distinction between GMO and NBTs – having a strongly held negative view about the idea of using DNA from another species. More were accepting of editing existing DNA versus adding DNA from another species.

There was a lack of understanding about all breeding techniques with many associating 'classical breeding' with 'natural' – and were sometimes concerned about long established techniques such as radiation mutagenesis.

Given the choice between an 'umbrella' term (such as 'New Breeding Techniques' or 'Precision Breeding'), a descriptive term (such as 'genome editing' or 'gene editing') and a technical scientific term (like 'targeted mutagenesis', 'cisgenesis' or transgenesis'), participants preferred an umbrella term followed by a descriptive term. Few preferred the technical or scientific term. The most preferred term was the umbrella term 'New growing techniques' (suggested by one of the focus groups), but other terms such as 'New Breeding Techniques' or 'Precision Breeding' were also deemed suitable.

[10] https://doi.org/10.46756/sci.fsa.ouv127

Risks and Benefits

Participants identified both risks and benefits to NBTs in foods. Key potential positive benefits identified included: cheaper food; longer shelf-lives; increased nutrition and other health benefits; and greater consumer choice.

Key risks and concerns included: unknown things added to food; lack of knowledge about what had been done to food; longer-term, unknown consequences; and risks of 'messing with nature'.

Still, more than half of participants were happy to have foods bred using NBTs (this was *before* the presentation on regulation).

Regulating NBTs

Once participants were informed about regulation of foods, most were reassured that the necessary safeguards would be in place. There was, however, a smaller group who remained unconvinced.

There were varying responses to the level of regulation of NBTs that participants wanted to see. Some wanted NBTs to be strictly controlled (liked GM), while others were content for NBTs to be authorised if they had gone through the regulatory process (the same as other 'new' or 'novel' foods).

Generally, participants also favoured other measures such as having a 'tiered' system that had different requirements for authorisation based on risk and having a dedicated committee to provide oversight and advice.

Overwhelmingly, participants expected that food products containing NBTs ingredients would be readily identifiable by information on labels.

Participants also did not generally favour NBTs at all in animals.

Appendix 1 – Positives and negatives associated with NBTs

Positives associated with NBTs	
• Making food more nutritious • If cheaper to grow these crops, hopefully this will be passed down to consumer • More variety and choice (inc. out of season) • Reliability of food production • Better shelf life of foods • Grow crops in extreme weather conditions • Improved yields for farmers • Carefully engineered by scientists (so safe) • Health benefits - using the techniques in medicine • Superfoods created, aiding health, e.g., cancer beating and helping with allergies • Increased sustainability • Wider distribution of food products • More efficient food production • Increased availability	• More profit for farmers, supports farming industry • Higher quality goods • More control • More food / help food poverty • Less reliant on workers • Encourage food diversity and promote a healthier lifestyle • Less waste potentially • Cost efficient - longer sell by date • More robust crops • Could help with agricultural issues such as pests and disease • Improved taste of food • Cut down on export/import of food / environmentally beneficial • Reduced environmental impacts (fertiliser/pesticides use, soil conservation, etc.)
Negatives associated with NBTs	
• Exposed to methods that we haven't heard enough about • Unacceptable to not provide information about how the fruits are grown • Potentially climate damaging as these crops will breed with non NBT crops too • Unfair advantage on larger businesses as the new equipment may not be affordable to smaller businesses • Not able to spot if it goes "wrong" • Compromising taste/ traditional goodness from food • These techniques should not be considered • Uncertainty in how altered produce could affect insect and other pollinators	• You don't know how regulated the process is/ methods not tested enough • Not the same nutritional value than being grown naturally • Genetic modification of animals is probably a bridge too far for now • Is this fundamentally the right thing to do - changing nature? • Companies hijacking the technology • Animals being hurt to benefit profit • This is going too far • Cost of the technologies, seeds, etc. could increase the cost for farmers, seeing them unable to meet the demand. Additionally, this could drive the cost of produce up for consumers, making it difficult for people to access products (leading to food poverty)

• Techniques not doing what they are meant to • Danger of crossing DNA between species • Morally wrong • Fear of the unknown - complexities • Chemicals in the food • Increased price of seeds sold to farmers • Public acceptance may be difficult to achieve • Consumers not trusting products using NBTs • Not much is known by the general public - could cause uninformed fear • Reduced quality of produce, which could have a negative impact on health and possibly increase waste (mass production) • People may be unsure if they don't understand the technique	• Harming natural ecosystems/ insect population if mistakes are made • Forcing these techniques through without consumers having much of a say • Safety assurance - who controls what producers do - and how is this assured - e.g., the horse meat scandal • Long term effect on wildlife and the environment • If these items are allowed onto the market it may not be mandatory to confirm that they are GMO on the packaging • Health risks/unknown long-term effect on the human body • Dangerous/unpredictable • Potential unfair distribution of supplies

Base – 38
Source: Follow-up questionnaire

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