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make history.

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1. Acknowledgements

Special thanks to Dr Heather Bray, Ms Kelly McKinley, and Dr Emily Buddle for their assistance in moderating the focus groups and to Dr Dessie Ambaw for providing statistical analysis of focus group data. Thanks also to Dr Bray, Prof Joan Leach, and Dr Will Grant for their insightful comments as part of an expert review panel and to Dr Emma Tonkin and her co-authors for their permission to use the trust measures developed as part of their scoping study on trust in food systems (Tonkin et al. 2021). For background to this report, we also drew on a recent literature review commissioned by FSANZ on consumer responses to NBTs in Australia and New Zealand to which we contributed (Grant et al. 2021).

2. Executive summary

Recent advances in gene technology have allowed food producers to make quicker and more precise changes to the DNA of plants, animals and microbes in order to introduce or modify traits of a target species. The aim of this research project was to gain a deeper understanding of Australian and New Zealand consumers' awareness and knowledge of these new breeding techniques (NBTs) and to determine whether there were any differences in the ways in which community members view NBTs compared to older techniques such as genetic modification (or GM). Although there are currently no NBT foods available in Australia or New Zealand, gaining a deeper understanding of consumers' attitudes towards NBTs will provide regulators with valuable information which can be used to help formulate future regulation around this new technology. In particular, this research was designed to help inform the current review of definitions in the Australia New Zealand Food Standards Code for 'food produced using gene technology' and 'gene technology,' which is being undertaken by Food Standards Australia New Zealand (FSANZ).

We conducted two asynchronous online focus groups with a mix of participants from Australia and New Zealand using samples that were representative of major demographic features of the respective populations. Participants responded to multiple choice/Likert style questions and provided short written responses in dialogue with one another and facilitators in response to questions and scenarios relating to their views on NBTs, GM, and related topics such as trust in authorities of various types including food regulators. They also provided detailed feedback on a draft Fact Sheet developed by FSANZ. We hence generated rich qualitative data that we analysed thematically, and some quantitative data which we used to assess significant differences in responses and views across various subgroups within our study population.

Our findings suggest that our consumer participants had relatively low levels of self-reported knowledge about NBTs; once they were given basic information, they had diverse views on NBTs, but appear to focus less on the details of the underlying science and more on the factors associated with specific applications. Many participants were generally positive about specific applications but had numerous questions and issues that they wanted addressed even about those applications that they were generally inclined to support. Repeated themes with regard to the questions raised and the information desired by participants included clarity on longer-term effects of applications on the crops or non-human animals on which they were used, the environment, humans, and the resulting food products. There were frequent requests for more evidence of safety and long-term testing in conjunction with applications of these technologies. There were some discussions about the need to ensure that such technologies could be reversible, and that conventional varieties would not be adversely affected or would be maintained in parallel to these new applications in part as an insurance policy and also to maintain biodiversity. Finally, there were concerns about whether these applications would result in increased costs for farmers or consumers.

A key theme amongst some participants was that NBTs do not represent an adequate solution to what some consumers perceive as the 'real problems' facing society, particularly in relation to environmental issues such as climate change or broader concerns about agricultural practices. Instead, some applications of NBTs were described by some participants as either unnecessary or, in some cases, a hindrance to achieving more meaningful changes in the food system. Thus although many participants found various specific applications of NBTs presented in the scenarios to be largely acceptable, the findings indicate that the details of particular applications make a difference to their acceptability for the broader community, whether they are generally positive or negative about them, and what is of concern

tends to depend on the perceived benefits of the applications as well as other options for addressing the problems in question, among other contextual factors.

3. Methods

a. Rationale

In order to gain an understanding of community attitudes towards NBTs, we conducted two asynchronous online focus groups with participants from Australia and New Zealand. Focus groups which are conducted in an online environment draw on methods associated with traditional face-to-face focus groups, where discussions are focused on a collective activity for the purposes of data gathering, rather than using data or discussions arising in a 'natural' environment such as social media discussion fora. Online focus groups clearly provide a convenient means for participation, particularly given current limitations on social gatherings due to COVID-19. They also provide an immediate transcript of discussions and allow provision of multiple types of prompts (such as visual, textual, and audio stimuli) in an accessible and attractive format. But most importantly, they also offer opportunities to foster more diversity in participation, as they do not require physical presence which may be difficult for certain types of people due to location, conflicting responsibilities, or psychological or social issues such as comfort in groups. Other researchers (e.g., Fox 2017) have noted that the online environment can enhance participants' sense of confidence in, and control over, the participation experience.

There are notable disadvantages to asynchronous online focus groups: the interactivity between participants is likely to be lower than in real-time focus groups (Fox, Morris, & Rumsey 2010), which might be problematic given that group interactions are known to be particularly useful in situations where little is known about a topic or context (Kitzinger 1994), which is the case with NBTs. However, in our previous usage of this method and platform, we have found that we can foster interactivity to a certain extent through active facilitation, as many participants come back online multiple times over the course of a day, so may return and respond if encouraged to do so and made comfortable within the online group. A clear advantage to this approach is that messages posted tend to be typically longer and more reflective than those provided by participants in real-time synchronous groups, as multiple participants can respond simultaneously so there are not the usual limits present in discussions, and because they can edit their messages before posting (Williams et al. 2012). Researchers serving as facilitators thus have opportunities to ask for clarification of meaning and probe for additional details, and we took full advantage of this feature of online focus groups in this research.

b. Recruitment

Participants were recruited through the Sydney-based panel recruitment company McNair yellowSquares. In order to obtain samples broadly representative of the respective national populations, McNair recruited a diverse mix of participants across Australia and New Zealand with attention to demographic factors such as self-described gender, age, self-described ethnicity (including Indigenous and Maori), level of education, socio-economic status, and location (urban/city, regional, and rural).

In order to take part in the focus groups, participants were required to be over the age of 18, proficient in English, and have access to the Internet. Considering the relatively high uptake of the Internet among our target population, this requirement was unlikely to be a limitation for the large majority of prospective participants. We did not exclude any participants based on dietary preferences, level of science education, or previous or current experience in agriculture, food, or genetics, but we included a screener at the outset so that we were aware of these background characteristics when conducting the focus groups and analysing the resulting data.

c. Demographics

In total, we had 79 participants (49 Australia, 30 New Zealand) who completed the online discussion groups, which were split over 2 separate online groups of roughly equal numbers who participated at their convenience over a 3-day period. This sample represented a roughly 60/40 split between Australia and New Zealand. We also were able to obtain a fairly representative mix in terms of basic demographics according to publicly available census statistics, particularly in relation to gender (41 female, 38 male), socio-economic status, and Indigenous/Maori background (2 Aboriginal or Torres Strait Islander and 4 Maori participants). We also had a good mix of participants from all age brackets over 18 years, although there was a slight oversampling in the 30–39 year age bracket and a slight undersampling in the over 65 year bracket. While we had a mix of participants with different levels of education, there was also a relatively high overrepresentation from those with university-level education. In terms of location, there was a slight oversampling of regional and urban participants, which was in fact useful as we were interested in obtaining these participants' views in particular, given previous studies on agricultural- and food-related topics that show differences in views among those not highly familiar with agricultural practices.

d. Format

The market research company McNair yellowSquares hosted the focus groups through their secure online platform. Each focus group took place over a three-day period with participants able to participate at their convenience and facilitators present for extended hours to accommodate the diverse time zones from New Zealand through to Western Australia. The discussion topics and other items were released on a staggered basis on each day (see Appendix, section 7.1) though participants could backtrack to earlier days if they wished. Participants were required to complete a minimum of 15 minutes of engagement for each day; however, many participants exceeded this minimal requirement. Throughout the focus groups, participants were provided with visual and textual prompts, and were asked a variety of questions which required either written answers or responses to polls/Likert scales. Aside from some components of the focus groups which were made private (e.g., attitudes data and trust measures), participants were able to see each other's responses and interact with one another. The focus groups were facilitated by several members of the research team who interacted with participants in order to encourage more detailed answers or to seek clarification of responses where necessary. Facilitators were selected due to their diverse backgrounds and knowledge, which we believe helped to make participants feel more comfortable. Facilitators also encouraged participants to engage with one other to simulate the interactions that occur in standard, face-to-face focus group settings.

Over the course of the three days, participants were asked to respond to a number of questions which sought to determine their knowledge about gene technology as well as their attitudes toward a range of applications of gene editing. We also used the focus groups to gauge participants' levels of trust in the Australian/New Zealand food systems and to ascertain their views on the role of regulation. During the first day of the focus groups, we provided an introduction to the concept of gene technology. We also gathered general attitudes data (e.g., attitudes towards science and technology) and gauged participants' knowledge of genetic modification and gene editing. On the second day, participants were presented with scenarios describing a range of potential applications of gene editing and were asked to share their thoughts on each application including any concerns or questions arising. We used scenarios that covered a range of possible applications (i.e., cosmetic, health or nutritional, environmental, and animal-related benefits, and benefits for producers). We also used scenarios contrasting in terms of additional variables which have been recognised in the broader literature on genetic modification as important to people's attitudes and values such as types of products (e.g., fruit and vegetables; grains; meat, fish, and other

animal-based products), the forms which the products take (e.g., whole/fresh versus processed products); whether the application is used only in the process of production or persists in the final product; and typical perceptions of products in terms of importance to diet (e.g., necessary or optional). On the third day, we asked a series of questions designed to gauge participants' levels of trust in the Australian/New Zealand food system. These measures were drawn from a scoping study which developed an instrument to measure dimensions of trust in the food system (called the DOTIFS scale) (Tonkin et al. 2021). We also asked participants to provide feedback on a Fact Sheet focused on NBTs which had been drafted by FSANZ and to reflect on their experiences taking part in the focus group. The focus group script can be found in the Appendix of this report (section 7.1).

e. Analysis

Analysis of the focus group data was based on a mix of reflexive thematic analysis and statistical analysis. The authors used the reflexive thematic approach to analyse the textual focus group data (following the methods in Braun & Clark 2013). This method involved iterative stages of coding of focus group transcripts and the organisation of codes in order to build themes which represent patterns of shared meaning among the participants and which assist in answering the research questions posed. In particular, we used an inductive approach to look for key concerns and concepts relating to the key themes across the focus group days, and also to trace individuals' responses across the scenarios. Following a process of data familiarisation, we nominated core themes and defined them in order to support further coding and identification of supporting verbatim participant quotes as illustrations of the emergent theme, iterating back to refine the themes. The analysis was undertaken independently by both authors. The main themes and codes were subsequently compared and collated before being presented together with the overall analysis of the data to a working group of experts for their critique and review, prior to finalisation.

As this research was largely qualitative in nature, we used best practices for qualitative thematic analysis (e.g., Braun & Clarke 2013), we did not seek to derive frequencies for themes discussed, but to articulate the range of themes that arose across the focus groups. This approach permits a rich understanding of the diversity of views held by participants arising within a particular context. We do use non-specific words such as 'some' and 'many' based on dominant coding practices in qualitative research, drawing on what is termed 'semi-quantification': when performed judiciously, such a process can enable researchers to draw attention to regularities ('many'), peculiarities ('some' or 'several'), and idiosyncrasies ('one participant') in the data without making any quantitatively grounded claims that would be unwarranted in this sort of qualitative research (Neale, Miller, & West 2014). Critically, such semi-quantification is not meant to convey generalisability beyond the study population, but in the spirit of qualitative research is intended to highlight the range of views present in the study population (Sandelowski, Voils, & Knafl 2009).

We supplemented this approach by coding each participant's responses to the five individual scenarios using a 5-point scale, which provides a form of corroboration for the underlying qualitative findings (see Hannah & Lautsch 2011) but which does not provide quantitative data strictly speaking on consumer views as would for instance a population-based survey which asked solely for their overall reactions to a scenario. Again, caution must be made in interpreting these charts: as we are using a 'process' oriented approach which focuses on the broader context and processes by which people come up with their views, we would strongly caution readers not to consider these charts outside of the context of the open-ended responses and themes. Our qualitative work seeks to answer questions about why and how, rather than to what extent or if, for example, they support or fail to support. However we do agree with scholars (such as Maxwell 2010) that the use of numbers can be a legitimate and valuable strategy for qualitative researchers when it is used as a complement to research that takes an overall process orientation.

A specialised statistician was employed to provide an analysis of the quantitative data, particularly in relation to the data on participants' trust in the Australian and New Zealand food systems. This analysis involved testing for any statistically significant associations between demographic characteristics and responses to the trust measures. However these findings are suggestive and not definitive, as the food trust tool that was utilised does not yet have a population baseline against which we could compare any patterns in the findings; applications of the food trust tool warrant future research by FSANZ.

4. Results and discussion

4.1. Knowledge of gene technology

4.1.1. Quantitative results

On Day 1 of the focus groups, we asked participants about their current knowledge of gene technology, using questions similar to those typically utilised in Australian national studies about technology awareness (e.g., Cormick & Mercer 2019). Responses to the question 'Which of the options below best describes your current awareness of gene technology?' can be seen in the following table:

Which of the options below best describes your current awareness of gene technology? (Day 1)	
59.5%	Have heard of, but know little or nothing about
32.9%	Know enough about it that I could explain it to a friend
7.6%	Never heard of
0.0%	Can't say/don't know

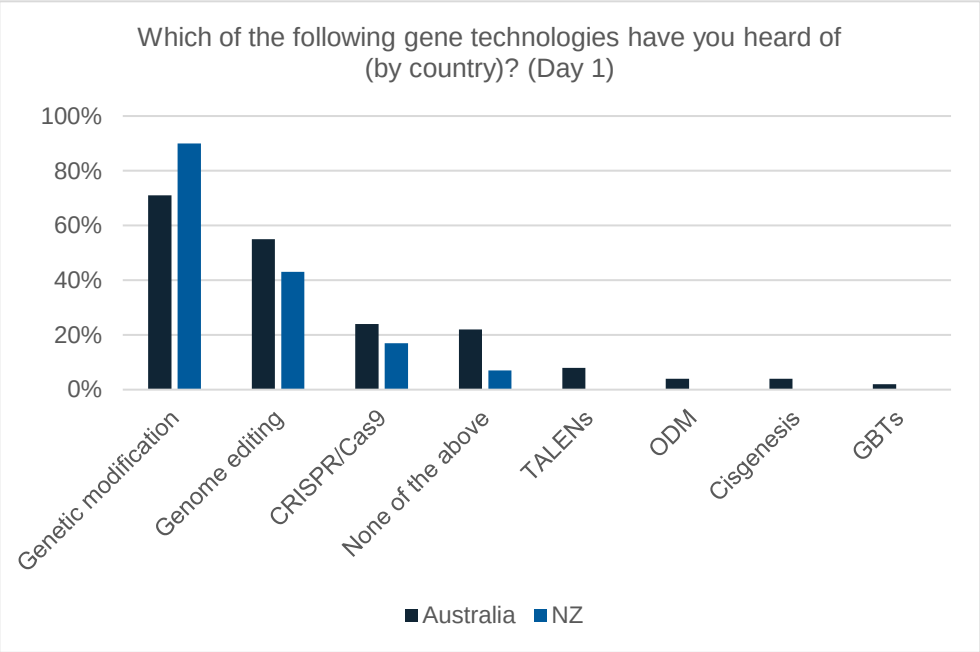
When broken down to distinguish Australian and New Zealand participants, the results indicate a slightly higher degree of knowledge about gene technology among Australian participants. For example, 36.7% of Australians indicated that they knew enough about the technology to explain it to a friend, while only 26.7% of New Zealanders indicated the same. Similarly, 66.7% of New Zealand participants had heard of gene technology but knew little or nothing about it compared to 55.1% of the Australian participants.

Participants were also asked on the first day to indicate which technologies they had heard of among a list of older and newer breeding techniques. Please note that a fake option (GBTs) was included in order to test whether many participants would indicate that anything that sounded technical would be included in their recognised types of gene technologies; only one participant selected this option which provides us some assurance that participants were trying to be accurate with their responses.

Which of the following gene technologies have you heard of? (Day 1)	
78.5%	Genetic modification
50.6%	Genome editing
21.5%	CRISPR/Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats)
16.5%	None of the responses listed
5.1%	TALENs (Transcription Activator-Like Effector Nucleases)
2.5%	ODM (Oligonucleotide-Directed Mutagenesis)
2.5%	Cisgenesis
1.3%	GBTs

As can be seen in the above table, a majority of participants (78.5%) had heard of genetic modification prior to taking part in the discussion. Interestingly, a relatively high number of participants (50.6%) had also heard of genome editing despite it being a newer technique. Unsurprisingly, knowledge of more specific NBTs such as CRISPR/Cas9, TALENs, and ODM was less frequent.

Knowledge of these technologies also tended to be higher among Australian participants (see below), although the notable exception was genetic modification which was more familiar to New Zealand participants (i.e., 90.0% of New Zealanders were aware of the term genetic modification versus 71.4% of Australian participants).



On the final day of the focus groups, we asked participants to again rank their current awareness of gene technology. These results show a significant increase in the number of participants who considered themselves to be knowledgeable enough about the technology to explain it to a friend (from 32.9% on Day 1 to 78.5% on Day 3).

Which of the options below best describe your current awareness of gene technology? (Day 3)	
78.5%	Know enough about it that I could explain it to a friend
20.3%	Have heard of, but know little or nothing about
1.3%	Can't say/don't know
0.0%	Never heard of

4.1.2. Discussion

A survey of 1248 Australians conducted by Cormick and Mercer in 2019 found that 22% of respondents knew enough about genetic modification to explain it to a friend, compared to 13% for gene editing (Cormick & Mercer 2019). A recent survey of 444 Australians by Shew et al. (2018) found that 68.2% of respondents were familiar with genetic modification while only 12.6% were familiar with CRISPR. No similar studies or results are available for New Zealand. Our results indicate slightly higher self-reported knowledge amongst our participants than these baselines; however, this difference is not particularly significant and we do not think it affects the validity of our results in terms of their representativeness of the respective populations. It is more likely that awareness has increased over the time period since the

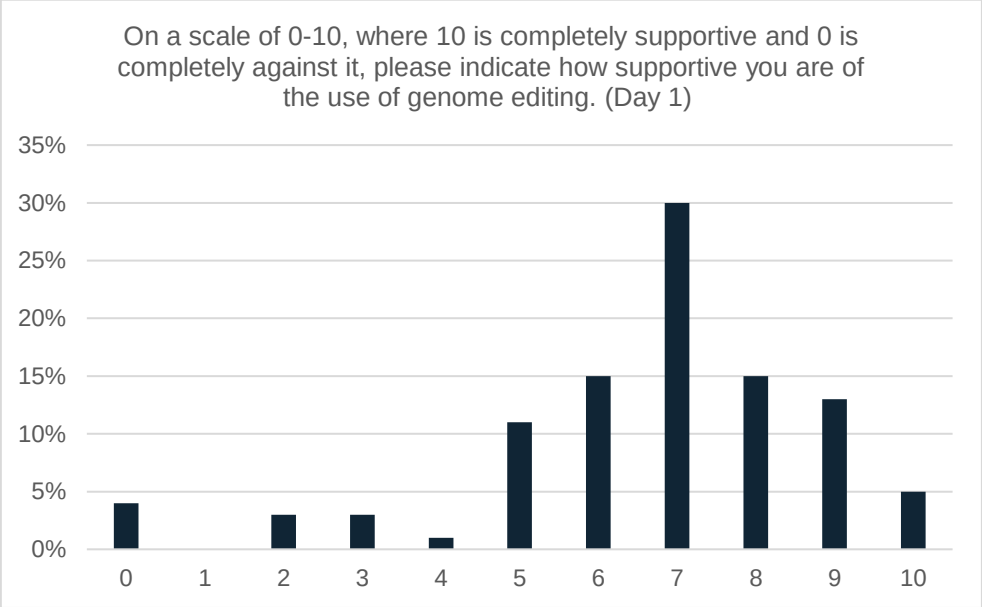
previous studies were performed, particularly given increasing popular media coverage about genetic modification and gene editing technologies.

The significant increase in awareness following participation in the focus groups indicates that such engagement could be a useful way to increase people's comfort levels with discussing these types of technologies and their applications, a point to which we return in our findings in section 5 below.

4.2. Attitudes towards gene technology

4.2.1. Quantitative results

On Day 1 of the focus groups, participants were shown a short video created by the Royal Society (UK) which provided an introduction to the concept of gene editing. In this video, gene editing was described as a new technology with various medical, plant and animal-based applications. We asked participants to rank their level of support for genome editing on a scale of 0-10, where 0 was being completely against the technology and 10 was being completely supportive of it. Responses to this question provided a baseline from which to understand participants' general views about gene editing which helped to shape our approaches in the facilitated discussions. The results indicate that participants tended to have a moderately supportive view of genome editing at the outset of the focus groups. It should also be noted that this question was presented immediately after the introductory video. As such, participants' responses may reflect their opinions on medical applications of gene editing which were discussed in the video as well as on plant and animal-based applications.



Responses to this question were relatively similar among Australian and New Zealand participants with participants from both countries generally conforming to the same overall pattern. The same can be said of responses to this question in relation to gender and location. Although there were some variations in the way males and females ranked their support for genome editing, their views followed the same general trend. Similarly, there were no major differences in the way participants from rural/regional and urban/city locations responded to this question.

We also asked participants to self-report at the end of the focus groups whether their views had changed since the beginning of the focus group. As can be seen in the following table, a slight majority of participants (53.2%) reported coming away from the focus group with a more positive outlook on gene technology. Conversely, only 8.9% indicated that their views on gene technology were more negative as a result of the discussions, and 32.9% indicated no change.

Have your views on gene technology changed since the beginning of the focus group? (Day 3)	
53.2%	More positive
32.9%	Neutral/hasn't changed
8.9%	More negative
5.1%	Can't say/don't know

Responses to this question were relatively similar among Australian and New Zealand participants. For example, 53.1% of Australians and 53.3% of New Zealanders indicated that they were more positive about the technology while 32.7% of Australians and 33.3% of New Zealanders indicated that their views had not changed. A slight difference can be seen between the percentage of Australians and New Zealanders who were more negative about the technology (10.2% Australians versus 6.7% New Zealanders), although this difference is relatively minor and not statistically significant given our sample sizes.

There are, however, some notable differences in relation to other demographic characteristics. For example, a higher percentage of male participants reported that they were more positive (60.5%) about gene technology than females (46.3%) following the discussions. Conversely, more females tended to be more negative (14.6%) compared to males (2.6%). Of those participants who indicated that their views remained the same, 36.6% of these were females and 28.9% were males.

An analysis in terms of location also revealed some differences between urban/city, regional, and rural participants. For example, urban/city (55.2%) and regional (52.9%) participants tended to be more positive about gene technology compared to rural participants (25.0%) following the discussions. Similarly, 35.3% of regional and 29.3% of urban/city participants indicated that their views were neutral compared to 75.0% of those from rural areas. In terms of more negative views, 10.3% of urban/city and 5.9% of regional participants were more negative at the end of the focus groups, while none of the rural participants indicated that their views were more negative.

4.2.2. Discussion

The demographic trends observed are notable as compared to what the existing, classic literature on attitude polarisation might suggest: this work has shown that individuals' initial attitudes tend to strengthen and intensify following group discussion (Myers & Lamm 1975), particularly where the issues under discussion are contentious. What we see in our results is that people changed their attitudes in diverse ways, presumably based on what they learned through the discussions and their experiences during the focus group. In addition, what is clear is that polarisation seems not to have occurred in a traditional manner, perhaps because people began with relatively low levels of (self-reported) knowledge and tended toward being more neutral (rather than either strongly in favour or strongly opposed). Hence this research indicates that it is critical when devising strategies for engaging with the public in association with issues about which they have limited prior knowledge not to assume that they begin with strong opinions or views, but to provide material or interventions that engage with their interests and help them to develop their opinions in a respectful environment. We believe that the format and the content of our focus groups which permitted participants to ask questions in a safe environment and to exchange views with others is a particularly good format for providing such engagement, and the numbers of people who changed their views (toward the positive or the negative) indicates that such processes are an important factor not only in research but also when engaging with the public, although how to scale up such approaches in a cost-effective manner requires further research.

Some of the other demographic findings likely warrant further research, for instance in relation to changes in views in terms of differences in gender and in location. In the previous literature on attitudes toward genetic modification particularly in food, there have been diverse results with regard to the gendering of views, and it is difficult to disentangle other factors in relation to these patterns (such as education and SEO status) (for a summary of this literature see Grant et al. 2021; on explorations of women's views about GM food, see Ankeny & Bray 2016; Bray & Ankeny 2017). We also know from other contexts that people located in Australian rural and even regional areas often are more positive about innovations in farming than those in other types of locales (but note the contrast in findings in the Yunes et al. 2019 study in Southern Brazil about views on gene editing to prevent boar taint) which might explain the relative immutability of their positive views on gene editing in this context; however, our sample numbers are too small to speculate on this point further. However, we do not believe that these quantitative patterns are as revelatory as the qualitative data to be discussed below.

4.3. Gene technology applications

On the second day, participants were presented with a series of scenarios, each of which described a potential application of a form of gene technology as part of the food supply. Participants were asked to share their thoughts about how they feel about the use of this type of gene technology, to provide as much detail as possible about why, and to discuss these reactions with others in facilitated discussion. Facilitators also provided clarifications and guidance about the factual details contained in the scenarios and encouraged participants to explore various aspects of each scenario as well as contrasts between them.

This type of open-ended approach is particularly valuable to use in domains in which people may not have detailed background knowledge, as it allows a window into their initial reactions but also presents an opportunity for engaging with others to learn a bit more and to alter or reinforce these reactions. Scenarios also permit participants and researchers to challenge existing assumptions and identify novel lines of inquiry, as well as helping researchers to make sense of and address complex and uncertain contexts (Ramirez et al. 2015). Finally, open-ended scenario-based qualitative approaches allow framing of the points of interest without closing off other concerns or issues, which permits the participants to introduce considerations that in fact are important to them but might not be foreseen by those planning the research.

Each scenario contained a paragraph of factual information provided in accessible language, along with a photograph illustrating the scenario. The scenarios were selected in consultation with FSANZ to cover a range of types of benefits related to applications of gene editing, such as cosmetic, health or nutritional, environmental, or animal-welfare related benefits, as well as benefits for producers. We also used scenarios that contrasted in additional ways which have been recognised in the broader literature on GM as important to people's attitudes and values, such as types of products (e.g., fruit and vegetables; grains; meat, fish, and other animal-based products), the forms which the products take (e.g., whole or fresh versus processed products), whether the application is used only in the process of production or persists in the final product; and typical perceptions of products in terms of importance to diet (e.g., necessary or optional).

In our process of analysis, we found that responses tended to group under a series of key themes which we have categorised as positive and negative. We also include questions raised and broader issues that participants discussed. Notice in the summaries below that questions that were raised by participants tended to form the bulk of the discussions (as compared to simple endorsement or rejection of any particular scenario) and some participants found it difficult to take a clear-cut position on most of the types of NBT proposed in the scenarios. A smaller number of participants tended to reject the focus on NBTs, a theme to which we return below, although similar questions were raised across all segments (including those who had overall positive, negative, and more neutral views on the application in question).

In addition, each participant's response to the five scenarios was manually coded in order to help gauge the distribution of participants' views across each of the scenarios. Participants were allocated a score from 1 to 5 depending on the sum of their individual responses to each of the scenarios (i.e., 1 = totally negative, 2 = generally negative, 3 = neutral, 4 = generally positive, and 5 = totally positive). Those participants whose overall responses were classified as a 5 (totally positive) did not raise any questions or concerns about the scenarios. All other participants (coded as falling into scores 1 to 4) raised questions about the scenarios and/or displayed varying degrees of concern or criticism about each of the scenarios. As will be seen below, the vast majority of participants discussed specific concerns or issues relating to each of the scenarios regardless of whether they were generally for or against a particular application of the technology. A small number of participants' responses were classified as 'unknown' where we were

unable to sort their responses into any of these categories either because of limited amount of response to a particular scenario or inconsistent or unclear responses.

4.3.1. Responses to scenarios of NBT applications

4.3.1.1. Heat-tolerant cattle

Participants were asked to give their thoughts on the following application of NBTs: 'Scientists have developed a variety of heat-tolerant cattle through a process of gene editing. Rather than adding any new genes, this method involves editing the genes found within the cow itself, namely the SLICK gene. The SLICK gene is a naturally occurring trait which is found in particular cattle breeds. Heat-tolerant cattle are able to withstand higher temperatures without developing heat stress. The skin and hair characteristics of this variety also helps protect them from sunburn and melanoma. There are no detectable negative effects of these changes in terms of meat quality and production.' This scenario was drawn from ongoing research about use of gene editing related to this gene in both meat and dairy cattle (e.g., Davis, Spelman, & Littlejohn 2017), and the name 'slick' derives from the fact that animals inheriting it have a short and sleek hair coat.

In our qualitative analysis, we identified the following themes:

Positive themes:

- This technology would help to reduce the discomfort felt by the cows by protecting them from harsh environments and hence keeping them 'safe.'
- It was also thought that this technology could help to reduce health implications of increasing heat due to climate change including fatalities.
- There are clear productivity gains associated with this technology (e.g., increasing the area in which beef or dairy cattle can be farmed, increased yields, and more generally addressing the problems caused by climate change).
- The fact that the changes that were being made came from genes already found naturally occurring in cows was viewed positively.

Negative themes:

- This technology is unnatural (i.e., is equivalent to 'messing with mother nature'), both due to the change in the genetics of the animals but also because it would cause phenotypic changes to the cattle themselves.

Questions raised:

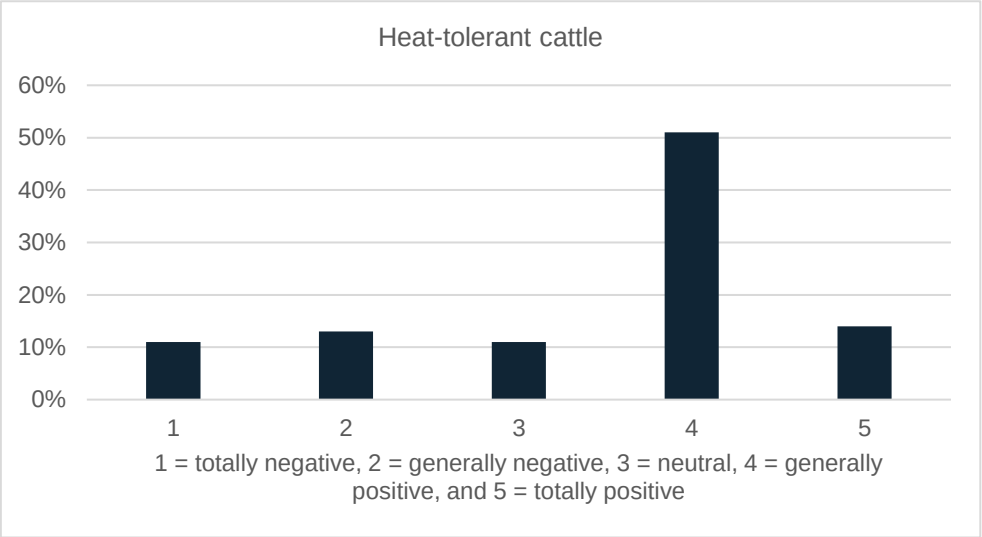
- What impacts would this technology have on the cows themselves (e.g., ability to withstand cold and changes to the cow's DNA)?
- Wouldn't it be difficult to know or prove whether the cows were actually less stressed from heat as a result of this technology?
- What would the impacts be of heat-tolerant cattle on the environment (e.g., whether it was possible to grow feed for cattle in hot climates, about more and different resources being used by these cattle including increased water use, and potential for increased methane production)?
- Would there be any changes to the meat (e.g., in terms of taste, quality and nutritional value)?
- Would this technology result in cheaper meat prices and higher quality meat?

- Are there possible human applications of the use of the technology (e.g., to protect humans from developing melanoma or military uses)? Participants also discussed concerns about this type of technological application being used in humans.
- Is there adequate evidence of the safety of the technology? (For example, it was argued that the technology would already be used in human applications if it was safe).
- One New Zealand-based participant wondered if there would be possible economic side effects in terms of trade (i.e., other countries no longer needing to import livestock).

Broader issues:

- Some participants' objections were related to farming more generally. These objections included general moral concerns about the farming of animals as well as perceptions that too much land is already being used for agricultural purposes.
- Some participants were concerned that this technology would allow farmers to treat the cows badly (i.e., by keeping cows in harsh environments if this was economically beneficial).
- Some participants questioned the necessity of this technology. For instance, some believed that cows would naturally adapt to hotter climates while others believed that producers should be using existing cow breeds which are suited to the environment.
- Some also suggested that a broader aim should be to produce less meat and to address climate change. For example, one participant commented: 'I do feel like trading in these genes to create a cow that is more heat resistant etc. isn't solving the issue, I feel like it's a way to produce more and more cows for the dairy/beef industry. It's all about profits.'
- Although many participants noted the benefits of this technology in terms of animal welfare, there were some concerns that this technology was ultimately being used for human gain and thus its use would support the continued neglect of attention to the broader conditions in which cattle are being farmed.
- Similarly, although some participants were supportive of the productivity gains associated with this technology, others were more concerned about the potentially damaging flow-on effects in terms of impact on the environment, particularly if cows were to be raised in areas previously not appropriate for farming.
- Some participants expressed wariness in putting trust in scientists and agricultural corporations in response to this specific scenario.
- Some participants claimed that they would be supportive only if there were *no* negative impacts (including negative impacts on the cows, humans, and/or the environment).

Based on an overall coding of each participant's responses to this scenario, we can see that the majority of participants (close to 65%) had responses that were totally positive (5) or generally positive (4). However it is critical to note that even those who were generally positive raised numerous questions and qualified their responses, with particular stress on the necessity of long-term testing, as discussed above.



Participants' responses (n=76) to the heat-tolerant cattle scenario were coded as follows. Please note that total participant numbers vary depending on the number of 'unknowns' across each scenario. 14.5% of participants were considered to be totally positive, 51.3% were generally positive, 10.5% were neutral, 13.2% were generally negative and 10.5% were totally negative.

In summary, a key theme was that some participants believed that this application was unnatural or unnecessary, and was distracting from the 'real issues' that need to be addressed around climate change and farming practices more generally. A prevailing sense of caution was also common amongst the comments made by many participants (i.e., a need for more testing and information about possible negative side effects), including those who were generally positive about this sort of application.

4.3.1.2. High oleic soybean oil

Participants were asked to give their thoughts on the following example of high oleic soybean oil: 'Scientists have found a way to increase the oleic acid in soybeans through a process of gene editing which involves turning off particular genes found within the plant itself. This is different to older methods of genetic modification which involved adding new genes into the plant. High oleic soybean oil does not require partial hydrogenation of the oil to stabilise the fatty acids, a process which normally results in the formation of undesirable trans fats. Soybean oil is commonly used as a cooking oil and is also found in salad dressings, baked goods, fried foods, snack foods and margarine. High oleic soybean oil is considered to be a healthier alternative but does not have any increased nutritional value compared to conventional varieties.' This scenario drew on current research on high oleic soybeans (Do et al. 2019).

In our analysis we found that participants' responses tended to cluster under the following themes:

Positive themes:

- This technology should be supported due to the associated health benefits.
- This technology could lead to cheaper production costs and thus would make soybean oil easier to sell as it would translate into a cheaper price for the consumer (although there were some participants concerned about price *increases* resulting).

- This application should be viewed positively because the changes that would be made were to the plant's own genes, rather than bringing in genes from other species or similar.
- Similarly, the fact that the technology was being used on a plant as opposed to an animal (e.g., because they noted that plants cannot feel pain) was viewed positively.
- One participant mentioned that they were comfortable with this application because plants have been adapted and changed in the past.

Negative themes:

- The lack of nutritional benefit makes the technology unnecessary or not particularly worthwhile (as compared to the potential for health benefits).
- This technology is unnatural.

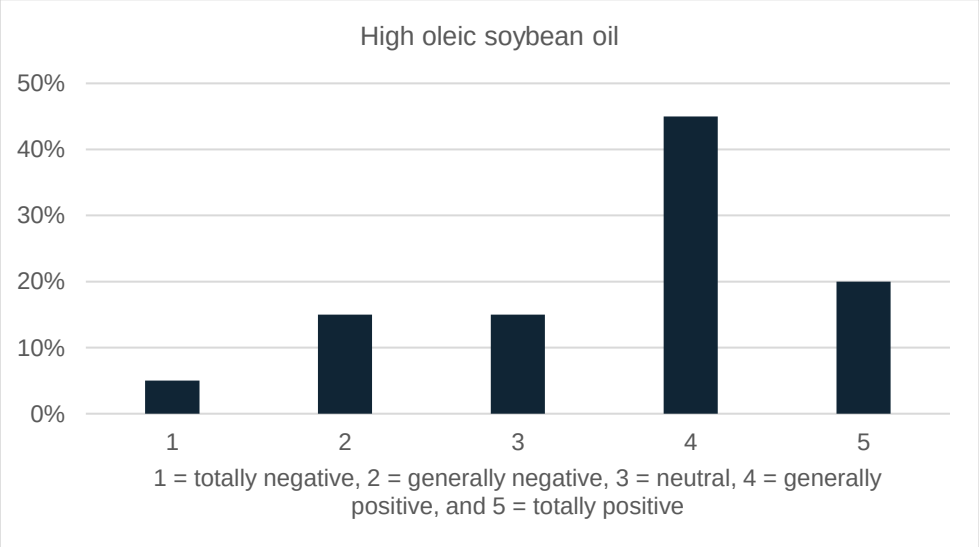
Questions raised:

- Would there be any changes in how the crop is grown (i.e., increased harvest time)?
- Would the technology be made available to farmers at a reasonable price?
- Would this technology be permanent, and would there be a way to revert back to conventional varieties if needed?
- What are the potential side effects for humans (e.g., potential for allergic reactions) and for the plant/environment, and will these be tested?

Broader issues:

- Several participants believed that oils are generally unhealthy and should be avoided altogether or else that healthier oils should be consumed (including oils that are naturally heathier or that can be genetically altered to be healthier).
- There was also a perception among some that soybean oil was particularly unhealthy for humans and for use as animal feed, and hence should not be targeted for increased use even if modified.
- Some participants expressed a distrust of corporations and scientists in relation to this application.

Based on an overall coding of each participant's responses to this scenario, we can see that the majority of participants (again, close to 65%) had responses that were totally positive (5) or generally positive (4). However as in the previous scenario, it is critical to note that even those who were generally positive raised numerous questions and qualified their responses, with particular stress on the necessity of long-term testing and effective regulation.



Participants' responses (n=75) to the high oleic soybean oil scenario were coded as follows. 20.0% of participants were considered to be totally positive, 45.3% were generally positive, 14.7% were neutral, 14.7% were generally negative and 5.3% were totally negative.

Many participants were supportive of this technology due to what they perceived to be the added health benefits. However, some participants were critical specifically of soybean oil and believed that healthier oils should be consumed instead, or else that consumers should avoid oils altogether. Many participants were confused about the distinction between health and nutrition and considered the technology to be unnecessary considering the lack of nutritional benefits that would result. The fact that changes were being made to the plant's own genes was viewed positively by many participants. Some participants were concerned about potential side effects not only for human health but for the plants themselves and the broader environment. These latter concerns were often expressed as general fears (i.e., perceptions that there may be some unintended consequences about which we are unaware).

4.3.1.3. Drought-tolerant wheat

Participants were asked to give their thoughts on the following example of drought-tolerant wheat: 'Scientists have developed a way to create drought-tolerant wheat through gene editing. Rather than adding any new genes, this method involves editing the genes found within the plant itself. Improving the environmental resilience of wheat will help improve the efficiency and sustainability of farming. Drought-tolerant wheat also has significant economic benefits considering the loss of yield which occurs during periods of drought.' This scenario drew on recent advances in the use of gene editing to develop desirable traits in wheat crops, including drought tolerance (Khadka et al. 2020).

Positive themes:

- This type of application should be supported due to the perceived benefits to producers (including benefits to those in developing countries) in terms of making increased land available for farming; increased yield, sustainability, and product quality; reduced water and pesticide use; and reduced waste.
- This application could be a good way to protect farmers and crops from drought, address the problems of climate change, and achieve food security.
- This application could lead to reduced prices for consumers (although there was some concern about price *increases* resulting).
- This technology should be supported because the changes would be made to the plant's own genes.
- This technology should be viewed positively because it would be used on plants (e.g., because plants cannot feel pain, or because it was thought that applications of gene technology would be cheaper in plants than animals).
- One participant was supportive of the technology as they saw wheat as already highly processed.

Negative themes:

- None identified, beyond general concerns about all types of applications of NBTs or rejection of the need to modify wheat altogether (discussed below).

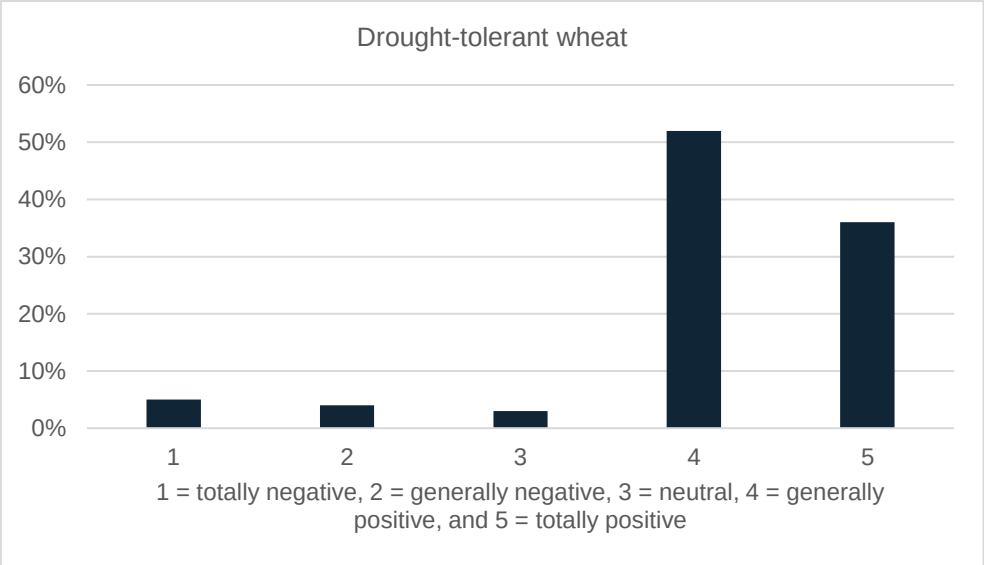
Questions raised:

- What would the impacts be of consuming the wheat (including impacts on taste and digestion, and any nutritional or quality differences as compared to conventional wheat)?
- Would the technology result in increased nutrition compared to wheat grown under drought conditions?
- How would labelling and regulation work for this type of product?
- What would be potential adverse impacts on the plants' capacities, such as on their wet or cold tolerance or response to bushfires?
- What would be the impact on genetic diversity and can we ensure that we will save seeds from conventional varieties?
- What would the potential be for contamination from these crops to other conventional wheat crops, and potential adverse effects on conventional varieties?

Broader issues:

- Some participants criticised farming practices more generally (e.g., farmers not allowing soil to recuperate between planting) as being the cause of this issue rather than drought or climate change as such.
- Some participants argued that farmers should be using conventional wheat varieties that are suited to drought conditions or instead should be using different types of grains (e.g., ancient grains or heirloom varieties).
- Some indicated that farming should be conducted in areas not prone to drought.
- There was some opposition to consuming wheat more generally (including references to wheat or gluten intolerance and perceptions that wheat is not particularly healthy).
- Many participants highlighted the need for testing in order to avoid side effects for humans, the plants and the environment, and non-human animals.
- Several participants expressed distrust of seed companies (e.g., concerns about whether seed companies would force farmers to pay a premium).

Based on an overall coding of each participant's responses to this scenario, we can see that the majority of participants (over 85%) had responses that were totally positive (5) or generally positive (4). However once again, it is critical to note that those who were generally positive raised numerous questions and qualified their responses.



Participants' responses (n=75) to the drought-tolerant wheat scenario were coded as follows. 36.0% of participants were considered to be totally positive, 52.0% were generally positive, 2.7% were neutral, 4.0% were generally negative and 5.3% were totally negative.

Many participants were supportive of this technology due to the benefits in terms of production (e.g., increased yield and area available for farmers to plant crops). Several also saw the technology as a way to address climate change. For example, one participant commented: 'Climate is changing and droughts are a thing. Changing a gene in crops seems easier than getting the whole world to act on climate change.' Several participants wanted to know about whether there would be any other changes to the crop as a result of making it more drought tolerant, particularly in terms of nutritional value. As seen with reference to the previous scenarios, many participants were concerned about potential negative side-effects. There was also a level of distrust shown toward seed companies (i.e., a perception that seed companies might force farmers to pay a price premium).

4.3.1.4. Non-browning apples

Participants were asked to give their thoughts on the following example of non-browning apples: 'The Arctic apple is a new variety of apple which has been genetically modified to prevent browning/bruising which occurs when an apple has been cut or damaged. The Arctic apple prevents this from happening by blocking the production of certain kinds of enzymes. By preventing browning, the Arctic apple better preserves its flavour and nutritional value than conventional varieties. It also helps to address the issue of food wastage as apples with bruises are commonly thrown away at all stages in the food chain.' This scenario strictly speaking was about genetic modification and not application of an NBT, but it allowed exploration of a different type of product (a whole fruit/vegetable) and engaged with different issues than the other scenarios such as waste reduction, and hence was included in consultation with FSANZ. Arctic apples are patented apples with a non-browning trait introduced which induces gene silencing and were approved by the U.S. Food and Drug Administration in 2015 for commercial sale.

Positive themes:

- This application was thought to be likely to be beneficial in terms of the potential for reduction in food waste, and increases in longevity and freshness as well as being more palatable, flavourful, and nutritious.
- Some participants noted that this type of apple would be particularly good for children.
- This application was thought to be potentially beneficial for producers and retailers in terms of reduced food waste.
- This application was seen as potentially beneficial in terms of export or import over long distances.

Negative themes:

- This application is not particularly useful as participants were not particularly concerned about bruising (e.g., because bruised apples can be used for other purposes such as composting, and fruit/vegetables don't need to be perfect).
- One participant suggested that this technology could lead to more food waste of existing/other varieties of apples/fruits.

- Several participants opposed this technology due to perceptions of unnaturalness.

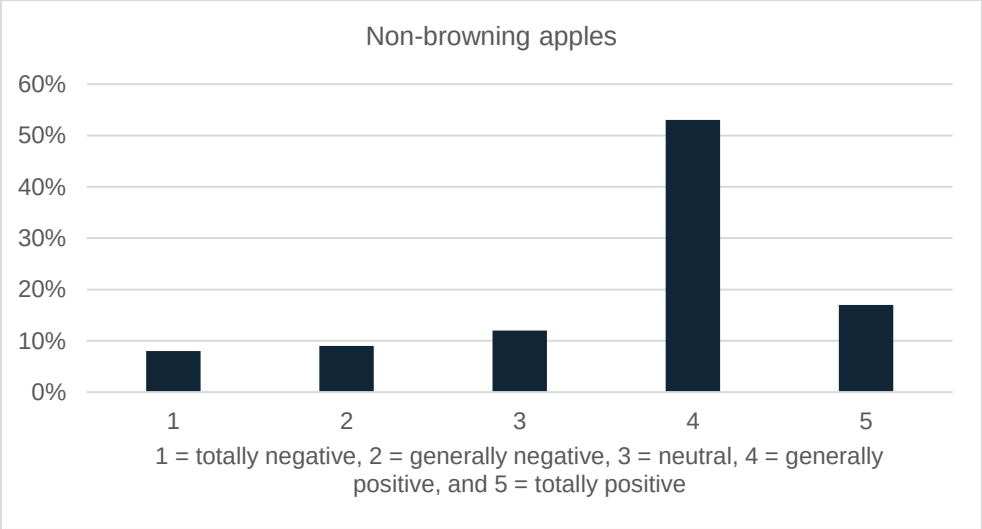
Questions raised:

- Would these apples maintain their usual taste, nutrition, freshness, and appearance?
- What would the long-term side effects be on human health (e.g., effects on digestion, and perceptions that something may be lost in the apples as a result of these changes)?
- Would there be losses of conventional or heirloom varieties if these types of applications became popular?
- Would it still be possible to determine the freshness of the apples without the bruising element?
- Would there be increased costs to consumers?

Broader issues:

- Several participants believed that the issue of food waste should be addressed through other means (e.g., only buying what you need, using leftovers, and composting).
- Some participants expressed a distrust of corporations that profit off gene technology.
- Some referenced a need for more testing and adequate regulation.

Based on an overall thematic coding of each participant's responses to this scenario, we can see that the majority of participants (close to 70%) had responses that were totally positive (5) or generally positive (4). However once again, it is critical to note that many of these fell in the generally positive category, and hence raised numerous questions and qualified their responses.



Participants' responses (n=75) to the non-browning apples scenario were coded as follows. 17.3% of participants were considered to be totally positive, 53.3% were generally positive, 12.0% were neutral, 9.3% were generally negative and 8.0% were totally negative.

Many participants were generally supportive of this application due to what they viewed as the potential advantages in terms of reduced food waste and relatedly cosmetic benefits. However, many participants pointed out the importance of the apples still maintaining their taste, nutritional qualities, freshness, and so on, and had some concerns about lack of ability to bruise potentially 'covering up' for inferior products particularly hiding what might be less fresh products. On the other hand, many participants indicated that they were not particularly concerned about bruising and believed that consumers are being too picky when it comes to seeking out only 'perfect' food. Again in this case, many participants were concerned about

the potential negative side effects of this application in terms of human health. More participants also seemed to be concerned about potential price premiums associated with this application as compared to those presented in the other scenarios.

4.3.1.5. Sex-selected chickens

Participants were asked to provide their thoughts on the following example of sex-selected chickens: 'Within the egg industry, non-egg laying male chicks are considered to be undesirable and are usually culled post-hatch. Every year, around 7 billion male chicks are culled worldwide. Being able to specifically select for female chicks would be possible through a process of genetic modification. In this case, no new genes would remain present within the female chicks. Being able to select the sex of layer chickens would eliminate the need to cull male chicks post-hatch. It would also reduce production costs and improve the sustainability of the egg and poultry industries.' This scenario was chosen to represent the applications which might occur via gene editing being utilised in the egg industry (Lee et al. 2019), and involves transgenesis resulting in female birds that have not inherited the inserted genes; the example was presented to participants as a clear instance of an NBT.

Positive themes:

- This application was seen as a way to prevent the mass culling of chicks (about which many were previously unaware or had not considered in any detail).
- This application was thought to have the potential to improve the sustainability of the industry (by reducing production costs, and with hopes that the lower production costs would be passed on to consumers through cheaper prices for eggs).
- Several participants also referenced reduced food wastage as a benefit of the technology (which possibly indicates a lack of understanding about how the egg industry culls, despite facilitators providing information), and might have meant less wastage more generally.
- That no new genes would remain was viewed positively by some participants.

Negative themes:

- This technology was viewed as unnatural or even immoral and unethical, with some links being made by individual participants to 'designer babies' and China's 'one-child policy.'
- Some participants who were opposed indicated that they had fears about versions of this application being used in humans.

Questions raised:

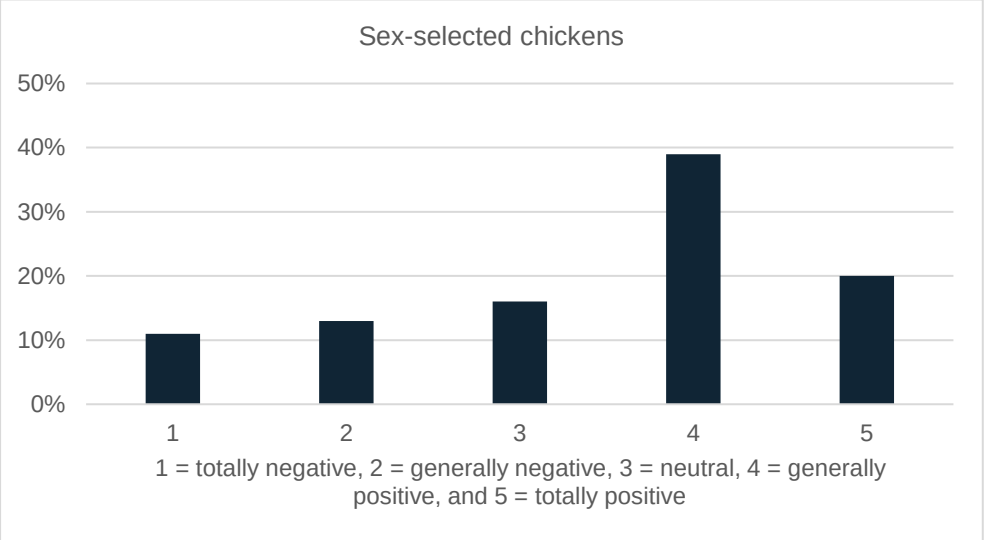
- What are the potential changes that could result in the eggs (e.g., in terms of nutrition)?
- What are the potential genetic impacts of this application (i.e., the possible elimination of the male line, reduced breeding stock, and not being able to revert to non-genetically modified breeds)?
- What are the long-term side-effects associated with this application (e.g., there needs to be more testing and adequate regulation)?

Broader issues:

- Many participants had concerns about the egg industry more generally and animal welfare in it (i.e., the conditions under which chickens are farmed, use of antibiotics, and so on).

- There were some perceptions that this application was not designed to improve chickens' lives but was being used for human gain or profit alone.
- Many participants were unaware that male chicks were culled, and many questioned why male chicks could not be used for meat consumption (including as feed for other animals), even once facilitators mentioned some of the impediments to this sort of solution (e.g., that the breeds for layers and meat products are different).
- Many participants simply found consideration of culling of male chicks to be difficult to think about and discuss, and hence were not able to provide much of a reaction to the scenario itself in terms of a use of NBTs (this parallels previous findings in relation to cognitive dissonance and the 'meat paradox': see Dowsett et al. 2018).
- Some participants expressed distrust of corporations that profit off gene technology.

Based on an overall coding of each participant's responses to this scenario, we can see that the majority of participants (close to 60%) had responses that were totally positive (5) or generally positive (4). The lower positive rate compared to the other scenarios might well be related to the negative reactions to the background information associated with the scenario, namely the standard culling practices, rather than the specific details of this type of NBT.



Participants' responses (n=79) to the sex-selected chickens scenario were coded as follows. 20.3% of participants were considered to be totally positive, 39.2% were generally positive, 16.5% were neutral, 12.7% were generally negative and 11.4% were totally negative.

While many participants saw the use of this application as a positive in terms of preventing mass culling of male chicks, others were not entirely comfortable with the application for reasons articulated above but nonetheless saw it as a more acceptable solution to culling. A common comment made by supporters of the technology related to the sustainability benefits for producers, with several participants hoping that these savings would be passed on to consumers through cheaper egg prices. However, some participants considered the application to be unnatural and unethical, and compared the use of this technology to sex selection in humans. Several participants were also concerned about the impact of these changes from a biological/genetic level. These responses are indicative of a general unfamiliarity with the processes of breeding within the egg industry and confusion more generally about how NBTs work, even among these participants who had received a considerable amount of information at this point in the focus groups.

4.3.2. Discussion

In summary, the response category which consistently aligned with the highest percentage of participants across all five scenarios was the generally positive category (i.e., 51.3% of participants for heat-tolerant cattle, 45.3% for high oleic soybean oil, 52.0% for drought-tolerant wheat, 53.3% for non-browning apples, and 39.2% for sex-selected chickens). Median scores for each of the scenarios were also calculated. Drought-tolerant wheat received the highest median score at 4.23. Next was the non-browning apples example with a median score of 3.89, followed closely by high oleic soybean oil at 3.84. The lowest median scores were associated with the two animal-related scenarios, with the heat-tolerant cattle scenario receiving a median score of 3.81 while sex-selected chickens had the lowest median score at 3.74.

Based on this data and the thematic responses to the scenarios above, there are some general points and trends worth highlighting, considered against the backdrop of existing literature in NBTs (Grant et al. 2021). First, many of the issues that arose in the current study of NBTs in the context of discussions around the above scenarios (e.g., about need for longer-term testing and changing the 'natural') directly parallel those commonly found in the literature on societal attitudes and views on genetically modified food. Our findings also parallel those found in studies elsewhere (e.g., Debucquet et al. 2020) that for non-experts, foods produced by NBTs will never be 'equivalent' to foods produced by traditional breeding techniques and are viewed along a continuum with foods produced using other forms of genetic modification rather than as distinct from them or obviously preferable.

Second, as hypothesised (and consideration of which was integrated into our choices of the application scenarios above), the type of modification matters. Many participants commented on being more inclined to support the application or feel positively about it where it involved making smaller changes or using genetic material from within the species (such as in the heat-tolerant cattle case). This finding parallels those in Cormick & Mercer's previous work (2017, 2019) in Australia, which found that use of cisgenesis (introducing the genes of a plant of the same species) and gene editing (making a small change to an existing gene) were considered most acceptable, as compared to various transgenesis options (introducing the genes of a different species) where ratings of low acceptability were highest when genes from the donor species were perceived to be least related to the recipient species. Again here, although NBTs might in principle involve less change than genetic modification from the point of view of those who are experts in these fields, other factors matter to non-experts even within applications of NBTs. Relatedly, the type of product seems to matter to participants' views on NBTs: there were frequent remarks about applications in plants being more acceptable than those in animals, despite there also being a general consensus that improving animal welfare through NBTs could be a good outcome.

Those participants who were concerned about the impact of applications of NBTs on the environment had distinct types of contextual and generalised concerns. The only scenario which appeared to raise contextualised environmental concerns was the heat-tolerant cattle example. In this scenario, some participants were concerned that this application in fact could lead to a greater number of cattle being farmed. This outcome in turn would have greater impacts on the environment through increased resource usage (including feed and water) and also would lead to greater pollution from waste and methane. In the other scenarios (particularly the soybean and wheat examples), some participants' concerns about the environment were more generalised. In other words, participants did not tend to point to specific concerns about these applications creating opportunities for flow-on effects that would harm the environment. Rather, there were concerns among some participants that the plants resulting from these types of applications could experience harmful effects or have harmful impacts on the environment in a general

sense. This distinction warrants additional exploration, and we make suggestions in our findings in section 5 below.

Finally and perhaps most strikingly, some participants rejected the framing of our request to consider and discuss these scenarios in the context of one or more of the scenario discussions, choosing to stress that NBTs would not be good solutions to the issues about which they had most concern either specifically in the scenarios presented or in the food system more generally. They argued that we should focus more closely on other types of responses to existing problems in agriculture and in the food supply, and use 'lower tech' solutions such as replacing the breeds currently used in Australian and New Zealand agriculture with those that are better adapted or even changing over to alternative and more sustainable or heathier products. They also were concerned that focus on NBTs and similar technological approaches could promote less concern about larger-scale issues, such as problems with intensive farming systems and climate change, and hence rejected the application of NBTs because of these broader concerns. We return to this theme in more detail below in section 5.

This last point provides an entry point into some of the limitations that we recognise in this part of the study: first, as noted at the outset, although online, asynchronous focus groups do provide many of the advantages of traditional face-to-face, synchronous groups, they do not typically permit the type of interactivity or in-depth probing that can go on in the latter settings. Because of this limitation, we were not able to discuss the implications of their rejection of the framing of the questions that we posed with the participants in as much detail as a face-to-face setting might have allowed. A second limitation arises from the complexity of the subject matter under investigation and the observed slippage in uses of terminology: although the facilitators frequently asked for clarification, particularly where participants seemed to be confusing terms (such as genetic modification and gene editing), it sometimes remained confusing why participants thought or said what they did. This outcome is not unusual in a qualitative, focus group study, but perhaps was made more noticeable because we could explore individual views in a more streamlined manner because the platform permitted us to trace these in detail over time. Finally, although the scenario about sex-selected chickens did provide some interesting things that we do think are more generally applicable to considerations about NBTs, it is clear that many participants found discussion of culling to be confronting, and that this may have impeded their abilities to discuss the topic of NBTs used in this context in any detail.

4.4. Trust in the Australian/New Zealand food systems

On Day 3 of the focus groups, participants were presented with a series of Likert-style questions which were designed to test their trust in various aspects of the Australian and New Zealand food systems. As discussed earlier, these trust measures were drawn from a scoping study that sought to establish a reliable trust metric for use in food systems research (Tonkin et al. 2021); the questions posed are included for reference (Appendix section 7.1). This metric has not yet been used to collect baseline population data so we have no information to which to compare our results; hence we highlight only those findings which are statistically significant and raise issues internal to the current project.

4.4.1. Quantitative results and discussion

Among the trust measures, only two questions were found to have responses with statistically significant differences in particular demographic factors after statistical analysis involving t-test and ANOVA (analysis of variance) analysis. Calculations were done on demographics previously found to be relevant to differences in views on NBTs or related topics such as genetic modification, or of particular importance or interest for this study, namely country of residence (Australia versus New Zealand), self-identified gender, type of locale of residence (urban/city versus rural or regional), and ethnicity or background (other Australian/New Zealand groups including migrants versus Indigenous/Maori). See the Appendix (section 7.2) for more detailed metrics on each of these demographics. There were no statistically significant differences in many of these demographic factors in terms of responses to the trust metrics, which in part may be a function of our relatively small sample size but also could point to findings worth validating in a larger sample, particularly due to the complexity of trust relationships especially during times of uncertainty and heightened risk perceptions such as the current period.

One of the statistically significant differences was found among Australian and New Zealand participants in response to the following question: ‘If you were to make a complaint about how food in Australia or New Zealand is made or sold, how likely is it that the problem would be easily resolved?’ Participants were asked to rank this statement on a scale of 1 to 7, where 1 meant ‘very likely’ and 7 meant ‘very unlikely.’ On average, New Zealand participants gave this statement a score of 4.43 compared to 3.67 among Australian participants ($p = .038$, thus $< .05$). These results represent a moderate to low belief in the ability to effect change in the Australian/New Zealand food systems, with less confidence found amongst New Zealanders. This result is worth exploring in a more detailed study focused on sources of distrust and understandings of food system regulation and oversight, given these low levels of trust in reporting and resolution procedures.

The other responses found to have a statistically significant correlation with demographics were in response to the following question: ‘How much do you trust scientists to do what is right with regard to food-related research and issues?’ Participants were asked to rank this question on a scale of 1 to 7, where 1 meant ‘do not trust them at all’ and 7 meant ‘trust them completely.’ On average males gave this a score of 5.42, while females ranked this lower at 4.68 ($p = .021$, thus $< .05$). As these scores are toward the middle of the scale, it is difficult to know what to make of them, but the data do suggest that drivers of trust (and distrust) particularly in relation to scientific inputs to and influences on the food supply are worthy of further investigation in demographically diverse populations.

4.5. FSANZ NBT Fact Sheet

On the third day of the focus groups, we provided participants with a copy of the draft FSANZ NBT Fact Sheet currently under development. Participants were asked to provide feedback on the Fact Sheet in terms of their reactions to it, using factors such as clarity, credibility, and bias.

4.5.1. Quantitative results

Did you understand the information?	
64.6%	Somewhat understood
31.6%	Completely understood
3.8%	Did not understand

How credible did you find the information?	
44.3%	Somewhat credible
22.8%	Completely credible
20.3%	Neither credible nor uncredible/don't know
10.1%	Somewhat uncredible
2.5%	Completely uncredible

In your view, was the material:	
45.6%	Neutral/balanced
32.9%	Somewhat biased in favour of gene technology
13.9%	Completely biased in favour of gene technology
7.6%	Somewhat biased against gene technology
0.0%	Completely biased against gene technology

4.5.2. Open-ended responses

We also asked the participants a series of open-ended feedback questions on the Fact Sheet, and grouped their responses thematically below each question:

1. What things helped you decide about the credibility?

To begin, it is important to note that it became clear from some of the responses that not all participants were familiar with the term ‘credibility’ and reversed the meanings of the terms ‘credible’ and ‘not credible,’ and so the quantitative responses summarised above are not as meaningful as the qualitative responses summarised here. Where individual participants later indicated in discussion that they had made mistakes in classifying the Fact Sheet as uncredible, we have corrected the quantitative results to reflect their revised answers, after confirming these answers with them.

Key themes among those who tended to find the Fact Sheet **credible** can be grouped under two main themes:

(a) Who produced it:

- That it was produced by FSANZ (including inclusion of professional layout/design, logo, and a governmentally affiliated website), which some explicitly mentioned was a cross-Tasman regulatory body and was 'trustworthy' (others were willing to assume as much even though they were unfamiliar with FSANZ)
- Lack of influence by financially or politically involved parties
- Assumption that scientists who are knowledgeable about these technologies contributed to the Fact Sheet
- Reference to the Food Standards Code which 'sounds scientific'

(b) The content within the Fact Sheet:

- The detailed explanations provided and use of clear examples
- Use of language about safety and desire for regulation and protection of people
- Inclusion of pictures to assist with understanding (some suggested adding a link to a video or similar for even more visual aids)
- Explanation of terminology and relatively simple language throughout (others viewed the 'super technical' information as particularly credible)
- Inclusion of references and website to be able to do further research
- Explicit comparison between GM and NBTs
- That the information did not try overly to persuade the reader
- That it was entitled 'Fact Sheet'

Those who were more uncertain or tended to find the Fact Sheet **less credible** tended to be concerned about the content, and identified a number of gaps that made the Fact Sheet less convincing to them, which can be grouped under the same two themes as above but also made some additional points particularly about process:

(a) Who produced it:

- Lack of interaction with and prior knowledge of the source (FSANZ)

(b) Problems with the processes associated with the Fact Sheet or FSANZ more generally:

- Lack of consultation with the public (e.g., seemed to have a tone of 'doing to' rather than 'doing with and for' the public), beyond the request for submissions
- Lack of oversight by a separate entity to ensure lack of influence by big corporations

(c) Why it was produced:

- Lack of clarity on why standards are being updated for NBTs from GMOs, and how precisely this is occurring, as well as how rules will be updated as techniques continue to change
- Lack of understanding of the regulatory processes

(d) The content within the Fact Sheet:

- The lack of detail, particularly what is needed for consumer decision-making
- Lack of direct access to the scientific research (these are 'just words')
- Lack of confidence that the information provided is correct (e.g., concerns about what is actually genetically modified and whether it is entering the food supply via imports)
- Lack of inclusion of sufficient data and peer reviewed reports relating to the claims

- The tone of the Fact Sheet, which had an air of 'experts know best,' and which was seen as very off putting to some; others saw it as 'boring' and non-engaging
- Lack of consideration of other solutions to food supply problems and prioritisation of genetic technologies to the exclusion of all else

2. What things would make you think a factsheet like this was biased (or not biased)?

Some of the responses to this question tended to address bias more generally or discussed scenarios that were provided in a different part of the research. The summary here is of key themes relating to those comments that appear to be directly responding to the above question. In this summary, we have corrected point of view where possible to summarise in terms of avoidance of bias.

To ensure there was **not bias,** participants said that they look for:

(a) Presentation of both points of view

- Lack of focus on one side more strongly or the benefits to them
- Provision of pros and cons, sometimes described as 'balance'
- Inclusion of some discussion of potential negative effects
- Inclusion of multiple perspectives
- Considering consumer perspectives

(b) A 'generic' presentation which is not trying to tap certain subpopulations

- Several noted that the use of gluten-free wheat as an example was problematic, particularly without adequate information on risks, benefits, and other options

(c) Use of neutral language

- Presenting 'just the facts' rather than views or opinions
- Not using emotive terms
- Not being 'opinionated'

(d) Provision of links to resources

- External credentialing was seen as decreasing bias

(e) Not seeming to 'sell' the technology

- Not representing a particular company or brand
- However, assuming that the technology as 'good to go' without adequate consideration of whether it in fact was, was taken as showing bias toward NBTs

(f) Not oversimplifying the details, considerations, or analysis

- Some noted that the focus on NBTs as a natural extension of current technologies was problematic and a sign of bias
- Focus on how the end product is the same regardless of the technique used was also seen by some as a sign of bias toward NBTs

(g) Offering options and alternatives

- Lack of discussion of whether these technologies should be used in the first place, rather than focusing on how to regulate them (and hence treating their introduction as a foregone conclusion) was taken by some as a sign of bias

3. Is there anything you would like to see changed or incorporated into this material?

Participants were asked about whether they would like to see any content changed or incorporated into the Fact Sheet. While a significant number of participants (40.5%) did not offer any suggested improvements, there were a few common suggestions, and many of the responses mirrored both the positive and negative views expressed above. These comments can be grouped into five main themes about what participants would like to see altered or incorporated in this Fact Sheet:

(a) Inclusion of more information about regulatory processes

- What FSANZ is and how it operates (one participant suggested a flow chart of processes)
- Whether independent scientific bodies are involved in regulatory decisions
- What the Food Standards Code is, and who has endorsed it
- How food regulation works in Australia/New Zealand
- Timeline for implementation of new NBT regulations
- How the public will be engaged and informed
- How labelling will work
- More details on risk assessment procedures and approval processes, and whether and how ongoing monitoring will occur
- Why safety isn't always assessed
- What potential limits might be placed on this technology, given our regulatory structures

(b) More information on potential negative effects or cons of use of NBTs

- Long-term risks of use of this type of technology
- Potential effects on consumer health
- Possible implications for IP and control of seeds
- Implications for organically produced food
- Any changes resulting for the taste and texture of foods

(c) More information on how NBTs are or will be used

- More concrete examples of NBTs (frequent comment was that descriptions were too 'high level')
- Summary of scientific data to date
- Declaration of who is looking to adopt the technology (e.g., what companies)
- More exploration of why NBTs are of interest and might be advantageous
- More discussion of how NBTs might benefit us (e.g., how will they 'make the world a better place')

(d) More background material

- More scientific references that could be followed up
- More history of how we got to where we are now

(e) Changes to the graphics

- Colours made the charts and illustrations difficult to read (this needs to be checked against standard accessibility requirements)
- Apple diagram was said to be confusing by numerous participants, and the distinction being made (genetic modification versus NBTs) was not at all clear

4.5.3. Discussion

Most participants claimed either to have somewhat understood (64.6%) or completely understood (31.6%) the information being presented in the Fact Sheet. One possible reason for the lack of complete understanding is likely to be related to the use of the apple tree diagram which contrasts GM and NBTs, which a number of participants indicated that they found confusing.

Several participants indicated that they would like to see more information about specific uses of gene technology, including how the technology is currently being used and the potential advantages of the technology. Such material would help to make the Fact Sheet more concrete and also of more interest to many readers.

In terms of credibility, 44.3% of participants found the information to be somewhat credible, followed by 22.8% who considered the material to be completely credible. While a majority of participants (45.6%) found the Fact Sheet to be neutral or balanced towards gene technology, a significant number of participants (32.9%) considered it to be somewhat biased in favour of gene technology. This split aligns with another relatively common suggestion related to the presentation of both positive *and* negative (or what they termed as 'balanced') viewpoints. In various places in this study, participants indicated that they would like to see more information included about the pros and cons of gene technology. An additional suggestion made by a number of participants is the need to acknowledge the diversity of public opinion towards gene technology (both positive and negative) which again could help to address these perceptions of bias in favour of gene technology.

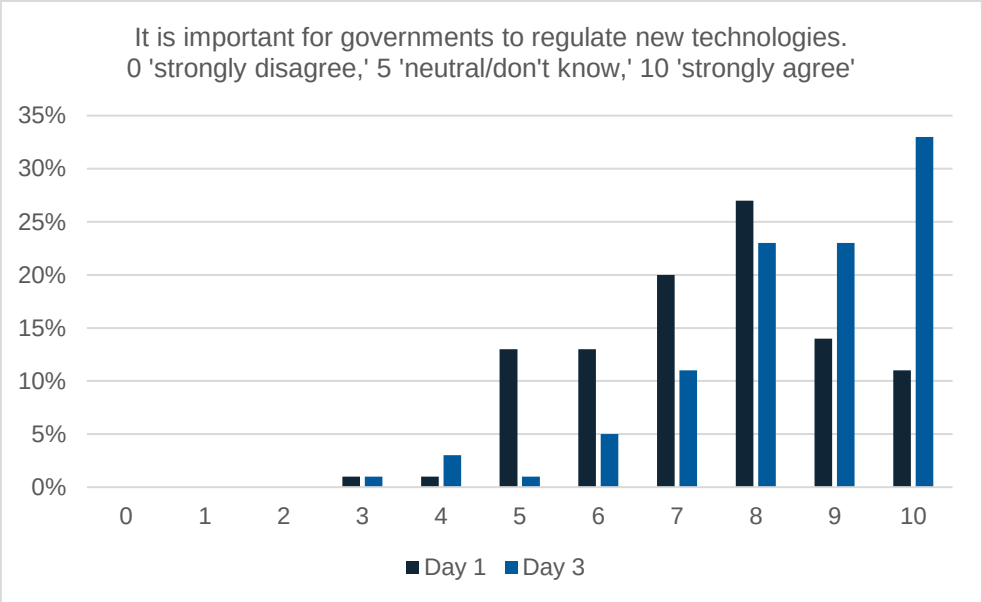
The most common suggestion raised by participants related to the concept of and processes associated with regulation. A number of participants indicated that they would like more information about the regulatory process, including current legislation and risk assessment as well as information about the role of FSANZ. Including more information about the associated regulatory processes may help to improve perceptions of credibility and also deepen public understanding about why they are being given this information. Many of these issues arguably go well beyond the limits of an individual Fact Sheet, but should be carefully considered as information sheets can be used out of their broader context on the FSANZ website and should stand alone as much as is practicable.

In summary, many of the participants were largely positive both about the Fact Sheet and the potential use of NBTs. There were calls for more public engagement, and for correcting the Fact Sheet to focus a bit more on how the public can contribute to these debates. As one participant put it, 'an air of cautious optimism should pervade, as opposed to "trust us, we know best."'

4.6. Regulation

4.6.1. Quantitative results

Although not a main focus of this study, on the first and last days of the focus groups, participants were asked to respond to a variety of statements which were used to measure general attitudes data, including attitudes towards regulation. Participants were asked to indicate their agreement with these statements (included in the Appendix section 7.1) on a scale of 0 to 10, where 0 meant 'strongly disagree,' 5 meant 'neutral/don't know,' and 10 meant 'strongly agree.' One of these statements ('It is important for governments to regulate new technologies') was designed to gauge participants' general views on regulation. By including this question both at the start and end of the focus groups, we were able to track whether there were any changes in participants' views on regulation as a result of our discussions. As can be seen in the following chart, there was a clear difference in how participants viewed the importance of regulation on Day 1 as compared to Day 3. On Day 1, participants tended to moderately agree with the importance of government regulation of new technologies. However, the shift towards stronger agreement on the third day indicates that participants generally placed higher value on regulation after taking part in the discussion.



4.6.2. Open-ended responses

Specific references to regulation were uncommon in the discussions, with participants tending to focus on the need for more information and testing and occasionally on the need for clear labelling of gene technology-related products. Many participants highlighted the need for more information about each of the applications of gene technology presented in the scenarios. While some were willing to accept information from companies which are developing gene technology-related products, others were more sceptical and preferred information to be provided by what they perceived to be independent sources such as researchers or scientists and health professionals; these points made in the qualitative discussions are supported by generally high rankings on the trust metrics for scientists involved in the food industry and health professionals across all demographic categories of the participants. Suggestions for ways in which information should be provided to consumers on NBTs in relation to food included product labelling, QR codes, company websites, and social media. Participants noted that this information should not be overly technical in order to provide useful inputs for consumers. Those participants who spoke about labelling

were mostly supportive of its use, particularly as a way of enabling consumer choice. However, not all thought it was necessary or even desirable to have labelling. A small number of participants thought that labelling would provide the consumer with too much information and be unnecessary considering the lack of genetic modification contained in the final product.

There was also some scepticism about the impact (if any) of consumer opinion on the likely use of these technologies for products that will enter the food supply. For example, according to one participant: 'It feels to me like people have already been doing a lot of research and testing and whatever it is will go ahead anyway whether we like it or agree with it, or not.' This type of comment also could be argued to align with some of the findings in the trust metrics which showed that participants did not think that they were likely to have effects on the food regulatory system or related matters.

4.6.3. Discussion

Although regulation is clearly an important part of the wider picture about public input and policymaking in relation to NBTs and their use in the food supply, participants rarely spontaneously brought up regulatory issues in the online focus group discussions. There are a number of potential reasons for this notable absence, although the fact that levels of knowledge about how the food regulatory system works in Australia and New Zealand seemed fairly low during the open-ended discussions is critical, which was confirmed in the feedback on the Fact Sheet which emphasised that participants felt they needed to know more about what FSANZ does and in particular what the regulatory processes are associated with approvals and oversight of NBTs and related technologies. The relatively large increases in desire to have government regulation of new technologies following discussions about NBTs including specific applications related to the food supply indicates a growing awareness amongst participants of the importance of regulation and potentially how it could relate to some of the concerns expressed by them, such as the need for longer-term data, controls over potential abuses of these technologies for unethical purposes, and the need for research on and tracking of environmental and other impacts. Again, these topics are worthy of continued focus, likely in conjunction with broader testing of the trust metrics utilised above.

5. Discussion of findings

This study sought to use primarily qualitative techniques, supplemented by some quantitative metrics, to develop a better understanding of Australian and New Zealand consumers' awareness and knowledge of NBTs including specific applications of these technologies that are directly relevant to the food supply. The research was designed to shape the current review of definitions for 'food produced using gene technology' and 'gene technology' in the Australia New Zealand Food Standards Code being undertaken by FSANZ.

First, it is clear that awareness and knowledge of NBTs is relatively low: although we only assessed these issues in terms of self-report, the detailed focus group discussions revealed considerable gaps and points of confusion that were important in shaping participants' understandings and views on NBTs. What this study does provide is much more clarity about the kind of information that consumers want about NBTs and their potential applications, and how these considerations connect to the broader contexts within which they might be deployed, in line with the call for more work in this domain in Grant et al. 2021. Key repeated themes with regard to the questions raised and the information desired by participants included clarity on longer-term effects of applications on the organisms in question, the environment, humans, and the resulting food products. In addition, there were frequent requests for more evidence of safety and the need for long-term testing in conjunction with applications of these technologies. There were some discussions about the need to ensure that such technologies could be reversible, and that conventional varieties would not be adversely affected or would be maintained in parallel to these new applications in part as an insurance policy and also to maintain biodiversity. Finally, there were concerns about whether these applications would result in increased costs for farmers or consumers.

In addition, the discussions particularly on the specific application scenarios revealed that many of the themes in the comments from those negatively disposed to NBTs, as well as many of the questions posed by those across all of the segments (negative, neutral, and positive), are similar to those found in the literature on attitudes toward other, older gene technologies, such as GM, such as need for reassurance about safety through long-term independent testing and monitoring. This finding is in contrast with what is often assumed in some regulatory approaches and in the scientific literature, namely that NBTs are clearly less invasive and more precise, and therefore likely to be much less problematic for the public than older types of genetic modification. This result is similar to Van Eenannam and Young's argument that 'the benefits perceived by scientists, producers and industry stakeholders are often not valued or even clearly understood by the lay community' (2018, 10; see also Bruce 2017 and Debucquet 2020). Instead, whether NBTs should be used was typically viewed by our participants as related to how they would be used (i.e., the particular application), for what reasons or benefits, and with what specific (rather than generic risks), rather than as uniformly acceptable or not acceptable. Their views were often richly contextual, inasmuch as they sometimes thought there was no reason to pursue creation of products using NBTs where the problem or issue that they were intended to address could be solved in other ways, particularly as NBTs were still viewed by many as risky and as problematic changes to what is 'natural.' This finding is critical to consider in conjunction with FSANZ's approaches to the Code and other regulatory instruments, as well as its communications and engagement with the public.

Importantly, some participants did not think that NBTs would present answers to the questions that they saw as being the most important for society, notably environmental issues such as climate change or broader concerns about agricultural practices. They were especially concerned that such technologies were just one further step in processes associated with the intensification of agriculture and the food supply (see the editorial in *Nature* [2021], which predicts that this might well be a concern amongst publics). At the extreme, they echoed a claim made by Bruce (2017) who noted that it is possible that 'some publics

may see unregulated adoption of [these technologies] as a way to introduce (by stealth) practices that they think are cruel or unnecessary' (396). Along these lines, some of our participants expressed concerns about how these sorts of changes could result in abuses to animals (e.g., by creating heat-resistant cows that could be exposed to extreme temperatures in an unethical manner) or even to humans (via a slippery slope of these applications from non-human animals to humans, for instance in the scenario involving changes to the sex ratio in layer hens). These findings amongst some participants who were quite vocal in their negative views suggest that public engagement about NBTs related to the food supply requires careful attention to the framing of questions but also appropriate usage of regulation in part to help meet public expectations and concerns. It should be noted that our participants rarely mentioned regulation spontaneously as noted above, but that by the end of the focus group, they felt that more regulation was a desirable outcome, given what they had learned and discussed.

Finally, at a methodological level, we contend that this study provides an excellent basis for considering alternative approaches to communicating and engaging with publics on NBTs and emerging technologies in relation to the food supply and its regulation. The data obtained clearly indicates that participants overwhelmingly thought that their awareness had increased over the course of the focus groups, enough so that over 78% indicated at the end that they could explain gene technology to a friend. We contend that this response does not primarily reflect an increase in their knowledge of technical details, particularly given their responses elsewhere about what they viewed as the most important issues, but more general awareness about the broader social, ethical, legal and regulatory, and other issues associated with gene technologies and NBTs in particular. In addition, the way in which we conducted the research provides evidence of the positive effects of using more narrative-based interventions when exploring attitudes and views on food-based technologies. Hence claims made by Yang and Hobbs (2019) about the potential value of narrative approaches as compared to more technical-scientific communication warrant more attention (though we would not endorse their conclusions that such approaches are particularly valuable in reducing negative perceptions regarding agricultural and food technologies, as we do not see wide-scale endorsement as a main goal of public engagement). In addition, coupling such narrative approaches with further measures and discussions about trustworthiness and credibility of certain actors and organisations that are involved in the chain associated with use of NBTs will be critical to FSANZ's ongoing public efforts.

In conclusion, as has previously been noted by numerous authors (e.g., Pirscher & Theesfeld 2018; Cormick & Mercer 2019; *Nature* 2021), the ways in which NBTs are framed will play crucial roles in shaping public attitudes into the future. We believe that this study shows that subtle changes in framing even within this relatively narrow research context can have considerable impacts on public views, and in turn that more major framing decisions (e.g., whether NBTs are presented as similar or different from genetic modification, and implications for regulation) will critically shape public understandings and reactions to uses of NBTs in the food supply and their regulation. As noted by our participants, they want considerations about NBTs to reflect the goal of working collaboratively toward policy and regulatory goals, 'doing with and for' them, rather than 'doing to them.'

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7. Appendix

7.1. Focus group script

WELCOME PAGE

Participants are linked to the front page of the platform where they will be shown the participant information sheet and a brief video by Prof Rachel Ankeny (project lead) in which she introduces the project, explains what the focus group is, and reminds participants to be respectful of each other's perspectives. Participants are asked to consent to participate in the study and are directed to click 'next' to continue to the site.

DAY 1

Day 1: Topic 1 [private]

Before we begin the discussion, please tell us a bit more about yourself by filling out this brief questionnaire.

1. How would you characterise your level of political engagement?
   - Not engaged
   - Somewhat engaged
   - Very engaged
   - Prefer not to say

2. Do you consider yourself to be religious?
   - Yes
   - No
   - Prefer not to say

3. Do you or anyone in your family have an inherited or genetic disease condition?
   - Yes
   - No
   - Prefer not to say

Questions 4-8 ranked on a scale of 0-10, where 0 means 'strongly disagree,' 10 means 'strongly agree,' and 5 means 'neutral/don't know.'

4. Science and technology can solve most problems faced by human beings.
5. It is important for governments to regulate new technologies.
6. Scientific advances tend to benefit the rich more than they benefit the poor.
7. Technological change happens too fast for me to keep up with.
8. New technologies excite me more than they concern me.

Which of the options below best describes your current awareness of gene technology?

- Never heard of
- Have heard of, but know little or nothing about
- Know enough about it that I could explain it to a friend

- Can’t say/don’t know

Which of the following gene technologies have you heard of? Be honest: we don’t expect most people to have heard of most of these!

- Genome editing
- TALENs (Transcription Activator-Like Effector Nucleases)
- CRISPR/Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats)
- Cisgenesis
- ODM (Oligonucleotide-Directed Mutagenesis)
- Genetic modification
- GBTs [note: a fake answer has been included for testing purposes]

Day 1: Topic 2

Welcome to the forum! Let’s start off by introducing ourselves. Please share with us a bit about yourself and describe (with words or images) what comes to mind when you see the term ‘gene.’

- [Textbox]

Day 1: Topic 3 [private]

To help with our discussions over the next couple of days, please watch this brief video about genome editing and answer the following questions (note: genome editing is a new breeding technique (NBT) which is different to older gene technologies such as genetic modification).

Participants to be shown the following video: https://www.youtube.com/watch?v=XPDb8tqgfjY

These questions are only visible after the participants have watched the video:

On a scale of 0-10, where 10 is completely supportive and 0 is completely against it, please indicate how supportive you are of the use of genome editing.

- 11-point Likert scale

Do you think genome editing will generally improve our way of life in the future, OR have no effect, OR make things worse in the future?

- Improve our way of life in the future
- Have no effect
- Make things worse in the future
- Don’t know/not sure

Day 1: Topic 4

What comes to mind after watching the video? What else do you think is important for you to know about gene technology? Please add your own questions and comments. You can also reply, react, or add to other people’s posts.

- [Textbox]

DAY 2

Day 2: Introduction

Welcome back! Today we are interested in exploring your views in more detail. Today we will be discussing some specific applications of gene technology. Please read the following descriptions of gene technologies. We would like to hear your impressions of the use of gene technologies in each of these scenarios. Feel free to ask us questions if you need more information, although we might not know all of the answers.

Day 2: Topic 1

Scientists have developed a variety of heat-tolerant cattle through a process of gene editing. Rather than adding any new genes, this method involves editing the genes found within the cow itself, namely the SLICK gene. The SLICK gene is a naturally occurring trait which is found in particular cattle breeds. Heat-tolerant cattle are able to withstand higher temperatures without developing heat stress. The skin and hair characteristics of this variety also helps protect them from sunburn and melanoma. There are no detectable negative effects of these changes in terms of meat quality and production.

In general, how do you feel about the use of this type of gene technology? Please provide as much detail as possible about why you feel the way that you do.

- [Textbox]

Day 2: Topic 2

Scientists have found a way to increase the oleic acid in soybeans through a process of gene editing which involves turning off particular genes found within the plant itself. This is different to older methods of genetic modification which involved adding new genes into the plant. High oleic soybean oil does not require partial hydrogenation of the oil to stabilise the fatty acids, a process which normally results in the formation of undesirable trans fats. Soybean oil is commonly used as a cooking oil and is also found in salad dressings, baked goods, fried foods, snack foods and margarine. High oleic soybean oil is considered to be a healthier alternative but does not have any increased nutritional value compared to conventional varieties.

In general, how do you feel about the use of this type of gene technology? Please provide as much detail as possible about why you feel the way that you do.

- [Textbox]

Day 2: Topic 3

Scientists have developed a way to create drought-tolerant wheat through gene editing. Rather than adding any new genes, this method involves editing the genes found within the plant itself. Improving the environmental resilience of wheat will help improve the efficiency and sustainability of farming. Drought-tolerant wheat also has significant economic benefits considering the loss of yield which occurs during periods of drought.

In general, how do you feel about the use of this type of gene technology? Please provide as much detail as possible about why you feel the way that you do.

- [Textbox]

Day 2: Topic 4

The Arctic apple is a new variety of apple which has been genetically modified to prevent browning/bruising which occurs when an apple has been cut or damaged. The Arctic apple prevents this from happening by blocking the production of certain kinds of enzymes. By preventing browning, the Arctic apple better preserves its flavour and nutritional value than conventional varieties. It also helps to address the issue of food wastage as apples with bruises are commonly thrown away at all stages in the food chain.

In general, how do you feel about the use of this type of gene technology? Please provide as much detail as possible about why you feel the way that you do.

- [Textbox]

Day 2: Topic 5

Within the egg industry, non-egg laying male chicks are considered to be undesirable and are usually culled post-hatch. Every year, around 7 billion male chicks are culled worldwide. Being able to specifically select for female chicks would be possible through a process of genetic modification. In this case, no new genes would remain present within the female chicks. Being able to select the sex of layer chickens would eliminate the need to cull male chicks post-hatch. It would also reduce production costs and improve the sustainability of the egg and poultry industries.

In general, how do you feel about the use of this type of gene technology? Please provide as much detail as possible about why you feel the way that you do.

- [Textbox]

DAY 3

Day 3: Introduction

Welcome back to the final day of our focus group. Today we would like to hear more about your thoughts on the processes of regulation of food, particularly NBTs such as genome editing.

Day 3: Topic 1 [private]

The following questions ask you to share your thoughts on food safety and consumer values.

Questions 1-2 ranked on a scale of 1-7, where 1 means ‘not confident at all’ and 7 means ‘completely confident.’

1. How confident are you that all food sold in Australian or New Zealand shops and supermarkets is safe?
2. How confident are you that the foods you buy for your household are safe?

Questions 3-11 ranked on a scale of 1-7, where 1 means ‘not safe at all’ and 7 means ‘completely safe.’

3. How much do you believe that fresh foods grown in Australia or New Zealand are safe?
4. How much do you believe that foods imported to Australia or New Zealand are safe?
5. How much do you believe that fresh foods from a farmers’ market are safe?
6. How much do you believe that packaged foods at a farmers’ market are safe?
7. How much do you believe that organic foods are safe?
8. How much do you believe that foods at a community garden are safe?
9. How much do you believe that fresh foods from a grocer are safe?
10. How much do you believe that packaged foods at a supermarket are safe?
11. How much do you believe that fresh foods from a supermarket are safe?

Questions 12-14 ranked on a scale of 1-7, where 1 means ‘not at all’ and 7 means ‘completely.’

12. How much do you think that all food sold in Australian or New Zealand shops and supermarkets reflects your consumer values?
13. How much do you think that the foods you buy for your household reflect your consumer values?
14. In general, when buying or eating food, how often do you feel confident that it is what it says it is on the label?

Day 3: Topic 2 [private]

The following questions ask about your trust in the people and organisations that make up the Australian/New Zealand food system.

Questions 1-12 ranked on a scale of 1-7, where 1 means ‘do not trust them at all’ and 7 means ‘trust them completely.’

1. How much do you trust press, television and radio to provide good information about food-related issues?
2. How much do you trust supermarket chains to do what is right?
3. How much do you trust small food companies to do what is right?
4. How much do you trust farmers to do what is right?
5. How much do you trust stall holders at farmers’ markets to do what is right?
6. How much do you trust consumer organisations (e.g., advocacy organisations, NGOs) to act on consumers’ behalf about food-related issues?
7. How much do you trust politicians to do what is right in terms of food-related issues?
8. How much do you trust governmental/public food authorities to do what is right?
9. How much do you trust food producers you know personally to do what is right?
10. How much do you trust large food companies to do what is right?
11. How much do you trust health professionals to provide good information on food-related issues?
12. How much do you trust scientists to do what is right with regard to food-related research and issues?

Questions 13-17 ranked on a scale of 1-7, where 1 means ‘do not agree at all’ and 7 means ‘completely agree.’

Here when we say 'food companies' we are referring to all contributors to the industry sector that makes and sells fresh and packaged food in Australia and New Zealand, from producers through to supermarkets and retailers. We are not talking about the hospitality or restaurant sector.

13. I trust food companies to do what is right.
14. Food companies are good at what they do.
15. Food companies are trying hard to have a positive impact on society.
16. Food companies keep their promises.
17. Food companies are honest.

Questions 18-22 ranked on a scale of 1-7, where 1 means ‘very likely’ and 7 means ‘very unlikely.’

18. If you were to make a complaint about how food in Australia or New Zealand is made or sold, how likely is it that the problem would be easily resolved?
19. In the event of a food incident, how likely do you think it is that government would manage it in a timely and efficient way?
20. If a decision affecting the way Australian or New Zealand food is made or sold were to be taken by the government, how likely is it that you and others in the community would have an opportunity to voice your concerns?
21. If the cost of food regulation increased, how likely is it that government would ensure the financial burden was shared fairly between consumers and food companies?
22. If a large food company lobbied the government about a food regulation decision, how likely do you think it would be that this lobbying influenced the government's decision?

Day 3: Topic 3 [private]

Please read this factsheet on NBTs which has been developed by FSANZ and answer the following questions.

Participants to be shown Fact Sheet as an attachment.

Did you understand the information?

- Completely understood
- Somewhat understood
- Did not understand

How credible did you find the information?

- Completely uncredible
- Somewhat uncredible
- Neither credible nor uncredible/don’t know
- Somewhat credible
- Completely credible

What things helped you decide about the credibility?

- [Textbox]

In your view, was the material:

- Completely biased against gene technology
- Somewhat biased against gene technology
- Neutral/balanced
- Somewhat biased in favour of gene technology
- Completely biased in favour of gene technology

What things would make you think a factsheet like this was biased/not biased?

- [Textbox]

Is there anything you would like to see changed or incorporated into this material?

- [Textbox]

Day 3: Topic 4 [private]

These questions are similar to those you answered on the first day but we want to return to them now that you have spent several days thinking about uses of gene technology in food.

Questions 1-5 ranked on a scale of 0-10, where 0 means 'strongly disagree,' 10 means 'strongly agree,' and 5 means 'neutral/don't know.'

1. Science and technology can solve most problems faced by human beings.
2. It is important for governments to regulate new technologies.
3. Scientific advances tend to benefit the rich more than they benefit the poor.
4. Technological change happens too fast for me to keep up with.
5. New technologies excite me more than they concern me.

Which of the options below best describe your current awareness of gene technology?

- Never heard of
- Have heard of, but know little or nothing about
- Know enough about it that I could explain it to a friend
- Can't say/don't know

Have your views on gene technology changed since the beginning of the focus group?

- More positive
- Neutral/hasn't changed
- More negative
- Can't say/don't know

Has our discussion on new breeding techniques influenced your thoughts about gene technology as a whole?

- More positive
- Neutral/hasn't changed

- More negative
- Can’t say/don’t know

What is your current view on/feelings about the use of gene technology? (please provide as much detail as possible)

- [Textbox]

Day 3: Topic 5

Has anything you discussed during the course of this forum (either within the group or with others) changed how you think about gene technology? If so, what?

- [Textbox]

Day 3: Thank You!

Thanks so much for all of your hard work and energy. You’ve been amazing.

We have asked all our questions, but is there anything else that you would like to say about the topic?

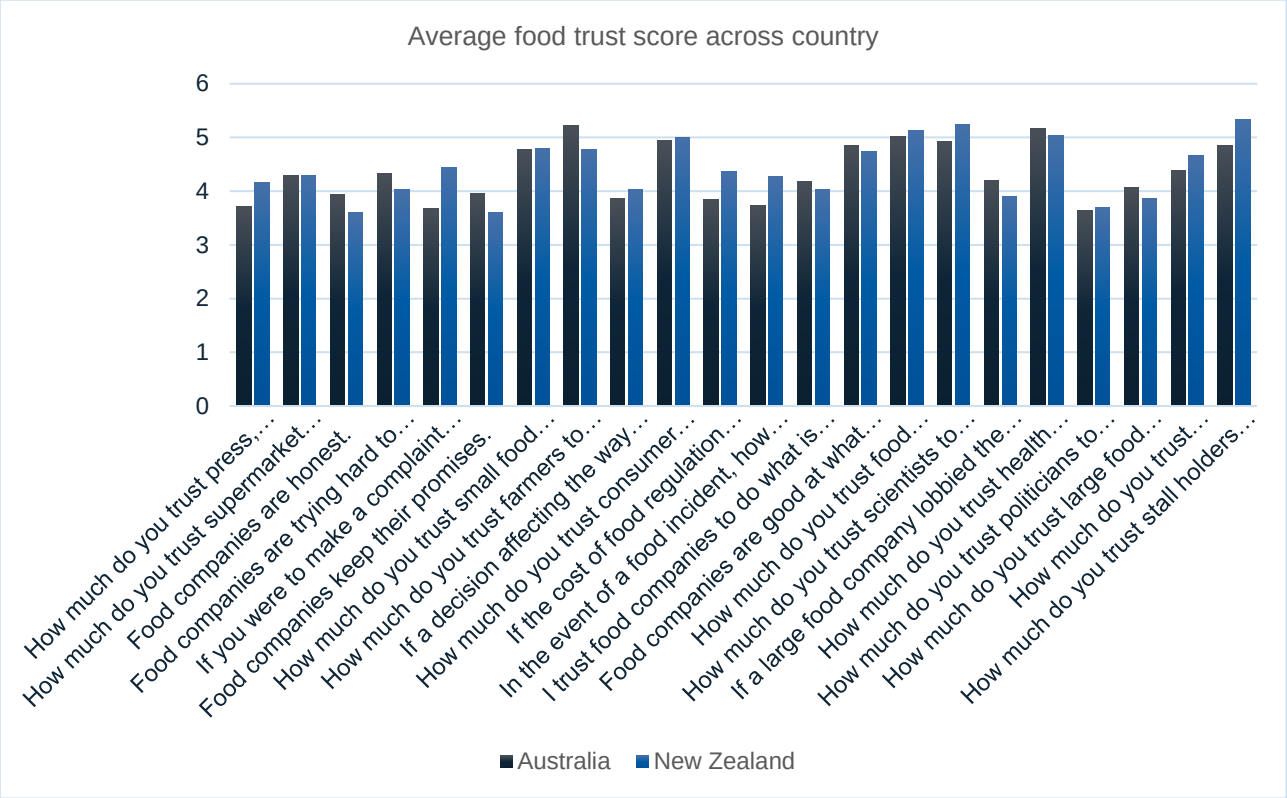
NOTE: If there is nothing else you'd like to add please comment with the word ‘Nothing’ so we can mark you as completing the discussion.

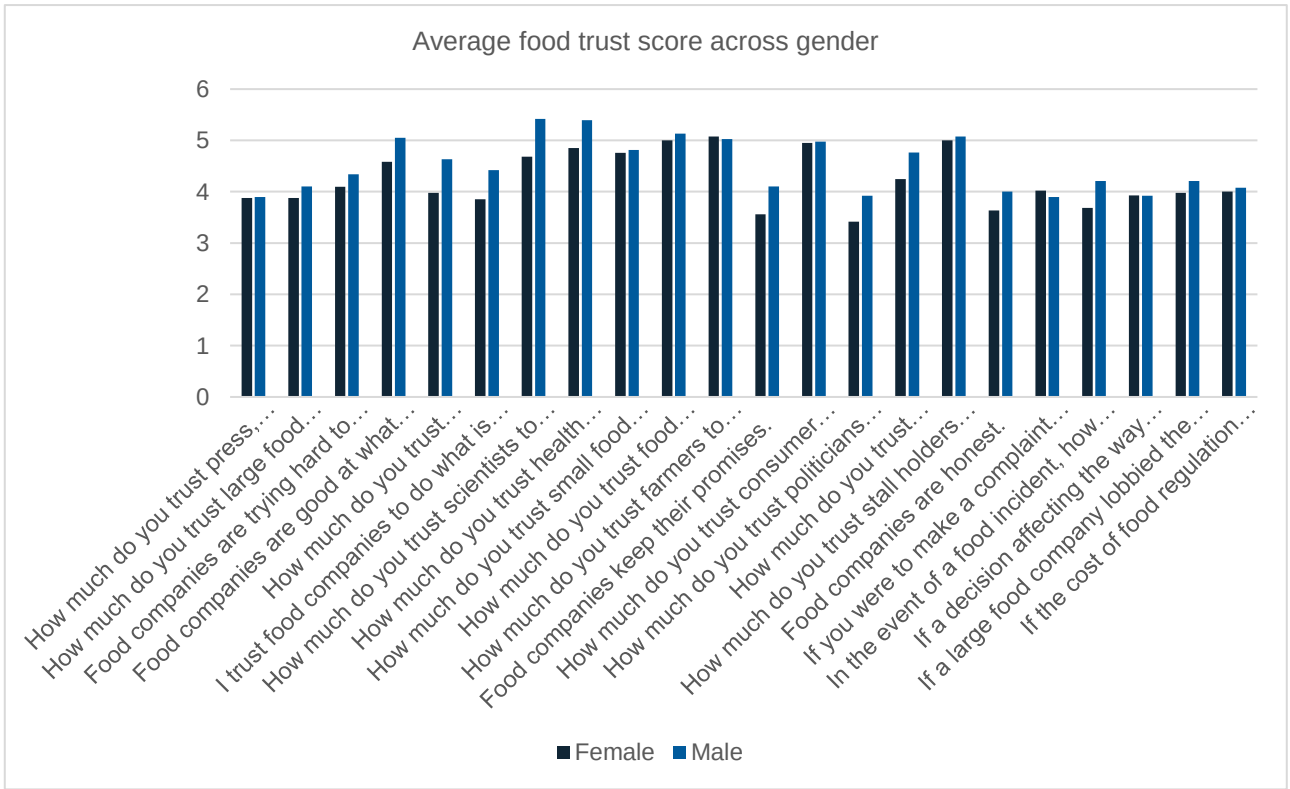
Thank you for participating in our forum on gene technology.

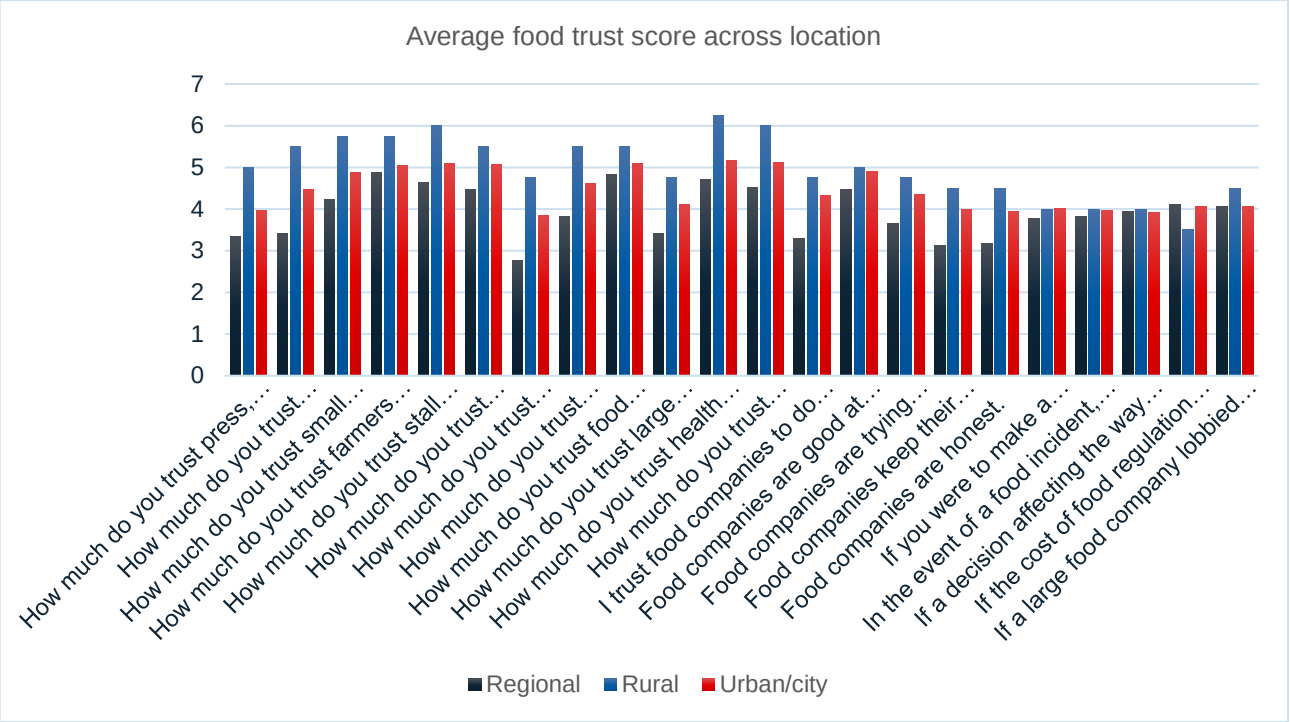
- [Textbox]

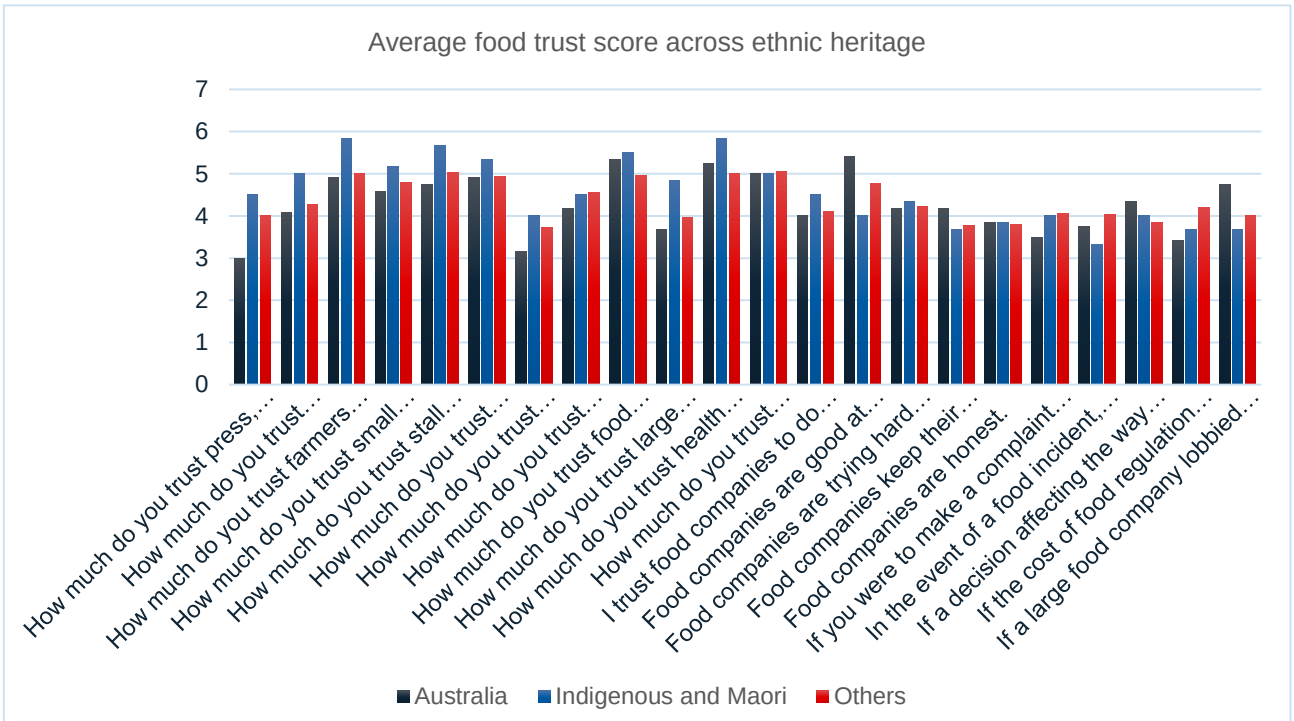
7.2. Trust metrics

Responses to trust measures from Day 3: Topic 2, according to country, gender, location and ethnicity.






Average food trust score across location
7
6
5
4
3
2
1
0
How much do you trust press,...
How much do you trust...
How much do you trust small...
How much do you trust farmers...
How much do you trust stall...
How much do you trust...
How much do you trust...
How much do you trust...
How much do you trust...
How much do you trust food...
How much do you trust large...
How much do you trust health...
How much do you trust...
I trust food companies to do...
Food companies are good at...
Food companies are trying...
Food companies keep their...
Food companies are honest.
If you were to make a...
In the event of a food incident,...
If a decision affecting the way...
If the cost of food regulation...
If a large food company lobbied...
Regional
Rural
Urban/city


Average food trust score across ethnic heritage
7
6
5
4
3
2
1
0
How much do you trust press,...
How much do you trust...
How much do you trust farmers...
How much do you trust small...
How much do you trust stall...
How much do you trust...
How much do you trust...
How much do you trust...
How much do you trust food...
How much do you trust large...
How much do you trust health...
How much do you trust...
I trust food companies to do...
Food companies are good at...
Food companies are trying hard...
Food companies keep their...
Food companies are honest.
If you were to make a complaint...
In the event of a food incident,...
If a decision affecting the way...
If the cost of food regulation...
If a large food company lobbied...
Australia
Indigenous and Maori
Others