The Future of Traceability and Transparency in the Food System

Market Opportunities

A joint analysis from Purdue University's **Center for Food Demand Analysis and Sustainability** (CFDAS) and **DIAL Ventures** examines current consumer and producer demand for transparency in the food supply chain.

This white paper is the result of the collaborative efforts of Caitlinn Hubbell, Lourival Monaco and Jayson Lusk. All views expressed and data found represents initiatives by CFDAS and DIAL Ventures.

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Executive Summary

Traceability and Transparency Defined

Traceability and *transparency* are two crucial concepts in the food value chain that help businesses ensure the safety and quality of their products.

In this context, transparency is defined as disclosing information about the product's production process, ingredients, and social and environmental impacts, enabling consumers to make informed choices. Traceability is defined as tracking the product's movement along the entire supply chain, identifying food safety risks, responding to illness outbreaks and ensuring compliance with regulations.

Consumers consider transparency extremely important, but there is no consensus on what it means to them.

Over the past three decades, consumer interest in the types of food products purchased has evolved. In today's food system, consumers want to know what is in their food as well as where it comes from. In fact, in a recent report, 72% of respondents indicated that transparency is extremely important to them when deciding which food brands and retailers to support.

Transparency and Traceability on the Label

- *Consumers say nutrition fact labels, ingredient lists and expiration dates are the most important food labels.*

    - In general, over 70% of respondents say that food labels give them the information they are looking for on their products.

- *Older consumers tend to trust food labels less than younger consumers.*

    - In general, it seems that age plays an important role when it comes to consumer trust in food labels. Older populations tend to trust less than younger populations.

- *Consumers are more interested in having information about the ingredients of their food than they are in the origin of their food.*

    - In a similar fashion to the importance of a label, trust is mostly related to ingredient lists, expiration dates, and nutrition fact labels. Objective claims that can be easily measured and observed tend to be considered more trustworthy by customers. More than that, some of the more "traditional" information contained on food labels is trusted more than "novel" claims.

- *Consumers are most interested in where their product was processed, packaged, produced, and harvested.*

    - Consumers tend to show interest in information about distributors in the food value chain first, then, how a product was processed and packaged, how a product was produced and harvested, information on producers, and information on processors. Overall, consumers tend to be least interested in information that has to do with how a product was transported from the farm to the grocery store. There are differences in the information consumers would like to know depending on where they are from, their political affiliation, and their age.

Future of Transparency and Traceability

While consumers indicate they want to know extensive information about their food products, only a small portion of them are likely to explore the information if provided to them. This implication is largely important for CPGs and food manufacturers. Several startup companies are entering the space to provide alternative information to consumers about their food products; however, only a small amount of this information will be used or sought after.

Managerial Implications: Challenges and Opportunities

Five key challenges related to traceability and transparency in the agriculture and food industry, from a food consumer perspective, that companies in this space should be aware of:

1. Ensuring food safety

2. Meeting consumer expectations

3. Building consumer trust

4. Promoting sustainable practices

5. Addressing data management challenges

Introduction

Now more than ever, consumers and producers alike are demanding transparency in the food system. But what does transparency really mean to these populations, and what are the challenges and market opportunities created by an increased demand for transparency?

In this paper, we will leverage results from the March 2023 Consumer Food Insights (CFI) survey to discuss a select few topics related to traceability and transparency. The monthly CFI surveys are conducted by the Center for Food Demand Analysis and Sustainability (CFDAS) at Purdue University, with more than 1,200 real consumer insights to offer. Then, we analyze how consumers perceive traceability in food items' labels regarding topics such as the types of information contained in them, consumers' trust in those labels, their preferences on how to access that information, and some key trends in traceability. Finally, we close with overall conclusions from this study and implications for the industry going forward.

Traceability and Transparency Defined

We emphasize *traceability* and *transparency* as critical concepts in the food value chain that aide businesses in ensuring the safety and quality of their products.

Definitions for traceability and transparency are abundant; however, their definition and application to the food system can be unclear, and there is no consensus. As an example, Webster's Dictionary defines "transparency" as the *quality or state of being transparent [characterized by visibility or accessibility of information especially concerning business practices]* and "traceable" as *something capable of being traced*.

These definitions, while relevant, do not give the food industry a better understanding of what consumers are searching for with their demand for these attributes or a clear way to add value for these attributes.

Throughout the remainder of this paper, we will proceed with the following definitions of traceability and transparency.

Transparency: Transparency refers to the disclosure of information about a product's production process, ingredients, and environmental and social impacts. This includes information on sourcing, manufacturing, and distribution practices, as well as certifications and labels that indicate the product's quality and sustainability. Transparency enables consumers to make informed choices about the products they buy, promotes trust and accountability in the food value chain, and encourages businesses to adopt sustainable and ethical practices.

Traceability: Traceability refers to the ability to track the movement of a product along the entire supply chain, from its origin to its destination. This includes information on the product's origin, production process, and distribution, as well as any changes that occur during transport or storage. Traceability is essential for identifying and managing food safety risks, responding to foodborne illness outbreaks and ensuring compliance with regulations.

Traceability and transparency are closely related concepts that reinforce each other in the food value chain. Traceability provides the data necessary for transparency, while transparency allows businesses to share that data with consumers and other stakeholders. Together, traceability and transparency enhance the visibility and accountability across the food value chain, allowing businesses to build trust with their customers and stakeholders, as well as respond quickly and effectively to any issues or challenges that arise. Ultimately, the adoption of traceability and transparency in the food value chain can help businesses to ensure the safety, quality and sustainability of their products, while also meeting the expectations of consumers and society at large.

Currently, there are labels on the market that fit into one or both categories, see **Table 1**. As you can see, there are certainly more labels present today that are said to be transparent, yet not traceable. These labels communicate to the consumer

something about the product that they cannot verify on their own (credence attributes); however, they do not provide the consumer with extra information that would allow them to trace how the product flows through the value chain.

Since there is already noted value for transparent products, what value opportunities exist for traceable products?

If a product is traceable, but that is not communicated to the consumer, it does not provide transparency for them. We see this in Table 1, box II. While there isn't direct value from the consumer in this category, there is certainly value that exists to manufacturers in products that are traceable and not transparent. This value comes in the form of insurance. Producers and manufacturers that adopt traceability practices in

Table 1. *Food labels – transparent, traceable, or both.*

	Transparent	**Not Transparent**
Traceable	**1** — **Cage-Free/ Branded Shell Eggs** *Ex: Niman Ranch Meat*	**2** — **Internal tracking across the value chain** **Fresh fruits** *(apples, oranges, berries, etc.)*
Not Traceable	**3** — Country-of-origin, Nutrition facts panel, USDA Certified Organic, Non-GMO-verified label, Natural claims, Gluten-free claims, Expiration date, Ingredient list, Allergen information, Low-calorie claims, Human welfare certifications, Religious certifications	**4** — **Bulk raw vegetables** **Butcher-wrapped beef**

their businesses are able to reduce the risk of large-scale recalls. The more traceable a product is, the easier it is to identify the source of a problem and correct the problem going forward.

Products that fall into box IV are presently neither traceable nor transparent; however, given the **FSMA Traceability & Transparency** final rule, some raw vegetables will be needing to be traced throughout the value chain. While this information is currently not intended to be shared with consumers, it does create opportunity for companies to use this information to share with consumers.

These concepts create many opportunities for companies, especially startups, to explore. Some good examples of those that are currently on the market are:

- **Aanika Biosciences** that develops traceable, microbial tags for food items,

- **TrusTrace** that uses artificial intelligence and blockchain technology to enable "product-level traceability" to can help enterprise customers in the food, fashion, and retail sectors to make better, more sustainably conscious and socially responsible sourcing decisions,

- **Fusionware** recently acquired by AgTech.io, that offers supply chain monitoring software that tracks produce from seed to shelf using blockchain technology to name a few.

Consumer Perspective on Transparency

Over the past three decades, consumer interest in the types of food products they are purchasing has evolved [1]. In today's food system, consumers want to know what is in their food, as well as where it comes from [2–4]. In fact, in a recent report by The Food Industry Association (FMI) and NielsenIQ, that communicated data from 1,035 U.S. adult grocery shoppers, 72% of respondents indicated that transparency is extremely important to them when deciding which food brands and retailers to support. Yet, transparency is not a simple concept as shown in **Figure 1**, which captures the responses of the FMI/NielsenIQ survey to the question "How do you determine whether a brand or manufacturer is being transparent?"

Acknowledging both consumers' desire for transparency and different interpretations of transparency, the food industry is putting emphasis on the labeling of various credence attributes such as nutrient content and product origin. Credence attributes embed quality features that cannot be evaluated by consumers either before or after purchase[5]. Hence, they are often depicted through labeling programs and claims. The increased recognition and demand for these attributes has provided, and continues to provide, market opportunities for both novel and established food products.

Figure 1. What do consumers mean by transparency?

How do you determine whether a brand or manufacturer is being transparent?

Provides a complete list of ingredients	59%
Plain English description of ingredients	49%
In-depth nutritional information	45%
Certifications and claims	37%
Allergen information that is required	30%
Provides nutrient and health claims	28%
Explanation of what ingredients are used for	28%
Information about how products are produced	26%
Value-based info (animal welfare, fair trade or labor practices)	26%
Information about how ingredients are sourced	25%
Provides allergen information beyond what is required	24%
Sustainability practices	19%

FMI, Transparency, Health & Well-Being, 2022

As part of consumer demand for transparency, including credence attributes, comes another element – traceability. Traceability in the food system is a concept that has recently received lots of headline attention, not only on the side of consumers but also on that of producers and manufacturers.

Transparency and Traceability on the Label

As mentioned before, the label on a food product is one of the most important mediums in which information is made available to consumers. In the context of the traceability/ transparency landscape, it is important to understand how consumers currently feel about their food products and the labels that exist on these products. Overall, most consumers believe that they are receiving enough information to make an informed choice when they are selecting a food product. A combined 25% of consumers, however, are unsure or do not believe that they have enough information to make these choices, see **Figure 2**.

Income and education are key demographic factors impacting this perception. The lower a consumer's income, specifically those making less than $34,999 per year, the less they feel they have enough information to make an informed decision. The same is true for their level of education. Those with some college experience, but not a degree or less education, are far less certain than those with a college degree. In fact, of those without a high school education, only 29% of consumers believe they have enough

Consumers consider transparency extremely important, but there is no consensus on what it means to them.

Do consumers feel they have the information needed on a food label to make an informed choice?
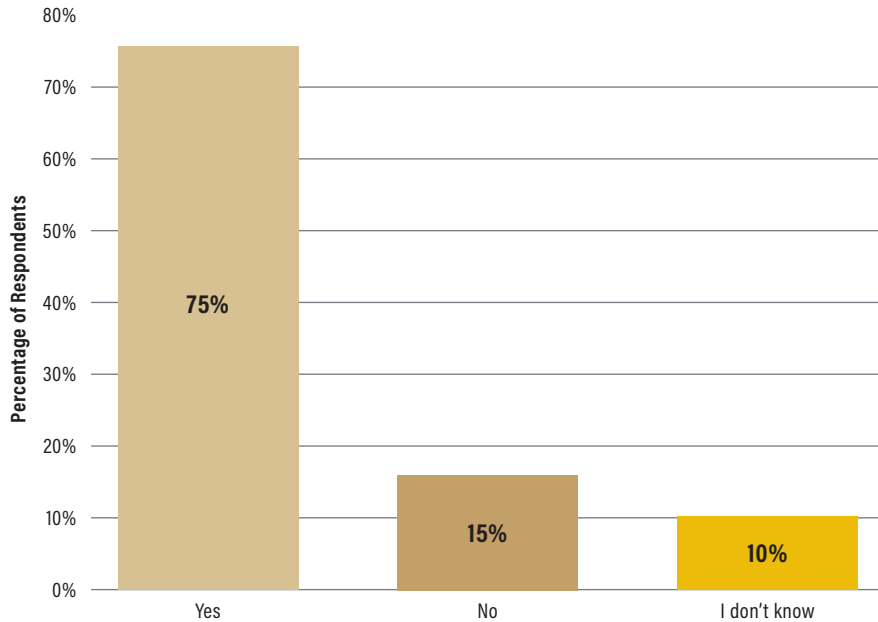
information to make an informed choice about their food. As one may think, these demographics are correlated. In our sample, there is a positive, significant relationship between income and education.

This finding suggests that, in general, consumers do not feel they need more information on the food label to make a more informed decision at the grocery store. However, there is a gap depending on the target market. For products that are intended to be marketed to lower income, uneducated consumers, there could be opportunities to provide more information about the product on the label. There is a balancing act to be considered on this topic, though, since usually, more information present on a label has the potential to generate more confusion about the product to the consumer, which could decrease overall willingness to pay for the product. For higher income educated consumers, perhaps it is not an issue of providing more information on a product label, although these segments tend not to have a need for that. But, if that's the strategy, it is important that the information tells the consumer a story about the product.

IN GENERAL,
over 70% of respondents say that food labels give them the information they are looking for on their products.
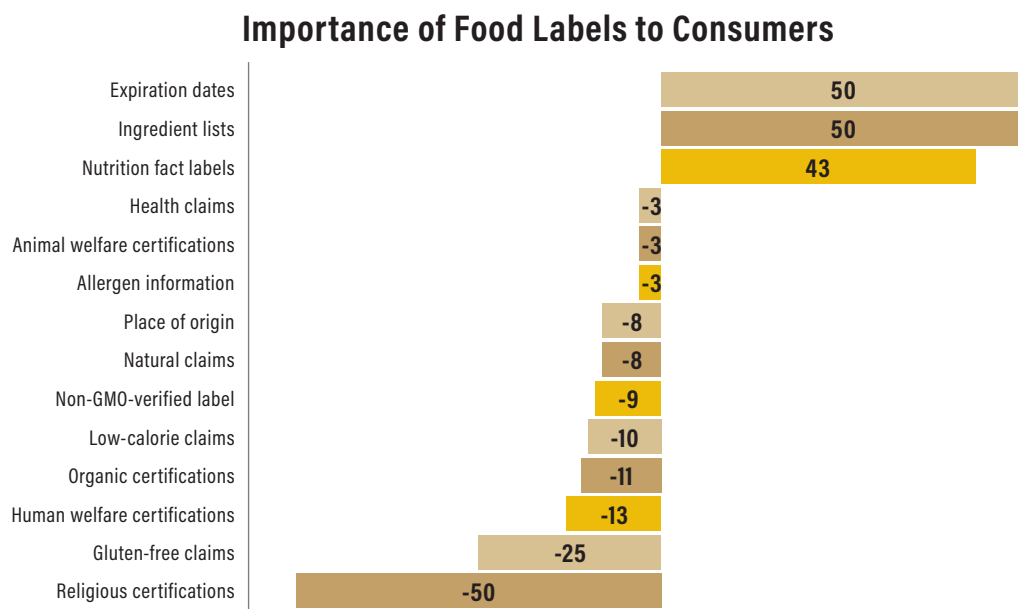
CONSUMERS SAY
nutrition fact labels, ingredient lists and expiration dates are the most important food labels.

If consumers are generally happy with the food labels they see on their food products, then what are their favorites? Consumers were asked to pick the three most important and three least important label components when deciding which food products to buy, which were then scored using a relative index of importance. Nutrition fact labels, ingredient lists and expiration dates were the most listed in the most important category, see **Figure 3**. All other labels were sorted more often in the least important category than they were in the most important category.

Of the 14 labels presented to consumers, all of them could be considered to aid in some level of transparency to the consumer. For example, ingredient lists and nutrition fact labels tell the consumer what is in the product and the composition of the food in terms of macro- and micro-nutrients. Place of origin and the non-GMO verification label, for example, can fall into the category of traceability to achieve transparency. Knowing the origin of a product, as well as the ingredient specificity within the product (i.e., non-GMO), helps consumers to understand what happened to the product before it reached the shelf in the grocery store.

Figure 3. *Importance of food label components.*

Importance of Food Labels to Consumers

| Label	Value
Expiration dates	50
Ingredient lists	50
Nutrition fact labels	43
Health claims	-3
Animal welfare certifications	-3
Allergen information	-3
Place of origin	-8
Natural claims	-8
Non-GMO-verified label	-9
Low-calorie claims	-10
Organic certifications	-11
Human welfare certifications	-13
Gluten-free claims	-25
Religious certifications	-50

OLDER CONSUMERS
tend to trust food labels less than younger consumers.

This may suggest that consumer packaged goods (CPG) manufacturers and retailers should ultimately communicate more about what is present in the product to the consumers, than perhaps where it came from, or the methods used to produce it. Also, another important point is that the three most important label components, according to consumers, are the ones more traditionally found in food products. So, a culture of looking for this information, and more importantly trusting them, was developed over time. If given enough time, consumers may perceive more value in other components, but companies will have to invest in developing the necessary culture (and trust) around those components.

In addition to how important specific labels are to consumers, it is fundamental to understand the level of trust consumers have in specific food labels. In a similar fashion to the importance of a label, trust is mostly related to ingredient lists, expiration dates and nutrition fact labels, see **Figure 4**. Consumers appear to put greater trust in utilitarian labels like allergen information and place of origin[6]. In these specific cases, having upstream traceability allows companies to make claims related to allergens and their place of origin. On the contrary, labels that require certification protocols, like non-GMO and organic, tend to have a lower premium of trust.

Figure 4. *Consumers' trust in food labels.*
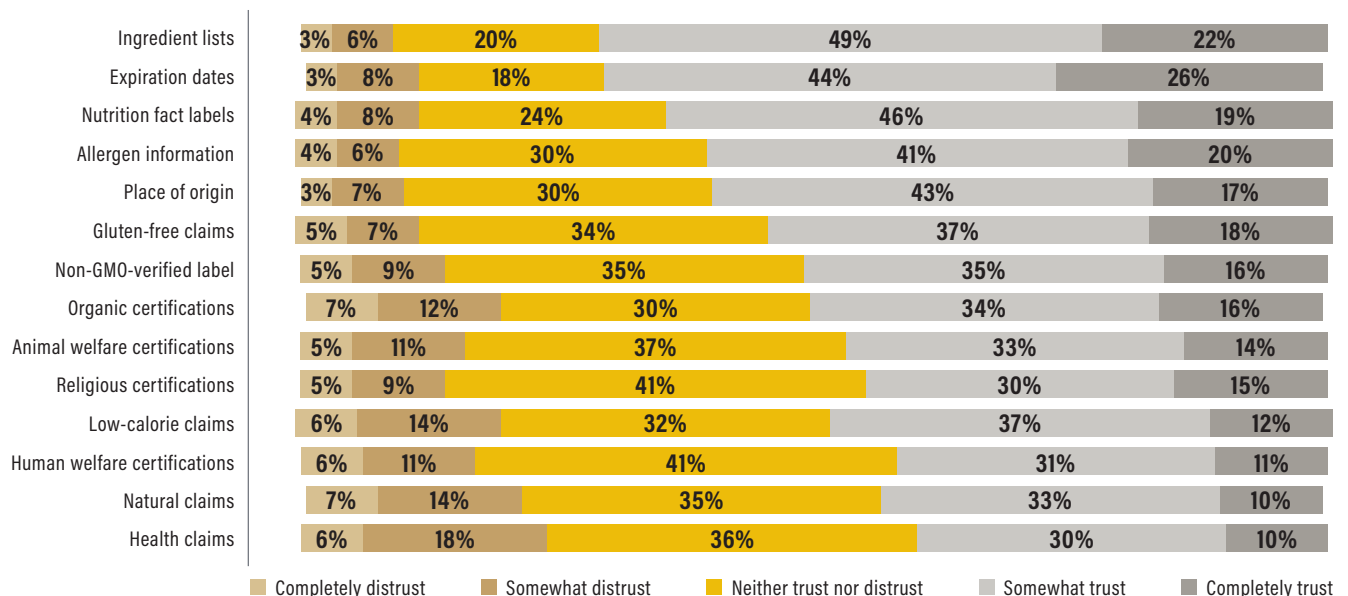
In general, it seems that age plays an important role when it comes to consumer trust in food labels. Older populations tend to trust less than younger populations. If income levels are considered, for the most part, the higher the income of consumers, the more trust they tend to have in food labels.

If all of this is considered, it is possible to notice that more objective claims, that can be easily measured and observed, tend to be considered more trustworthy by customers. More than that, some of the more "traditional" information included on food labels are trusted more than "novel" claims. Interestingly, some of the information that is considered less trustworthy, especially by some customer segments, is usually targeting these same groups. Good examples of this are products with low calorie, human welfare, natural and health claims, that usually present premium pricing over their "regular" counterparts and target higher income populations or those with health issues (in which older populations tend to be highly represented). This signals that companies need to invest more in creating trust related to these topics to capture the value potentially perceived by specific populations.
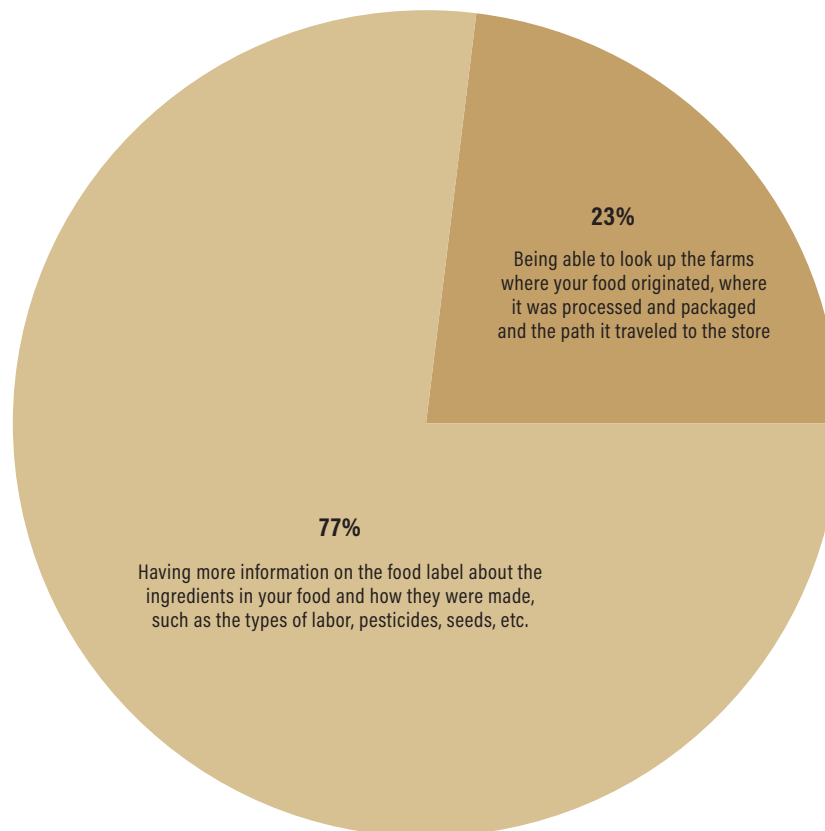
Consumers are more interested in having information about the ingredients of their food than they are in the origin of their food.

It is a well-documented fact that consumers are willing to pay for products that display either country-of-origin or region-of-origin labeling [7-10]. However, when consumers were faced with two options: 1. To be able to look up precisely where their foods originated, where it was processed/packaged and the path they would travel to the store, or 2. To be able to have more information about the ingredients in their food and how they were made – they chose the latter.

This story is consistent across all types of consumers. Regardless of age, education, income, and other demographics, consumers are interested in information specific to ingredients and how they were made and not necessarily the farm in which they originated or where it was processed or packaged, see **Figure 5**. We know that consumers have a willingness to pay for origin labeling, but, perhaps if put up against an ingredient label or production practices, (i.e., non-GMO) origin labeling may not win.

This aligns well with the fact that consumers have more trust in information about ingredient labeling, expiration dates and the nutrition fact labels. This suggests that as the food industry is working to communicate more information to consumers, the most sought-after information for the consumer has to do with what is in their product.

Figure 5. Overall importance of key traceability trends.

23%
Being able to look up the farms where your food originated, where it was processed and packaged and the path it traveled to the store

77%
Having more information on the food label about the ingredients in your food and how they were made, such as the types of labor, pesticides, seeds, etc.

Consumers are most interested in where their product was processed, packaged, produced and harvested.

Perhaps one of the most interesting topics in this report, is about the kinds of information consumers would want to learn from a food tracking system. Consumers were given the option to select multiple choices of what they would hope to receive from a food traceability system.

It was found that consumers tend to show interest in information about distributors in the food value chain first, then, how a product was processed and packaged, how a product was produced and harvested, information on producers and information on processors, see **Figure 6**. Overall, respondents were least interested in information that had to do with how a product was transported from the farm to the grocery store.

*Figure 6.* *Information consumers are interested in from a food tracking system.*
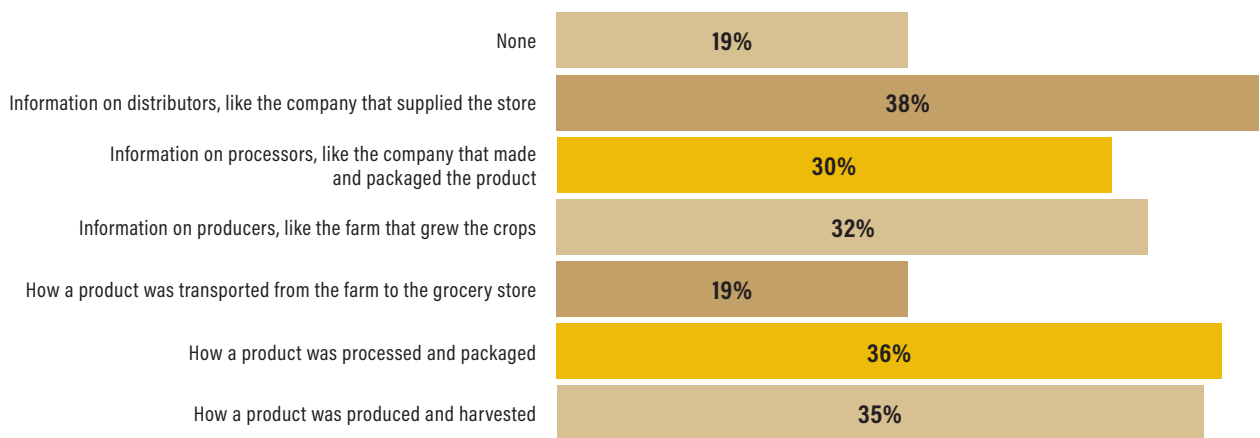
Analyzing the responses by demographics, we found that there are differences in the information consumers would like to know depending on where they are from, their political affiliation and their age. For example, respondents from the West Coast are more interested in a food tracking system information than those from the Midwest. In addition, those who consider themselves "liberal" or "very liberal" on the political spectrum, are more interested in information on how a product was processed, packaged, produced and harvested and information on producers, than those who consider themselves to not be on these parts of the political spectrum.

When it comes to age differences and generational gaps, there are divides that arise. In all but one category – how a product was produced and harvested – millennials (those born from 1980 to 1994) are the most interested in all types of information related to traceability, see **Figure 7**. Baby boomers are the most interested in how a product was produced and harvested. There are many hypotheses for these behavioral differences, for instance, one being the fact that millennials tend to see food as an experience (they are referred to as "foodies"), and the attributes related to this identity are an integral part of that experience (Mintel, 2019), but it is not possible to infer causality. The silent generation is the least interested in this information with less than 5% interested across all categories.

These findings begin to suggest that consumers are most interested in information that is related to distributors, producers, and processors and how a product was processed and packaged, produced and harvested (in order). However, when added to consumers' strong interest in information related to the ingredients in their products and how they were produced, these results show consumers are interested in many facets of the value chain. Not only do they want to know the processes a product went through to get to a store, but some of the key players that took part on that journey, and they want (and trust) information about what the product is made of. This supports the concept that "consumers are demanding traceability," and demanding is a key word here. Consumers are interested in knowing lots of information about their food product. One key question that arises here is, would consumers use all the information if it was provided to them? It is very hard to provide all this information on a product label, but it could be possible to provide alternate information sources that accompany products. Also, another question that comes from this discussion is whether consumers are willing to pay for all this information. There is no doubt that tracking and sharing all this information across multiple segments of the value chain, all the way to the consumer, generates considerable costs, and someone will need to pay for it. But, what is not clear now is who.

Figure 7. Information consumers are interested in from a food tracking system by generation.
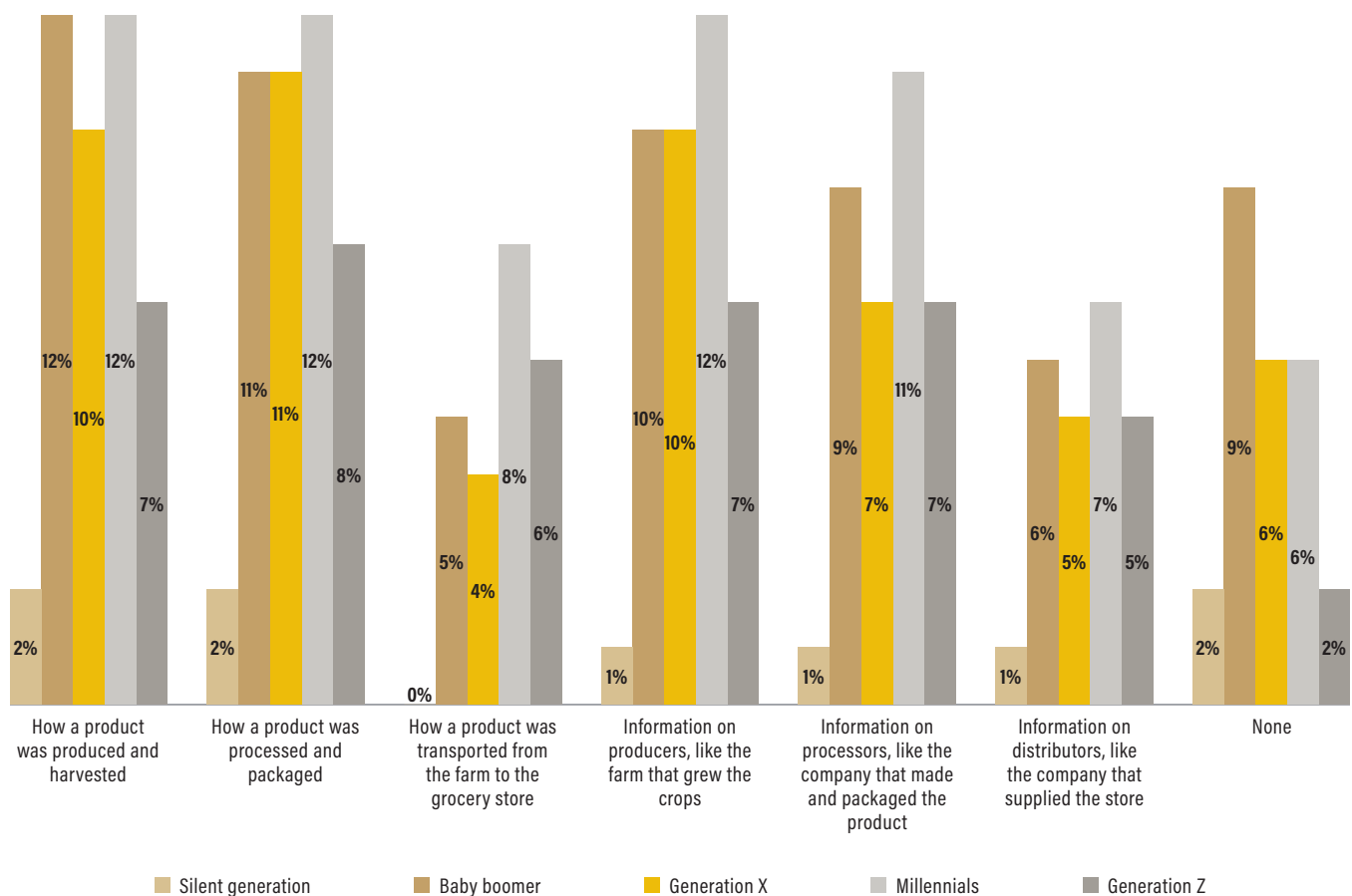
Future of Transparency and Traceability

As previously discussed, there is only so much information that can fit on a food product label. Many companies are exploring alternative ways to provide additional information about a product to consumers through QR codes and company websites. Contact information, including company websites, have long since been present on food labels. Often, these websites are featured in small print on the back of a product.

We asked consumers, if additional information were available for a product other than on the product label, how likely would they be to explore three additional options for information about their food: 1. A QR code on a product package that directs you to a website, 2. A QR code that I can scan through an app on my phone or 3. The company website only. Overall, nearly 50% of consumers indicated they are somewhat unlikely or very unlikely to explore any of these three options for additional information on their food, see **Figure 8**. On the other hand, nearly 30% of consumers indicated that they would be somewhat likely or very likely to explore or visit this additional information. When comparing the three ways they would be viewing this information – QR codes or the company website – there was not a difference in method for these consumers.
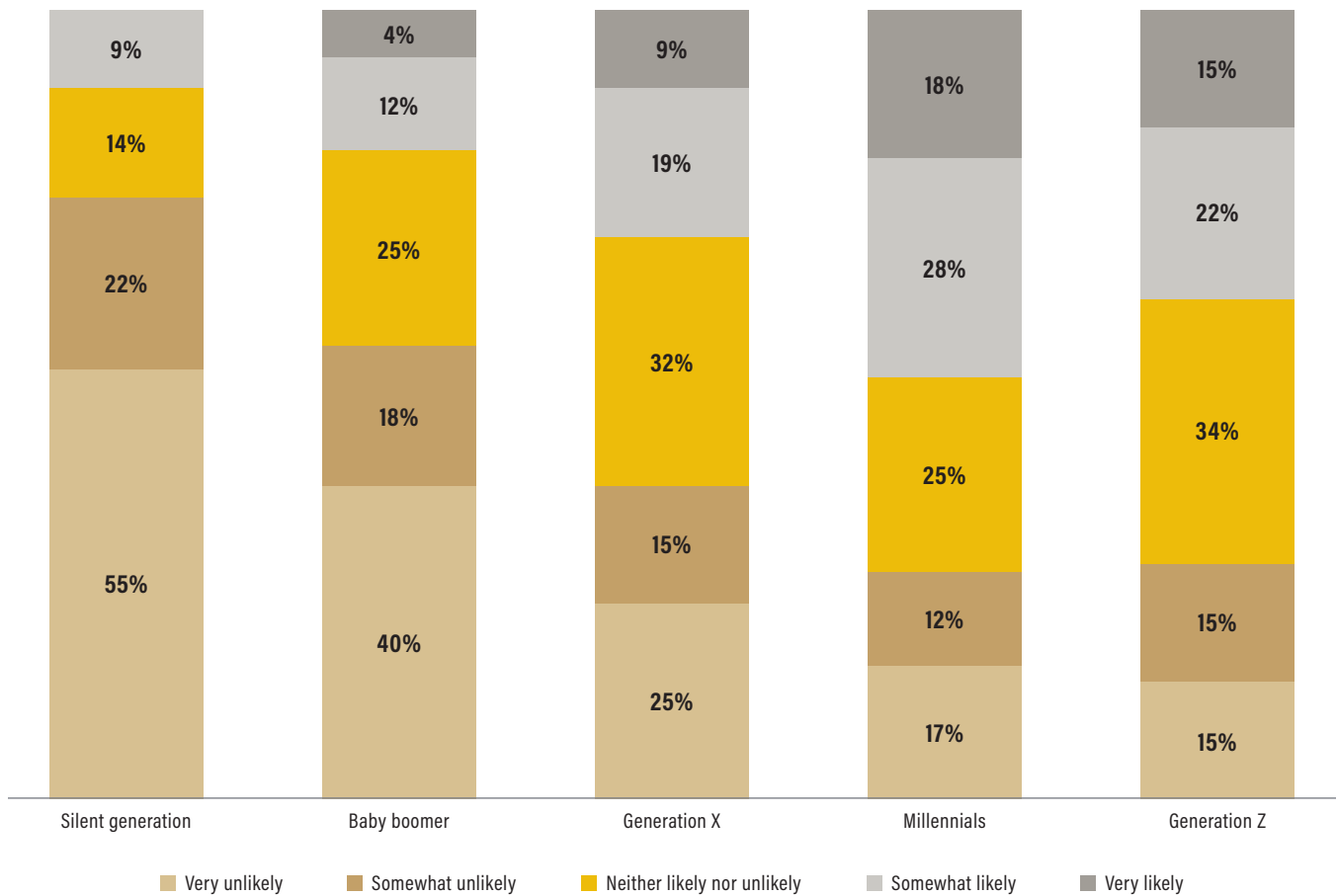
However, when looking at generation, those that are in the silent generation or baby boomer generation are far less likely to use either of these sources of information. If the silent generation or baby boomers were to use these methods to receive more information about the product, they would be most inclined to use the company website.

For food companies, this piece of information is important depending on the type of product they are trying to market. If a product is targeted at a younger generation – Generation Z or millennials – then perhaps a QR code on a product that directs them to a website or app, could be helpful. Between 40-50% of these populations indicate that they would be somewhat likely or very likely to seek additional information in this way. On the contrary, for baby boomers and the silent generation, less than 15% indicate that they would use a QR code to seek additional information. The company website is more likely to be used by these two generations.

Subsequently, this suggests that while consumers indicate they want to know extensive information about their food products, only a small portion of them are likely to explore the information if provided to them. This implication is largely important for CPGs and food manufacturers. Several startup companies are entering the space to provide alternative information to consumers about their food products; however, based on our study, only a small amount of this information will be used or sought after.

Another key question presents itself: If consumers want more traceability and transparency about their products, but aren't willing to devote resources to find this information, how does the food industry provide it to them? We believe there is opportunity for innovation in this space to enhance current food product labels and the trust consumers have in these labels. If a consumer understands what an organic label means, for example, then they in turn know more about the production practices than they may have originally thought.

Figure 8. *Consumers interested in information from a company website.*

	Very unlikely	Somewhat unlikely	Neither likely nor unlikely	Somewhat likely	Very likely
Silent generation	55%	22%	14%	—	9%
Baby boomer	40%	18%	25%	12%	4%
Generation X	25%	15%	32%	19%	9%
Millennials	17%	12%	25%	28%	18%
Generation Z	15%	15%	34%	22%	15%

Conclusions

Managerial Implications: Challenges and Opportunities

Considering all of the findings that were presented in this paper, we reiterate the five key challenges related to traceability and transparency in the agriculture and food industry, from a food consumer perspective, that companies in this space should be aware of:

- *Ensuring food safety:* The primary job that traceability and transparency need to fulfill from a food consumer perspective is to ensure the safety of the products they buy. Consumers expect food companies to prioritize this job by implementing comprehensive traceability and transparency systems that provide clear labeling and information on the origin of the product and its production process. This includes quickly identifying and responding to any issues related to food safety and contamination.

- *Meeting consumer expectations:* Traceability and transparency are essential in tackling the job of meeting consumer expectations in the agriculture and food industry. Consumers are very specific about the types of information that they trust and want to find out about the food they consume. Even though there is a trend, especially among younger generations, to have a greater understanding of the food they consume, people are very clear on demanding to know what their food is made of. This must drive companies to meet their customers' needs where they are, and don't try to force behaviors that aren't necessarily perceived as valuable by them.

- *Building consumer trust:* Traceability and transparency are also critical in fulfilling the job of building consumer trust in the food value chain. Consumers expect food companies to provide clear and accurate information on the origin, quality and safety of their products. This includes providing transparent information on the ingredients and production processes, which can build long-term relationships with their customers.

  Also, this must be done in a way that the customer is willing to receive this information. Some forms of communication are less effective than others, and for a brand to build trust among its customers, an effective communication strategy is important.

- *Promoting sustainable practices:* Traceability and transparency can also fulfill the job of promoting a brand's positioning on sustainable practices in the agriculture and food industry. Consumers are increasingly interested in supporting sustainable agriculture and reducing their environmental impact through their food choices. But consumers have also shown that more information about a product (especially on its label) is not what they are looking for. Consumers want to know what a brand stands for regarding sustainability, and traceability and transparency can be the way to show that. By meeting this need, food companies can create brand equity around a topic considered important by a growing share of the population, thus differentiating themselves.

- *Addressing data management challenges:* One of the key challenges for food companies in implementing effective traceability and transparency systems, is managing the huge amounts of data generated by their supply chains. It is not possible to address any of the challenges and topics mentioned in this paper if the data component of traceability and transparency is not properly managed by food companies. This includes data related to sourcing, production, transportation and distribution. Food companies need to invest in advanced technologies and data management systems to capture, analyze and share this data effectively, while ensuring data security and privacy.

Interestingly, companies that choose to tackle one or more of these challenges, need to understand the heterogeneity of perceptions and behaviors related to how customers react and interact with information regarding the traceability and transparency aspects of the food products they buy. With that in mind, companies need to create value propositions that cater to specific segments of their target market to address these customer needs, alleviating their pains and maximizing the gains perceived when interacting with these food items.

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