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The End of Animal Welfare Labelling as We Know It? Persisting Problems at the Consumer Level and PLF-Based Solutions

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Over the last few decades, animal welfare (AW) labels have become permanent factors in consumer markets for animal-based food products across Europe. During this time, scholarly thinking about consumer perspectives on AW labelling has identified problems that hinder the effectiveness of labels, pertaining to (*i*) consumers' trust in labels, (*ii*) the number of labels present in the market, (*iii*) confusion about the meaning of labels, (*iv*) trade-offs between AW labels and price, (*v*) consistency between the AW standards and consumers' individual opinions about AW and (*vi*) the ability of animal-based sectors to innovate in AW labelling. Based on these insights, this study explores the current state of these problems by questioning 2.433 consumers from four countries in the European Union (Finland, the Netherlands, Spain, and Italy) about these issues. The results show that, while opinions differ between countries and cross-border consumer segments, these issues persist for many consumers. These results cast doubt on the idea that AW labels in their traditional form can substantially increase their effect on the market. The study therefore explores potential data-based solutions to persistent consumer problems by drawing on precision livestock and e-commerce technologies. It extends current data use, which is often limited to farms and value chain actors but rarely reaches consumers. We argue that innovative technologies create opportunities to influence consumers in the often neglected pre- and post-purchase stages, through a selection system where consumers can indicate their AW preferences, receive feedback, and transparently provide insight into their preferences to other value chain actors.

Keywords: animal welfare, labelling, consumer perceptions, precision livestock farming (PLF), e-commerce, supply chain management, marketing

"It's the end of the world as we know it … and I feel fine"
R.E.M.

INTRODUCTION

In most high-income countries, like those in Western Europe and Northern America, the main instrument to inform consumers about animal welfare (AW) are labels. AW labels are also an important instrument for AW policy to achieve the goal of improving AW in the market domain (McInerney, 2004; Veissier et al., 2008; Ingenbleek et al., 2012 ; Clark et al., 2017). Traditionally, labels are signs or cues – such as logos – that are placed on a product's packaging to inform customers at the moment of purchase that the product or producer complies with a predefined set of standards (Gracia et al., 2011). Labels are thus an integral part of the information used by consumers when making purchase decisions about animal-based food products (Caswell and Padberg, 1992).

AW labels include specific criteria pertaining to AW standards and/or issues concerning the farming environment. The organisations and institutions behind labels set standards, certify, control, and legitimise the labelling systems, based on state-of-the-art evidence from animal science and ethical principles. Developing the label itself and applying it to a product seems like a simple task. However, the past few decades have shown that it is far from easy to have a strong effect on the market, as evidenced by the fact that the impact of AW labels is generally considered disappointing at best (*cf.*, Promarket, 2021; Forbes, 2021; BEUC, 2021). Different forms, names, multi-level systems and connections with well-known brands, retailers and AW organisations like the RSPCA have, therefore, been introduced to increase their market shares. Nevertheless, in a large EU-wide consumer survey in 2016 (Eurobarometer, 2016), 64% of respondents said they were not satisfied with the information provided, suggesting that consumers need more, or more specific, information about AW issues. In response to this demand, the European Commission started to work on a new European wide, harmonised AW label (EU 2020, 2021).

The innovations in AW labelling are paralleled by the thinking about labels in academic circles. Over time, authors have conducted specific studies to seek explanations and to improve the market shares of AW labels. This includes research on the ability of labels to increase transparency in the market (Tregidga et al., 2019), into the extent to which the labels address underlying consumer concerns (de Jonge and van Trijp, 2013), into labels' ability to influence consumers' purchase decisions (Hawley et al., 2013) and into consumers' willingness to pay for products with increased AW standards (Lagerkvist and Hess, 2011; Clark et al., 2017; van Riemsdijk et al., 2020). These studies have, thus, identified a number of specific problems with AW labels at the consumer level, such as consumers' trust in the labels, confusion about their meaning and consumers' price sensitivity, while also providing insights into the barriers that may hinder AW labels from increasing their effects.

The aim of this study is to compare and examine the extent to which these barriers play a role in consumer markets and to suggest a thinking direction for new solutions. To this end, we show results from a study that questions consumers from EU countries about the barriers related to AW labels (Finland, the Netherlands, Spain, and Italy). We show results by comparing the four countries, but we also examine the existence of cross-border consumer segments that take different attitudes toward AW labels. To suggest a new thinking direction, to deal with the problems related to AW labels, we take an approach based on connecting AW data to consumer decision-making processes through digitalization (Stygar et al., 2022). More specifically, we combine insights from precision livestock farming (PLF) technologies (Berckmans, 2017; Vranken and Berckmans, 2017) and e-commerce (Grewal et al., 2021; Verhoef et al., 2015). The approach relies therefore on PLF that use environmental indicators, indicators in the housing system (e.g., ambient temperature measurements), and animal-based indicators (e.g., accelerometers, cameras and computer vision, or microphone-based systems) to generate data directly or indirectly related to AW issues (Neethirajan, 2020). As such, PLF offers real-time data on vital AW parameters, thus generating a continuous, validated and potentially detailed stream of information about AW, as AW parameters are based on multiple data-points in time (Gómez et al., 2021). To date, PLF instruments have mostly been used to manage on farm processes like feed optimisation (Gómez et al., 2021). As is currently examined in the EU-funded ClearFarm project, the future use of PLF-data can extend beyond the farm by making the data, or more precisely the information originated from the data, accessible to other users in the value chain. These users also include AW labels, who can bring the information to the consumer, especially in a digital environment like is used for e-commerce. While this approach perhaps would mean an '*end to AW labelling as we know it*', it does give direction to how AW labels can survive into the digital age, not only maintaining their current effects, but potentially increasing them.

In the remainder of the paper, we discuss the major problems associated with AW labels at the consumer-level, as indicated by the existing literature. We use these insights to formulate several questions included in our questionnaire. After explaining the methods and results, we conclude that all indicated problems persist to a substantial extent. In the last sections of the paper, we discuss potential solutions to the problems in the era of digitalisation.

PROBLEMS WITH ANIMAL WELFARE LABELLING FROM A CONSUMER PERSPECTIVE

For a long time, AW was seen as a 'supply' problem rather than a 'demand' problem. As several parts of Europe faced food shortages after the Second World War, policy makers aimed to secure the availability of adequate food in the future.

Accordingly, agriculture was intensified, with larger production quantities per farm, while unit costs were decreased in parallel (Fraser, 2008). In animal-based food sectors like pork, beef, veal and poultry meat production, and dairy and egg production, the new policy focus had far-reaching consequences for the conditions in which farm animals lived: they were kept in smaller spaces, fed with feed to speed up growth and breeding practices were implemented that focused on adapting animals to the husbandry systems (Fraser et al., 2001).

Consumers initially enjoyed the great availability and the associated price decreases of animal-based food products. Over time, however, concerns were raised about how farm animals were treated (Blandford et al., 2002; Ufer et al., 2019). With post-war hunger still in mind, initiatives for setting legal standards for AW stood little chance. The only option for changing the conditions of animals was to differentiate supply and to make the differentiated animal-friendly options the preferable ones to the alternatives for consumers. The public understanding that emerged in the 1970s that animals also experience pain and stress, suffer, rage, fear, apprehension, frustration, and pleasure (Gonyou, 1994) probably fostered the transformation, at least in part. Prominent examples are the growth of organic agriculture and the transformation of farm animal husbandry systems, such as the transition from conventional laying hen cages to furnished cages, to cage-free system in Europe (*cf.*, Ingenbleek et al., 2007).

With animal-friendly product alternatives being available, the problem arose of how to convince consumers to buy them. From an economics point of view, the problem either was that consumers were not ethical enough to purchase products with increased AW characteristics or that the market failed to provide consumers the information about AW levels of the alternative products. Given that consumer studies indicated that consumers found AW important and were willing to pay for it (Lagerkvist and Hess, 2011; van Riemsdijk et al., 2020), market failure was considered the more likely explanation (Frey and Pirscher, 2018). The attention accordingly moved to creating awareness among consumers. By providing a label on the product and making consumers aware of them, consumers would – at least in theory – have everything at hand at the moment of purchase to make an informed and presumably ethical choice. The effect of the labels was, however, often disappointing, leading to at least one Minister of Food and Agriculture calling consumers 'hypocrites' (Trouw, 2021). There are, therefore, several potential explanations for why labels in the market do not achieve what they aim at.

First, AW is a credence attribute and as such the actual value determined by the increased AW cannot be observed during the purchase phase (by product inspection) nor during the consumption phase (by experiencing the product, such as tasting it) (Verbeke, 2009). Consumers need therefore to trust (Krampe, et al., 2020) that animals were kept under the conditions promised by the label. Trust has thus become a frequently studied variable in literature on AW labelling (e.g., Tonkin et al., 2016). To get a picture on the state of AW labelling, the question of *how confident consumers are that AW labels properly protect farm animals* is therefore a logical first one.

Second, literature indicates that the differentiation of labels was overdone and that there are too many labels on the market that specifically target AW or at least integrate too many specific dimensions of it, making it impossible for consumers to oversee their meaning and to make decisions that truly reflect their opinion (*cf.*, Roosen et al., 2003; Miele and Evans, 2010). Thus, in contrast to making the market for animal-based products more transparent, labels were accused of doing the opposite, creating *confusion* among consumers, because consumers were no longer able to understand all their different meanings (Verbeke, 2005; Verbeke, 2008). As a result, the criticisms of labels as an effective instrument increase (Grunert et al., 2010). The question of *how consumers perceive the multitude of labels* is therefore reasonable.

Third, it is probably not only the number of labels that is the cause of consumer confusion, but also the complexity of the standards that the labels stand for. When confronted with the actual indicators measured to define the label, consumers are likely to discover that the way standards are set, and the level of the standards may be very different from what they had in mind. Several authors have therefore argued that consumers often have an idealistic picture about livestock farming and the way in which, and how long animals are kept and live, even if they are produced under improved AW standards (e.g., Boogaard et al., 2011; de Jonge and van Trijp, 2013). A simple example is the average life of a broiler, which is about 40 days for a fast-growing 'mainstream' broiler, 56 days for one raised under the RSPCA standards and 81 days under an organic slow growing scheme (de Jonge and van Trijp, 2013, RSPCA, 2021). This may dramatically differ from the idea of the '*long and happy life*' that consumers may expect when purchasing animal-friendly products. As such, *AW labels may confuse consumers* even more if they start searching for additional information.

Fourth, some research has pointed out that explanations about AW are not necessarily found in the information provision *per se*, but in the way in which consumers incorporate and process the information in their decision-making processes. Dual-process-theories (*e.g.*, Strack and Deutsch, 2006; Gawronski and Creighton, 2013) suggest that consumers make use of two distinctive decision-making systems, generally known as 'system 1' and 'system 2'. Following 'system 1', consumers make decisions based on their intuition and/or easy-to-access cues from the environment, like prices tags, in-store promotions and merchandising activities, information cues on the packages, brand names and the logos of other products in the shelves (Krampe Gier et al., 2018; Krampe et al., 2018). Consumers using 'system 2', are expected to go through a more sophisticated reasoning process that requires more thinking, considering the benefits and risks related to a purchase decision. When it comes to food shopping, 'system 1' is usually the predominant system because consumers are often under time pressure and because food purchases are associated with low risks for consumers. Given that an average grocery shopping trip takes about 33 minutes, the average grocery stores' assortment consists of approximately 40,000 units and the time consumers look at a product is less than four seconds (Statista, 2021), well-advertised discounts weigh heavily in the intuitive trade-off (Gier et al., 2020). Hence, it comes as no surprise that consumers arrive

at different decisions in the supermarket than when they are at home answering questions about AW issues (also see literature on the 'attitude-behaviour gap'; Hassan et al., 2016; Auger and Devinney, 2007; Vanhonacker et al., 2007). We therefore ask the question, whether *consumers sometimes buy products that are not labelled because they are on discount*.

Fifth, while some have argued that labels lack effectiveness because there are too many of them, the opposite can also be true. Because there is no such thing as 'the' consumer, but rather a heterogeneous group of consumers, it may be the case that some find AW standards more important than others and are therefore willing to pay more for products produced according to higher animal-welfare standards. Consumers may also differ in the aspects of AW that they find important. The answer to this issue would be to differentiate the supply, for example, in different levels of AW, indicated by multi-level systems, such as stars or traffic light symbols. In a study on broilers that investigated the multi-layer label 'Beter Leven' from the Dutch 'Society for the Protection of Animals', De Jonge and van Trijp (2013) found that the label would indeed lose market share if the labelling system would be simplified to one or two levels only, because consumers differ in their levels of preferences for AW. Hence, consumers may refrain from purchasing labelled products because they are not *confident that the labels indeed reflect their own opinions about AW*.

Sixth, rather than acting as an instrument to remove market imperfections, labels might be part of an innovation process in which companies, labelling organisations, AW organisations and perhaps other value chain actors would continuously search for labels, brands and standards that tap into the preferences of newly recognised market segments (Ingenbleek et al., 2013; Ingenbleek, 2011). The essential role of labelling would then become an innovation to actively create new markets for animal-friendly products. Against this background, it is important to ask consumers how they rate the *innovative power of the sector* in introducing animal-friendly innovations.

MATERIALS AND METHODS

Based on the discussion above, we formulated six simple questions for a consumer survey. The questions were attached to a questionnaire developed for the ClearFarm project. As this project focuses on dairy and pork, our questionnaire adopted these contexts. The following six statements were included in the questionnaire:

1. I am confident that animal welfare labels properly protect farm animals.
2. There are too many labels.
3. The labels on meat and dairy products sometimes confuse me.
4. I sometimes buy products that are not labelled because these products are discounted.
5. How confident are you that the labels set standards that are consistent with the way you think farm animals should be kept?
6. How innovative do you think the dairy/pig sector is in improving animal welfare standards?

The first five statements were examined on 5-point Likert scale. However, as both, the pig and dairy sectors are considered as rather conservative and traditional production areas, less variance in consumer responses to the last two sub questions of question 6, about the innovativeness of the sectors, was expected. We therefore decided to enlarge the 5-point Likert scale to a 10-point Likert scale to increase the explained variance for both questions.

Sample

The data for this study are collected in four EU countries: Finland, the Netherlands, Spain, and Italy. Drawing on the results from the Eurobarometer (2016), the four countries appear interestingly positioned within the EU-27 on two important dimensions, namely: the perceived need for AW information (on which Italy scores highest, the Netherlands the lowest, and the other two countries take positions towards the middle with Spain experiencing a considerably stronger need for information than Finland), and consumers' use of AW labels in their purchase decisions (for which the Netherlands is among the highest scoring countries in the EU, Spain among the lowest, and Finland and Italy take positions in the middle with Finland scoring higher than Italy). As such the four countries together cover important variance regarding consumers' stated need for and use of AW information.

Within these countries, we selected main shoppers (responsible for the grocery purchases of their household) below the age of forty. Age was used as a selection variable because the relatively younger age groups are more likely to be confronted with future-focussed digital innovations than older age groups. Vegetarians, vegans, and people working in the areas of marketing, market research and agriculture were excluded from the study, because they are known to have more background knowledge, leading to stronger opinions on AW labelling (Verbeke, 2009). Following this procedure, 520 Finnish, 437 Dutch, 606 Italian and 529 Spanish consumers completed the questionnaire (2.433 in total). The mean age of the sample was 29.45 years (SD=6.16). The gender distribution was aligned with the gender distribution of main shoppers in the respective country: 53.5% women, 46.3% men and 0.2% diverse across all four European countries. 46% of the participants were employed, 15.2% were unemployed and 38.8% indicated that they were in education or following an apprenticeship, were entrepreneurs or were retired. Most participants indicated that they eat animal-based products, being 77.1%, whereas 22.9% indicated having a flexitarian diet, meaning that they occasionally consume animal-based products.

Procedure

The questionnaire was developed in the English language and subsequently translated into Finnish, Dutch, Spanish and Italian. To guarantee consistency and to detect possible translation mistakes, the questionnaires were back translated. Moreover, prior to the actual data collection in the four European countries, the questionnaires were pre-tested in online and face-to-face interviews

with five consumers. The feedback gained from the pre-test interviews was considered when finalising the questionnaires.

The questionnaire consisted of three parts. In the first part, consumers were provided with information about the aim of the study and educated about the privacy regulations that align with EU privacy legislation. Afterwards, consumers were asked to answer three selection questions with regards to age, gender and shopping responsibilities (see above). In the second part of the questionnaire, consumers were asked to answer some questions relevant to the ClearFarm project, before in the third and final part of the questionnaire, consumers were provided with the six questions described above in randomised order, as well as the mentioned demographic and socioeconomic questions.

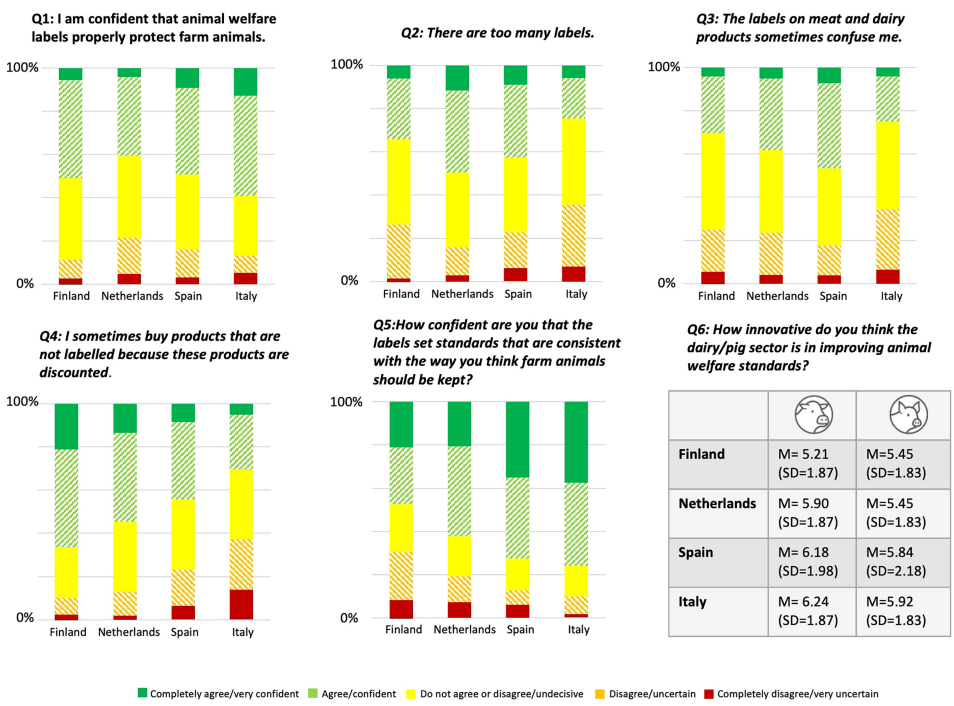
Data Collection

The data collection was administered by the international market research company Kantar (kantar.com) in October and November 2020. The used consumer panel is based on a portal that EU citizens can enrol in. This portal presents them with all questionnaires available, and respondents are free to complete the questionnaires in which they are interested. In the portal, there is no information available about the subject of the questionnaire: only the length of the survey and the incentives provided are shown. By completing this questionnaire, consumers received an incentive of 40 'LifePoints', equivalent to €40 and which can be used to receive all kinds of benefits (e.g., product vouchers). The data collection was completed simultaneously in all four European countries to minimise time dependent interference.

FINDINGS AND INTERPRETATION

The results are shown in **Figures 1**, **2**. The first panel in **Figure 1** (Q1), shows the results of the first statement, asking consumers about their *confidence that AW labels properly protect farm animals*. The results show that, in general, consumers are confident that AW labels protect farm animals, indicated by the fact that 51% of the Finnish, 41% of the Dutch, 49% of the Spanish and 59% of the Italian consumers (completely) agreed with the statement. Dutch consumers, however, seemed more sceptical compared to consumers in the three other European member states: less than half of the participants agreed with the statement. A possible explanation is that the influence of AW organisations and activists is somewhat greater in the Netherlands due to the business climate characterised by increased Dutch government investment in NGOs (Ingenbleek et al., 2012; Dutch government, 2022). Overall, however, the results show that in three of the four European countries, the majority of consumers have a high level of confidence and trust in the AW labels. As such, the trustworthiness of AW labels does not seem to be a major issue for consumers. Still, the results may indicate the existence of critical consumer segments that need more convincing data/information or control of the information process.

The second panel (Q2) indicates *consumers' perceptions of the number of labels*. The results indicate that consumers from the Netherlands (49.5%) and Spain (42.7%) perceive the number of labels on the market as 'too many'. Comparatively, only a third or less of Finnish (34.1%) and Italian consumers (24%) agreed with the statement that there are too many labels. As the question



Finland	M= 5.21 (SD=1.87)	M=5.45 (SD=1.83)
Netherlands	M= 5.90 (SD=1.87)	M=5.45 (SD=1.83)
Spain	M= 6.18 (SD=1.98)	M=5.84 (SD=2.18)
Italy	M= 6.24 (SD=1.87)	M=5.92 (SD=1.83)

FIGURE 1 | National results of the consumer questionnaire.

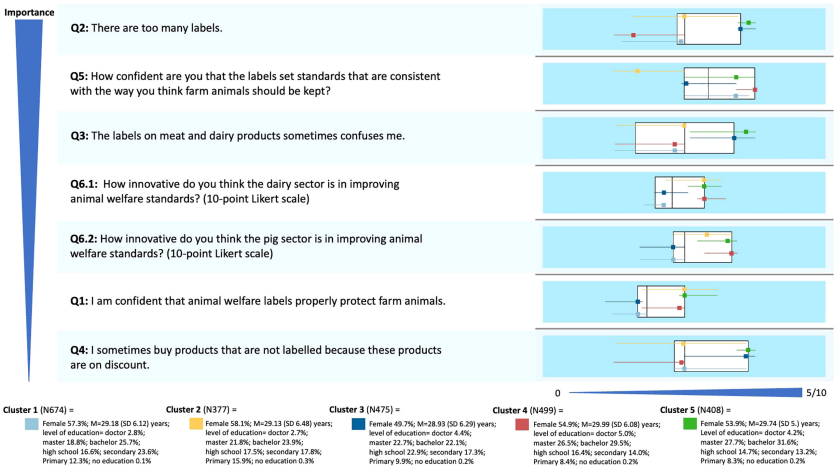


FIGURE 2 | Cross-national results of the consumer questionnaire.

was asked about labels in general and not specifically about AW labels, consumers were probably influenced by the number of sustainability, health, quality, and safety labels. As in the Netherlands and Spain, there are only one independent, national-wide AW certification scheme for meat and dairy (the 'Beter Leven keurmerk' and 'WelFair' certification schemes).

When it comes to the *confusion elicited by labels (standards)*, in Spain, almost half of the participants agreed with the statement of Q3 (47%), followed by Dutch (38%), Finnish (30%) and Italian (25%) consumers. A logical explanation for the higher number in Spain is that labelling schemes in Spain, in accordance with autonomous regional legislation, differ between regions. Consequently, consumer confusion is increased by the multiplicity of regional labels and the associated labelling standards.

When asking consumers *whether they would also purchase products that are not labelled, because they are on discount* (Q4), almost two third of the Finnish consumers indicated that they would do so. This was followed by 54.7% of the Dutch consumers and 44.4% of the Spanish consumers, but only 30.3% of the Italian consumers. These results seem to show that consumers are somewhat less price sensitive in countries with a 'stronger' food culture, where food quality differences play a greater role in the evaluation of food products (*cf.*, Askegaard and Madsen, 1998).

When asking consumers about *the consistency between the standards behind the labels and the way they think about farm animals should be kept* (Q5), almost three quarters of the Italian and Spanish consumers agreed with the statement. Comparatively, 62.2% of the Dutch and 47.4% of the Finnish consumers thought that labelling supported their reasoning of how farm animals should be kept. The results indicate that consumers in the two northern European countries have stronger personal opinions about how farm animals should be kept and a more critical stance on labels. The longer tradition in civic society and the higher number of and more differentiated active AW organisations may explain this finding.

In response to the questions about the *innovativeness of the dairy and pig sectors* (Q6), the results indicate that consumers across the four countries consider both sectors as moderately innovative. It appears, however, that consumers from southern European countries (represented by Spain and Italy) consider the sectors to be more innovative than consumers in northern European countries. The results further indicate that consumers across the four European countries perceive the dairy sector as more innovative than the pig sector.

In addition, to identify consumer segments beyond European country-driven effects, a two-step cluster analysis was conducted (Tkaczynski, 2017), using IBM SPSS Statistics [version 25, https://www.ibm.com/analytics/spss-statistics-software]. The variables included in the cluster analysis were the consumers answers to the six-research questions. The two-step cluster analysis first uses a distance measure to separate groups and then a probabilistic approach to choose the optimal subgroup model (*cf.*, Benassi, et al., 2020). The two-step cluster analysis determines the number of clusters based on a statistical measure of fit rather than on an arbitrary choice, can handle categorical and continuous variables simultaneously, and can analyse atypical values (*cf.*, Benassi et al., 2020). Data were standardised, converting raw data into z-values. The standardised values were in the first step (pre-clustering) used in a sequential approach to pre-cluster the cases based on the definition of dense regions in the analysed attribute-space. In the second step (clustering), the pre-clusters are statistically merged in a stepwise way until all the observation clusters are in one cluster. Following this procedure, the results suggest a five-cluster solution. The consumer clusters do not differ in the age, gender, or education distribution, but show some important differences in terms of individual consumer perceptions of labelling (**Figure 2**). The most discriminating factors pertain to the number of labels at the market (Q2), consumers' confidence that the labels are in line

with their own welfare standards (Q5), the consumers' confusion elicited by the labels (Q3), the perceived innovativeness of the sectors (Q6), the perceived consumers' confidence that labelling approaches properly protect farm animals (Q1) and the consumers price sensitivity when purchasing AW products (Q4).

The first cluster –*the neutral consumer clus*ter, consisting of 674 consumers (of which 31% are Finnish, 20.5% are Dutch, 20.2% are Spanish and 28.3% are Italian) is the largest clusters. Consumers in this cluster have a relatively neutral opinion towards labelling approaches, while being confident that labels protect farm animals. They see the livestock sectors as moderately innovative, do not feel overwhelmed by the number of existing labelling approaches and do not seem to disagree nor agree with existing labelling approaches.

The second cluster –*the positive consumer cluster*– consists of 377 consumers (of which 16.2% are Finnish, 13% are Dutch, 24.4% are Spanish and 46.4% are Italian). Consumers in this cluster perceive the livestock farming sectors as more innovative than their peers in the first cluster. Consumers also display higher trust that the labels fulfil their personal AW requirements but are less certain about whether labels generally protect the AW of farm animals.

The third cluster –*the critical consumer cluster*– consisting of 475 consumers (of which 20.6% are Finnish, 30.7% are Dutch, 24% are Spanish and 24.6% are Italian), displays a rather critical group of consumers who are confused by the (number of) labels and have a high disbelieve that AW labels protect AW of farm animals. They also see the innovativeness of the livestock sectors as low.

The fourth cluster –*the innovation-recognition consumer cluster*– consists of 499 consumers (of which 22.8% are Finnish, 32.1% are Dutch, 29.5% are Spanish and 15.6% are Italian) who perceive the livestock farming sectors as extremely innovative. In addition, these consumers believe that the labelling standards are consistent with the way they would like farm animals to be kept. Moreover, the multitude of labels does not confuse them.

The fifth cluster –*the confused consumer cluster*– consists of 408 consumers (of which 20.8% are Finnish, 25.2% are Dutch, 34.8% are Spanish and 19.1% are Italian) who believe that there are too many labels that sometimes confuses them. Nevertheless, consumers assigned to this cluster display a high believe that the labelling approaches protects farm animals and that they are consistent in the way farm animals should be kept. They also believe that both the dairy and pig sector are innovative, but also admit being price sensitive in their shopping decisions for AW products.

The results confirm that interpreting country-specific results alone can be misleading, as the way consumers view AW labels also differs between cross-border consumer segments. However, some country-driven findings return in the cluster analysis. Consumers from Spain are, for example, more present in the clusters that perceive animal husbandry as more innovative and who believe that the labelling standards are consistent with the way they would like farm animals to be kept. Finally, consumers' age, gender and education do not seem to be driving forces in the labelling perception, given that age and gender are evenly distributed across the identified four consumer segments, leading to the conclusion there are individual driving forces that determine consumers' opinions about AW labelling.

DISCUSSION

Our findings should be interpreted in the light of the limitations of this study. First, while we have had the opportunity to question many consumers from four different EU member states, many European countries are not included in the study. In particular, Eastern Europe was not covered. Second, in our questionnaire, we addressed several issues regarding AW labelling that were raised in the existing literature. It should be noted that addressing these issues with single-item questions can often not address multi-dimensional labelling effects, mechanism and complexities that are explained in the underlying literature. Such simplification seems an inevitable consequence of attempting coverage of all these issues at the same time within the budget constraints of an expensive international consumer survey.

Bearing these limitations in mind, several important insights can be derived from the results. First, none of the questions shows extreme scores, indicating that a particular problem may have been solved. The problems stated in the literature therefore persist to at least some considerable degree for a fair share of the consumers who answered the questionnaire. Second, while we do find some country-related differences, these differences are not extreme. As such, the issues with AW labels at the consumer-level identified in the literature are not restricted to some national environments without having relevance for other countries. Third, while the sample of consumers used in this study is clearly highly heterogeneous in how they perceive some of the problems with labelling, the cluster analysis shows that they can be grouped according to their individual perceptions. This means that interventions to remove some of the problems are likely to be effective with some groups, but not with all consumers. Fourth, the segments we identified are found in all EU Member States and in all age and gender groups, suggesting that country, age, education, or gender are not the only discriminating factors, but that there might be other influencing factors, such as income or individual consumer perceptions. This means that policies to improve AW labelling may not need a nationality, age, gender, or education dependent approach, but rather a segmented marketing approach in which various market segments are addressed that live in different parts of the EU and that may have more in common (i.e., a similar perception of AW labelling) with each other than with other segments that happen to live in the same country or be in the same age group.

For the EU initiative to implement a new AW label, our results present both promising news, but they also cast a few doubts. First, as our results indicate that opinions on AW are not strongly country-dependent, a European cross-country initiative seems a logical direction to take. At the same time, a warning should be placed about high within-country variance, which is not dependent on demographical variables, such as age and

gender. A new label is unlikely to have the desired effect on all consumers. In particular, concerning the results regarding confusion, one may question whether adding a new label to the existing set of labels is the right approach, or whether integrating AW in broader labelling approaches is likely to be more fruitful. Finally, our study indicated some problems that a new label is unlikely to address, such as the price sensitivity issue. Even if the new label were to be successfully implemented, it would be unlikely to solve all persisting problems regarding AW labelling at the consumer-level simply because it would add an instrument that, overall, would likely have more similarities than differences with existing labels on the market. Therefore, it would likely encounter the same problems as already existing labels. Hence, in general, the results cast doubt on the idea that AW labels in their current form can increase their effect on the market substantially.

Therefore, below, we explore how AW related data converted into information and integrated with e-commerce can provide opportunities for ensuring trust in labelling systems, bridging the gap between consumer preferences and AW standards, end consumers confusion about labelling, solve the problem of price sensitivity and develop AW innovation in the supply chain, thus offering contemporary solutions to the problems that still exist in relation to AW labelling. It should therefore be evident that our study broadens the scope of using PLF (data) to manage and optimise on-farm processes, demonstrating the benefits to integrate these data to inform consumers and other stakeholders in the value chain.

IMPLICATIONS: DATA-BASED SOLUTIONS FOR PERSISTING LABELLING PROBLEMS

Securing Trust

Although trust does not seem to be the most widespread problem in our data, the results on trust are alarming in that despite all the efforts to establish AW assurance schemes, a substantial share of the consumers still do not trust them. A likely explanation is that the incidents and excesses of violations of AW standards are often brought to the attention of the public without further context. The underlying problem of why such incidents occur is that control of compliance with standards that are mostly based on housing systems and management is still labour-intensive and expensive (*cf.*, Woodhouse, 2010). The data from the farming environment can create a solution here. Through such data the claims of AW labels can be substantiated by precise (real-time) information on AW parameters at the farm-level or even at the level of the individual animals by providing consumers information before, during or after purchase (e.g., using smartphones or in-store terminal applications). Given the ways in which consumers make decisions about food products, it is unlikely that many consumers will make frequent use of the information provided, but perhaps that is not the point. The point is that they can use the information if they want to and, therefore, have the autonomy to monitor compliance with AW standards themselves at any time in the (*pre, during* and *post*) purchase process, or an animal welfare organisation they support and trust can do so on their behalf. This secures trust in the labelling and food system as a whole (Kang and Hustvedt, 2014), as consumers have the possibility to access validated PLF-based information at any time *via* the system.

Overcoming the Mismatch Between Consumer Preferences and AW Standards

The use of PLF data converted into meaningful information at the consumer level can potentially solve another persistent problem: the mismatch between the standards used by labelling systems and the way consumers perceive how animals should be treated. Our data indicates that there are still substantial groups of consumers who see this as a problem. The solution to this problem can be found by simply allowing consumers to set their own AW standards, if they want to. In a system that is based on PLF data, all that is needed is an application based on a database in which consumers can set their individual AW preferences. The parameters may include the traditional factors that certification systems use to determine whether a farm qualifies for a label, but they may also include indicators that are of individual relevance for consumers to find the products, providers, or livestock systems that stand out positively, as proposed in the concept of positive welfare (Yeates and Main, 2008). The consumers' personal standards can then be compared to the actual AW performance of an underlying product in the database. This may be done at the level of a supply chain, farm or even the individual farm animal, depending on the data that are available. Hereafter, we refer to this as a *selection system*.

In the supermarket setting, the results of the comparison in the selection system may be communicated by a simple green or red light on a mobile phone application that consumers use to scan products. This reduces the complexity of AW information provided at the point-of-sale. Alternatively, retailers could build such systems inside smart shopping trollies or self-service price scanning devices to account for individual consumer demands (Larson, 2019). In an online environment, the comparison between preferences for AW and performance in AW would be even easier to establish because the entire purchasing process occurs online, allowing consumers to 'filter' their shopping baskets based on the indicated, personalised preferences. Considering that filtering based on personal preferences is already a common service for customers in other areas of e-commerce, such as insurance, energy, finance, telecommunication, and travel; and the fact that about 36% of Dutch consumers do their grocery shopping online even before the Covid-19 pandemic (Statista, 2022), online shopping might be the status quo in future retailing, once again pointing to the need for innovative, technology-based labelling solutions. A potential pitfall of the solution, of course, is that it requires consumers to actively input and indicate their preferences in the selection system on topics they are unlikely to have heard of, let alone have opinions on, like tail-biting pigs, lameness in cows and stress levels in laying hens, for example. Here, a simple solution is that consumers need not form

opinions about each parameter themselves, but adopt the standards of organisations, institutions, or someone they trust (*cf.*, Cheung and Lee, 2006). This can be the organic community, the RSPCA, Jamie Oliver, Dwayne 'The Rock' Johnson, Greta Thunberg or any other organisation or role model that people respect and identify with. With a simple click, these pre-defined sets of preferences may be adopted and used, and at whatever point in time a consumer wishes to deviate, they can change back to their personal preferences. An interesting side-effect is that farmers and companies in the chain can use the information form the selection system to obtain a better understanding of their customers' preferences, allowing them to produce matching AW levels and predict demands.

Ending the Confusion

A selection system will solve at least some of the confusion pertaining to labels (Krampe, et al., 2021). This is for the simple reason that labels as we know them would cease to exist. They might transform into organisations that advise consumers about the standards that they may use in their selection system. At the same time, when the confusion about labels is removed, it can give way to another source of confusion, namely, between organisations and individuals that inform consumers on which standards to use. The underlying problem, that AW is in fact too technical for most consumers to form opinions about, is after all not solved and probably inevitable to some extent. There could potentially be many influencers. One way to prevent new confusion is to allow only a limited number of advisory 'standard setters' in the selection system that consumers can choose from. The debate will than focus more on which 'standard setters' should have access to the system than on the standards themselves. The system would become less democratic though.

Our results on confusion about AW labels may be affected by the presence of many other labels in the market, pertaining to the environment, fair trade, nutritional value, food safety and other aspects. The selection systems sketched out above are not limited to AW, of course, but are much more likely to succeed if they incorporate all important aspects of nutritious, healthy sustainable food or price issues. Having one system that includes different sections in which consumers can indicate their preferences will probably limit the confusion. Currently, an eco-score system for food is being developed along the same lines as the nutri-score system, which has been implemented in several European countries (Chantal and Hercberg, 2017; De Bauw et al., 2021). The integration of such a system leads to debates that focus on whether or not, and if so how, the different scores should be presented or merged into a single score (Julia, 2020). This movement (the integration of additional consumer demands related to sustainability) seems a logical candidate to evolve into a selection system that could also include AW scores.

Bringing the Price-Sensitivity Problem to a Halt

The price sensitivity of 'hypocritic' consumers that want animals to be treated well but do not want to pay for it in a shopping context is perhaps the most persistent problem. The selection system can potentially help to solve the price sensitivity problem. First, after entering their preferences in the selection system, consumers may see a restricted number of products for them to consider. This probably works particularly well in an online context, which is usually designed for consumers to make their purchases as efficiently as possible. If they voluntarily agree to limit their options to those that meet their preferences, they can easily pick their products from the options available without later regretting their decisions. In a physical, offline supermarket, this process will be more difficult. Stores are often designed to keep consumers in the supermarket as long as possible to bring promotions and more expensive products to their attention. Being confronted with one's self-determined limitations may then be perceived as annoying. Those who persist purchasing the items that fit their AW preferences may, over time, develop purchasing routines, thus leading to the desired behaviour change. Retailers can also foster those developments by integrating innovative technology at the point-of-sale, which allow consumers to select their preferred products *via* their smartphone devices, for example using the beacon technology that allows to transmit Bluetooth signals/information to consumers' mobile smart(phone) devices in a specific area, such as in the supermarket (van De Sanden, et al., 2019).

The system may potentially offer another incentive to help consumers stick to their indicated preferences, namely by providing feedback after purchases, for example by sending them weekly or bi-weekly feedback reports about how their purchases match their criteria and giving them concrete suggestions for alternative products to improve their (AW) performance. Currently, however, AW labels are mostly presented to consumers in the *purchase stage*. So, adding a selection system to increase the emphasis or even shift it to the pre-purchase stage might complete the customer journey (*cf.*, Lemon and Verhoef, 2016). The *post-purchase stage* is also an unexplored territory where AW and other sustainability aspects could also play a role through the provision of the feedback reports. Consumers could share their performance on social media. By showing how well they perform, they could inspire their friends and acquaintances to improve their performances and establish new social norms about what is acceptable in terms of AW (*cf.*, Melnyk et al., 2019).

Innovation to Trade AW Up

According to our findings, consumers perceive the innovative capacity of the dairy and pig sectors as moderate. The selection system as described above can provide another push to innovation, not only on the consumer side, but also along the supply chain. If companies in the supply chain were to get access to the information from the selection system and consumers would at least stick to what they promised to a reasonable extent, companies would know what to bring to markets and farmers would know at which welfare levels they should keep their animals without wondering too much whether there would be a market for their products. Such information, therefore, considerably lower the investment risks for farmers and other companies along the value chain. In addition, the information may help them to find new market segments. For example, farmers can possibly discover a group of consumers in their

neighbourhood with AW demands that are too specific for sales through a supermarket, but feasible for sales through local butchers. This would create shorter supply chains and involve direct connections between consumers and farmers as an innovative business model. Such innovations could therefore create upward competition in which welfare standards increase every time an entrepreneur found another market segment to serve at higher standards.

FUTURE RESEARCH AND FINAL CONSIDERATIONS

Our study also raises some additional questions that can be explored in future research. Although some potential PLF-based indicators have been identified that could be incorporated into the selection system, the question remains *whether* and *how* the data generated can provide reliable and validated information. In addition, future research should identify the 'standard setters' that should have access to the selection system. From a traditional economic perspective, the added value of sharing PLF data is benefits minus costs, a view that indicates the importance of perceived costs and risks in explaining the primary (data) producers' preference formation for adopting innovations. It is therefore crucial to also consider the perspective of primary (data) producers on the selection system in future research.

The scenario outlined here for overcoming the persistent problems at consumer level related to AW labelling is undoubtedly futuristic. For supermarkets, cheap meat can, for example, be a strong instrument for attracting consumers to their stores. Supermarkets are currently in a position in the chain that allows them to ignore or even obstruct the implementation of a selection system. In addition, many consumers will not be eager to adopt a selection system right away, as they may consider it too different from their current ways of purchasing groceries. Traditionally, such radical innovations would be implemented from north to south as a 'waterfall' strategy, assuming that the most innovative consumers are in the north and the most conservative in the south (Kalish et al., 1995). Our findings, however, show that market segments exist across the four countries examined here, suggesting that innovativeness is not just determined by hemisphere, but by other factors. A 'sprinkler' strategy to disseminate the innovation therefore seems more fitting, introducing the innovation in several countries, in places where it would be promising and grow further from these centres out, towards the peripheries (Kalish et al., 1995). The transformation of markets for animal-based food will not happen overnight, but PLF and the integration of PLF-data into e-commerce and supply chain management certainly offer new solutions to incorporate animal product labelling into the entire consumer purchase process (including the pre-, during and post-purchase phases). Companies, governments, NGOs, farmers, and other supply chain actors together have the agency to bend the process of market innovation in different directions, leading to different outcomes with different roles of AW labelling. To accomplish their mission more successfully, perhaps AW labels should evolve into something that we would no longer recognise as AW labels.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Conceptualisation, PI and CK; methodology, CK and PI; formal analysis, CK and PI; writing, PI and CK. Both authors have read and agreed to the current version of the manuscript.

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