

Public perceptions of precision livestock farming use in the dairy industry: A narrative review

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Abstract

To remain sustainable, the livestock industries must demonstrate commitment to addressing animal welfare concerns from the public. Researchers have proposed precision dairy technologies (PDTs) as a potential solution to ameliorate concerns from the public. The aims of this review were to identify methods used by researchers in the investigation of public perceptions of PDTs and describe the current knowledge of public perceptions. Three online databases (Google Scholar, PubMed, and Web of Science Core Collection) were used to search for scientific articles that investigated public concerns and attitudes toward the use of technology in the context of dairy farming. A total of 453 publications were screened; two publications fit all inclusion criteria and were included in this review. Both focused on studies conducted among the European public, with one using publicly distributed surveys and another using focus groups. Investigated topics included the state of public perceptions related to PDTs, as well as desires for using technology on dairy farms. Public concerns related to three major concepts: 1) industrialization in agriculture, 2) transparency of dairy products, and 3) animal welfare. Knowing more about how the public views technology use as well as how to best engage society in conversations about technology use on farms is integral to improving the social sustainability of the dairy industry.

Keywords: animal welfare, precision dairy technology, public perception, social science

Introduction

As the dairy industry has continued to evolve in the pursuit of refining practices and enhancing productivity, there has also been an increase in public scrutiny surrounding many practices performed on farms (Weary and von Keyserlingk, 2017). Issues related to animal welfare, environmental considerations, and the welfare of farm workers are of special consideration (Cardoso et al., 2016). To enhance the sustainability of the dairy industry, there must be a reconciliation of these concerns, particularly as they relate to animal welfare (Weary and von Keyserlingk, 2017). As a potential solution for the mitigation of these concerns, various approaches have been utilized to identify, as well as attempt to ameliorate, the concerns of the public. For example, the use of publicly distributed surveys and focus groups has been instrumental in furthering scientific understanding of these issues (Pfeiffer et al., 2020; Krampe et al., 2021).

Much attention has been directed toward the development and implementation of precision dairy technologies (PDT), which are technologies that allow individual animals to be tracked to monitor behavioral patterns for the purposes of detecting estrous, calving, disease, or other behaviors of interest (Eckelkamp and Bewley, 2020). A recent review by Henchion et al. (2022) addressed the use of prior research to better inform the development of technologies used in dairy production; however, the focus of their work was on the development and implementation of technologies for the dairy industry while also exploring areas of agreement and tension between different stakeholders. Their work also included technologies such as genetic modification, which do not fit the classification of precision technology. To date, specific reviews are lacking with respect to public perceptions of precision technology use on dairy farms. Thus, the objective of

this narrative review was to address this gap. Specifically, we sought to: 1) identify methods used by researchers in the investigation of public perceptions of PDTs and 2) describe the current knowledge of public perceptions on PDTs.

Materials and methods

Populations

For inclusion in this review, papers must have focused on members of the lay public as their population of interest. Within the literature, some terms to describe the lay public (hereafter, ‘public’) appear to have been used interchangeably. For the purposes of this review, we use the term ‘public’ to refer to individuals without any affiliation with the dairy industry at any stage of production. Such individuals have been referred to as consumers, citizens, and laypersons in the literature; while the terms ‘consumer’ and ‘citizen’ are distinct with respect to their societal roles (consumers act as purchasers in the market economy, while citizens are those who contribute to a social consensus as members of civil society (Thomas, 2013)), they each are considered as ‘the public’ and hence were relevant for inclusion in this review.

Outcomes

Outcomes of interest were those which resulted in conclusions of relevant areas of concern related to precision technologies, as well as public perceptions and attitudes toward precision technology usage on dairy farms. In addition, papers that identified public opinions and perceptions toward precision technologies used on dairy farms were also within the scope of this review.

Table 1: Database searches and queries

Search String	Number of Results	Database
consumer perce* use technology agriculture dairy	~18,700	Google Scholar
attitude consumer perception AND dairy "precision livestock"	256	Google Scholar
public OR consum* perception "precision dairy technology"	36	Google Scholar
(ALL=(public perc*)) AND ((ALL=(precision dairy technolog*)) OR ALL=(dairy technolog*))	115	Web of Science Core Collection
(TS=(opinion* OR percep*)) AND ALL=(dairy)) AND ALL=(technolog* precis*)	30	Web of Science Core Collection
(dairy farming) AND (public perception) AND (technolog*)	13	PubMed

Limitations

Academic journals written in English were included in this review. No limitation was imposed on the year of publication or the country of origin. As this was a preliminary review of the literature, we chose to focus on

3 databases which may have resulted in missing manuscripts that may have been captured in other databases.

Search

Searches were designed in three databases with the assistance of the University of Kentucky library system. The databases utilized were PubMed, Web of Science Core Collection, and Google Scholar. Table 1 contains all search terms organized by database along with the number of results returned by each query. The initial literature search was conducted to establish a preliminary foundation to roughly determine the number of articles likely to contain relevant information, while a more in-depth search was performed to better capture papers that had relevant materials. Search terms utilized in finding articles included perce*/opinion*/consider*, consum*/ public*/ laymen*/ citizen*, precis* technolog*/ PDT/ PLF, and dairy*. Searches were conducted from November 1st, 2022 to January 10th, 2023.

Selection

Due to the relatively low quantity of papers discussed within the scope of this review, papers returned from the search were manually screened for inclusion in the review. Initial screening involved selecting papers according to relevant titles and abstracts, followed by further exclusion by incorrect publication type, as only peer-reviewed academic journal articles were included. After this selection, papers were then examined and excluded if the population of interest included individuals other than the public, or did not have an emphasis on technology usage with dairy cattle.

Appraisal

The papers included in this review were appraised to best fit the goals of this paper. All papers were reviewed by a trained scientist and the full text of each manuscript was evaluated to ensure accordance with the themes of the review, e.g., to confirm use of validated methodologies and papers' ability to draw conclusions related to public perceptions of the uses of PLF in dairy production systems. Individual papers were analyzed to highlight their research aims, methods of investigation, and conclusions.

Results and discussion

Search results and inclusion

Preliminary search results returned approximately 18,700 results from all databases searched in Table 1. After adding more relevant search terms and excluding terms outside the scope this yielded 453 papers. After further exclusion due to remaining criteria (e.g., improper study population, non-English language, and incorrect publication type), this left us with two papers for review. The publication years of the final analyzed set of papers were 2020-2021.

Approaches to investigate perceptions of PDT

There are several ways that researchers have investigated public perceptions and acceptance of technology usage on dairy farms. In the context of this review, perception refers to the mental interpretation and understanding of a concept (Pfeiffer et al., 2020). The term 'acceptance' has some nuance in its usage, but for the purposes of this article, the term refers to the concept of measuring either advocacy or rejection of a specific topic by a population (Amin et al., 2011). 'Attitude' refers to an individual's positive or negative feelings associated with the topic being investigated (Ajzen, 2001).

(Pfeiffer et al., 2020): This paper developed a specific model to evaluate the acceptance of digital farming technologies used in livestock production in Germany. Their approach was organized into 3 distinct phases, allowing them to form a construct of acceptance. The first phase had the purpose of assessing the attitudes

of a subject toward a product prior to any purchase or use. The next phase, called the action phase, was characterized by the adoption or purchasing of the product. The third and final phase consisted of the product being utilized by the subject. Notably, in the case of technology usage on farms, there is not a use phase that can be assessed using this model as the benefits of using technology on farms does not directly benefit the consumer but rather may impact their beliefs and values (i.e., influencing animal welfare or the environment). To gain a comprehensive view of opinions, this research team used a mixed methods approach. This was accomplished through a nationwide survey distributed online to German citizens, for a total of 2012 samples available for analysis.

Five-point Likert scales were employed to evaluate 3 research fields: 1) attitudes toward farming technology usage and evaluation of the effects of DFT (digital farming technology) on the farm staff, consumers, and crop/animal production, 2) the extent of agreement to a proposed state subsidy to farmers to incentivize the use of DFT in a practical setting, and 3) the influence of demographic factors and attitudes toward farming and farmers on attitudinal acceptance of DFT. By using this multifaceted approach, the researchers had the ability to evaluate acceptance as well as infer sources of acceptance in connection with other factors inquired about in the questionnaire.

In addition, a fourth research field was investigated using a qualitative approach, allowing respondents to openly provide their thoughts on images of specific technologies. The technologies pertinent to this review were milking robots and automated feeding technologies, although crop production was a topic included in the original study as well.

(Krampe et al., 2021): In this study, the research team sought to investigate public perceptions of Precision Livestock Farming (PLF) using consumer focus groups conducted in Finland, the Netherlands, and Spain.

A total of 56 individuals participated in focus group discussions about the use of PLF technologies in the context of pork or dairy production, depending on their group. Three main topics were discussed in the groups to identify perceptions related to PLF and the implication of implementing PLF into livestock production systems. First, consumers were asked about the constraints and opportunities of PLF to explore what factors may have an impact on their acceptance of PLF. Next, they were asked about the benefits and drawbacks of using PLF as well as the possible implications of influences on production. Third, the groups were asked about their demands and desired approaches to communicating about PLF topics.

Perceptions of technology use on dairy farms

Public perceptions can differ greatly, depending on how topics are presented. Weary and von Keyserlingk (2017) discussed how simply providing information on a topic may not be sufficient for increasing acceptance of a practice already viewed as contentious. Krampe et al. (2021) reported that the public perceives precision technologies as a potential means to improve animal welfare, especially regarding early disease detection. In addition, they found that the public is more likely to accept a technology so long as there is a trustworthy source that they feel validates its usage. Pfeiffer et al. (2020) found that a large proportion of the public was ultimately undecided in their attitudes toward PDT usage, leading them to conclude that careful facilitation of dialogues between farmers and the public may be necessary to build trust and ultimately understanding of PDT usage.

Areas of public concern

Public perceptions toward dairy production vary widely in part because they are intrinsically linked to demographic factors and values for agricultural production and animal welfare (Boogaard et al., 2011). Erosion of public trust (Weary and von Keyserlingk, 2017) and unfamiliarity with agricultural practices (Ritter et al., 2019) have been cited as potential sources for public concern. The main areas of public concern around

technology usage in the dairy industry identified from this review can be organized into 3 major categories: industrialization of agriculture, labeling and transparency, and animal welfare.

Industrialization of agriculture

The industrialization of agriculture is a contentious and multifaceted issue (Clay et al., 2020). This area of public concern has been investigated recently with respect to the dairy industry (Busch et al., 2022), with practices resulting from intensification regarded as unnatural and undesirable to the members of the public (Busch et al., 2022). In addition to industrialization, there has been a growing gap between social and physical proximity to farming that has influenced the acceptance of animal agriculture practices and technology usage in agriculture (Boogaard et al., 2011). Implementing precision technologies on farms has the potential to generate additional public concern about unnaturalistic circumstances, further stoking concerns relating to industrialization in the food supply chain, especially for individuals unfamiliar with the technologies and their purposes (Ritter et al., 2019; Krampe et al., 2021).

Labeling and transparency

Transparent labeling and public trust are integral to the commercial success of food products, as labels are regarded as the primary source of information for animal-based products for those who purchase them (Krampe et al., 2021). Members of the public want to know the methods and technologies used in the production of their dairy products to make more informed decisions that align with their values (Krampe et al., 2021). There is a precedent that the use of technologies in food production, especially in the case of genetic modification, can be seen as problematic to members of the public (Ritter et al., 2019). Conversely, increased transparency around PLF usage via clearer labeling may lead to improved public trust, though this has not yet been investigated.

Animal welfare

A key source of public concern related to precision technology is the potential for reducing the welfare of animals on farms (Pfeiffer et al., 2021). Notably, there are concerns that a decrease in human attention directed toward animals may be detrimental to animal welfare (Krampe et al., 2021). At the same time, other work has shown that the public is more accepting of innovations if they are perceived to enhance animal welfare (Ritter et al., 2019), even more so than other demonstrated benefits such as profit or worker welfare.

Summary and recommendations

There is a complex relationship between the perceptions of the public and the use of technology in dairy farming. In this review, methods to investigate and findings relative to public concerns about precision technology usage in dairy farming were explored. As the sustainability of animal agriculture is increasingly called into question (Weary and von Keyserlingk, 2017), it is imperative to better understand the contributions of new innovations prior to their adoption so that more informed decisions can be made.

If precision dairy technologies are to be proposed as a socially sustainable concept, we require scientific evidence for enhanced animal welfare through the adoption and implementation of precision dairy technologies on farms. Concurrently, it would be beneficial to more clearly understand how the public regards PLF to inform labeling practices. The results of this review indicate that there have been two methods employed to investigate public perceptions of technology use in animal agriculture, namely the use of focus groups and online surveys (Krampe et al., 2021, Pfeiffer et al., 2020). However, there remains ample opportunity to expand on current knowledge, particularly regarding the interplay between the use of precision technologies on farms and animal welfare, and how this is perceived by the public. Studies thus far have sought to understand how very specific implementations of technologies (genetic modification or

automatic milking systems) are perceived by the public. However, there is a need for further research to directly investigate public perceptions of precision technologies in the dairy industry.

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