3.4 Novel technologies and responsibilities

Animal-centred AI: On the need of value-sensitive innovation in the context of animal production

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Abstract

Within the current, transformative developments of the agricultural sector, animal welfare plays an important role. Societal acceptance of using animals in food production systems is no longer a given. The present understanding of animal welfare goes beyond a mere prevention of harm and focuses on enabling positive experiences and an overall 'good life'. At the same time, the development and application of Artificial Intelligence (AI)-based methods in animal production is advancing faster than a comprised socio-ethical assessment of these technologies. This approach may favour short-term improvements of certain production variables. However, it is not sustainable in the long-term, for instance if the actual aims of technology use, the responsibilities for achieving these aims and the duty towards the animals subjected to the technologies are unclear. A mismatch between the values implied in the applied AI-based methods and the values implied in people's visions on animals may lead to increased societal concerns and a rejection of technology use in animal production or animal production in general. In this paper, I argue why there is a need to develop and apply AI-based methods which align with people's visions on animals, which enable a 'good life' for animals in food production systems and which support farmers to sustainably transform their production. This includes a shift from monitoring variables that can be monitored with AI-based methods towards monitoring variables that are actually meaningful for (1) implementing people's visions on animals into practice; (2) improving animals' lives; and (3) supporting farmers to meet societal demands regarding animal production. Using AI in a way that is in line with people's values concerning animals can be a major driver for transformative developments in the animal agricultural sector which will contribute to its public acceptance and long-term sustainability. To reach this aim, I propose a collaborative approach involving experts from the fields of animal ethics, ethics of technology, computer science and animal welfare science. Moreover, these efforts can only be successful if partners from the relevant animal industries are already involved in the design-phase of innovations.

Keywords: automatic monitoring, animal welfare, public values, transdisciplinary collaboration

Introduction

The agricultural sector is facing major challenges, such as climate change, limited natural resources and biodiversity loss. As a response to these challenges, several transformative developments are currently taking place, including a shift towards more circular food production systems. Within these developments, animal welfare plays an important role, since societal acceptance of using animals in food production systems no longer depends on economic, environmental or public health criteria only (Kanis *et al*., 2003). At the same time, the development of AI-based methods in animal agriculture is outpacing the socio-ethical assessment of these technologies. While AI-based methods could lead the way in meeting the increasing demand for animal welfare monitoring, they also come with their own challenges (e.g. Tuyttens *et al*., 2022).

Adopting a welfarist perspective, I first argue why the currently parallel developments of more complex concepts of animal welfare and more advanced technologies in animal agriculture need to be reconciled in order to facilitate a transition towards humane livestock farming through meaningful, animal-centred welfare monitoring. Second, I elucidate the assumptions and scenarios on which my argument is based. I close by proposing a collaborative approach that involves relevant stakeholders right from the design-phase of innovations to realise animal-centred, value-sensitive AI methods for animal agriculture.

Two parallel developments in animal agriculture

The growing emphasis on animal welfare in animal agriculture is accompanied by the adoption of more diverse and complex concepts of animal welfare in academia and society (e.g. Arndt *et al*., 2022; Weary and Robbins, 2019). Recent initiatives like 'Dierwaardige veehouderij' (humane livestock farming) on a national level in the Netherlands (RDA, 2021) and 'End the cage age' on a European level (Rodenburg *et al*., 2020), illustrate that the present understanding of animal welfare goes beyond a mere prevention of harm. What these novel views on animal welfare have in common is that they focus on enabling positive states and experiences (Mellor, 2015) and an overall 'good life' for animals in food production systems (Edgar *et al*., 2013).

These developments make animal welfare monitoring in practice increasingly important but also increasingly challenging. Important because society demands that the level of animal welfare increases and that academic and public perspectives on animal welfare are realised in the field. As animal welfare is not directly reflected in the characteristics or the quality of animal products, it is essential to assess how an animal is faring during its lifetime. Animal welfare monitoring is therefore the basis for all public information strategies, such as labels or certification schemes, regardless of whether these rely on direct consumer control or trust. Animal welfare monitoring is also in the producers' interest as it allows them to intervene in time, to adapt their management strategies and to check the effects of these adaptations. Finally, animal welfare monitoring is the only way of 'asking' the animals themselves how they experience their situation. This knowledge about animal experiences and conditions is the basis for developing and implementing meaningful strategies to improve animal welfare in practice. What makes animal welfare monitoring challenging from this more complex perspective on animals in food production systems, is that it requires more sophisticated and more frequent assessments. Routinely collected indicators, such as mortality rates or antimicrobial use do not provide sufficient information on how an animal experiences its living conditions and is able to adapt to them.

By exceeding human observing capacities in terms of accuracy and continuity, AI-based methods could be a promising step towards a novel monitoring approach that accounts for more complex concepts of animal welfare. Indeed, such technologies are emerging rapidly in the field of animal agriculture, and their proponents promise, in addition to various other benefits, an improvement of animal welfare (Vranken and Berckmans, 2017). However, these two developments — the adoption of complex concepts of animal welfare and the application of AI-based methods in animal agriculture – are parallel phenomena rather than a concerted initiative to improve the living conditions for animals in food production systems. On the one hand, initiatives like 'Dierwaardige veehouderij' and 'End the cage age' correspond to several aspects of people's visions on animals, and thus pave the way for a transition towards humane livestock farming. At the same time, these initiatives tend to ignore the technological advances emerging in the sector. On the other hand, the development of AI-based methods in animal agriculture is advancing faster than a comprised socio-ethical assessment of these technologies. This tension is not sustainable in the long-term, for instance if the actual aims of technology use, the responsibilities for achieving these aims and the duty towards the animals subjected to the technologies are unclear. A mismatch between the values implied in the applied AI-based methods and the values implied in

people's visions on animals may lead to increased societal concerns or even a rejection of technology use in animal agriculture or animal agriculture in general.

To make full use of the potential of AI-based technologies for animal welfare monitoring in a sustainable way, they must be responsive to publicly shared views on concepts of animal welfare. To develop and apply such technologies, we need to better understand the underlying values of scientific animal welfare concepts and explore ways to implement these values into the proposed AI-based monitoring solutions. For this, we do not need to start from scratch but can build on recent innovations, for instance regarding computer vison- or sensor-based animal behaviour monitoring (e,.g. Stygar *et al*., 2021). These existing technologies offer unique opportunities for analysing their implicit values. Are the behaviours monitored for instance indicators for the fulfilment of species-typical desires, such as foraging? In this way, existing technologies can serve as building blocks for an integration with animal welfare concepts. Using AI in a way that is in line with people's values concerning animals can be a major driver for transformative developments in the animal agriculture sector which will contribute to its public acceptance and long-term sustainability.

Three assumptions in the context of animals and AI-based technologies

My argument is based on the following assumptions and scenarios. First, animals will be part of future food systems. It is beyond question that the per capita consumption of animal proteins must be radically reduced to be considered sustainable. The urgent societal goals for the agricultural sector to be future-proof include a transition towards circular and climate-neutral food production systems. Within these systems, animals play an important role. This is due to their ability to convert leftovers from the food industry and sources of raw fibre that are not suitable for human consumption into nutritious, high-quality proteins. Second, animal welfare is important and a goal in itself. Animals in food production systems are more than roughage or leftover converting units. They are recognized as sentient beings who can interact and build relationships with other animals and humans. Therefore, it becomes increasingly important to provide animals with the capacities, the abilities and the opportunities to adapt to their social and physical environment in a way that they themselves experience as rewarding. Finally, AI-based technologies have the potential to transform animal welfare monitoring. As animals lack direct self-reporting capacities, their conditions and experiences can only be assessed by using (behavioural-) indicators. Complex concepts of animal welfare require more detailed indicators and more sophisticated methods to monitor these in order to ensure that animals are leading a 'good life' in practice. Deployed properly, AI-based technologies can exceed human observing capacities in terms of accuracy and continuity. These technologies make it possible to collect, analyse and process large amounts of information on animals over long periods of time without binding human labour.

It should be noted that adopting alternative assumptions or scenarios will obviously lead to different conclusions regarding the use of AI-based technologies for animals. If for instance future food systems will be animal free, AI-based welfare monitoring systems will be obsolete, at least in the context of farm animals. Similarly, if animal welfare was not important and at most an instrumental goal, there would be no interest in an AI-based animal welfare monitoring system, as it does not directly increase production performance or product quality.

One approach to realise animal-centred AI in animal agriculture

As argued above, the adoption of complex concepts of animal welfare makes a radical chance in animal welfare monitoring practices inevitable. In terms of accuracy, reliability and continuity of data collection and analysis, only AI-based technologies have the potential to meet the demands of these novel monitoring approaches. However, if current developments continue and AI methods are mainly

used for production-oriented workflows, neglecting important societal values regarding animals, societal concerns will increase and technology use in animal agriculture and animal agriculture in general will be rejected. There needs to be a shift from monitoring variables that can be monitored with AI-based methods towards monitoring variables that are actually meaningful for (1) implementing people's visions on animals into practice; (2) improving animals' lives; and (3) supporting farmers to meet societal demands regarding humane livestock farming. Initiating this shift requires the expertise of disparate academic fields, such as animal ethics, ethics of technology, computer science and animal welfare science. To ensure that AI-based monitoring technologies are socially robust and offer real solutions to the challenges stakeholders face in practice, it is essential to also involve partners from industry and public organisations from the start.

The monitoring of animal welfare is more than just a technical challenge. As normative choices are inevitable in the context of animal welfare, it is important to make them as explicit as possible, to discuss them with relevant stakeholders and to analyse them through the animal welfare ethics literature. Traditional approaches in animal ethics focus on individual animals, whereas AI-based methods may also or only be relevant on a group or a population level. Traditional approaches also tend to centre on welfare or rights, whereas with AI for animals, questions of care and responsibility may become more prominent. Therefore, building blocks of an animal ethics that can deal with the dynamics and broad range of ethical dimensions of AI in the context of animal agriculture need to be defined. In addition, approaches of animal ethics need to directly interact and be compatible with insights from ethics of technology, which is currently still being neglected. One possibility of integration would be to use the Design for Values framework (Kroes and van de Poel, 2015) to translate people's values regarding animals and animal welfare into design specifications for AI-based animal welfare monitoring technologies. The design requirements need to be specified in a way that they operationalise the overall aim of creating AI-based methods which enable animals to lead a 'good life' and support farmers to sustainably transform their production. These considerations should serve as guidance for the practical development of AI-based technologies for animal welfare monitoring.

For the practical development of AI-based technologies, expertise from the fields of computer science and animal welfare science is necessary. This includes knowledge on defining soft- and hardware requirements, on establishing a data pipeline and on the biological relevance of certain animal welfare indicators. Obviously, technologies developed in this way need to be used and valued by farmers and their advisors, and they need to act based on the systems' outputs. Therefore, farmers and their advisors need to know how to use the system and how it benefits their animals and their business. To realise this, farmers should be involved in the design-phase of novel AI-based technologies, for instance by inviting them to training workshops. These trainings should not be limited to the one-sided sending of information by the technology developers or providers, but should be focussed on moments of reflection in which farmers can contribute first experiences with for instance the user friendliness of the technology. The technology developers should use this input to further advance and improve the AI-based monitoring technologies and thus encourage their broader adoption.

To ultimately mitigate societal concerns about animal agriculture and technology use by implementing AI-based methods for animal welfare monitoring which are coherent with people's values, society needs to know about these technologies and value them. This can be realised — at least for a group of people from the broader society — by organising expedition activities on collaborating farms. During these activities, people explore the technologies in an interactive way. They may for instance get the chance to experiment with parts of the technology, such as trying out activity sensors on themselves. Through this activity, people can learn about the practical functions of the technology, but also take the perspective of the animals for which it is developed. This is a starting point for reflection on the values implemented in AI-based technologies for animal welfare monitoring. In order to communicate the use of AI-based

monitoring technologies to the general public, it can be indicated on the packaging of animal products, as for instance the use of green energy in agriculture is currently explained on milk packages of some companies. In the long-term, the use of the monitoring technologies can also be linked to established labels that consumers trust.

Collaboration among these diverse stakeholders in research projects or other initiatives does not happen spontaneously. If we take transdisciplinary collaboration seriously, additional efforts are needed to develop integrated knowledge from science and society, which has the potential to bring about change and real societal impact. What is needed is a strong facilitation programme to ensure an integration of knowledge and methods from the different disciplines and branches involved. This integration should be understood as mutual learning moments, which means that academic partners should not only present their initial findings to other stakeholders and ask for their feedback, but that reliable and socially robust knowledge is created together. These mutual learning moments are important, as they allow for a 'reality-check' of assumptions and results and also enable to take stakeholder experiences seriously and integrate them into further efforts of development and innovation.

Conclusions

In this paper, I argued that the currently parallel adoption of more complex concepts of animal welfare in science and society and the development of advanced AI-based technologies in animal agriculture need to be reconciled in order to facilitate a transition towards humane livestock farming through meaningful, animal-centred welfare monitoring. I further explicated the assumptions and scenarios which underlie my argument. In practice this implies that a) the development of AI-based technologies for animal welfare monitoring should be characterised by a strong theoretical underpinning and a close interaction with agricultural practice and society, b) the expertise of various academic fields, industries and public organisations is necessary to achieve this, and c) continuous, thorough facilitation is essential to establish mutual trust and collaboration among a diverse group of stakeholders.

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