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Appropriate data visualisation is key to Precision Livestock Farming acceptance

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ABSTRACT

Most farmers do not have the skills and time to utilize new Precision Livestock Farming (PLF) technologies effectively. It is time consuming to combine and analyse the data coming from sensors in different formats and frequencies. As part of the EU-PLF project, the authors have developed a visualisation tool to bring together and analyse the scattered data, and present them in an easy to use format to the end user. The correct use of these data might improve animal welfare, and reduce emissions through the application of PLF techniques. Data were collected at five broiler farms and ten pig farms across Europe. At the farms, a number of variables were automatically measured including climate data, production data, environmental data, and data on animal behaviour coming from cameras and microphones. Simultaneously, the welfare of the animals was assessed by trained assessors on a regular basis by using the standardized Welfare Quality protocol. All data were gathered, stored and processed on a daily basis, and visualised on a web-based tool. End-users of the tool were trained on how to interpret the available information on the visualisation tool. This paper presents the development of this PLF data visualisation tool. The farmer's use of this tool and the early warning capabilities are described by six case studies. The selected farmers participated actively in evaluating its usefulness, resulting in a web-based visualisation tool that is practical and useful for both the farmer and other stakeholders (e.g. vets, advisors, researchers, etc.).

1. Introduction

The world population is expected to grow to 9.15 billion by 2050 according to the latest projections of the United Nations Population (FAO - Food and Agricultural Organization of the United Nations, 2017). The current population is 7 billion inhabitants, implying an increase of over 34%. Especially in former lower income countries the population in 2050 is likely to have higher economic possibilities (Charles et al., 2010). This has an impact on the worldwide demand for animal products. The demand is expected to increase by more than 40% in the next 15 years (Charles et al., 2010; FAO - Food and Agricultural Organization of the United Nations, 2017). Strikingly, the number of livestock farmers is decreasing (European Commission, 2017a) whilst the demand for livestock products (meat, milk, eggs) is increasing (Charles et al., 2010). This leads to larger farms and more intensive production (European Commission, 2017a, 2017b).

Recent years show a growing trend in intensive animal production resulting in an increased number of animals per stockperson (European Commission, 2017a). As highlighted in a recent study on animal welfare in the EU by Broom (2017) society believes that animals are entitled to receive individual attention while, due to scale, farmers have less time to extensively observe each individual animal (Verbeke and Viaene, 1999). It is practically impossible for most European farmers to meet the society's beliefs to have a strong relationship with their animals. As a result of this contradiction there are social and economic consequences for all stakeholders involved, particularly the farmers (Gocsik et al., 2013). Besides, there is an increasing awareness and concerns about animal welfare and health. Today's consumers are more convinced that animals kept for food production should be raised, treated and slaughtered in a more humane way and should have a life worth living (Charles et al., 2010; Tuyttens et al., 2014; Wathes et al., 2008). While Europe has invested in developing standardized

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methodologies for assessing and scoring animal welfare at farm level (Blokhuis et al., 2010) there is still a long way to go to actually improve animal welfare in intensive production systems. There is a growing awareness of welfare conditions in animal production and a tendency towards more intensive production, resulting in a need for more precise monitoring (Berckmans, 2006; Robbins et al., 2016). For these reasons Europe has invested in a large multi-partner research project called EU-PLF, in order to deliver a validated blueprint proven through extensive field studies for an animal and farm-centric approach to innovative livestock farming in Europe (Berckmans, 2017).

Nowadays, a range of technologies is available that potentially can help farmers in real time monitoring of each individual animal (Ahrendt et al., 2011; Hemeryck and Berckmans, 2015; Huybrechts et al., 2014). Information and computer technologies (ICTs) offer a huge potential in this regard (Manning, 2015). The continuous automated monitoring of varying needs of individual living farm animals at every moment in space and time is called Precision Livestock Farming (PLF) (Berckmans, 2006). This results in automated "early warning systems" that simplify and improve the management of individual animals needs at any time (Dawkins et al., 2017; Huybrechts et al., 2014; Kashiha et al., 2014). The use of modern technology offers several advantages like ensuring more attention and 24/7 care to the individual animals but also automated welfare monitoring methods based on imaging and sounds without the need of human experts visiting the farms on a regular basis (Berckmans et al., 2015; Butterworth et al., 2015; Silvera et al., 2017). PLF has the potential to improve animal welfare (Rushen et al., 2012), increase the technical results (Cangar et al., 2006; Firk et al., 2002; Parsons et al., 2007), and minimize the environmental footprint (Parsons et al., 2007; Van Hertem et al., 2016). Sound and image analysis are interesting non-invasive technologies to monitor a group of animals without interfering their natural behaviours. The significant potential to automate continuous measurements on farms using modern technologies has been demonstrated on seven European Conferences on PLF and by peer-reviewed conference proceedings: ECPLF 2003 in Berlin, Germany (Werner and Jarfe, 2003), ECPLF 2005 in Uppsala, Sweden (Cox, 2005), ECPLF 2007 in Skiathos, Greece (Cox, 2007), ECPLF 2009 in Wageningen, the Netherlands (Lokhorst and Groot Koerkamp, 2009), ECPLF 2011 in Prague, Czech republic (Lokhorst and Berckmans, 2011), ECPLF 2013 in Leuven, Belgium (Berckmans and Vandermeulen, 2013), and ECPLF 2015 in Milano, Italy (Guarino and Berckmans, 2015). The main focus on these conferences is on the sensor development of new and improved measurement techniques in order to monitor animal behaviour, health and production in an automated way. Although there is a trend in the last few conferences towards sensor integration, there is still a lack of sensor data interpretation, sensor integration and data driven support decisions (Rutten et al., 2013). Despite the great potential of PLF, most farmers and other stakeholders (e.g. vets, feeding company advisors and so forth) do not currently have the skills to utilize these technologies effectively. It is time consuming to combine and analyse the data derived from different sensors in different formats and frequencies. So adoption of PLF technologies remains a big challenge and how to make the collected data relevant and useful for the farmer.

The aim of this work described in this paper was to describe a tool based on PLF technologies that has added value for the farmer and his animals, so that the farmer is able to improve his technical results, ensure animal welfare, and potentially reduce emissions. The authors have developed a visualisation tool to bring together data from multiple control units and PLF sensors on the farm, analyse the data and present them in an easy to interpret format to the farmer, so the farmer was able to make data driven decisions on his management. The visualisation tool was constantly adapted based on the feedback of the farmers.

2. Materials and methods

2.1. Selection of farms

The PLF-technologies were implemented on ten fattening pig farms and five broiler farms. The farms were selected by the technology providers (Fancom BV, Panningen, the Netherlands; SoundTalks NV, Leuven, Belgium). The selection of the farms was made based on a number of selection criteria (Table 1). Because two technology providers were included in the project, an emphasis was made on farms equipped with technology from these partners. In all farms, each criterion was rated (0: not available; 0.5: somewhat available; 1: available). For this study, the ten highest scoring pig farms and the five highest scoring broiler farms were selected (Table 2).

2.2. Data collection

Each farm was equipped with a set of PLF sensor techniques and control units. Data from the climate control units, control units for feed distribution and the weight biometrics unit were extracted

Table 1
Overview of the objective selection criteria for the farms in this study.

Criterion	High rating	Medium rating	Low rating
Score	1	0.5	0
Location in at least five different European countries	New country		Repeated country
Compatible climate control system	FANCOM	Other	None
Compatible feed control system	FANCOM	Other	None
Farm Management system	FANCOM	Other	None
At least 4 identical compartments of 100 to 200 pigs in same pig house	Yes	More or less	No
Reliable internet connection at farm	>5 MB	1–5 MB	<1 MB
History of respiratory health problems	Yes		No
Distance to local welfare assessors	<200 km	200–500 km	>500 km
Controlled light levels in compartment	Good	Adequate	Poor
Ability to connect to slaughterhouse reporting system	Yes	Not clarified	No
Willingness to cooperate in project	High	Medium	Low
Willingness to provide access to the farm for external people	High	Medium	Low
Willingness to act as an ambassador for PLF	High	Medium	Low
Familiarity with PC use	High	Medium	Low

Table 2
Geographical overview of the selected farms in the EUPLF project.

Farm	Country	Species
Farm 1	Netherlands	Poultry
Farm 2	Netherlands	Pigs
Farm 3	Spain	Pigs
Farm 4	Spain	Pigs
Farm 5	Hungary	Pigs
Farm 6	Hungary	Pigs
Farm 7	Netherlands	Pigs
Farm 8	United Kingdom	Poultry
Farm 9	Northern Ireland	Pigs
Farm 10	Spain	Poultry
Farm 11	United Kingdom	Poultry
Farm 12	France	Pigs
Farm 13	France	Pigs
Farm 14	Italy	Pigs
Farm 15	Italy	Poultry