

FARM
ANIMAL
WELL
BEING

12th Boehringer Ingelheim
Expert Forum

June 6th – 8th 2019 | Prague, Czech Republic

Do consumers and citizens want the **same thing?**



FARM
ANIMAL
WELL
BEING

Science shows that when farm animals are not just healthy, but also free of pain and discomfort, there are far-reaching positive consequences.

At Boehringer Ingelheim, we believe that vets play a key role in promoting better farming practices. Our aim is to build and share scientific knowledge around farm animal well-being, where effective pain management benefits livestock and rewards farmers, while satisfying the social demands for responsible farming.

Because farm animal
well-being **works.**



Boehringer Ingelheim Vetmedica GmbH
Binger Strasse 173
55216 Ingelheim am Rhein/ Germany
www.boehringer-ingelheim.com

Contact:
Dr. Laurent Goby - SBU Cattle / Ruminants
Email: laurent.goby@boehringer-ingelheim.com

Issued by Boehringer Ingelheim Vetmedica GmbH.
All rights reserved.

The enclosed abstracts are the property of the individual authors. The comments and opinions expressed therein are those of the authors and do not necessarily reflect the position or beliefs of Boehringer Ingelheim or its employees. No abstract should be reproduced, transmitted or used for 3rd party purposes without the express written consent of the author.

Contents

Do consumers and citizens want the same thing?

Do farm assurance schemes address consumers' expectations for better animal welfare? 7
Laura Higham, FAI Farms, UK

Citizens, consumers, farm animal welfare and willingness-to-pay 11
Professor Lynn J. Frewer, Newcastle University, UK

Setting up a safe and sustainable supply chain 15
Robert M. Erhard, Nestlé, Switzerland

Aligning the food value chain on animal welfare 21
Dr. Jeff Brose, Cargill Animal Nutrition, USA

From field to fork: ethical beef for everyone 25
Rob Drysdale, StraightLine Beef, UK

Ranking global food companies on farm animal welfare 29
Dr. Rory Sullivan and Nicky Amos, Chronos Sustainability, UK

The OIE Global Animal Welfare Strategy 33
Leopoldo H. Stuardo Escobar, World Organisation for Animal Health, France

Antimicrobial resistance and animal welfare: two sides of the same coin? 39
Professor Xavier Manteca, Autonomous University of Barcelona, Spain

Is lying time a relevant indicator of cow comfort around parturition? 45
Marianne Villettaz Robichaud, University of Montréal, Canada

50 Shades of Pain 47
Charlotte Winder, University of Guelph, Canada



Laura Higham
FAI Farms, UK

Laura graduated as a veterinary surgeon from the University of Edinburgh in 2008 and worked in mixed practice in the UK and New Zealand. To pursue an interest in international animal health, Laura joined an international animal welfare charity as a veterinary programme advisor, coordinating development and disaster response projects to support animal health and livelihoods in Africa, the Middle East and Central Asia. Her work also included the delivery of training to vets and animal health workers, the development of M&E tools and participatory research. Laura joined the FAI team in 2014 to pursue her interests in sustainable agriculture and farm animal welfare, and currently manages consultancy and research programmes with a number of high-profile food brands, driving sustainability in global food supply chains. She holds an MSc in International Animal Health with the University of Edinburgh and has a particular interest in food security, livestock-based livelihoods, 'One Health' and antimicrobial resistance.

Laura Higham
FAI Farms, UK

Do farm assurance schemes address consumers' expectations for better animal welfare?



The BVA's recent #ChooseAssured campaign kick-starts the UK veterinary profession's dialogue with citizen audiences regarding farm animal assurance schemes. The campaign's infographic¹ simply and effectively compares the standards of seven prominent schemes in terms of selected BVA priority areas, to support consumers' purchasing decisions. It shows that only two schemes prohibit confinement systems for laying hens and sows, highlighting the facilitation of normal behaviours as a critical differentiating factor between the standards. To drive positive outcomes for all aspects of animal welfare, I believe vets and citizens should support the assurance schemes that facilitate behavioural opportunity for all species, and help to provide a "good life" for animals.

In the UK, farm assurance schemes such as Red Tractor certify most of the livestock we produce, claiming to 'guarantee' defined standards for animal welfare, food safety and environmental practices. Compliance with such schemes has become a market qualifier for farmers to supply UK supermarkets, but the potential benefits generated by this method of product differentiation for animals and farmers may not have been fully captured to date, due to an uninformed consumer base². Farm assurance

is an area in which shoppers are thought to have a limited level of understanding, potentially due to the diversity of labels on packs and the complexity of standards for individual livestock species.

Citizen power

The potential to leverage the benefits of such schemes exists through a growing contingent of conscientious consumers – an emerging trend coined the 'Citizen Shift'³, in which individuals are wishing to create a more positive society including utilising their spending power to drive ethical food supply chains. Not least – they are interested in the animal welfare standards behind the meat, milk and egg products they buy. The #ChooseAssured campaign is a means of establishing a dialogue between vets and citizens, allowing us to drive purchasing decisions towards animal-based foods produced to the standards we advocate.

Differentiating factors

The #ChooseAssured infographic compares seven schemes according to their requirements for stunning prior to slaughter, veterinary involvement in health planning, prohibition of environments that substantially reduce behavioural opportunity, responsible use of antimicrobials, animal health

Consumers' expectations for better animal welfare?

and biosecurity, lifetime assurance and measures to protect the environment. There is broad agreement amongst schemes across most of the BVA priority areas; however, confinement systems that substantially reduce behavioural opportunity for laying hens and sows are only prohibited by two out of five relevant schemes – RSPCA-Assured and Soil Association, setting apart the facilitation of normal behaviours as a critical differentiating factor between the standards.

Species-specific behaviour

As a component of the FAWC's five freedoms⁴ of animal welfare, facilitating normal behaviours should be considered a requirement in the husbandry of all species, not a feature of premium standards alone. Indeed, more modern animal welfare philosophy views good welfare as a 'life worth living' or a 'good life for animals'⁵, and such definitions further elevate the importance of environmental enrichment in animal husbandry and positive indicators of welfare, including species-specific behaviours and play behaviours. Although such behaviours would be conspicuous in their absence in the assessment of companion animal welfare, their importance is not as prominent in farm animals. For example, use of the enriched colony cage for the productive lifetime of laying hens impedes the performance of dust bathing in hens⁶, and use of the farrowing crate for 4-5 weeks prevents nest making in farrowing sows⁷. Proponents of these confinement systems refer to their favourable health and productivity outcomes – for example, reduced prevalence of infectious diseases, reduced risk of keel bone damage in hens and reduced piglet mortality. But prioritising a limited repertoire of health and performance outcomes and excluding behavioural enrichment fails to capture the full impact of a farming practice or assurance scheme on animal welfare.

Challenging norms

In driving sustained improvements in animal welfare, it is necessary to question some of the 'norms' that are engrained in standard farming practice. For example, the farrowing crate was designed to reduce laid-on piglet mortality, and coupled with genetic selection of sows for litter size has created a highly efficient pig production system, but one that does not facilitate normal sow behaviours at farrowing. In free-farrowing systems, genetic selection for maternal behaviours⁸ is much more important to reduce the incidence of laid-on

piglet mortalities, and together with effective free-farrowing pen infrastructure⁹, provides a robust solution to mitigating the trade-off between providing behavioural opportunity and increasing piglet mortality.

Likewise, genetic selection in commercial laying hens has focused on prolific egg production over a 72-week lifecycle, but increasing productivity is linked to osteoporosis¹⁰. Keel bone fractures are a manifestation of this problem, and are often less prevalent in cage systems compared to cage-free environments, due to limited freedom of movement. This argument supports the confinement of laying hens based on a limited repertoire of health outcomes; but selecting robust laying hen genetics that are suitable for cage-free environments allowing hens to exhibit their full behavioural repertoire, and reviewing the design of house furniture to reduce keel bone fractures, offer more sustainable solutions that optimise all welfare outcomes.

I believe it is time for vets to be constructively critical about the systems deployed to farm the animals under our care, and support a shift towards those that generate balanced outcomes for all aspects of animal welfare, including physical health and psychological well-being. Because – as highlighted by the #ChooseAssured campaign – when it comes to facilitating normal, species-specific behaviours, the most prevalent standards for farm animal production in the UK are falling short of our ambition to provide a "good-life" for all animals.



Copyright ©2019, FAI Farms Limited, a Benchmark Holdings company. These materials are the exclusive property of FAI Farms Limited. All rights reserved.

References

1. BVA (2017) UK Farm Assurance Schemes. BVA, London [online] Available from: https://www.bva.co.uk/uploadedFiles/Content/News,_campaigns_and_policies/Policies/Farm_animals/FINAL%204.7.18%20-%20BVA%20UK%20Farm%20Assurance%20Schemes%20Infographic.%20pdf.pdf [Accessed 18 Jan 19].
2. Duffy, R. & Fearn, A. (2009) Value perceptions of farm assurance in the red meat supply chain. *British Food Journal*, 111 (7): 669-685. <https://doi.org/10.1108/00070700910972369>.
3. The New Citizen Project (2019) This is the citizen shift. [online] Available from: <https://www.citizenshift.info/> [Accessed 18 Jan 19].
4. Farm Animal Welfare Council (2009) The Five Freedoms. [online] Available from: <https://web.archive.org/nationalarchives.gov.uk/20121010012427/http://www.fawc.org.uk/freedoms.htm> [Accessed 19 Jan 19].
5. Farm Animal Welfare Council (2009) Farm Animal Welfare in Great Britain: Past, Present and Future. FAWC, London.
6. Lee, H.W., Louton, H., Schwarzer, A., Rauch, E., Probst, A., Shao, S., Schmidt, P. & Erhard, M.H. & Bergmann, S. (2016) Effects of multiple daily litter applications on the dust bathing behaviour of laying hens kept in an enriched cage system. *Applied Animal Behaviour Science*. 178: 51-59.
7. Free Farrowing (2019) Why is nest-building behaviour so important? [online] Available from: https://www.freefarrowing.org/info/10/why_free_farrowing/31/why_is_nest-building_behaviour_so_important [Accessed 18 Jan 19].
8. Andersen, I.L., Berg, S. & Bøe, K.E. (2005) Crushing of piglets by the mother sow (*Sus scrofa*)—purely accidental or a poor mother? *Applied Animal Behaviour Science*. 93 (3-4): 229-243.
9. Free Farrowing (2019) Pig SAFE. [online] Available from: https://www.freefarrowing.org/info/10/why_free_farrowing/31/why_is_nest-building_behaviour_so_important [Accessed 18 Jan 19].
10. Farm Animal Welfare Council (2010) Opinion on Osteoporosis and Bone Fractures in Laying Hens. FAWC, London.



#ChooseAssured: UK Farm Assurance Schemes Infographic

Below is a reference grid that sets out BVA priorities for farm animal welfare against what is addressed in the standards of different UK farm assurance schemes. Products may be assured by more than one of these schemes or an assurance scheme not addressed in this graphic. Please check the label of food products carefully.

As part of the #ChooseAssured campaign, BVA wants to encourage the veterinary profession and the wider public to #ChooseAssured by purchasing UK animal-derived products that are farm assured. Through the campaign we hope to raise awareness of the great work of the UK's farm assurance schemes and the crucial work of vets within the schemes to safeguard high animal health and welfare.

*including farmed fish

	Farm Assured Welsh Livestock	Lion Eggs Code of Practice	Northern Ireland Beef and Lamb Farm Quality Assurance Scheme	Quality Meat Scotland	Red Tractor	RSPCA Assured	Soil Association
Please note that this list of the BVA's welfare priorities is not exhaustive and these priorities will be addressed and assessed differently across the different schemes. The level of welfare achieved across the different schemes may vary. For more detailed information about the different standards and requirements used by farm assurance schemes please visit their respective websites.							
Animals are stunned before slaughter	Assurance does not cover slaughter	Assurance does not cover slaughter	Assurance does not cover slaughter	✓	✓	✓	✓
Veterinary involvement Veterinary professionals are involved in livestock health planning and review	✓	✓	✓	✓	✓	✓	✓
Prohibit environments that substantially reduce behavioural opportunity Enriched cages for laying hens Farrowing crates for sows (pre-birth until weaning)	N/A – Scheme only applies to beef and lamb	Permits enriched cages for laying hens	N/A – Scheme only applies to beef and lamb	Permits farrowing crates for sows (pre-birth until weaning)	Permits farrowing crates for sows (pre-birth until weaning)	✓	✓
Support responsible use of antimicrobials	✓	✓	✓	✓	✓	✓	✓
Animal health and biosecurity Measures to protect animal health and prevent the spread of disease	✓	✓	✓	✓	✓	✓	✓
Lifetime assurance Animals spend their whole lives on an assured farm, livestock transport is assured ie. standards assure the management of health and welfare during transportation and scheme has standards to ensure welfare at slaughter*	Assurance does not cover slaughter	Assurance does not cover slaughter	Assurance does not cover slaughter	✓	Pigs and meat poultry only	All species except dairy – dairy calves can be sourced from non-assured farms	Assurance does not cover transport
Measures to protect the environment ie. guidance on preventing environmental contamination, pollution and minimising waste	✓	✓	✓	✓	✓	Farmed salmon and trout only	✓

**Schemes may address some of these areas even if products are not lifetime assured.

Last reviewed: January 2019, Review date: 2022



Professor Lynn J. Frewer
Newcastle University, UK

Professor Lynn Frewer is chair of Food and Society at Newcastle University, (UK). Previously she was Professor of Food Safety and Consumer Behaviour at Wageningen University (Netherlands), and Head of Consumer Science at the Institute of Food Research at Norwich, (UK). Lynn's research interests focus on developing effective risk and benefit communication strategies with consumers, understanding and measuring societal and individual responses to risks and benefits associated with food security issues throughout the supply chain, and agrifood governance and associated policy issues. Lynn also has interests in stakeholder engagement in the development of improved food security linked to agrifood research.

Professor Lynn J. Frewer
Newcastle University, England

Citizens, consumers, farm animal welfare and willingness-to-pay

Conflicts may arise between the drive to increase productivity in animal production systems, and farm animal welfare (FAW). There is a need to increase food production in line with increased global population, and that increased efficiency within production systems is required to meet growing demands for animal products (Godfray and Garnett 2014). At the same time, animal production systems are a focus of increased public attention because of societal concerns linked to the ethical basis of farming methods (European Commission 2007).

However, the public may have very little or no understanding of modern farming practices and their impact on productivity and welfare. One issue which requires further investigation relates to the increased incidence of production diseases in intensive systems, and which can negatively affect FAW issues (Bengtsson and Greko 2014), and how these are perceived. Consumer decision-making regarding production attributes can drive demand for specific food products and consumer concerns and preferences must be taken into consideration in animal production.

Public attitudes towards FAW and production diseases in intensive systems

A systematic review was conducted to assess consumer perceptions and attitudes towards FAW. Four databases were searched to identify relevant studies. These were Scopus, ISI Web of Knowledge, AgEcon Search and Google Scholar, with the latter two enabling the identification of relevant grey literature.

A screening process, using a set of pre-determined inclusion criteria, identified 80 studies relevant to the research questions, with the strength of evidence and uncertainty assessed for each. Only studies from the past 20 years (1995 onwards) were included. A thematic analysis led to the identification of 6 overarching themes constructed from 15 subthemes (Table 1). Qualitative and quantitative studies which measured consumer attitudes, preferences, perceptions, beliefs and perceived ethical obligation towards products produced to a specified FAW standard were included. All the research papers included sampled members

of the general public, and utilised qualitative, quantitative or mixed methods. 80 studies were included for analysis and the majority of studies included were quantitative (n = 62).

Table 1. Summary of thematic analysis, n=80 papers (adapted from Clark et al, 2016).

Theme and subthemes
<p>Concept of welfare</p> <p>Definition of welfare, Naturalness, Humane treatment (including production diseases)</p>
<p>Attitudes towards welfare</p> <p>Overall, Animal type, Demographic differences in attitudes</p>
<p>Role and orientation</p> <p>Citizens versus consumer role, Anthropocentric versus zoo-centric concerns</p>
<p>Consumer Behaviour</p> <p>Consumption patterns, Willingness to pay</p>
<p>Barriers and facilitators</p> <p>Barriers to consumption, Facilitators of consumption</p>
<p>Mediators</p> <p>Trust, Responsibility, Knowledge</p>

The majority of studies were conducted in Europe (n = 59), with Northern and Western European countries most commonly represented. Of the remaining studies, 14 were conducted in North America, 2 in South America, 2 in Australasia, 2 in Asia, 1 in Africa, and 1 in multiple regions. Nearly half of studies (n = 33) did not focus on specific animal types. Of the remainder, pigs were most commonly addressed (n = 17), followed by multiple named animal types (n = 8), broiler chickens (n = 8), and layer hens (n = 6), with fish, lamb, beef and dairy cows being the only other animal types studied. The results

indicate that the public are concerned about FAW in modern production systems, although this varies in relation to age, gender, education and people's familiarity with farming. Younger participants were more aware of FAW issues, and held more zoo-centric centred attitudes. Women tended to be more concerned than men, and had more negative views towards modern farming overall, as were participants those with higher education. In addition, FAW was reported as being more important for urban, as opposed to rural, dwellers. Overall, naturalness and humane treatment were perceived to contribute to good welfare. However, an evidence gap was highlighted in relation to attitudes towards specific production diseases, with no studies specifically addressing this. However, the prophylactic use of antibiotics was identified as a concern.

A number of dissonance strategies were adopted by consumers to enable guilt free meat consumption. Consumers were also concerned about the impact of poor animal welfare conditions on food safety and quality. This may reflect consumer and societal concerns about food safety incidents and disease epidemics involving animal production systems, such as BSE (Grunert et al. 2004).

Consumer willingness to pay (WTP) for FAW

A question arises as to whether consumers are willing to pay (WTP) more for Animal friendly production systems. There is a considerable body of evidence focused on consumer WPT for FAW, although this does not specifically focus on animal production diseases. As before, a systematic review and meta-analysis were conducted to establish the publics' WTP for farm animal welfare, with 54 relevant studies meeting the inclusion criteria (Clark et al, 2017). A random effects meta-analysis was applied to understand heterogeneity in relation to a number of factors, with a cumulative meta-analysis conducted to establish changes in WTP over time. A small, positive WTP for farm animal welfare was observed, varying in relation to a number of factors including animal type and region.

Data came from 17 different countries, with over half of studies being conducted in Europe (56%), 37% being conducted in the USA, the remainder being conducted in Canada, Australia and South

Korea. The majority of studies (30) reported WTP for a variety of different welfare measures, with the majority of individual measures relating to overall welfare, free range produce and outdoor access for animals. The analysis suggests that consumers are WTP a small additional price consumers are WTP for improved welfare, which may result in consumers changing their behaviour and purchasing higher welfare products, although this assumes that an appropriate and trustworthy identification and certification policy can be implemented to facilitate consumer recognition of high FAW products. However, consumer WTP for FAW does not remove the need for implementation of *de minimis* policies to promote FAW.

Conclusions

Concerns associated with FAW and production may not correspond to purchase and consumption practices, with sales of welfare friendly products (WFP) much lower than the reported levels of concern, suggesting a discrepancy between an

individual's role as a citizen and as a consumer, such that citizens and consumers having different concerns in different contexts.

In addition, citizens can express concerns about food production while not actually purchasing specific foods produced using the methods under consideration. If a product is more expensive people may not be able to afford to buy it because of competing financial constraints on their budgets. People may not purchase the products of animal production systems at all but still have concerns about animal welfare.

Thus citizen concern may be interpreted as a proxy for what people would prefer as an "ideal" situation, which is not attainable because of financial constraints, or because people cannot use consumer purchases to shape production. This explains why non-consumers hold opinions of FAW and look to legislation, government and other stakeholders to improve standards (Kjærnes et al. 2007).



References

Bengtsson, B. and Greko, C., (2014). Antibiotic resistance—consequences for animal health, welfare, and food production. *Upsala journal of medical sciences*, 119(2), pp.96-102.

Clark, B., Stewart, G.B., Panzone, L.A., Kyriazakis, I. and Frewer, L.J., (2016). A systematic review of public attitudes, perceptions and behaviours towards production diseases associated with farm animal welfare. *Journal of Agricultural and Environmental Ethics*, 29(3), pp.455-478.

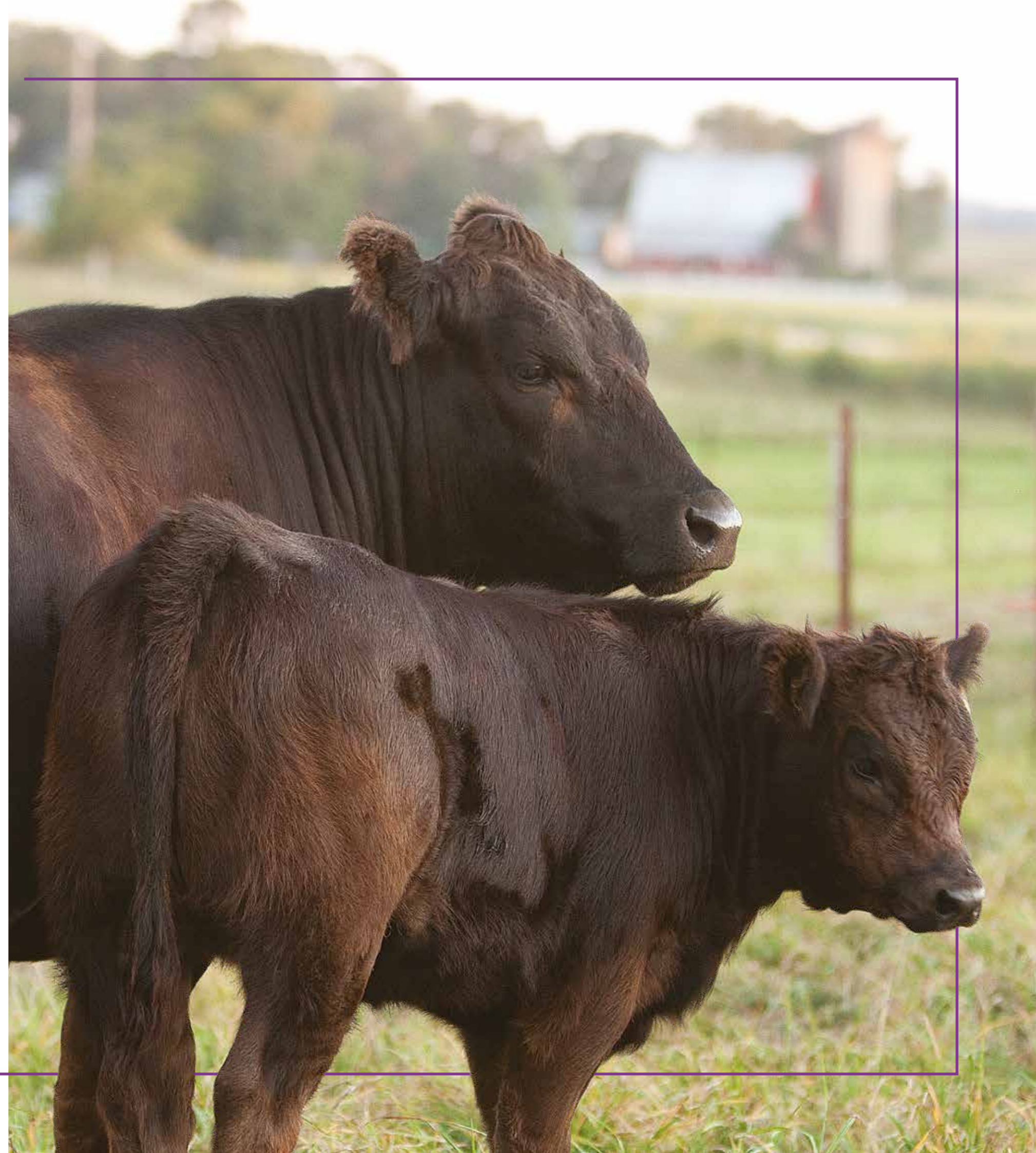
Clark, B., Stewart, G.B., Panzone, L.A., Kyriazakis, I. and Frewer, L.J., (2017). Citizens, consumers and farm animal welfare: A meta-analysis of willingness-to-pay studies. *Food Policy*, 68, pp.112-127.

European Commission. (2007). Attitudes of EU citizens towards animal welfare. Special Eurobarometer 270. Wave 66.1.TNS Opinion and Social. IR. http://ec.europa.eu/public_opinion/archives/ebs/ebs_270_en.pdf. Accessed Oct 20, 2014.

Godfray, H.C.J. and Garnett, T., (2014). Food security and sustainable intensification. *Philosophical transactions of the Royal Society B: Biological Sciences*, 369(1639), p.20120273.

Grunert, K.G., 2006. Future trends and consumer lifestyles with regard to meat consumption. *Meat science*, 74(1), pp.149-160.

Kjærnes, U., Miele, M. and Roex, J. eds., 2007. Attitudes of consumers, retailers and producers to farm animal welfare. Cardiff University, Cardiff School of City and Regional Planning.





Robert M. Erhard
Nestlé, Switzerland

Since 2015, Mr. Erhard has been serving as the Functional Head of Fresh Milk in Nestlé globally. This scope covers more than 30 countries and close to 300,000 dairy farmers. Complementing to this, he has until recently been chairing the Dairy Working Group and is an EXCO member at the Sustainable Agriculture Initiative Platform (SAI P). He is also a member of the Dairy Sustainability Framework (DSF) and International Dairy Federation (IDF). Prior to these roles, Mr. Erhard has been working in various positions within Fresh Milk sourcing especially as Director of Agricultural materials in the Greater China Region including overall responsibility, end-to-end project and startup management of the Nestlé Dairy Farming Institute (DFI). The DFI is a center of excellence in collaboration with multiple partners, developing the future dairy farming model suitable for China.



Robert M. Erhard
Nestlé, Switzerland

Setting up a safe and sustainable supply chain

Creating Shared Value (CSV) is fundamental to how we do business at Nestlé. We believe that our company will be successful in the long term by creating value for both our shareholders and for society. Our activities and products should make a positive difference to society while contributing to Nestlé's ongoing success.

Our commitment

Implement responsible sourcing in our supply chain and promote animal welfare.

Why it matters

Consumers and stakeholders increasingly want to know where their food comes from, what it contains and how it was made.

Transparency in our supply chains and responsible sourcing of our materials are essential to ensuring our sustainable future. Many farmers, their families and their communities survive on low incomes. As a result, fewer young people view

farming as a viable livelihood, choosing instead to move to urban areas to find employment. This presents a challenge that jeopardizes future supplies of the raw materials.

Our approach

As a leading food and beverage manufacturer, we have established a robust set of guidelines on responsible sourcing and are continually working to make our supply chain more transparent.

Working closely with farmers, their communities and expert organizations, we look to identify the root causes of challenges farmers face and develop solutions to help them improve their practices, increase their productivity and income, and make farming a more attractive sector.



We do this across four key areas:

- Assessing farmers' needs, to ensure we address the right issues.
- Farmer economics, to help make farms and farming economically viable and attractive for the next generation (Agripreneurship programs).
- Farmer diets, to ensure farmers and their families are healthy and have access to the nutrition they need.
- Responsible sourcing, ensuring our supplies of raw ingredients are sourced in a way that meets our Responsible Sourcing Standard and the growing demand from consumers for ethical sourcing.

To address these areas, we now focus increasingly on impact by using our Theory of Change (ToC), which we have developed for the different categories we buy. This allows Nestlé to focus our activities where it matters most and measure our impact at a global level. The ToC methodology identifies desired long-term goals, and then works back to determine what conditions must be in place for the goals to be reached.

In the case of dairy, each market has applied the ToC and has defined areas of priority and clear impact targets. Nestlé supports farmers with technical skills through training, financial support, technological innovations and farmer clubs.

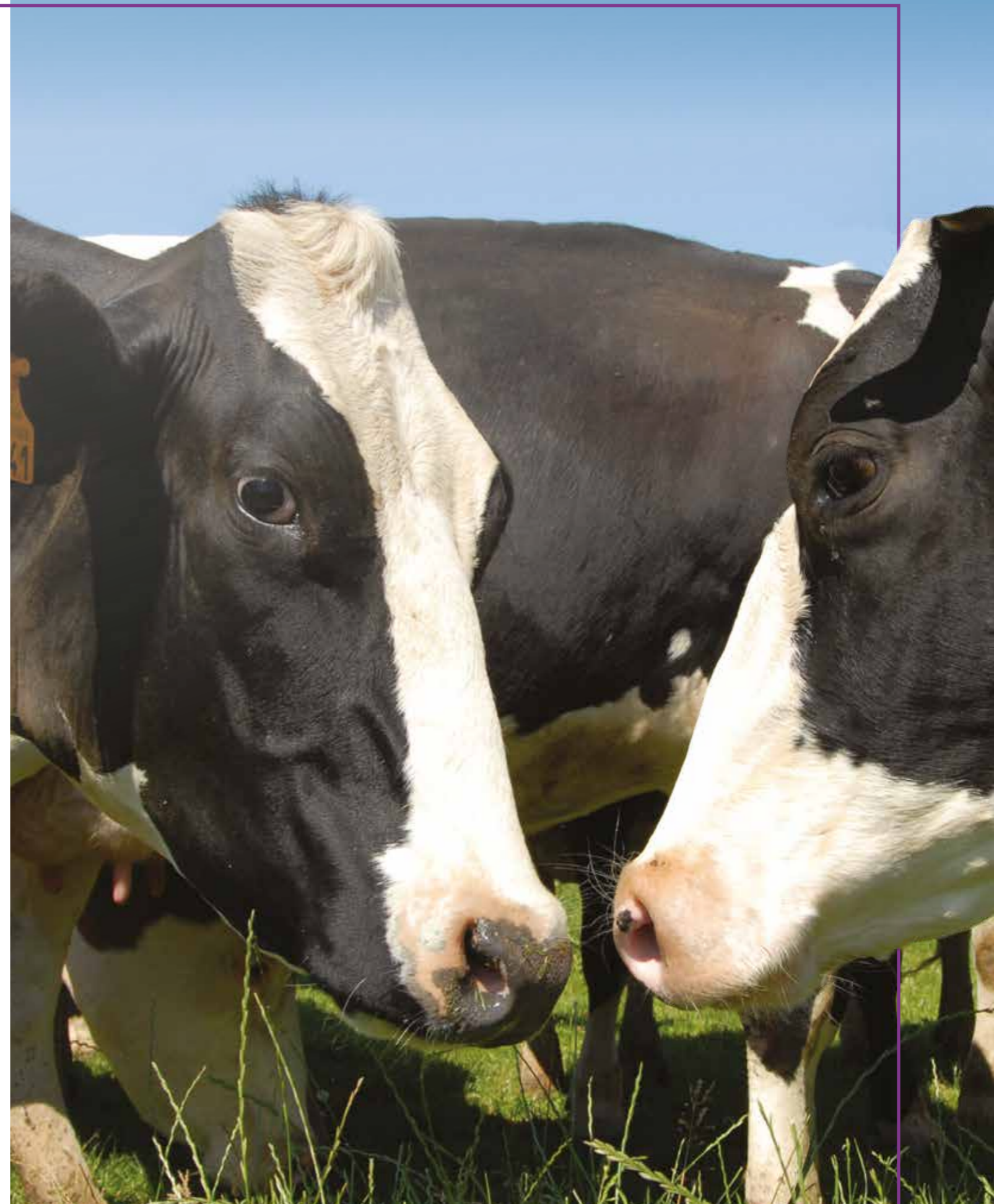
This is done on farms or dedicated training centers such as the Nestlé Dairy Farming Institute in China, which is a collaboration of key industry leaders and universities. In 2018 in 30 countries, more than 81,500 dairy farmers of which more than 6,000 were women attended trainings offered or organized by Nestlé.

Some the new innovations being brought into dairy farming are:

- LEAN management systems to reduce food waste and loss while improving farm economics and reducing the environmental "hoof-print".
- Low cost field water sensors for areas that increasingly face challenges of drought or irregular weather patterns.
- Digitizing animal welfare.
- IS/IT solutions.

As our finished products also contain milk or milk derivatives bought from cooperatives, they too are externally assessed according to our Responsible Sourcing Standards. Adopting the Dairy Sustainability Framework and its 11 sustainability key performance indicators, Nestlé was involved in co-developing the industry B2B model. This is being done through the Sustainable Agriculture Initiative Platform (SAI P). The aim of the B2B model is to hold each other accountable by understanding where companies are on their sustainability journey, what impact is being achieved.

Only a sustainable supply chain that matches consumer's expectations, will have a future.





Dr. Jeff Brose
Cargill Animal Nutrition, USA

Dr. Jeff Brose is a veterinarian with Cargill's Dairy Enterprise Team working to align processors with producers. Dr. Brose developed Dairy Integrity Services, working with dairy farms and processors to align their shared values and protect their brand. Dairy Integrity Services works to assure implementation of best practices in at-risk areas of animal welfare, employee safety and training, residue avoidance, security, emergency preparedness and biologic risk management. Dr. Brose also provides technical support and training to Cargill Animal Nutrition's Dairy Focus Consultants.

Dr. Brose received his B.S. and D.V.M. degrees from Kansas State University. Following graduation, he owned and managed a private practice serving farms and ranches in Nebraska and Kansas. Dr. Brose specialised in dairy production medicine as part of a predominantly large animal mixed practice providing veterinary medicine and consultation services to dairy clients. After 14 years in practice, Dr. Brose joined the industry as a Technical Service Specialist, working with dairy herds, veterinarians and nutritionists throughout the U.S.

Dr. Brose is currently President of the Dairy Cattle Welfare Council, a U.S. nonprofit organisation dedicated to promoting dairy cattle welfare. He is also a member of the American Association of Bovine Practitioners Animal Welfare Committee.



Dr. Jeff Brose
Cargill Animal Nutrition, USA

Aligning the food value chain on animal welfare

First, a little about Cargill. It all started in 1865 when William Wallace Cargill became the proprietor of a grain warehouse in Conover, Iowa, at the end of the McGregor & Western Railroad line. From a humble grain storage business, it has grown into the largest privately held company in the world with a diversified portfolio of business units.

Our purpose is to nourish the world in a safe, responsible and sustainable way. Every day, we connect farmers with markets, customers with ingredients, people and animals with the food they need to thrive. We combine our experience with new technologies and insights to serve as a trusted partner for food, agriculture, financial and industrial customers in more than 125 countries with 155,000 employees generating \$116 billion sales and other revenue.

Animal welfare at Cargill

For more than 150 years we have been guided by the philosophy that doing the right thing is beneficial to all and helps our customers and communities thrive as we nourish the world in a safe, responsible and sustainable way. As we deliver protein to the tables of the world, we understand and embrace our

responsibility to ensure animals are treated with respect and dignity throughout their life cycle. The proper care and handling of animals is critically important as the global population and their demand for nutritious, affordable and high-quality protein increases.

Cargill takes pride in being an industry leader in animal welfare and we maintain high standards for our suppliers and ourselves. We employ a zero-tolerance policy on animal abuse. We do not tolerate abusive behavior directed at animals by employees, suppliers, transporters, or others in our supply chains.

We work with a variety of stakeholders, including farmers, ranchers, customers, NGOs, academics, veterinarians, and scientists including world renowned animal welfare expert Dr. Temple Grandin, to ensure that we employ best practices.

Cargill animal nutrition

Most in the dairy industry may be familiar with our role in working with dairy farms as we are an industry leading provider of Nutrition Consulting, Technical Services, Sales of Diet Ingredients and developing rations that drive animal health and productivity. Helping them live



up to their full potential is a key part of what we do. Through our research, we have developed feeding programs and nutritional solutions to keep animals healthy today while maintaining robust lines of defense for animal and human health in the future. Our training programs with farmers in many countries are structured to facilitate the sharing of best practices that improve the overall well-being of the animals they raise. This is what we mean by better nutrition for better lives.

Cargill Dairy Enterprise Group

Dairy Enterprise Group exists to assist Consumer Packaged Goods companies (CPG) develop and maintain consistent standards for their suppliers and enable them to deliver a consistently safe and secure dairy supply chain.

In the United States, most milk is marketed through dairy cooperatives. Many CPGs and dairy producers have interest in the advantages of a direct market agreement. Cargill has a long standing relationship as a preferred partner and trusted supply chain consultant for food companies. As a dairy nutrition company, we also have great farm relationships and a deep understanding of dairy production and management. This unique combination provides the knowledge and skills needed to help align CPGs with dairies that have a mutual interest in a direct market arrangement.

As these partnerships developed it became apparent that having a valuable brand directly linked with a farm could potentially expose risk for the brand. Dairy farms and working closely with animals does have inherent risks. If something negative happens on a dairy linked to a CPG, now their brands are at risk of being associated with the farms actions. By recognizing the critical areas of risk, we can utilize the implementation of standard operating procedures and best management practices to maximize animal care and minimize the chance of negative outcomes.

Alignment of values between the Dairy Producer, CPG, and the Consumer.

Dairy Integrity™ Services

Cargill's Dairy Integrity™ services help align the values of a Consumer Packaged Goods company's dairy brand with the supplying farms. Dairy Integrity Services provides on farm services to protect the brand of the partner CPG. On-farm experts provide transparency and routinely evaluate dairy farm suppliers in 7 critical integrity areas ranging from animal welfare and employee safety, to milk quality, traceability and overall dairy sustainability.

Critical Integrity Areas: 7 areas of the dairy that present the highest risk to a brand.

1. Animal Care & Well-being (Animal Welfare)
2. Human Welfare (Farm Safety & Training)
3. Residue Avoidance (meat & milk)
4. Milk Quality
5. Farm Security / Traceability
6. Emergency Preparedness
7. Biologic Risk Management

Alignment Assessment

The process begins with selecting a herd that already has similar values as the CPG. Through on farm interviews, assessment and evaluations we determine a dairy producer's interest and suitability as a CPG partner. Finding producers willing to fully embrace the values and concerns of the CPG and their consumers is critical for a successful partnership.

Dairy integrity standards

After a farm has been selected and CPG and the dairy producer has an agreement, the process of implementing Dairy Integrity™ standards begins. The farm is assessed in the 7 critical integrity area. Standard Operating Procedures and Protocols are developed and implemented based on best management practices through our industry recognized Subject Matter Experts working with the farm's ownership and leadership. The current employees knowledge base and capabilities are assessed and finally a training program is developed, established and implemented.

Beyond excellence

The goal is to establish a Culture of Dairy Integrity™ so all owners, managers and employees work

together to operate with the same values as the CPG. Dairy Integrity™ Services continue to monitor performance and adherence to Dairy Integrity™ standards with a goal to improve production efficiency, animal and human well-being and performance. The CPG receives feedback related to ongoing performance that is monitored via on farm visits and evaluations that are reported and recapped. Communication is key so regular calls between the CPG, Dairy and DIS to work together to maintain high standards.

Conclusion

Through transparent partnerships, the Consumer Packaged Goods Company and Dairy Producer can work together to achieve shared values on the care and well-being of the animals that produce our food and fiber.



For farmers
We supply feeds, other inputs and expertise to farmers, and buy crops and livestock from them



For customers
We deliver finished goods to customers in the foodservice, retail, consumer packaged goods and industrial sectors

We provide insights to our partners



We transform raw materials into finished goods



We move products around the world





Rob Drysdale
StraightLine Beef, UK

After graduating from Edinburgh University, Rob worked across the UK in various practices before starting Westpoint Farmvets in July 2000. Initially based in South East England the business grew to have a national footprint, vet tech team, lab services and a research division alongside an internet medicines site. Westpoint was sold to private equity in 2014.

After selling his vet business Rob took the opportunity to undertake a Nuffield Farming Scholarship travelling and studying supply chain management for beef, farming and other industries. His dissertation "Beef from the dairy herd: is integration the answer?" was published in June 2016.

During his scholarship Rob started his own beef supply chain. StraightLine Beef has grown from its first batch of 60 calves in 2014, to 4,500 head of cattle across 14 sites in Wales and South West England currently. Since March 2017 Rob has farmed his own 800 acre finishing unit in Somerset, where he undertakes research on both intensive and grass based beef production.

The business runs multiple supply chains, from pure dairy bulls through to grass fed Angus cross cattle. Fully integrated, calves are taken from four dairy farms at 2-4 weeks old through to finishing, often using its own selected Elite Beef sires, to produce consistent, quality beef effectively from conception to consumption.

Rob still works as an independent veterinary consultant with clients in the UK and beyond, ranging from large dairy and beef farms, and across the wider farming, veterinary and pharmaceutical industries.



Rob Drysdale
StraightLine Beef, UK

From field to fork: ethical beef for everyone

StraightLine Beef is the result of one man's vision to grow great tasting beef but with a conscience. Its model uses retained ownership at all stages: from calving to processing with a balanced, vertically integrated model of production achieved.

This initiative has been developed to bring about continuous improvement in sustainability from the dairy farm to the restaurant plate or retailer shelf. Knowing the end customer's requirements has led to early success.

Ruminants, and especially beef production, are being blamed for global warming, antibiotic resistance and cruel practices. How can we counter the anti-livestock farming lobby?

Producing beef can be both ethical and sustainable, and it is up to the producers to show this. As consumer trends move towards a more ethical beef industry, and pressure

to cease livestock farming grows, there is an obligation to do better.

Dairy bred beef is considered to have 50% less of the carbon footprint than pure bred, suckled beef as the carbon associated with the dam sits with the milk she produces.

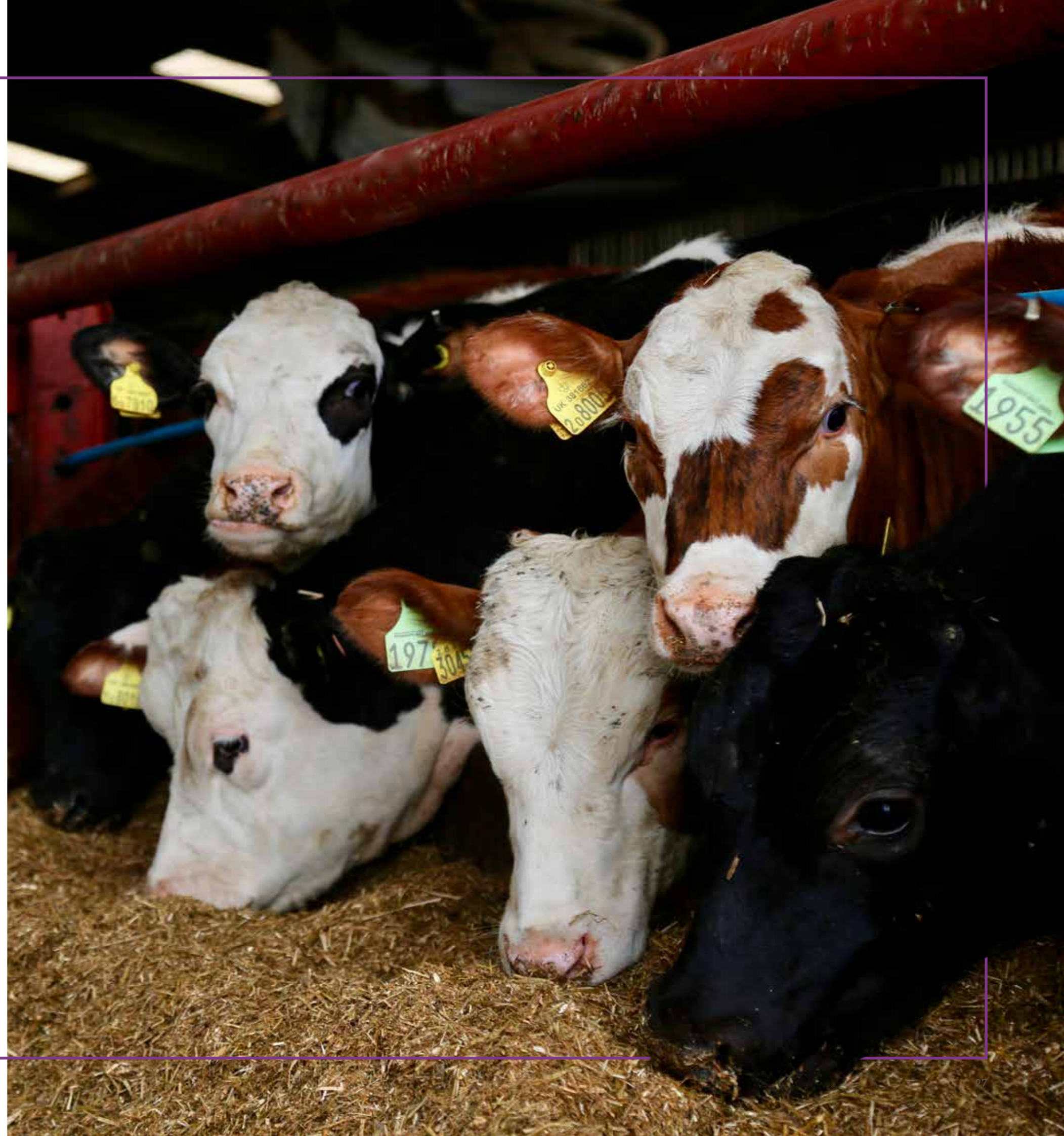
Dairy demand and production is increasing across the globe, however in the UK cow numbers are reducing. Beef cows are also increasing globally, but at a lower rate of expansion compared to dairy – although again in the UK numbers are dropping.

Taking dairy beef from by-product to an ethical and sustainable resource

It is vital we make better use of any calf born, be it to a beef or dairy cow. We have an ethical obligation to reduce bobby calves, calf mortality and disease, and maximise feed conversion of any potential proteins as we approach tipping point for food production. The carbon implications of producing beef, and consumer demands on sustainable farming, all need to be included in any supply chain. Beef from the dairy herd also offers potential to improve consistency and quality of product to the consumer, whilst reducing the environmental impact.

Farming in a country that is only 70% self-sufficient for beef, and more than 55% of the beef consumed in 2018 was dairy bred, there is scope to grow beef production. Per capita consumption in the UK may be reducing, but overall demand is rising as well as the value of the beef eaten. Post Brexit will we be protected from lower assurance levels of production? Probably not. What about our exports? Where will demand come from in 2020 and beyond?

Labels such as grass grazed, pasture-for-life, antibiotic free, are simple to say but who monitors, measures and oversees all these systems? Working with retailers, butchers and several meat processors, StraightLine Beef produces dairy bred beef through several supply chains. Multiple management systems are in place aimed at maximising the potential of every animal, be it a Jersey bull calf or an Aberdeen Angus sired heifer. Every supply chain is managed with ethical and sustainable production as the main priority with quality and consistent beef to a price point the end goal.





Dr. Rory Sullivan
Chronos Sustainability, UK

Dr. Rory Sullivan is a Director and Co-Founder, Chronos Sustainability and Visiting Professor in Practice at the Grantham Research Institute at the London School of Economics – is an internationally recognised expert on responsible investment and on benchmarking. With Nicky Amos, he developed the Business Benchmark on Farm Animal Welfare (BBFAW), which is now in its seventh annual cycle. He is the Strategic Advisor to the Business Benchmark on Farm Animal Welfare and Chief Technical Advisor to the Transition Pathway Initiative, and has advised, amongst others, PRI, UN Global Compact and UNEPFI on how investors analyse and use corporate responsibility information. He is the author/editor of eight books on these and related issues, including *The Business of Farm Animal Welfare* (co-editor with Nicky Amos, Routledge, 2017), *Valuing Corporate Responsibility: How Do Investors Really Use Corporate Responsibility Information?* (Greenleaf, 2011), and *Corporate Responses to Climate Change* (editor, Greenleaf, 2008).



Nicky Amos
Chronos Sustainability, UK

Nicky Amos has over 25 years' experience in managing and directing corporate responsibility programs in global companies, specialising in the development and implementation of sustainable development and responsible sourcing strategies, multi-stakeholder partnerships and corporate reporting. She leads Chronos Sustainability's engagement with the private and NGO sectors, and is the Executive Director of the Business Benchmark on Farm Animal Welfare (BBFAW) and Executive Director of the Global Coalition for Animal Welfare (GCAW). Nicky is responsible for managing and delivering these programs in liaison with the program partners and members. Nicky is the co-editor, with Dr Rory Sullivan of *The Business of Farm Animal Welfare* (Routledge, 2017).



Dr. Rory Sullivan & Nicky Amos
Chronos Sustainability, UK

Ranking global food companies on farm animal welfare

The Business Benchmark on Farm Animal Welfare

Since it was established in 2012, the Business Benchmark on Farm Animal Welfare has become recognized as the leading global measure of farm animal welfare management, policy commitment, performance and disclosure in food companies. BBFAW's main objective is to improve farm animal welfare practices, performance and reporting in the world's leading food businesses by providing investors and other stakeholders with an independent, impartial and reliable assessment of food companies' reported practices and performance.

The central deliverable of BBFAW's work is an annual public benchmark of how global food companies report on how they are managing farm animal welfare. The Benchmark assesses company reporting on farm animal welfare – using a framework that broadly aligns with the manner in which companies report to investors on other corporate responsibility issues (Amos & Sullivan, 2018; Sullivan, 2011) – in four core areas as follows:

- **Management Commitment** (policies and positions on farm animal welfare, including specific commitments on issues such as the avoidance of close confinement and long-distance live transportation).
- **Governance and Management** (including board and senior management oversight of farm animal welfare strategy and operations, objectives and targets, and internal controls).
- **Leadership and Innovation** (including investments in projects to advance farm animal welfare and advocacy on farm animal welfare).
- **Performance Reporting and Impact** (performance against key animal welfare policies, targets and welfare outcome-based measures).

The 2018 Benchmark (Amos and Sullivan, 2019) analysed the farm animal welfare policies, management systems, reporting and performance of 150 of the world's largest food companies (food retailers and wholesalers, food producers, and restaurants and bars)

across 35 distinct, objective criteria. A full description of the Benchmark methodology, criteria and universe of companies is provided in Amos, Sullivan and van de Weerd (2019).

Key Findings: 2018

The 2018 Benchmark suggests that farm animal welfare is now a leadership issue. As shown in Figure 1, the number of companies that are considered to have farm animal welfare as an integral part of their business strategy (corresponding to Tiers 1 and 2 in the Benchmark) has grown significantly over the seven Benchmark cycles, from 3 (out of 68) in 2012 to 17 (out of 150) in 2018. However, Figure 1 also highlights that there is a long way to go; seventy (70) companies are in Tiers 5 and 6 of the Benchmark, suggesting that they provide little or no information on their approach to farm animal welfare.

Figure 1. Evolution of farm animal welfare (2012-2108) (Amos and Sullivan, 2019: 6)



When we look more closely at the data, we see that global food companies are improving their management practices, processes and reporting on farm animal welfare. For example, of the 150 companies covered by the Benchmark, 64 (43%) now have explicit board or senior management oversight of farm animal welfare, and 106 (71%) now have published formal improvement objectives for farm animal welfare. These are significant changes from earlier Benchmarks; in

the 2012 Benchmark, only 22% of companies reported on senior management oversight of farm animal welfare and only 26% had published formal improvement objectives for farm animal welfare. Other actions being taken by companies include using outcome measures to drive and incentivise continual improvement in farm animal welfare performance, working with suppliers to develop and implement effective farm animal welfare policies and processes, appointing dedicated farm animal welfare managers and other specialist staff, and educating their consumers about higher animal welfare.

Close confinement is seen as a key issue by much of the food industry. From an animal welfare perspective, many of the major animal welfare issues can be directly attributable to the systems in which animals are raised. Close confinement systems are associated with higher injury and mortality rates, as well as higher prevalence of aggression and other abnormal and stress-related behaviours. Furthermore, antibiotics are widely used in these systems to compensate for the extreme proximity of animals to each other facilitating the spread of infectious diseases. One hundred and fifteen of the 150 companies (77%) have now made commitments to the avoidance of close confinement in one or more of the major markets in which they operate. The most common commitments relate to cage-free laying hens, to the phasing out of sow stalls/gestation crates, and to the setting of lower maximum stocking densities for broiler chickens. These correspond to the species and the confinement systems that have received most attention from consumers and from NGOs in recent years.

Finally, while we are seeing a progressive improvement in the proportion of companies reporting animal welfare performance data, the quality of performance reporting – in terms of consistency, comparability and coverage – is still not fit for purpose. Despite 77 of the 150 companies (51%) now reporting at least some animal welfare performance data, it is often not possible to understand how companies are translating policy commitments into action, nor is it possible to get an accurate picture of the welfare impact on animals. In turn, this makes it very difficult to assess the quality of a company's management systems or to answer questions such as whether a company is effectively implementing its policies, whether it is delivering on its objectives and targets, whether it is effectively

managing the risks and opportunities presented by farm animal welfare, or whether it is improving the welfare of the animals in its operations and supply chain (Sullivan, Amos and van de Weerd, 2017).

The weaknesses in performance reporting are not unsurprising. Farm animal welfare remains a relatively new issue for many global food companies. Many are still focusing on strengthening their internal management systems and processes, and on working internally and with their suppliers to gather the data they need to report on performance. In discussions with us, companies have indicated that they are withholding the publication of data until they are confident about the quality and reliability of the data reported internally and through their supply chains. Companies are also cautious about reporting as

they are concerned that performance data will be misconstrued by audiences that lack the technical or industry knowledge to effectively understand what acceptable or good practice looks like.

Drivers and Barriers

Over the past three years, our discussions with companies and investors have consistently pointed to four key drivers of change (Sullivan, Amos and Tjärnström, 2018):

- The recognition of farm animal welfare as a business risk that needs to be managed in a similar manner to other business risks.
- The recognition of farm animal welfare as a strategic opportunity, both in terms of the

Producers and Manufacturers



potential for new product offerings and market access and in terms of the potential for brand differentiation and reputation enhancement.

- Customer and client demand, which is creating pressure both to raise standards within core product offerings, and to innovate and invest in new, higher welfare products.
- Investor action on farm animal welfare, which has raised the profile of farm animal welfare and created pressure on companies to manage the business risks and opportunities presented by farm animal welfare.

Despite these drivers, the business case for action remains the critical barrier to progress. In our 2018 survey of how companies use the Benchmark, 82% of company respondents identified customer willingness to pay as a barrier to adopting higher standards of farm animal welfare (Sullivan, Amos and Tjärnström, 2018). They also identified the absence of a compelling business case for adopting higher welfare standards, and a general lack of awareness of the wider business and marketing benefits of higher welfare as important barriers to progress.

The balance between the drivers and for action and the barriers to action is changing. The high proportion of companies with commitments to phase out eggs from caged hens, to eliminate sow-stalls and to reduce the maximum stocking density for broiler chickens reflects the impact of the significant and sustained NGO campaigning pressure and media attention on the issue of close confinement. The improvements in company practices and performance on farm animal welfare, as evidenced by the results of the Benchmark, also reflect the changing relationship between retailers and their suppliers. Many retailers now provide their suppliers with financial incentives (e.g. higher pricing, extended-term contracts) to adopt higher standards, support with capital investment, and access to education, training, marketing and technical support on farm animal welfare.

We are also seeing the beginning of a collective response from the food industry. One example is the Global Coalition for Animal Welfare (GCAW), founded by seven major food production and food service companies: Aramark, Compass Group, Elior Group, IKEA Food Services, Nestlé, Sodexo and Unilever. GCAW is a global platform where these companies, with stakeholders

and farm animal welfare experts work together to collectively address the systemic barriers to improving animal welfare, to accelerate the development of standards and to drive progress on key welfare issues. Its initial priority work streams include cage-free policies, improved broiler chicken welfare, farmed fish welfare, antimicrobial resistance, and global standards for transportation and slaughter. Another example is the BBFAW Global Investor Coalition on Farm Animal Welfare where major investors writing formally to the companies covered by the Benchmark, commending leading and improving companies on their performance, and encouraging poorer performers to improve. As of January 2019, 21 investors, representing over UK£2.3 trillion in assets under management, were participants in the Global Investor Collaboration on Farm Animal Welfare.

Looking forward

We have seen remarkable progress over the past seven years in how food companies manage farm animal welfare in their own businesses. We are starting to see evidence that this is translating into improved outcomes for the animals in their care and in their supply chain. The evidence is that these trends will accelerate, delivering tangible welfare benefits for many of the 70 billion animals that are farmed for food annually.

Notes

1. The Business Benchmark on Farm Animal Welfare (BBFAW) is the leading global measure of farm animal welfare management, policy commitment, performance and disclosure in food companies. It enables investors, companies, NGOs and other stakeholders to understand corporate practice and performance on farm animal welfare, and it drives – directly and through the efforts of others – corporate improvements in the welfare of animals reared for food. BBFAW maintains the Global Investor Statement on Farm Animal Welfare and convenes the Global Investor Collaboration on Farm Animal Welfare. The programme is supported by the BBFAW's founding partners, Compassion in World Farming and World Animal Protection, who provide technical expertise, guidance, funding and practical resources. More information on the programme can be found at www.bbfa.com.

2. The Global Coalition for Animal Welfare (GCAW) is the world's first industry-led initiative aimed at driving welfare improvements in global supply chains. The GCAW was founded in 2018 by seven leading food companies – Sodexo, Compass Group, Elior Group, IKEA Food Services, Nestlé and Unilever. More information can be found at www.gc-animalwelfare.org.

References

Amos, N. and Sullivan, R. (2018), *The Business of Farm Animal Welfare* (Routledge, Abingdon, UK).

Amos, N. and Sullivan, R. (2019), *The Business Benchmark on Farm Animal Welfare: 2018 Report* (Business Benchmark on Farm Animal Welfare, London, UK).

Amos, N., Sullivan, R. and van de Weerd, H. (2019), *The Business Benchmark on Farm Animal Welfare: 2018 Methodology Report* (Business Benchmark on Farm Animal Welfare, London, UK).

Sullivan, R. (2011), *Valuing Corporate Responsibility: How Do Investors Really Use Corporate Responsibility Information?* (Greenleaf Publishing, Sheffield).

Sullivan, R., Amos, N. and Tjärnström, E. (2018), *How Companies and Investors are Using the Business Benchmark on Farm Animal Welfare*. October 2018 (Business Benchmark on Farm Animal Welfare, London, UK).

Sullivan, R., Amos, N. and van de Weerd, H. (2017), 'Corporate Reporting on Farm Animal Welfare: An Evaluation of Global Food Companies' Discourse and Disclosures on Farm Animal Welfare', *Animals*, Vol. 7, No. 3, Article 17, 21 pp. doi:10.3390/ani7030017.





Leopoldo H. Stuardo Escobar
World Organisation for Animal Health, France

Leopoldo graduated from the Veterinary Faculty of the University of Chile and obtained his master's degree in Environmental Science and Management from the Catholic University of Louvain (LLN) in Belgium. Leopoldo has a broad experience working at a national and international level dealing with sanitary negotiations related to trade and in developing international standards and national regulations on animal welfare. Leopoldo has been developing these activities at the Agriculture and Livestock Service (SAG) from the Chilean Ministry of Agriculture, at the Chilean Mission to the European Union in Brussels and at the Headquarters of the World Organisation for Animal Health (OIE) in Paris. Currently, Leopoldo is working at the Standards Department of the OIE, in charge of the animal welfare activities related to the OIE Terrestrial and Aquatic Animal Health Code.



Leopoldo H. Stuardo Escobar
World Organisation for Animal Health, France

The OIE Global Animal Welfare Strategy

The need to fight animal diseases at a global level led to the creation of the Office International des Epizooties through the International Agreement signed on January 25th, 1924. In May 2003 the Office became the World Organisation for Animal Health but kept its historical acronym, OIE.

The OIE is the intergovernmental organisation responsible for improving animal health, animal welfare and veterinary public health worldwide.

In 1995, when the World Trade Organisation (WTO) was established, the OIE standards for animal health and zoonoses were recognised in the WTO Sanitary and Phytosanitary Agreement.

The OIE comprises a total of 182 Member Countries and it maintains permanent relations with 71 international and regional organisations and has Regional and Sub-Regional Offices on every continent.

The main authority of the OIE is the World Assembly of Delegates (the Assembly) consisting of Delegates designated by the Governments of

all Member Countries. The day-to-day operation of the OIE is managed at the Headquarters situated in Paris, France and placed under the responsibility of a Director General elected by the World Assembly of Delegates. The Headquarters implement the resolutions adopted by the Assembly and developed with the support of Specialist Commissions elected by the Delegates.

OIE animal welfare mandate

In 2002, at the request of its Member Countries, the OIE broadened its mandate to include animal welfare standards, noting that animal health is a key component of animal welfare.

The publication, in 2005, of the first animal welfare chapters for the transport of animals, and slaughter and killing of livestock for the purpose of disease control was a significant achievement and provided recommendations for Member Countries to implement at the national level. OIE international standards are adopted by the Assembly, which is the only pathway for the adoption of OIE international standards. As for

all OIE international standards, recommendations on animal welfare are based on science. Most importantly for this complex and multi-faceted issue, the recommendations take full account of the differing ethical, cultural, religious and political contexts of all OIE Member Countries.

The OIE animal welfare standards¹

In addition to publishing standards in the Codes, the OIE also produces guidance or reference documents such as the recent “Guidelines for disaster management and risk reduction in relation to animal health, animal welfare and veterinary public health”. The main objectives of these guidelines are to strengthen the capacity of Veterinary Services in Member Countries and bring together all components of disaster management in cohesive response plans, at both national and international levels, using a multidisciplinary approach to achieve optimal efficiency and effectiveness.

OIE Global Animal Welfare Strategy

As part of the OIE mandate for animal welfare, the OIE has convened four Global Conferences on animal welfare to support Member Countries with the implementation of OIE animal welfare standards. These conferences have provided OIE national Delegates and Focal Points for animal welfare, and representatives of international organisations, industry sectors, NGOs and civil society an opportunity to engage with the OIE in its activities to further improve animal welfare globally.

The last OIE Global Conference on animal welfare was held in 2016, in Guadalajara, Mexico. The main goal of the Conference was to encourage and support the implementation of OIE animal welfare standards by Member Countries, with attention to strategies and specific tools.

The conference also highlighted the improvement of animal welfare legislation, the inclusion of OIE standards in the negotiation of bilateral trade agreements for animals and products of animal origin, the ways to develop strong partnerships with relevant stakeholders, and the discussion of an OIE Global Animal Welfare Strategy (GAWS). This OIE Strategy was adopted by

the World Assembly of Delegates in May 2017 during the 85th OIE General Sessions of the World Assembly of the Delegates of the OIE.

The OIE GAWS is based on four pillars:

- The development of international animal welfare standards;
- The enhancement of capacity building and training of Veterinary Services;
- The communication with governments, national and international organisations, and the public to raise awareness on animal welfare, and
- The progressive implementation of OIE standards on animal welfare and their corresponding policies.

Implementation of OIE standards is recognised as an integral and important part of establishing and improving the legal framework for animal welfare.

The OIE has various activities and tools that can be used by Member Countries to help to support the implementation of the GAWS pillars. These can be adapted to regional and national contexts and used in isolation or in various combinations.

Activities and tools that have proven to be effective for the implementation of the OIE animal welfare standards and include among others, the OIE Regional Animal Welfare Strategies (RAWS) and Platforms, the strengthening of National Veterinary Services through capacity building activities, the establishment of Collaborating Centres on animal welfare at regional level and the development of long-term partnerships and robust support mechanisms.

Furthermore, considered as one of the GAWS's main activities, was the establishment of the OIE Animal Welfare Global Forum which brings together members of the animal welfare research community, the global animal welfare movement and the global animal-source food sector, to provide a forum for active debate relevant to animal welfare topics such as: animal welfare policies, issues and activities at global level; sources of expertise, educational programmes

related activities; guidance in supporting communication and advocacy activities; areas for the development of additional animal welfare standards; and to encourage and support the implementation of animal welfare standards.

The first meeting of the OIE Animal Welfare Global Forum was held in Paris, from 28 to 29 March 2018, where governments, NGOs, academia and industry, discussed the main challenges in the implementation of OIE animal welfare standards. The second OIE Animal Welfare Global Forum is planned for April 2019.

Reference

1. These standards for terrestrial and aquatic animals can be accessed via the OIE website at <http://www.oie.int/en/international-standard-setting/terrestrial-code/access-online> and <http://www.oie.int/en/international-standard-setting/aquatic-code/access-online/> respectively.





Professor Xavier Manteca
Autonomous University of Barcelona, Spain

Xavier Manteca Vilanova received his BVSc and PhD degrees from the Autonomous University of Barcelona and an MSc in Applied Animal Behaviour and Animal Welfare from the University of Edinburgh. Currently, he is full professor of animal behaviour and animal welfare at the School of Veterinary Science in Barcelona. He has published extensively and is a diplomate of the European College of Animal Welfare and Behavioural Medicine.

Professor Xavier Manteca
Autonomous University of Barcelona, Spain

Antimicrobial resistance and animal welfare: two sides of the **same coin?**

Antimicrobial resistance (AMR) is a major public health issue and it has been estimated that *ca.* 70,000 people die each year from causes related to AMR. If effective measures are not implemented, AMR will become one of the major causes of death by 2050. Although the factors responsible for AMR are complex, it is widely accepted that massive use of antimicrobials contributes significantly to AMR. In many countries, the livestock industry consumes a large proportion of the total amount of antimicrobials used.

Animal welfare is an essential element of modern animal production. First and foremost, animal welfare is grounded on ethical concerns that derive from the fact that animals are sentient beings, i.e. able to suffer and experience emotions. Moreover, improving the welfare of farm animals may have additional benefits for human health and food security, and the link between animal welfare and AMR is a potentially important aspect of such benefits.

Two questions arise when addressing the relationship between farm animal welfare and AMR:

1. Is AMR an animal welfare problem?
2. Can the use of antimicrobials in livestock production be reduced through better animal welfare?

Physical health is an essential part of animal welfare and hence diseases (including infectious diseases) then must be treated with antimicrobials) reduce welfare (e.g. Mellor, 2016). Therefore, AMR is a major concern from an animal welfare standpoint. Digestive and respiratory conditions, lameness and mastitis are some of the main drivers of antimicrobial use in farm animals (EMA and EFSA, 2017), and all of them cause pain and discomfort in animals thus having a pronounced effect on their welfare.



It has been suggested that improving the welfare of farm animals can help to reduce the use of antimicrobials (EMA and EFSA, 2017) and the main objective of this presentation is to review the evidence supporting this idea. First, I will provide several examples that demonstrate that animal welfare problems which are not directly related to health increase the risk of infectious diseases and, therefore, the need to use antimicrobials. Secondly, I will discuss the mechanisms that underlie the link between animal welfare and susceptibility to infectious disease.

Dairy calves have traditionally been fed an amount of milk replacer much smaller than the amount they will consume if fed *ad libitum*. It has been shown that this causes chronic hunger (which is a direct welfare problem) and increases the risk of respiratory disease, which is one of the main reasons for antimicrobial use in dairy calves (Khan et al., 2011).

Heat stress is one of the main welfare problems of dairy cows and is a risk factor for both mastitis and lameness. Dairy calves are susceptible to cold stress, which increases the risk of respiratory problems. Lying behaviour has been shown to be a fundamental requisite for good welfare in dairy cows (Metz, 1985) and adequate resting behaviour results in reduced lameness, among other benefits.

Weaning is stressful, and the amount of stress increases as weaning age decreases (Weary and Fraser, 1997). Further, it has been shown that the stress of early weaning may have long-lasting effects on intestinal health, increasing the risk of diarrhoea for several months after weaning (Moeser et al., 2017).

Poor stockmanship causes fear of humans and is a major welfare problem in all species and it also increases the risk of several health problems, including lameness (Chesterton et al., 1989) and mastitis in dairy cows.

A few studies have shown a link between overall welfare and prevalence of infectious diseases. For example, broiler flocks which have a low animal welfare score according to the Welfare Quality[®] protocol have a higher prevalence of *Campylobacter* infection than flocks with better welfare (Alpigiani et al., 2017).

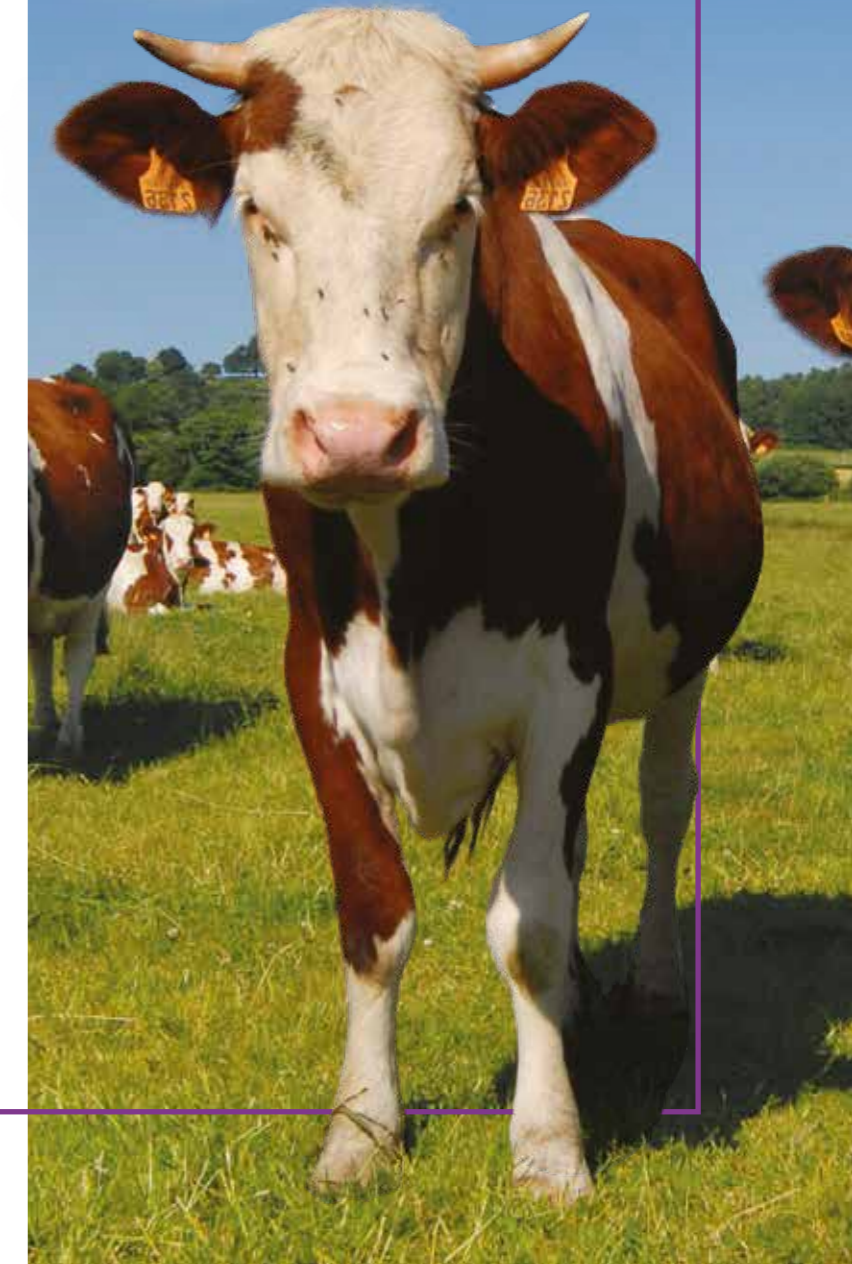
There are several mechanisms that may explain the link between poor animal welfare and increased risk of diseases, including the stress response and changes in behaviour. Many welfare problems (including chronic hunger, thermal and physical discomfort, early weaning and poor stockmanship) are associated with a stress response. The effects of stress on the immune system may vary depending on the type of stressor, among other things. However, chronic stress is likely to reduce the immune function and hence increase the susceptibility to infectious diseases.

Many welfare problems cause changes in behaviour and these may have a negative effect on health. For example, heat stress may increase the risk of lameness because resting time is shorter in cows suffering heat stress than in cows that are not exposed to high temperatures. Cows that make sudden movements due to inappropriate handling are also more likely to become lame (Chesterton et al., 1989).

In conclusion, although the link between farm animal welfare and antimicrobial resistance needs further research, the available evidence strongly suggests that improving the welfare of farm animals has the potential to reduce the prevalence of diseases that are treated or prevented with antimicrobials. Therefore, improving farm animal welfare can be an important strategy to address AMR.

References

- Alpigiani I, Abrahantes J C, Michel V, Huneau-Salaün A, Chemaly M, Keeling L J, Gervelmeyer A, Bacci C, Brindani F, Bonardi S and Berthe F (2017) Associations between animal welfare indicators and *Campylobacter* spp. in broiler chickens under commercial settings: A case study. *Preventative Veterinary Medicine* 147: 186-193.
- Chesterton R N, Pfeiffer D U, Morris R S and Tanner C M (1989). Environmental and behavioural factors affecting the prevalence of foot lameness in New Zealand dairy herds—a case control study. *New Zealand Veterinary Journal* 37: 135-142.
- EMA and EFSA (2017) EMA and EFSA Joint Scientific Opinion on measures to reduce the need to use antimicrobial agents in animal husbandry in the European Union, and the resulting impacts on food safety (RONAFA) doi: 10.2903/j.efsa.2017.4666.
- Khan M A, Weary D M and von Keyserlingk M A G (2011) Effects of milk ration on solid feed intake, weaning, and performance in dairy heifers *Journal of Dairy Science* 94: 1071-1081.
- Mellor D J (2016) Updating Animal Welfare Thinking: Moving beyond the "Five Freedoms" towards "A life Worth Living" *Animals* 21 doi:10.3390/ani6030021.
- Metz J H M (1985) The reaction of cows to short-term deprivation of lying *Applied Animal Behaviour Science* 13:310.
- Moeser A J, Pohl C S and Rajput M (2017) Weaning stress and gastrointestinal barrier development: Implications for lifelong gut health in pigs *Animal Nutrition* 3. 313-321.
- Weary DM and Fraser D (1997) Vocal response of piglets to weaning: effect of piglet age. *Applied Animal Behaviour Science* 54: 153-160.





Marianne Villettaz Robichaud
University of Montréal, Canada

Marianne graduated as an agronomist from Laval University in 2008 and holds a PhD in epidemiology from the University of Guelph. For her PhD, she worked on calving management and calving assistance in dairy cows. Since graduating, she worked as an animal welfare research technician and a scientist and advisor for commercial dairy farms in the US. She recently joined the University of Montréal as an assistant professor in production animal welfare with the veterinary medicine clinical science department, after completing a series of post-docs working on animal welfare oriented animal husbandry practices and the economics of dairy cattle welfare.



Marianne Villettaz Robichaud
University of Montréal, Canada

Is lying time a relevant indicator of cow comfort around parturition?

Parturition is a stressful period in all species and is associated with a higher risk of disease, injury and mortality. The post-calving inflammatory response has been well investigated in both healthy and diseased cattle. However, the pain component is less documented. Many research studies have used lying behavior as a non-invasive indicator of discomfort and pain in cattle.

Parturition is recognized by farmers and bovine practitioners as painful, especially when dystocia occurs. Major fetal-maternal disproportion requiring important traction for expulsion and caesarean section have been ranked amongst the procedures leading the highest estimated severity of pain (Huxley and Whay, 2006). In order to accurately prevent and treat the pain experienced by the animals, its reliable evaluation is paramount. As pain is a subjective experience for each individual, its objective assessment is a challenge, especially when the aim is to use a non-invasive method. Pain related behaviours can be used to assess pain level in animals, but these can represent both objective and subjective methods, depending on the type and implementation of the assessment and the experimental design (Millman, 2013). Both the occurrence and the

frequency of specific behaviors can inform on the pain experienced by the animals. In cattle, behaviors related to feeding, activity level, attitude and demeanor have been used in research to assess if pain was experienced by the animal, and its level, for specific procedures and conditions. Standing and lying time, frequencies and postures are certainly some of the most commonly used behavioral indicators of discomfort and pain in cattle.

Lying time

Resting is one of highest ranked behavioral priorities for cows. On average, a cow will lie down or rest between 10 to 14 hours per day, depending on her living conditions and physiological state (Charlton et al., 2014; Ito et al., 2014). When deprived of rest, cows show high motivation (willing to work) to access a comfortable lying area and modify their time budget to compensate the deprivation in the following days (Metz, 1985; Tucker et al., 2018).

Because it can be easily obtained through automated devices, lying time has been used in many studies as a non-invasive indicator of comfort and discomfort. Recent researches

Is lying time a relevant indicator of cow comfort around parturition?



have clearly shown that dairy cows' daily lying time can be affected by the quality of housing; overcrowding, poor stall design and poor bedding management lead to lower daily lying time (Solano et al., 2016; Krawczel and Lee, 2019). Some studies also aimed at using daily lying time as an early indicator of diseases, sometimes with conflicting results. For example, cows experiencing metritis have been shown to have altered lying time, a study reported that cows experiencing metritis had shorter lying time in the 2 weeks prior calving but that no differences were found between diseased and healthy animal in the days prior diagnosis (Neave et al., 2018).

Differently, another study reported that primiparous animals experiencing clinical metritis spent more time lying compared to healthy counterparts in the days prior diagnosis but this was not observed for multiparous animals (Barragan et al., 2018). Finally, lying time has also been used to predict future performances of dairy cows with longer lying time in the first weeks of lactation being associated with increased odds of culling before 60 days in milk and animals lying between 9 to 13 hours per day in the same period reported to have improved cyclicity at 42 days in milk (Piñeiro et al., 2019a).

An indicator of discomfort around parturition?

The reliability of lying time as an indicator of pain and discomfort around calving time is questionable. Many studies looking at dystocia, periparturient diseases and pain relief medication have reported the effects on lying time. Their findings are sometimes conflicting and generally difficult to compare due to elements such as varying definitions of dystocia, lying data summarizing techniques, and analysis of external factors known to affect lying time. Some research also report results pre- or post-calving exclusively, while others follow the animals through the entire process.

Parity or age of the animals is one important factor which is not always included in the analysis investigating lying behavior. One study specifically followed the lying patterns of healthy dairy cows for 28 days after calving and found that lying time significantly increases with the age of the animal (Steensels et al., 2012). Other studies showed that primiparous have a steady decrease in lying time starting 10 days pre-parturition, while multiparous animals have decreased lying time only 2 days pre-calving and also found that multiparous had greater lying time

post-calving (Borchers et al., 2017; Piñeiro et al., 2019b). When investigating the changes in lying duration, another study found that multiparous cows undergoing eutocic calving were lying approximately one hour less during the 24 hours prior completion of calving compare to a control period during late pregnancy (Miedema et al., 2011). In addition to changes in lying time, an increased level of activity, sometimes referred to as restlessness, is often mentioned for cows in the days prior parturition and is thought to be related to discomfort felt by the animals (Maineau and Manteca, 2011).

During the calving process itself, the effect of dystocia on cows' lying time has been examined. When dystocia was defined as an assisted parturition, some results showed no difference in the hours prior calving and a tendency for greater lying time in the 24 hours post-parturition for dystocic animals but not in the following day (Barrier et al., 2012; Proudfoot et al., 2009). A number of studies also investigated the effects of pain relief medication around parturition on lying time. When dystocia was defined as the second stage of parturition lasting longer than 70 minutes, animals receiving NSAID between 48 to 6 hours prior calving had similar lying time

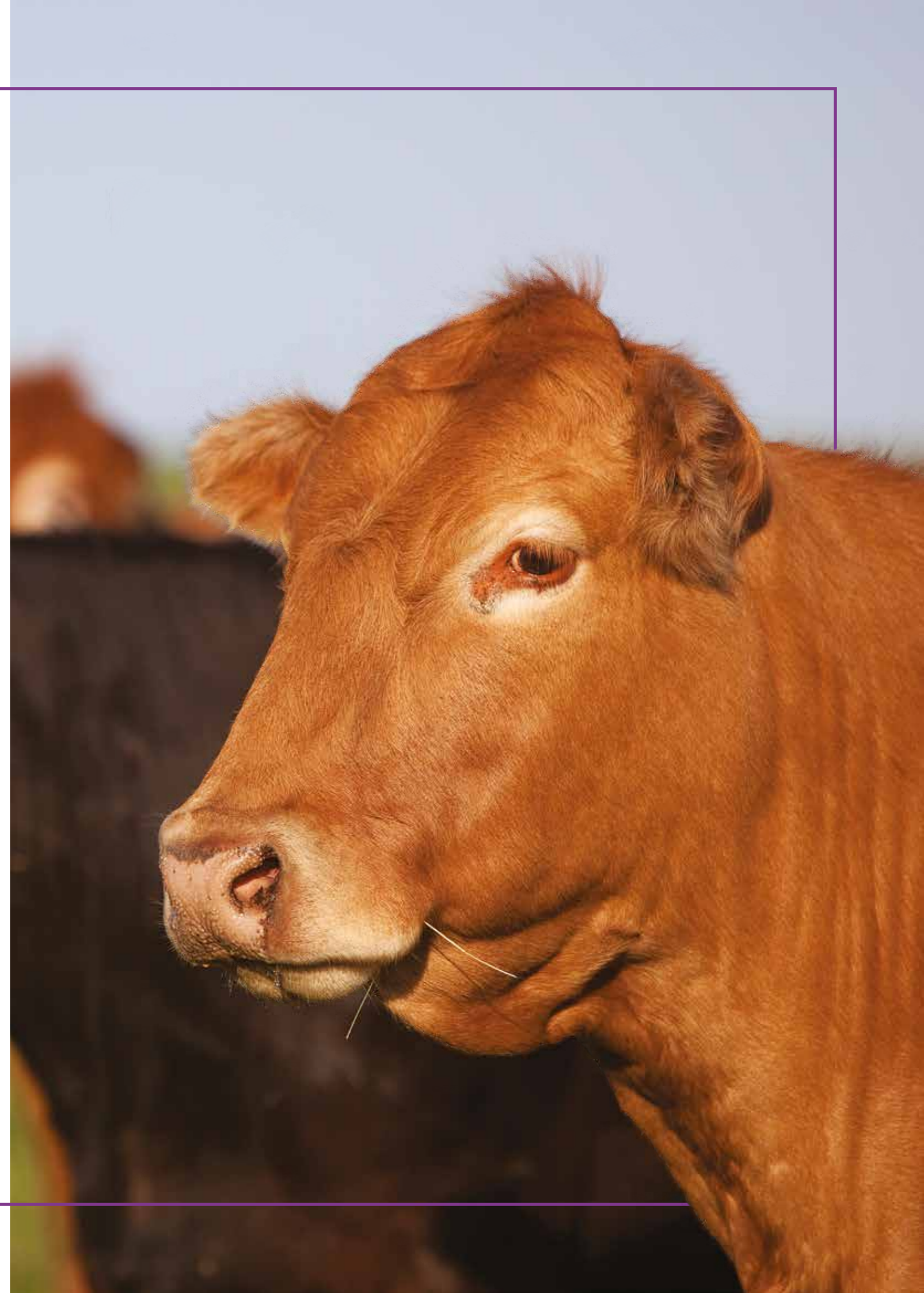
to non-medicated control animals (Swartz et al., 2018). Differently, when examining animals undergoing caesarean section in beef cattle, the use of NSAID lead to longer lying time in the first 16 hours after parturition (Barrier et al., 2014). These results show important variations in findings depending on the definitions and procedures used. Unfortunately, most of these studies did not differentiate between primiparous and multiparous animals and very few followed the animals on a longer period to allow a baseline to be established.

Overall, monitoring changes in lying time around parturition may offer some insight of cow comfort around of parturition but great caution needs to be apply when analysing and interpreting the results. Elements such as parity, seasons and health should be controlled for either through study design or during statistical analysis, when appropriate. Information on lying time should be accompanied by other behavioural signs of discomfort such as a direct measure of level of activity and behaviors directed toward the site of pain. Research is still needed to evaluate the associations between lying time, calving progress measured objectively and pain related physiological indicators.



References

- Barragan, A. A., J. M. Piñero, G. M. Schuenemann, P. J. Rajala-Schultz, D. E. Sanders, J. Lakritz, and S. Bas. 2018. Assessment of daily activity patterns and biomarkers of pain, inflammation, and stress in lactating dairy cows diagnosed with clinical metritis. *J. Dairy Sci.* 101:8248-8258.
- Barrier, A. C., M. J. Haskell, A. I. Macrae, and C. M. Dwyer. 2012. Parturition progress and behaviours in dairy cows with calving difficulties. *Appl. Anim. Behav. Sci.* 139:209-217.
- Barrier, A. C., T. M. Coombs, C. M. Dwyer, M. J. Haskell, and L. Goby. 2014. Administration of a NSAID (meloxicam) affects lying behaviour after caesarean section in beef cows. *Appl. Anim. Behav. Sci.* 155:28-33.
- Borchers, M. R., Y. M. Chang, K. L. Proudfoot, B. A. Wadsworth, A. E. Stone, and J. M. Bewley. 2017. Machine-learning-based calving prediction from activity, lying, and ruminating behaviors in dairy cattle. *J. Dairy Sci.* 100:5664-5674.
- Charlton, G. L., D. B. Haley, J. Rushen, and A. M. de Passillé. 2014. Stocking density, milking duration, and lying times of lactating cows on Canadian freestall dairy farms. *J. Dairy Sci.* 97:2694-2700.
- Huxley, J. N., and H. R. Why. 2006. Current attitudes of cattle practitioners to pain and the use of analgesics in cattle. *Vet. Rec.* 159:662-668.
- Ito, K., N. Chapinal, D. M. Weary, and M. A. G. von Keyserlingk. 2014. Associations between herd-level factors and lying behavior of freestall-housed dairy cows. *J. Dairy Sci.* 97:2081-2089.
- Krawczel, P. D., and A. R. Lee. 2019. Lying time and its importance to the dairy cow: Impact of stocking density and time budget stresses. *Vet. Clin. of North Ame: Food Anim. Prac.* 35:47-60.
- Maineau, E. and X. Manteca. 2011. Pain and discomfort caused by parturition in cows and sows. *Appl. Anim. Behav. Sci.* 135:241-251.
- Metz, J. H. M. 1985. The reaction of cows to a short-term deprivation of lying. *Appl. Anim. Behav. Sci.* 13:301-307.
- Miedema, H. M., M. S. Cockram, C. M. Dwyer, and A. I. Macrae. 2011. Changes in the behaviour of dairy cows during the 24h before normal calving compared with behaviour during late pregnancy. *Appl. Anim. Behav. Sci.* 131:8-14.
- Millman, S. T. 2013. Behavioural responses of cattle to pain and implications for diagnosis, management, and animal welfare. *Vet. Clin. Food Anim.* 29:47-58.
- Neave, H. W., J. Lomb, D. M. Weary, S. J. LeBlanc, J. M. Huzzey, and M. A. G. von Keyserlingk. 2018. Behavioral changes before metritis diagnosis in dairy cows. *J. Dairy Sci.* 101:4388-4399.
- Piñero, J. M., B. T. Menichetti, A. A. Barragan, A. E. Relling, W. P. Weiss, S. Bas, and G. M. Schuenemann. 2019a. Associations of postpartum lying time with culling, milk yield, cyclicity, and reproductive performance of lactating dairy cows. *J. Dairy Sci.* 102:3362-3375.
- Piñero, J. M., B. T. Menichetti, A. A. Barragan, A. E. Relling, W. P. Weiss, S. Bas, and G. M. Schuenemann. 2019b. Associations of pre- and postpartum lying time with metabolic, inflammation, and health status of lactating dairy cows. *J. Dairy Sci.* 102:3348-3361.
- Proudfoot, K. L., J. M. Huzzey, and M. A. G. von Keyserlingk. 2009. The effect of dystocia on the dry matter intake and behavior of Holstein cows. *J. Dairy Sci.* 92:4937-4944.
- Solano, L., H. W. Barkema, E. A. Pajor, S. Mason, S. J. LeBlanc, C. G. R. Nash, D. B. Haley, D. Pellerin, J. Rushen, A. M. de Passillé, E. Vasseur, and K. Orsel. 2016. Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in freestall barns. *J. Dairy Sci.* 99:2086-2101.
- Steensels, M., C. Bahr, D. Berckmans, I. Halachmi, A. Antler, and E. Maltz. 2012. Lying patterns of high producing healthy dairy cows after calving in commercial herds as affected by age, environmental conditions and production. *Appl. Anim. Behav. Sci.* 136:88-95.
- Swartz, T. H., H. H. Schramm, J. M. Bewley, C. M. Wood, K. E. Leslie, and C. S. Petersson-Wolfe. 2018. Meloxicam administration either prior to or after parturition: Effects on behavior, health, and production in dairy cows. *J. Dairy Sci.* 101:10151-10167.
- Tucker, C. B., L. Munksgaard, E. M. Mintline, and M. Bak Jensen. 2018. Use of a pneumatic push gate to measure dairy cattle motivation to lie down in a deep-bedded area. *Appl. Anim. Behav. Sci.* 201:15-24.





Charlotte Winder
University of Guelph, Canada

Charlotte is a veterinarian and epidemiologist who holds an appointment as Assistant Professor in the Department of Population Medicine at the University of Guelph. She is a clinician with the University's Ruminant Field Service, and teaches in the undergraduate, graduate, and veterinary medicine curriculum.

Her graduate work focused on gaining a better understanding of strategies for pain mitigation during disbudding of dairy calves through primary research, knowledge synthesis, and knowledge translation. Currently, she maintains this broad approach to the research cycle in several areas, including work in dairy welfare focusing on pain mitigation for calves and the care and management of non-ambulatory cows. She is passionate about bridging the gap between evidence and practice in order to maximize the value of research for farmers, veterinarians, and industry stakeholders.

Charlotte Winder
University of Guelph, Canada

50 Shades of Pain

Pain research in non-human animals is uniquely challenging. Self-reporting is considered the gold standard in humans, even in more difficult circumstances such as assessing those with cognitive impairments (Herr, 2011; Chen et al., 2015). No such gold standard has been shown in non-human animals, and often multiple outcomes are required in order to gain an understanding of their sensory and emotional experience associated with actual or potential tissue damage. This may include a host of physiologic and/or behavioural indicators or tests which, when interpreted en bloc, should give a general impression of the experience of the animal.

Increased societal concern for food animal welfare has driven changes regarding recommendations and regulations for pain mitigation and prevention in livestock. It is in the best interests of these animals that these requirements are as evidence based as possible. Evidence based regulations likely also have advantages in acquiring buy-in from farmers and industry stakeholders. Although there is certainly criticism of evidence based medicine, Godlee (2014), channelling Churchill (1947), fittingly argues that "[it] may be the worst system for clinical decision making, except for all those other systems that have been tried".

Considering the evidence

Replication is an essential part of the scientific process (Fidler and Wilcox, 2018), as an individual study is a sample, providing one answer in a distribution of possible answers. Results between studies may vary due to chance, heterogeneity, or bias. As a result, rarely should an individual study be persuasive enough to change practices (Grimshaw, 2010). If multiple studies have asked the same research question, such as how efficacious a given pain control practice (or multiple practices) is (are) on a given condition or procedure, a systematic review and pair-wise or network meta-analysis would yield the highest level of evidence under field conditions (Sargeant and O'Connor, 2014). While this methodology is increasing in animal welfare research (Dzikamunhenga et al., 2014; Canozzi et al., 2017; Winder et al., 2018), it is certainly not as widely adopted in decision making as in human health.

Key areas impacting confidence

What is the research question? Studies informing decision making are hypothesis-testing, whether specifically designed to assess superiority, non-inferiority, or equivalence. While pain research often must use a host of outcomes, interpretation

of the results necessitates identification of the outcome the sample size was based on, and if the estimated difference is considered biologically or clinically meaningful. Non-independence (e.g. potential for clustering at the group or herd level) should also be considered at this stage. Conduct of over- or under-powered trials is arguably unethical from several standpoints (Halpern et al., 2002), and although under-powered studies can be combined in meta-analysis, there is ample evidence that 'small study effects' (publication bias) results in biased overall effect measures. In human health, this has helped to lead the movement towards preclinical registration of trial protocols. Trial registries have begun to arise in animal health research, but little adoption of preclinical registration has been seen to date.

What is the study design? An advantage in animal welfare research is that our questions are often suitable for controlled trials, such as assessing relative efficacy of pain mitigation strategies, or determining averseness of procedures or conditions. However, challenge trials or observational studies may provide some evidentiary value in situations where controlled trials are not possible, while recognizing limitations such as appropriateness of the challenge model, or confounding by indication in observational studies.

What, exactly, is being assessed? Determining how similar treatment groups in one study are to another allows for better comparison of the same treatment, or exploration of potential discrepancies between different approaches. This includes the specific treatment of interest (e.g. local anesthetic administration, or application of a hoof-block) and also consideration of the baseline for comparison, which may include potential additive effects of concurrent procedures, nutritional status, social conditions, etc. Similar to the challenges with interventions, outcomes should be similar enough between studies to warrant comparison, including both how the outcome is defined and when it is measured. A lack of replication of interventions and/or outcomes may account for substantial heterogeneity in the overall pooled estimates (Winder et al., 2018) or may preclude quantitative synthesis completely (Dzikamunhenga et al., 2014). In human health, initiatives such as COMET (Core Outcome Measures in Effectiveness Trials) to develop application of standardized sets of outcomes (COMET, 2016), including areas of pain research (e.g. Wuytack et al., 2018).

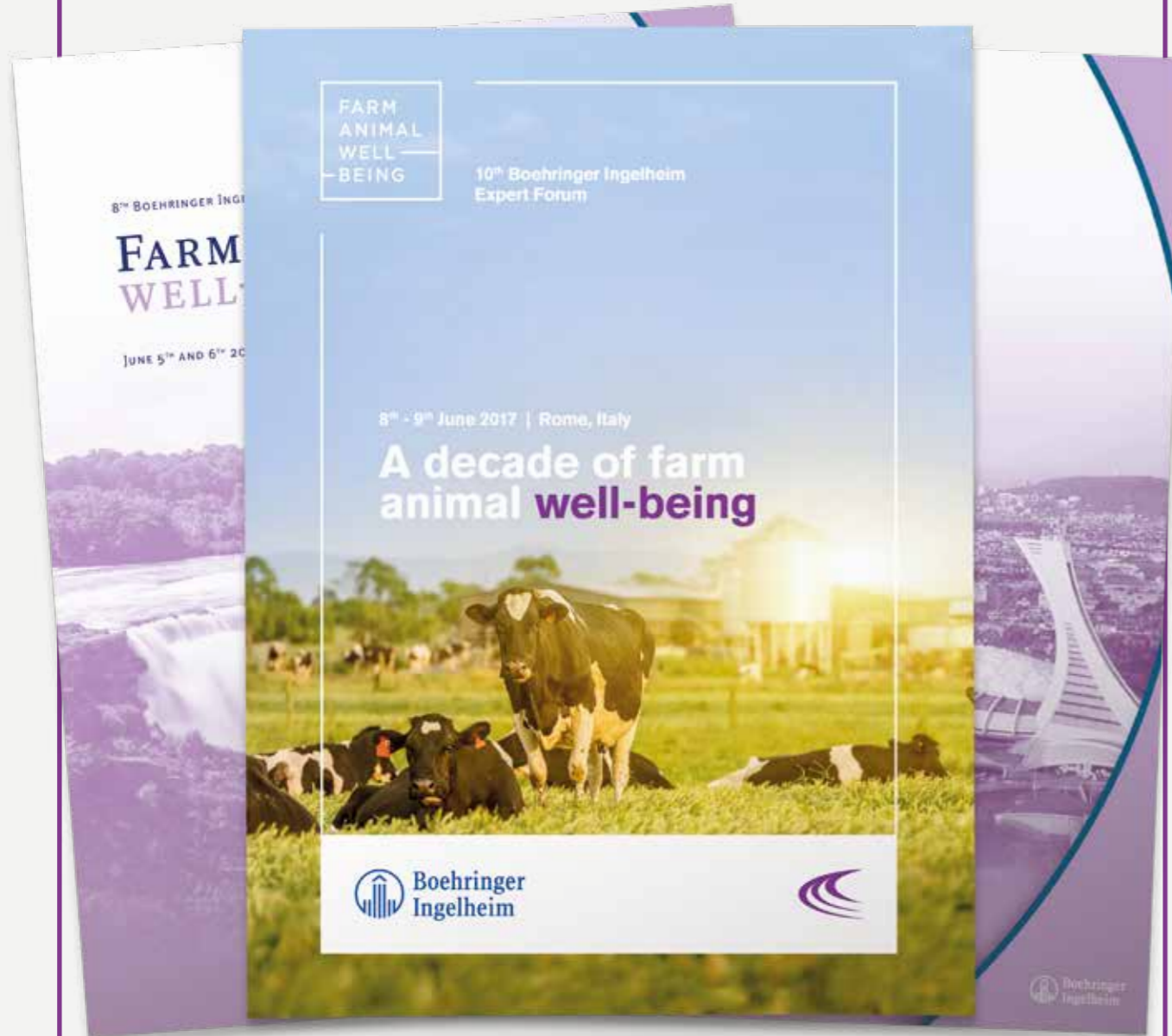
Was the study executed appropriately? Flaws in study execution can lead to biased effects. It has been shown in animal health that studies failing to report key design features, such as random allocation, exclusion criteria, blinding, or details of intervention protocols and outcome measures, are more likely to report positive intervention effects (Wellman and O'Connor, 2007; Burns and O'Connor, 2008; Sargeant et al., 2009a,b; Brace et al., 2010). Even in genetically identical mice, failure to randomize has shown to exaggerate outcomes by a substantial margin (Egan et al., 2016). In human health, failure to conceal allocation sequence is associated with biased effect estimates (Schulz et al., 1995), but in animal health research this is so infrequently reported (Totter et al., 2018; Winder et al., 2019) that a similar association has not been able to be assessed.

Is the analysis appropriate? Without an *a priori* study protocol, it is impossible to assess multiplicity of outcome measures or analyses, which is another reason protocols are crucial to study interpretation. Additionally, clustering often occurs over both space and time in livestock studies. For example, enrolling animals housed in multiple groups, or on multiple farms, and use of repeated measures over time, results in a lack of statistical independence of observations. As a result, the effective sample size will lie somewhere between the number of observations and the number of clusters at the highest level, depending on the degree of non-independence. Without accounting for clustering in the analysis, precision of the estimate will be inappropriately narrow, which may influence decision making. As well, a study with a large apparent sample size may be inappropriately viewed as influential when the actual sample size is far smaller. The effects of inappropriate analysis have been specifically highlighted for animal welfare science (Stevens et al., 2017), and appropriate methodology for animal populations has been promoted for some time (McDermott and Schukken, 1994).

References

- Brace, S., D. Taylor, A.M. O'Connor. 2010. The quality of reporting and publication status of vaccine trials presented at veterinary conferences from 1988 to 2003. *Vaccine* 28:5306–5314.
- Burns, M. J., and A.M. O'Connor. 2008. Assessment of methodological quality and sources of variation in the magnitude of vaccine efficacy: A systematic review of studies from 1960 to 2005 reporting immunization with *Moraxella bovis* vaccines in young cattle. *Vaccine* 26:144–152.
- Canozzi, M.E.A., A. Mederos, X. Manteca, S. Turner, C. McManus, D. Zago, J.O.J. Barcellos. 2017. A meta-analysis of cortisol concentration, vocalization, and average daily gain associated with castration in beef cattle. *Res. Vet. Sci.* 114:430-443.
- Chen, Y.H., and L.C. Lin. 2015. The credibility of self-reported pain among institutional older people with different degrees of cognitive function in Taiwan. *Pan Manag. Nurs.* 16:163-172.
- COMET. 2016. Aims and objective, COMET Initiative. <http://www.comet-initiative.org/aboutoverview>. Accessed April 2, 2019.
- Dzikamunhenga, R.S., R. Anthony, J. Coetzee, S. Gould, A. Johnson, L. Karriker, J. McKean, S.T. Millman, S.R. Niekamp, A.M. O'Connor. 2014. Pain management in the neonatal piglet during routine management procedures. Part 1: A systematic review of randomized and non-randomized intervention studies. *Anim. Health Res. Rev.* 15:14–38.
- Egan, K.J., H.M. Vesterinen, V. Beglopoulos, E.S. Sena, M.R. Macleod. 2016. From a mouse: systematic analysis reveals limitations of experiments testing interventions in Alzheimer's disease mouse models. *Evid. Based Preclin. Med.* 3(1):e00015.
- Fidler, F., and J. Wilcox. 2018. Reproducibility of scientific results. *The Stanford Encyclopedia of Philosophy*. <https://plato.stanford.edu/entries/scientific-reproducibility/>. Accessed April 2, 2019.
- Godlee, F. 2014. Evidence based medicine: flawed system but still the best we've got. *BMJ* 2014;348:g440.
- Grimshaw, J. 2010. A knowledge synthesis chapter. Canada Institute of Health Research. www.cihr-irsc.gc.ca/e/documents/knowledge_synthesis_chapter_e.pdf. Accessed April 2, 2019.
- Halpern, S.D., J.H.T. Karlawish, J.A. Berlin. 2002. The continuing unethical conduct of underpowered clinical trials. *JAMA* 288:258-362.
- Herr, K. 2011. Pain assessment in older patients. *J. Pain.* 12:S3-13.
- McDermott, J.J. and Y.H. Schukken. 1994. A review of methods used to adjust for cluster effects in explanatory epidemiological studies of animal populations. *Prev. Vet. Med.* 18:155-173.
- Sargeant, J.M., R. Elgie, J. Valcour, J. Saint-Onge, A. Thompson, P. Marcynuk, K. Snedeker. 2009a. Methodological quality and completeness of reporting in clinical trials conducted in livestock species. *Prev. Vet. Med.* 91:107–115.
- Sargeant, J.M., J. Saint-Onge, J. Valcour, A. Thompson, R. Elgie, K. Snedeker, P. Marcynuk. 2009b. Quality of reporting in clinical trials of pre-harvest food safety interventions and associations with treatment effect. *Foodborne Pathog. Dis.* 6:989–999.
- Sargeant, J.M., and A.M. O'Connor. 2014. Introduction to systematic reviews in animal agriculture and veterinary medicine. *Zoon. Public Health.* 61: 3 – 9.
- Schulz, K.F., I. Chalmers, R.J. Hayes, D.G. Altman. 1995. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA* 273:408-412.
- Stevens, K.N., L. Asher, K. Griffin, M. Friel, N. O'Connell, L. Collins. 2017. A comparison of inferential analysis methods for multilevel studies: Implications for drawing conclusions in animal welfare science. *App. Anim. Behav. Sci.* 197:101-111.
- Totton, S.C., J.N. Cullen, J.M. Sargeant, A.M. O'Connor. 2018. The reporting characteristics of bovine respiratory disease clinical intervention trials published prior to and following publication of the REFLECT statement. *Prev. Vet. Med.* 150:117–125.
- Wellman, N.G., and A.M. O'Connor. 2007. Meta-analysis of treatment of cattle with bovine respiratory disease with tulathromycin. *J. Vet. Pharmacol. Ther.* 30:234–241.
- Winder, C.B., C.L. Miltenburg, J.M. Sargeant, S.J. LeBlanc, D.B. Haley, K.D. Lissemore, M.A. Godkin, T.F. Duffield. 2018. Effects of local anesthesia or systemic analgesia on pain associated with caudal disbudding in dairy calves: A systematic review and meta-analysis. *J. Dairy Sci.* 101:5411–5427.
- Winder, C.B., K.J. Churchill, J.M. Sargeant, S.J. LeBlanc, A.M. O'Connor, D.L. Renaud. 2019. Completeness of reporting of experiments: REFLECTing on a year of animal trials in the *Journal of Dairy Science*. *J. Dairy Sci.* In Press.
- Wuytack, F., A. Gutke, B. Stuge, S. Mørkved, C. Olsson, H.S. Robinson, N.K. Vøllestad, B. Öberg, L.N. Wikmar, J.J.S. Menda, V. Smith. 2018. Protocol for the development of a core outcome set for pelvic girdle pain, including methods for measuring the outcomes: the PGP-COS study. *BMC Medical Research* 18:158 <https://doi.org/10.1186/s12874-018-0624-5>.

FARM
ANIMAL
WELL
— BEING



Download the proceedings
of previous events on

www.farmanimalwellbeing.com

THEY DON'T CARE WHO'S BEHIND ADVANCING THEIR WELLBEING

Of course not, that's our job.

At Boehringer Ingelheim, we're dedicated to finding ways to improve farm outcomes through supporting animal wellbeing. Take METACAM®, approved in Australia for the management of pain and inflammation in sheep – a world first. Helping farmers maintain the health of their flock. Now that's something we all care about.



FARM
ANIMAL
WELL—
—BEING

**Because farm animal
well-being works**

www.farmanimalwellbeing.com

