The first section covers the abstract and concrete connections between abuse of animals and humans and gives examples of a Spanish programme for raising awareness and supporting victims where companion animals are also catered for, and of a US collaboration between organisations acting on law enforcement/prosecution, domestic violence and abuse, animal welfare and veterinary and human healthcare. The second chapter covers companion animal welfare, working animals and livestock-supporting livelihoods, natural disasters and war and animal welfare and crime. It includes eight real-life examples, including support to UK farmers who suffer livestock attacks by uncontrolled dogs, cat hoarding action in Canada and work with Kenyan donkey owners. The third section covers animal welfare and food safety, animal welfare and farmer well-being, animal health and welfare and environmental protection, food security and sustainability. Five real-life examples are presented, including a support network for UK farmers and an early warning/support system for Irish farmers with emerging animal welfare issues on their farms. The fourth section covers different interventions with animals and presents an example of animal-assisted therapy for children in New York. The fifth and final section addresses the connections between biodiversity, the environment, animal welfare and human well-being, using examples from an indigenous tribe in the Amazon and how they cohabit with other beings as well as international work on animal welfare, biodiversity and environmental protection.

I hope that this book will be able to achieve its aim and I agree with the author that it is much-needed. In the contemporary discussion of how to mitigate the negative effects of human expansion on the planet, focus tends to be on humans and the environment, and the interests of animals often fall by the wayside. Others have tried to change this, for example, by integrating animal welfare in sustainability, but with questionable success. To develop and launch a conceptual framework is no small ambition, and to do so as a private research project is admirably brave. Unfortunately, this is also where the book falls a little short. The ideas and examples presented in the five sections convey the message that what is missing to make the world a better place for humans and animals is the *One Welfare* approach. There is little critical analysis of any limitations. I understand that to sell the idea, it is tempting to focus on the solutions it can provide, but a serious discussion of the concept needs to account for those scenarios for which no straightforward solution exists. For example, in modern animal production, there are few remaining situations where improving animal and human welfare clearly go hand-in-hand. Similarly, in many parts of the world, there are conflicting interests of wild animals and humans whose habitats overlap. That said, the enthusiasm of the author and the engaging style of the book bode well for its dissemination and the *One Welfare* movement that it is part of. If successful, in a few years there will hopefully be material and resources available for a second book which can address the topic in more depth and from several perspectives.

I Anna S Olsson,
i3S, University of Porto, Portugal

Achieving Sustainable Production of Pig Meat, Volume 3: Animal Health and Welfare

Edited by J Wiseman (2018). Published by Burleigh Dodds Science Publishing Ltd, 82 High Street, Sawston, Cambridge CB22 3HJ, UK. 326 pages Hardback (ISBN: 978-1-78676-096-8). Price £140.00.

It is important for animal welfare and animal welfare scientists to be an integral part of the grand challenges that livestock production faces, such as climate change, food security, food safety, animal and human health, and sustainability (Marchant-Forde 2015). And it was really on the basis of the word 'sustainable' in the book's title that I took on the task of this review. This book is one of a series of three volumes on sustainable pig production, the other two covering *Safety, Quality and Sustainability* and *Animal Breeding and Nutrition.* They are also part of an expanded series entitled *Burleigh Dodds Series in Agricultural Science* so far comprising 67 volumes, of which 52 have sustainable or sustainability in the title. This volume, however, does not really do what it says on the tin, and it has left me feeling rather disappointed within the context of sustainability, although some individual chapters do provide very thorough up-to-date reviews of health and welfare of pigs during different stages of production.

By now, we are all aware of the projections in human population growth, to reach 9.8 billion by 2050 from its current 7.6 billion (UN 2017) and the concomitant demand for food, especially food from animal sources. Pig meat continues to be the most consumed meat globally, but now vying for that position with poultry meat. Over the last few years, however, although total pig numbers worldwide have been fairly flat, we have continued to see increased industrialisation of pig production, especially within SE Asia, with rapid decrease in small- to mid-scale farms and corresponding increase in large-scale farming, somewhat in line with, or even surpassing the US model. In the last few months, the construction of multi-story sow breeding units in China has attracted media attention (https://www.pigprogress.net/World-of-Pigs1/Articles/2018/4/The-future-of-swine-breeding-278517E/) with accompanying comments made about sustainability of such systems.

What is sustainability defined in terms of agriculture? We have a legal definition here in the United States, which defines 'sustainable agriculture' (US Code Title 7, Section 3103) as "an integrated system of plant and animal production practices having a site-specific application that will over the long-term:

- Satisfy human food and fibre needs;
- Enhance environmental quality and the natural resource base upon which the agriculture economy depends;
- Make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls;
- Sustain the economic viability of farm operations; and
- Enhance the quality of life for farmers and society as a whole."

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When we examine and discuss sustainability of pig production, we need to consider economic, environmental and social sustainability. Future production systems have to be holistic and have to balance the necessity of making profit for the farmer, safeguarding the environment — both near and far — and meeting society's varied demands including, among many things, rearing the pigs in ways that meet or exceed society's welfare expectations and do not contribute to antimicrobial resistance. My feeling is that this series of books is focused on ways to maximise production efficiency, and hence, economic sustainability, though in producing more with less, there will be knock-on effects into the other aspects of sustainability. There is a rather cursory nod to both the environmental impact and the societal opinion of pig production in various systems and production phases, but with limited discussion of these topics with regard to sustainability. However, I did only have full access to the volume on health and welfare and the cursory information I could glean on the other two volumes from the publisher's website, so my comments must be taken with these limitations in mind.

A production system is unsustainable if it "impinges on the general public's values in a way that the members of the public find unacceptable" (Broom 2010). So, even if a production system is economically and environmentally sustainable, it can be socially unsustainable, for example, if the welfare of the animals housed within the system does not meet the public's moral standards for treatment of animals. Within pig production, over the last 30 years, there has been increased public awareness of welfare issues and the most widespread concern has been the housing of sows in crates or stalls during gestation. This has become an unacceptable production system in the eyes of the public in many parts of the world, with change to open pen systems occurring through a mix of consumer pressure, legislation and retailer initiative.

Although many producers feel frustrated by the public's unfamiliarity with, and their influence on, livestock production, the importance of the public's opinions or perceptions will determine what is sustainable. When the public is questioned about pig farms, the feedback from many parts of the world shows some general similarities in concerns (eg food quality and safety, welfare, environmental impact), and individual studies give greater detail of which aspects of these concerns are at the forefront of consumer expectation. Not surprisingly, animal welfare is high on the agenda. A study of 200 US citizens by Sato *et al* (2017) generated open-ended responses to the question of what characteristics might be considered to make up an ideal pig farm and why. Six emergent themes were identified based on response content, with 77% of respondents' replies referencing animal welfare, 44% referencing business operation, 25% referencing naturalness, 25% referencing ethical considerations, 22% referencing use of antibiotics, hormones and chemical residues, and 10% referencing environment. This demonstrates that there is genuine public concern about elements of economic, environmental and social sustainability.

Delving deeper into this dataset (Sato *et al* 2017), we see recurring focuses across some of those themes. The public wants pig production to be humane and meet ethical ideals. 'Naturalness' was emphasised, with pigs having freedom of movement, lots of space and access to outdoors. There should be an absence of pain, no routine antibiotic use and quality of life should be positive, including experience of positive emotions. The environment should be protected, with water use and pollution minimised, and air and water quality safeguarded. But there should also be incorporation of technology to help cost efficiency and profitability. These opinions may be 'uninformed' by production reality, but they cannot be dismissed as such and failure of the global pig industry to take public views into consideration will ultimately lead to unsustainability.

And, so, to the volume in hand. The book has 12 chapters with four on pig health and eight on pig welfare. The majority are from UK (five) and US (four) authors, with single chapter contributions from Australia, Belgium and Denmark, so a Western world viewpoint predominates. The health section does a good job of summarising the current major disease challenges facing pig production both broadly (Chapter 1; Ramirez), and PRRS and PED in particular (Chapter 2; Correia-Gomes). Chapter 4 (Maes and colleagues) summarises disease identification and management, including biosecurity and other preventative measures. Chapter 3 (Bailey and colleagues), which I found the most interesting in this section, covers the gut microbiome. There is real potential not only to influence the immune and metabolic functions by nutritionally modifying the microbial populations within the gut, which this chapter details, but through the gut-brain axis, we can also influence behaviour and the ability of the pig to cope with stress (Parois *et al* 2018).

The animal welfare section leads off with 'Understanding pig behaviour' (Chapter 5; Turner & D'Eath), with the authors astutely summarising the natural behaviour of the pig and providing a very useful table detailing the welfare issues that arise from the mismatch between the natural environment for which the pig has evolved and the environment presented by commercial production systems. This is an excellent resource for understanding why certain welfare issues manifest themselves and many of these are explored in greater depth in the remaining chapters. Chapter 6 (Hemsworth) gives an overview of defining and ensuring welfare in pig production and does touch on social sustainability, detailing public concerns with common production practices and advocating for a continued role of science in informing and shaping public concern, though acknowledging that it is only one ingredient that influences societal values. The chapter does give thorough, up-to-date mini-reviews on such issues as gestation and lactation housing for sows, restricted feeding and hunger, barren environments, lameness and painful procedures of tail-docking and castration.

Chapter 7 (Pietrosemoli and Green) covers pasture systems for pigs but is focused on production, with some reference to impact on environment and virtually no coverage of welfare; hence rather out of place in a section on welfare issues. Chapter 8 (Edwards) gets us back on the welfare track, and

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details the welfare of gestating gilts and sows, with focus on such issues as close confinement, hunger, stereotypic behaviour, feeding systems, social organisation and aggression. There is also some discussion about the trend away from close confinement and of welfare in extensive systems. The next chapter is entitled 'Welfare of weaned piglets' (Garcia and McGlone) but does also cover the farrowing environment, welfare aspects of cross-fostering and pre-weaning mortality, and revisits painful procedures previously covered in Chapter 6. Other contents in this chapter are weaning stress, transportation and the potential of new technologies, such as PLF and gene editing.

The final three chapters focus on the finishing pig, including on-farm welfare and welfare during transport and slaughter. Chapter 10 (Amory) covers welfare on the farm with an important section focused on tail-biting and environmental enrichment. Chapter 11 (Young) covers transportation, detailing loading and handling, factors affecting welfare during the actual transport process, and lairage at the slaughter plant. The volume wraps up with a short Chapter 12 (Støier and colleagues) on humane slaughter techniques and discusses handling and stunning impacts on welfare, mostly in relation to EU requirements.

So, overall, I was disappointed. If you want to learn about how pig production can be economically, environmentally and socially sustainable, then this book will not give you the answers. But, if you want up-to-date reviews on some of the most pressing welfare issues in different stages of production, or an introduction to pig health, then there are some good chapters included.

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Jeremy N Marchant-Forde,
USDA-ARS Livestock Behavior Research Unit, West Lafayette, IN, USA

Animal Welfare, Third Edition

Edited by MC Appleby, IAS Olsson and F Galindo (2018). Published by CABI, Nosworthy Way, Wallingford, Oxon OX10 8DE, UK. 440 pages. Paperback (ISBN: 9781786390202). Price 39.99, €55.00, US$ 65.00.

Ever since its first edition, *Animal Welfare* has been the point of first call of many students, lecturers and researchers in the animal welfare science field. It is therefore timely that a new edition has been released seven years after the second edition was published. In line with previous editions, the third edition is very accessible and aimed at undergraduate and postgraduate students, as well as early career researchers and animal professionals outside of academia. It provides a concise summary of a wide range of aspects relating to animal welfare. The book is organised into 19 chapters over five parts. The parts form a logical journey, starting with an introduction to animal welfare issues, followed by a concise description of problems relating to animal welfare, assessment of animal welfare, solutions to animal welfare problems, before ending with a chapter on implementation of animal welfare solutions. New to this edition is the provision of supplementary material online, two digital-only chapter appendices and the option to also obtain a free e-book version of the book.

Although no major additions or deletions appear to have been made to the content, overall the content has been updated, and rewritten where evidence has evolved since the last edition of the book. For example, recent work on genetic polymorphism and temperament (Table 10.2; p 200) has been added to Chapter 10 on physiology to reflect our greater understanding since the previous edition. In a number of cases, content has been clarified with clear examples and explanations (see, for example, Table 8.1 on p 144 of the new third edition compared to section 8.1.2 on p 121 of the previous edition). This has made the text much more accessible to readers. Similarly, examples have been updated to demonstrate that classic topics (such as preference and motivation; Table 11.1; p 215) remain current. The reproduction of photos and figures in colour add to the increased accessibility of the new edition. Moreover, where required, figures have been updated to reflect advances in our understanding (see, for example, the addition of epigenetic influences to the diagram on physiological processing on p 184 of the new edition). Similarly, where appropriate, figures have been replaced with more up-to-date examples (eg Fig 10.4 on p 195 on cortisol secretion in sheep replaces Fig 10.3 on p 167 on the same topic).

Although this third edition sees many positive updates compared to its predecessor, there are a number of weaknesses which may need addressing in a future edition. Firstly, prediction of welfare problems through technology-enhanced behaviour analysis is covered only briefly in Chapter 9, even though this area of animal welfare science is currently seeing rapid developments (see, for example, Kashiha *et al* 2014, Vásquez Diosdado *et al* 2015 and