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Animal Board Invited Opinion Paper: Planet, people and poultry - more and better data needed to get the balance right

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Introduction

Since the mid-20th century, the poultry industry, especially the commercial chicken components, has been celebrated by the animal agriculture sector as a major success story due to highly efficient production, significant investment in research, and globalisation of input and output value chains. Chickens were very well suited for rapid intensification as they were already efficient food converters with lower greenhouse gas emissions compared to ruminant livestock. Intensification, driven by the private sector and supported by government-funded research and regulation, relied on selective breeding (for high meat or egg yields), competitive production within economic systems where wider environmental issues (such as deforestation and biodiversity loss) are considered externalities, increased ability to diagnose and control disease with antimicrobials, disinfectants and vaccines and growing attention to animal welfare.

What will sustainable and safe poultry production look like in the 21st century?

Globally, poultry meat and eggs are the most abundant animal products in human diets and intensification of chicken production, which has outpaced that of other livestock, is predicted to expand in a similar vein for the next three decades. However, with less than 10 years remaining to achieve the 2030 Agenda for Sustainable Development, a simple focus on economically efficient production can no longer serve the interests of the poultry industry, consumers or other stakeholders. The industry is not alone in facing the multiple and complex challenges confronting the planet in the 21st century and must respond to a global need to achieve enhancements to productivity in ways that are economically, socially and environmentally sustainable (Alders et al., 2021).

Food and nutrition security underpin human society as we know it, and crucial decisions that aim to drive sustainable transformation of food systems and associated bioeconomies are made at national and global levels. However, the quality and generalisability of publicly available data on which many current decisions are based are often insufficiently addressed. At the production unit level, many countries rely on data from agricultural censuses and product sales with no linked information on important factors such as nutrition inputs, water and land use, therapeutic interventions (including vaccines and antimicrobials), production chain risk factors, condemnation rates or handling of waste. An additional factor in the paucity of publicly available data is the general practice by large-scale commercial production companies to hold their data as 'commercial in conference.' Livestock data tools rarely provide information disaggregated by production system, breed, or supply and distribution chain, or that can be readily linked to agroecological zones. Beyond production units, tracked data generally relate to commodities such as meat and eggs in the case of poultry. The end point and efficient utilisation of products such as nutrient-rich offal are rarely tracked by national and global bodies, and so the extent of the loss of essential nutrients to the human food chain is largely unknown (Wingett et al., 2019). The poultry industry is looking to the future and exploring Blockchain technology (which establishes an irreversible date-stamped timeline of data that becomes embedded and distributed across a network) as companies look to enhance traceability, particularly in high-income countries. This is encouraging and provides an opportunity to ask, what should be traced and what should be shared and with whom?

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What aspects of poultry production should be monitored transparently?

Clearly, to maintain the social licence, key concerns to be monitored include: (i) welfare of birds and those who raise them; (ii) pandemic risk, especially the emergence of avian influenza subtypes with pandemic potential; (iii) antimicrobial resistance, particularly in relation to antimicrobial stewardship that ensures the responsible use of antibiotics that are approved for use in animals; (iv) biodiversity loss associated with land clearing for the production of feedstock, such as soy and maize; (v) the homogeneity of commercial genetic lines and further biodiversity loss that ongoing intensification of indigenous breeds will have, particularly on traits that are important for extensive production; (vi) redirection of nitrogen and phosphorus pollution generated by intensive systems into useful products such as organic fertiliser; and (vii) quality of carcass nutritional value.

Going forward, nutrient yield and quality relative to resources used and greenhouse gases emitted will receive increasing attention as the application of bioeconomy principles becomes mainstream (Bogdanski et al., 2021). Assessing nutrient yield and quality requires increased frequency and diversity of analyses of poultry carcasses and eggs across a range of production systems. Wang et al. (2007) reported a marked increase in the fat content of standard broiler chickens in recent decades, with the modern broiler providing more energy from fat than protein and a significant reduction in omega-3 fatty acids. Similarly, de Bruyn et al. (2016) noted that national food composition tables generally present data on commercial chicken products only; and these data are often imported from a third country. Increased investment is required to generate data on the nutrient composition of birds from indigenous and other breeds and those raised under diverse production systems.

In terms of direct greenhouse gas emissions, poultry rank below those associated with ruminant and pig systems. However, when indirect emissions (such as those associated with feed production, feed and animal transport, and processing) are considered, poultry industries struggle to achieve net zero carbon systems. In addition, ammonia pollution (due to large quantities of poultry manure), water usage, deforestation and biodiversity loss (associated with broadacre production of maize and soy that form essential components of intensive poultry rations in many parts of the world), the homogeneity of commercial breeds and hybrids (to the point where the genetics of commercial broiler meat production is essentially in the hands of two multi-national companies), and the relatively high levels of food waste/spoilage reported for chicken products in high-income countries, all contribute to the environmental impact of large-scale poultry production that will be more closely assessed as sustainable and circular bioeconomies become more commonplace. The relative importance of each of these issues will require discussion based on sound evidence during the establishment and implementation of sustainable bioeconomic principles.

Scientific advances are enabling the rapid development and expansion of technology that supports verification systems required to build blockchains. This presents an opportunity to use such approaches to facilitate equitable profits that reward safe and sustainable production. Crucial to success will be the active participation of key stakeholders, including those from large-scale poultry production sectors, to co-develop with researchers and regulators the most appropriate modalities for data collection and sharing, to ensure the protection of commercial in confidence data whilst allowing scientific advances and analyses to be harnessed for the benefit of planet, people and poultry (Table 1).

Table 1
An overview of areas of concern and associated data gaps regarding poultry production in the 21st century and the key stakeholders who must play integral roles in addressing them.

Concern	Examples of gaps in publicly available data from global commercial chicken production	Stakeholders
Welfare	**Chickens:** Stocking density, air quality, gait score, dirtiness, litter condition, hock burn, pododermatitis, body condition, meat quality, egg quality, feather loss, beak trimming, mortality/culls, farm to market transportation, sick birds at slaughter. **Those who raise them:** Household and individual incomes and consumption, job security, access to health care and education.	Small- and large-scale producers including companies, producer associations, research scientists, veterinarians, consumers, public and animal health professionals
Pandemic risk	Farm and market biosecurity measures, vaccination status, veterinary surveillance and diagnostics, food safety inspection, producer and trader pandemic preparedness plans, adherence to national policies and guidelines.	Small- and large-scale producers, producer associations, research scientists, national and international reference laboratories, consumers, policymakers (national, regional, global, including public health and trade organisations)
Antimicrobial resistance	Farm-level antimicrobial usage, adherence to regulations on withdrawals, residues in meat, feathers and waste.	Small- and large-scale producers, pharmaceutical companies, research scientists, consumers, regulators, policymakers (national, regional, global, including trade organisations)
Biodiversity loss	Quantities, sources, transportation and formulation of inputs (feed, water and supplements).	Small- and large-scale producers, indigenous communities, research scientists, consumers, policymakers (national, regional, global, including environmental and trade organisations)
Genetic homogeneity	Disaggregation of bird numbers by breed, location and typography of production, and distribution chain. Phenotypic analysis of indigenous breeds subject to crossbreeding and intensification of production.	Commercial breeding companies and producers, small-scale producers of indigenous chickens, national livestock departments, environmental agencies
Pollution	Quantities, types and disposal of waste products from farms and markets, measurement of nitrogen, phosphorous, potassium and heavy metal in emissions and waste, monitoring of local watercourses and wells.	Commercial producers, research scientists, traders, market regulators, consumers, policymakers (national, regional, global, including environmental and trade organisations)
Nutrition	Nutrient yield and quality of poultry products. Tracking of all poultry products including nutrient-rich offal.	Small- and large-scale producers, research scientists, food testing laboratories, consumers, policymakers (national, regional, global, including public health organisations)

Conclusions

People have raised poultry (which includes turkeys, ducks, geese and quail in addition to chickens) for thousands of years in a multitude of locations utilising diverse production systems. For poultry to deliver net good for people and planet in the 21st century, robust data collection and analysis across all geographies and production systems are vital. In the short term, and with the current spotlight on zoonotic disease and antimicrobial resistance, harnessing the rich array of data associated with the different poultry production systems will greatly increase the sensitivity and specificity of disease surveillance activities leading to enhanced efficacy.

Ethics approval

Not applicable.

Data and model availability

Not applicable.

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Author contributions

RA conceived the study, both authors developed the analysis and contributed to writing and revising the manuscript.

Declaration of interests

There is no potential conflict of interest.

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