GLOBAL AGENDA FOR SUSTAINABLE LIVESTOCK

Animal welfare for production and working animals: evidence and need for action

Technical background paper

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The goal of this technical paper is to draw attention to the importance of animal welfare and how it connects to wider social, environmental, and agricultural issues. It focuses on how animal welfare improvements within farming systems can lead to other benefits, as well as benefitting the animals themselves. The examples throughout this paper demonstrates how sustainable livestock systems can benefit when animal welfare is incorporated as a priority. It is hypothesised that many more opportunities for welfare and sustainability gains exist. To identify these, and to mitigate situations that create trade-offs, system changes need to be grounded by evidence of improvements and include animal welfare assessment.

1. Key messages

1. Livestock play vital and diverse roles. For transformation to more efficient, inclusive, resilient and sustainable agrifood systems, animal welfare needs to be integrated. Across species there are strong correlations between improved welfare and improved production; positive connections between animals and their users; and societal concerns for animals and an ethical duty-of-care for the well-being of animals. We conclude that the benefits and contributions of good animal welfare would be even greater if it was better incorporated at multiple levels of food systems governance. Improved animal welfare needs to be more widely implemented across farming systems and integrated into sustainability frameworks, and where implementation has started, continuous improvement approaches should be taken.

2. Applying a One Health/One Welfare lens can assist in identifying the important contributions animal welfare makes to society, and its inter-connectedness with the environment and human well-being. Changes made to improve animal welfare, for the benefit of animals and for wider benefits, need to be grounded by evidence that demonstrates improvements. The impact of changing food systems, from incremental to transformative, should consider animal welfare. In many situations, improvements in animal welfare can contribute to food system change.

3. Integration of animal welfare into efforts to improve animal health can be effective but will only capture certain aspects of animal welfare. There is a responsibility to respect animals' capacity for feelings and ensure that their biological and behavioural needs are met. Identifying animal sentience in policy helps define how they need to be cared for.

4. The behavioural or emotional needs of animals are rarely considered and are typically not provided for by measures to improve health alone. There are many diverse options for providing animals with environmental enrichment that can address these needs. As well as welfare improvements, health, production, and environmental benefits are associated with effective enrichment with greater behavioural opportunities. Good animal welfare can contribute positively to major livestock issues of sustainable livestock systems including food security and nutrition, inclusive economic growth, One Health and One Welfare, and natural resource use and climate change adaptation.

5. Good animal welfare can lead to improved *animal health*. Often the link between good health leading to good welfare is emphasised, but there are numerous examples where good welfare leads to improved animal health, and this can include the reduction of the need for antimicrobials.

6. Good animal welfare can contribute to improved *nutrition and food safety*. Good animal welfare is associated with reduced risks to food safety, and nutritional benefits for consumers. Good animal welfare can also increase the longevity and functionality of animals, directly improving the food security of their owners and local communities that rely on them.

7. Opportunities for *livelihoods and economic growth* resulting from improved animal welfare are possible for individual animal owners, men and women, to sector-level gains, including diverse examples of investment in specific agriculture approaches that consider animal welfare. Different market opportunities also provide examples of where animal welfare can drive economic growth and gender equality. As women are key in livestock keeping in smallholder systems, they are not only essential to animal welfare, but will also profit from more resilient livestock production systems.

8. Good animal welfare and environmental outcomes can occur simultaneously. There are numerous examples of production systems that are beneficial to both *climate and natural resources* and animal welfare. These can include alternative systems to those that are currently common, as well as modifications to existing systems to create these win-wins.

2. Background

Production and working animals are more than an agricultural commodity. They contribute to aspects of all Sustainable Development Goals, particularly poverty alleviation, food security and nutrition, health and wellbeing, gender equality, economic growth, responsible production, and climate action. There are also strong social connotations to animal keeping.

Our most common production animals - poultry, pigs, small and large ruminants - have welfare needs that when provided, can improve their quality of life, as well as their productive lives and enhance the contributions they make to us and the environment. Working equids, which are a key production species in subsistence farming and lower input food systems, have similar welfare needs and contributions to the domains of sustainability, and so have been equally incorporated and considered here.

While animal welfare is recognised and incorporated by private and public groups, from individual farms to intergovernmental organisations, growth opportunities and needs remain. Considering animal welfare in production, development and policy is important for more equitable and sustainable outcomes for animal owners and society, and so the needs of the foundational stakeholder - the animals - are met.

2.1 What is animal welfare

Animal health and animal welfare are complementary but not synonymous concepts. Without good health, there cannot be good welfare, but good health alone does not guarantee good welfare. Not only does science recognise a multidimensional approach to animal needs, but animal owners describe this as well: farmers, consumers and society consider welfare to be more than just animal health (https://doi.org/10.3389/fanim.2021.63878 & https://www.frontiersin.org/articles/10.3389/fvets.2022.980192/full, https://doi.org/10.3390/ani10030385).

Animal welfare is 'the physical and mental state of an animal in relation to the conditions in which it lives and dies' (Terrestrial Animal Health Code: 2019 ...). Good animal welfare is based on the principle that an animal should be treated in a way that meets its biological, behavioural, and emotional state needs, giving the animal a good quality of life. This means that an animal's welfare is not a simple provision of resources, or action at a point of time, it involves ongoing considerations and care.

Based on scientific evidence, our understanding of animals has evolved to understand how the resources and care we provide to them interact with their experiences and feelings, to give an overall view of their welfare. These resources, and their interaction with feelings, are described by the concept of the 5 domains. Animals need to have their nutritional, environmental, health and behavioural needs met, and in doing so their mental state, or emotional, needs will be met. [link to the breakout box: Evolution in understanding animal welfare].

2.1.1 Evolution in understanding animal welfare

The 'Five Freedoms' framework has been the basis for animal welfare action and policy work since its inception in 1965. While this is a sound foundation, an updated framework - 'Five Domains' - recognises the importance of limiting animal welfare constraints, while recognising more directly (1) that animals are sentient (meaning that they experience feelings and have an awareness of this) and (2) that providing positive opportunities, resources and experiences is beneficial for animals beyond the prevention/alleviation of negative experiences. This framework has been taken up by a number of different industry groups to guide their action on animal welfare (e.g. Fonterra)

Fig: 5 freedoms contrasted with 5 domains, and an image to demonstrate how the 5 domains interact with each other.

3. Why animal welfare is a priority issue

Animal welfare is a priority consideration in production because it is ethically important to treat animals well. Animal welfare also impacts and is impacted by all different domains of agricultural sustainability. In the long term, good animal welfare can make good economic sense also.

The following sections outlines the evidence behind why animal welfare is a priority issue. It starts with the needs of animals as a unique key stakeholder, and then describes how animal welfare is connected to universal goals for development. The relevance of animal welfare to higher-level frameworks that connect people, animals and the environment are then outlined. Following this, specific examples of the co-benefits of improving animal welfare to the four domains of sustainable livestock production are provided, further highlighting the importance of including animal welfare comprehensively when considering sustainable livestock production. Throughout these subsequent sections examples from global to local levels are provided.

3.1 Animal sentience

Animals are sentient. More simply, they have feelings and can experience both positive and negative states. For animals under human care, we have a responsibility to respect their capacity for feelings and ensure that their biological, behavioural needs are met, giving them the chance to experience positive feelings and limit negative. This ability to experience feelings is what underpins both the practical and moral concerns when caring for animals and why they need a high standard of care, including a humane death.

Animal keepers have long recognised the emotional capacity of their animals. This has been associated with better welfare outcomes too https://doi.org/10.1080/10888705.2023.2228029. Animal sentience is recognised as a specific term in legislation across a growing number of countries (e.g. WAP update). Animal sentience is also used by the FAO and by industry (e.g. dairy SA). Acknowledgement of sentience also occurs indirectly, including descriptions of "providing positive experiences" for animals (Fonterra), and the French national Livestock, Meat

and Dairy Associations. While sentience may not be included explicitly as a term, the recognition of positive experiences for animals implies their ability to feel.

Recognising the term sentience in policy has fundamental importance, as it underpins how we need to care for animals, and with farmed animals having this capacity, it relates to all systems worldwide. By recognising sentience, the need to provide essential nutrition, health and environmental resources, behavioural opportunities, and limit negative experiences are implied. Sentience recognises an animal's ability to feel.

Alongside the essential need to consider animal experiences, recognising and improving the welfare of animals is connected to a number of human- and production-related benefits.

3.2 Animal welfare and SDGs

The Food and Agriculture Organization of the United Nations (FAO) links sustainable livestock systems to all 17 of the Sustainable Development Goals (SDGs); https://www.livestockdialogue.org/fileadmin/templates/res_livestock/docs/2016/Panama/FAO-AGAL_synthesis_Panama_Livestock_and_SDGs.pdf), and considers animal welfare to be a core component of sustainable livestock production https://www.fao.org/publications/card/en/c/I8384EN/, making animal welfare an important need to consider when delivering on the SDGs, even though both welfare, and livestock in general, are largely missing from the heavily anthropocentric SDGs.

A systematic evaluation of the compatibility between achieving the UN sustainable development goals (SDGs) and improving animal welfare indicated that there is a mutually beneficial relationship between improving animal welfare and achieving SDGs. Improving animal welfare was evaluated as being a significant contributor to achieving SDG 2 Zero Hunger, and the strongest mutual reinforcement were identified for SDG 12, which deals with responsible production and consumption, and SDG 14, which deals with life below water. Identifying these relationships between animal welfare and the sustainable development goals helps highlight the importance of animal welfare when implementing these goals in practice. https://doi.org/10.3389/fvets.2019.00336.

Beyond SDG 2, 12 and 14, in most scenarios, acting on the SDGs can positively contribute to the improvement of animal welfare, making it a 'passive' way to improve on welfare. However, due to the mutually beneficial relationship between animal welfare and many of the SDGs, taking action to improve animal welfare can lead to progress of SDGs. For example, improving the welfare of working equids has been directly associated with improved opportunities and quality of life for women and girls in households reliant on these animals (https://www.worldhorsewelfare.org/what-we-do/our-positions/working-equids-and-the-sdgs, https://doi.org/10.1079/cabionehealth.2023.0023; https://doi.org/10.1007/s10393-022-01613-8).

Animal industries have also outlined contributions of their species to the SDGs, and both dairy and working equids in particular presenting detailed analyses of their species' contributions to the SDGs (https://research.rabobank.com/far/en/sectors/dairy/dairy-and-the-sustainable-

development-goals.html, https://www.worldhorsewelfare.org/what-we-do/our-positions/working-equids-and-the-sdgs). Contextualising species production amidst global development is an important way to have livestock recognised in these broader contexts. in these documents, the welfare of these livestock species is implicit.

3.3 One Health, One Welfare

One Health and One Welfare recognise the interconnectedness of people, animals and the environment. With One Health describing these connections on a health dimension, which includes a broader definition of health that recognises not only the interconnectedness between the three entities, but also the societal dimension to One Health (One Health High Level Expert Panel (OHHLEP) https://www.who.int/news/item/01-12-2021-tripartite-and-unep-support-ohhlep-s-definition-of-one-health and https://doi.org/10.17269/s41997-024-00872-y). One Welfare complements this and describes these connections between animal welfare, human wellbeing and the environment (Pinillos, Rebeca Garcia, ed. *One welfare: A framework to improve animal welfare and human well-being*. Cabi, 2018, Stephens, Tanya, ed. *One welfare in practice: the role of the veterinarian*. CRC Press, 2021.).

Recognising these connections are important because they help to identify the complex interactions that exist. When animal welfare is assessed simplistically, and contrasted only to productivity or economic gains, important and tangible benefits may be overlooked. The impact assessments of specific interventions aimed at improving animal welfare would benefit from being multi-dimensional assessments, which is something that a One Health/One Welfare framework would provide. Similarly, many sustainability assessments, and evaluation of systems/approaches aimed to address unsustainable farming practices largely fail to address animal welfare beyond a token mention. The current approach of mono-dimensional assessments of systems and interventions mean that benefits of improving animal welfare are likely underrepresented at minimum, or that environmental or production focused adaptations can be negatively affecting animal welfare at worst. Evaluating actions, including welfare-focused interventions dynamically across the complexity of a system is important to effectively capture impacts in a more holistic way than is done currently.

Figure: examples of ways to consider evaluation of animal welfare as a part of a multidimensional approach, capturing animal welfare beyond health and production measures

One Welfare in Action: Composting shelters used by the dairy industry create One Welfare benefits. Composting shelters use deep bedding comprising plant-based material that composts urine and dung *in situ*. Composting shelters have attributed animal welfare benefits, specifically improving cow comfort and calmness. Staff wellbeing has also increased, with staff being able to manage cows more easily, and the system attributed to reducing aspects of staff stress and labour. Positive environmental benefits include creating a composted organic fertiliser and eliminating the need for effluent management/capture. Document link

3.4 Role of animal welfare in sustainable animal production

Animal productivity cannot be a proxy for welfare. Animal productivity and welfare may be positively correlated in many production systems; however, pushing productivity too high can compromise animal welfare, as described by McInerney (2004).

All production systems will have welfare benefits and disadvantages. The welfare of the animal is highly dependent on the practices involved in that management system can affect animal welfare in different ways; however, some systems have ceilings where important aspects of welfare can never be met due to restrictions in how they are produced. These limitations particularly exist in very intensive confined systems where there are practical limits to 'good' welfare (Webster 1994, https://doi.org/10.3389/fanim.2023.1225839).

Tethered cows are an example of a system that has a welfare ceiling. Many aspects of their welfare can be managed exceptionally well, but important aspects, like movement, exercise and self-grooming cannot be met due to the physical limitations of the system. Understanding these restrictions are important when evaluating system options and is why evaluating animal welfare using a comprehensive definition is so important. This builds on the acknowledgement of sentience and what that means for animal needs.

The co-benefits of improving animal welfare in sustainable livestock production can be identified across a variety of different areas and have been recently published in the WOAH vision paper (https://www.woah.org/en/document/animal-health-and-welfare-cornerstones-of-sustainable-animal-farming/). The Global Agenda for Sustainable Livestock (GASL) has taken on a Livestock System-approach to address the economic, social and environmental livestock issues. For this broad and inclusive approach GASL has adopted the four sustainability domains that the FAO-NSA/NSAL presented at the Global Forum for Food and Agriculture in Berlin in 2018:

- Animal health and animal welfare,
- Food and nutrition security,
- Livelihoods and economic growth,
- Climate and natural resource use.

Co-benefits of improving animal welfare are outlined against these four sustainability domains below, further highlighting the importance of including animal welfare comprehensively when considering sustainable livestock production.

3.4.1 Animal health and animal welfare

Animal health and welfare are tightly interconnected: good health is a central component of welfare, and good welfare promotes good health.

Poor health/welfare can impair productivity and it can block trade. Consequently, poor health and welfare can negatively impact income at a farm level to a national one. Animal diseases may also directly affect humans by transmission of disease-causing zoonotic microbes or as food borne diseases.

Good animal welfare can bolster animal health by increasing resilience to disease and climate shocks. For instance, responsible use of antimicrobials by improving health preventive measures and husbandry has important implications for human health and the environment, making it a One Health issue. At the same time, blanket elimination of antimicrobials also creates an animal health and welfare issue for those in need of treatment. Judicious use of anti-microbials, facilitated by anti-microbial stewardship, creates One Health benefits (https://hdl.handle.net/10568/125970).

Animal management strategies that benefit the welfare of animals can reduce the need for antimicrobial use. Better welfare of farm animals is associated with lower antimicrobial use (https://doi.org/10.3390/ani12081025), and this includes reduced antimicrobial resistance in organic farming systems (http://doi.wiley.com/10.2903/j.efsa.2017.4666) with evidence of this in cattle, chicken, pigs and turkeys (https://www.biorxiv.org/content/10.1101/2023.04.07.536071v1.full). Conversely, farming intensification has been linked to increased diversity of antibiotic resistance in the faeces of a variety of farmed animal (https://doi.org/10.1038/s43247-023-00790-w).

Evidence indicates that increased movement is associated with good physical welfare and health. Broilers that had access to an outdoor range and moved further from the shed also had improved leg health and reduced physiological stress responses to acute challenges (https://doi.org/10.1017/S1751731119001514). Birds that accessed the outdoors more frequently also have better cardiovascular health, plumage and leg health (https://www.sciencedirect.com/science/article/pii/S0032579119307497). Environments must both feel safe and stimulating to animals for them to be effectively used. The rate of production also affects both broiler health and welfare, with slower growing broiler strains having both significantly better health (less morbidity and mortality) and displaying more behavioural indicators of positive welfare (https://doi.org/10.1038/s41598-020-72198-x).

In situations where painful husbandry practices continue to be practiced at the moment, these practices need to be performed in the least painful and most ethical way possible to reduce the short- and long-term impacts on animal production and performance. Extensive research around effective approaches to painful husbandry practices, including the use of pain relief, is well established.

Good welfare for disbudding

Based on research, best practice approaches for the removal of horns in cattle have been established. If this process needs to be undertaken, the most humane way to do this includes:

- Disbudding is preferred to dehorning
- Should be performed as soon as horns are palpable (~3 weeks of age)
- Hot iron/cauterised disbudding is the best practice method.
- Anaesthesia and analgesia should be used to reduce pain during and after the procedure
- Sedation beforehand helps reduce pain and improve ease of handling.

- (https://www.fawec.org/en/what-do-we-do/inspiring-pilot-farms/379-disbudding-calves)

Even with all these practices in place, the use of NSAIDs combined with a local anaesthetic does not fully eliminate the welfare challenges from disbudding with healing and pain being long-term https://www.frontiersin.org/articles/10.3389/fvets.2018.00117/full. An alternative to dehorning is to select for polled calves, which is an option for some cattle breeds already. In many geographies, access to these methods of disbudding and pain relief are unavailable and/or too expensive, highlighting that best practice cannot always be achieved. For these reasons, moving away from painful husbandry procedures all together is still a necessary goal.

Antimicrobial use and animal welfare

The connections between different ways to improve animal welfare and reduced antimicrobial use are well documented. A snapshot of evidence from pigs and poultry:

- A study comparing national production systems identified that pig production in Sweden uses substantially less antimicrobials post weaning compared to Belgium, France and Germany (https://www.sciencedirect.com/science/article/pii/S0167587716301593?via%3Dihub). This over 20-fold difference in antimicrobial use has been attributed to an older weaning age in Sweden (35 days old) compared to the other countries (24, 22, 25 days old respectively). Later weaning is also attributed to better social and cognitive development.
- Welfare friendly production systems have been shown to use less antimicrobials later in production too. Farms producing pigs for welfare-friendly labels have lower antimicrobial use levels than conventional farms (https://www.mdpi.com/2076-2615/10/3/417 and https://www.sciencedirect.com/science/article/pii/S0167587721000271). Pigs raised in 'welfare friendly' grower and finisher systems (described as housing systems with multiple areas, straw bedding and daily access to outdoor facilities) receive less antimicrobials than traditional slatted floor systems (https://pubmed.ncbi.nlm.nih.gov/15795015/).
- The reduction of antimicrobials in pigs raised in welfare friendly systems have been established to be the result of reduced environmental and management stressors, which allow pigs to become more immunocompetent and prepared to overcome pathogenic challenges (https://doi.org/10.3390/ani12020216).
- With antimicrobial resistance being primarily associated by the pig industry as relevant to human medicine, rather than livestock farming, personal behaviour change alone is not strong enough to create practice change (https://www.frontiersin.org/articles/10.3389/fvets.2022.980546/full). Pig producers in Brazil site agro-industries and foreign markets as motivators for change around antimicrobial use, making these potential drivers for other welfare changes too (https://doi.org/10.3390/antibiotics10030331).
- Slower-growing broiler chickens (with improved welfare outcomes) require fewer antibiotics (https://www.sciencedirect.com/science/article/pii/S0308521X21000238).
- Dutch slower growing broilers use nearly 9x fewer antibiotics than fast-growing breeds. They also have better health and reduced mortality and culling (https://cdn.i-pulse.nl/autoriteitdiergeneesmiddelen/userfiles/sda%20jaarrapporten%20ab-gebruik/AB-

rapport%202022/def-sda-rapport-met-brief---het-gebruik-van-antibiotica-bij-landbouwhuisdieren-in-2022.pdf).

Health and welfare are closely linked, and both are of importance in production. Farmers have been shown to prioritize the minimization of health issues for their animals, while also wanting to create environments where animals are able to express natural behaviours (a key aspect of creating positive animal welfare) https://www.frontiersin.org/articles/10.3389/fanim.2021.638782/full. Advocating for animal health improvements are therefore critical for animal welfare improvements, making campaigns like Action for Animal Health (https://actionforanimalhealth.org/), important ways that animal welfare improvements can occur.

Animal welfare action can be effectively integrated with animal health. At an industry level, many industry bodies are integrating animal health and animal welfare, including having specific appointments to address health *and welfare* (e.g. Dairy South Africa, Fonterra). Industry-led auditing now includes animal welfare as a part of routine farm assessments (e.g. Dairy South Africa includes Animal Welfare Standards in their Farm Food Safety Audits. Beef Quality Assurance, Verified Beef Production Plus, and New Zealand Farm Assurance Programme all assess animal welfare compliance to ISO standards). When done effectively, this can be a powerful way to improve health, welfare and production at once. It brings attention to the importance of animal welfare beyond health where it may not be already a point of focus and offers an approach where it can be integrated into the farming system, rather than an addition afterwards.

Focusing only on health is oversimplifying the complexity of welfare and animal requirements. While integration of health and welfare messaging and action is positive, emphasis is largely on the absence of disease and injury. Health is strongly tied to productivity and profitability, as well as being simpler to measure, than other aspects of welfare. Suitable husbandry, housing and veterinary care can still be hard to provide in many production systems/parts of the world; however, these are more readily understood and more often enacted improvements. The lesser addressed and understood component of welfare tends to be meeting behavioural needs and the positive emotional experiences that come as a consequence of positive behavioural opportunities. These behavioural needs are often harder to communicate to farmers and other stakeholders as well.

Enriching environments are essential for creating these behavioural opportunities. Enrichment means increasing the complexity of the animal's environment and may include foraging opportunities, social housing, or positive human contact where appropriate https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=1&htmfile=chapitre_aw_pigs.htm#:~:text=For%20the%20purposes%20of%20this%20chapter%2C%20environmental%20enrichment%20means%20increasing,the%20expression%20of%20abnormal%20behaviour.

When used in conjunction with good management, enrichment can improve the welfare of animals in many environments, including in many intensive production systems https://doi.org/10.3390/ani13142372. Enrichment does not always imply good welfare. To improve welfare, it needs to be *effective*.

The provision of *effective* enrichment, which is defined as: being implementable, leading to an improvement in animal welfare and affordable, is key to providing these behavioural opportunities (https://doi.org/10.1017/awf.2023.5). Of the wide variety of environmental enrichments available, welfare benefits of effective enrichment can include one or more of the following:

- Improved health;
- Generating pleasure/enjoyment, which may also reduce stress;
- and/or generating other long-term benefits though cognitive development, stable social interactions, or stress resilience

Enrichments that improve health indicate that welfare is compromised without enrichment. As a result, these should be considered as essential resources and provided at minimum for animals. Effective enrichment has the potential to improve animal welfare to create a "life worth living" (https://doi.org/10.1017/awf.2023.5).

Policy action is demonstrating increased focus on animal welfare on neglected species. With growing awareness of animal welfare, the gaps that exist in policy are being incrementally filled. The welfare of working equids, which are a chronically overlooked set of animals that contribute significantly to production, has received attention on a global level with the creation of a specific chapter on the welfare of working equids in the World Organisation for Animal Health's Terrestrial Animal Health Code in 2016. Guidelines for working equids specific to tourism were also published in 2022 by the EU Platform on Animal Welfare.

Improving animal welfare can enhance animal health. Examples of this include using best practice approaches for management practices in the short term (e.g., painful husbandry practices) and long term (e.g., ongoing provision of behavioural opportunities and effective enrichment). While combining animal health and welfare is an effective way to integrate welfare into production systems, this needs to be done in a way that recognises good animal welfare requires action beyond good animal health.

3.3.2 Food and nutrition security

Livestock species, including working equids, are essential to food and nutrition security of their owners, and the community on a local to global scale. Animal-derived foods could be a critical contributor to the unmet nutritional needs of around 3 billion people worldwide (https://doi.org/10.4060/cc0639en). Taking care of livestock welfare directly therefore makes meaningful contributions to important aspects of food and nutrition security. At the same time, overconsumption of animal-derived food is contributing to negative health outcomes, as well as other aspects of sustainability. Opportunities to reduce consumption and as a result reduce some

populations of livestock are being explored (https://www.cabidigitallibrary.org/doi/pdf/10.1079/cabionehealth.2023.0021).

Hen welfare, farmer and community wins Small-holder cage-free egg production can be a model system for food security. Farmer cooperatives pool their eggs to supply high-end buyers in the cities, boosting rural economies. For example, Happy Hens in India [https://thehappyhensfarm.com/] is a partnership of free-range farmers, each with an average of just two acres. The enterprises are largely run by women and are family owned. They are certified by Humane Farm Animal Care, and so are inspected and audited for animal welfare. Some of the farmers supplement income from eggs by growing semi-perennial fruit trees in the area where the hens range outdoors. The model is a win-win-win solution for small farmers, rural communities, and the animals. Buyers benefit from telling the story of how the eggs were produced and the benefits for animal welfare and alleviating rural poverty.

Poor welfare of working animals leads to reduced longevity and functionality, directly putting at risk the food security of their owners and local communities. Small-scale farmers are responsible for producing 80% of food in low and middle income countries (https://www.sciencedirect.com/science/article/pii/S2211912417301293). Many of these farmers rely on working equids for labour support, field work, market transport and other household contributions to produce this food https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9434516/, https://www.ilri.org/news/study-highlights-essential-role-working-equids-advancing-sustainable-development). Despite this, their contribution and other critical roles of working equids are often overlooked when considering veterinary care, national livestock management plans policies, and the economic contributions of livestock to the detriment of working equid welfare. The role of working animals to transhumant populations will increase because of the important role they play supporting community movement, which is a climate mitigation strategy.

Poor welfare and stress in production species can pose risks to consumers, for example through common food-borne infections such as *Salmonella*, *Campylobacter* and *E. coli*. Good animal welfare practices not only reduce unnecessary suffering but also help to make animals healthier.

Good animal welfare can lead to improved food safety. Poor animal welfare contributes food borne disease, with increased shedding of contaminating zoonotic bacteria (*E coli, Salmonella and Campylobacter*) from stress and poor management (https://www.efsa.europa.eu/en/topics/topic/animal-welfare). Good welfare can increase the immune status of animals, reducing susceptibility to and spread of disease (Manteca, X. (2008). Physiology and disease. In *Long distance transport and welfare of farm animals* (pp. 69-76). Wallingford UK: CABI.; https://doi.org/10.1071/AN15297).

Good animal welfare has been associated with potential nutritional benefits for consumers. Higher welfare chickens have more protein, less fat and better fat, with free-ranging chickens having higher protein content and lower fat compared to intensively reared birds (https://doi.org/10.1007/S13197-017-2612-X). Free range chicken also had higher levels of unsaturated fatty acids, more favourable ratios between PUFA and mono-unsaturated fatty acids

than intensively reared birds (https://doi.org/10.3382/PS/PEW226). Conversely, fast growing broilers can develop meat quality issues (white striping caused by myopathy; https://ift.onlinelibrary.wiley.com/doi/abs/10.1111/1541-4337.12431). Free-range eggs had more total fat, monounsaturated fat and polyunsaturated fat, higher n-3 fatty acids and beta-carotene than caged hens' eggs https://doi.org/10.3382/PS.2010-01289.

Pasture-fed beef, which is commonly associated with better welfare, has more beneficial fatty acids for human health than concentrate-based diets (https://doi.org/10.3390/foods11050646). Forage-based finishing and differential fatty acid profiles are included in the Protected Geographical Indication (PGI) descriptions of types of grass-fed beef and sheep (e.g. https://www.gov.uk/protected-food-drink-names/west-country-beef). As PGIs are a way to create consumer and market products, this also relates to the economic benefits of good animal welfare outlined in the following section. Housing systems associated with positive welfare in pigs also contribute to improved meat quality and nutritional profiles beneficial to human health (https://doi.org/10.1016/j.livprodsci.2004.11.028, https://doi.org/10.1017/S1751731108002796).

When animal-based products provide beneficial micronutrients, while overconsumption creates significant health risks, it is essential to understand how rearing conditions contribute to the nutritional value of the meat produced by the animal. This is an example of how integrated One Health, One Welfare research would add real depth to the evaluation of different production systems and interventions.

3.3.3 Livelihoods and economic growth

The contributions livestock make to individual livelihoods through to national economies is extensive. In high-income countries, livestock contribute to more than 40% of agricultural gross domestic product. In low and middle-income countries, livestock support the livelihoods of hundreds of millions of poor people (https://era.ed.ac.uk/handle/1842/30115). Welfare improvements are associated with livelihoods and economic growth in several different ways. Beyond this, and as outlined in the One Health, One Welfare section above, animals can serve other important functions, which are not always captured economically.

Livelihoods are interconnected with good animal welfare, and this is recognised by animal owners, providing them with feelings of satisfaction while also being sources of household nutrition and income (https://doi.org/10.3389/fvets.2022.1006505). Good animal welfare, including that of working equids, has been associated with women's empowerment and economic opportunities (https://doi.org/10.3390/ani13121927, https://doi.org/10.3389/fvets.2020.00060, https://doi.org/10.3389/fvets.2022.980192).

Examples exist in different farming settings where improving practices can improve welfare and production. Immunocastration, rather than physically castrating male pigs, has economic gains for both the production and slaughter components of the supply chain due to improvements on farm and in carcass traits https://www.thepigsite.com/articles/comprehensive-economic-analysis-of-improvest-adoption-by-the-us-pork-industry. Part of this economic benefit is attributed to an improved feed conversion in immunocastrated pigs, which is also associated

with environmental benefits. Similar economic and feed conversion benefits exist for raising entire male pigs, compared to physically castrated males https://www.sciencedirect.com/science/article/pii/S1751731109990693. Both alternatives remove the need for painful physical castration.

Positive human-animal interactions can result in improved health and productivity of farm animals, while on the contrary, animals subjected to aversive human contact become more fearful of humans, which can cause stress mediated reductions in reproduction and growth [https://doi.org/10.1186/2049-1891-4-25]. These positive human-animal interactions are also beneficial to farmers, because it is a strategy for farmers to "work safely and efficiently in a healthy environment" (https://shs.hal.science/halshs03469481v1/file/BeaujouanCromerBoivin.pdf).

Good handling and animal care also has immediate benefits at points along the production system. Improved handling practices can reduce carcass bruising by over 50% compared to routine farm handling practices https://pubmed.ncbi.nlm.nih.gov/22503613/. Acute stress preslaughter, including the use of electric prodders, leads to tougher meat with inferior quality https://www.publish.csiro.au/an/ea05155.

Refining farming practices have created sustainable gains for farmers. Technology in farming makes important contributions; at the same time, revisiting traditional practices have been used to make substantive improvements for livelihoods and animal welfare. Livestock guarding dogs (LGDs) remain one of the most effective non-lethal methods to reduce losses to predators. Other than reducing predation, using LGDs has been attributed to calmer, easier to handle and therefore more productive livestock. LGDs provide farmers with a work companion and transmit self-security and emotional support to the farmer/shepherds (https://www.fawec.org/es/que-hacemos/granjas-piloto/359-el-perro-de-proteccion-de-rebanos-el-mejor-amigo-de-la-ganaderia-de-montana), acting as an example of One Welfare connections.

Examples now exist where cow-and-calf dairy systems are both technically possible and financially viable, having been tested at the family farm scale (e.g. https://www.theethicaldairy.co.uk/about-ethical-dairy). The price gap in production between conventional and higher welfare production is also closing and the higher welfare product can command a higher price than conventional in the market that the dairy operates, so profit margins are growing. These cow-calf systems are associated with other One Welfare benefits as well: staff satisfaction/retention can be improved; rearing more robust heifers that better integrate into the milking herd, recover from first calving better; and it leads to reduced GHG/kg milk produced at that farm (https://doi.org/10.3390/ani13162571; https://doi.org/10.1016/j.applanim.2012.08.011; https://doi.org/10.1590/1984-3143-AR2023-0066; https://doi.org/10.3168/jds.2018-16021.

Investment in specific agriculture approaches that consider animal welfare can support the transition to sustainable systems. One example from the Sustainable Agriculture Finance Initiative (SAFI) is a New Zealand based organisation providing guidance for decision-making to encourage sustainable agriculture finance. The SAFI guidance aims to integrate environmental and social factors, including animal health and welfare metrics, to encourage sustainable

investment, lending, insurance, and risk management (https://www.sustainablefinance.nz/work-changing-norms-safi). SAFI guidance includes a requirement of "adequate natural shade and shelter at all times of the year", in addition to meeting domestic animal welfare standards.

Another example is the "IFC Practices for Sustainable Investment in Private Sector Livestock Operations", which is the lending policy of the International Financial Corporation (IFC), the private arm of World Bank. The fundamental practices that inform IFC investments in livestock include animal welfare. IFC guidelines require group housing for sows and prohibit force-feeding of ducks and geese and the keeping of animals exclusively for fur production https://www.ifc.org/en/what-we-do/sector-expertise/agribusiness-forestry/supporting-sustainability/ifc-practices-for-sustainable-investment-in-private-sector-livestock-operations.

The Sustainability Accounting Standards Board (SASB), whose global standards guide investors on financially material sustainability information of companies, now has identified crate confinement as reasonably likely to affect the financial performance of a company. Their Meat, Poultry and Dairy Sustainability Accounting Standard states that "Consumer demand has driven shifts in industry practices, such as eliminating the use of gestation crates in pig production and eliminating caged enclosures for poultry. Entities that are prepared to anticipate or adapt to these trends may be able to increase their market share by capturing this changing demand and being first to market with products that comply with new regulations." https://d3flraxduht3gu.cloudfront.net/latest_standards/meat-poultry-and-dairy-standard_en-gb.pdf

Consumer willingness to pay for high welfare is an established opportunity for value chains in many countries. Minimum standards are critical to guarantee important aspects of animal welfare. These are changing in response to societal concerns for animal welfare. At the same time, markets exist for animal welfare that goes beyond minimum standards in a number of different countries and animal products. Many market examples for this exist across countries and livestock products and are not only limited to the high income or western contexts (https://doi.org/10.1093/af/vfac082). Discreet choice experiments indicate that a significant proportion of consumers are willing to pay for welfare labelling and products associated with causes (https://doi.org/10.1016/j.ecolecon.2023.107852). The 2023 Eurobarometer on Attitudes of Europeans towards animal welfare found that six in ten Europeans are willing to pay more for products sourced from animal welfare-friendly farming systems (https://europa.eu/eurobarometer/surveys/detail/2996). While willingness is not always evenly distributed across species, there is an increasing appreciation of animal welfare parameters over other quality attributes and growing awareness of importance on action to improve animal welfare (https://doi.org/10.3390/ani10030385).

Consumer awareness and concern regarding farm animal welfare is increasing and is not limited to high income countries. A study published in 2022 surveyed over 4,000 members of the general public in 14 countries on their perceptions of animals and animal welfare. Most participants agreed that the welfare of farm animals is important, without distinction between developed and developing regions https://www.frontiersin.org/articles/10.3389/fanim.2022.960379/full

Marketing and consumer purchasing power is not a solution to all welfare issues, nor is it applicable to all contexts; however, it does create opportunities for progressive improvements on animal welfare.

Welfare standards can be both a source of trade opportunity and a barrier. The 2023 OECD Guidelines for Multinational Enterprises on Responsible Business Conduct recognise that enterprises should respect animal welfare standards and that animals have the opportunity to experience good welfare. Animal welfare can be a marketing opportunity, while low welfare practices can put companies and investors at a higher risk. Conversely, when welfare standards are not harmonized, it can distort competitiveness.

Because consumer sentiments are evolving, and because companies are paying more attention to responsible purchasing, national and international brands are enacting animal welfare policies. There are hundreds of companies that have made public-facing commitments to rid their supply chains of cages for egg-laying hens and gestation crates for sows (cagefreeworld.org and cratefreeworld.org). Independent evaluation of the policies, management systems, reporting and performance of companies with regard to animal welfare is also publicly produced (e.g. Business Benchmark on Farm Animal Welfare).

Welfare action is also being industry-led. As just some examples, members of the Dairy Sustainability Framework identified Animal Care as the number one priority in 2022 (https://www.dairysustainabilityframework.org/publication/dsf-annual-sustainability-progress-2022-calendar-year-reporting/) and have included Animal Health and Welfare Plans as a part of their annual reporting process. Eight of the Global Roundtable for Sustainable Beef (GRSB) member countries are also either developing or demonstrating progress toward global goals on animal health and welfare in 2023 (https://grsbeef.org/wp-content/uploads/2023/12/GRSB_2023_Annual_Report.pdf).

Beyond company or industry-level decisions, both international and domestic trade is at risk or has been negatively affected by animal welfare issues. Industries have been severely disrupted (e.g. live export in Australia), received challenge in the court (e.g. fast growing broilers in UK), and are a recognised risk by industry groups (e.g. Dairy SA). If consumer willingness to pay is a positive driver for animal welfare improvement, barriers to trade is an example of a *command-and-control* policy tool.

Animal welfare can drive livelihood and economic opportunities from improved animal growth and production at an on-farm level, through to positive and negative sales and trade opportunities. The diversity of these opportunities and wide range of existing examples makes this an important facet of sustainable production systems that animal welfare can connect to, and is a particularly valuable driver for animal owners, private enterprise, and government to explore.

3.3.4 Climate and natural resource use

Livestock production contributes to climate change and natural resource degradation, and the welfare of animals will be at risk from extreme weather events and overarching changes in climate. Contributions of good animal health to sustainability have been well quantified (e.g. https://healthforanimals.org/resources/publications/publications/full-report-animal-health-and-sustainability-a-global-data-analysis/). Beyond these health-related contributions, other aspects of welfare can positively contribute to climate and environmental interactions with livestock.

Improving welfare can reduce climate emissions. Improving sheep health and welfare can provide relative reductions in GHG emissions of sheep. Compared to other emission mitigation measures, there are no welfare hazards of using this approach. https://www.sciencedirect.com/science/article/pii/S1751731116001440?via%3Dihub
Evidence from the dairy industry demonstrates how positive cow health and welfare correlates with reduced GHG emissions. Clinical mastitis increased the carbon footprint of milk (Mostert et al. 2019). Reducing culling rates contribute to lower whole system GHG emissions (Knapp et al. 2014). Cows of 5-8 lactations have lower intensity emissions compared to heifers (Von Soosten et al. 2020); with longevity attributed to good health and welfare, this demonstrates the importance of quality cow care.

Awareness of production implications from climatic extremes can be a further driver for action that improves animal welfare. Swedish farmers attribute hot summer to reduced milk production and increased somatic cell count (SCC), indicating health issues in cows (DOI: 10.1016/j.prevetmed.2024.106131). Heat also impacts fertility and has other long-term consequences, but farmers do not connect the two as readily. Farmers may benefit from increased awareness on the impacts of animal heat in the longer term, also making the animals more thermally comfortable at the time. These needs for animal care and raising awareness for farmers will become more important with climate extremes and increasingly erratic weather conditions. Changing climate will make animal health and welfare management substantially more challenging.

Good animal welfare and environmental outcomes can occur simultaneously. There are numerous examples of production systems that are beneficial to both climate and natural resources and animal welfare. Silvopastoral systems, which suit tropical climates, are more resilient to climatic changes, have reduced methane emissions from improved nutrition, higher carbon sequestration, better soil water retention and deeper infiltration and higher biodiversity compared with conventional extensive systems without trees or bushes. These systems lead to improved animal welfare due to reduced temperature stress, reduced parasite load, reduced stress and increased nutrition (https://www.ciwf.org.uk/media/7430275/case-study-6-silvopastoral-systemspdf_87238.pdf; https://doi.org/10.1007/978-3-031-21020-4_13). Mutual benefits between animal welfare and livelihoods in small scale agroforestry systems have also been recognised (https://hdl.handle.net/10568/119297, https://doi.org/10.1093/af/vfac082). Other alternative systems for dairying, including sustainable intensification and multifunctionality are likely to have welfare benefits, but are less well documented (https://doi.org/10.1007/s13280-019-

01177-y). Each system is specific to climatic conditions needed for plant/tree growth as well as other key environmental factors (rain, soil etc.).

Pasture systems that use hay over winter are demonstrating positive environmental and animal welfare benefits in New Zealand dairying. The hay is used for animal bedding and insulation in colder winter months to help maintain their body temperature and energy, and it is hypothesised to reduce nitrate leaching and paddock pugging (mud; https://www.agresearch.co.nz/news/soil-armour-tools-to-help-provide-winter-grazing-options/). This type of modification is less dramatic than an ecosystem change, like silvopastoral systems, for example.

When cattle are housed indoors, much of the nitrogen and ammonia ends up in the atmosphere, where it contributes to greenhouse gas emissions, and particulate matter that impacts lung health (https://www.sciencedirect.com/science/article/pii/S0301479722018588#:~:text=These%20health%20impacts%20can%20include,of%20asthma%20in%20young%20children). Warmer climates allow for soil integrity to be conserved year round, and so nitrogen and ammonia from cattle waste can be sealed in soil where it can be converted to nitrates as fertiliser for plants (https://royalsociety.org/~/media/policy/projects/evidence-synthesis/Ammonia/Ammonia-report.pdf and https://uk-air.defra.gov.uk/assets/documents/reports/cat07/2103191000_UK_Agriculture_Ammonia_Emission_Report_1990-2019.pdf). Cattle also prefer to be on pasture when conditions are good, so this benefits the cows, climate and natural resource use (https://link.springer.com/chapter/10.1007/978-3-031-21020-4_6 and https://link.springer.com/chapter/10.1007/978-3-031-21020-4_5).

Straw is a highly effective form of enrichment for indoor housed pigs (https://www.mdpi.com/2076-2615/9/6/383), as well as bedding material for multiple domestic animals. Increasing the amount of straw per animal can reduce emissions as it provides a barrier between the urine and air (https://royalsociety.org/~/media/policy/projects/evidence-synthesis/Ammonia/Ammonia-report.pdf). The use of straw facilitates the collection of waste as a solid rather than a liquid slurry, and this is easier to store and emits less ammonia (https://royalsociety.org/~/media/policy/projects/evidence-synthesis/Ammonia/Ammonia-report.pdf). The mixture of manure and straw can then be converted to biogas (e.g. https://www.sciencedirect.com/science/article/pii/S0961953417301691?casa_token=viPYQEhvmRQAAAAA:4_ugBOvchgcge_2zF2oX9XHxcyfkthNLCrcrlb0YmgI3hFlF6cmKsTZ5KzwFU-ZXzotux0eKFA).

Each of the examples above describe systems that are specific to climate/resources that enable both environmental and animal welfare benefits. As alternative systems for production are evaluated, animal welfare needs to be a key consideration in all.

4. Conclusion

This document captures the examples of where good animal welfare can potentially create positive gains to key domains of livestock sustainability – health and welfare, food and nutrition, livelihoods and economic growth, and climate and natural resources. However, trade-offs between good animal welfare and sustainability domains also do occur. Examples include slow growing strains of broiler chickens have a greater carbon footprint than fast growing strains. Shade trees/hedges on farms have welfare and environmental and biodiversity benefits, but the financial and labour requirements for maintenance farmers may go unrecognised. Providing more space to animals may require significant infrastructure and investment.

Mono-dimensional assessments of modifications to existing farming practices, or alternative farming approaches, risk missing broader benefits and trade-offs. It is recommended that evaluation occur more dynamically at the systems level, using One Health/One Welfare approaches, to capture impacts across all aspects of sustainability. It is of real importance that animal welfare be incorporated into assessments for the system benefits it can provide, and critically for the lives of the animals themselves.

Reference list

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