

*Article***Animal Welfare for Corporate Sustainability: The Business Benchmark on Farm Animal Welfare**Joaquín Fernández-Mateo ^{1,*}, Alberto José Franco-Barrera ^{2,*}

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ABSTRACT

We are living in a new human-dominated geological epoch, the Anthropocene. Human activity is the dominant cause of most contemporary environment change. At the same time, digital transformation is changing our societies. The intersection of both processes compels us to harness the potential of new technological systems to transform how humanity manages its environmental footprint. However, our interaction with the environment is not the only interaction we have to change. New technologies can automatically monitor animal welfare. These management processes will increase stakeholder confidence and therefore the reputation of food companies. Since corporate governance is key for corporate sustainability, new monitoring processes should begin to be included in the animal welfare questionnaires. This research highlights the disruptive potential of Fourth Industrial Revolution technologies applied on farms. Like the sustainability questionnaires, the Business Benchmark on Farm Animal Welfare (BBFAW) have shortcomings. However, animal welfare indices are very useful tools to measure the performance of companies and can be easily improved by following the recommendations of this research. The importance of a formalised system of responsibilities and the advances offered by audio-visual and smart technologies, that provide real-time data, will be a key dimension for the farm of the future and therefore should be part of the BBFAW questionnaires.

KEYWORDS: animal welfare; governance; sustainability; corporate sustainability; management system; forth industrial revolution; digital transformation; board of directors; sustainability indices; accountability

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Abbreviations

SDGs, sustainable development goals; UN, United Nations; IoT, internet of things; CSR, Corporate Social Responsibility; ESG, environmental, social

and corporate governance; ESGAW, environmental, social, corporate governance and animal welfare; AI, artificial intelligence; CCTV, closed circuit television; BBFAW, Business Benchmark on Farm Animal Welfare; PLF, Precision Livestock Farming

INTRODUCTION

The Sustainable Development Goals (SDGs) were presented at the UN General Assembly on September 25th 2015. The new Agenda 2030, adopted unanimously by 193 UN member states in September 2015, includes 17 SDGs, 169 targets and 232 indicators focusing on people, planet, prosperity, peace and partnerships, the means for their implementation and the mechanism for monitoring and review at national, regional and global levels [1]. On January 1st 2016, the 17 SDGs officially came into force. Since then, SDGs have become firmly on the agenda of governments [2] and business [3]. However, as far as animal welfare is concerned, there is no direct reference or recognition. The recognition of animals as sentient beings makes them worthy of moral consideration, liberties and rights [4–9] as, for example, direct rights against abuse, violence or cruelty [10]. However, for cultural reasons, anthropocentrism, “a clear and morally relevant dividing line between humanity and the rest of nature” [11], has been dominant. In spite of this, instruments such as the SDGs allow us to erase the line that separates us from nature, and new moral discourses and social practices are also blurring the dividing line that separates us from sentient beings [12,13].

The consumption of animal-source foods is one of the most powerful negative forces affecting the conservation of terrestrial ecosystems and biological diversity [14]. However, livestock and farm animals appear to be a central element in achieving nutrition and food security objectives. In emerging countries, food is a key element in the fight against malnutrition and the development of their economies (SDG 2). The consequences of livestock management that does not follow environmental parameters are obvious. Water consumption, greenhouse gas emissions and waste generation directly affect SDGs [15,16]. At the same time, some companies are beginning to recognise the welfare of farm animals as a commercial risk that must be managed in a similar way to other business risks [17]. This has led companies to integrate farm animal welfare into the management infrastructure through auditing processes, training programs, monitoring and reporting mechanisms that they have already developed for other social and environmental issues [18–21]. This aspect leads us to the recognition of farm animal welfare as a strategic opportunity. Meanwhile, investors may find companies that are committed to animal welfare more attractive. Investors seek guarantees that the companies in which they invest have fully considered the risks and opportunities associated with farm animal welfare and have effective policies and processes to address the challenges [22]. They demand

information on the quality of risk management processes, analysis of practices and company performance, far beyond just financial data [23].

When considering the management of farm animal welfare, supervisory responsibilities and the implementation of animal welfare monitoring measures are very important. Thus, a starting point is the existence of some document to formalise animal welfare policies, such as a code of good practice or statement of guiding principles, which is recognised by current animal welfare indices [24]. The consequences of this recognition imply a moral commitment, which has to do with the integrity of the business model. The core of an effective ethical program is the notion of integrity: doing the right thing, always [25]. However, this is only the starting point for its effective implementation. Understanding how companies structure their governance and management is particularly significant in the case of farm animal welfare. Companies should ensure that their managers and boards of directors are aware of the business implications of animal welfare and are prepared to respond, both to ensure the effective implementation of the policy and when evidence of failures in the management systems arises.

One of the functions of the new corporate government is to monitor sustainability policies. In our case, good corporate governance must ensure animal welfare through compliance and implementation of appropriate policies. To this end, technology can be very useful for company's top management to oversee the implementation of company's farm animal welfare policy. However, The Business Benchmark on Farm Animal Welfare (BBFAW), the leading global measure of company performance in farm animal welfare, do not give adequate weight to this important dimension. Consequently, their measurements are not really objective. The aim of this paper is to demonstrate the value of technology as a monitoring tool for good corporate governance of companies that use animals in their supply chain and to show that this dimension is not correctly assessed and measured. New technologies could offer new possibilities for achieving considerable improvements in the health and welfare of animals. Consequently, the BBFAW may under-represent those companies that make valuable efforts to monitor animal welfare policies. Similarly, it may give a misleading message to investors, who would treat different companies in the same way. Sustainability and animal welfare indices can be biased by the inadequate weighting of each dimension. It is therefore necessary to recognize the value of corporate governance to achieve the corporate sustainability of an organisation and to change the model for measuring the weights associated with each of the variables used by the BBFAW.

CONCEPTUAL FRAMEWORK AND FORMULATION OF HYPOTHESIS

Sustainability and Animal Welfare

Sustainable development was defined by the Brundtland report as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” [26]. However, this concept has exceeded its environmental limits, referring to aspects such as social, economic and even cultural sustainability [27–30]. These factors lead us to the notion of corporate sustainability, that is, voluntary activities developed by companies that demonstrate the inclusion of social and environmental concerns in business operations and in interactions with stakeholders. For Van Marrewijk, corporate sustainability focuses on value creation, environmental management, environmental friendly production systems, human capital management and so forth [31]. In this sense, corporate sustainability would replace Corporate Social Responsibility (CSR) [32]. For Andreu & Fernández, corporate philanthropy would have won the battle against CSR, generating a “halo effect” that would have hijacked the true nature of CSR. CSR would be related to philanthropy as a tool for marketing and improving the reputation of companies [33]. This is why in this text we will talk about *corporate sustainability*.

In the 20th century, the defence of animals emerged in the United Kingdom politics when members of the League against Cruel Sports pledged to sabotage hunting with dogs. In 1964, the book *Animal Machines* by Ruth Harrison, a massive critique of the suffering of animals in the food sector, was very important for the British government to consider animal welfare issues [34]. In 1967, Peter Roberts, a farm owner, founded the organization “Compassion in World Farming” [35]. *Animal welfare* as a formal discipline began with the publication of the Brambell Report on the welfare of farm animals, issued by the British government in 1965. The report defines animal welfare as follows:

“Welfare is a wide term that embraces both the physical and mental well-being of the animal. Any attempt to evaluate welfare, therefore, must take into account the scientific evidence available concerning the feelings of animals that can be derived from their structure and functions and also from their behaviour.” [36]

From its conclusions, the British government created the Farm Animal Welfare Advisory Committee, which years later, in 1979, was renamed the Farm Animal Welfare Council. The conditions specified in the study were extended by this committee and led to the *Five Freedoms*. Since then they have set the standards of animal welfare that today influence legislation around the world. The Five Freedoms in their current format are listed below:

“1. Freedom from hunger and thirst, by ready access to water and a diet to maintain health and vigour. 2. Freedom from discomfort, by providing an appropriate environment including shelter and a comfortable resting area. 3. Freedom from pain, injury and disease, by prevention or rapid diagnosis and treatment. 4. Freedom to express normal behaviour, by providing sufficient space, proper facilities and appropriate company of the animal's own kind. 5. Freedom from fear and distress, by ensuring conditions and treatment, which avoid mental suffering.” [37]

For Hughes animal welfare is a state of complete mental and physical health, where the animal is in harmony with its environment [38]. For Duncan animal welfare implies the absence of negative subjective emotional states, usually called suffering and probably the presence of positive subjective emotional states, usually called pleasure [39]. Finally, Dockès and Kling-Eveillard establish four criteria based on the fundamental needs and freedoms they should have, the recognition of their sensitive nature, their role in human society and the interaction between human and non-human animals, in particular, the farmer-animal relationship [40].

Many companies begin to commit to animal welfare criteria by discarding suppliers that use Concentrated Animal Feeding Operation (CAFO) to prevent abuses through intensive confinement [41], and set targets for obtaining all egg products from free-range farms, because a range of welfare problems have been related to the combination of rearing in cages, followed by housing in aviaries during the laying period [42].

Corporate sustainability indices [43] and animal welfare indices in particular [44] play a very important role to recognise the best in class companies. Awards from credible animal welfare organisations, consumer associations and industrial and agricultural agencies provide tangible evidence that companies are achieving good practices in those areas of their operations. On the other hand, poor animal welfare presents operational and reputational risks for companies. Social concern about the abuse of animals on farms and in slaughterhouses is gradually growing, and images of violence against them are taking up more and more space in the media. These images are usually obtained by investigative activists who gain access to these places by hand, or by the use and placement of hidden cameras, exposing the public to the reality of the industry. To prevent these activities, many livestock producers have supported legislation that restricts covert investigations. Commonly referred to as *Ag-gag laws*, this legislation prohibits taking or possessing photographs, video or audio recordings without the consent of the farm owner [45,46]. However, *Ag-gag laws* negatively impact perceptions of the current status of farm animal welfare as well as the perception that farmers do a good job of protecting the environment. Robbins and others demonstrates that the intention to restrict access to information can undermine trust [47].

Along with traditional financial risks, companies must demonstrate, if they want to create long-term value and lead their sector, that they are capable of handling environmental, social and governance factors. Farm animal welfare is a key factor for companies in the food sector, including suppliers, the retail and food processing sector. It generates a whole range of actions such as regulation, labelling requirements and addressing consumer concerns. All these factors must be addressed, and they are also an opportunity; studies based on choice experiments and cost estimates showed that animal friendly practices may be economically sustained by consumer increased willingness to pay [48]. For food companies, animal welfare is added to non-financial factors (ESG) by completing the following scheme *ESGAW*. Corporate sustainability would be now those voluntary activities that add to social and environmental aspects, the animal welfare factor in their business operations and in interactions with stakeholders.

Therefore, here appears a first concept to construct our hypothesis, (1) *corporate sustainability*, understood as a complex of dimensions that include *the social, environmental, governance and animal welfare dimensions (ESGAW)*. See Figure 1.

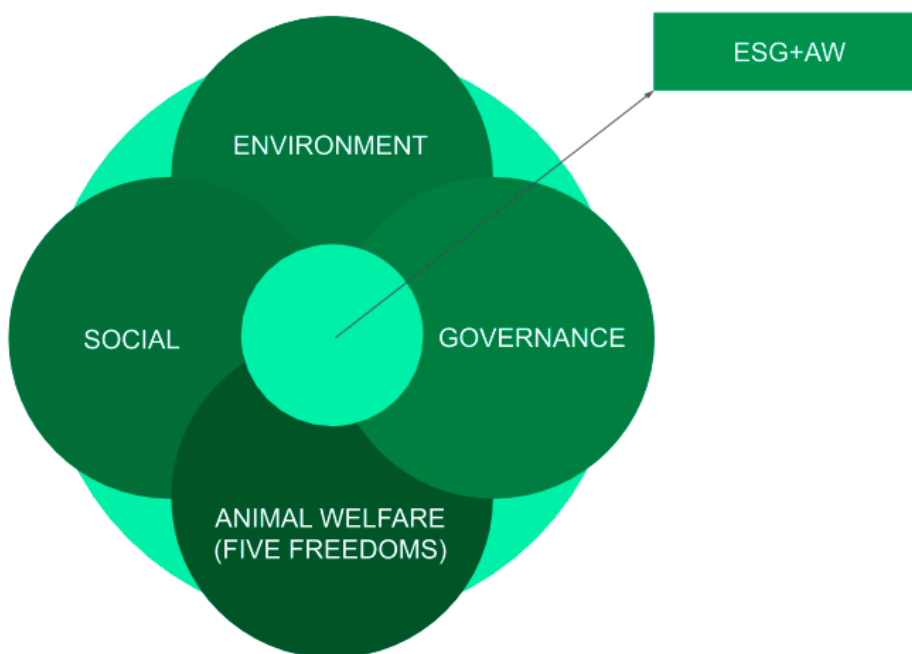


Figure 1. Corporate sustainability and Animal Welfare.

Digital Transformation as a Transversal Objective for Sustainability and Animal Welfare

Human transformation, including land surface transformation and changing the composition of the atmosphere, has led to the definition of a new geological epoch, the Anthropocene [49,50]. The ecological crisis forces us a transformation of our behaviours and habits if we want to preserve the conditions of existence on the planet. Human activity is the most important cause of the transformation of the environment and its

impacts will probably be observable in the geological stratigraphic record for millions of years into the future [51]. The transformation of the territory by the production of food, fuel or raw materials has resulted in species extinctions some 100 to 1000 times higher than background rates [52], and probably constitutes the beginning of the sixth mass extinction because current extinction rates are higher than would be expected from the fossil record [53].

Today, farm birds represent 70% of all birds on the planet, and 60% of all mammals on Earth are livestock, mostly cattle and pigs [54]. This expansion of animal use and consumption at these levels contributes to increased carbon emissions, water scarcity, food insecurity, biodiversity loss and antimicrobial resistance. The increase in the consumption of animal products is likely to put further pressure on the world's freshwater resources. From a freshwater perspective, animal products from grazing systems have a smaller blue and grey water footprint than products from industrial systems, and that it is more water-efficient to obtain calories, protein and fat through crop products than animal products [55]. Extensive cattle enterprises have been responsible for 65–80% of the deforestation of the Amazon [56–58]. The rate of forest loss for crops is projected to increase as the demand for pig and poultry meat increases [59]. Climate change affects every country on every continent [60], negatively impacting their economy [61], the lives of individuals and communities [62]. Global greenhouse gas (GHG) emissions from livestock increased by 51% during the analysed period (1961–2010). Beef and dairy cattle are the largest source of livestock emissions with 74% of global livestock emissions [63]. All livestock enterprises will increasingly face physical risks related to the impacts of climate change: from lower fodder quality and more droughts to the negative impacts of rising temperatures on animal health and productivity. As a result of all these human activities, livestock activity can directly complicate the achievement of the SDGs 6 (Ensure availability and sustainable management of water and sanitation for all), 13 (Take urgent action to combat climate change and its impacts) and 15 (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss).

Despite all these negative effects, SDG 2 considers the food and the agricultural sector as key sectors for development, and vital for the elimination of hunger and poverty. Responsible management can feed the entire planet, generate benefits, develop local and rural communities, and protect the environment. The goal of sustainable consumption and production is to do more and better things with fewer resources, and livestock are especially suited to making the most of uncultivated grasslands. By raising livestock on this land, farmers double the amount of land that is useful for growing food. In addition, animal waste has valuable nutrients that are recycled to improve soil health. Shortage of water resources, together with poor water quality and inadequate

sanitation, have an impact on food security. A sustainable farm can develop water recycling systems, improve water treatment plants and other new technologies. These aspects connect directly with SDG 6, and in particular target 6.3 (improving water quality by reducing pollution) and target 6.4 (efficient use of water resources).

SDG 3 considers it essential to ensure a healthy life and promote universal well-being. For Food and Agriculture Organization (FAO), health goes beyond human health; animal, plant and environmental health are also part of the “one health” approach. Healthy animals contribute to healthy people and sustainable food production. FAO promotes best practices aimed to make animal production efficient and sustainable, while protecting public health and ensuring safe trade. Growing public concern makes it necessary to pay attention to improving hygiene on farms and to the correct application of vaccines and treatments to protect animals from disease [64]. Within SDG 3, target 3.3 states that, “By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases”. A series of high-profile food safety incidents across the globe have focused consumer concerns on threat of food contamination and foodborne illnesses. Today we have a new threat, Covid-19, with an uncertain origin that is associated with animal consumption and that can be reproduced with another animal source in the future. Digital technologies can monitor and control their health and welfare. In this context, a responsible and sustainable farm is key. The benefits of improved animal health and welfare are very important in achieving the objectives set out in SDG 2 and SDG 3. Poor animal welfare is directly related to production losses due to poor growth, disease and injury [65]. Improved animal welfare leads to improved productivity and increased food safety. Good animal health and welfare outcomes mean good animal housing, good nutrition, good health and natural behaviour [66].

In this framework, technology can play a very important role in achieving the 2030 Agenda [67]. The digitalization of industry and the combination of the internet, sensors and intelligent objects is leading to a paradigm shift in industrial production. The efficient use of resources and sustainable design enabled by technological efficiency promotes business sustainability [68]. The sustainable development and sustainability concepts could be improved by the smart factory and manufacturing systems [69]. Now a *Fourth Industrial Revolution* is building on the Third, the digital revolution that has been occurring since the middle of the last century. Fourth Industrial Revolution will be characterised by the existence of machines and systems permanently interconnected throughout the production process and is based on technologies such as robotics, artificial intelligence (AI), big data or the internet of things (IoT) [70]. All segments of society will be transformed by these technologies in the coming years. The digital transformation we are undergoing could

mean a revolution that affects the sustainable management of farms, increasing both agricultural and livestock productivity. New computing technologies can be used to ensure the welfare of animals [71]. For example, IoT is a highly promising family of technologies which is capable of offering many solutions. The analysis of IoT big data could be used to automate processes, predict situations and improve many activities, even in real-time [72]. The use of Internet of Nano Things (IoNT) in agriculture will lead to development of several precision farming applications, leading to efficient environment monitoring, crop growth and even animal monitoring [73]. These technological factors could improve animal health by increasing production processes and decreasing the environmental impacts of agricultural and livestock activities. As we will see in detail, this research tries to identify how these new technologies can improve the processes of tracking and monitoring practices that ensure animal welfare.

Therefore, the second and third concepts composing the research hypothesis appear: (2) *the Fourth Industrial Revolution*, a transformation that can facilitate the creation of a smart and sustainable farm to contribute to the achievement of the SDGs (3), in particular, two specific objectives, SDG 2 and 3. Achieving SDG 3 is not possible without understanding that for good human health there must be good animal health and welfare.

Governance Dimension of Sustainability Index Questionnaires

Corporate governance refers to the entire set of legal, cultural, and institutional rules and standards that determine what corporations can do, who controls them, how that control is exercised, and how the risks and benefits of the activities they do are assigned [74]. Corporate governance was originally about the proper management of companies to meet the needs of their owners and shareholders but broader issues such as ethical supply chains, human rights, bribery and corruption, and climate change become part of corporate boards [75]. In view of the growing social concern about the conditions in which animals are treated on farms and in slaughterhouses [76–78], corporate directors of companies that use animals for the production of consumer goods must integrate animal welfare policies into their core business.

Conversely, companies will not act responsibly as long as aspects of corporate sustainability or social responsibility are not addressed from the point of view of corporate governance: who makes the decisions and what the governance structure is. The understanding that organisations are formed and reconstituted by their relationships with different stakeholders modifies the traditional purpose of the organisation [79–81]. With this new frame of reference, there is a need to identify the most important roles and responsibilities of senior management [82]. Clarifying these responsibilities is key to promoting the good governance, which involves overseeing the organisation as a whole. Therefore, it is recognised

for the governance of an organisation not only to represent the interests of the shareholders but also the interests of the organisation as a whole [83]. In our case, it is necessary for senior management to be responsible for animal welfare policies by ensuring supervision and monitoring tools. Thanks to these tools they will be able to ensure that the policies advocated are implemented and are not just a piece of paper.

Therefore, although corporate governance and corporate sustainability have been two dimensions studied separately [84,85] and the work carried out in this respect, both empirical and theoretical, has not been too extensive [86,87], in recent years the two domains have begun to approach each other [88], being studied jointly and systematically [85]. For Beltratti, corporate governance and CSR are complementary; socially responsible firms are often the most respected and profitable firms and a good corporate governance protects the stakeholders which contribute to the long term of the company [89]. Recent research by Jo and Harjoto has empirically demonstrated the existence of a specific correlation between the governance dimension and the success of CSR [90]. While the lag of CSR does not affect corporate governance variables, the lag of corporate governance variables positively affects firms' CSR engagement:

“All of our chosen CG variables are significant in explaining the CSR engagement (...) These findings suggest that internal and external monitoring by board leadership, independent boards, institutional investors, and security analysts are positively related to CSR activities (...) Taken together, our combined results indicate that CG causes CSR, while CSR does not cause CG.” [90]

Eccles and others, demonstrated that companies that adopt a comprehensive set of corporate policies relating to the environment, employees, community, products and the environment outperform their counterparts over the long term, both in terms of stock market and accounting performance [91]. The low sustainability firms follow the traditional model of corporate profit maximisation, in which social and environmental issues are seen predominantly as externalities that end up being the responsibility of governments. In contrast, *High sustainability* firms pay attention to externalities and are characterised by governance mechanisms that directly involve the board in sustainability issues, linking executive compensation to sustainability objectives. Applied to the problem at hand, corporate governance is the key for achieving corporate sustainability: respect for animal welfare and protection for the environment depends on senior management. It is not easy for senior management to ensure that animal welfare policies are enforced. That is why technology, as a monitoring and control tool, can guarantee the traceability of processes and the recording of data so that the top management knows that the animal welfare policies are correctly implemented, without infringing the company's code of ethics.

Animal welfare, given the changes in consumption patterns [92,93], is a risk factor for companies. Cases of animal abuse can quickly become a global corporate crisis through their viralisation in social networks. For farmers it is an added risk because they may see their contracts cancelled under pressure from consumers. Senior management has the responsibility to advise, monitor and supervise decision-making in a way that is consistent with corporate sustainability [91]. Achieving corporate sustainability for organisations that have animals in their value chain depends on good governance practices.

Therefore, a fourth element arises here to construct the research hypothesis, the importance of (4) *corporate governance* as the key to achieve corporate sustainability, defined as the convergence of environmental, social, governance and animal welfare aspects (ESGAW).

Sustainability Indices and Animal Welfare

The idea underlying sustainability indices is that sustainability practices constitute a potential element for long-term value creation from which shareholders will benefit [94]. Investors need more exact information regarding social, environmental and corporate governance behaviour in order to invest in socially responsible companies. These factors gave rise to the inevitable appearance of sustainability indices and ESG agencies [95]. Investors are attracted to this new investment style because it promises to create long-term shareholder value by embracing opportunities and managing risks deriving from ongoing economic, environmental and social developments [96]. Investors may exclude from their portfolio companies that do not respect human rights, the environment or generate their economic returns from ethically questionable activities [43]. For example, the Dow Jones Sustainability Index is a family of global indices created in 1999, representing the companies and industries that have achieved the best ratios of ESG criteria according to the social and environmental rating agency RobecoSAM. However, the livestock industry is under-represented within most global benchmarks, even if it is among the most over-exposed in terms of risks. Fewer than 25% of the companies in The Collier FAIRR Protein Producer Index are invited to participate in the Dow Jones Corporate Sustainability Assessment or represented in CDP's (formerly Carbon Disclosure Project) risk databases. To fill this gap, The Collier FAIRR Protein Producer Index helps to assess how some of the largest global intensive livestock and fish farming companies (by market capitalisation) are managing critical risks facing the sector. The scope of this Index focuses on companies primarily involved in breeding, processing, distributing and selling meat, dairy and/or aquaculture products, rather than food manufacturers or retailers. Investors can exclude companies that do not hold a leading position in the sector [97].

Despite the proliferation of sustainability indices and ESG agencies, there is no standard methodology for the evaluation of companies [95].

Sustainability indices have been criticised for their lack of a common methodology and questionnaire [98]; for the different weights assigned to the variables that comprise it [95,99]; for the heterogeneity and insufficiency of information and the different definitions of risk [95]; for the lack of standardisation [100], transparency and credibility [101]; for the lack of independence of the rating agencies, which seek an improvement in corporate ratings [99,102], as well as for the existence of barriers and prejudices and the need to not excessively damage companies [103]. Recently it has been discovered that measurements of sustainability indices may not be entirely accurate as they do not include items related to the corporate governance dimension considered key to measuring corporate sustainability [104].

This provides an opportunity for research: to discover the reliability of the corporate governance dimension in the animal welfare indices. In particular, the justification of the weightings given to the variables that compose it. The research hypothesis tries to check if all the variables are being weighted according to the relevance or materiality of their dimensions. Materiality is the principle that determines which issues are important enough to make it essential to disclose information. Not all material issues are equal and different scores on questionnaires are expected to reflect their relative priority. The object of our analysis is The Business Benchmark on Farm Animal Welfare (BBFAW), the leading global measure of company performance in farm animal welfare. The Benchmark is a tool for investors seeking to evaluate the relative performance of food companies on farm animal welfare management. To that end, it 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. Since its appearance in 2012, it has been a catalyst [44] for influencing change in corporate animal welfare management and reporting practices. It is the equivalent in animal welfare to the most reliable international ratings and rankings that measure ESG criteria: The Carbon Disclosure Project (CDP), The FTSE4Good Index Series or The Dow Jones Sustainability Indices.

Since 2012, food manufacturers and retailers have been able to benchmark their animal welfare practices using an industry benchmark created by the Compassion in World Farming and the World Society for the Protection of Animals. The introduction of the BBFAW has enabled organisations, retailers and investors alike to pay attention to the animal welfare dimension. By ranking companies based on their animal welfare performance, the BBFAW provides data and credible information for investors to make better decisions, limiting risks and taking advantage of opportunities (See Table 1). The questions are divided into 4 dimensions: Management Commitment and Policy, Governance and Management, Leadership and Innovation and Performance Reporting and Impact.

Table 1. Benchmark questions and scoring.

MANAGEMENT COMMITMENT AND POLICY (BENCHMARK QUESTION AND SCORE)
Question 1 Does the company acknowledge farm animal welfare as a business issue? Max Score 10
Question 2 Does the company publish an overarching corporate farm animal welfare policy (or equivalent)? Max 10
Question 3 Does the policy statement provide a clear explanation of scope? Max 15
Question 4 Does the company have a clear position on the avoidance of close confinement and intensive systems for livestock (e.g., sow stalls, concentrated animal feeding operations (CAFOs), feedlots, farrowing crates, single penning, battery cages, tethering, veal crates, force feeding and, for finfish, high stocking densities and close confinement of solitary finfish species)? Max 5
Question 5 Does the company have a clear position on the avoidance of products from farm animals subject to genetic engineering or cloning and/or their progeny or descendants throughout its products? Max 5
Question 6 Does the company have a clear position on the avoidance of growth promoting substances? Max 5
Question 7 Does the company have a clear position on the reduction or avoidance of antibiotics for prophylactic use? Max 5
Question 8 Does the company have a clear position on the avoidance of routine mutilations (castration, teeth clipping, tail docking, toe clipping, dehorning, desnooding, de-winging, disbudding, mulesing, beak trimming, fin clipping)? Max 5
Question 9 Does the company have a clear position on the avoidance of meat from animals that have not been subjected to pre-slaughter stunning, or (in the case of finfish) meat from animals that have not been rendered insensible? Max 5
Question 10 Does the company have a clear position on the avoidance of long distance live transportation? Max 5
GOVERNANCE AND MANAGEMENT (BENCHMARK QUESTION AND SCORE)
Question 11 Has the company assigned management responsibility for farm animal welfare to an individual or specified committee? Max 10
Question 12 Has the company set objectives and targets for the management of farm animal welfare? Max 10
Question 13 Does the company report on its performance against its animal welfare policy and objectives? Max 10
Question 14 Does the company describe its internal processes for ensuring that its farm animal welfare policy is effectively implemented? Max 10
Question 15 Does the company describe how it implements its farm animal welfare policy (or equivalent) through its supply chain? Max 15
Question 16 Does the company assure its welfare scheme to a prescribed standard? Max 20
LEADERSHIP AND INNOVATION
Question 17 Is the company currently investing in projects dedicated to advancing farm animal welfare practices within the industry? Max 10
Question 18 Has the company received any notable awards or accreditations for its farm animal welfare performance in the last two years? Max 10
Question 19 Does the company promote higher farm animal welfare to consumers through education and/or awareness-raising activities? Max 10
PERFORMANCE REPORTING AND IMPACT
Question 20 Does the company have a position on promoting non-animal derived protein alongside animal protein?
Question 21 Does the company report on the proportion of animals (or volume of fresh or frozen animal products and ingredients) for own-brand products in its global supply chain that is free from close confinement (i.e., those in barn, free range, indoor group housed, outdoor bred/reared)? Max 5
Question 22 Does the company report on the proportion of animals for own-brand products in its global supply chain that is free from routine mutilations (i.e., castration, teeth clipping, tail docking, toe clipping, dehorning, desnooding, de-winging, disbudding, mulesing, beak trimming, fin clipping)? Max 5
Question 23 Does the company report on the proportion of animals in its global supply chain that is subject to pre-slaughter stunning? Max 5

Table 1. Cont.

PERFORMANCE REPORTING AND IMPACT
Question 24 Does the company report on the average, typical or maximum permitted live transport times for the animals in its global supply chain? Max 5
Question 25 Does the company report on welfare outcome measures (i.e., measures linked to the physical, emotional and/or behavioural wellbeing of animals)? Max 5
Question 26 Does the company provide an explanation of progress and trends in performance (either in terms of input measures or welfare outcome measures)? Max 10
Question 27 What proportion of laying hens (for shell eggs and fresh/frozen products and ingredients) in the company's global supply chain is cage-free? Max Weighted Score 1.25–5 *
Question 28 What proportion of fresh/frozen pork products and ingredients in the company's global supply chain is sourced from pigs that are free from sow stalls/gestation crates? Weighted Score 1.25–5
Question 29 What proportion of fresh/frozen milk or milk products and ingredients in the company's global supply chain is sourced from cows that are free from tethering? Max Weighted Score 1.25–5
Question 30 What proportion of broiler chickens for own-brand fresh/frozen products and ingredients in the company's global supply chain is reared at lower stocking densities (specifically, 30 kg/m ² or less)? Max Weighted Score 1.25–5
Question 31 What proportion of laying hens in the company's global supply chain is free from beak trimming or tipping? Max Weighted Score 1.66–5 **
Question 32 What proportion of pigs in the company's global supply chain is free from tail docking? Max Weighted Score 1.66–5
Question 33 What proportion of dairy cows in the company's global supply chain is free from tail docking? Max Weighted Score 1.66–5
Question 34 What proportion of animals (excluding finfish) in the company's global supply chain is pre-slaughter stunned? Max Weighted Score 10
Question 35 What proportion of animals (excluding fin fish) in the company's global supply chain is transported within specified maximum journey times?

Note: Prepared by authors following Amos and Sullivan [24]. * For questions 27–30, they only assess those questions that are relevant to the company. They assess relevant questions, with the maximum possible score being five (5) points per question and use the scores to calculate the overall average for these relevant questions. ** For questions 31–33, they only assess those questions that are relevant to the company. They assess relevant questions, with the maximum possible score being five (5) points per question and use the scores to calculate the overall average for these relevant questions.

The authentic scientific theories are those determined by decisive test; a test in the form of prediction deduced from the theory itself and that could be confirmed by observation, or not. The non-scientific theories are those that accumulate facts that reinforce their own approaches, disregarding other facts that refute them. The overcoming of the empirical evidence to which the theory has been subject allows one to maintain the valid character of the conjectures, until there is new evidence. Therefore, the questioning of the sustainability indices (4) offers a case to test the hypothesis.

The existence of *animal welfare indices* (5) add a fifth concept that can be falsifiable by a conclusive proof [105]: *If the governance dimension (4) of the animal welfare indices (5) is weighting the most material aspects for corporate sustainability (1) given the context posed by the Fourth Industrial Revolution (2) and the need to achieve the SDGs (3).*

Responsibility, Decision-Making and Animal Welfare Monitoring System

Nowadays, mechanical or trivial decisions can be made by AI or robots [106,107]. The formalisation of this type of decisions can lead to a bureaucratisation of the organisation, limiting its spontaneity, flexibility and adaptation to changes. It is therefore very important to study the materiality of the decision to be taken and, if it is a strategic decision, to assign those responsible in a formalised manner. We decide when there is no algorithm that tells us what to do, that tells us what the solution is. AI gives us solutions to problems, reduces the complexity of the situation but always in a logical-mathematical sphere, since AI can be seen as science and mathematics [108]. A search algorithm takes as input a problem and returns a solution of the form sequence of actions. Once we find a solution, we proceed to execute the actions it recommends [109]. Decisions appear when there are no clear solutions to the problems. We move in the field of the problematic, of the hypothetical. As opposed to the categorical, the circumstantial. Reflection on knowledge has always distinguished between what is necessary and what is probable, what is demonstrated and what is conjectured. In decision-making we are closer to the second than to the first:

“Sometimes it’s possible to predict a single outcome with reasonable certainty, as when a company has made similar decisions many times before. More often, decision makers can identify a range of possible outcomes, both for specific success factors and for the decision as a whole. Often they can also predict the probability of those outcomes. However, under conditions of uncertainty, it’s common for executives not to be able to specify the range of possible outcomes or their probability of occurring with any real precision.” [110]

The board’s role in strategy processes has been highlighted suggesting that boards are significantly involved in the decision-making process [111–113]. What decisions should be formalised? *Strategic decisions* affecting the governance of an organisation must be formalised. The governance of an organisation must be clarified. That means knowing who makes the decisions and who is responsible. Responsibility is a core concept for understanding how people evaluate, sanction, and try to control each other’s conduct [114]. An example of this is *the problem of many hands*, defined by Dennis Thompson: “because many different officials contribute in many ways to decisions and policies of government, it is difficult even in principle to identify who is morally responsible for political outcomes” [115]. If an organisation does not have defined responsibilities across departments, different departments can work on the same thing without coordination or cross-cutting. If the ownership of an issue is questioned, a non-aligned organisation can be generated with the corresponding silo structure [116]. Finally, ignoring the decision that has been made and who

has made the decision makes it difficult to follow up the achievement of objectives.

Dahl argues that power can only be analysed after a series of concrete decisions [117]. For Polsby, determining who makes decisions is the way to determine who has power [118]. But, for that very reason, power tends to escape formalisation. The formalization of decision-making makes it possible to identify who is responsible. Non-formalised strategic decisions tend to coincide with charismatic personalities, with a decisive influence within an organisation [119]. This is why it is very important to formalise decisions after a meeting, because it often happens that, despite the presence of several people in a meeting, the decisions are taken by a minority (two, three people at most). The more formalised the decisions are, the more visibility there will be in the organisation and less arbitrariness. On the other hand, it is also necessary to recognise the exercise of power by the absence of decisions. Deciding not to deal on a certain topic can obviate a latent or manifest problem [120]. Deciding not to recognise problems is to make them invisible. Frederic Bird provides a taxonomy of the forms of moral silence: (1) not blowing the whistle on observed abuses, violations, or misconduct; (2) not audibly dissenting from organisational policies which could include morally questionable behaviour; (3) not questioning or debating aspects of decisions thought to be morally unclear if not questionable; (4) not speaking up for one's moral ideals; (5) not bargaining hard enough for positions that might advance morally valued objectives; and (6) not providing adequate feedback either in supervisory or collegial relationships [121].

The attribution of power is an attribution of responsibility. We can attribute power to that person who, because of their strategic position in an organisation, can induce change. If decision-making is clarified and those responsible are identified, it is easier for power not to be blurred and, therefore, to be able to demand accountability. Responsibility has been used in the general sense of being accountable to others; there is an authority or other judge who requires information about some event to evaluate and sanction the actor's conduct [114]. Accountability can be defined as a social relationship in which an actor feels an obligation to explain and to justify his or her conduct to some significant other [122]. If a company is not clear about who makes the decisions, that company will not be accountable. If there is no accountability, there is no justification for action and this increases an organisation's risk. Accountability makes it possible to reward decision-makers, linking executive compensation to sustainability objectives, and to correct bad decisions and even punish decision-makers. All this makes it possible to reduce the risks of an organisation by having a knowledge of where the weak points are, the failures or the things to change.

In most large companies, there is generally a clear demarcation between those responsible for overseeing a policy and those responsible for day-to-day policy implementation. Policy oversight is usually the

responsibility of senior management or the board of directors. In contrast, day-to-day implementation is generally the responsibility of specific individuals or teams and encompasses tasks such as developing and implementing management systems and processes, setting objectives and targets, measuring and monitoring performance, and reporting [22]. However, it is recurrent that supervisors, if they exist, know relatively little about the specific details of how to effectively manage the welfare of farm animals. The identification of people responsible for ensuring animal welfare connects actual management with senior management. In this way, senior management can implement management follow-up channels. This form of supervision will allow the implementation of formal declarations and documents that establish animal welfare policies.

The emergence of a *delegation of authorities* is a practice of good governance. Thanks to this protocol, it is possible to define who, in terms of both governance and management, is responsible according to their nature. An example of the formalisation of decisions can be found in the RACI (Responsible, Accountable, Consulted and Informed) responsibility assignment matrix. This matrix will make it possible to identify the roles (the part of a project for which the person is in charge) and competencies (the abilities to achieve the project objective) of each of its members, and thus be able to identify who decides when and where. With this we can formalise all the activities, achieving that a certain task is developed by a single person, avoiding confusion [82].

With this section we can define more precisely the object of the research: if the questionnaires of the sustainability indices *recognise the relevance of the formalisation of the oversight of the animal welfare strategy by senior management* (6). Therefore, the hypothesis is as follows:

If the governance dimension (4) of the animal welfare indices (5) is weighting the most relevant aspects for corporate sustainability (1) in particular the formalisation of the oversight of farm animal welfare strategy by senior management (6) given the context posed by the Fourth Industrial Revolution (2), and the need to achieve the SDGs (3).

Technology as a System for Monitoring and Supervising Animal Welfare

Forth industrial revolution and the internet of things

Industry 4.0 is a new policy-driven discourse [123] that started in the German language at the “Hannover Fair” in 2011. It is a proposal for the development of a new concept of German economic policy based on high-tech strategies [124]. The Fourth Industrial Revolution [70] will be characterised by the existence of machines and systems permanently interconnected throughout the production process and is based on technologies such as Robotics, AI, Blockchain, Big Data, IoT or 3D printing [104]. This industrial and technological transformation has great potential to overcome the problems of the 21st century and may also generate

economic prosperity and well-being. In a socio-economic scenario influenced by the idea of innovation, digital transformation, the use of technology to radically improve the performance of companies, is a crucial current issue. Executives across industries around the world are using digital advances such as analytics, mobility, social networking, and smart devices to change customer relationships, internal processes, and value generation. Those companies that do not make the right decisions (implementing AI tools, for example) will see that the performance gap between front-runners and non-adopters will benefit the front-runners disproportionately [125].

The new technologies of digital transformation change the structure of organisations. In the past, digital technologies were tools used by organisations for specific or particular activities. Today they are the backbone of organisations and most organisational processes involve digital activities. The processes of digitisation and the creation of large databases create new conditions for organisations; new issues such as data processing, new modes of production, social problems and, of course, new forms of corporate governance appear [126]. Since the digital era began with the launch of the first computers, digitalisation has not ceased to advance at rates that have surpassed the most optimistic forecasts and, right now, there is nothing to indicate that this rate of change will be interrupted. It can even be accelerated. The revolution that gave rise to the digital era is changing almost everything: how we communicate, how we live, how we work, how companies are organised.

One of the technologies of the Fourth Industrial Revolution, the IoT, is indispensable for the smart farm [127]. The development of the IoT takes us back to the origins of computer science. In 1948, Norbert Wiener introduced the idea of “cybernetics” in his work “Cybernetics or control and communication in the animal and the machine”. The first developments of the great computers were made considering them as great instruments of calculation; their objective was the calculation with the great numbers, in the same way that what Wiener pursued was a technique of control that allowed to automate many behaviours of the machines without needing that control, in many phases of the process, required the human intervention [128]. Although the Internet is one of the key characteristics of IoT, the internet as we know it today is mostly an internet of human end-users, “while the IoT will be an internet of non-human entities, therefore a lot of machine-to-machine (M2M) communication will take place” [72].

The IoT represents a vision in which the internet extends into the real world embracing everyday objects. Physical items are no longer disconnected from the virtual world but can be controlled remotely and can act as physical access points to Internet services. IoT makes computing truly ubiquitous. This development is opening up huge opportunities for both the economy and individuals [129]. Although IoT promises an easier and pleasant life, its true impact will be in the enrichment of the value

chain and, in particular, in the industrial sector, such as automotive parts manufacturing plants. The data captured by sensors can be studied in a wide range of applications using big data techniques. It will also be relevant in healthcare environments, where the aim is to minimise human error, such as surgical blocks in hospitals. Other applications include the functionality of real-time location (where objects or people indicate their position at all times) and the logistical and transport environment (with the introduction of sensors in vehicles, cranes and containers to optimise land operations, achieving energy savings and improving the exploitation of critical resources) [130,131].

The economic and business world is undergoing a process of transformation. The old industrial ecosystem is giving rise to a new digital ecosystem and new smart farms. Different examples of smart farming have already been documented; SmartAgriFood, the Dutch Smart Dairy Framing project; EU Precision Livestock Farming (EU-PLF) and Cow of the Future [132]. In the smart farm, new communication systems are applied with cyberphysical systems and sensors that facilitate the decentralisation, interoperability, virtualisation, real-time capability, modularity and service orientation [133]. The different sources of information made possible by new technologies with new ways of capturing information and displaying it make it possible to increase process efficiency, improve economic performance and protect the environment. As we will see later on, a conscious application of new technology can improve animal welfare.

Internal processes for animal welfare

Many of the commercial risks associated with farm animal welfare are related to business supply chains. Companies have the ability to influence the performance of their suppliers, formally, through contracts and auditing processes, or informally, by encouraging the development of employee skills or education. In this way, if monitoring processes through CCTV systems or whistleblowing processes, are established, it is easier to ensure compliance with the farm animal welfare policy and, therefore, profitability and production. From an institutional point of view, Scotland joins other places such as England, Israel or France, which will install closed circuit television in all areas of slaughterhouses where there are live animals to ensure the highest standards of animal welfare. The regulation aims to ensure a unified model, which will require the installation of cameras [134].

Other supervisory measures are *whistleblowing processes*. Whistleblowing was defined by Near and Miceli as “the disclosure by organisation members (former or current) of illegal, immoral or illegitimate practices under the control of their employers, to persons or organisations that may be able to effect action” [135]. But the whistleblowing processes are seen from opposing points of view; as a tool to prevent bad practices and increase the transparency of the

organisation, or as a threat to the reputation and stability of organisations [136]. Robbins and others suggest that reducing the flow of information often reduces feelings of trust [47]. Their study shows that the intention to restrict access to information can undermine trust in suppliers and farmers, and thus in the value chain of companies. The ethical culture of organisations appears as a key element in facilitating an environment that encourages employees to report irregularities [137,138]. Good corporate governance needs responsible and accountable executives. If scientific studies show that transparency increases trust, visibility is the best tool to demonstrate animal welfare and stakeholder confidence. Concealment of information on farms is clearly counterproductive, introducing distrust in consumers.

The life of farm animals is full of suffering. Chickens and hens are crammed into small spaces for meat and egg production. Artificial light, which is more economically profitable, alters their biological cycles and generates enormous stress, leading them to pluck each other's feathers or to cannibalism. To avoid this behaviour, it is common that the chickens' beaks are amputated, a very painful operation. For this reason, the BBFAW recognises those companies that guarantee a supply chain free from beak trimming (Question 31). Similarly, on most farms, pigs live in terrible conditions with very little space. Sows used for breeding are locked up in cages where they cannot move, and their children are mutilated in different ways and killed when they are only a few months old. Once again, the BBFAW values those companies with a higher proportion of products and ingredients that comes from pigs that are free from sow stalls/gestation crates (Question 28).

The development of technologies in the field of Precision Livestock Farming (PLF) has, to date, largely focused on intensive animal production. However, these technologies could also offer possibilities for achieving greater animal welfare. PLF has “the potential to deliver considerable improvements in the health and welfare of animals in rangeland systems by facilitating the remote and/or automatic implementation of many of the recommended actions associated with the Five Freedoms” [139]. Unlike previous methods, PLF aim to provide a real-time monitoring and management system with the basic objective of improving the life of the animals, alerting the farmer to any potential problems so that he can take immediate action. This should enable continuous and fully automated monitoring and improvement of animal health and welfare, performance and environmental impact. PLF try to “create a management system based on continuous automatic real-time monitoring and control of production/reproduction, animal health and welfare, and the environmental impact of livestock production” [140].

PLF is a tool for real-time monitoring of farm animals, with measurements, predictions and data analysis without imposing additional stress on the animals. The development of algorithms allows to monitor the behaviour of animals automatically, achieving an accurate monitoring

of their health and welfare [141]. These technological tools make it possible to detect problems and make decisions at the right time, replacing the human observation processes, which have a higher cost and cannot be carried out during the whole life of the animal. The smart farm allows the constant monitoring of farm animals, the early diagnosis of their needs and the early detection of unforeseen events and incidents, thus increasing the welfare of mammals and birds. In modern agricultural scenarios, stored data are automatically processed under AI algorithms, machine learning technologies and model-based decision-making systems, in order to extract knowledge about phenomena that cannot be directly measured. Thanks to new technologies it is possible to optimise processes, with fast and reliable measurements for a more detailed vision. In precision agriculture, it is possible to optimise water consumption, energy, chemical use, pest control, etc. The information from many different places and the application of smart algorithms allow to obtain a better insight into the ongoing processes, issuing early warnings about possible dangers. With IoT, “all the objects will be interconnected, and therefore the computational overhead can be easily shifted to the cloud or be distributed among more than one” [72].

Environmental parameters are important for farm activities [142]. Heat stress causes cows to produce less milk with the same nutritional input, which effectively increases farmers’ production costs [143]. Livestock and poultry living environment are very important for the quantity and quality of animal products and IoT technology can provide a solution for automatic control and precise simulation of animal breeding environment [144]. Because animal behaviour provides reliable information about animal health and welfare, recent research has aimed at designing monitoring systems capable of measuring behavioural parameters [145].

The full investigation hypothesis is as follows:

To find out if the governance dimension (4) of the animal welfare indices (5) is weighting the most relevant aspects for corporate sustainability (1) in particular the formalisation of the oversight of farm animal welfare strategy and operations by senior management (6) with the potential of tools such as CCTV, whistleblowing processes or the IoT applied to livestock’s (7) given the context posed by the Fourth Industrial Revolution (2) and the need to achieve the SDGs (3). See Figure 2.

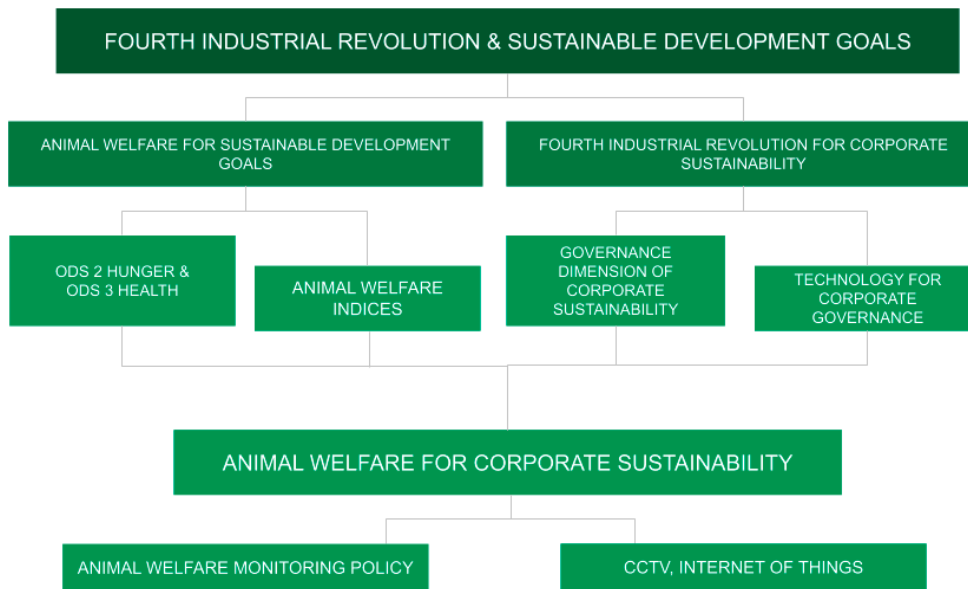


Figure 1. Elements of the research hypothesis.

DISCUSSION

The leading companies in corporate sustainability are adapting their production lines to the new demands and lifestyles of society. Concern for animal welfare is growing. Therefore, the animal welfare dimension of corporate sustainability is being considered to prevent food safety issues (caused by poor animal welfare), reputational damages (NGO campaigns can damage the brand image of companies), regulatory risks and environmental aspects (water pollution and scarcity, among others). The BBFAW provides an annual and independent assessment of farm animal welfare management, policy commitment, performance and disclosure in food companies.

However, not all dimensions of the BBFAW have the same materiality. In fact, the weights of the different dimensions have changed in recent years, and the governance dimension, which is key, has reduced their weight (see Table 2). Consequently, we believe that our study can help to properly weigh the governance and management dimension. In this sense, the recognition of farm animal welfare as a business issue (an important first step towards implementing a comprehensive approach to farm animal welfare management), or the publication of an overarching corporate farm animal welfare policy (the existence of a policy may not provide a guarantee of implementation), is not the same as the direct implementation of animal welfare policies (see Table 3). Although they are intuitively different in their value for ensuring animal welfare, they all score the same (10 points). Policy oversight is usually the responsibility of top management. In contrast, day-to-day implementation is generally the responsibility of specific individuals or teams and encompasses tasks such as developing and implementing management systems and processes, setting objectives and targets, measuring and monitoring performance,

and reporting. These activities are part of a key dimension: governance and management.

How does technology connect to the governance of an organisation? The Fourth Industrial Revolution will change the scope and accuracy of farm oversight and monitoring. Farms will be smart farms. Precision management technologies that combine IoT, AI or real-time data monitoring and analysis could facilitate the monitoring and implementation of animal welfare policies. Having an automated digital system for animal welfare supervision and monitoring cannot be considered the same as having only a policy that does not guarantee implementation. In this sense, senior management is responsible (accountable) for the introduction of a technological system that facilitates the supervision of animal welfare by middle management (responsible) and employees (informed).

The Fourth Industrial Revolution (IoT, AI, Big Data) add a disruptive advance that is not limited to CCTV system or whistle-blowing processes. It is possible that, in the near future, animal welfare can be achieved through new technologies that efficiently guarantee the amount of fresh water, food, health and welfare standards through remote digital devices, automatically. In fact, in the case of the European Union, “The EU Strategy for Animal Welfare 2012–2015” has supported farmers in achieving the animal welfare standards of the EU law. The evaluation of EU animal welfare policy concluded that welfare standards have imposed additional costs on the livestock (around 2% of the overall value of these sectors). The European Union does provide some instruments to compensate producers for higher production costs [146]. We believe that, in the near future, the European Union could help farmers to implement animal-friendly technologies through a new strategy for animal welfare. This can happen because it has already provided resources for animal welfare: now technology can make it more efficient.

Following the research hypothesis, the lack of materiality of the questionnaire [147] is demonstrated because the implementation of the company’s farm animal welfare policy (Q14), through an accountable senior management (that turns a farm into a smart farm), ensuring the monitoring of animal welfare by the middle management (responsible) and employees (informed), cannot have the same value as questions 1 and 2 [24]. In fact, the governance dimension has reduced its weight from 33% in 2017 to 28% in 2018 edition [24]. In this sense (see Tables 2 and 3), a first step cannot have the same score as the implementation of a complex and laborious monitoring process: a smart farm for animal welfare. Consequently, it is necessary to change the weights to obtain a truly objective questionnaire. The implementation of animal welfare policies by an accountable senior management and a responsible middle management is a key dimension.

Table 2. Relative weighting (or importance) variation.

Dimension	2017 (% weighting)	2018 (% weighting)
1. Management Commitment	30	26
2. Governance and Management	33	28
3. Leadership and Innovation	13	11
4. Performance Reporting and Impact	24	35

Governance and Management is a key dimension (Prepared by authors following Amos and Sullivan [24]).

Table 3. Different materiality, same scoring.

BENCHMARK QUESTION	MAX. SCORE
Q1. Does the company acknowledge farm animal welfare as a business issue? Acknowledging farm animal welfare as a business issue is an important first step towards implementing a comprehensive approach to farm animal welfare management. It is good practice for food companies to identify whether and why farm animal welfare is a relevant issue for the business.	10
Q2. Does the company publish an overarching corporate farm animal welfare policy (or equivalent)? It is good practice for companies to formalise their approach to animal welfare in a policy (or equivalent document such as a statement of guiding principles, a code of practice or a sourcing charter). While the existence of a policy may not provide a guarantee of implementation, the absence of a policy is a clear sign that farm animal welfare is not on the business agenda.	10
Q14. Does the company describe its internal processes for ensuring that its farm animal welfare policy is effectively implemented? The effective implementation of a farm animal welfare policy relies on employees who are competent to oversee the implementation of the policy, and on controls that allow the company to respond quickly and effectively in the event of non-compliance with the policy.	10

Same weight for different dimensions. The implementation of animal welfare policies is a key dimension (Prepared by authors following Amos and Sullivan [24]).

Hypothesis: To find out if the governance dimension (4) of the animal welfare indices (5) is weighting the most relevant aspects for corporate sustainability (ESGAW) (1) in particular the formalisation of the oversight of farm animal welfare strategy and operations by senior management (6) with the potential of tools such as CCTV, whistleblowing processes or the IoT applied to livestock's (7) given the context posed by the Fourth Industrial Revolution (2) and the need to achieve the SDGs (3).

Falsifiability of hypothesis: the governance dimension (4) of sustainability indices in animal welfare (5) is not weighting the most relevant aspects for corporate sustainability (1) in particular the formalisation of the oversight of farm animal welfare strategy and operations by senior management (6) with the potential of tools such as CCTV, whistleblowing processes or the IoT applied to livestock's (7) given the context posed by the Fourth Industrial Revolution (2) and the need to achieve the SDGs (3). Conversely, elementary management issues like explanation of why farm animal welfare is important to the business and statement of overarching farm animal welfare policy receive the same score than material issues.

The BBFAW does not pass the test presented by the research hypothesis, given the importance of the governance dimension [90,91] and in accordance with the need for constructive criticism [99–101]. In particular, it does not address specific questions that recognise the importance of key tools, oversight processes or new technologies for animal welfare monitoring.

CONCLUSIONS

Poor animal welfare presents operational and reputational risks for companies. Digital transformation provides advanced systems to monitor animal welfare, increasing confidence in companies. The existence of technological monitoring and oversight tools (from the simplest to the most advanced technologies), implemented in the organisation through a formalised system of responsibilities (RACI), could be part of the BBFAW questionnaires, increasing their objectivity (and therefore, the credibility of the corporate sustainability assessment). While the BBFAW is very relevant to measuring the animal welfare performance of companies, it should improve questionnaire structure with new scores and questions given the scientific evidence that relates governance dimension with corporate sustainability. The importance of a formalised system of responsibilities and the advances offered by audio-visual and smart technologies (that provide real-time data) will be a key dimension for future editions of the questionnaire.

Sustainability indices, and in particular the BBFAW, can help investors to select those companies that have the best environmental, social, governance and animal welfare performance. But if the information provided by these indices is not correct, they can give equal value to companies that have made a more specific effort and attention. Companies that make a real effort to make effective monitoring of animal welfare policies may be disadvantaged. Conversely, those that do not reach really material aspects would get a similar rating. Clearly, digitally transforming a company to achieve high standards of sustainability and animal welfare is a huge effort. The fact that these companies were not recognised for this effort may discourage them. And it can provide misinformation to responsible investors.

AUTHOR CONTRIBUTIONS

JF-M: Animal welfare and corporate governance conceptual framework and hypothesis. AF-B: Sustainability conceptual framework, tables & figures. All authors discussed the implications and commented on the manuscript at all stages.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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