Interference Journal
ISSN 2009-3578
DOI
A2 QUALIS SUCUPIRA
2017-2020

"ONE HEALTH" AS A RESOURCE FOR COST REDUCTION AND IMPROVEMENT OF RESULTS IN THE POULTRY INDUSTRY

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https://doi.org/10.36557/2009-3578.2025v11n2p2509-2527
Artigo recebido em 11 de Julho e publicado em 11 de Setembro de 2025

ARTIGO ORIGINAL

ABSTRACT

This study analyzes the intersection between modern poultry farming and the "One Health" approach, demonstrating how the integration of human, animal, and environmental health principles can lead to economic gains and strategic competitiveness for the sector. Poultry farming, crucial for global food security, faces challenges such as market volatility and the emergence of diseases, like avian influenza.Implementing the "One Health" approach proposes proactive management that includes biosecurity, animal welfare, and healthy working conditions. Preventing outbreaks and reducing antibiotic use strengthen consumer trust and minimize production losses and treatment costs. By adhering to the "Five Freedoms" of animal welfare, the industry not only improves the quality of its birds but also its overall efficiency.In the environmental field, proper waste management, such as water reuse and the valorization of manure as biofertilizer, mitigates pollution and creates new revenue streams. The adoption of renewable energy sources, such as photovoltaic panels, also contributes to sustainability and a reduction in operational costs.In conclusion, "One Health" transcends a mere matter of ethical responsibility, acting as a robust business strategy. By investing in the health of their flocks, their workers, and the ecosystem, the poultry sector protects its operational base and builds a reputation for safety and sustainability that adds value to the final products, ensuring the long-term viability of the industry.

Keywords: Poultry Farming ,One Health, Sustainability, Animal Welfare

“SAÚDE ÚNICA” COMO RECURSO PARA REDUÇÃO DE CUSTOS E MELHORA DE RESULTADOS NA AVICULTURA

RESUMO

O presente estudo analisa a intersecção entre a avicultura moderna e a abordagem "Saúde Única", demonstrando como a integração de princípios de saúde humana, animal e ambiental pode resultar em ganhos econômicos e competitividade estratégica para o setor. A avicultura, crucial para a segurança alimentar global, enfrenta desafios como a volatilidade de mercado e a emergência de doenças, como a influenza aviária. A implementação da "Saúde Única" propõe uma gestão proativa que abrange a biosseguridade, o bem-estar animal e a salubridade das condições de trabalho. A prevenção de surtos e a redução do uso de antibióticos fortalecem a confiança do consumidor e minimizam perdas produtivas e custos com tratamentos. Ao aderir às "Cinco Liberdades" do bem-estar animal, a indústria não só aprimora a qualidade de suas aves, mas também sua eficiência geral. No campo ambiental, o manejo adequado de resíduos, como a reutilização de água e a valorização do esterco como biofertilizante, mitiga a poluição e cria novas fontes de receita. A adoção de energias renováveis, como a solar, também contribui para a sustentabilidade e a redução de custos operacionais.Conclui-se que a "Saúde Única" transcende a mera responsabilidade ética, atuando como uma estratégia de negócios robusta. Ao investir na saúde de seus plantéis, de seus trabalhadores e do ecossistema, o setor avícola protege sua base operacional e constrói uma reputação de segurança e sustentabilidade que agrega valor aos produtos finais, assegurando a viabilidade a longo prazo da indústria.

Palavras-chave: Avicultura, Saúde Única, Sustentabilidade, Bem-Estar Animal

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INTRODUCTION

Poultry farming is the branch of animal husbandry dedicated to raising avian species, promoting food production, with emphasis on meat and eggs. These products boast several nutritional advantages over other animal sources, such as higher amino acid and micronutrient contents and lower fat levels (Brito & Coelho, 2021). Chicken stands out as the main poultry species, being acceptable to almost all ethnic and cultural groups; other commonly raised species include turkey, duck, goose, ostrich, and quail (Thorp, 2021).

Poultry farming has been considered an integral component of food production since the earliest days of livestock farming (Himu & Raihan, 2023). The oldest known evidence of bird domestication lies in Southeast Asia, with fossil records dating back over 8,000 years; followed by China, from approximately 6000 BC, and India, around 2000 BC (Wood-Gush, 1959; Clarke, 2004). Chickens were among the animals that the Austronesian peoples carried with them on their migratory movements through South and Southeast Asia, which occurred between 3500 and 2500 BC; they reached the valley of the Indus river, in the Indian subcontinent, at about 2000 BC, and Egypt some 250 years later (Eda, 2021). Some authors argue that avian dispersal throughout the ancient world was driven more by the fighting characteristics of males than by the species' food potential (Wood-Gush, 1959). Furthermore, in many cultures, birds played roles in various religious rituals, particularly in Africa and Asia (Clarke, 2004). Evidence obtained via mitochondrial DNA genomic studies suggests that the multitude of species known today descend from a common ancestor, the Asian gallus (*Gallus gallus*), as a result of hybridization and interbreeding through many centuries (Lawal et al., 2020; Eda, 2021).

In Brazil, poultry farming had modest beginnings, based on family subsistence and small-scale surplus trade. The first parent stock birds were brought in 1502 by the Portuguese fleet commanded by Gonçalo Coelho (Costa & Ferreira, 2011). The first register of commercial production date back to the 1860s, in the region that now belongs to the state of Minas Gerais. At that time, poultry farming was carried out artisanally in rural settings, which made reaching ideal slaughter weight slow and irregular (Sagrilo et al., 2007). In the mid-20th century, the activity was boosted by the

emergence of specialized cooperatives, particularly those of Japanese immigrants, mostly in the state of São Paulo (Zen et al., 2014). From the 1970s onwards, vertical integration with processing companies brought training and technical assistance to breeders, with the adoption of management standards and "good practices" and the definitive incorporation of intensive production techniques (Sakamoto et al., 2020; Brasil, 2022).

Throughout the 19th and early 20th centuries, with the Industrial Revolution, scientific advances, particularly in biology, enabled the evolution of management and nutrition techniques, which greatly improved the activity's performance (Clarke, 2004). Over the last five decades, poultry farming has experienced substantial growth on a global scale, with a progressive migration from old open-range and/or subsistence farming models to intensive, professionalized commercial production—which, in turn, generates growing demand for qualified personnel for its operations (Alders et al., 2019; Thorp, 2021; Korver, 2023). Equally notable were the advances in the nutritional area and in the production of vaccines, as well as the progress in environmental conditions, facilities and the use of high-tech equipment, with favorable impacts on the biosafety, health and welfare of birds, and the consequent improvement in the quality of the final products (Sakamoto et al., 2020; Brasil, 2022).

In 2024, Brazil produced approximately 38% of all chicken meat consumed worldwide, exporting the product to 172 countries; in 2023, more than US$9.61 billion was sold abroad, representing more than 5 million tonnes (Brasil, 2024). Today, the country is the world's leading exporter, with a 36.27% market share, and the third-largest producer, behind only China and the United States (Soares & Ximenes, 2025). Until recently, Brazilian farms enjoyed an advantage compared to other locations due to the absence of major contagious diseases, such as avian influenza and Newcastle disease, on Brazilian soil (Brasil, 2022); however, the discovery of the first outbreak of Highly Pathogenic Avian Influenza in a commercial flock in Rio Grande do Sul, in May 2025, as well as the effects of international embargoes (in turn related to global geopolitical issues) and recent increases in import tariffs on several products, determined by the United States government, reveal a new and challenging scenario for the national poultry industry, with expectations of lower exports and the return of surplus stocks to the domestic market in the short term (Soares & Ximenes, 2025).

As in other branches of the animal protein industry, attention to cost-effectiveness is a permanent necessity within the poultry production, in order to obtain the best possible balance between ensuring the quality and safety of its products and price competitiveness (Hafez & Attia, 2020), and also to resist the impacts arising from political and economic fluctuations – for instance, variations in the dollar exchange rate, which affect the prices of inputs (such as feed consumed by production birds), fuels (making transportation more expensive) and increased inflation in general, with reduced profits for producers (Bazzo, 2024). In this sense, the continuous improvement of processes, intending lower production costs, shorter delivery times, lower treatment costs, without relinquishing the best responding practices to emerging and re-emerging zoonotic diseases, as well as ways to stimulate customer attractiveness, trust and satisfaction, become imperative to achieving commercial success – or, at times, mere survival in the market (Samad et al., 2022; Korver, 2023).

The purpose of this paper is to discuss the possible ways through which the implementation of "One Health" advocated practices may bring better economic outcomes for poultry farming, while conciliating the promotion of human and environmental health with the industry's strategic future.

2. ONE HEALTH TION

"One Health" is conceptualized as a work approach that encourages interdisciplinary coordination and collaboration between different professionals, institutions and sectors, with the aim of providing inclusive, sustainable and effective solutions to improve people, animals and the environment's health and well-being, acknowledging the permanent connection and interdependence between them (MacKenzie & Jeggo, 2019; Lefrançois et al., 2023; Pungartnik et al., 2023).

Although the origins of the concept can be traced back more than 200 years of history, the modern global situation corroborates its relevance and current status, given that the roots of the main problems that plague humanity and threaten ecosystems are complex and multifactorial, not restricted to the biological field, but rather incorporating geopolitical and socioeconomic factors (Menin et al., 2021; Carneiro & Pettan-Brewer, 2021).

Projections from the United Nations indicate that the amount of people on the planet will continue to increase over the next 50-60 years, reaching approximately 10.3 billion people by 2080; moreover, global life expectancy has resumed increasing following the COVID-19 pandemic (United Nations, 2024). As the global population grows and ages on average, the demand for healthy and safe sources of protein for their diets also increases. The availability of consistent animal protein matrices not only helps ensure overall dietary stability, benefiting human health and longevity, but is also essential for addressing the nutritional needs of communities, particularly in the least developed parts of the world (Alders et al., 2019; Viegas et al., 2024). In this sense, one of "One Health" favorable differentials is the promotion of long-term balance of potentially conflicting interests, such as the health and well-being of production animals and human populations, and the sustainability of agricultural production and subsistence means (Douphrate, 2021).

3. HUMAN ONE HEALTH

In recent years, consumption habits have undergone considerable changes across virtually the entire world. Particularly in the aftermath of the COVID-19 pandemic, there has been a growing demand for transparency, sustainability, and ethics in production practices across all sectors of the animal protein industry, enabling consumers to make informed choices based on their individual values (Bist et al., 2024). In this sense, attention to the welfare of farm animals and the humanization of management practices, as well as limiting the indiscriminate use of antibiotics and hormones, tend to be more positively received by the public, improving customer confidence (Vannier et al., 2022; Pandanwangi et al., 2023; Ammann et al., 2024).

The rise in antimicrobial resistance is a concern for both human and veterinary medicine, being directly linked to the incidence of diseases whose treatments require antibiotics (Rahman et al., 2020; Himu & Raihan, 2023). As the frequency of antibiotic use increases, the risk of resistance also increases proportionally, leading experts to worry that germs will no longer be affected in the near future, making patient treatment difficult or even impossible (Saraiva et al., 2022; Gržinić et al., 2022).

Another significant human health issue involves the risks to which poultry

workers are exposed during their professional activities. Such risks may involve skin or inhalation contact with various pathogens, e.g. bacteria, fungi, mites, and viruses, excreted by live birds or transmitted through excreta or carcasses, as well as parasites and ticks. Also, contact with different sorts of chemicals during their preparation or use (medicines, cleaning products, pesticides, etc.), dust, mold, aerosols, airborne particles (from bird droppings), and several others should be considered (Kumar & Patyal, 2020; Himu & Raihan, 2023). Furthermore, the workers themselves may participate in the transmission of human diseases to birds, and their spreading among them (Bissong et al., 2022; Gomes et al., 2022).

According to Douphrate (2021), one of the key issues facing poultry farming in the 21st century is balancing attention to the welfare of a growing number of production animals with protecting the health of the workers who handle them, the communities where they live, and end customers. According to this author, recent scientific research has emphasized production practices and poultry health but gave little attention to employees and their interactions with the animals, or to health conditions in the workplace.

Therefore, investments in outbreak prevention programs, vaccination protocols, and food safety are crucial not only for animal welfare and disease prevention, but also for the health of society as a whole, even for people who do not consume chicken meat (WOAH, 2022). Furthermore, attention to safe working conditions – through promoting the use of comfortable and well-fitting uniforms and equipment, adequate ventilation, breaks for rest and hydration during the workday, prevention of postural problems (particularly in activities that require physical effort), strict personal hygiene practices, regular training and development, among others – leads to less accidents and handling errors (which, in turn, reduces avoidable losses), as well as absenteeism (and, with fewer absences, individual worker productivity increases) (Junges & Zat, 2022). Furthermore, it indirectly contributes to improving animal care, resulting in greater productive efficiency (Sakamoto et al., 2020; Kumar & Patyal, 2020; Gomes et al., 2022).

4. ANIMAL HEALTH

The "Five Freedoms of Animal Welfare" were developed in the United Kingdom

during the 1960s and 1970s, initially aimed at farmed animals (FAWC, 1979). Nowadays, they are also validated for companion animals and even wildlife and endorsed by international veterinary associations and organizations such as the World Organization for Animal Health and animal cruelty prevention associations in the US and Europe (FVE, 2016; CFMV, 2020). They advocate that all animals should be guaranteed: 1) *freedom from hunger and thirst* (i.e., access to food and water in quantities, quality, and frequency akin to their physiological needs); 2) *freedom from pain and disease* (also encompassing injury and general physical suffering); 3) *freedom from discomfort* (i.e., kept at comfortable temperatures and surfaces, sheltered from the elements, and with appropriate resting places); 4) *freedom to express their natural behavior*, or at least most of it (avoiding physical space restrictions and excessive reprimands); and 5) *freedom from fear and stress* (implying protection from emotional suffering and negative feelings).

Possible consequences of their violation in production animals include: (1) not being *free from hunger and thirst* can result in imbalance between nutrient demand and intake, leading to starvation and increased incidence of disease, due to greater frailty; (2) not being *free from pain and disease* can be associated with negligence in the care of the animals and/or the facilities where they are housed, absence of measures that prevent or limit the occurrence of confrontations between them, which can culminate in trauma and injuries, as well as carrying out procedures without appropriate antisepsis care or by cruel means (e.g. without anesthesia); (3) not being *free from discomfort* typically occurs in poorly constructed shelters, with floors made of inappropriate materials, subject to wide temperature variations and other features that prevent the animals from resting properly; (4) not being *free to express their natural behavior* (or at least most of it) is generally associated with excessively restrictive confinement, which can induce inconvenient abnormal manifestations, such as repetitive movements, causing them to injury themselves or damage the facilities, etc. And, finally, (5), not being *free from fear and stress* is generally directly related to inadequate or negligent handling practices, particularly when moving animals from one sector to another, and also to slaughter carried out by means contrary to humane principles.

Some of the most common diseases in poultry include salmonellosis, coccidiosis, laryngotracheitis, Newcastle disease, and others. "One Health" principles regarding

animal health promotion often requires proactive approaches to anticipate the hazard of diseases that are expensive and/or complex to treat, or even premature death of birds. These can result in financial losses for producers due to reduced final productivity or delays in meeting deadlines (Saraiva et al., 2022). One practical example is prophylactic intestinal health care in chicks to control disease outbreaks (WOAH, 2022).

Both small and large producers should benefit from the acquisition of knowledge regarding the main zoonoses' pathogenesis and transmission mechanisms (or hiring qualified professional advice), as well as the implementation of standard procedures that enable early detection of disease signs in their poultry. This allows for the prompt recognition of symptoms and agility in implementing response and control measures, such as isolation, treatment and/or disposal of affected specimens, recall of goods and end products associated with these, etc. (Varela et al., 2022; Sharma et al., 2024), and also the adoption of more effective preventive measures. These, in turn, tend to reduce the incidence of diseases and the risks of their transmission, culminating in lower treatment expenses and, therefore, reduced losses (Samad et al., 2022).

In recent years, there has been increasing proximity between wild animals and human-occupied areas, which can expose farmed animals to the risk of contracting a multitude of diseases (Gržinić et al., 2022). Farm animals can act as amplifiers for the spread of pathogens from wild animals, which, in turn, can be vectors or reservoirs of several etiological agents (Gržinić et al., 2022; Wannous, 2024). However, the manifestation of clinical disease relates to multiple features of both the host and the environment, and not merely the pathogen's presence in the organism; therefore, not all human- and poultry-pathogenic microorganisms will necessarily be pathogenic to wild animals (Wannous, 2024).

Waste left in the environment by wild animals, such as feces, urine, waste droppings, and others, may contain germs such as *Salmonella*, *E. coli*, *Vibrio cholerae* (cholera), *Pasteurella* (avian cholera), *Campylobacter*, *Yersinia*, *Clostridium botulinum* (avian botulism), and others, as well as single-celled organisms (such as *Cryptosporidium*, *Microsporidia*, *Giardia*, etc.) and viruses (such as paramyxovirus, influenza, etc.) (Kumar & Patyal, 2020). Poultry can be infected directly through physical contact with these, or indirectly through contamination of resources such as water sources and pastures (Kumar & Patyal, 2020; Wannous, 2024).

Furthermore, potential encounters with wild animals can lead to competition for resources such as water, food, or simply space, culminating in physical fights between them, which can cause injuries. These, in turn, can not only affect their health but also leave irreversible consequences that reduce final products' quality (Thorp, 2021). Therefore, in addition to the measures already described regarding contact with humans, it is advisable to prevent or limit contact with wild animals as much as possible, through raising them in closed or otherwise controlled environments (Gržinić et al., 2022; Himu & Raihan, 2023).

It is important to highlight that, in modern poultry farming, increasing productivity involves subjecting birds to increasingly extreme conditions, close to their physiological limits, which reinforces the importance of appropriate attention to physical and nutritional health, as well as the environment in which they are raised (Korver, 2023). However, broiler breeders are at greater risk of contracting diseases and trauma when subjected to strenuous production processes, many of which can leave intractable after-effects on their bodies. Furthermore, their neurohormonal and immune systems trigger defensive responses that negatively impact the organoleptic and nutritional characteristics of the future consumption products (Sakamoto et al., 2020; Bist et al., 2024).

5. ENVIRONMENTAL HEALTH

The adverse environmental impacts of poultry farming relate to the consumption of resources such as water, electricity, and fuel, as well as the waste it generates: manure, feathers, carcasses, egg hatching waste, polluted water, etc. (Kumar & Patyal, 2020; Himu & Raihan, 2023). If not managed properly, air quality may be compromised, soil contamination may occur, and local water resources (such as waterways and groundwater) may be contaminated. These, in turn, can lead to changes in the local ecosystem, such as plant contamination, changes in local wildlife behavior patterns, migration and reproduction, reduced food availability for animals, and reduced fish availability in nearby rivers and lakes, among many other factors, potentially damaging biodiversity (Kumar & Patyal, 2020; Gržinić et al., 2022; Fonseca & Rossoni, 2022). Strong odors, typical of the activity itself or its waste, could attract flies, rats, snakes, and

scavenging birds (which, in addition to being potential disease transmitting themselves, make the environment unpleasant); and there is also noise pollution. All these factors can harm the quality of life in areas surrounding farms, particularly those with intensive production, often giving rise to complaints and conflicts with local residents (Kumar & Patyal, 2020).

In poultry farming, electricity and potable water consumption is typically higher than in other branches of the animal protein industry, given the need for equipment to continuously control humidity and ambient temperature, key parameters for achieving optimal chick maturation rates and adult bird health (Cui et al., 2020). However, in Brazil, the predominant geographic characteristics offer advantages compared to other countries, such as the abundant availability of water resources and the reduced need for electricity for shed heating due to higher ambient temperatures (Junges & Zat, 2023).

Poultry wastewater is characterized by the presence of suspended solids, heavy metals, pathogenic microorganisms, drug metabolites, and others, and by its oxygen deficiency. These contaminants can have adverse impacts on air and soil quality, as well as on surface and groundwater sources, posing a potential risk to human health (Vaishnav et al., 2023; Hargitai et al., 2024).

The so-called "recycled water" is an alternative of growing popularity in several centers. Water discarded after use in industrial and production processes in general, is collected and subjected to total or partial treatment, enabling it to be recycled. The new use may have the same or different purposes. In addition to reducing pollutant emissions into the environment, it results in lower consumption of water from natural sources and/or from public supply systems, which reduces costs for property owners and promotes water conservation (Matthiensen et al., 2022; Hargitai et al., 2024).

In recent years, multiple targeted treatment strategies have been developed to make wastewater suitable for reuse in specific applications (Vaishnav et al., 2023; Hargitai et al., 2024). The processes involved can be chemical (oxidation reactions and particle agglutination, aiming at their sedimentation and subsequent removal), physical (filtration through semipermeable membranes), or biological (cultured microalgae and bacteria); it can also be used to produce bioplastics, biofertilizers, and biofuels (Vaishnav et al., 2023).

The manure produced by poultry contains nutrients which are paramount for

plant growth, such as nitrogen in the form of ammonia (3-5%), phosphorus (1.5-3.5%), and potassium (1.5-3.0%), in higher levels than their bovine and swine counterparts, and also considerable levels of micronutrients such as calcium, magnesium, sulfur, manganese, copper, zinc, iron, molybdenum, and others. For this reason, its traditional application as fertilizer remains the most common form of use to this day (Kacprzak et al., 2022; Fonseca & Rossoni, 2022). However, it is a potential pollutant, as it may contain toxins, drug metabolites, supplements and other feed additives, disease-causing microorganisms, and antibiotic-resistant bacteria (Kumar & Patyal, 2020). Furthermore, fresh manure is rich in moisture and cannot be applied directly to plants due to its caustic effects on foliage. Besides, the longer the manure is used, the faster its nitrogen content is lost, reducing its fertility potential (Kacprzak et al., 2022). The high solubility of manure in water favors the penetration of its components into the soil and the contamination of both surface and groundwater sources, and the high volatility of ammonia contributes to the foul odors that worsen air quality (Kacprzak et al., 2022; Fonseca & Rossoni, 2022).

Therefore, proper effluent management is essential for the industry's long-term sustainability (Kumar & Patyal, 2020; Fonseca & Rossoni, 2022). Furthermore, using resources that favor renewable sources in the supplying of breeding grounds, such as photovoltaic panels (Cui et al., 2022), as well as periodic maintenance and upgrades of equipment to allow for operations with lower consumption, and strict control over the disposal of waste and rejects such as garbage and manure (Gomes et al., 2022), tend to favor the economic viability of the activity, reducing expenses and losses.

6. CONCLUSION

The success of the "One Health" approach is grounded on how following its precepts *pays off* (i.e., business owners will be able to attain greater profit and/or economic benefits), as the mere "environmental awareness" is insufficient to achieve such goal.

Health safety is known to be one of the customers' top concerns when purchasing animal-based foods for their families. Therefore, the productive chain's reputation (including the ways the media publicizes data regarding it) becomes a

determining factor in potential perceptions of health risks (regardless of these actually being substantiated or not) – and, therefore, in customer preferences.

Therefore, as important as adopting best practices in prophylaxis and food safety is demonstrating this ethically and respectfully to the public, in order to increase their trust in the industry, which adds value to the final products. This communication can also instill in consumers the idea of empowerment and environmental "consciousness" – that is, purchasing goods from producers who adhere to "One Health" principles means supporting the local economy, while simultaneously contributing to environmental preservation.

The implementation of "One Health" principles turns economically attractive for producers the continued investment in interventions that support food safety, such as biosecurity, vaccines, and everything else necessary to improve the health of their livestock. By doing so, they protect not only the core of their operations, but also the health of their customers and society as a whole.

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