

Innovative Approaches for Sustainable Poultry Production

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Abstract

The article provides a detailed summary of sustainability in chicken farming, highlighting the need to balance consumer demands with the preservation of natural resources, animal welfare, and environmental health. It identifies three key areas of sustainability: environmental, economic, and social. Environmental sustainability aims to minimize pollution, greenhouse gas emissions, and resource depletion. Economic sustainability focuses on maintaining profitability and managing market fluctuations, while social sustainability ensures fair labour practices and community well-being. Sustainable practices are essential for environmental conservation, resource efficiency, meeting consumer expectations, complying with regulations, and ensuring long-term success. Key approaches include enhancing feed efficiency with alternative ingredients, precision feeding, and waste reduction. Technological innovations such as robotics and IoT play a significant role in boosting productivity and sustainability. Additionally, genetic selection and breeding are crucial for creating resilient chicken breeds that can handle climate stress and improve feed conversion. Emerging technologies like AI and block chain are revolutionizing the industry by enhancing operational efficiency and transparency. Nonetheless, regulatory challenges require adherence to evolving environmental and animal welfare standards, encouraging a shift towards sustainable practices that meet consumer demand for ethically produced poultry.

Keywords: Artificial Intelligence; Poultry; Internet of Things

Abbreviations

FCRs: Feed Conversion Ratios; IoT: Internet of Things; AI: Artificial Intelligence.

Introduction

In the context of chicken farming, sustainability is the industry's capacity to supply demand for chicken products

while maintaining the long-term viability of natural resources, environmental health, and animal welfare. It includes actions that prioritize animal care and social responsibility, encourage resource efficiency, and reduce adverse environmental effects.

Environmental sustainability: This refers to actions that lessen pollution from sources like manure runoff that contains nutrients, cut down on greenhouse gas emissions, and preserve natural resources like water and land.

Economic Sustainability: Agricultural methods that are sustainable in the long run while taking profitability, input costs, and fluctuations in markets into account

Social Sustainability: Ensuring that fair labour standards, cultural values, and community health are upheld in chicken farming in order to make a beneficial impact on the local communities.

Animal welfare: Putting into effect measures to guarantee the health and welfare of chickens throughout their life cycle, such as proper housing, handling techniques, and access to nutritious meals and veterinary care.

Importance of Sustainable Practices in the Poultry Industry

Environmental Conservation: Deforestation for the production of supply, greenhouse gas emissions, and waste contamination of the air and water are just a few of the negative effects that poultry farming may have on the environment. By reducing these effects, sustainable practices protect ecosystems and natural resources for coming generations.

Resource Efficiency: Using feed, water, and energy resources effectively lowers production costs and increases profitability. Sustainability depends on methods and technologies that maximize water utilization, lower energy consumption, and increase feed conversion efficiency.

Consumer Demand: Food goods made sustainably and ethically are becoming more and more important to customers. Fulfilling these requirements not only increases market competitiveness but also fosters consumer loyalty and trust.

Regulatory Compliance and Risk Mitigation: Legal risks and reputational harm are reduced when environmental regulations and ethical standards are followed. Poultry farms that proactively implement sustainable practices are better equipped to adjust to changing regulatory environments.

Long-Term Viability: By lowering reliance on limited resources, boosting resilience to the effects of climate change, and encouraging innovation in production techniques, sustainable practices help poultry farming businesses remain viable over the long term.

Enhancing feed efficiency has a direct impact on costs, environmental impact, and total production, making it essential for sustainable chicken farming. The following are some essential tactics to improve feed efficiency.

The Use of Alternative Ingredients in Feed:

Insect meal: Mealworms and black army flies are examples of insects that are high in protein and may be raised organically on trash. By adding insect meal to their meals, chickens become less dependent on traditional protein sources like soybean meal.

Algae: Algae may be grown with few resources and are rich in nutrients. They offer a sustainable substitute for conventional feed ingredients by supplying proteins, vitamins, and minerals that are appropriate for chicken diets.

By-products: Reducing waste and feed costs can be achieved by using by-products from the food processing industries (such as distillers' grains, oilseed cakes, and brewers' grains) as feed ingredients.

Technologies and Techniques for Precision Feeding:

Nutrient Requirements: Precision feeding entails creating a meal that is specifically suited to the nutrient requirements of chickens at various phases of development or production. This method reduces surplus nutrients that can pollute the environment and maximizes nutrient usage.

Feed Monitoring Systems: These automated systems track feed intake, detect trends of consumption, and modify feeding methods based on the information gathered from sensors and data analytics. This method minimizes waste and maximizes feed efficiency.

Feed Additives: By increasing nutrient absorption and digestive efficiency, probiotics, prebiotics, enzymes, and feed additives like phytogenic can raise feed conversion ratios (FCRs) and lower the quantity of feed needed per unit of chicken output.

Minimizing Feed Waste:

Feed Management Practices: You can minimize spoilage and waste by putting effective feed management techniques into place, such as routinely checking feed quality, storage conditions, and feeding schedules.

Feed Formulation: Accurate diet formulation that incorporates high-quality components and is based on nutritional requirements reduces overfeeding and guarantees feed utilization that is optimal.

Feeding Systems: Feeders and automated feeding systems made to prevent leaks and provide restricted access to feed aid in waste reduction and hygienic maintenance.

Poultry producers can improve sustainability, lower production costs, increase feed efficiency, and make a positive impact on the environment and resource efficiency of the poultry business by using these strategies. These methods meet consumer preferences for ethically produced poultry products while also improving the bottom line [1].

Alternative Strategies for Preventing Illnesses:

Vaccination Strategies: The incidence and consequences of infectious diseases can be greatly decreased by putting into place efficient vaccination programs that are adapted to the unique disease risks in chicken populations.

Probiotics and Prebiotics: By bolstering immune responses and supporting gut health, probiotics (good bacteria) and prebiotics (substances that encourage the growth of good bacteria) can help chickens use less antibiotics.

Natural Immunostimulants: Adding natural Immunostimulants to chicken feed, such as organic acids, botanical extracts, and essential oils, can strengthen their

immune systems and increase their resistance to illness.

Improving Living Environments and Space Use:

Optimal Housing Design: Fostering health and lowering stress levels requires housing that is clean, well-ventilated, brightly lit, and tailored to the demands of certain chicken species.

Space Management: Providing enough room for each bird in accordance with suggested recommendations reduces aggression, wounds, and the spread of disease.

Enrichment of the Environment: Providing perches, nesting places, and surfaces for pecking and scratching encourages natural behaviors and mental health.

Minimizing Stress during Handling and Transport:

Training and Handling Techniques: Staff that have received the appropriate instruction in gentle handling methods are better able to handle and transport poultry with less stress.

Transport Conditions: Reducing overcrowding, keeping the right temperature and humidity levels, and making sure transport vehicles are well-ventilated all help to reduce stress.

Cutting Down on Transport Time: Poultry's physiological and behavioral stress reactions can be decreased by cutting down on the amount of time spent in transit and the frequency with which it is handled.

Automation and cutting-edge technology are essential for updating methods of raising chickens, increasing productivity, and fostering sustainability. This is the way that different technologies are being used [2].

Robotics Applications in Poultry Farming:

Automated Feeding Systems: Using robotics, feed is precisely delivered to poultry according to their feeding schedules and nutritional requirements. In addition to ensuring maximum feed conversion efficiency, this lowers feed waste.

Egg Collection Systems: Automatic systems are capable of gathering eggs from nests, classifying them according to quality standards, and packing them effectively. This lowers the possibility of egg damage and lessens the amount of labour needed.

Robotic Upkeep and Cleaning: Robots reduce the need for physical labour and improve hygiene by cleaning chicken houses, picking up rubbish, and carrying out regular maintenance duties.

Applications of IoT (Internet of Things) for Data Analysis and Monitoring:

Environmental Monitoring: IoT sensors track temperature, humidity, air quality, and ammonia levels in chicken houses. Farmers may optimize environmental conditions for poultry health and productivity with the use of this real-time data. IoT devices have the capability to monitor several health parameters of individual birds, including activity levels and feed intake. This allows for the early detection of illness and the provision of preventive veterinarian care.

Analytics of Data: IoT-generated data is processed by

advanced analytics software, which then offers insights into trends, performance measures, and prediction models for maximizing output and resource efficiency.

Methods of Precision Farming:

Environmental Sensors: In order to optimize irrigation and fertilization techniques, sensors measure crop growth parameters, soil moisture, and nutrient levels in feed crops and forages.

GPS and Telescopes: Data on crop health, vegetation cover, and land use are gathered using satellite imaging and camera-equipped drones, which helps with land management choices and enhances field operations.

Accurate Livestock Production: Precision livestock farming uses wearable sensors or RFID tags to monitor the behavior, health, and productivity characteristics of individual animals. This allows for more focused management approaches.

In order to increase production, health, and sustainability in chicken farming, genetic selection and breeding are essential practices. The following are important factors and methods in genetic breeding and selection [3].

Breeding to Adapt to Climate Stress and Resist Disease:

Genetic Markers: Breeders may develop chicken breeds that are more resistant to common diseases by locating and choosing genetic markers linked to disease resistance.

Selective Breeding Programs: By implementing programs for selective breeding that give priority to features related to disease resistance, the need for antibiotics and other treatments can be decreased, leading to healthier chicken and less negative effects on the environment.

Climate Adaptation: Poultry may adapt to a variety of climatic situations by selecting for traits including heat tolerance, cold tolerance, and resilience to environmental stresses. This increases overall resilience and lowers production risks.

Using Genetic Selection to Increase Feed Conversion Efficiency:

Feed Efficiency characteristics: Reducing the quantity of feed needed per unit of chicken production is achieved by selecting for characteristics associated with feed conversion efficiency (FCR), such as efficient nutrient utilization and metabolic efficiency.

Growth Rates: To achieve optimal growth performance while reducing feed costs and environmental effect, fast growth rates must be balanced with feed efficiency qualities.

Nutrient Utilization: The environmental impact of chicken production systems is decreased by choosing birds that effectively turn feed into body weight and generate less waste.

Long-Term Breeding Techniques to Preserve Genetic Variety:

Genetic Conservation: By using breeding techniques that preserve genetic variety among chicken populations, beneficial features are kept intact and the birds' resistance to illness and environmental changes is increased.

Population Control: Implementing breeding plans that control inbreeding and encourage outcrossing contributes to the long-term maintenance of genetic stability and adaptation.

Collaborative Breeding Networks: By participating in genetic exchange initiatives and collaborative breeding networks with other breeders and organizations, one can guarantee access to a variety of genetic resources and advance sustainable breeding methods around the world.

Exploring future trends and challenges in poultry farming reveals opportunities and considerations for advancing sustainability, efficiency, and profitability in the industry [4].

Impact of Emerging Technologies on Poultry Farming

Genomic Selection: Recent advancements in genomic technologies allow for precise selection of traits such as disease resistance, feed efficiency, and growth rates. This accelerates genetic improvements in poultry breeds.

Artificial Intelligence (AI) and Machine Learning: AI-powered systems can analyze extensive datasets from poultry farms to optimize feed formulation, predict disease outbreaks, and enhance overall operational efficiencies.

Robotics and Automation: Ongoing developments in robotics enable automated tasks such as feeding, egg collection, and environmental monitoring. This improves labor efficiency and reduces operational costs.

Blockchain Technology: Implementing blockchain enhances supply chain transparency and traceability in poultry products. This ensures authenticity and ethical sourcing, meeting consumer demands for food safety and sustainability.

Regulatory Challenges and Opportunities for Sustainable Practices

Environmental Regulations: Increasingly stringent regulations address waste management, emissions, and water usage. Poultry farms must adopt sustainable practices

to comply with legal requirements.

Animal Welfare Standards: Evolving global regulations impact housing systems, handling practices, and antibiotic use in poultry production, reflecting growing concerns for animal welfare.

Market Access: Certification schemes for sustainable and organic poultry products present opportunities to access premium markets. Products can be differentiated based on environmental and social responsibility, meeting consumer preferences.

These trends underscore a shift towards integrating advanced technologies and sustainable practices in poultry farming, aiming for improved efficiency, profitability, and environmental stewardship [5]. Innovative approaches for sustainable poultry production focus on enhancing efficiency, reducing environmental impacts, and improving animal welfare. Here are some key insights based on the provided search results.

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