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EXPLORING SIMULATION MODELLING AS A STRATEGY FOR ENHANCING POULTRY MANAGEMENT IN TERTIARY EDUCATION

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Abstract
Poultry production is a vital component of agricultural economies, particularly in regions like Anambra State, Nigeria, where it supports food security and livelihoods. This study explores the application of a Chicken Growth Simulation (CGS) program to optimize poultry production by modeling growth parameters, feed efficiency, and environmental factors. Using a sample of 50 poultry farms in Anambra State, the research evaluates the effectiveness of CGS in improving broiler growth rates and reducing production costs. Results indicate that farms utilizing CGS achieved a 15% increase in growth efficiency and a 10% reduction in feed costs compared to traditional methods. These findings suggest that integrating simulation technologies can enhance sustainable poultry production in Anambra State, offering a scalable model for other regions.

Keywords: Chicken Growth Simulation, Poultry Production, Growth Modeling, Sustainable Farming, Precision Agriculture

Introduction
Poultry farming, particularly broiler production, is a cornerstone of agricultural development in Anambra State, Nigeria. With a growing population and increasing demand for protein, optimizing poultry production is critical. Traditional methods often face challenges such as high feed costs, disease outbreaks, and suboptimal growth rates. The Chicken Growth Simulation (CGS) program, a computational tool designed to model chicken growth based on variables like feed intake, genetics, and environmental conditions, offers a promising solution. This study investigates how CGS can be leveraged to enhance poultry production in Anambra State, focusing on growth efficiency, cost reduction, and sustainability.

Poultry production in Nigeria is vital to the country's agricultural sector, contributing significantly to food security, economic growth, and employment opportunities. The industry continues to expand, driven by increasing demand for poultry products such as eggs and meat, fueled by population growth and rising consumer preference for affordable protein sources. However, its success is intricately tied to effective poultry management practices, including housing, feeding, disease control, biosecurity, and waste management. Nigeria boasts one of the largest poultry industries in Africa, with an estimated poultry population of approximately 180 million birds, comprising indigenous and commercial breeds. According to the Food and Agriculture Organization (FAO), the country produces around 300,000 metric tons of poultry meat and 650,000 metric tons of eggs annually, making it the leading egg producer on the continent.

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Poultry systems in Nigeria are broadly categorized into extensive, semi-intensive, and intensive systems. The extensive system dominates rural areas, accounting for nearly half of the poultry population, while intensive systems, concentrated in urban and peri-urban regions, contribute significantly to commercial output. The industry employs approximately 85 million Nigerians, many of whom operate small to medium-scale enterprises. Despite its growth, local production meets only about 30% of the demand for poultry products, indicating a substantial gap that imports currently fill. This gap underscores the potential for expansion, provided effective management practices are scaled up across all production systems. Effective poultry management is the cornerstone of a thriving poultry industry. For example, proper housing is critical for optimizing poultry health and productivity. Adebayo et al. (2023) noted that climate-controlled housing reported a 20% increase in egg production and a 15% reduction in mortality rates compared to traditional systems. Thus, ventilation, temperature regulation, and adequate space reduce stress and disease incidence, directly contributing to higher yields.

Similarly, Ogunjimi (2021) notes that farms implementing balanced feed formulations tailored to local resources achieved a 25% reduction in feed costs and improved feed conversion ratios. This suggests that adequate nutrition enhances growth rates in broilers and egg-laying consistency in layers, bolstering overall productivity. Feed constitutes 60-70% of poultry production costs in Nigeria, making efficient feed management essential. The high cost of conventional feed ingredients like maize and soybeans has driven innovation, with farmers exploring alternative sources such as insect-based proteins and agro-industrial by-products. Atiku et al. (2023) emphasize that farms with robust biosecurity protocols experienced 30% fewer disease incidents, translating to higher flock survival rates and profitability. Disease outbreaks, such as Newcastle disease and avian influenza, remain a significant threat to poultry production in Nigeria. Effective biosecurity measures, such as vaccination programs, restricted farm access, and sanitation, have proven instrumental in mitigating these risks.

Additionally, improved breeds, such as hybrid layers and broilers, have significantly enhanced productivity and ensured genetic quality and consistency, driving industry growth. Effective waste management practices, such as composting and biogas production, have turned this challenge into an opportunity. Eze and Chukwu (2024) report that farms integrating biogas systems reduced energy costs by 15% while improving farm sustainability. This supports environmental health and enhances farm profitability, a critical factor in Nigeria's resource-constrained context. In other words, effective poultry management is linked to poultry improvement. Recent studies provide evidence linking effective poultry management to industry success in Nigeria. Ogunjimi (2021) argues that poultry production's potential for rural youth empowerment hinges on improved management practices, such as access to extension services and affordable inputs. The study found that farms with regular training on management techniques increased output by 35% within a year. Similarly, Atiku et al. (2024) identify disease control and technical know-how as pivotal, noting that farms with veterinary support and extension services saw a 50% reduction in losses due to pests and diseases.

Adebayo et al. (2023) explore the socioeconomic impacts of poultry production, asserting that effective management practices, particularly housing and feed optimization, enable small-scale farmers to achieve economic independence. Their data show that well-managed farms contribute 25% more to household income than poorly managed ones. Furthermore, Eze and Chukwu (2024) underscores the role of waste management in sustainable poultry farming, linking it to reduced production costs and improved community relations, which enhance market access. While challenges persist, strategic interventions leveraging these practices can close the demand-supply gap, reduce import dependency, and position

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Nigeria as a poultry production powerhouse in Africa. Continued research, policy support, and farmer education will be key to sustaining this trajectory.

Research on simulation technologies in agriculture has expanded, with tools like CGS gaining attention for their precision in predicting livestock performance. A study by Chiekezie et al. (2021) on layers poultry production in Anambra State found that feed costs constituted 42.82% of total production expenses, underscoring the need for efficient resource use. Similarly, simulation programs have been successfully applied to poultry farming. Simulation modelling involves creating virtual representations of real-world systems to study their behavior under various conditions. In poultry management, it entails developing computational models that mimic poultry production processes, such as growth rates, feed utilization, disease spread, or environmental impacts, allowing farmers and researchers to test scenarios without real-world risks or costs. Common approaches include system dynamics, agent-based modelling, and discrete-event simulation, each tailored to specific aspects of poultry operations. In Nigeria, simulation modelling remains underutilized in poultry management, though its potential is significant. Smallholder farmers, who dominate the sector, often lack access to advanced technology, but simplified models delivered via mobile apps or extension services could bridge this gap. However, limited research on simulation tools specific to Anambra State creates a gap that this study aims to address. The CGS program builds on these foundations by offering a tailored approach to broiler growth optimization, aligning with precision agriculture trends.

Method

The study was conducted in Anambra State, Nigeria, a region known for its agricultural potential and poultry farming activities. Anambra's climate and economic conditions make it suitable for testing innovative farming technologies.

Data Collection

Data were collected from 50 randomly selected poultry farms in Anambra State between January and March 2025. Farms were divided into two groups: 25 using the CGS program (experimental group) and 25 using traditional methods (control group). Variables measured included average daily weight gain (ADWG), feed conversion ratio (FCR), and total production costs.

Chicken Growth Simulation Program (CGS)

The CGS program uses algorithms to simulate chicken growth based on inputs such as feed type, quantity, temperature, and flock size. It provides predictive outputs on optimal feeding schedules and growth timelines, calibrated to local broiler breeds in Anambra State.

Analysis

Data were analyzed using descriptive statistics and t-tests to compare outcomes between the experimental and control groups. Growth efficiency was calculated as the percentage increase in ADWG, while cost efficiency was assessed as the percentage reduction in feed costs.

Results

The results, summarized in Table 1, demonstrate the impact of CGS on poultry production in Anambra State.

Table 1: Comparative Results of Poultry Production with and without CGS

Parameter	CGS Group (n=25)	Control Group (n=25)	Difference

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Average Daily Weight Gain (g)	45.2	39.1	+6.1 (15.6%)
Feed Conversion Ratio (FCR)	1.8	2.1	-0.3 (-14.3%)
Feed Cost per Bird (₦)	900	1,000	-100 (-10%)
Total Production Cost (₦)	1,200	1,350	-150 (-11.1%)

(ADWG): Average Daily Weight Gain.

The CGS group recorded an ADWG of 45.2g compared to 39.1g in the control group, a 15.6% improvement. The CGS group achieved an FCR of 1.8, indicating better feed efficiency than the control group's 2.1. Feed costs dropped by 10% in the CGS group (₦900 vs. ₦1,000). Overall costs decreased by 11.1% with CGS implementation. Statistical analysis (t-test, $p<0.05$) confirmed significant differences in ADWG, FCR, and costs between groups, validating CGS's effectiveness.

Discussion

The findings align with global trends in precision agriculture, where simulation tools enhance resource use and productivity. The 15.6% increase in ADWG reflects CGS's ability to optimize feeding schedules, consistent with Optimizing Poultry Production (2023), which reported improved growth through data-driven systems. The 10% reduction in feed costs addresses a key challenge identified by Chiekezie et al. (2021), potentially increasing profitability for Anambra farmers. However, adoption barriers such as technical training and initial investment costs must be considered, as noted in Sustainable Poultry Farming Practices (2023).

Conclusion

The Chicken Growth Simulation Program offers a viable strategy to enhance poultry production in Anambra State by improving growth efficiency and reducing costs. Its integration into local farming practices could bolster food security and economic resilience. Future research should explore scaling CGS across Nigeria and adapting it for layers and indigenous breeds.

Recommendations

- Provide training for farmers on CGS use to ensure effective implementation.
- Subsidize initial setup costs to encourage adoption among smallholder farmers.
- Expand CGS to include disease prediction and environmental monitoring features.

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