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Economic viability of closed house and open house systems among medium-scale broiler farms in Malaysia

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ABSTRACT

Broiler production is a major contributor to Malaysia's livestock industry, accounting for approximately 52% of total national livestock production. However, rising feed prices and increasing production costs have intensified the need for more efficient and financially sustainable production systems. This study evaluates the economic viability and operational efficiency of the Closed House System (CHS) and the Open House System (OHS) using projected cash flow analysis and partial budgeting. Primary data were collected through face-to-face interviews with three medium-scale commercial broiler farms, each managing 25,000–30,000 birds per production cycle. Financial feasibility was evaluated over a 35-year project horizon using a 10% discount rate. The findings indicate that CHS requires substantially higher initial capital investment than OHS but provides greater production capacity due to lower floor space requirements (0.7–0.9 ft^2 per bird) compared with OHS (1.0–2.0 ft^2 per bird), enabling annual production of approximately 185,714 birds compared with 100,000 birds under OHS. Operationally, CHS demonstrated superior performance, recording lower mortality (<5%), reduced labour costs (RM0.25 per bird compared with RM0.47 under OHS), and improved production efficiency. Financial analysis confirmed that both systems were economically viable, with positive Net Present Values (NPV) and Internal Rates of Return (IRR) exceeding 25%. Nevertheless, CHS exhibited stronger financial performance, achieving an NPV of RM2,392,982 and a payback period of 3.5 years. Despite its higher initial investment, CHS offers superior long-term profitability, greater resource utilization, and improved production efficiency, making it a more sustainable and competitive housing system for medium-scale broiler production in Malaysia while providing empirical evidence to support investment and policy decisions on broiler housing modernization.

1. Introduction

The poultry sector is a vital component of Malaysia's agri-food industry, contributing significantly to national food security by serving as the primary source of affordable animal protein for consumers. The sector supplies more than 70% of Malaysia's animal protein requirements, highlighting its strategic importance in ensuring a stable and reliable food supply (Ministry of Agriculture and Food Security, 2026). In response to increasing domestic demand and government efforts to strengthen food self-sufficiency, the poultry industry has continued to expand through improvements in production capacity, farm management practices, and technological adoption. However, despite its strategic role, national chicken production has experienced a declining trend over the past seven years, decreasing from 1.60 million tonnes in 2017 to 1.53 million tonnes in 2023 (Department of Veterinary Service, 2024) (Table 1). Although production temporarily increased in

2020 due to elevated domestic consumption during the COVID-19 pandemic, output declined thereafter as producers faced increasing production pressures, particularly rising feed costs, labour constraints, and operational challenges. These pressures have affected farm profitability, resulting in some producers reducing production capacity or discontinuing operations. Consequently, improving production efficiency through the adoption of appropriate farm management systems, including optimized housing systems, has become increasingly important for sustaining the competitiveness and resilience of Malaysia's poultry sector.

Table 1. Chicken Meat Production, Import, and Export (2017-2022)

Item	2017	2018	2019	2020	2021	2022	2023
Production (MT)	1.598.258	1.587.539	1.589.080	1.628.609	1.583.219	1.543.425	1.525.000
Import (MT)	62.897	71.183	72.431	68.244	96.588	176.191	237.629
Export (MT)	87.904	95.498	94.821	95.107	94.745	64.752	67.532

Source: Department of Veterinary Service (2024)

Although Malaysia maintains a self-sufficiency ratio exceeding 90% (Department of Statistics Malaysia, 2024), significant chicken imports persist, driven by demand from large-scale food industries, including food processing, quick-service restaurants, and hotel, restaurant, catering (HoReCa) sector. Imported products, such as frozen cuts, deboned meat, and poultry by-products, offer advantages in handling and cost efficiency. At the same time, Malaysia exports poultry products, mainly to Singapore with accounting for over 80% of total exports (World Integrated Trade Solution, 2024). Export volumes, however, have been subject to fluctuations due to domestic policy measures, such as the 2022 ban on live and fresh chicken exports implemented to stabilise local supply amid soaring retail prices. These dynamics illustrate the structural vulnerabilities and operational challenges faced by the poultry industry, highlighting the need for improved production efficiency and supply chain resilience.

Table 2. Broiler farmers using closed-house and open-house systems, 2021

State	Close House System		Open House System	
	No. of Farm	Chicken Capacity	No. of Farm	Chicken Capacity
Perlis	3	305.000	6	230.500
Kedah	43	1.652.200	183	10.781.700
P. Pinang	7	326.000	114	6.945.200
Perak	151	14.545.611	168	10.537.400
Selangor	99	10.517.974	108	4.373.400
N. Sembilan	48	8.187.542	106	5.866.550
Melaka	38	9.356.657	63	2.172.300
Johor	162	13.956.560	381	28.513.300
Pahang	30	2.908.000	166	8.576.330
Kelantan	27	1.461.300	144	2.839.430
Terengganu	15	1.072.000	123	2.815.980
Total	623	64.288.844	1.562	83.652.090

Source: Department of Veterinary Services, (2022)

Malaysia's broiler industry comprises small-scale family farms and large vertically integrated operations, covering the full production chain from breeding to processing, which facilitates control over product quality, safety, and consistency (Table 2). Modernization efforts, particularly the promotion of Closed-House Systems (CHS), have been driven by objectives to enhance productivity, improve animal welfare, mitigate environmental impact, and ensure food safety, in line with the

Department of Veterinary Services' guidelines. CHS allows precise regulation of environmental parameters such as temperature, humidity, and ventilation, in contrast to traditional Open-House Systems (OHS) that are largely dependent on external conditions, resulting in more variable production outcomes. Despite these advantages, CHS adoption remains limited, with only 623 farms using CHS compared to 1,562 OHS farms in 2021, and approximately 28.5% of broiler farms nationwide having transitioned to CHS, indicating both the progress and ongoing challenges in modernizing Malaysia's broiler sector (Department of Veterinary Services, 2022).

The adoption of the CHS enables precise dietary formulation and environmental control, resulting in balanced nutrition, higher feed digestibility, and improved feed conversion efficiency. Based on data collected from the three commercial broiler farms in this study, CHS achieved a feed conversion ratio (FCR) ranging from 1.6 to 1.9, reflecting efficient feed utilization under commercial production conditions. This finding is consistent with previous studies reporting superior feed efficiency in CHS compared with conventional open-house systems. For example, Setiadi et al (2021) reported an average FCR of 1.44 under controlled experimental conditions, compared with approximately 1.8 in open-house systems, demonstrating the potential performance gains achievable under optimal management.

In addition to improving feed efficiency, CHS provides precise control of critical environmental parameters, including temperature (24–26°C), humidity, ventilation, and lighting, thereby minimizing heat stress and enhancing bird welfare, growth performance, and meat quality. Vandana et al (2021) reported that maintaining an optimal microclimate through CHS significantly reduced heat stress and mortality, while Cobb Vantress (2022) emphasized that adequate air exchange is essential for removing excess heat and moisture from poultry houses. Mortality records from the commercial farms surveyed in this study were generally below 5%, which is comparable to field observations reported by Ramadhan et al (2025) for commercial CHS operations in tropical environments. Although (Setiadi et al (2021) reported a substantially lower mortality rate of 0.98%, this value was obtained under controlled experimental conditions with optimized management practices. Therefore, the mortality rates observed in the present study are considered more representative of commercial broiler production under practical farm conditions in Southeast Asia.

Despite these advantages, the adoption of CHS remains limited, with many farmers continuing to rely on traditional OHS due to high initial investment costs and financial constraints. To accelerate the modernization of the poultry industry, the Malaysian government has prioritized technology adoption, productivity enhancement, and the transition from open-house to closed-house production systems under the National Agrofood Policy 2.0 (NAP 2.0). These policy priorities are complemented by various financing and entrepreneurship programmes aimed at supporting agricultural modernization (Ministry of Agriculture and Food Industries, 2021). At the state level, the Johor government has implemented the Johor Special Broiler Farming Permit (PKTA; Permit Khas Ternakan Ayam di Johor), which allows eligible farmers to upgrade their farms to CHS under a phased regulatory framework. Farmers granted the permit are typically provided with a two-year transition period to complete the conversion, while broader state transformation programmes generally allow three to five years for existing OHS farms to comply with CHS requirements. These policy measures aim to facilitate gradual industry transformation while minimizing disruption to broiler production.

However, the high initial investment required for infrastructure and equipment remains a major barrier to the adoption of CHS, particularly among small- and medium-scale broiler farmers. Consequently, many producers continue to rely on conventional OHS despite their relatively lower production efficiency (Sulfawati et al., 2025). Although government initiatives, including transformation funds, subsidized financing schemes, and phased modernization programmes, have been introduced to facilitate the transition, evidence on the economic performance of CHS under Malaysian commercial farming conditions remains limited. Previous studies have compared the technical and economic performance of CHS and OHS. However, these studies were conducted under different production environments and did not comprehensively evaluate the long-term financial viability of CHS using primary farm-level data from Malaysian commercial broiler operations. This study addresses this gap by integrating production performance indicators with projected cash-flow analysis and partial budgeting to provide a comprehensive assessment of CHS adoption at the medium-scale commercial farm level in Malaysia. Addressing this gap is essential for determining whether the higher capital investment required for CHS can be justified by improvements in productivity, operational efficiency, profitability, and long-term financial sustainability. Such evidence will provide practical guidance for farmers, policymakers, and industry stakeholders in making informed investment and policy decisions regarding broiler housing systems.

Few studies have explicitly highlighted the importance of housing density. CHS also allows for higher stocking densities, reducing the floor space requirement per bird to 0.7–0.9 ft² while maintaining optimal welfare conditions. Higher stocking densities is an important environmental factor and the main constraint in modern poultry production to reach their full growth potential at market age as well as livability, and intestinal health (Chegini et al., 2019; Franco-Rosselló et al., 2022; Son et al., 2022). With controlled temperatures, stocking densities can be increased, and broiler production cycles can be accelerated. Production rounds can be conducted up to seven times per year, as birds reach market weight (1.8–2 kg) in just 32–35 days (Loh, 2020). Moreover, CHS effectively mitigates environmental and biosecurity issues. It significantly reduces odor and fly infestations, and limits the spread of infectious diseases such as Newcastle Disease and colibacillosis, owing to the enclosed environment and positive-pressure ventilation systems. Mechanical ventilation and systematic manure management further reduce ammonia and bacterial loads in the housing environment.

2. Method

2.1. Data Collection

The assessment of economic viability and feasibility was conducted using projected cash flow analysis based on estimates of production capacity, capital cost, operating cost, and service cost. Primary data were collected through face-to-face interviews using a purposive sampling approach involving three medium-scale broiler farms located in Johor and Melaka, each with a production capacity of approximately 25,000–30,000 birds per production cycle. The selected farms operated both CHS and OHS, enabling a direct comparison of the two housing systems under comparable farm management conditions. The collected information included housing investment costs, equipment costs, feed costs, chick costs, labour costs, electricity costs, maintenance expenses, mortality rates, production cycles, selling prices, and farm revenues. The farms were purposively selected based on their operational experience with both housing systems and their willingness to provide detailed production and financial information. In addition, one of the participating farmers was an established supplier and contractor of CHS and OHS housing facilities, providing detailed information on construction costs, housing equipment, and capital investment requirements used in the economic analysis.

2.2. Cash Flow Projection Analysis

Projected cash flow analysis was used to assess the economic viability of CHS and OHS broiler production systems through discounted cash flow analysis. The analysis estimated key financial indicators, including Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PBP), based on projected revenues, capital investments, operating costs, and maintenance expenses over a 35-year project horizon, representing the expected structural service life of the poultry houses. The capital investment components considered in the analysis included initial housing construction, equipment installation, biosecurity facilities, and contingency allocation required for establishing each housing system. Major equipment components, including ventilation fans, cooling pads, sensors, controllers, lighting systems, and curtain mechanisms, were assumed to be replaced every 10 years according to their expected service life, while annual maintenance costs were incorporated throughout the analysis period. A discount rate of 10% was applied to determine the present value of future cash flows. All financial projections were calculated using current market prices under constant price assumptions without incorporating future inflation adjustments.

Annual production was estimated based on the housing capacity per production cycle and the expected number of production cycles per year. The CHS was assumed to accommodate 28,571 birds per cycle at a stocking density of 0.7 ft² per bird, while the OHS accommodated 16,667 birds per cycle at a stocking density of 1.2 ft² per bird. Based on commercial production practices adopted in this study, CHS completed approximately 6.5 production cycles per year compared with 6 cycles for OHS due to its shorter grow-out period. The number of production cycles per year adopted in the cash flow model was based on production records obtained from the surveyed commercial farms.

Consequently, the estimated annual production was 185,714 birds for CHS and 100,000 birds for OHS, and these values were used in the projected cash flow analysis.

This method is used in the decision to make an investment. Investors found that the predictability of future cash flows can be increased by emphasizing the analysis of operating cash flows instead of income when making investment decisions (Lee & Kim, 2019). Investors will estimate the worth of firms, investment opportunities, capital projects, new enterprises, and cost-cutting strategies through cashflow analysis (Ouyang & Zhong, 2023). Through this method, the Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR) and Pay Back Period (PBP) can be calculated to predict the viability and feasibility of a business. Net Present Value (NPV) was calculated by discounting the projected annual net cash flows over the 35-year project horizon using a 10% discount rate and subtracting the initial investment cost. The Internal Rate of Return (IRR) was estimated as the discount rate at which the NPV equals zero, while the Payback Period (PBP) was determined based on the time required for cumulative net cash flows to recover the initial investment. NPV is widely used for investment decisions (Magni, 2009). The value of the project will be measure by comparing value of NPV with other similar tools including IRR and PBP. It can illustrate the advantages and disadvantages of the project. The IRR is the maximum opportunity cost of the capital that can be accepted by the investor. If the discount rate higher than IRR, the NPV would be negative, which means the project is not worth for investing (Dai et al., 2022). There are two other investment indicators that can be obtained from this analysis, which are Return on Investment (ROI) and Break-Even Point (BEP). BEP is the situation where business is at the stage of not making a profit but not losing. These economic indicators are important and interrelated. Each of these indicators will give a clear picture of the viability and feasibility of the business in terms of the financial investment involved.

2.3. Partial Budgeting Analysis

Partial budgeting was employed to identify the incremental costs and additional returns associated with the adoption of a specific farm decision or technological change. This approach focuses only on cost and revenue components that differ between alternatives rather than evaluating the entire farm budget (El Deep Soha, 2014; Prosanta et al., 2023; Kasron et al., 2023). This partial budget analysis was developed involving four sections which are Added Income, Reduced Cost, Added Cost and Reduced Income. The basic principles of partial budgeting include focusing only on the changes in income flows or expenses such as added income, reduced costs, reduced income, and increased costs (Ronald et al., 2011). According to Cai et al (2024), partial budgeting analysis requires both revenue and cost information. Positive effects might include increased revenue and decreased costs, while negative effects could encompass decreased revenue and increased costs. This situation is caused by several factors such as adaptation of new technology, changes in project management, increase in workforce, changes in project operation period etc. The results of this analysis are very important as the main indicator that can be used as a guide to the viability of the project when the situation as stated occurs or needs to be adapted to one project.

3. Results and Discussion

3.1. Production Performance of CHS and OHS

Broiler chicken farming, whether under a CHS or an OHS, requires the use of various types of equipment to meet the environmental needs of the birds. The availability and proper functioning of this equipment are essential for maintaining bird welfare, enhancing production efficiency, and ultimately improving meat quality and marketable output. CHS are automated and equipped with temperature control systems, includes food and drinking systems, generators, alarm systems, heaters, and automatic control panels. In addition, there are additional equipment that can assist in the farm management such as CCTV and computers. The use of automatic equipment is encouraged as it has been found to enhance worker efficiency and minimize management costs. The initial capital cost involve for CHS is estimated at RM222,492. However, the cost for OHS which is only involves the feeding and drinking system is estimated at RM4,240 (Table 3).

The capacity of chicken depends on the size of the built-up plot. There are various sizes of house used by farmers. The common size use is 50 x 400 square feet which follows the semi-commercial scale farm. Housing capacity was determined based on the usable floor area divided by the recommended floor space allowance per bird. A stocking density of 0.7 ft² per bird was adopted for the CHS, resulting in a housing capacity of approximately 28,571 birds. While a stocking density of 1.2 ft² per bird was applied for the OHS, resulting in a capacity of 16,667 birds. Adequate floor space is crucial to ensure the health of the livestock, such as reducing heat stress, skin diseases, and leg problems (Taira et al., 2014). Limited space may lead to wet litter conditions and the accumulation of ammonia odor (Nagaraj et al., 2007). Furthermore, overcrowding can disrupt growth and increase mortality rates (Estevez, 2007). The higher annual output of CHS resulted from both its greater per-cycle capacity (28,571 vs. 16,667 birds) and higher number of production cycles per year (6.5 vs. 6), enabled by a shorter grow-out period (33 vs. 45 days).

Table 3. Components required for the CHS and OHS

Equipment		Unit	Price/Unit (RM)	Total Price (RM)
CHS				
	Fan	9	1.380	12.420
Main	Cooling Pad	800	95	76.000
	Generator	1	35.000	35.000
	Food/Water System	200	190	38.000
	Lamp	48	14	672
	Temperature Sensor	1	10.000	10.000
	Heater	4	3.000	12.000
Support	Blinds	4	600	2.400
	CCTV	3	1.000	3.000
	Alarm System	1	1.500	1.500
	Computer	1	1.500	1.500
	Automatic Control System Panel	2	15.000	30.000
Total cost equipment of CHS				222.492
OHS				
Feeding/drinking system		200	20	4.000
Lamp		48	5	240
Total cost equipment of OHS				4.240

Source: Department of Veterinary Services (DVS) (2022)

Table 4 shows the production results demonstrate that CHS provided substantially greater production capacity than OHS. The annual production capacity of CHS was approximately 86% higher than that of OHS (185,714 vs. 100,000 birds), while the lower mortality rate under CHS (5% vs. 10%) further increased the net marketable output to 176,429 birds per year compared with 90,000 birds under OHS. These differences indicate that the combination of higher housing capacity, shorter production cycles, and lower mortality under CHS contributed to greater annual production output.

Table 4. Production Information of Broiler Chicken Farming under Closed and Open House System

Item	CHS	OHS
House size (feet)	50 x 400	
No. house	1	
No. cycle	6.5	6
Floor Space for each broiler (ft²)	0.7	1.2
Capacity (birds/house)	28.571	16.667
Production capacity/cycle (birds)	28.571	16.667
Production capacity/year(birds)	185.714	100.000
Mortality rate (%)	5[a]	10[b]
Net Production capacity/year(birds)	176.429	90.000
Bird weight (kg)	2.2	
Selling price (RM/kg)	7.73	

Source: data processed

3.2. Economic and Financial Analysis

The difference in production capacity between the two housing systems directly influenced the projected cash flow outcomes. Higher annual production under CHS increased revenue generation, while lower mortality reduced production losses and improved saleable output. Although CHS required substantially higher initial capital investment, its higher production capacity resulted in a considerably higher annual net profit per house. Economic and financial performance was evaluated based on production costs, returns, investment viability indicators, and the economic implications of converting from OHS to CHS. The analysis was conducted over a 35-year project period, representing the expected structural service life of the poultry house. Major mechanical and electrical components were assumed to be replaced every 10 years according to their expected operational lifespan, while annual maintenance costs were incorporated throughout the analysis period. The cash flow model included initial development costs, annual operating expenditures, revenues from marketable birds, equipment replacement costs, and maintenance expenses. Future net cash flows were discounted at a 10% discount rate. Table 5 presents the resulting production costs, returns, and investment viability indicators for CHS and OHS.

Table 5. Economic Viability Analysis of Broiler Chicken Farming under CHS and OHS

Item	CHS		OHS	
	Cost	Cost per Unit	Cost	Cost per Unit
Development cost (RM)	2.262.716	0.35	1.086.750	0.31
Operational cost (RM)	90.456.802	13.92	48.490.925	13.85
Average production cost (RM/bird)		14.26		14.18
Average production cost (RM/kg)		6.48		6.45
Net margin (RM/kg)		1.24		1.28
Net profit (year/house)		508.014		281.861
Economic Indicator	CHS		OHS	
NPV (RM)	2.392.982		817.232	
Internal Rate of Return (IRR)	28%		25%	
Return on Investment (ROI)	9%		6%	
Payback Period (PBP)	3.5 year		3.9 year	
Benefit Cost Ratio (BCR)	1.09		1.06	

a. CHS mortality (5%) is the value reported by the three interviewed farmers; (Ramadhan et al., 2025).
b. OHS mortality (10%) reflects the average of the interviewed farmers' experience; (Manullang et al., 2024).

On average, the development cost per bird for the CHS is estimated at RM0.35, compared to RM0.31 for the OHS. The higher initial cost of CHS primarily attributed to the structural and technological requirements, which is highly automated and equipped with environmental control systems. These include automated feeding and drinking systems, generators, alarm systems, heaters, and centralized automatic control panels. In addition, CHS farms are often supported by supplementary equipment to enhance farm management efficiency, such as closed-circuit television (CCTV) systems and computer-based monitoring tools. In contrast, OHS facilities are generally limited to basic building structures and essential equipment, such as manual feeders and drinkers. Farm biosecurity constitutes a critical component of poultry production, aimed at preventing and controlling the introduction and spread of infectious diseases within livestock areas. Biosecurity measures typically include pest control pathways, perimeter fencing, designated storage facilities, and water tanks.

Operating costs are closely associated with production capacity. As presented in Table 5, operating costs comprise labour wages and other essential expenditures, including utilities, maintenance, depreciation, vehicle rental, administrative expenses, and contingency costs. Feed cost is consistently the most dominant component of operating expenditure, accounting for approximately 60% to over 75% of total production costs (Department of Statistics Malaysia, 2022). The feed cost per bird is estimated at RM9.21 for CHS and RM9.80 for OHS, covering the grower to finisher phases. Although both CHS and OHS used the same commercial broiler feed formulation, the average feed cost per bird was lower under CHS than OHS. A lower FCR indicates more efficient feed utilization, leading to a faster achievement of the 2.2 kg market weight (33 days) compared to production systems with higher FCR (45 days). Birds reared in OHS exhibited higher feed consumption to attain the same market weight because of poorer feed conversion efficiency, higher maintenance energy requirements under fluctuating environmental conditions, and greater feed wastage. Consequently, the lower feed requirement per bird translated into reduced feed cost under CHS despite identical feed prices. CHS demonstrates superior labor efficiency, with labor costs per bird 46.8% lower (RM0.25) than OHS (RM0.47), highlighting how automation reduces reliance on manual labor and optimizes economies of scale. Depreciation and maintenance costs are also incorporated, reflecting the use of equipment throughout the production process. Nevertheless, these costs may decrease on a per-unit basis as production scale increases.

The production cost per kilogram for CHS was RM6.48, equivalent to RM14.26 per bird based on an average live weight of 2.2 kg. In comparison, the production cost for OHS was RM6.45 per kilogram, or RM14.18 per bird at the same market weight. Although CHS incurred a slightly higher production cost per kilogram than OHS, its substantially higher production capacity resulted in a considerably higher annual net profit per house. The investment appraisal further demonstrated the economic advantage of CHS, with a higher NPV (RM2.39 million), IRR (28%), and ROI (9%) compared with OHS (RM0.82 million, 25%, and 6%, respectively). The shorter payback period of CHS (3.5 years) compared with OHS (3.9 years) further indicates a faster recovery of the initial investment.

Table 6. Impact of Transformation OHS to CHS

Benefit		Cost	
a) Added Income	RM/house/cycle	c) Added cost	RM/house/cycle
- Income	RM 202.439	- Development cost	RM 4.771
		- Food	RM 109.667
		- DOC	RM 30.952
		- Broiler Requirement	RM 3.571
		- Other	RM 23.113
b) Reduced cost	RM/house/cycle	d) Reduced Income	RM/house/cycle
- Salary	RM 600	- None	RM -
Total Benefit	RM 203.039	Total Cost	RM 172.074
Net Benefit	RM 30.965	per house/ cycle	

Source: data processed

The partial budgeting analysis indicates that converting from OHS to CHS would generate a net benefit of RM30,965 per house per cycle. The positive net benefit was primarily driven by additional returns of RM202,439 arising from the higher production capacity and output under CHS, together with RM600 in reduced labour costs resulting from greater automation. These benefits exceeded the additional costs of RM172,074 associated with the adoption of CHS. The positive net benefit indicates that the transition from OHS to CHS would improve farm-level economic returns on a per-cycle basis (Table 6).

3.3. Sensitivity Analysis

A one-way sensitivity analysis was conducted to evaluate the impact of changes in feed cost on the financial feasibility of the CHS and OHS. Feed cost was selected because it represents the largest component of broiler production costs and is highly susceptible to market price fluctuations. The analysis examined two scenarios, which are 10% reduction and 10% increase in feed cost, while all other variables remained constant.

Table 7. Sensitivity Analysis of The Financial Feasibility of CHS And OHS Under ±10% Changes in Feed Cost

	CHS			OHS		
	-10%	Baseline	10%	-10%	Baseline	10%
NPV	RM4.125.401	RM2.392.982	RM660.563	RM1.771.811	RM817.232	-RM137.347
IRR	41.00%	28.00%	15.00%	43%	25%	7%
ROI	17.00%	9.00%	2.00%	14%	6%	-1%
PBP	17.00%	9.00%	2.00%	14%	6%	-1%
BCR	1.17	1.09	1.02	1.14	1.06	0.99

Noted: NPV= net present value; IRR= internal rate return; ROI= return on investment; PBP= pay back period; and BCR= benefit cost ratio

Table 7 shows reducing feed cost by 10% substantially improved the financial performance of both housing systems. The NPV for OHS increased from RM817,232 to RM1,771,811, while the IRR increased from 25% to 43%, the ROI rose from 6% to 14%, the payback period shortened from 3.9 years to 2.3 years, and the BCR improved from 1.06 to 1.14. Similarly, CHS recorded an increase in NPV from RM2,392,982 to RM4,125,401, with the IRR increasing from 28% to 41%, the ROI from 9% to 17%, the payback period decreasing from 3.5 years to 2.5 years, and the BCR increasing from 1.09 to 1.17. Conversely, a 10% increase in feed cost reduced the financial viability of both systems. Under this scenario, the NPV of OHS became negative (−RM137,347), accompanied by a decline in IRR to 7%, a negative ROI (−1%), an extended payback period of 12.8 years, and a BCR of 0.99, indicating that the investment was no longer financially viable. Although the financial indicators of CHS also deteriorated, the system remained economically feasible with a positive NPV of RM660,563, an IRR of 15%, an ROI of 2%, a payback period of 6.2 years, and a BCR of 1.02. These findings indicate that feed cost is a critical determinant of investment performance in broiler farming. While both production systems are sensitive to fluctuations in feed prices, CHS demonstrates greater financial resilience than OHS, as it continues to generate positive returns even under adverse feed cost conditions.

4. Conclusion

This study indicates that although the CHS requires substantially higher initial capital investment compared to the OHS, it represents a superior production system in terms of productivity, operational efficiency, and long-term economic viability. However, CHS demonstrates superior production capacity due to its lower floor space requirement per bird (0.7–0.9 ft^2) which allows for higher stocking densities, compared to OHS where birds require 1–2 ft^2 per bird. This higher capacity translates into significantly greater annual production, with CHS achieving 185,714 birds per year while 100,000 birds per year under OHS. Although CHS requires a higher life-cycle investment cost (RM2,262,716) compared with OHS (RM1,086,750), the discounted cash flow analysis demonstrated that the additional investment was economically justified through higher production capacity, greater cumulative net returns, and more favourable investment indicators. The operational costs of both systems were comparable on a per-unit basis, with feed cost remaining the largest expenditure component. The economic advantage of CHS was primarily associated with its ability to accommodate higher stocking density per cycle, increase annual production capacity, and achieve economies of scale that are not attainable under OHS. Therefore, CHS represents not only a technological improvement in broiler housing management but also an economically viable investment option for medium-scale broiler production.

Economic indicators further support the feasibility of CHS, with higher NPV and an IRR approximately 3 percentage points higher than OHS, while both systems demonstrated comparable payback periods. The partial budgeting analysis also indicated a positive net benefit from converting to CHS, although the short-term gain per production cycle remained modest. These findings suggest that CHS provides an economically viable and operationally competitive alternative for addressing the production challenges faced by the poultry industry. The improved environmental control capability of CHS contributes to a more stable production environment, which can reduce mortality risk and improve labour efficiency compared with conventional OHS.

The findings suggest that broader adoption of CHS requires coordinated financial, technical, and regulatory support. The Malaysian government should strengthen existing financial assistance programmes, including soft loans, investment grants, and livestock modernization funds, to reduce the high capital barrier faced by small- and medium-scale broiler farmers. State governments and relevant agencies should continue implementing phased transition programmes supported by clear technical guidelines and realistic implementation timelines to facilitate the gradual conversion from OHS to CHS. In addition, extension services should provide continuous technical training on environmental control systems, equipment maintenance, and farm biosecurity to ensure efficient operation of CHS and minimize production risks associated with equipment failure. Finally, future policy initiatives should integrate financial incentives with capacity-building programmes to enhance productivity, improve animal welfare, strengthen biosecurity, and increase the long-term competitiveness and sustainability of Malaysia's broiler industry.

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Declarations

Author contribution	:	N. K: data collection, data analysis, interpretation of the results, and preparation of the original manuscript M. A. M. N. H: validated and reviewed the financial analysis, contributed to the interpretation and discussion of the economic findings, and critically reviewed and edited the manuscript Both authors read and approved the final version of the manuscript.
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