Productivity and Financial Viability of Commercial Broiler Farm Using Climate Controlled System: 
The case in a State-owned University in Nueva Ecija

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ABSTRACT

Raising broilers under climate controlled system (CCS) is the newest venture of the Central Luzon State University’s Broiler Project, started only in September 2011. This study analyzed the performance and profitability of the system with a total capacity of 25,000 birds. Weekly production efficiency indicators such as average live weight (ALW), feed conversion ratio (FCR) and livability or harvest recovery (HR) for 11 growing cycles from September 2011 to June 2013 were analyzed and compared with those birds in conventional housing. Cost and return were analyzed to measure the financial viability of using CCS. All the data were subjected to t-test with uneven number of observation using the General Linear Model of Statistica for Windows Version 8, 2007. Likewise, regression analysis was done to determine the effects of type of housing on productivity and profitability.

Live weight did not differ (P>0.05) between conventional and CCS housing from day-old to 5th week, 1.63kg and 1.65kg respectively. However, FCR at 3rd and 4th week of age and HR of the birds under CCS housing was significantly improved (P<0.05). Flocks under CCS have more uniformity and cumulative livability than those grown in conventional housing. With better feed conversion efficiency, uniformity of birds, and harvest recovery, the use of CCS resulted in higher revenue per bird, Php 14.69 vs Php 11.96. Moreover, return over expenses was significantly higher at 150% for CCS and 84% in conventional housing.

Key Words: Broilers, climate controlled system, productivity, profitability
INTRODUCTION

For the last 15 years, the CLSU Broiler Project has been raising 24,000 birds/growing cycle of 7 cycles/year in contract with San Miguel Foods Inc. (SMFI). It has generated substantial income for the university as a result of its excellent performance. From 2008-2010, it generated an average of ₱1.1 M/year with return on expenses of 150.87%. In 2008, it has been cited as one of the best (ranked 9th) contract grower in Region III. The project utilized four open-side-elevated conventional housing units (6,000 birds capacity/house) with curtains installed around the entire building to control draft or strong winds. The conventional housing system is cheaper to build and operating cost is lesser because it takes advantage of natural ventilation. But the conventional design is now outdated by the changing climatic condition and farm performance is being affected. In recent operations in CLSU Broiler Project, higher mortality had been recorded. From 2005-2008, the average mortality rate was 5.13% and this increased to 5.8% from 2009-2011, much higher than SMFI's standard of 5.0%.

In response to this major problem, the present management felt the need for a new system to ensure higher performance. Hence, the establishment of a new housing unit with climate controlled system (CCS) was conceptualized, proposed and completed in August 19, 2011. Loans were acquired from Land Bank of the Philippines and Technology Application and Promotion Institute- Department of Science and Technology (TAPI-DOST) to finance the construction of 40 x 400 ft broiler house with 25,000 bird-capacity and installation of CCS and mechanized facilities and equipment.

CCS is now the trend in modern broiler production in the industry. Local integrators for contract broiler require existing and new growers to use CCS. This technology was developed for the tropical zones where temperature is warm day and night. Raising broilers in CCS allows more birds per unit area and is reported to have improved feed efficiency, growth rate and livability. However, CCS requires higher initial investment and operating cost than the conventional system.

After two years of its operation, there is a need to evaluate the project’s performance under CCS for future management decision-making. Furthermore, the management would like to evaluate whether the improved performance of birds under this system can be translated to higher profitability. Moreover, the CLSU Broiler Project provides a venue in determining the performance and economic viability of CCS vis a vis the conventional type.

Objectives

This study determined the production performance and financial viability of broiler chickens raised under climate controlled housing systems in comparison with the conventional housing type.

REVIEW OF LITERATURE

Housing for broilers must be focused on providing an environment that satisfies the birds’ thermal requirements. Newly hatched birds have poor ability to control body temperature thereby require supplementary heat during the first few days after hatch. But during the later stage, broilers are more prone to heat stress due to its limited ability to dissipate large amount of body heat rapidly. Critical at this stage is the provision and maintenance of favorable temperature and ventilation to enhance the overall performance of the birds.

Seasonal Pattern of Philippine Climate
The general seasonal pattern in the Philippines is influenced by the cool northeast wind and the southwest wind which carries the southwest monsoon. The cool northeast wind, known as the Amihan season, is characterized by moderate temperatures, little or no rainfall, and a prevailing wind from the east. On the other hand, southwest wind is the Habagat season characterized by hot and humid weather, frequent heavy rainfall, and a prevailing wind from the west (Wikipedia, 2013).

As a general rule of thumb, the Philippines’ Amihan weather pattern begins sometime in September or October and ends sometime in May or June. There may, however, be wide variations from year to year. The main indicator of the switch between the Amihan and Habagat seasonal patterns is the switch in wind direction. In most years this transition is abrupt and occurs overnight. In some years there is a period of perhaps a week or two where the wind will switch between Amihan and Habagat patterns several times before settling into the pattern for the new season (Lonely Planet, 2013).

Effects of Temperature and Relative Humidity on Birds

Temperature and humidity determine bird comfort in order to utilize feed efficiently and grow fast. Birds are like air-cooled engines. Air moving over the birds picks up their body heat and transfers it to the environment. Birds do not sweat and therefore lack the ability for efficient and rapid evaporative cooling. Their ability for evaporative cooling by respiration is limited and they rely mainly on direct body-to-air heat transfer for cooling. Birds subjected to heat stress will spread their wings to expose more of their body surface area to allow moving air to get rid of the excess body heat.

According to Donald (2010), for fully feathered birds to stay comfortable, there has to be a substantial difference between house air temperature and their own internal temperature, which normally is above 37.8°C. As the in-house air temperature rises higher and higher, the birds’ heat shedding mechanisms become less and less effective. The birds’ internal temperatures then begin to rise, and they slow down or stop eating and growing. If the situation isn’t controlled, they eventually will die. Under most conditions as birds give off heat, the house temperature can be kept from rising too high by exhausting warm air and replacing it with cooler outside air. Since birds get rid of excess heat mainly by warming the air around them, the more rapidly that air is replaced the more excess heat they can lose. In most poultry houses, for outside air temperatures up to approximately 27°C, the ventilation system can be operated so that the warmed-up in-house air is removed at the proper rate to maintain overall house temperature within the birds’ comfort range.

In addition to simply changing house air, getting wind on the birds can help them cope with high temperatures. The wind-chill effect of moving air creates a lower effective temperature for them. For example, if air in the house is at 32°C (and average humidity) and moving at 2.54 m/s, it will feel to fully-feathered birds like about 27°C air. The effect is even greater for younger birds, which may be chill-stressed. Tunnel ventilation creates the most effective wind-chill cooling. In non-tunnel houses, stirring or circulation fans can help.

Birds also lose some body heat by evaporative cooling while breathing. This is why birds pant when they feel over-heated. Panting is triggered when temperatures rise around 4-6°C above their current comfort zone. When birds pant they are able to maximize evaporative cooling effect as moisture evaporates from their air-ways and lungs. This cooling method works best when the air is relatively dry. If the air is already holding a great deal of moisture, it can’t readily evaporate the birds’ moisture and the evaporative cooling effect doesn’t work as well.

In managing house temperature and humidity Donald (2010) recommended an old rule of thumb used by many poultry producers and managers in the US says that in non-tunnel conventional houses if the in-house air temperature is in the 80’s (°F) or above and the temperature and relative humidity numbers add up to 160 or more, birds begin to have trouble shedding their excess body heat. That is, temperature plus humidity gives you a heat stress index. For example, if air temperature is 85°F at 70% humidity (85 + 70 = 155) the birds will be reasonably comfortable. But if the relative humidity goes to 80% (85 + 80 = 165), you’re likely to be losing feed efficiency because of overheating. Note that this rule works only in
conventional open-sidewall ventilation or in cold weather power ventilation when air is not moving over the birds. It does not apply to tunnel ventilation because of the wind-chill effect.

In cold weather when direct combustion heaters are being used, not only the birds but the house heaters add moisture to house air, since water vapor is one of the combustion products from burning most fuels. This is a small amount compared with the moisture coming from the birds, but the combination can produce high house humidity if the ventilation rate is too low. This means you can have a heat stress problem with the birds when you would least expect it, if the temperature (°F)/humidity index goes above 160. Too much moisture contributes to litter caking and ammonia problems. However, if a heat exchange system is used so that combustion products are not released into the house, heating will not add moisture to house air.

In warm weather, humidity is not often a problem, except in connection with rainstorms on hot days. For example, after an afternoon thunderstorm on a hot summer day the air temperature may reach 90°F, with relative humidity above 90%. You must have maximum air exchange and air movement under these conditions to avoid heat stress.

**Broiler Housing Systems**

Modern climate controlled housing and equipment make it possible to control the microclimate provided in technologically advanced commercial broiler production. But such houses are expensive to build and operate and require a large turnover of birds to make them viable (Glatz, P. and R. Pym, 2013). Because of the lower investment costs, the conventional open-side-elevated housing for broilers still persists.

Conventional commercial broiler houses are elevated with slatted floor made of bamboo or wood slats. The open side and elevated design are intended to allow natural ventilation inside the house and to eliminate noxious gases produced by the accumulating manure under the house. Removal of warm air is augmented by the monitor type roof design. Laminated plastic curtains are installed surrounding the entire house to control temperature and ventilation inside the house. Infrared heaters are used during brooding of chicks. Additional fixtures like ventilating fans and roof sprinklers aid in reducing temperature inside the house to prevent birds from suffering heat stress. Feeders and waterers can be manual, semi-automatic or fully automated. Generally, the minimum floor space requirement in slatted floor type broiler houses is 1 ft² per bird. Orientation of the house is East-West direction to minimize exposure of birds to sunlight preventing heat stress (De Asis, 2011).

Most large-scale commercial farms use controlled environment systems to provide the ideal thermal environment for the birds (Glatz and Bolla, 2004). Birds’ performance in controlled environment sheds is generally superior to that in naturally ventilated houses, as the conditions can be maintained in the birds’ thermal comfort zone. Achieving the ideal environment for birds depends on appropriate management of the poultry house. Modern houses are fully automated, with fans linked to sensors to maintain the required environment. Some commercial operators use computerized systems for the remote checking and changing of settings in houses. Forced-air furnaces and radiant heating are the main methods of providing heat to young chicks. Birds in climate controlled systems are provided a minimum of 0.64 ft² per bird.

**Tunnel Ventilation**

Properly ventilated housing is essential for profitable poultry production. There are basically five reasons why we must ventilate poultry houses: 1) remove heat 2) remove excess moisture 3) minimize dust and odors 4) limit the build up of harmful gases such as ammonia and carbon dioxide and 5) provide oxygen for respiration. Of these five, the most important are removing built up heat and moisture. The time of the year determines which of these is of primary concern (Bucklin et al., 2012).
The ventilation system is a key tool in achieving the genetic potential of broiler flocks and multifunction systems are proving increasingly popular, such as those with a tunnel ventilation mode to help overcome the effects of excess temperatures. A ventilation system should enable performance from birds throughout the year, regardless of the season. It should be capable of maintaining in-house temperature and air quality (Green, 2008).

All poultry houses need some form of ventilation to ensure an adequate supply of oxygen, while removing carbon dioxide, other waste gases and dust (Glatz and Bolla, 2004). In large-scale automated operations, correct air distribution can be achieved using a negative pressure ventilation system. When chicks are very young, or in colder climates, the air from the inlets should be directed towards the roof, to mix with the warm air there and circulate throughout the shed (Figure 1). With older birds and in warmer temperatures, the incoming air is directed down towards the birds, and helps to keep them cool. Evaporative cooling pads can be placed in the air inlets to keep birds cool in hot weather. Tunnel ventilation is the most effective ventilation system for large houses in hot weather.

Tunnel ventilation systems (Figure 2) are popular in hot climates. Exhaust fans are placed at one end of the house or in the middle of the shed, and air is drawn through the length of the house, removing heat, moisture and dust. Evaporative cooling pads are located at the air inlets. The energy released during evaporation reduces the air temperature, and the resulting airflow creates a cooling effect, which can reduce the shed temperature by 10 °C or more, depending on humidity. Maximum evaporation is achieved when water pumps are set to provide enough pad moisture to ensure optimum water evaporation. If too much water is added to the pads, it is likely to lead to higher relative humidity and temperatures in the shed (Glatz and Bolla, 2004).
Airflow can be augmented by fans strategically situated inside open-side houses. Reducing temperature can be enhanced by fogging systems. Fogging involves several rows of high pressure nozzles that release fine mist inside the house. Cooling effect is attained by evaporative cooling and enhanced by increased airflow with the use of fans. However, evaporative cooling works best in dry climates and not when the condition is humid.

Ventilation Effects on Performance

Present day high yielding and efficient broiler strains are products of continuous improvement in genetics, nutrition and health programs. Modern broiler housing with better environmental control capability is important for optimizing weight gain, feed conversion and livability.

According to Liang et al. (2013), poultry producers have experienced increased production efficiency that is partially attributable to advances in housing technology and instrumentation. Performance improvements due to housing and equipment changes, including replacing curtain-sided with totally enclosed housing systems, were quantified by measuring the difference between the test farm and the industry live performance for corresponding years between 2004 and 2008. This advancement, coupled with continual strain improvements in commercial broilers for growth rate, feed efficiency and livability, resulted in realized annual improvements in productivity.

Conversely, poor ventilation management resulting to temperature problems reduces growth rate and also affect performance by elevating feed conversion ratio (FCR). If ventilation problems result in cooler than ideal temperatures, broilers will still eat sufficiently and will grow; however, proportionately more of the energy consumed will go towards maintaining normal body temperature instead of towards growth. In this case, although weight gain will be on target, the cost of production is higher because of the elevated FCR. Cooler than desirable temperatures, even for a few hours, increase feed requirements and result in poorer performance (Bucklin, 2012).

In the simplest of terms, the modern-day broiler requires: (1) feed and water; (2) environmental protection; and (3) health protection. It is impossible to prioritize these three elements, because all are critical to the broiler chicken's survival and performance. But environmental protection is the area that probably has the most variables, and is the area where broiler producers have the greatest opportunity to manage the variable factors involved for improved livability and performance (Donald et al., 2001).
Interest to build tunnel ventilation as a method of enhancing broiler performance and reducing mortality during warm weather started since the early 1990’s. The perception that operating costs associated with this system may be high has caused concern. Lacy and Czarick (1992) studied and compared broiler performance data and operating costs of conventional and tunnel-ventilated broiler houses on a commercial broiler farm. Daily high temperatures during the study averaged 93°F (36°C). Typically, house temperatures were reduced 2 to 4°F (1 to 2°C) in the conventional house and 7 to 12°F (4 to 7°C) in the tunnel-ventilated house. Body weights at 55 days averaged 5.35 lbs. (2.43 kg) in the tunnel-ventilated house and 5.13 lbs. (2.33 kg) in the conventional house. Feed conversion was 2.03 and 2.05 in the tunnel-ventilated and conventional houses, respectively. Livability was essentially the same in both houses.

Lacy and Czarick (1992) further stated that electricity costs over the entire growout in the tunnel-ventilated houses were nearly double those of the conventional house. However, these costs were only 20 to 30% higher on hot days. Fogging system water usage in the tunnel-ventilated house was more than twice that of the conventional house. Overall, the value of the enhanced performance of the broilers in the tunnel-ventilated house slightly offset the additional operating costs. According to SMFI (2012), broiler operation in climate controlled houses can have a payback period of 4.7 to 6.9 years depending on flock performance.

**METHODOLOGY**

*Theoretical / Conceptual Framework*

Broiler production requires relatively high investment and operating cost to ensure good performance in every growing cycle. The cost of housing and other facilities make up the high investment requirement, whereas the cost of chicks, labor, feeds, biologics, power and water, and house repair and maintenance constitute the high operating cost. Nowadays, there are two types of housing, the conventional and the controlled climate system of housing. The latter is more expensive to put up than the former, Php382 per bird vs Php250 per bird. However, the latter has lower life span; repair and maintenance is done after five years and bi-yearly or yearly thereafter. On the contrary, the CCS housing has longer life span of 15-20 years and requires less maintenance and operating cost. It has higher bird capacity that makes the cost per unit area relatively less expensive. Moreover, the use of CCS has productivity gains for broiler raisers. The good atmosphere for growth improves feed efficiency, growth rate and livability. Therefore, the adoption of CCS could improve productivity, hence supply.

Evaluating the use of CCS was anchored on the partial equilibrium analysis given demand and supply for broiler (Figure 1). Its use would increase the number of broilers per growing cycle from $S_0$ to $S_1$. Given the same level of demand the user of CCS faces a higher output at the prevailing price ($Q_1$), hence, higher income from production ($P_e Q_1 - P_e Q_0$).
The positive effects of quality day-old chicks, feeds, biologics and over-all management on the production performance of broiler farms have long been studied in most animal science researches. Under contract growing, day-old chicks, feeds and biologics are provided by the integrator, whereas, growers provide the over-all management, housing and facilities. To attain the standards set by the integrator, the management practices set forth have to be ensured such as good feeding practices, brooding, bio-security, vaccination and medical schedule, house cleaning, and disinfection. Good management practice leads to maximum utilization of material inputs resulting in higher productivity (Kachilei, 2012).

The grower’s fee is determined by the farm’s productivity. The grower’s fee for broiler is dependent on performance as indicated by ALW, HR and FCR upon harvest. Payment scheme is standardized depending on these performance indicators. Payment is constant throughout the growing cycles as stipulated in the contract. Hence, it is the productivity that determines the grower’s fee. This and the operating expenses determine the profit per growing cycle. The performance of the CLSU Broiler Project was examined in terms of its production performance, grower’s fee and profit as differentiated by the type of housing. This conceptual framework is depicted in Figure 4.

![Figure 4. Conceptual framework to determine the effects of CCS on productivity and profitability of contract broiler operation](image)

**Data Gathered and Analysis**

The operation of the project started in 1996 through a contract growing scheme with San Miguel Foods Incorporated (SMFI). Until 2010, the project had four conventional type broiler houses each with a capacity of 6,000 birds per batch, a total of 24,000 birds per batch. In 2011, the climate controlled broiler
house was constructed adjacent to the conventional houses. The new broiler house with climate controlled system has a capacity of 25,000 birds per batch.

As a means to facilitate management, the four old conventional houses were grouped as Farm A while the new climate controlled system is Farm B. The modules are separated by fence and about 100 m apart. Operation of Farm A and Farm B are synchronized from chick-in to harvest. Although identified as separate modules in the project, Farm A and Farm B are delivered the same broiler strain, and given the same nutrition and health program as set by SMFI. Practically, the main difference of Farm A and Farm B are the design and structure of the houses and the feeding and watering equipment used.

This study analyzed 11 synchronized batches for both Farm A and Farm B. Considering that the housing design and equipment used are all the same in the four houses in Farm A, the records of the four units were simply summarized as one.

Farm A and Farm B are both under the same integrator, location and management. Both farms are given the same broiler strain, nutrition and health program, and production cycles are synchronized. Although the data available were not taken following strict experimental procedure, rest assured it was done according to the standard protocol of SMFI.

The study covers only the data collected from September 2011 until July 2013. Data collected were summaries of periodic (weekly) report from the eleven batches of broilers (Farm A and Farm B) within the covered period. Summary reports of the project included the following:

- Date of chick delivery and harvest
- Average chick weight (g) at delivery (5% of bird population)
- Weekly average live weight (g) (5% of bird population)
- Average live weight (kg) at harvest (SMFI dressing plant harvest report)
- Cumulative weekly mortality (%)
- Cumulative weekly bags of feed per 1000 birds
- Cumulative Feed Conversion Ratio (FCR)

The following were the parameters analyzed:

1. **Average Live Weight (ALW):**
   - Sample weighing of 5% of the bird population was the procedure in taking the ALW at weeks 0, 1, 2, 3 and 4. Week 0 corresponds to day of chick delivery.
   - Adjusted day 35 (week 5) weight was based on ALW on day 28 (week 4) and ALW at harvest (34-42 days). ALW at harvest was taken from the harvest report from the SMFI dressing plant.

   Formula for Week 5 ALW = ALW_{d28} + \frac{[(ALW_h – ALW_{d28})/(D_h-28)]}{7}

   Where:
   - \(ALW_h\) = ALW at harvest
   - \(ALW_{d28}\) = ALW at day 28 (Week 4)
   - \(D_h\) = age of birds in days on harvest date

2. **Cumulative Bags of feed per 1000 birds**
   - Periodic cumulative bags of feed consumed/ (periodic flock ending inventory/1000).

3. **Cumulative Livability**
   - Periodic flock ending inventory / number of birds started X 100%

4. **Cumulative FCR**
\[ \text{Feed per 1000 birds} = \frac{\text{Bags of feed per 1000 birds \times 50kg per bag \times (periodic flock ending inventory/1000)}}{\text{(periodic flock ending inventory \times ALWkg)}} \], \text{ or} \[ \text{Feed per 1000 birds} = \frac{(\text{Bags of feed per 1000 birds \times 50kg per bag})}{(ALWkg \times 1000)} \]

5. Grower’s Fee per Bird

\[ \text{Grower’s Fee per Bird} = ALW \times \text{SMF}_i \]

\[ \text{ALW rate} + \text{SMF}_i \text{FCR rate} + \text{SMF}_i \text{HR rate} \]

**Statistical Analysis**

Means of all parameters (FCR, ALW, Livability and Grower’s Fee per Bird) were analyzed using the MS Excel Data Analysis Tool. Effects of Type of Housing, Season and Housing-Season interaction were tested using Anova Two Factors with Replication. Initial results indicated that Season and Housing-Season interaction effects were not significant therefore the said factors were eliminated in the final statistical analysis. The effects of type of housing on the different parameters were analyzed by Student’s TTest. Correlation and regression analysis were also conducted.

**RESULTS AND DISCUSSION**

**Agro-Climatic Data during the Period of the Study**

Agro-climatic data from September 2011 to July 2013 were obtained from the PAGASA Agromet Station in CLSU. The location of the CLSU Broiler Project is under Type 1 climatic condition characterized by pronounced dry and wet season. The dry season is normally from December to April while May to November falls under the wet season.

The effect of the external weather condition could be more pronounced in Farm A than in Farm B. Farm A has limited means to control internal house temperature and humidity. The effect of external weather conditions to Farm B is more on the energy consumption in maintaining the ideal range of micro-climate for the optimum performance of the birds.

Figures 5, 6 and 7 show the mean monthly rainfall (mm), relative humidity (%) and range of temperature (°C) observed from September 2011 to July 2013, respectively. What used to be the pronounced dry season a decade ago now had records of rainfall (Appendix Table 1). Highest rainfall and relative humidity were observed in the months of June to September at 14-17.8 mm and 83-88 %, respectively. This is the period of heavy rains in the country brought about by the southwest monsoon. Temperature observed in the same period was 28.4-31.6 °C. The warm temperature caused rapid moisture evaporation resulting in the humid condition during the period.
The coolest period was January-February with average temperature range of 24.4-30.4 °C and 74.5% relative humidity. Conversely, the warmest period observed was in April-May with average maximum temperature of 34.9 °C and 69% relative humidity. This is the summer period in the country when the cool northeast wind has already diminished. Heat stroke incidence is commonly observed during this period in conventional housing system. During this very warm period, an effective ventilation system is needed to remove heat from the birds' body to prevent heavy losses due to heat stroke. However, there is no mechanism for this in conventional housing system except for curtain management and installation of electric fans.
Air temperatures that cause heat stress and mortality are considerably below broiler body temperature (40.6-41.7°C). Broiler surface temperatures typically range from 35.37°C, with skin temperatures warmer than feathers (Univ. of Kentucky, 2010). Air temperatures in this range can virtually stop heat loss from the broiler and accelerate heat prostration. For this reason, an important goal for hot weather ventilation systems is to keep air temperatures below 35°C.

![Figure 7. Mean monthly maximum and minimum temperature (°C) during the period of the study.](image)

**Design and Structural Differences of Farm A and Farm B**

Design and structure of broiler houses are primarily based on the industry's recommended specifications, technology available, size of operation, and financial capability of the grower. The conventional housing system is cheaper to build. On a per bird basis, the cost of housing is Php250. Strength of the wooden frames, columns, and the bamboo slats diminishes in time due to water soaking during cleaning, thus requires regular repair after 5 years. Without regular repair and maintenance the whole structure of the house will succumb eventually to the massive total weight of broilers. Common in conventional houses are bamboo slats which tend to have irregular spaces causing leg injuries to birds. Injured birds are no longer able to recover resulting to stunted growth and eventually rejection at harvest time. Severely injured birds are no longer able to stand and die of starvation.

Whereas, broiler houses with climate controlled system are generally more expensive, about Php382 per bird. They are constructed with permanent structures and durable materials that will last from 15-20 years and require minimal maintenance cost.

Presented in Table 1 and Figures 8-11 are the observed differences in the design and structure of Farm A and Farm B of the CLSU Broiler Project.
Table 1. Design and structural differences of Farm A and Farm B, CLSU Broiler Project

<table>
<thead>
<tr>
<th>Factor or Condition</th>
<th>Farm A</th>
<th>Farm B</th>
</tr>
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<tbody>
<tr>
<td>Design and structure</td>
<td>Monitor type roofing; Open-side-elevated, lumber on concrete columns and wooden trusses</td>
<td>Closed housing and not elevated, concrete floor and side walls with windows, and steel trusses</td>
</tr>
<tr>
<td>Micro-climate control</td>
<td>No direct control; Curtain management and use of fans to modify house microclimate</td>
<td>Directly controlled by electronic sensors; Use cooling pads and exhaust fans to control micro-climate</td>
</tr>
<tr>
<td>Feeding system</td>
<td>Trough and Tube feeders</td>
<td>In-line automatic feeders</td>
</tr>
<tr>
<td>Watering system</td>
<td>Galloners, and bell waterers</td>
<td>In-line automatic nipple drinkers</td>
</tr>
<tr>
<td>Brooding set-up</td>
<td>Infrared heater; floor with laid with plastic sacks, rice hull and old news paper</td>
<td>Infrared heater; plastic slatted floor laid with old news paper</td>
</tr>
<tr>
<td>Floor</td>
<td>Elevated-slatted floor. Uses wood or bamboo slats; Allows minimum 1 ft^2 floor space per bird or 10.76 birds per m^2</td>
<td>Plastic slat floor overlaid on ground concrete floor; Allows minimum 0.64 ft^2 floor space per bird or 16.82 birds per m^2</td>
</tr>
<tr>
<td>Roofing system</td>
<td>Corrugated GI sheets; monitor-type without insulation</td>
<td>Corrugated GI sheets; double span with insulation</td>
</tr>
</tbody>
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Figure 8. Conventional housing at Farm A with the feed bodega

Figure 9. Bamboo slat flooring design and bell drinkers in Farm A
Management Practices

The comparative management practices adopted and the use of poultry equipment and facilities in Farm A and Farm B before the arrival of DOC until harvest are presented in Table 2. Details of the management practices under conventional housing are in Kachilei (2012).

Table 2. Management practices for broilers employed in Farm A and Farm B, CLSU Broiler Project

<table>
<thead>
<tr>
<th>Activities</th>
<th>Farm A</th>
<th>Farm B</th>
</tr>
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<tbody>
<tr>
<td>Before arrival of DOC</td>
<td>Cleaning and disinfection of boiler house and poultry equipments and facilities two weeks before loading</td>
<td>Cleaning and disinfection of boiler house and poultry equipments and facilities two weeks before loading</td>
</tr>
<tr>
<td>Brooding</td>
<td>29.4 - 32.4 °C for 2 weeks, Rice hull and old newspapers, Infrared heaters, Proper curtain management, Via drinking water using galloner following SMFI program, Via drinking water at day 14, Ad libitum feeding of chick booster using chick feeders, Daily recording of mortality &amp; feed intake, and weekly live weight</td>
<td>29.4 - 32.4 °C for 2 weeks, Old newspapers, Infrared heaters, Exhaust fans, Via drinking water using nipple drinkers following SMFI program, Via drinking water at day 14, Ad libitum of chick booster using feeder lines, Daily recording of mortality &amp; feed intake and weekly live weight</td>
</tr>
<tr>
<td>Growing</td>
<td>600 (10 pens/building), Proper curtain management</td>
<td>5,000 (5 pens for the building)</td>
</tr>
</tbody>
</table>

Figure 10. 40x400 ft broiler house with CCS in Farm B

Figure 11. Plastic slat overlaid flooring, feeder lines and nipple drinkers in Farm B
<table>
<thead>
<tr>
<th>Record keeping</th>
<th>using tube feeders</th>
<th>using tube feeders</th>
</tr>
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<tbody>
<tr>
<td>Daily recording of mortality &amp; feed intake, and weekly live wt</td>
<td>Daily recording of mortality &amp; feed intake, and weekly live wt</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Finisher</th>
<th>Proper curtain management</th>
<th>Exhaust fans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation &amp; elimination of NH₃</td>
<td>Via drinking water using bell waterers following SMFI program</td>
<td>Via drinking water using nipple drinkers following SMFI program</td>
</tr>
<tr>
<td>Medication</td>
<td>Ad libitum feeding of finisher diet (5th wk) using tube feeders</td>
<td>Ad libitum feeding of finisher diet (5th wk) using feeder lines</td>
</tr>
<tr>
<td>Feeds</td>
<td>Daily recording of mortality &amp; feed intake, and weekly live weight</td>
<td>Daily recording of mortality &amp; feed intake and weekly live weight</td>
</tr>
<tr>
<td>Record keeping</td>
<td>Manual hauling using contractual labor excluding undersize birds</td>
<td>Manual hauling using contractual labor excluding undersize birds</td>
</tr>
</tbody>
</table>

**Before the Arrival of the Day-Old Chicks**

Broiler houses, poultry equipment and other facilities were cleaned and disinfected properly two weeks prior to the arrival of chicks as standard bio-security program. Chicken manure underneath the broiler houses were removed at least two weeks after previous harvesting to eliminate micro-organism build-up that could possibly contaminate the incoming flock. Lighting facilities, infrared heaters, LPG-gas line and curtains were checked and tested. Footbaths were filled with disinfectant solution.

**Brooder Set-Up**

In Farm A, litter materials such as rice hull and old-newspapers were used in setting-up the brooding area to provide the needed temperature during the downy feather development of the chicks and absorb droppings to keep them dry. In Farm B, only old-newspapers were used as litter materials since flooring is made up of slatted plastic. Each brooding area was enclosed with 1.5 ft wide plane galvanized iron sheet as brooder guard to keep the birds within the source of heat. Infrared heaters were used as source of heat in brooding. Plastic drinkers with water and electrolyte supplements are evenly distributed in the brooding pens.

**Upon the Arrival of Chicks**

Arrivals of chicks in the farm are usually at night time or early in the morning to minimize stress. Chicks were inspected, selected and counted before placing in the brooding pens. About 5 to 10 percent of the total population were weighed to get the initial weight of the day-old chicks (DOC). Small amount of feeds were scattered on the floor to stimulate feeding and water with electrolytes was provided to minimize stress.

**Brooding Management**

Brooding is the process of providing the necessary heat (29.4 to 32.4 °C) during the downy feather development of the chicks. During this period optimum environmental temperature is provided because chicks could not regulate their body temperature within two weeks. Infrared heaters were turned on from 5 pm to 6 am the following day. With proper temperature the chicks could move, eat and drink comfortably, thus enabling them to attain their full growth potential. Dirty newspapers were removed everyday to prevent ammonia build up. Fresh and clean water are always made available to prevent stress and occurrence of diseases.

**Growing Management**

Growing period starts when birds are weaned from the source of artificial heat after 14 days. In Farm A, the birds were equally distributed to 10 pens in each house upon reaching the growing stage of
about 17 days (Figure 12). On the other hand, each pen in Farm B has 5,000 chicks (Figure 13). The pens are expanded every three days until the birds reach the market age so as to provide them adequate area. Each bird should have a minimum floor space of 1.2 ft² (Farm A) and 0.64 ft² (Farm B). Expansion of the pens was done early in the morning to minimize stress among birds. Tube feeders and bell waterers were used during growing period.

**Feeding Management**

*Ad libitum* feeding was implemented in the project for faster growth and development of the broiler chicks. Feeding in Farm A is done manually and mechanically in Farm B, with less human interventions. Each bird is allotted with 3.0 kg from day-old to harvest. There are four types of broiler feeds given according to age namely; chick booster (1st-2nd week), broiler starter mash (3rd week), grower crumbles (4th week) and finisher diet (5th week-harvest). All the feeds were provided by the integrator. Feed formulation for broiler is based on nutritional requirement at specific growing stage.

![Figure 12. Broilers in their growing period under conventional housing](image1)

![Figure 13. Broilers in their growing period in building with CCS](image2)

**Medication and Vaccination Program**

The project implements the SMFI medication and vaccination program throughout the growing cycle. Adjustments are made when there are signs of respiratory diseases. Day-old chicks delivered in the project were already vaccinated against Infectious Bursal Disease (IBD) and New Castle Disease (NCD) in the hatchery. However, booster vaccination for NCD through the drinking water is done in the project at 14 day of age. Before the vaccine is given, water supply is withdrawn for an hour to thirst the birds to make sure that the birds will consume all the water with vaccine.

**Harvesting Practices**

For both farms, harvesting is done through labor contract at Php 0.25/bird and usually scheduled during the night and early morning. The birds were placed in plastic coops (6-8 birds/coop) and hauled by trucks from the integrator for transportation to the dressing plant. The runts or undersized birds are not included for harvest. Harvest is normally scheduled between 33 to 35 day old. Harvesting in both farms can occur simultaneously depending on the ALW at harvest and the schedule at the dressing plant. However, birds hauled from Farms A and B are placed in different coops and delivery trucks because they will be weighed and recorded separately at the dressing plant.

**Manure Management**
After harvesting the birds, manure were placed in sacks to maintain the cleanliness of the houses and to lessen microbial growth. Collected chicken manure was sold to the local buyers who cater to the vegetable growers in Baguio City.
Record Keeping

Daily feed intake and mortality were recorded while live weight was determined weekly in both farms. This helps the management to track down the performance of the project and to serve as basis for decision making especially if these parameters fall below standard. Data gathering was under the supervision of the project manager.

Production Performance

Average Live Weight (ALW)

ALW of birds in Farm A and Farm B from 0 to 5 weeks old (Table 3) did not yield significant differences (P>0.05). The factors that directly influence body weight are most likely genetics and nutrition which are the same for both farms. The growth pattern is not affected by the housing condition as indicated by the non-significant differences at various ages. The micro-climate in Farm A is suitable enough to elicit normal growth of birds. Moreover, it is important to note that favorable temperature and humidity limited the stress of overcrowding of birds in Farm B (16.82 vs. 10.76 birds/m² in Farm A). This concur with the study of Tayeb et al. (2011) which indicated that birds raised in densities of 8.66, 10.41 and 13.36 birds/m² had no significant differences in live weight. Effect of increased stocking density does not necessarily lead to stress as long as the other vital factors for birds’ comfort (ventilation, temperature and humidity) are adequately provided (Kleyn, 2013). The average final weight of birds of 1.63kg and 1.65 kg in Farms a and B, respectively, are better than Magnolia’s standard of 1.55kg.

Table 3. Average live weight of broilers from 0 to 5 weeks old as influenced by type of housing

<table>
<thead>
<tr>
<th>AGE (wk)</th>
<th>Cumulative Average Live Weight (g)</th>
<th></th>
<th></th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Farm A</td>
<td>Farm B</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>42.55 ± 0.77</td>
<td>42.55 ± 0.74</td>
<td>0.5000 ns</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>165.55 ± 4.70</td>
<td>163.82 ± 3.60</td>
<td>0.3868 ns</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>397.00 ± 12.18</td>
<td>414.64 ± 13.68</td>
<td>0.1736 ns</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>759.64 ± 25.97</td>
<td>806.82 ± 28.30</td>
<td>0.1168 ns</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1257.36 ± 44.17</td>
<td>1293.00 ± 42.10</td>
<td>0.2829 ns</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1631.91 ± 56.85</td>
<td>1650.76 ± 39.56</td>
<td>0.3941 ns</td>
<td></td>
</tr>
</tbody>
</table>

The non-significant differences in the weekly ALW are clearly shown by the almost identical growth patterns in Figure 14.
Feed Conversion Ratio (FCR)

FCR during the brooding period (first two weeks) indicated no significant differences (P>0.05). Later onwards, mean cumulative FCR of Farm B on weeks 3, 4 and 5 were significantly better than Farm A (Table 4). Difference in the final FCR at week 5 of Farm B (1.7764±0.0175) and Farm A (1.8952±0.0266) was highly significant (P<0.01). These differences are clearly depicted in Figure 15.

Table 4. Cumulative FCR of broilers from 1 to 5 weeks old as influenced by type of housing.

<table>
<thead>
<tr>
<th>AGE (wks)</th>
<th>Farm A</th>
<th>sem</th>
<th>Farm B</th>
<th>sem</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9951</td>
<td>±</td>
<td>1.0014</td>
<td>±</td>
<td>0.3929</td>
</tr>
<tr>
<td>2</td>
<td>1.3385</td>
<td>±</td>
<td>1.3147</td>
<td>±</td>
<td>0.2415</td>
</tr>
<tr>
<td>3</td>
<td>1.5397</td>
<td>±</td>
<td>1.4400</td>
<td>±</td>
<td>0.0130</td>
</tr>
<tr>
<td>4</td>
<td>1.6777</td>
<td>±</td>
<td>1.5842</td>
<td>±</td>
<td>0.0108</td>
</tr>
<tr>
<td>5</td>
<td>1.8952</td>
<td>±</td>
<td>1.7764</td>
<td>±</td>
<td>0.0007</td>
</tr>
</tbody>
</table>
The efficiency to utilize feed for growth decreases with age. It is important that all possible measures are taken to sustain efficient growth of broilers from brooding until harvest. The controlled environment in Farm B contributed to the better brooding conditions than Farm A. This is confirmed by the significantly higher livability of birds in Farm B vs. Farm A during the brooding period (Week 1 P<0.05, Week 2 P<0.01) and the entire growing period from weeks 3 to 5 (P<0.01). According to Arbor Acres (2011) the brooding period is a critical time for gut development and hence the efficiency of feed utilization.

The controlled environmental temperature in the entire growing period and the lower mortality contributed to the significantly better FCR of Farm B compared to Farm A. Fluctuating environmental temperatures causes birds to expend more energy to maintain normal body temperature. Adding to poor FCR performance is the high mortality particularly during the late stage of production. Feed consumed by the lost birds are still included in the total feed consumption of the remaining birds thereby increasing FCR.

Controlled environment provides better biosecurity and air quality resulting to lesser disease challenges and improved FCR. Cooling pads filter the air for dust and pathogens as fresh cooler air is drawn inside the house. Exhaust fans constantly remove spent air, odor from manure, and dust thereby maintaining a favorable environment for the efficient growth of the birds.

**Livability**

Livability or the relative number of surviving birds is a good indicator of the degree of comfort the birds experienced during the entire growing period. The controlled environment in Farm B significantly improved the livability of birds in all the periods observed (Table 5). Climate controlled system enabled Farm B to attain 96% livability at week 5 which is higher than the standard livability or harvest recovery in commercial broiler production (SMFI, 2012). In essence, the 93.49% in the conventional housing is
lower than the SMFI standard harvest recovery of 95% while the 96% in the CCS is higher. These differences could have great bearing on grower’s fee.

Table 5. Cumulative livability of broilers from 1 to 5 weeks old as influenced by type of housing

<table>
<thead>
<tr>
<th>AGE (wks)</th>
<th>Farm A</th>
<th>Farm B</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>98.3382 ± 0.2258</td>
<td>98.9473 ± 0.1057</td>
<td>0.0141 *</td>
</tr>
<tr>
<td>2</td>
<td>97.2627 ± 0.2663</td>
<td>98.3536 ± 0.1432</td>
<td>0.0013 **</td>
</tr>
<tr>
<td>3</td>
<td>96.0618 ± 0.3369</td>
<td>97.7536 ± 0.2387</td>
<td>0.0003 **</td>
</tr>
<tr>
<td>4</td>
<td>94.7055 ± 0.5483</td>
<td>97.1227 ± 0.2837</td>
<td>0.0007 **</td>
</tr>
<tr>
<td>5</td>
<td>93.4982 ± 0.7863</td>
<td>96.0000 ± 0.4207</td>
<td>0.0066 **</td>
</tr>
</tbody>
</table>

Figure 16 shows the pattern of livability of broilers in Farm A and Farm B from week 1 to week 5. Trend in livability in Farm A tend to decline at significantly larger increments (P<0.05 in week 1; P<0.01 in weeks 2 to 5) compared to Farm B. Tunnel ventilation promotes higher livability by providing birds better environmental protection which include proper temperature and humidity, and clean air.

Broilers in Farm A are predisposed to higher stress due to fluctuations in temperature and humidity. Poorer air quality due accumulation of noxious gases, dust and pathogenic microbes aggravate the condition resulting to reduced resistance against respiratory diseases which may lead to higher bird mortality. These problems are not common in the controlled environment, hence, significantly higher livability was observed in Farm B.
Whenever two broiler flocks show a marked difference in overall performance, the bottom line is that the difference in performance will be the result of a difference in body maintenance requirements. The specific causes might be identified as temperature extremes, drafts or chills which drain heat away from the bird’s body, better or poorer air quality, different feeding/drinking patterns, infectious causes, etc. But always the flock with the lowest maintenance requirements will shift the most nutrients into growth, which will be reflected in better overall performance (Donald, 2001).

Financial Performance

Grower’s Fee per Bird

Mean Grower’s Fee per Bird (GFB) adjusted to 35 days production period is presented in Table 6. GFB gained by Farm B amounting to PhP 14.69±0.73 was significantly higher than the PhP 11.96±1.12 received by Farm A (P<0.05). Payment received per bird based on the SMFI scheme can be proportioned into 50-60% ALW; 20-40%FCR; 10-20%HR. ALW can be considered as the most important factor as it accounts to 50-60% to the total fee. Payment received per bird based on the SMFI scheme can be proportioned into 50-60% ALW; 20-40%FCR; 10-20%HR. Therefore, ALW can be considered as the most important factor to the total fee.

Table 6. Mean grower’s fee per bird adjusted to 35 days production period.

<table>
<thead>
<tr>
<th>Mean Grower’s Fee per Bird</th>
<th>Farm A</th>
<th>sem</th>
<th>Farm B</th>
<th>sem</th>
<th>P-value</th>
</tr>
</thead>
</table>

Figure 16. Cumulative livability of broilers in Farm A and Farm B from 1 to 5 weeks old.
Increasing ALW while maintaining ideal FCR and HR will provide the grower the highest possible GRB. This can be readily attained in a controlled environment as provided in Farm B. However in Farm A, increasing ALW to get higher GFB may lead to poorer FCR due to increased energy expenditure on maintaining equilibrium while coping with fluctuating environmental conditions. Broilers, like all animals, tend to use more energy for maintenance as they age and increase in size. According to Donald (2001), the first four weeks of the growout is the stage when broilers are most efficient in utilizing energy intake for growth. After four weeks, more than 50% of the energy intake is utilized for maintenance and this continues to increase as less is needed for growth as the bird matures.

Body size is negatively correlated to body surface area needed to dissipate excess body heat. Without an effective ventilation system, heavy broilers in intensive operation are prone to cannibalism and heat stroke due to limited space or over crowding. Incidence of high mortality directly relates to poorer FCR.

It is normal that harvest schedule is set when the estimated ALW of a flock is already above 1.55 kg. This is the minimum target weight to get the maximum fee of PhP 5.30 per kg ALW per bird. The minimum for livability or harvest recovery (HR) is 95% for a fee of PhP1.50 per bird. A higher HR at 96% will be for a maximum fee of PhP2.00 per bird. From 1.96 down to 1.6 FCR, the fee ranges from PhP 2.39 to PhP7.63 per bird. Poorer performance leads to lower pay and in some cases even a payback to the integrator. To attain the highest possible GFB it is important that the best performances in all the three parameters are met.

The key to profitability is to attain the desired harvest weight at the shortest possible time when birds are still efficient in utilizing feed for gain in weight. Practically, this is attaining the genetic potential for efficient growth in the most favorable environment. The closest this phenomenon can be attained is through a controlled environment as in a climate controlled system. In a climate controlled system, as in Farm B, the critical environmental factors such as ventilation, temperature and air quality are all provided appropriately from day one up to harvest.

Figure 17 shows the estimated net income over operating expense (OE) of Farm A vs. Farm B. The OE was based on the actual expenses of the CLSU Broiler Project for the production year July 2012-June 2013 (Table 7). Estimated net income over expenses of Farm A was PhP 5.52 (86% ROE) while Farm B was PhP 8.81 (150% ROE). The highest expense per bird in Farm B was cost of electricity and fuel amounting to PhP 3.24 per bird which is 357% higher than in Farm A (PhP 0.71 per bird). The high power expense of Farm B was due to the automated ventilation and feeding systems which require uninterrupted power supply to keep the internal condition of the house within the ideal range of the birds’ comfort zone. The power expense of Farm B accounts to 55% of its total operating expense as compared to only 11% in Farm A. But because of higher labor, material and maintenance requirements, Farm A had a higher total OE per bird amounting to PhP 6.44 against PhP 5.88 for Farm B.
The synchronized growing of Farm A and Farm B yielded 6.18 batches per year. Correspondingly, estimated net income per bird per year amounted to PhP 34.12 for Farm A and PhP 54.41 for Farm B. Building and equipment for conventional housing system costs about PhP 250 per bird (De Asis, 2011) and PhP 382 per bird for climate controlled system (SMFI, 2012). Using the said figures, the payback period for Farm A and Farm B can be considered comparable at 7.33 and 7.02 years, respectively. Even with the additional PhP0.25 repair and maintenance costs per bird in Farm B, the payback period will only increase to 7.23 years.

Interests on capital and depreciation costs were not included in the financial analysis. Including these values will add more to the total cost per bird in Farm B than in Farm A. However, considering that more birds per unit area can be kept in Farm B, cost of investment on land per bird will be higher in Farm A. Assuming these non-cash costs evens out the expenses of both farms, it can be surmised that greater returns can still be expected in climate controlled system or Farm B.

Table 7. Comparative cost and return analysis of Farm A and Farm B of the CLSU Broiler Project

<table>
<thead>
<tr>
<th></th>
<th>Farm A</th>
<th>Farm B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue per bird</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grower’s Fee</td>
<td>11.96</td>
<td>14.69</td>
</tr>
<tr>
<td><strong>Total Revenue</strong></td>
<td>11.96</td>
<td>14.69</td>
</tr>
<tr>
<td><strong>Expenses per bird</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages</td>
<td>3.04</td>
<td>1.38</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.48</td>
<td>2.19</td>
</tr>
<tr>
<td>LPG</td>
<td>1.08</td>
<td>0.74</td>
</tr>
<tr>
<td>Vet. drugs/biologics</td>
<td>0.27</td>
<td>0.22</td>
</tr>
</tbody>
</table>
Repair materials 0.58 0.00
Laminated sack 0.05 0.00
Old newspapers 0.12 0.02
Rice hull 0.05 0.00
Gasoline/diesel 0.23 1.05
Other farm supplies 0.13 0.00
Tube feeders 0.05 0.00
Other MOE 0.14 0.12

Total Expenses 6.44 5.88

Net Income per Bird 5.52 8.81

Investment cost per year
Building & Equipment 250.00$ 382.00$

Net Income per Year$ 34.11 54.44

Payback Period$ 7.33 7.02

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**Effects of Type of Housing on Farm Productivity and Profitability**

Regression analysis was done to determine the effects of the type of housing on the performance of the broiler project during the period under study. Results in the previous sections are confirmed in Table 8. Among the indicators of performance, FCR is the most affected by the type of housing. There is better FCR in Farm B brought about by higher livability as a result of better growing environment. The R squared is 0.4108 which indicates that the variation in FCR is explained by the type of housing at 41.08%. Livability and grower’s fee per bird were also positively influenced by the type of housing. This factor explains 28.24% and 17.06% of the variation in these parameters, respectively.

<table>
<thead>
<tr>
<th>Dependent Variables (Y_i)</th>
<th>Y_1 = ALW</th>
<th>Y_2 = FCR</th>
<th>Y_3 = Livability</th>
<th>Y_4 = Grower’s Fee/ Bird</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>16.319089</td>
<td>1.8952</td>
<td>93.4982</td>
<td>111.9644</td>
</tr>
<tr>
<td>Coefficient</td>
<td>18.8509</td>
<td>-0.1188</td>
<td>2.5018</td>
<td>2.7297</td>
</tr>
<tr>
<td>P-value</td>
<td>0.7883</td>
<td>0.0013</td>
<td>0.0109</td>
<td>0.0560</td>
</tr>
<tr>
<td>R²</td>
<td>0.0036</td>
<td>0.4108</td>
<td>0.2824</td>
<td>0.1706</td>
</tr>
<tr>
<td>F stat</td>
<td>0.0741</td>
<td>13.99450</td>
<td>7.8712</td>
<td>4.1632</td>
</tr>
<tr>
<td>F significance</td>
<td>0.7783</td>
<td>0.0013</td>
<td>0.109</td>
<td>0.056</td>
</tr>
<tr>
<td>SEE</td>
<td>162.4168</td>
<td>0.0746</td>
<td>2.0913</td>
<td>3.1495</td>
</tr>
</tbody>
</table>

---

* a Computed Grower’s Fee per Bird
* b Based on the production year July 2012-June 2013
* c De Asis, R. (2011)
* d SMFI 2012 estimate for Climate Controlled System Broiler house
* e Batches per Year = 6.18
* f Formula from SMFI = Investment cost/Net Income per Year
CONCLUSION AND RECOMMENDATION

Conventional and climate controlled systems can produce broilers with comparable ALW performance within 35 days growing period. This phenomenon can be attributed to the fact that within a certain range of environmental conditions body size is determined by genetics and nutrition. CCS improved the performance of birds as indicated by better feed efficiency and livability. It provides birds with the ideal range of temperature, relative humidity and air quality throughout the entire growing period. Sustained favorable environment exposes birds to lower risks of stress and infection thereby enabling birds to utilize energy intake more efficiently for growth. For these reasons, broilers raised in climate controlled system had improved FCR and livability that translated to higher income than in conventional type.

Investment for CCS is relatively high to encourage small growers or new entrants to engage in broiler production. The system is imported and this could be one reason why it’s expensive. Locally made structure should be developed to reduce the cost of CCS.

Power cost is the most expensive component in operating a climate controlled broiler house. Research must be conducted on how power cost can be reduced in order to further increase the profitability and reduce the payback period for this type of system. Moreover, a distant alarm system for changes in temperature and relative humidity inside the system could be very helpful to the management to ensure sustained performance.

REFERENCES


