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Comparative Productivity Analysis of Broiler under Climate Controlled System and Conventional Housing in Selected Municipalities of Nueva Ejica: Philipines

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Abstract: *The study compared the productivity performance of broiler under conventional Housing and Climate Controlled System (CCS) and how it translates the productivity to profit. The study covered three farms under contract with Magnolia Foods Company in the areas of Nueva Ejica: San Jose City, Science City of Munoz, and Guimba. This study covered a period of 4 years (2010-2013) with seven growing cycles per year for both CCS and Conventional house. It was classified to small farms with an average of 5,000 birds, medium farms with an average of 10,000 birds, and large farms with an average of 20,000 birds.The findings indicated that the production performance of the CCS houses under small, medium, and large had better Feed Conversion Ratio compared to conventional house type with a significant difference.CCS farms had better productivity which is explained by better growing conditions for the birds. It is recommended that CCS houses be established so as to maintain the conducive conditions for bird growth. The results of the study provides government agencies likeDepartment of Agriculture, State Universities, private investors and other stakeholders with a basis and required information to trump up support for CCS housing.*

Keywords:*Climate Controlled System, Conventional, Productivity; Profit; Broiler*

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I. Introduction

Research on meat production worldwide indicates that poultry is the fastest growing in livestock sector, especially in the developing countries (Arbor, 2011). The Philippines is no exception. The outlook for the Philippine chicken industry appears optimistic because the demand for chicken products is expected to increase, along with population and income growth (Liang*et al*., 2013). Productivity improvements and developments in marketing infrastructure, such as the expansion of food processing, the modernization of the retail sector (e.g., growth in supermarkets and hypermarkets), and increasing refrigeration ownership are additional drivers for future demand growth. However, there are increasing concerns about the threats from imports due to the more liberalized trade policies(Estevez, 2007).

Chicken meat production worldwide has been significantly increasing with an annual increase of about 3.63% for the recent past five years (2008-2012) and with highest production in 2012 as of the latest data statistics from the Food and Agriculture Organization (FAO) of the United Nations. World chicken meat production was around 75.8million metric tons (mmt) and about 51.1billion heads slaughtered in 2011. The United States of America posted the highest output (21%) with a volume of 16.2mmt and slaughtered about 9.0billion heads for the same period (FAOSTAT | FAO Statistics Division 2009 | 2013) Other top producers include China (14%), Brazil (11.85%), Mexico (3.35%), India (2.95%), Russian Federation (2.46%), Islamic Republic of Iran (1.88%), Japan (1.80%), Indonesia (1.71%), and United Kingdom (1.68%) (FAO Statistics Division 2013).

Improvement in animal breeding, nutrition and animal husbandry has led to change inmodern poultry from the past birds. Accordingly, modern poultry particularly broiler chickensunder intensive production are susceptible to many disorders, stressors and diseases more thanever before (Liang*et al*., 2006).Consequently, poultry in unfavorable environmental conditionscannot show their true genetic potential, therefore, leading to economic losses (BAS, 2012). Providing a suitable place for growing the birds is one of important and basic issues inpoultry production (Lacy and Czarick, 1992). The main reason to building houses for poultryis to provide protection from the weather. Many parameters such as temperature, humidity, etc. affect environmental conditions of within poultry house. Most of these parameters are dynamic and will frequently be changing depending on the weather conditions, season,location, time of day (Estevez, 2007). Effects of these parameters on poultry health,welfare and performance arewell documented (Craig, 2007). One of the key parametersaffecting poultry house environment is weather conditions. It has been indicated that anydeviation from optimal environmental conditions controlling can have deleterious impacts onpoultry welfare, health and performance. Some negative consequences of these variationsfrom natural amplitudes are heat stress, cold stress, wet litter, ammonia emissions, etc.(Lacy and Czarick, 1992). Because of heat stress condition in tropics in comparison with moderate regions, typicallylower densities are applying in broiler production. For example, in summer in some provinces of the Philippines, stocking density of 10 to 14 Birds/m2 is common in conventional houses inorder to reduce heat stress effects on birds whereas, higher densities are typical at coolerseasons of the year (Kachilei, 2012).

According to Donald*et al*., (2010), for fully feathered birds to stay comfortable, there has to be a substantialdifference between house air temperature and their own internal temperature, which normally is above37.8°C. As the in-house air temperature rises higher and higher, the birds' heat shedding mechanismsbecome less and less effective. The birds' internal temperatures then begin to rise, and they slow down orstop eating and growing. If the situation isn't controlled, they eventually will die. Under most conditions asbirds give off heat, the house temperature can be kept from rising too high by exhausting warm air andreplacing it with cooler outside air. Since birds get rid of excess heat mainly by warming the air aroundthem, the more rapidly that air is replaced the more excess heat they can lose. In most poultry houses, foroutside air temperatures up to approximately 27°C, the ventilation system can be operated so that thewarmed-up in-house air is removed at the proper rate to maintain overall house temperature within thebirds' comfort range.

In addition to simply changing house air, getting wind to the birds can help them cope with hightemperatures. The wind-chill effect of moving air creates a lower effective temperature for them. Forexample, if air in the house is at 32°C (and average humidity) and moving at 2.54 m/s, it will feel to fullyfeatheredbirds like about 27°C air. The effect is even greater for younger birds, which may be chillstressed.Tunnel ventilation creates the most effective wind-chill cooling. In non-tunnel houses, stirring orcirculation fans can help (Estevez, 2007).

Poultry producers have experienced increased production efficiency that is somewhat attributable to improvement in housing technology and equipment (Liang *et al*., 2013).

Nowadays, modern poultry houses with good construction insulation, ventilation design, within environmentally conditioned control system and automatic equipments inside of the house provide the possibility of rearing the birds at higher stocking density (Estevez, 2007; Liang *et al*., 2013). Some researchers have introduced applying environmentally controlled condition poultry houses as an alternative way to achieve good performance and increasing stocking density in tropic areas (Lacy and Czarick, 1992).

Housing for broilers must be focused on providing an environment that satisfies the birds' thermalrequirements. Newly hatched birds have poor ability to control body temperature thereby requiresupplementary 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 thisstage is the provision and maintenance of favorable temperature and ventilation to enhance the overallperformance of the birds(Craig, 2007).Properly ventilated housing is essential for profitable poultry production. There are basically fivereasons why we must ventilate poultry houses: 1) remove heat, 2) remove excess moisture, 3) minimizedust and odors, 4) limit the buildup of harmful gases such as ammonia and carbon dioxide, and 5) provideoxygen for respiration. Of these five, the most important are removing built up heat and moisture. Thetime of the year determines which of these is of primary concern (Bucklin et al., 2012).

Modern climate controlled housing and equipment make it possible to control the microclimateprovided in technologically advanced commercial broiler production. But such houses are expensive tobuild and operate and require a large turnover of birds to make them viable (Glatz andBolla, 2004).Because of the lower investment costs, the conventional open-side-elevated housing for broilers stillpersists.Conventional commercial broiler houses are elevated with slatted floor made of bamboo or woodslats. The open side and elevated design are intended to allow natural ventilation inside the house and toeliminate noxious gases produced by the accumulating manure under the house(Craig, 2007). Removal of warm air isaugmented by the monitor type roof design. Laminated plastic curtains are installed surrounding theentire house to control temperature and ventilation inside the house. Infrared heaters are used duringbrooding of chicks. Additional fixtures like ventilating fans and roof sprinklers aid in reducing temperatureinside the house to prevent birds from suffering heat stress. Feeders and waterers can be manual, semiautomaticor fully automated. Generally, the minimum floor space requirement in slatted floor type broilerhouses is 1 ft2 per bird. Orientation of the house is East-West direction to minimize exposure of birds tosunlight preventing heat stress (Bucklin et al., 2012).Kachilei (2012), on his study about the productivity and profitability of Central Luzon State University broiler production under contract with Magnolia Foods Company, concluded that broiler production is profitable. The study analyzed the effect of each of the production factors such as labor, feeds, day old chicks, LPG, rice hull, management and temperature on average live weight (ALW), mortality rate (MR), and feed conversion ratio (FCR). He found out that the project recorded a high productivity above the Magnolia's standards resulting in high profit. Production performance for six years in terms of ALW (1.687) and FCR (1.849) were superior compared to the Magnolia's standards of 1.55 and 1.99, respectively. However MR and harvest recovery (HR) are lower at 5.28% and 94.72% than Magnolia's 5% and 95% standard, respectively. Based on the estimated Cobb-Douglas production function, the factors of production that significantly affect both MR and ALW were feeds and management practices. The project earned a net profit amounting to an average of Php 952,960 per year. The financial condition of the project was further evaluated given un-subsidized rate of electricity and the minimum wage rate for laborers (Kachilei, 2012). Even at this rate the broiler production is profitable. Many broiler farms in Nueva Ejica have also experienceda steady increase in Production.TheCLSU Broiler Project raises 24,000 birds/growing cycle of 7/year in contract with San Miguel Foods Inc. (SMFI) for the last 17 years under conventional housing.

In response to this major problem, the 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. CCS is now the trend in modern broiler production industry. CCS is a system where exhaust fans are located at one end of the house and two large openings are installed at the opposite end. Air is drawn through these openings, down the house, and out the fans. 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 dryclimates and not when the condition is humid(Glatz and Bolla, 2004).All poultry houses need some form of ventilation to ensure an adequate supply of oxygen, whileremoving carbon dioxide, other waste gases and dust. In large-scale automatedoperations, correct air distribution can be achieved using a negative pressure ventilation system. Whenchicks are very young, or in colder climates, the air from the inlets should be directed towards the roof, tomix with the warm air there and circulate throughout the shed. With older birds and in warmertemperatures, 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. Tunnelventilation is the most effective ventilation system for large houses in hot weather(Glatz and Bolla, 2004).

Local integrators for contractBroiler especially in lowlands like Nueva Ejica 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(Green, 2008).

Therefore, the objectives of this study were 1) compare broiler performance in conventional houses withclimate controlled system (CCS) modern broiler houses in Nueva Ejica province of the Philippines;2) evaluate the performance of the farms under CCS and conventional housing for future management decision-making; and3) evaluate whether theimproved housing of birds under this system can be translated to better productivity.

1.1 Problem Statement

The purpose of this study was to evaluate broiler performance, the effects of environmental conditions in conventional housing and environmentally controlled condition modern broiler housing. Bird performance including live body weight, feed intake, feed conversion ratio, mortality rate, production efficiency index and litter pH, moisture content and air ammonia levels may be significantly affected by the type of the houses.Since the climate controlled system (CCS) is considered modern, it was expected that CCS should have better performance to enjoy higher productivity than conventional housing. Specifically,the study aimed to achieve the following objective:

i. Describe the production and grow out process of broiler production;
ii. Determine and compare efficiency of inputs from total cost of production using industry standards ;
iii. Evaluate and compare the production trends over time;
iv. Determine and compare broiler productivity under climate controlled system, and conventional housing, and

v. Identify the problems that hinder the performance in terms of productivity.

The major question addressed by the study is;

Does environmentally controlled modern broiler house increase productivityefficiency of Broiler Production?

II. Materials And Method

The research design, population and locale of the study, data collection procedure, data collection instrument, and treatment of data used in the study are presented in this section. The descriptive-qualitative and quantitative methods of research were adopted in this study. The broiler production situation in Nueva Ejicawas described and analyzed based on the data gathered. An interview was conducted by the researcher with the farm managers and employees. Also personal observation was applied as the researcher frequently visited the farms. The study was carried out in the following areas of Nueva Ejica, namely: San Jose City, Munoz City and Guimba. These were respectively chosen because it is one of the regions in the Philippines with high broiler production. Data was collected from three identified broiler growerswhich use CCS housesand another three growers using conventional houses.Table 1 shows the number of grower farms in three municipalities of San Jose, Munoz and Guimba. Comparisons were made between CCS and conventional housing based on large, medium and small sizes. A large grower has a minimum of 20,000 birds per growing cycle; a medium grower has a minimum of 10,000 birds, while a small grower will have a minimum of 5,000 birds per cycle.

Farms in three areas of Nueva Ejica namely: San Jose city, Science City of Munoz, and the municipality of Guimba were selected purposively to achieve the objectives of this study. The data were collected from two farms in San Jose city, namely; barangay Apolinio and Calaocan located 5.5 Km and 7 Km from the city, respectively. Two farms in the Science city of Munoz were covered namely; one in barangay Linalingay and another in San Andres located 6.8 Km and 8Km from the city center, respectively. In Guimba, the farms are located in barangays San Marcelino and Bacayao located 5.3 Km and 7 Km, respectively, from the municipal centre. The profile of the selected farms had the same identity as described by the integrator Magnolia Foods Company.

To facilitate the gathering of data, interview was conducted among those personnel who were directly involved in the farms, the project manager and the farm employees. Other necessary sets of information whereacquired from the farm owners through interview which was administered during their convenient time. Secondary data was obtained from the offices which run these projects and keeps its records. The total sample size of three broilers farms under CCS and three conventional houses was studied covering production of every cycle in the last four years (2010-2013).

The multiple linear regression models specifically expressed using the Cobb-Douglas production function was estimated to identify significant factors affecting the productivity of the farms in terms of FCR (Appendix 12-16). FCR was used as the dependent variable over the other variables because the cost of feed claims over half of the total budget for most of the broiler farms and FCR tell us the performance efficiency of broiler bird to convert feed into live broiler weight (Arbor, 2011).

The Cobb-Douglas production function is expressed as:

$$Y = AK^{\alpha}L^{1-\alpha}$$

Y= Dependent variable (FCR)

A= Constant

Land K = variable inputs

α and $^{1-\alpha}$ = Elasticity of production with respect to variable inputs

Specifically, the regression model estimated for FCR is:

$$Yi = A\, X_1^{\,b1}\, X_2^{\,b2} \ldots Xn^{bn} e$$

Y = FCR, kg/ farm

Xi = Inputs

bi = Regression coefficients

This was transformed to a linear logarithmic function in order to facilitate computation.

The log linear model is:

$$\text{Log } Y = \log A + b_1 \log X_1 + b_2 \log X_2 + \ldots + bn \log Xn + e$$

Where: Y = FCR ; X_1 = electricity consumed (k/watts); X_2 = labor (number of man day); X_3 = feeds consumed (kg) ; X_4 = LPG (kg); X_5 = Rice hull (kg); X_6 = management (frequency in hours/day)

Note; X_4 , X_5 = to be used only for conventional house.

III. Results And Discussion

The observed differences in the design and structure of conventional and CCS are presented in Table 2 and Figures 2, 3.

Table 2. Design and structural differences of conventional and CCS houses

DESIGN AND STRUCTURE	CONVENTIONAL	CCS
Outlook	Monitor type roofing; Open-sideelevated,lumber on concrete columnsand wooden trusses	Closed housing and not elevated,concrete floor and side walls withwindows, and steel trusses
Micro-climate control(Temperature, relativehumidity and ventilation)	No direct control; Curtain managementand use of fans to modify house microclimate	Directly controlled by electronicsensors; Use cooling pads andexhaust fans to control microclimate
Feeding system	Trough and Tube feeders	In-line automatic feeders
Watering system	Galloners, and bell waterers	In-line automatic nipple drinkers
Brooding set-up	Infrared heater; floor with laid withplastic sacks, rice hull and old newspaper	Infrared heater; plastic slatted floorlaid with old news paper
Floor	Elevated-slatted floor. Uses wood orbamboo slats; Allows minimum 1 ft^2 floor space per bird or 10.76 birds perm^2	Plastic slat floor overlaid on groundconcrete floor; Allows minimum0.64 ft^2 floor space per bird or 16.82 birds per m^2
Roofing system	Corrugated GI sheets; monitor-typewithout insulation	Corrugated GI sheets; double spanwith insulation

3.1 Farm Performance: The parameter FCR was used as the indicator of productivity in the study. Feed conversion ratio is a measure of how well a flock converts feed intake (feed usage) into live weight. Even a small change in FCR will have a substantial impact on payments.The key to preventing FCR problem is ensuring that throughout the brooding and grow-out period, good management practices are in place so that birds performance is optimized (Kleyn, 2013).Table 4 shows that FCR value varied from one house type to another over the growing cycle. In comparing the FCR for CCS and conventional houses, CCS under small farm had a better FCR (1.78) over conventional small farm (1.80) while CCS medium had better FCR (1.77) over conventional medium (1.82), and CCS large had better FCR (1.79) over conventional large (1.85).The best mean FCR was recorded in the medium farm of CCS house at 1.77 and the worst FCR was recorded in large farm under conventional house at 1.86. In general CCS houses had better average FCR than conventional and can be concluded that from this study CCS farms have better productivity than conventional farms it supports the findings of (Green, 2008) that CCSimproved the performance of birds as indicated by better feed efficiency.

Table 4. Trend analysis of productivity per cycle/season per house type

		CCS			CONVENTIONAL		
CYCLE	Month	Small	Medium	Large	Small	Medium	Large
Batch 1	June-July	1.76	1.75	1.82	1.81	1.90	1.91
Batch 2	Aug- Sept	1.80	1.79	1.80	1.76	1.85	1.88
Batch 3	OCT- Nov	1.77	1.77	1.76	1.83	1.84	1.8
Batch 4	Dec- Jan	1.77	1.76	1.79	1.83	1.82	1.87
Batch 5	Feb – Mar	1.79	1.78	1.77	1.78	1.80	1.82
Batch 6	Mar-Apr	1.76	1.75	1.76	1.82	1.79	1.83
Batch 7	Apr-May	1.76	1.78	1.75	1.75	1.78	1.81
Average		1.78	1.77	1.79	1.80	1.82	1.85
T-value	6.38*		7.36**			9.21**	

The best FCR per cycle was realized on the 1st cycle of June- July 2013 from the medium farm under CCS. This period had the lowest amount of food consumption ratio at 20,070 kg per 10,000 birds (Appendix 13). Feed intake is one of the factors that affect the FCR, this shows that there was low feed wastage and high feed conversion to live weight as indicated by high management (8hrs/day) practices experience during the same period (Appendix 12). The worst FCR (2.26) was experienced in the 4th cycle, Dec-Jan 2010 in a large farm under conventional housing. At this period the biologics used was the lowest at a ratio of 5.3 liters per 20,000 birds; this was below the recommended vaccination standards of the integrator. This may have led to higher mortality rate in the farm thus resulting in poor FCR.

The T-test results indicate that comparing the productivity between the two farms it has significant difference at 5% level in the three house size(small, medium, large).

a) Trend Comparison for Feed Conversion Ratio per Farm Size

Fig 6 shows the FCR comparative production between the large farms under both CCS and conventional. The farms under CCS have a superior FCR in average of 1.78 over the conventional at 1.85.

The production performance under the medium farm was better in CCS farms with average FCR of 1.77 while the conventional had anaverage FCR of 1.83 as shown in figure 5.
Fig 4 compare the production performance of the two housetypes under the small farms of average 5,000 birds. CCS farms had the best FCR at an average of 1.77 while the conventional had a lower FCR of 1.80. Under the three farm size the productivity is generally better in CCS houses than conventional houses. The productivity performance of conventional houses had a trend of producing better FCR as the farm size reduces (Table 4). The largest farm with 20,000 birds had a lower FCR while the small farm recorded the best FCR. In the CCS, medium farm recorded the best FCR of 1.77 slightly better than the small farm at 1.78. This can be attributed to the management practices, the number of hours spent attending to the small farm had a lower ratio per bird meaning the birds may have lack proper care in small farm. According to Liang et al. (2013),the modern-day broiler requires: (1) feed and water; (2) environmental protection; and (3) health protection which is managed by farm manager and employees. But environmental protection is the area that probably has the most variables which is exhibited in conventional, and is the area where broiler producers have the greatest opportunity tomanage the variable factors involved for improved livability and performance (Donald et al., 2011).

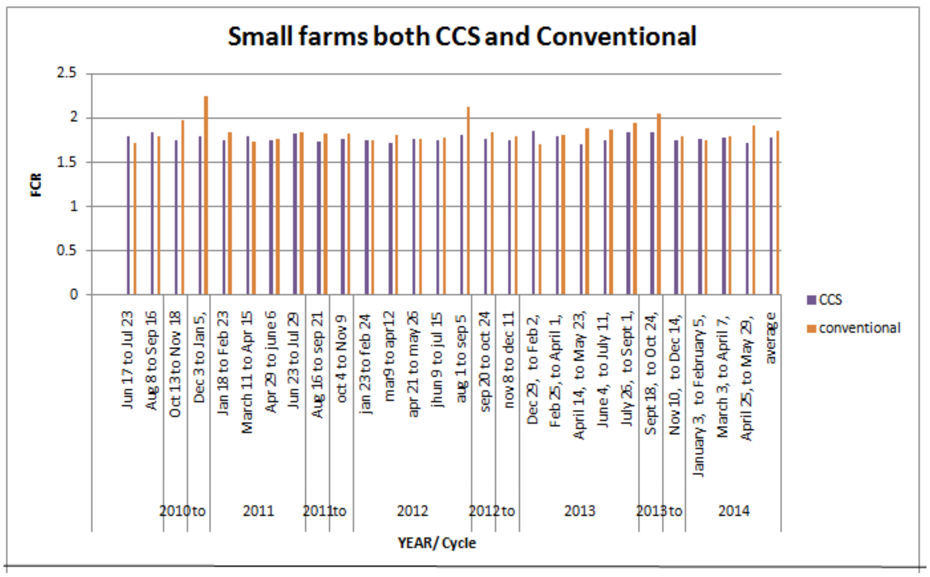

Figure 4. Comparative FCR between the small farms under CCS and Conventional(For detailed table, refer to Appendix 12-14)

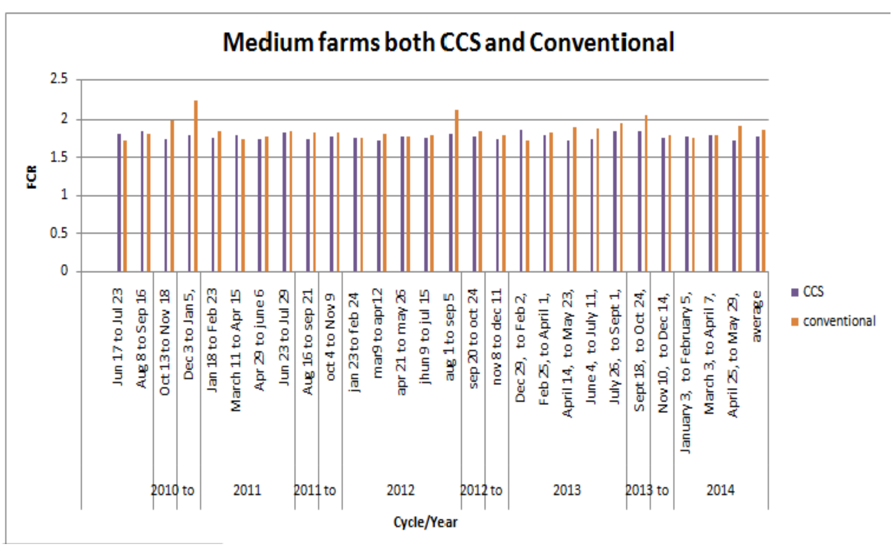

Figure 5.Comparative FCR between the medium farms under CCS and Conventional(For detailed table, refer to Appendix 12-14)

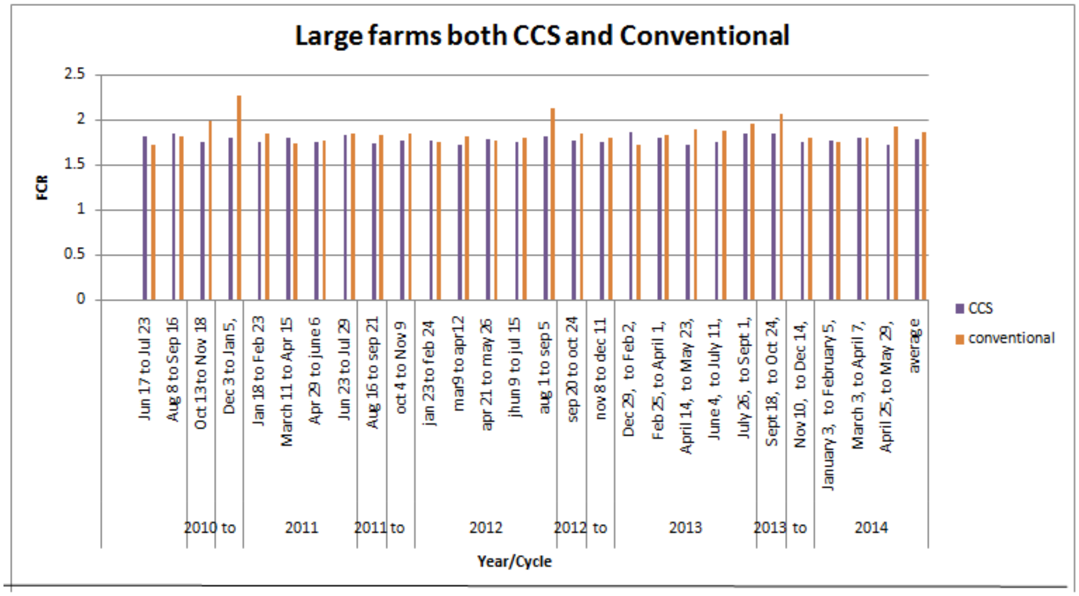

Figure 6. Comparative FCR between the large farms under CCS and Convention(For detailed table, refer to Appendix 12-14)

b) Regressionand Comparative Analysis of the Factors of Production per Farmssize and House type

Table 5 shows the factors that affected the productivity of broiler both in conventional and CCS type of housing under the small, medium,and large farms. The factors included in the models for conventional are electricity, labor, biologics, feeds, LPG, rice hull, and management practices. While in CCS LPG and rice hull was not included because of its nature during brooding. In conventional houses LPG is used to run infrared heaters which provide heat during brooding, whereas CCS houses uses air-conditioned facilities being run by electric current.

i) Productivity Comparison of Small Farms

The small farm with an average of 10,000 birds per cycle under conventional house had biologics, feeds, LPG, and management as significant variables. Productivity is the measure of efficiency as a means of assessing how effectively economic inputs used in production are converted into output (Green, 2008). Biologics is significant 5% level at -.2102 indicating that for every % litter increase in biologics the FCR will reduce by 0.2102% holding the effect of the other factors constant. Biologics administered through vaccines is a crucial factor in production as it prevents mortality rate. Under the CCS farm the biologics is not significant because the birds are rarely exposed to air transmitted diseases like IBD and ammonia. 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 isdrawn inside the house. Exhaust fans constantly remove spent air, odor from manure, and dust therebymaintaining a favorable environment for the efficient growth of the birds (Lonely Planet, 2013).

Feeds are significant for both types of houses. The regression coefficient for conventional house is -.29 significant at 10% level indicating that for every 1% kg increase in the feed the FCR will improve by 0.29% holding the other factors constant whilethe regression coefficient for CCS house is -6.14 explaining that for every 1% increase in the feed intake the FCR will improve by 6.14% ceteris paribus. The coefficient for CCS is more responsive to feeds than conventional, 1%kg increase in feeds has more effect on CCS house (6.14%) over conventional (0.29%). It supports the findings of (Craig, 2007) thatfeeds are essential in birds' growth and the calculation of FCR.The feed to meet conversion is dependent on the amount of feeds given to birds per day and as the birds grow the feed consumed increases, it constantly increases from day old to harvest as the birds grow.

LPG is significant only in conventional house at -.34 significant at 10% level, indicating that 1 kg% increase in the LPG gas the FCR will improve by 0.3402% holding the other factors constant. LPG is used in brooding. Electricity is significant in CCS houses only because they are air-conditioned throughout the growing period. The regression coefficient of -4.1785 explains that for 1% increase in the electric kilowatts consumed the FCR will improve by 4.1785% ceteris paribus. It improved the brooding process and a general more conducive growing environment for the birds throughout the period thus reducing the mortality rate.

The management practices are significant in both houses at 5% level. The coefficient of -5.012 in conventional house shows that for every % hour spent in attending to the birds the FCR will improve by

5.012%holding the other factors constant. The coefficient -.3003 for the CCS farm indicates that for every 1% increase in an hour spent in the farm, the FCR will reduce at 0.3003% ratio holding the other factors constant. The co-efficient for conventional houses is more responsive to management than CCS houses; with 1% increase in an hour spent in the farm the small conventional house improves its productivity by 5.012% while CCS improves by 0.3003%.

Green, (2008)explains that achieving the ideal environment for birds in conventional houses depends on appropriate management ofthe poultry house. Since some CCShouses use computerized systems for the remote checkingand changing of settings in houses it requires lesser management practices.Management practices are crucial in conventional broiler production since the farm employees acts as the parents of the chicks from day old to harvest.

The coefficient of determination (R^2) for the conventional house is 0.62 it implies that 62% of the variation in productivity (FCR) is explained by all the independent variables included in the model, while the remaining 38% are accounted for by other factors not considered in the study. The R^2 for the CCS house is .801 indicates that 80.1% of the variation in FCR can be explained by all the independent variables included in the model while the remaining 19.9% can be explained in other factors not considered in the model.

ii) Productivity Comparison of Medium Farms

The medium farms had an average of 10,000 birds per growing cycle. The regression analysis for the two types of houses showed that feeds and management practices is significant in both. LPG and biologics is significant in conventional house only while electricity is significant in CCS house.

The regression coefficient for feed at -.32106 for conventional house indicates that for a 1% kg increase in the amount of feeds given to a bird the FCR will improve by 0.3216 %, ceteris paribus. While CCS house is -3.646, explaining that for 1% increase in the feeds the FCR will improve by 3.64%, holding the other factors constant.

Table. 5 Factors that affected the productivity of broiler under conventional and CCS houses in small, medium, and large farms size

Farm Type	**Small**		**Medium**		**Large**	
House Type	**Conventional**	**CCS**	**Conventional**	**CCS**	**Conventional**	**CCS**
Constant	1.59	1.79	1.53	1.59	1.95	1.71
R Squared	0.62	0.80	0.71	0.82	0.59	0.61
Variables; Electricity	-0.24	-4.17**	-.530	-1.89**	-0.34	-2.96**
Labor	-0.30	-3.21	-.124	-1.25	-0.67	-3.94
Biologics	-0.20*	-0.03	-0.33*	-0.27	-0.22*	-0.01
Feeds	-0.29**	-6.14*	-0.42*	-3.65**	-0.17*	-9.67*
LPG	-0.34**	-	-0.37**	-	-0.45*	-
Management practices	-5.01*	-0.30*	-3.102*	-0.23*	-6.02*	-.24*
Dummy **X** Feeds	-0.18**	-3.86*	-.32**	-4.78*	-0.39**	-2.24*
Dummy **X** Management	-3.16*	-0.18**	-5.26*	-0.31**	-1.38*	-0.53**

* signinificantat 5% level
** Significant at 10% level
Dummy variable: 0 = conventional
1= CCS

The management practices in conventional house are significant at -3.102 and at -.2302 for CCS house. It implies that for an extra 1% hour spent per day in the production, the FCR will improve by 3.102 % in conventional house and by0.2302% in CCS house, ceteris paribus.

LPG had a coefficient of -.3721 significant in conventional house while electricity was significant in CCS at -1.895 both being used in brooding. This indicates that in conventional house, for every %kg increase in LPG usage the FCR will improve by 0.3721% while in CCS 1% increase in kilowatts of electricity consumed FCR will improve by 1.89% holding the other factors constant.

The coefficient of determination (R^2) for the conventional house is .71. This shows that 71% of the variation in broiler production is represented by all the independent variables included in the model thus the remaining 29% are explained by other factors not included in the study. The R^2 for CCS house is .8252, indicating that 82.52% of the independent variables included in the study is explained in the model while the remaining 17.48% are explained by other factors not included.

The statistical results confirm that there is a significant difference for feeds and management practices at 5% level between both CCS and conventional.

iii) <u>Productivity Comparison of Large Farms</u>

Large farms were categorized to an average of 20,000 birds per growing cycle. The two houses indicated a significant regression coefficient for the independent variables of management practices and feeds while LPG is significant in conventional house, electricity is significant in CCS (Table 5).

Management practices are significant at -6.002 in conventional house and at -.24 in CCS house. This explains that every 1% extra hour spent per day in the production process it result in a better FCR by 6.002 % for conventional house and at 0.24% improvement of FCR in CCS house holding the other factors constant.

Feeds had a coefficient of -.165 in conventional house and -9.6708 for CCS house. This implies that for every 1% increase in the amount of feeds given to a bird there will be a corresponding improvement of 9.6708% of FCR in CCS house while 1% kg increase in the amount of feeds given to a bird the FCR will be better by 0.165% in conventional house, ceteris paribus.

Electricity is significant in CCS house at -2.9605 while LPG is significant in conventional house at -.45. This explains that with 1%kg increment of LPG consumption during brooding FCR will improve by 0.45%, while a 1% increment in the kilowatts of electricity consume in CCS house FCR will improve by 2.96%, holding the other factors constant.

The coefficient of determination (R^2) for conventional house is .59 while for CCS house is .613, this imply that 59% of the variation in FCR for conventional house can be explained by all the independent variables included in the model while 41% can be explained by other factors not included in the model. 61.3% of the variation included in the CCS house can be explained by the variables studied while the remaining 38.7% is explained by factors not included in the model. It accepted the hypothesis of the study that CCS housing have better productivity and is more efficient than conventional, this is testified by the general superior FCR in CCS houses using the statistical results. Its supported by (Estevez, 2007) that birds' performance in controlled environment sheds isgenerally superior to that in naturally ventilated houses, as the conditions can be maintained in the birds'thermal comfort zone.

IV. Summary

This study was conducted to compare the productivity performance of broiler under conventional house and CCS house. Both houses was studied under small farms with an average of 5,000 birds, medium farms with an average of 10,000 birds and large farms with an average of 20,000 birds.The study covered three areas of Nueva Ejica; San Jose City, Science City of Munoz, and Guimba all the farms studied are under contract with Magnolia Foods Company. This study covered a period of 4 years (2010-2013) with seven growing cycles per year.

Based on the results, production performance of the CCS houses under small farm, medium farm, and large farm had better FCR compared to conventional house type with significant difference. Fig 4 shows the FCR comparative productivity between the large farms under both CCS and conventional. The farms under CCS had a superior FCR,with FCR for small houses as 1.78 CCS compared to 1.80 conventional, medium houses as 1.77 CCS compared to 1.82 conventional, and large houses as 1.79 CCS compared to 1.85 conventional.

The statistical test shows that there is significant difference for the parameter used to measure productivity (FCR) exhibited in the three house types. It showed that CCS had better performance in all farm sizes compared to conventional. It accepted the hypothesis of the study that CCS housing have better productivity and profitability over conventional, this is testified by the general better FCR in CCS houses.

V. Conclusions and Recommendations

Conventional and climate controlled systems can produce broilers with better performance above the integrators' standards. CCS improved the performance of birds as indicated by better feed efficiency (FCR).The significant factors that affect FCR in both house types were feeds and management practices. The percentage responsiveness of bird FCR to foods is higher in CCS houses while percentage increases in management practices produce higher responsiveness in conventional houses. The kilowatts of electricity used have significant effect on CCS farms only, while LPG has a significant effect on conventional farms due to the nature of their brooding.

CCS 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 the conventional type.

The following are being recommended in view of the findings generated from this study. In the low land regions of the Philippines and during summer periodswhen the temperatures are generally high, it is recommended that CCS be established so as to maintain the conducive conditions for bird growth. The CCS houses are advantageous since it help to remove excess moisture, minimize dust and odors, and limit the buildup of harmful gases such as ammonia and carbon dioxide. Exposure of workers to health and safety risks was identified as a problem to CCS houses since they are exposed to chemicals and high risk machines and equipments, therefore it is recommended that employees be equipped with protective gears like respiration mask and educate them through safety seminars. Moreover, a distant alarm system forchanges in temperature and relative humidity inside the system be installed. This will help the managementto ensure sustained performance.

Since feeds and management practices significantly affected the FCR in both houses,it is therefore,recommended that the management team should make sure that appropriate management practices be continuously done in the farms since they significantly affect productivity and profit. It is recommended that since there is significant net profit margin in large and medium houses, the growers producing in large and medium house are recommended to use CCS houses so as to realize higher profit. The adoption of CCS should be promoted by the Department of Agriculture and other stake holders like State Universities so as to realize self-sufficiency in the country's meat industry.Power cost is the most expensive component in operating a climate controlled broiler house. Research should 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.

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