A STUDY OF TOTAL WEIGHT GAIN, AGE WITH THE DIFFERENT CHICKEN FEED SYSTEMS AND PROFITABILITY OF FARMERS OF THE ORGANICALLY FARMED CHICKEN PRODUCTION IN MALAYSIA

NG ZHAO FANG

BACHELOR OF ECONOMICS (HONS)
GLOBAL ECONOMICS

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF ACCOUNTANCY AND MANAGEMENT
DEPARTMENT OF ECONOMICS

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BY

NG ZHAO FANG

A research project submitted in partial fulfilment of the requirement for the degree of

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DECLARATION

We hereby declare that:

(1) This undergraduate research project is the end result of our own work, and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) The word count of this research report is 24923.

Name of Student:	Student ID:	Signature:
NG ZHAO FANG	18UKB02001	

Date: 27 April 2022

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DEDICATION

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LIST OF ABBREVIATIONS

T	Treatment
FAO	United Nation Food and Agriculture Organization
MT	Metric Tons
(‘000)	Thousand
SDGs	Sustainable Development Goals
SPV	Shared Prosperity Vision
CPKO	Crude Palm Kernel Oil
KW	Kitchen Waste Meal
ANOVA	Analysis of Variance
UCBs	Underaged Coloured Broilers
PCA	Principal Component Analysis
BCR	Benefit Cost Ratio/Cost Benefits Ratio
TR	Total Revenue
TC	Total Cost
TFC	Total Fixed Cost
TVC	Total Variable Cost
STAR	Statistical Tool for Agricultural Research

LSD	Least Significant Difference
ROI	Return on Investment
D	Day
GLIMMIX	Generalized Linear Mixed Models
BC	Beta-Carotene
HSD	Honest Significant Difference
CP	Crude Protein
CF	Crude Fibre
EE	Ether Extract
PKC	Palm Kernel Cake
CPO	Crude Palm Oil
POME	Palm Oil Mill Effluent
GLM	Generalized Linear Model
EU	European Union
ADF	Augmented Dickey-Fuller Test
PP	Phillip-Perron Test
VAR	Vector Autoregression Analysis
SVAR	Structural Vector Autoregressive
OLS	Ordinary Least Square
VIF	Variance Inflation Factors
RMSE	Root Mean Square Error
MAE	Mean Absolute Error

MAPE	Mean Absolute Percent Error
Obse	Observations
VECM	Vector Error Correlation Procedure
Ln	Natural logarithm
Ho	Null Hypothesis
HA	Alternative Hypothesis
JB	Jarque-Bera Test

PREFACE

Organic chicken meat has a large market potential in Malaysia as 32.7 million of the population are Muslim. During the pandemic, it is directly affecting food production and financially affecting farmers and households, which is causing a liquidity crunch and debt burden. The consumption of chicken grows faster than production, and it needs to be sourced from foreign countries to meet local demand. So, the main objective is to develop a model for total weight gain and age with the different chicken feed systems and profitability of farmers of the organically farmed chicken production in Malaysia.

In this research, there were four (4) different feed systems, ages, and profitability that were selected to investigate the impact on total body weight of chickens. The four different feed systems are: Treatment 1 (Normal Feed) (Premium Stater Feed), Treatment 2 (Mixed 100 gramme of SK Gold into 50 KG of Normal Feed), Treatment 3 (Mixed 200 gramme of CKPO into 50 KG of Normal Feed), and Treatment 4 (Mixed 100 gramme of PERFAT Pfi-7 into 50 KG of Normal Feed). The purpose of this study is to look into the effects of four (4) different feed systems, age, and profitability on total body gain in organic farm chickens. Time-series data for one production cycle will be included in 56 observations (4 different diet systems x 14 weeks for average body weight of 50 chickens = 56 observations). As a result, this research provides more information and a clear direction for farmers, government institutions, and private institutions interested in studying this sector.

ABSTRACT

In Malaysia, there is a lot of room for organic chicken meat because people are becoming more interested in eating healthy. The halal and organic food industries have now spread far beyond the food industry, and it can be seen in the global food market. During a pandemic, food production, safety, and farmers' and households' finances are all affected. This is causing a liquidity crunch and a debt load. It is not just farmers and workers who do not want to move. People are afraid of COVID-19, which makes them stay at home. Because of this, the normal production capacity of chicken food processing factories has been reduced. This is because the environment has become more important, and people are thinking more about organic chicken food. People who are COVID-19, normal, and pregnant are more concerned about food safety. In addition, food security means that everyone has access to enough safe and healthy food that meets their dietary needs and food preferences for an active and healthy life. So, during COVID-19 in Malaysia, demand for halal and organic chicken meat is growing faster than production, so the government needs to get it from outside the country to meet the needs of local people. So, the main goal of this project is to build a framework to show how different diet systems affect the growth performance (body weight) and profitability of organically farmed chicken farmers in Malaysia, so that they can make more money. In the study and financial benefit-cost analysis of farmers' profitability based on the different diet systems they use in at least one production cycle, there are FOUR (4) different diet systems that are taken into account. It will also give unbiased and comparable results from testing the different diet systems in a way that is very relevant to the commercial market, so this project will be very useful.

Keywords: Chicken Production, Profitability, Growth Performance, Cost-Benefits, Age

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

The first chapter of the study consist of introduction, background of the organically farmed chicken production in Malaysia, current situation of the chicken industry, problem statement, research objectives, research questions, significant of study such as theoretical and practical significant of the study and followed by the chapter layout and conclusion of the chapter.

1.1 Research Background

Chicken is one of the bird's species. One of the differences between chicken and most other birds is that it has a comb and two wattles. The comb is the red appendage on the top of the head, and the thorns are the two appendages under the chin. These are secondary sexual characteristics, which are more prominent among male chicken. The comb is the basis for the Latin name or classification of chickens. In Latin, gallus means comb, and domestic chicken is ***Gallus domesticus***. The red rock fowl is the ancestor of most domestic chickens called as ***Gallus bankiva***. Nowadays, chicken is being raised in poultry or in animal husbandry. Chickens, ducks, turkeys, and geese are primary commercial importance. Commercially or domestically raised of birds, mainly are for their meat, eggs, and feathers. In terms of the number of animals worldwide, poultry is the largest livestock stock in the world, and poultry is the fastest growing component of global meat production at the beginning of the 21st century (Garrigus, 2021). Chicken and eggs provide high quality protein at an affordable price. Poultry farming, especially small-scale farming, is renewable and efficient, and can provide farmers, citizen, and the country with existing sources of income and nutrition.

Production theory, in economics, attempts to explain how a commercial company determines how much of each commodity it will produce, as well as each type of labour, raw materials, fixed capital goods it will use. This theory involves some of the most basic economic principles. This includes the relationship between the price of a commodity and the price of the factor of production used to produce the commodity, as well as the relationship between the price of the commodity and the factor of production, and the quantity of those commodities. On the contrary, the factors of production are produced or used (Dorfman, 1998). Commercial companies' decisions about their production activities can be divided into three levels, with each level increasing in complexity. The first level involves decisions about how to produce a specific number of products in a factory of a specific size and with a specific set of equipment. It is about the so-called "short-term cost-cutting" issue. The second level entails determining the number of most profitable products produced in each factory, a process known as "short-term profit maximization." The third layer, referred to as long-term profit maximization, determines the size and equipment of the most profitable factory.

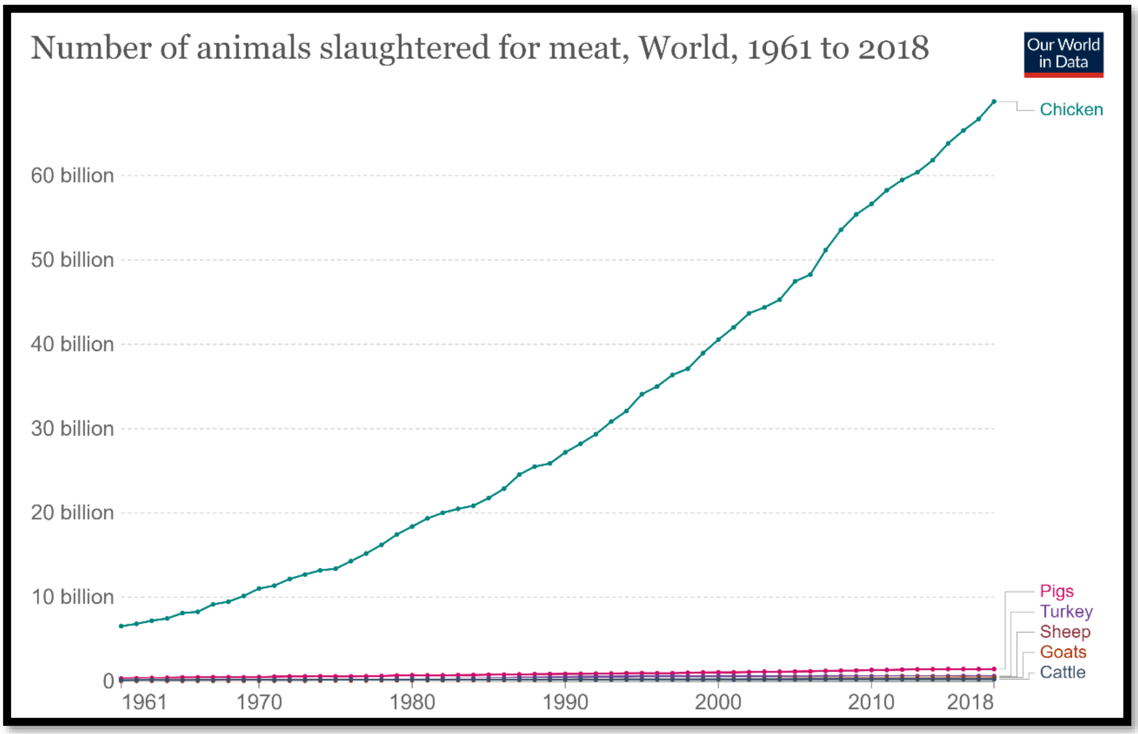
Growth performance is determined by the feed intake by the animals. The performance will be based on the chicken weight gain and the changes of size. In this study, growth performance will refer to the total weight gain of a chicken through different feeding systems. As we all know thar chicken meat is considered as an easily available source for most of the country which obtained high-quality protein and other nutrients that are necessary for proper body functioning (Kralik et al., 2018).

Profitability is important for every business organization. Their main goals are to generate more income and expand their business in the future, but no one will wish their business gain losses. If a company or an organization does not have profitability over the year, the business would not survive in the long-term as they would need to pay the expenses over the years (Hofstrand, 2019). Therefore, it is very important to measure current and past profitability and predict future profitability. Profitability of the company is measured by income and expenses. Revenue is the money generated from business activities by selling their products in the market. For example, if crops and livestock are produced or supplied by the company and the goods will be sold in the market as it demanded by the consumer, income will be generated as buy and sell involved in the marketplace. In this study, the profitability will refer to the chicken then been raised in different feeding systems that been sold in the market depends on the weight and the quantity and the quality of the chicken. It will deduct the cost of raising the chicken to get the profit at the end of the study.

Besides, most of the people right now focus on organic food rather than non-organic food. Organic food is defined as fresh or processed food produced by organic farming methods. Organic food is grown without the use of synthetic chemicals, such as human-made pesticides and fertilizers, and does not contain genetically modified organisms (GMOs). Organic foods include fresh produce, meats, and dairy products as well as processed foods such as crackers, drinks, and frozen meals. According to (Duram, 2019) , the market for organic food has grown significantly since the late 20th century, becoming a multibillion-dollar industry with distinct production, processing, distribution, and retail systems. Organic livestock that raised for meat, eggs, and dairy products must be brought up under living conditions that adapt to their natural behaviors, such as being able to graze on field and feed organic feed and grass fodder. They should not take antibiotics, growth hormones or any drugs that stimulate rapid growth and any animal by-products (Mokhtar, 2014).

The world's population has more than doubled in the last 50 years. However, the amount of meat we consume has increased by threefold. The majority of this increased demand has come from middle-income countries, particularly China, which has become the world's largest meat consumer as its economy has grown. In Europe and North America, on the other hand, meat consumption has remained stable, if not declining. Despite rapidly catching up to China in terms of population, India consumes only a small percentage of global meat. According to Figure 1.1, since the year 1961 until 2018 the number of chickens being slaughtered for meat in the worldwide are increasing drastically from 6.58 billion in the year 1961 to 68.79 billion in the year 2018 (Richie & Max, 2017). The growth trend of chicken slaughtered means that the total meat production is growing much faster than the population growth rate.

Figure 1.1 Numbers of Animal Slaughtered for Meat in Worldwide.

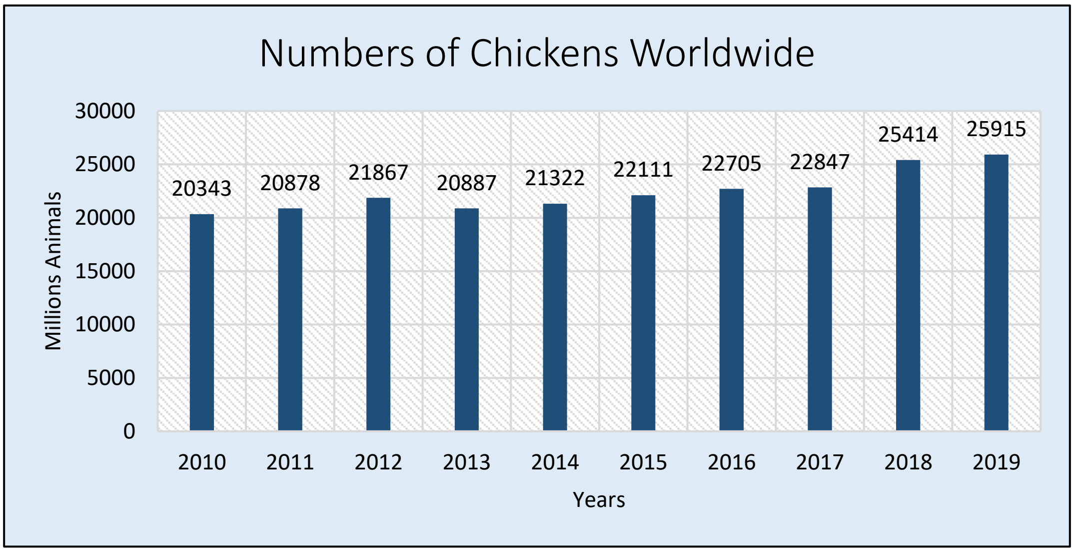


Source: UN Food and Agriculture Organization (FAO) (2019)

1.2 Current Situation of Chicken Industry

The poultry industry continues to grow and industrialize in many parts of the world. A growing population, greater purchasing power and urbanization are powerful drivers of growth. Based on Figure 1.2, the number of chickens at the chicken industry in worldwide is about 25915 million of chicken. The number of chickens were increase since year 2010 with 20343 million of chicken to 25915 million of chicken in year 2019. According to Food and Agriculture Organization of United Nations, since 1990, the number of chickens in the world has more than doubled and the largest share of this existence belongs to Asian countries.

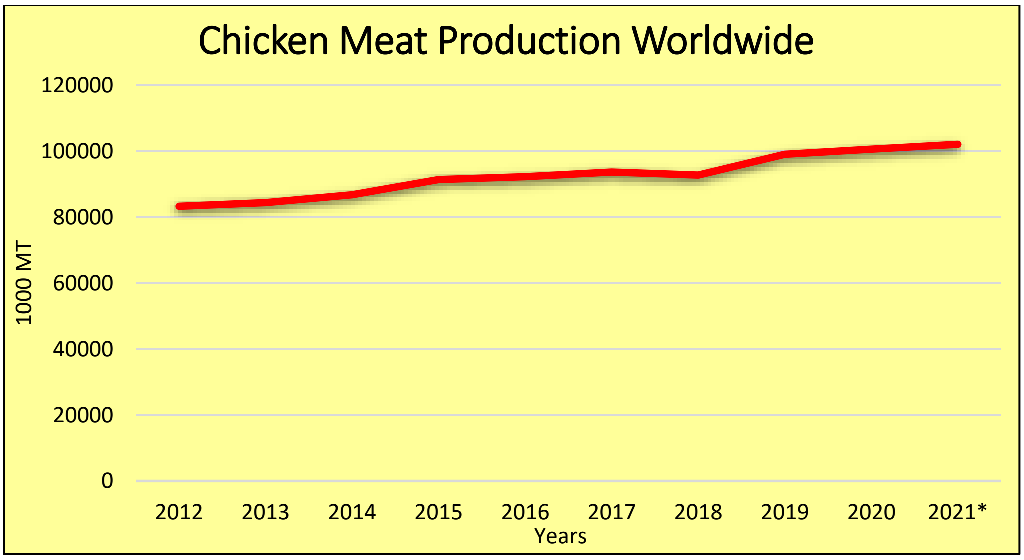
Figure 1.2 Number of Chicken at the Chicken Boiler Industry in Worldwide.



Source: Statista (2021)

In the past 50 years, global chicken meat production has increased rapidly, increasing from 83267 metric tons (MT) to 102060 MT between years 2012 to 2021. The global trends in poultry production are shown in the Figure 1.3. The demand for alternative meats is driving the growth of poultry meat production and trade. Because compared with other meats, the price of chicken is easier for consumers to buy as chicken is one of the fastest growing animals. This in turn will have a gradual impact on the poultry market from production to trade. For example, the production of chicken meat was 92,726 metric tons in 2018 and 99,027 metric tons in 2019. However, in 2020, due to Covid-19, the closure of popular food stores such as restaurants, the introduction of certain production procedures, and the flare-up of bird influenza, the growth was lower than anticipated.

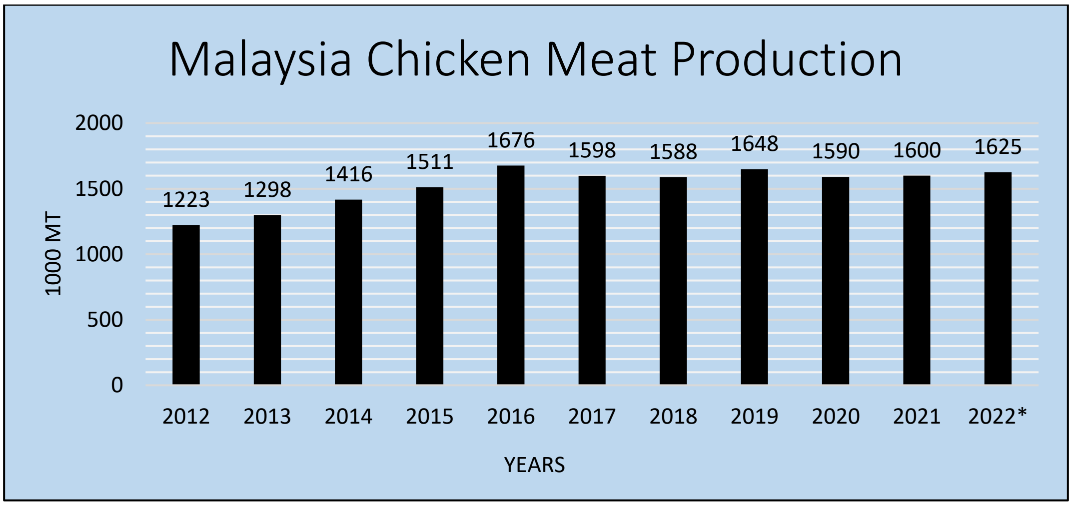
Figure 1.3 Chicken Meat Production in Worldwide.



Source: Statista (2021)

According to Figure 1.4, the chicken meat production in Malaysia increases significantly since year 2012 to 2016 from 1223 (‘000) MT to 1676 (‘000) MT. But in the year 2017 and 2018, the chicken meat production in Malaysia decreased from 1598 (‘000) MT to 1588 (‘000) MT and it increased back to 1648 (‘000) MT in the year 2019. When the pandemic outbreak was in 2020, the chicken meat production in Malaysia had slightly decreased to 1590 (‘000) MT. This might be due to the farmers reduced the farm size and switch to other crop types. It expected to increase to 1625 (‘000) MT in the year 2022 when the consumption of chicken meat increases as the farmers will raise more chicken to meet the demand.

Figure 1.4 Chicken Meat Production in Malaysia.

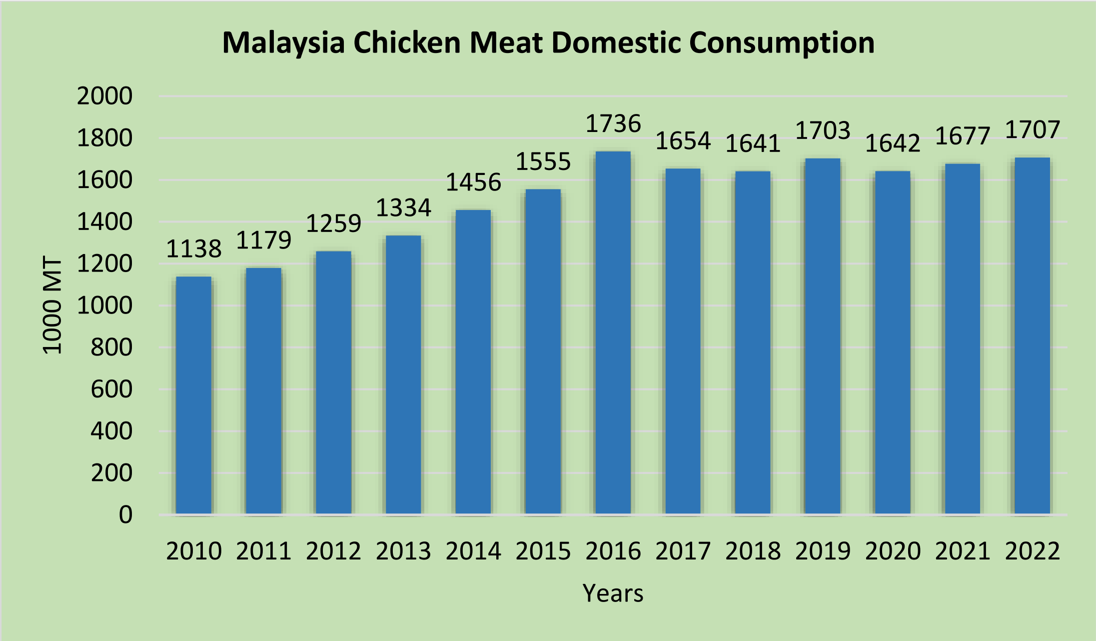


Source: Index Mundi (2021)

Malaysia is a multi-racial and multi-religious country. All ethnic groups in Malaysia consider chicken acceptable, and Muslims eat halal chicken. Malays, Chinese and Indians eat chicken in their daily lives, while there are some religious prohibitions on other meats such as pork and beef. Chicken is the most common dish in Malay, Chinese or Indian communities during festivals. Based on the Figure 1.5, the trend of chicken meat consumption is getting higher every year. But in year 2020, the domestic consumption of chicken meat was decreased to 1642 ('000) MT compared to year 2019 at 1703 ('000) MT. According to the Enforcement Division of the Ministry of Domestic Trade and Consumer Affairs (KPDNHEP), it is due to the increase of price for chicken at the beginning of the year (*Domestic Trade Ministry: Prices of Chicken Showing Downward Trend | Malaysia | Malay Mail*, 2020). In the middle of year 2020, they found out that in the second week of July, the price of chicken declined. This is due to the Enforcement Director Datuk Iskandar Halim Sulaiman had carried out the price control to maintain the prices of chicken in the market at an affordable price for the consumer to purchase. Since the covid-19 pandemic outbreak, most of the Malaysians start cooking at home and lead to increase in the consumptions of chicken meat in year 2021. The domestic consumption of chicken meat it expected in increase to 1707 ('000) MT in the year

2022. Malaysians are expected to consume 48.7 kilograms of poultry meat per person in 2021, according to estimates. Malaysia is now one of the world's largest consumers of poultry meat. Meat production has been shown to have negative effects on the environment and the global climate, and scientists have recommended that the amount of meat consumed be drastically reduced. Malaysian consumers, on the other hand, were hesitant to give up their meat (Hirschmann, 2021).

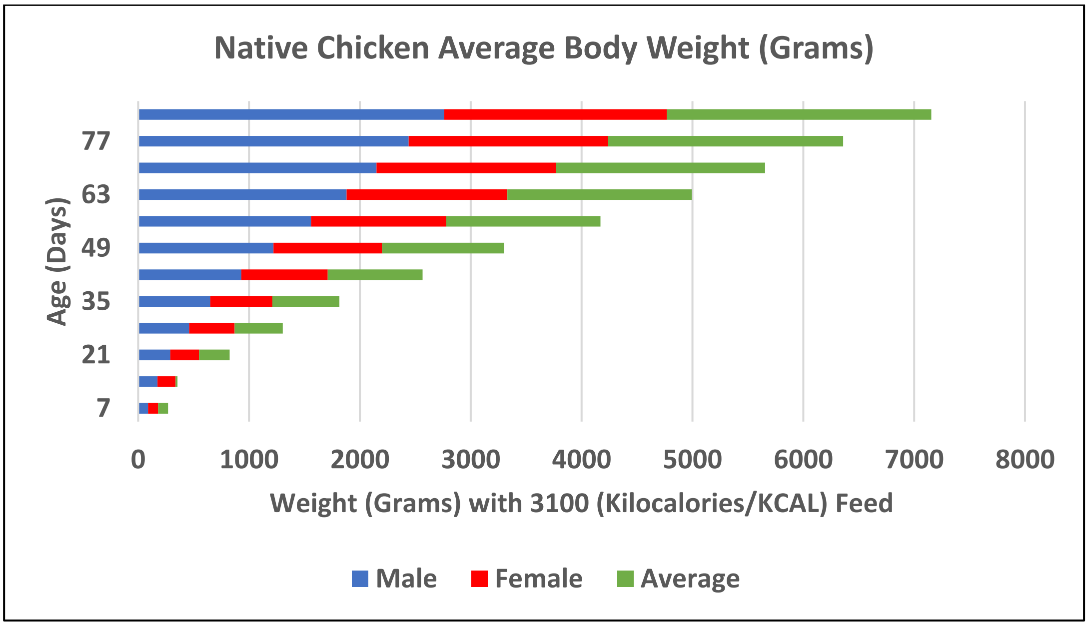
Figure 1.5 Malaysia Chicken Meat Domestic Consumption.



Source: Statista (2021)

From the Figure 1.6, it is obvious that male chicken consumes more than female chicken. Male chicken weights are 1.3 times more than female chicken. Male broilers have larger bodies than female broilers. This would not occur if the guy were a "runt”. Therefore, female broilers have a greater body size than male broilers of the same age. Furthermore, male broilers have longer, thicker, and larger legs than female broilers.

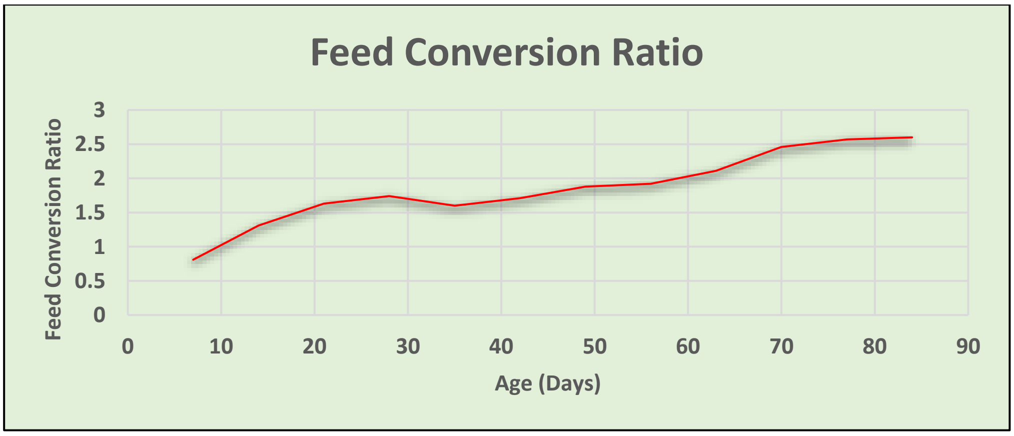
Figure 1.6 Native Chicken Average Body Weight Gain in 1 Production Cycle.



Sources: Bintang Maju Agri SDN. BHD (2021)

Based on Figure 1.7, when the age of the chicken increased every day from day 0 to days 84, the amount of feeds given to the chicken will be increase. The amounts of feed needed daily are few times higher when they grow bigger. As food will brings energy for them to consume for their daily usage.

Figure 1.7 Feed Conversion Ratio of Native Chicken.



Sources: Bintang Maju Agri SDN. BHD (2021)

1.3 Problem Statement

Future consumption of animal-based food products in developing countries is expected to rise from 29 percent to 35 percent in 2030 to 37 percent in 2050, according to UN Food and Agriculture Organization (FAO Statistics, 2018) projections, compared to an average of 48 percent in industrial countries in 2050. Because the environment has become more important and the concept of organic-based food consumption, food safety, and security has emerged, some consumers have begun to seek out more environmentally friendly alternatives to their traditional purchases at supermarkets, restaurants, hotels, wet markets, and concept shops, particularly for patients and pregnant women (Akehurst et al., 2012).

Moreover, there are also around 1.9 billion people in the world's Muslim population, and it is estimated that 30 percent of the world's population in 2025. Approximately 1.5 billion halal and organic-based food consumers, or one out of every four people, consume halal products (Syndicated News, 2016).

The halal and organic-based food industries have now expanded well beyond the food sector with their strong presence, and it can be witnessed in the global food market. Consumer preferred and selected foods from the supply sector (SSL) are 130 percent of poultry organic chicken meat, followed by eggs, fisheries products, and pork meat in 2018 (MOA, 2018). Malaysians preferred 1.8 million chickens and 2.8 million chicken eggs per day (DVS, 2016). Furthermore, a significant number of Malaysian consumers' organic-based food consumption patterns and broiler chicken population increased from 400 million birds in 2000 to 800 million birds in 2013. It is projected to also increase to 1 million birds in 2020 in Peninsular Malaysia (Kumaran et al. 2016). Therefore, consumption grows faster than production, and it needs to source to meet local consumers' demand.

Global population growth combined with degraded natural resources and greater urbanization means that more people must be fed on less water, farmland, and rural labor. To meet anticipated increases in water, energy, and food demands, we must adopt more sustainable production and consumption practices. Today, the globe wastes or loses over a third of the food it produces, leaving nearly 690 million people hungry. Producers must grow more food while lowering negative environmental impacts such as soil, water, and nutrient loss, greenhouse gas emissions, and ecosystem deterioration to feed the world sustainably. Consumers must be urged to switch to more nutritionally, safely, and environmentally friendly diets.

To achieve economic growth and long-term development, we must drastically reduce our environmental footprint by altering how we produce and consume commodities and resources. Agriculture is the world's largest water user, with irrigation accounting for about 70 percent of all freshwater available for human use. To achieve this goal, we must manage our common natural resources efficiently as well as dispose of toxic waste and pollutants in a responsible manner. Encouraging industries, businesses, and consumers to recycle and reduce waste, as well as aiding developing countries in their transition to more sustainable consumption habits by 2030, are both critical. Even now, a substantial portion of the world's population consumes far too little to meet their basic needs. Reduced global food waste per capita at the retailer and consumer levels is also critical for more efficient manufacturing and supply networks. This could improve food security and lead to a more resource-efficient economy.

The alignment of SDGs with national development is achieved by a mapping effort that entails linking the action plans, initiatives, and outcomes of the national development plan to the SDGs' goals, targets, and indicators. In 2019, the

Shared Prosperity Vision (SPV) 2030 was announced. The implementation of the SPV 2030 will be further crystallised by the Twelfth Malaysia Plan (12MP) from 2021 to 2025, which will encompass three development dimensions: economic empowerment, environmental sustainability, and social reengineering. It is the main idea of SPV 2030, which lists eight enablers, seven strategic thrusts, and 15 guiding principles. Economic growth is achieved through equitability of outcome, which is the main point (Azman, 2020).

According to the Shared Prosperity Vision 2030 (SPV 2030) plan, it is critical that Malaysia grows sustainably with a fair economic distribution and equitable growth at all income levels, ethnic groups, regions, and supply chains by 2030. Using the correct feeds or ingredients to raise animals and crops is critical in the agriculture sector since it can boost farmers' profitability by increasing daily sales. SPV 2030 has the potential to reduce inequality, particularly in Sabah and Sarawak, and across strata such as cities, metropolitan regions, rural areas, the interior, and islands. With a well-balanced and large income from selling their commodities, individuals may be able to improve their living standards.

It has a direct influence on organic food production during the pandemic, as well as a financial impact on farmers and households, resulting in a liquidity shortage, imported feeds, and debt burden (Fatimah, 2020). On the other hand, the sector is subjected to too many variables that might impair farmers' profits and viability, such as a strong reliance on imported chicken feed, which causes price volatility. This study will see which of four different feeding systems, such as normal feed (*Treatment 1*), normal feed + SK Gold (*Treatment 2*), normal feed + Crude Palm Kernel Oil (CPKO) (*Treatment 3*) and normal feed + PERFET Pfi-7 (*Treatment 4*), is optimal for chicken feed growth performance and cost savings. Furthermore, it is due to movement restrictions or fears of COVID-19 that farmers and workers are remaining at home together. Farmers' and food processing plants' typical production capacities have been lowered. According to Channel News Asia, 2020, the chicken factory in Pedas and Negeri Sembilan in Malaysia has registered 60 confirmed COVID-19 cases to date.

1.3.1 Knowledge Gap

Chickens are likely to perform differently when subjected to different feeding systems. Some researchers are using different method to study which is suitable for the growth of chicken and the type of chicken that we are preferable by the consumers as it will increase their income level.

The effect of dry kitchen waste meal (KW) as a partial replacement for maize on broiler chicken development, nutrient digestibility, and carcass characteristics was investigated in a study (Sani et al., 2021). The study used a total of 160 broiler chicks. In a perfectly randomised design, 40 broiler chicks were randomly assigned to four nutritional treatment groups: T1, T2, T3, and T4. Each treatment had ten birds per repeat (CRD). The research lasted six weeks. For all starter and finisher diets, four experimental diets were created with KW replacing maize at amounts of 0 percent, 10 percent, 20 percent, and 30 percent, representing T1, T2, T3, and T4, respectively. The findings revealed that daily and total feed intake differed significantly between treatment groups.

Analysis of variance (Proc ANOVA) was used to examine the data, and Tukey's test was used to see whether there were any significant differences between the means. Broilers given 20 percent KW had the highest average daily feed consumption, while those given 30 percent KW had the lowest. The digestibility metrics of nutrients, such as ash and crude fiber, differed significantly between treatments. As a result, KW can replace up to 20 percent of maize in the diet of broilers without affecting feed consumption, and it can also be fed to hens.

Due to the enormous demand for village chickens in Malaysia and indigenous chicken are being fraudulently replaced with cheaper alternatives. One technique for avoiding chicken adulteration is to differentiate between different chicken breeds based on their phenotypic traits (Nematbakhsh et al., 2021). The study's major goal was to identify and classify Malaysia's most popular chicken breeds, including commercial chickens like Cobb, Hubbard, and DeKalb while cross-bred village chickens which is *Ayam Kampung* and *Akar Putra*. On the basis of phenotypic features, village chickens were distinguished from underaged coloured broilers (UCBs) such as Hubbard and Sasso. The results revealed that the breed had a substantial statistically significant at α level 0.05 effect on phenotypic features, but the sex effect was not significant for any. The belly fat weight, breast muscle weight, chest circumference, shank length, and wingspan were the most notable distinguishing characteristics in the first phase.

However, no significant differences in phenotypic traits between rural chickens and UCBs were seen in the second phase. Village chickens were successfully separated from high-performance varieties using principal component analysis (PCA) (broiler and coloured broiler). Nonetheless, there was overlap in observations for Sasso and village chickens, indicating that their phenotypic traits may be similar. The study found clear breed grouping, which leads to phenotypic characteristics-based chicken verification.

1.4 Research Objectives

1.4.1 General Objective

To develop a model for total weight gain, age with the different chicken feed systems and profitability of farmers of the organically farmed chicken production in Malaysia.

1.4.2 Specific Objectives

1. To analyze the relationship between the 4 different chicken feed systems and the total weight gain of the Halal and Organic farmed chicken production.
2. To estimate the relationship between the chicken age and the total weight gain of the Halal and Organic farmed chicken production.
3. To examine the profitability of the farmers based on the 4 different chicken feeds systems of the organically farmed chicken production at least 1 production cycle.

1.4.3 Research Questions

1. How are the relationship between the 4 different feed systems and the total weight gain of the Halal and Organic farmed chicken production to meet for local consumer demand and food security?
2. What is the relationship between the chicken age and the total weight gain of the Halal and Organic farmed chicken production?

3. Which different feed system is more improving for the chicken weight gain of the farmers and how can the farmers achieve more profitability based on the 4 different feed systems of the Halal and Organic farmed chicken production during the pandemic?

1.5 Significant of Study

The aim of this study is to study the Total Weight Gain, Age with the Different Chicken Feed Systems and Profitability of Farmers of the Organically Farmed Chicken Production in Malaysia. This could help the producers to produce more quality of chicken and brings more profitability for the farmers. By considering the different feeding system to raise the chicken, sufficient information could be provided to farmers to determine which feeding systems has the highest total weight gain of the chicken in order to maximize profits of the farmers. Besides, the study also allows the chicken industry players to determine which feeding systems are the most effective. Thus, it is wised that this study could fill up the gap of the consumer acceptance preference on different type of chicken meat in Malaysia. This study will provide some valuable information for the farmers by identifying the best feeding systems for producing chicken meat in Malaysia and which treatment is more effective towards the farmer where, which treatment has the lowest cost and to bring higher profits.

1.6.1 Theory Significant of the Study

A cost-benefit analysis compares the expected or estimated expenses with the advantages or opportunities connected with a project decision to see if it makes sense from a business standpoint (Stobierski, 2019). In general, cost-benefit analysis entails adding up all a projects or decision's costs and subtracting that number from the project's or decision's total predicted benefits. The value is sometimes expressed as a ratio. We could argue that the decision is sound if the predicted benefits outweigh the costs. If, on the other hand, the costs outweigh the advantages, the decision or project may need to be reconsidered. Cost-benefit analysis is a type of data-driven decision-making that is commonly used in businesses, both large and small. The fundamental ideas and structure can be used in almost any decision-making process, whether it is business-related or not.

We can define organic "growth" as the measurable increase in weight or length of an organic system, as opposed to "differentiation" and "shape development," which represent a rise in organization (Morbos et al., 2016). Excluding, as is customary, grows through simple imbibition and the accumulation of reserve elements. Growth can be linked to the fundamental features of living systems, and it can be defined as follows. Growth is the observable expansion of an organic system as a result of its assimilation of materials from its surroundings. Growth is, of course, enormously varied and complex in both its descriptive and causal analytic aspects. Even the chemical side of the process, the creation of body-specific building materials, remains a mystery. Mitosis has yet to be defined in physicochemical terms. Even if we had these things, we would still be a long way from understanding growth in higher organisms. Because an organism's growth capability is determined by the organic systems, not by individual cells, the latter, obviously, decides when, where, and when cells divide, increase, differentiate, and how metaplasms and intercellular substances are generated. Furthermore, growth is influenced by external elements like diet and temperature, as well as internal factors such as hormones, progressive differentiation, water content changes, and age.

1.6.2 Practical Significant of the Study

"Griller-type birds" are broilers butchered between 27 and 29 days old, weighing 1.3 to 1.5 kg, and sold as a whole carcass. The purpose of the study was to assess the growth performance, carcass features, and meat quality of female broilers from four genetic lines that were raised to produce griller-style chickens (Filho et al., 2017). A total of 960 broiler chicks were randomly assigned to four treatments and eight replicates of 30 birds per experimental plot in a randomized block design. A, B, C, and D were the names of the four different commercial lines used in each experimental treatment. The data were subjected to analysis of variance (ANOVA), and the means were then compared using Tukey's test at a significance level of 5 percent. Weight increase, feed intake, feed conversion ratio, livability, production efficiency index, carcass and cut yields, and meat quality were among the metrics studied. The results demonstrated that the lines performed similarly, but lines A, B, and C had higher carcass and breast yields, and line A had the highest meat quality. As a result, line A would be the best choice for producing griller chickens.

A study had conducted by Obasa et al. (2017) are about growth performance and cost benefit of broiler chickens raised on mash and pellet diets accessed at different feeding periods. In a 2 x 4 factorial experiment, 160-day old Marshall broiler chicken were used to investigate the impact of different feed types and feed access periods on broiler chicken growth performance and cost benefits. For three weeks, the birds were weighed and randomly assigned to one of eight treatments, each with four replicates of five birds and fed two different feed forms (mash and pellet) and four distinct meal access times. Following this time, all birds were restored to ad libitum eating until they were 8 weeks old. Feed intake, weight gain, feed conversion ratio, mortality, cost of feed eaten, and cost per gramme of weight gained were all recorded. In a completely randomized design in factorial configuration, the data was subjected to Analysis of Variance

(ANOVA). The New Duncan's Multiple Range Test was used to distinguish significant differences between treatment means. The results showed that ad libitum pellet-fed pigeons with a 4- and 6-hour feed access time gained more weight. Pellets fed to birds ad libitum had the greatest cost of feed consumed per bird in a cost-benefit study. Broiler hens should be raised on pellet diets and should not be subjected to less than 4 hours of feed access time for the third week of production out of an 8-week period to lower the cost of production without compromising growth performance.

1.7 Chapter Layout

The study will be divided into 5 chapters. Chapter 1 have already briefly discussed about the research background, current situation of study, problem that faced in the industry, research questions and objectives of the study.

Chapter 2 will be summarizing the previous reviews of relevant theoretical models, empirical reviews of the study and the summary of empirical review.

Chapter 3 will explain about the conceptual framework, hypothesis development, methodology and research method that will be used in the study.

Chapter 4 will discuss about the finding of the study. It will be explained about the descriptive finding, regression analysis, diagnosis analysis and model evaluation. Not only that, conclusion will also be summarize for each chapter.

Lastly, chapter 5 will be summarizing the findings from chapter 4, conclusion of the study, recommendation, limitation of the study and provide suggestions for the future research.

1.8 Conclusion

In chapter 1, it had been discussed the background of the study and the current situation of Chicken meat in the world and in Malaysia. After that, it also discussed about the problem statement, research objective and research questions of this study. Next, it also explained the significant of the study and the chapter layout of this thesis. Lastly, Chapter 2 will be discussed about the relevant and previous theoretical and empirical reviews of total weight gain, age with the different chicken feed systems and profitability of farmers in Malaysia.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

Chapter 2 will be explaining the reviews on relevant theoretical models about the chicken growth performance (Body Weight), age and the profitability. Besides, it will discuss about the empirical reviews for this study on the total weight gain on the different feed systems and the profitability of the farmers in Malaysia. Last but not least, summary table of empirical review will be provided and the conclusion for this chapter.

2.1 Reviews of Relevant Theoretical Models

2.1.1 Theory of Cost and Benefit Analysis.

In applied economics, cost–benefit analysis is a technique that is used to evaluate a government program or project in order to determine whether society's welfare has increased or will improve in the aggregate, more individuals are better off) as a result of the program or project (Kee, 2004). At its most useful, cost–benefit analysis can offer information on the total expenses of a program or project and compare those costs to the financial value of the benefits. The analyst can then calculate the program's net benefits (or costs), assess the benefit-to-cost ratio, calculate the rate of return on the government's initial investment, and compare the benefits and costs of the program to those proposed alternatives.

Cost-benefit analysis (Table 2.1) is a method used to compare the costs and benefits of government policies or actions from the perspective of the entire society. In the broadest sense, it compares the value of resource-use goods and services that communities must give up in order to implement government actions or policies, and the benefits generated over time. In essence, it tries to determine whether it can make society as a whole better after considering all the impacts on individuals in society including the environmental and social impacts. It is for this reason that economists often use the term "social cost-benefit analysis", although the acronym cost-benefit analysis is now more commonly used. Non-economists usually do not understand the comprehensive nature of cost-benefit analysis and try to supplement it with further environmental or social perspectives. However, a basic problem with cost-benefit analysis is that it aggregates utilities as measured by individuals' willingness to pay (Haveman & Weimer, 2001).

To determine the profit or lost for the farmers, it was based on an accounting or financial cost-benefit analysis of the profitability of the farmer based on the different diets on chicken farming for at least two production cycles. For standard calculation, normally chicken will sell in after 100 days (around 3-4 months). Therefore, it will be calculated the profitability based on the cost-benefit analysis for at least two production cycles (after 3-4 months per time). Farmer was best advised to diversify to meet the local demands in a sustainable manner and also be able to maximize their profit (Morel et al., 2019). To compare the results of the aggregate costs and benefits quantitatively, it was to determine if the benefits outweigh the costs. If so, then the rational decision is to go forward with the project. If not, the business should review of the project to see if it can adjust either increase benefits or decrease costs to make the project viable. Otherwise, the company may abandon the project. However, the cost-benefit analysis typically fails to account for important financial concerns such as inflation, interest rates, varying cash flows and the present value of money.

Alternative capital budgeting analysis methods including net present value (NPV) or internal rate of return (IRR) or returns on investment (ROI) are more appropriate for these situations (Kenton, 2019).

Table 2.1 Formula and Decision Rules of Cost Benefit Ratio.

Cost Benefit Ratio	
Formula	
BCR	$\frac{Total\ Revenue}{Total\ Cost}$
Decision Rules:	
Accept:	Accept the treatment with highest BCR as it brings profit.
Reject:	Reject the treatment with lowest BCR as the cost is higher compared to others.

Source: Kenton (2019)

2.1.2 Theory of Profitability

Figure 2.1 shows the profitability theory for the firm is Profit = Total revenue - Total cost. Total revenue is the amount of a firm receives for the sale of its output. Total cost is the market value of the inputs of a firm uses in production. If TR > TC = Profit; If TR < TC = Loss. A firm's cost of production includes all the opportunity costs of making its output of goods and services. A firm's costs of production include explicit costs and implicit costs. Explicit costs are input costs that require a direct spend (an outlay/expenditure) of money by the firm. Implicit costs are input costs that do not require a direct spend (an outlay/expenditure) of money by the firm. A firm's costs reflect its production process. A typical firm's production function gets flatter as the quantity of input increases, displaying the property of diminishing marginal product. In Figure 2.1, a firm's Total Costs (TC) = Total Fixed Costs (TFC) + Total Variable Costs (TVC). Fixed costs do not change when the firm alters the quantity of output produced. Variable costs do change as the firm alters quantity of output produced. In particular, many costs are fixed in the short-run but variable in the long-run (Mankiw et al., 2013).

Figure 2.1 Profitability formula.

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost}$$

$$TR > TC = \text{Profit}$$

$$TR < TC = \text{Loss}$$

Source: Mankiw et al. (2013)

2.1.3 Theory of Growth Performance

Figure 2.2 explained that the theory of growth performance and the basic weight gain theory developed by Morbos et al. (2016), if the feed intake increased, it was significantly for the weight gain increased. Jonna et al. (2018) also assessed the growth performance of broilers supplemented with Madre de Agua (T. gigantea), Malunggay (M. oleifera) and Pinto Peanut (A. pintoi) leaf meals. Seventy-two (72) male Cobb broilers randomly assigned to four treatments and replicated six times with three birds per replication laid out in a Completely Randomized Design set-up. They gathered data and subjected to one-way Analysis of Variance (ANOVA) using Statistical Tool for Agricultural Research (STAR) 2.0.1

and treatment means compared using Least Significant Difference (LSD) Test. The result showed that the control with commercial ration alone consistently displayed highest feed intake. Supplementation of leaf meals from different plant sources at 10 percent level of inclusion reduced feed cost; however, it could not offset the higher gain in weight on commercial ration that resulted to significantly Higher Return on Investment (ROI).

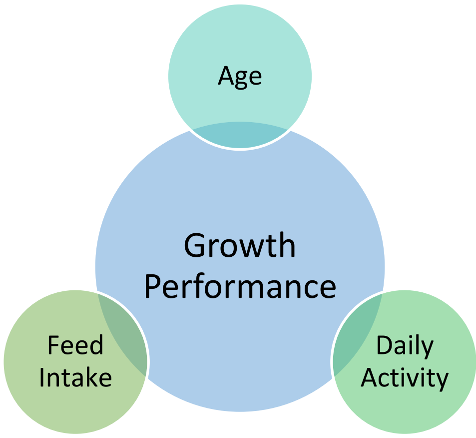
Figure 2.2 Theory of Growth Performance.

Source: Esmail (2017)

2.1.4 Relationship between Age and Growth Performance

As a human or an animal being, age and body weight growth every day in Figure 2.3. It will affect our body weight by consuming the amount of food that we consume daily and the numbers of times we consume in a day. The composition of the body changes with age (Santaleesa, 2017). Changes in metabolism and hormonal levels affect the extent and speed of fat accumulation. For human, men and women weigh the most at age 50-59, and gradually lose weight after age 60. The mid-1970s tended to increase again, followed by a small decrease. For animal, when the feed intake increased, it was significantly lead to weight increased. As time goes by, they will consume even more as the changes in metabolism and hormone levels of each age level. Not only that, when their daily activity increases, the consumption of chicken feeds will also increase as their daily activity will stimulate digestive systems.

Figure 2.3 Theory of Age on Growth Performance



Source: Adedeji et al. (2014)

2.2 Empirical Reviews of the Study

2.2.1 Growth Performance

According to Atansuyi et al. (2017), the experiment aims to evaluate the growth performance characteristics of four chicken genotypes managed under a deep litter feeding system. The research was conducted at the teaching and research farm (poultry unit) of the Federal University of Technology in Akure, Ondo State, Nigeria. A total of 240 chicks were used for the study. They are using ANOVA to analyse the collected data and

Duncan's multiple range test to determine the significance of the mean. The research shows that the body weight and linear body size of native chicken genotypes are smaller than those of foreign chicken genotypes. Age, variety of chicken and feed consumption is the main determinants of growth. Linear measurements of body weight and body at different ages indicate that an increase in the growth rate of any body part will correspondingly lead to an increase in feed consumption and an increase in live weight of poultry. The growth parameters of different genotype chickens revealed changes in weight gain and feed intake.

Adedeji et al. (2014) they conducted a study on the effect of the organic production on the growth of broiler chickens. They included 4 different feeding systems as their independent variable. In response to the experimental diet, data on total feed intake, total weight gain, and feed conversion rate were obtained. In their research, they used one way analysis of variance (ANOVA) and the means of the descriptive analysis they were using Duncan Multiple range test. The results show that, the organic broilers showed lower growth performance compared to broilers fed with conversion feed. Not only that, they also found out that the control group has the highest total feed intake and has the highest total weight gain among others groups. Many researchers found out that the feed quality and management systems will bring impact on the broiler feed conversion rates. The results of this study showed that at week 8, the feed conversion ratio (FCR) of conventional poultry was better than that of organically fed poultry. The reason may be that the physiology of organic birds adapts to the diet they are fed, and that outdoor activities increase their activity and may reduce their weight gain.

Food and nutrition management will affect the production and breeding performance of chickens. Foods defined by protein and energy density have different effects on growth parameters such as weight gain, feed conversion rate and chicken growth rate (Kuietche et al., 2014). The acquired data was treated to a one-way analysis of variance (ANOVA) to compare treatment means at 5 percent probabilities. When substantial variations between means were found, the Duncan Multiple Range Test was used to separate them. When receiving different feeding systems; the performance of chickens may differ. In fact, in the case of breeders, the growth response of local chickens to different nutrition and nutritional management and their survival is not well understood.

2.2.2 Age

The study findings reported by the researchers can be utilized to assess potential health risks resulting from unwanted variations in specific organ development rates and whole-body growth rates in birds (Murawska, 2017a). For carcass quality and poultry production efficiency, the link between muscle tissue and adipose tissue growth rates is also crucial. Because of the unique nature of subcutaneous adipose tissue in chickens, fat content assessments should include both skin with a subcutaneous fat layer and abdominal fat. Information on age-related changes in the weight and content of edible and inedible carcass components, such as bones separated from muscle tissue in the mechanical deboning process, may aid in the efficient processing of poultry meat and the management of slaughter offal, including bones separated from muscle tissue. Although a longer raising period results in a higher final body weight and muscle output, total production costs rise because older birds grow at a slower rate and consume more feed per kg of body weight gain. When calculating the ideal slaughter age, several parameters should be considered.

The live weight of chickens usually increases with age. Although chickens fed commercial feed (D18) (18 percent CP 2800 Kcal ME/kg) had lower values at the end of the experiment, the final live weights of birds under different diet treatments were statistically similar period. There is no difference in live weight of intensive and partial brooding chicks in the first week. However, from the second week to the sixth week, the intensively fed chickens were heavier than the chickens raised under the partial manure removal system (Nakkazi et al., 2015).

2.2.3 Treatment 1: Normal feed (Premium Stater Food)

Chicken feed comes in two basic forms which is staters and growers. Staters feeds are fed to the chicks after they hatch. Usually, chicks are given starter food until they are six weeks old. Starter feeds are rich in protein, usually 20-24 percent protein, and are designed to meet the nutritional needs of chicks. Chicks aged 6 to 20 weeks should be switched to a growth feed that is lower in protein than the starter feed which is 16-18 percent protein and lower in calcium than normal layer feed breeds. Switching to a growing food is important because feeding a growing pullet too much protein can cause kidney or liver problems later on (Janet, 2021). The whole grain organic chicken feed brand consists of a balanced mix of whole grains or lightly ground grains. Feeds provide a balanced supply of protein, carbohydrates, and fats as well as vitamins and minerals. High quality food allows birds to eat all the nutrients they need without wasting them with products they do not have. Eating foods that are closer to their natural state provides nutrients that are more easily digested by the body. Nutrients are lost during processing and must be replaced with supplements or synthetic forms of vitamins. To raise broilers, be sure that they have access to food 24 hours a day, to encourage maximum growth and weight gain.

In a recent study, according to the study of evaluating the effect of feeding staters crumbles on the overall performance of broilers raised in 42 days by Idan et al. (2020). The researcher aim is to study the physical form of feed affects the feed consumption and growth rate of broilers. They will be using 2 different form of staters feeds which is mash and crumbles for 21 days. All collected experimental data were analyzed using the GLIMMIX SAS 9.4 program, while mean differences were separated using the Tukey test. Results of the study showed that feeding broiler chicks for at least 7 days improved body weight, average daily gain, average daily feed intake and feed conversion ratio compared to mashed feed.

According to Omede & Iji (2018), their study are about the response of broiler chickens to processed soy protein product when offered at different inclusion level in mash or crumbled pre-stater diets. Data were fitted with a general linear model, and Fisher's multiple range test was used to test for significance between treatments at $P \leqslant 0.05$. They investigated that broiler chicken responses to processed soy protein products and found that chickens had higher feed intake, resulting in weight gain, compared to mashed food fed 24 days after hatching higher. The increase in food intake was due to the larger flake size compared to the reduced selective mash feed.

2.2.4 Treatment 2: SK Gold

SK Gold is made using stearin derived from the patented first cut cold process by JF Nutritech SDN. BHD that preserves the natural nutrients available from palm oil, especially the beta carotene and Vitamin E. it contained 1000 ppm of carotene content and 800 ppm of vitamin E. SK Gold is a specially formulated supplement which is designed to improve the general health of the animal thereby allowing for better growth and survival. It also increases the available energy of the chicken, improves feed efficiency, improves overall health, improves growth, and also maintain good quality of meat. For textual, it is highly palatable. SK Gold is specially designed for supplemental additives. SK Gold is a functional powdered fat used as a supplement to improve overall health by providing animals with the necessary energy and vitamins to improve growth and survival. SK Gold contains medium chain triglycerides (MCTs) and emulsifiers that allow animals to better absorb fatty acids and boost immunity. Increased levels of beta-carotene and vitamin E also allow animals to excel even in extreme farm conditions. SK Gold is produced using advanced granulation technology to achieve a highly consistent particle size for good product uniformity.

A study about health benefits of carotenoids and potential application in poultry industry had been by (Nabi et al., 2020), mentioned that carotenoids are lipid-soluble pigments that generate a wide spectrum of colours and are present in a wide variety of plants, microalgae, bacteria, and fungi. Because of their proactive and health-promoting capabilities, there has recently been a surge in interest in employing carotenoids as a feed element in the chicken sector. Carotenoids are potent antioxidants that can reduce the negative effects of oxidative stress through a variety of mechanisms, including free radical scavenging, activation of the phase II cytoprotective response, and downregulation of signaling pathways. As a results, feeding trials in poultry have demonstrated that it improves productivity and reproduction, as well as the oxidative stability of chicken products like eggs and meat.

One of the most important carotenoids is beta-carotene (BC), which is the principal source of vitamin A in poultry feeds. It works on the pigmentation of hens' skin and egg yolks. The antioxidant effects of BC prevent egg and meat degradation. BC has also been found to have a significant impact on the immune system and the endocrine system. BC improves vision, lowers the risk of cardiovascular disease, and prevents inflammation and several cancers (Calistar, 2019). In studies, BC has been found to boost the immune system by increasing antibody responses in poultry and preventing acute respiratory infections. Carotenoids tend to accumulate in the immunological organs of birds. Carotenoids were found to accumulate significantly in the thymus and bursa of fabricius of hens when they were added to the breeding diet. Furthermore, carotenoids from the chicken food were found in carotenoid-consuming diets offered to chicks 4 weeks after hatching. In a century when organic egg and meat production is gaining traction, it is critical to focus more intently on BC, which is thought to have a significant contribution to the achievement of organic and sustainable animal production that is fit for human health.

A study about provitamin A carotenoids from an engineered high carotenoid maize are bioavailable and zeaxanthin does not compromise b-carotene absorption in poultry had been conducted by Díaz-Gómez et al. (2017). The test will be using analysis of variance (ANOVA) statistical tests and Tukey's honest significant difference (HSD) test was used for comparison of means. The results show that, the desirable skin colour of the poultry is achieved by the feed supplementation of synthetic or natural carotenoids. The researchers stated that genetically modified maize having a higher concentration of lutein, β-carotene and zeaxanthin showed similar pigmentation and growth performance to those fed commercial diet with synthetic colour additives.

According to Nogareda et al. (2016), they conducted a study on carotenoid-enriched transgenic maize, which gives bioavailable carotenoids to chickens and protects them from coccidiosis. Experimentation is used to accomplish this study. Carotenoids are organic compounds that promote health by acting as antioxidants and necessary nutrients. They discovered that chickens fed an engineered corn diet have higher levels of four major carotenoids: beta-carotene, lycopene, zeaxanthin, and lutein, as well as more bioavailable carotenoids in peripheral tissues, such as muscle, skin, and fat, and higher retinol levels in the liver, than chickens fed a standard corn diet, including commercial corn supplemented with bird colour additives. When birds were given the protozoan parasite Eimeria tremella, those on the high-carotenoid diet grew normally, had only moderate illness signs such as diarrhea, footpad dermatitis, and digital ulcers, and had lower faucal oocyst counts than those on the control diet. According to the study, a high carotenoid diet administered to broilers improved pigmentation and provided protection against infectious bursal disease. Carotenoid-rich maize can also improve the health of poultry and the nutritional value of poultry products without the use of feed supplements.

2.2.5 Treatment 3: Crude Palm Kernel Oil (CPKO)

Azizi et al. (2021) examine whether palm kernel cake is suitable to be an alternative of feed ingredient for poultry as the cost of feeds have increased continuously due to the price fluctuation of the high quality of raw material as feed ingredient such as corn, wheat, soybean, and others. As Malaysia are the one of the largest productions of palm oil where there is large amount of ready stock for palm oil by-products. The outcomes show that, Palm bit cake (PKC) is probably the most noteworthy amount of locally accessible and conceivably economical agricultural products. PKC provides approximately 14-18 percent crude protein (CP), 12-20 percent crude fibre (CF), 3-9 percent ether extract (EE) and different amounts of various minerals, which can be used as partial replacements Soybean meal (SBM) and corn are used in poultry nutrition. According to the reports, due to indigestion due to high fiber content, the digestibility of poultry is affected, so that the PKC of poultry may be lower. However, solid state fermentation (SSF) can improve the nutritional quality of PKC by increasing CP and reducing CF content. PKC also contains β-mannan polysaccharide, which can be used as a prebiotic. However, the content of PKC in broiler diets varies greatly. These changes may be due to the quality of PKC, its sources, processing methods and value-added processing. According to records, 10-15 percent of processed PKC can be included in broiler diets. The inclusion level does not negatively affect growth performance and carcass yield. In addition, it does not damage the intestinal microbiota, morphology, nutrient digestibility, and immune system. PKC with proper SSF process (FPKC) can provide up to 10-15 percent in the diet without affecting the performance of broilers.

Crude palm oil (CPO) and the main by-product of palm oil milling which is palm kernel cake (PKC) and palm oil mill effluent (POME) have great potential nutritional value for laying hens. The study aims to examine the effects of CPO, OKC and POME as feedstuffs on growth performance and quality characteristics of laying hens (Saminathan et al., 2020). CPO supplies high levels of calories, and its inclusion can increase the absorption of oil-soluble vitamins. The high content of carotenoids in CPO improves egg quality by increasing the fatty acid content and colour intensity of the egg yolk. The eggs can tolerate up to 20-30 percent of PKC in the diet without adversely affecting growth performance or egg quality characteristics. POME can be used as a feed ingredient for laying hens, and the recommended optimal addition amount is 10 percent of the total diet. However, due to high levels of fibrous content in PKC and POME, further biotechnology processing is required to use a better layer diet to produce optimal egg production. The study also found out that replacing conventional food ingredients in the egg-laying diet with PKC and POME was cost effective in improving lining performance and egg quality.

According to Akpodiete (2009), the author examines the performance response and egg qualities of laying birds feed enzyme supplemented palm kernel cake (PKC) based diets. It is using Fisher Least Significant Difference (LSD) Method to test the data. Not only that, they also measure the weight before and after of the chicken to gather the total weight gain of the chicken. The results show that, PKC is a kind of fiber feed. Since nutrients are diluted by fiber, it releases fewer nutrients. Therefore, laying hens can adjust their feed intake to obtain the daily dietary energy levels required for optimal production performance. The increased feed intake of hens fed PKC-based layer diets may also be due to the presence of residual palm oil in PKC, which leads to increased feed palatability.

2.2.6 Treatment 4: PERFAT Pfi-7 (Organic Acids)

Organic acids are increasingly favored by enterprises and researchers as green feed additives, however little attention has been paid to the effects of organic acids on broiler meat quality and blood lipids. According to Ma et al. (2021), their research are about supplementation of mixed organic acids improves growth performance, meat quality, gut morphology and volatile fatty acids of broiler chicken. Experimental data were analyzed by one-way ANOVA using the GLM method and Duncan's multiple comparisons were performed to analyze differences between treatments. The results shows that the dietary supplementation with mixed organic acids can improve growth performance, meat quality, fatty acid profiles and also gut morphology. It also mentions that mixed organic acids can be an effective measure to prevent meat quality decline in chicken meat.

Besides that, Ma & Mahfuz, et al. (2021) also study on the effect of dietary supplementation with mixed organic acids on immune function, antioxidative characteristics, digestive enzymes activity and intestinal health in broiler chickens. Experimental data were analyzed by one-way ANOVA using the GLM method. The results shows that the dietary supplementation of mixed organic acids improved broiler health by boosting immune function, enhanced antioxidant properties and tight junction protein expression and cecum microbiota. But, by considering the combined effect that they found out in their study, the low mixed organic acid group may have suitable for experimentation and economical cost.

According to Hajati (2018), the risk of microorganisms developing resistance to specific antibiotics and antibiotic residues in meat has resulted in a ban on antibiotics as growth promoters in the European Union (EU) since January 2006. Organic acids have gotten a lot of attention recently because of their excellent nutritional value and antibacterial properties. The United States, China, Brazil, Mexico, and Japan are major producers of feed acidifiers, and demand is growing in developing regions such as Latin America, Asia-Pacific, and the Middle East. Organic acids are acidifying nutrients that can be used in poultry feed to avoid or combat undesirable bacteria populations, thus improving the health and performance of the birds in a natural way. However, nutritionists must consider factors such as the kind and age of the birds, the microbial ecology of their gastro-intestinal tracts, and the pH and buffering capacity of nutritious elements. It appears that more research is needed to identify the optimal dosage of each organic acid supplementation at different phases of a fowl's life as well as at different stages of viral disease in poultry.

Phoprasit et al. (2014) study about the effect of adding Vitamin and Organic Acids into the drinking water on growth performance, carcass yield and the meat quality of broilers rose under tropical condition. It divided the broilers into 5 groups, each groups have total of 6 pens. All together it has total of 1500 broilers as its observations. This study was conducted under the Department of Animal Science from Kasetsart University, Thailand at their Animal Research Farm. They used ANOVA to analyze the data and the mean were used Duncan Multiple Range Test. When the treatment with Vitamin A and E added Organic acids into the drinking water, the results shows that the chicken body weight were highly significant, and it shows that the percentage of drip loss of the broiler were significantly decreased. Overall, the combination shows improved in the growth performance and better meat quality in broilers raised in the hot environment.

2.3 Summary of Empirical Reviews

Table 2.2 Summary of Empirical Review of Growth Performance, Age, Different Diet Food Treatments of the Chicken Meat Production Industry.

No	**Author/Years**	**Title**	**Methodology**	**Results**
		Growth Performance		
1.	Atansuyi et al. (2017)	The growth performance characteristics of four chicken genotypes managed under a deep litter feeding system.	ANOVA and Duncan Multiple Range Test	Linear measurements of body weight and body at different ages indicate that an increase in the growth rate of any body part will correspondingly lead to an increase in feed consumption and an increase in live weight of poultry. The growth parameters of different genotype chickens revealed changes in weight gain and feed intake.
2.	Adedeji et al. (2014)	A study on the effect of the organic production on the growth of broiler chickens.	ANOVA and Duncan Multiple Range Test	At week 8, the feed conversion ratio (FCR) of conventional poultry was better than that of organically fed poultry.
3.	Kuietche et al. (2014)	Effect of dietary energy level on growth performance and morphometric parameters of local barred chickens at the starter phase.	ANOVA and Duncan Multiple Range Test	Receiving different feeding systems, the performance of chickens may differ.

No.	Author/Years	Title	Methodology	Results
		Age		
1.	Murawaska (2017)	The Effect of Age on Growth Performance and Carcass Quality Parameters in Different Poultry Species.	-	A longer raising period results in a higher final body weight and muscle output, total production costs rise because older birds grow at a slower rate and consume more feed per kg of body weight gain.
2.	Nakkazi et al. (2015)	The effect of diet and feeding system on the on-farm performance of local chickens during the early growth phase.	Analysis of variance (ANOVA)	The live weight of chickens usually increases with age.
		Treatment 2: SK Gold		
1.	JF Nutritech (2000)	Specially designed supplement additive, SK Gold.	-	To improve the general health, increases the available energy of the chicken, improves feed efficiency, improves overall health, improves growth, and also maintain good quality of meat.
2.	Nabi et al. (2020)	Health benefits of carotenoids and potential application in poultry industry: A review	-	It improves productivity and reproduction, as well as the oxidative stability of chicken products like eggs and meat.
3.	Calislar (2019)	The Important of Beta Carotene on Poultry Nutrition.	-	As organic egg and meat production grows, it is important to focus more on BC, which is thought to play an important role in the development of an organic and sustainable animal production system that is safe for humans.

No.	Author/Years	Title	Methodology	Results
4.	Diaz Gomez (2017)	Provitamin A carotenoids from an engineered high carotenoid maize are bioavailable and zeaxanthin does not compromise b-carotene absorption in poultry	ANOVA and Tukey Honest Significant Difference	The desirable skin colour of the poultry is achieved by the feed supplementation of synthetic or natural carotenoids.
5.	Nogareda et al.(2016)	Carotenoid-enriched transgenic corn delivers bioavailable carotenoids to poultry and protects them against coccidiosis	Experiment	Improved pigmentation and provided protection against infectious bursal disease
Treatment 3: Crude Palm Kernel Oil (CPKO)				
1.	Azizi et al. (2021)	Is palm kernel cake a suitable alternative feed ingredient for poultry?	-	Palm bit cake (PKC) is probably the most noteworthy amount of locally accessible and conceivably economical agricultural products.
2.	Saminathan et al. (2020)	Potential of feeding crude palm oil and co-products of palm oil milling on laying hens' performance and egg quality: A review	-	Replacing conventional food ingredients in the egg-laying diet with PKC and POME was cost effective in improving lining performance and egg quality.
3.	Akpodiete (2009)	Performance response and egg qualities of laying birds feed enzyme supplemented palm kernel cake (PKC) based diets	Fisher Least Significant Difference (LSD) Method	The increased feed intake of hens fed PKC-based layer diets may also be due to the presence of residual palm oil in PKC, which leads to increased feed palatability.

No.	Author/Years	Title	Methodology	Results
Treatment 4: Organic Acid (PERFAT Pfi-7)				
1.	Ma et al. (2021)	Supplementation of mixed organic acids improves growth performance, meat quality, gut morphology and volatile fatty acids of broiler chicken.	One-way ANOVA using the GLM method and Duncan's multiple comparisons	Dietary supplementation with mixed organic acids can improve growth performance, meat quality, fatty acid profiles and also gut morphology.
3.	Ma & Mahfuz, et al. (2021)	Effect of dietary supplementation with mixed organic acids on immune function, antioxidative characteristics, digestive enzymes activity and intestinal health in broiler chickens.	One-way ANOVA using the GLM method.	Dietary supplementation of mixed organic acids improved broiler health by boosting immune function, enhanced antioxidant properties and tight junction protein expression and cecum microbiota.
4.	Hajati (2018)	Application of organic acids in poultry nutrition	-	Organic acids not only improved weight gains also lead to increase of feed consumption and improve feed efficiency.
5.	Phoprasit et al. (2014)	The effect of adding Vitamin and Organic Acids into the drinking water on growth performance, carcass yield and the meat quality of broilers raised under tropical condition.	ANOVA and Duncan Multiple Range Test	The combination of Vitamin C and C with organic acids, the result shows improved in the growth performance and better meat quality in broilers raised in the hot environment.

2.4 Conclusion

In Chapter 2, it has been reviewed on relevant theoretical models and empirical reviews of the study. A summary table about the empirical reviews had summarized the main point of the study by previous researchers. In the next chapter, it will discuss about the methodology that will be use in this study.

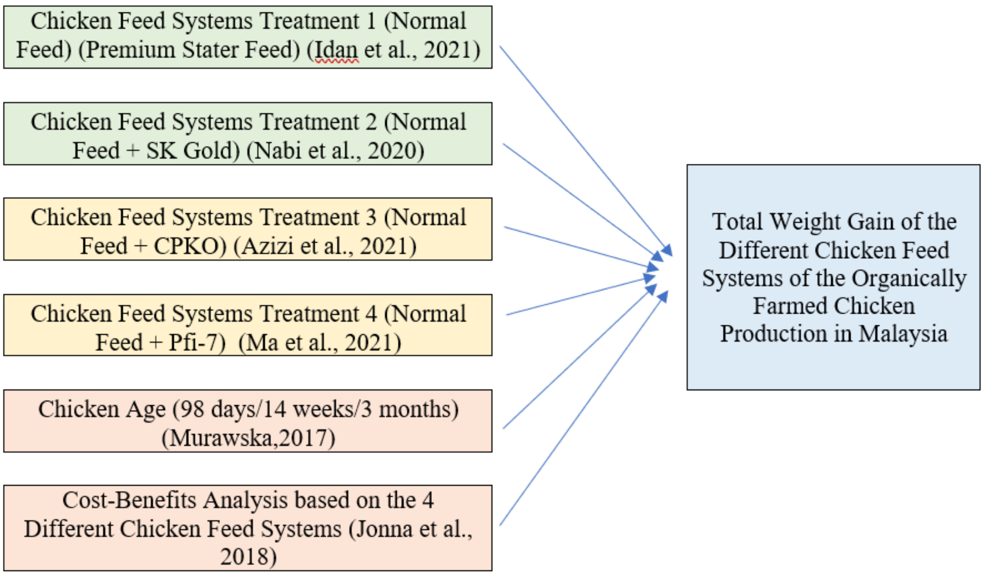
CHAPTER 3: METHODOLOGY

3.0 Introduction

In Chapter 3, an overview of the methods used to collect data was presented to help readers get a better understanding. This chapter will show and describe the many techniques used by researchers, including the study design, variable data collecting method, sample design, data processing, and methodology.

3.1 Conceptual Framework

Figure 3.1 Conceptual Framework of Total Weight Gain of the Different Chicken Feed Systems of the Organically Farmed Chicken Production in Malaysia



Source: Own Development

3.1.1 Model Specification

$TWG_t = \beta_0 + \beta_1 T_{1i} + \varepsilon_i$ (3.1)

$TWG_t = \beta_2 + \beta_3 T_{2i} + \varepsilon_{2i}$ (3.2)

$TWG_t = \beta_4 + \beta_5 T_{3i} + \varepsilon_{3i}$ (3.3)

$TWG_t = \beta_6 + \beta_7 T_{4i} + \varepsilon_{4i}$ (3.4)

$TWG_t = \beta_8 + \beta_9 Age_i + \varepsilon_{5i}$ (3.5)

Benefits and Cost = Total Revenue – Total Cost (3.6)

$$\boldsymbol{BCR = \frac{PV_{benefits}}{PV_{cost}}} \quad (3.7)$$

Where:

TWG_i = Total Weight Gain of the Organic Chickens

T_{1i} = Treatment 1 (Normal Feed) (Premium Stater Feed)

T_{2i} = Treatment 2 (Mixed 100 gram of SK Gold into 50 KG Normal Feed)

T_{3i} = Treatment 3 (Mixed 200 gram of CKPO into 50 KG Normal Feed)

T_{4i} = Treatment 4 (Mixed 100 gram of PERFAT Pfi-7 into 50 KG Normal Feed)

$PV_{benefits}$ = Present Value of Benefits

PV_{costs} = Present Value of Costs

Age_i = Organic Chicken Age from 7 days to 98 days

$\beta_0, \beta_2, \beta_4, \beta_6, \beta_8$ = Intercept

$\beta_1, \beta_3, \beta_5, \beta_7, \beta_9$ = Coefficient of Independent Variables (IV's)

$\varepsilon_i , \varepsilon_{2i} , \varepsilon_{3i} , \varepsilon_{4i} , \varepsilon_{5i}$ = error term

t = Time period 1-3 Months (1 cycle)

3.2 Hypothesis Development

H01: There is no significant relationship between Chicken Feed Systems Treatment 1 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

HA1: There is a significant relationship between Chicken Feed Systems Treatment 1 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

H02: There is no significant relationship between Chicken Feed Systems Treatment 2 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

HA2: There is a significant relationship between Chicken Feed Systems Treatment 2 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

H03: There is no significant relationship between Chicken Feed Systems Treatment 3 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

HA3: There is a significant relationship between Chicken Feed Systems Treatment 3 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

H04: There is no significant relationship between Chicken Feed Systems Treatment 4 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

HA4: There is a significant relationship between Chicken Feed Systems Treatment 4 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

H05: There is no significant relationship between Chicken Age and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

HA5: There is a significant relationship between Chicken Age and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.

H06: There is no significant relationship between Profitability and Total Weight Gain related with the 4 different Chicken Feed Systems of Famers of the Organic Farm Chicken Production in Malaysia.

HA6: There is a significant relationship between Profitability and Total Weight Gain related with the 4 different Chicken Feed Systems of Famers of the Organic Farm Chicken Production in Malaysia.

3.3 Data Estimation Method

3.3.1 Data Collection

In this study, I will be studying the relationship between Total Weight Gain of the Different Chicken Feed Systems and Profitability of Farmers of the Organically Farmed Chicken Production in Malaysia. All the data will be collected by Bintang Maju Agri Full Nature Fresh Sdn Bhd. The data estimation period is from 15 October 2021 to 14 January 2022 total of 1 production cycle which is 14 weeks. 50 pcs of chicken are given for each sample test and will be doing data collecting for 14 weeks. As the results, the replication will be **50pcs x 4 blocks (treatments) x 14 weeks = 2,800 replications**. At least TWO (2) production cycles should be done for this experiment and compared with body weight and cost-benefit of farmers within TWO (2) production cycles. However, the final year project is only 2 semesters (6 months) to complete it the whole process. Therefore, only (1) production cycle data will be analyzed for this study.

The farming experiment research will be conducted in an organic chicken farm, in Sungai Lalang, Semenyih. FOUR (4) different diets feed systems selected include:

1. Premium Starter Feed (as control farm/Treatment 1),
2. Yellow Pigment (Brand: SK Gold) mixed with 100 grams into 50 kg normal feed (as Treatment 2),
3. Crude Palm Kernel Oil (CPKO) mixed 200 grams into 50 kg normal feed (as Treatment 3), and
4. Organic acid mixed with 100 grams into 50 kg normal feed (as Treatment 4).

3.3.2 Sources of the Data

In this study, data will be utilizing from secondary resources. Secondary data is data collected through primary sources that researchers can easily use for their own research. This is the kind of data collected in the past (Wagh, 2022). Researchers may have gathered data for a particular task, at that point, made it accessible to be utilized by other researchers. Data may also be collected for general purposes without specific research purposes, such as a national census. Secondary data classified as a particular study can be said to be primary data for other studies. This is the situation when the data is being reused, making it primary information for the first study and secondary information for the second study. Secondary data sources include books, websites, newspapers, journals, personal profiles, government records and others. Secondary data are known to be promptly accessible contracted than primary data. Using these resources requires a little research and needs of manpower. With the approach of electronic media and internet, secondary data sources can be more easily to access.

3.4 Research Methods

3.4.1 Descriptive Analysis

Descriptive statistics help describe and understand the characteristics of a particular data set by providing a concise summary of the sample and size of the data. Most of the descriptive analysis are using either measure of central tendency or measure of variability. The best-known types of descriptive statistics are measures of central tendency: mean, median and mode, which are used at almost all levels of mathematics and statistics. The data set mode is the most common value, and the median is the graph located in the center of the data set. Calculate the mean or average by adding all the numbers in the data set and dividing by the number of numbers in the set. It is the number that separates the higher number from the lower number in the data set. However, there are also few types of common descriptive statistics that are still very important. While measures of variability include standard deviation, variance, minimum and maximum variables, kurtosis, and skewness. Standard deviation, which describes the variance, or how the observed data in a variable is distributed around the mean (Rawat, 2021).

3.4.2 Correlations Analysis

Correlation analysis is a statistical strategy used to evaluate and show the direction, strength and also degree of association of linear relationship between response and explanatory variables. In short, correlation analysis calculates the degree of change in one variable due to changes in another variable. A high correlation indicates a strong correlation between the two variables, while a low correlation means a weak correlation between the two variables (Gujarati et al., 2009). For market research, most of the researchers use correlation analysis to analyze the quantitative data that been collected through research methods. It will help to determine the relationships, pattern, significant correlations and the trends between both variables and the data that been collected. Besides that, a positive correlation exists between two variables when an increase in one variable leads to an increase in the other variable. On the other hand, a negative correlation means that when one variable increases, the other variable decreases, and vice versa. The coefficient correlation is known as "r" which depicts how strong or how weak pairs of variables are connected in Table 3.1. There are 3 types of correlation between both variables which is positive correlation, negative correlation and weak or zero correlations. First, a positive correlation between two variables means that both variables are moving in the same direction. An increase in one variable leads to an increase in the other variable, and vice versa. Second, a negative correlation between two variables means that the variable is moving in opposite directions. An increase in one variable leads to a decrease in the other, and vice versa. Lastly, when one variable does not affect the other, there will be no weak or zero correlation (Glen, 2013).

Table 3.1 Strength of "r" Relationship.

r	**Strength of Relationship**
< 0.20	Almost Negligible Relationship
0.0 - 0.40	Low Correlation
0.40 - 0.70	Moderate Correlation
0.70 - 0.90	High Correlation
> 0.90	Very High Correlation

Source: Gujarati (2009)

3.4.3 Unit Root Test

A unit root is a metric for determining the degree of stationarity in a time series model. We use statistical Hypothesis testing to determine the stochasticity of the model, also known as a unit root process. Unit roots, according to Hyndman & Athanasopoulos (2021), are statistical hypothesis tests of stationarity used to determine whether differencing is needed. I used an Augmented Dickey Fuller test to check for the presence of a unit root process, though there are a variety of ways to do so. Unit root is important because spikes and shocks to the model will occur in a model with a unit root. That is, a stock price may experience a significant increase or decrease that has nothing to do with seasonality. If the model contains stochasticity, the shock's effect will fade over time. When developing a larger business model, this is an important factor to consider. To determine whether a time series variable has a unit root, the Augmented Dickey-Fuller (ADF) test and the Phillip-Perron test (PP) are used to test for each of the variables at three levels: level, first difference, and second difference.

When serial correlation is a problem, the Augmented Dickey-Fuller (ADF) test can be used. The ADF is capable of handling larger, more complex models. It does, however, have a relatively high Type I error rate. The key is listed in the title for an Augmented Dickey Fuller, and it deals with augmented data. It is a tweaked algorithm that can deal with data with a lot of dimensions.

3.4.4 Vector Autoregression (VAR) Model Analysis

In time series research, vector autoregressive (VAR) models are commonly used to investigate the dynamic relationships that exist between variables that interact with one another. They are also important forecasting tools used by the majority of macroeconomic institutions or policy makers. A vector autoregressive method (VAR model) is a type of unrestricted vector autoregression (VAR) designed for use with cointegrated stationary series by Gilbert (1986) and Hendry & Ericsson (2001). According to Box & Jenkins (1976) and Engle & Granger (1991), all variables are considered endogenous in the VAR approach, which is based on a simultaneous system (dependent). When using VAR, the value of a variable is expressed as a linear function of its lagged values as well as all other variables in the model (Engle & Granger, 1987). The main goal of the VAR is to create a model that can be used for forecasting and modelling. These procedures should not be used unless the underlying variables are stationary or cointegrated.

The Simple Autoregressive Model:

$$Y_t = \sum_{i=1}^{p} \phi_i Y_{t-1} + e_t \quad (3.8)$$

The basic information where Vector Variables (Y_t) = f (Lagged Variables (Y_t)

Following Sims' seminal contribution of 1972, which established a framework for modelling endogenous variables in a multivariate setting, much ongoing research is focused on the development of these models. Following the creation of this framework, a set of statistical tests was created to determine interdependencies and the nature of dynamic relationships between variables. In addition, structural decompositions, sign restrictions, the incorporation of time-varying parameters, structural breaks, and stochastic volatility are just a few of the more recent developments (Gujarati et al., 2009).

The structure of VAR models allows one to explain endogenous variable values based on their previous observed values. 2 These models differ from structural vector autoregressive (SVAR) models in that they allow for the explicit modelling of contemporaneous interdependence between the variables on the left side. Furthermore, important contributions by Engle and Granger (1987) provided econometricians with powerful tools for modelling cointegrated relationships.

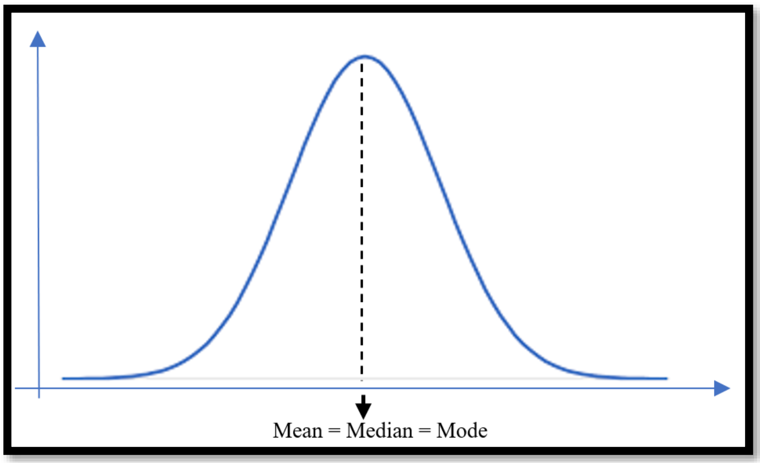
3.5 Residual Diagnosis

3.5.1 Normality

The normal distribution, also known as the Gaussian distribution, is a symmetric probability distribution centered on the mean, indicating that data near the mean occur more frequently than data far from it. The normal distribution will appear as a bell curve on a graph. In statistical reports, most people are familiar with the bell-shaped curve (Gujarati et al., 2009). The mean, mode, and median all have the same value. The normal distribution is a symmetrical continuous probability distribution with most observations clustering around the central peak and probabilities for values further away from the mean tapering off equally in both directions. Extreme values in both the left and right tails of the distribution are also unlikely. While the normal distribution is symmetrical, it is not the same as all symmetrical distributions.

The normal distribution, like any other probability distribution, describes how the values of a variable are distributed. Because it accurately describes the distribution of values for many natural phenomena, it is the most important probability distribution in statistics. Characteristics that are the result of a few independent processes tend to follow a normal distribution.

Figure 3.2 Normal Distribution Graph.



Source: Statistics How To (2018)

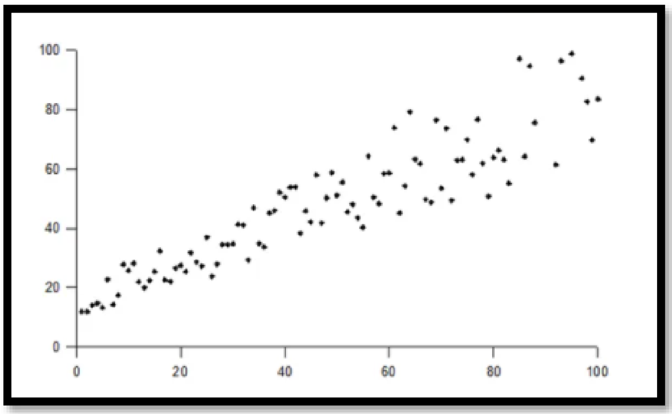
3.5.2 Heteroskedasticity

Heteroskedasticity is when the residual variance is not the same across a series of measurements. When performing regression analysis, heteroskedasticity results in an uneven residual dispersion, also known as an error term. When looking at the plot balance, sectors or cones show heteroskedasticity. In statistics, heteroskedasticity is considered a problem because regressions involving common least squares (OLS) assume that the remainder comes from a population with constant variance. If the residues are unevenly distributed, the populations used in the regression contain unequal variances, and the results of the analysis may be invalid.

To check for heteroskedasticity, it is necessary to first run a regression and analyse the residue. The most common way to check for heteroskedasticity is to plot the residual and run a general White heteroskedasticity test. Visually, if a sector or cone appears in the tray plot, it indicates heteroskedasticity (Gajinkar, 2020). Furthermore, regression with heteroskedasticity showed a pattern of residual variance that increased with the installed values. When there is heteroscedasticity in regression, it can be divided into two types: pure heteroscedasticity and impure heteroscedasticity. Pure heteroskedasticity is when the correct number of independent variables, it also called model specifications, but the residual plots show unequal variances. Impure heteroskedasticity refers to the use of an incorrect number of independent variables, known as incorrect model specification. In this case, the regression may contain too few variables (below the specified value) or too many variables (beyond the specified value). Either way, it produces models with unequal variances.

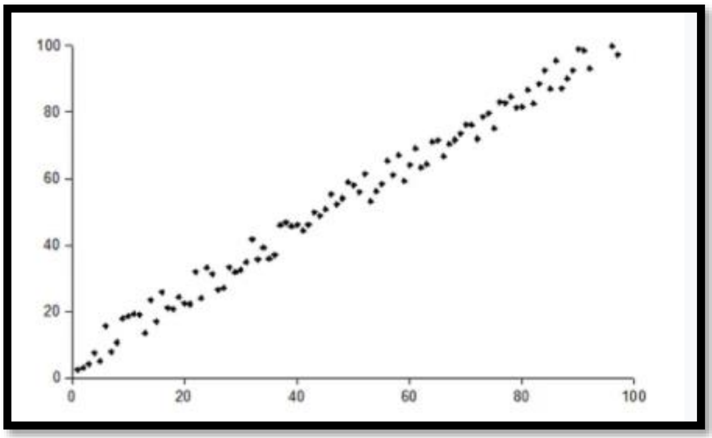
When analyzing regression results, it is important to ensure that the residue has constant variance. Heteroskedasticity (Figure 3.3) is indicated when the observed residues have unequal variances. However, when the residue has a constant variance, it is called homoscedastic. Homoskedasticity (Figure 3.4) refers to a situation where all the independent variables are the same. If the model is homoscedastic, we can assume that the rest come from populations with constant variance. It will satisfy one of the OLS regression assumptions and ensure the model is more accurate.

Figure 3.3 Heteroskedasticity.



Source: Medium (2020)

Figure 3.4 Homoskedasticity.



Source: Medium (2020)

3.5.3 Multicollinearity

Multicollinearities happen when there is high intercorrelations between two or more independent variables in a single multiple regression model. When researchers try to determine the best way to use each independent variable to predict or understand the dependent variable in a statistical model, multicollinearity can lead to biased or misleading results. Normally, multicollinearity results in wider confidence intervals and thus a lower probability of reliability for the effects of independent variables in the model. When building multiple regression models that use two or more variables, it is best to use uncorrelated or repeated independent variables. The presence of multicollinearity in the dataset can lead to less reliable results due to large standard errors.

In the multiple regression model, multicollinearity shows that collinear independent variables are associated in some way, whether or not the relationship is casual. In other words, when two independent variables are significantly associated, multicollinearity might occur. It can also happen if an independent variable is calculated using data from other variables in the data set, or if two independent variables produce similar and consistent findings. In a regression model, there is an easy test for determining multicollinearity. The Variance Inflation Factors (VIF) determines the degree of the connection between the independent and dependent variables (Frost, 2017).

For each independent variable, statistical software creates a VIF. VIFs have no maximum limit and start at 1. A value of 1 denotes that there is no relationship between this independent variable and any other variables. VIFs between 1 to 5 indicate a moderate association, but not one significant enough to justify corrective action. VIFs larger than 5 indicate critical levels of multicollinearity, with poorly calculated coefficients and doubtful p-values. Determine the strength of linkages by using VIFs to detect correlations between variables. Most statistical software can show you VIFs. Because observational studies are more likely to have multicollinearity, assessing VIFs is particularly crucial.

3.6 Model Evaluation

3.6.1 RMSE

The Root Mean Square Error (RMSE) (Figure 3.5) is the standard deviation of the residuals. Residual is a measure of the distance of a regression line data point. However, RMSE is a measure of the way this waste is distributed. In other words, it shows how concentrated the data is near the most appropriate line (Gujarati et al., 2009). RMSE is commonly used in climatology, prediction, and regression analysis to validate experimental results.

Figure 3.5 Root Mean Square Error formula.

$$\text{Root Mean Square Error (RMSE)} = \sqrt{\frac{\sum (P_t - A_t)^2}{T}}$$

3.6.2 MAE

The Mean Absolute Error (MAE) (Figure 3.6) is a statistic that assesses the average magnitude of errors in a group of forecasts without taking into account their direction. It assesses the precision of continuous variables. Expressed in words, the MAE is the average of the absolute values of the discrepancies between the forecast and the relevant observation over the verification sample. The MAE is a linear score, which implies that in the average, all individual differences are equally weighted.

Figure 3.6 Mean Absolute Error formula.

$$\text{Mean Absolute Error (MAE)} = \frac{\sum(|P_t - A_t|)}{T}$$

3.6.3 MAPE

The mean absolute percentage error (MAPE) (Figure 3.7) is the average or mean of all anticipated absolute percentage errors. Error is defined as the difference between the actual or observed value and the projected value. To compute MAPE, percentage errors are added together without respect to sign. Because the mistake is expressed in percentages, this measure is simple to comprehend. The problem of positive and negative errors cancelling each other is also avoided when absolute percentage errors are employed. As a result, MAPE has managerial appeal and is a common forecasting metric. The better the forecast, the lower the MAPE.

Figure 3.7 Mean Absolute Percent Error formula.

$$\text{Mean Absolute Percent Error (MAPE)} = \frac{\sum \left(\left| P_t - A_t \right| / A_t \right) * 100}{T}$$

3.6.4 U-Theil Statistics

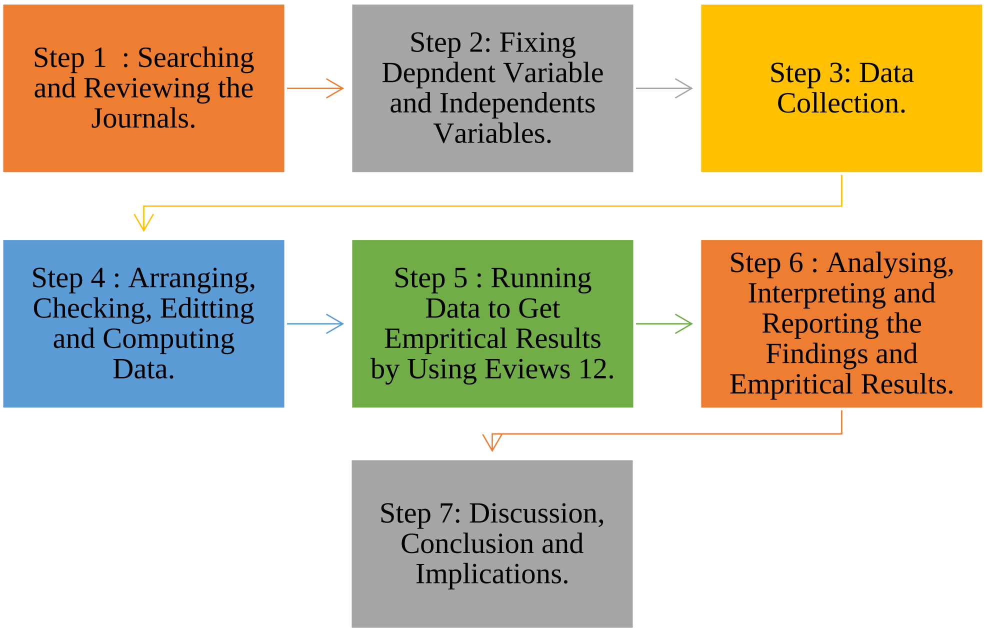
Theil's Inequality Coefficient, commonly known as U-Theil Statistics (Figure 3.8), is a measure of inequality. It shows how well a time series of estimated values matches up with a time series of observed values. The model's fitness is also measured using U-Theil Statistics, which has a range of 0 to 1. The model is better if the result is close to 0, because a model that is close to 0 is a fitted model. It will be chosen the model with the best and smallest values.

Figure 3.8 U-Theil Statistic formula.

$$\text{U-Theil (U-Stat) Criteria} = \frac{\sqrt{\frac{\sum (P_t - A_t)^2}{T}}}{\sqrt{\frac{\sum (P_t)^2}{T}} + \sqrt{\frac{\sum (A_t)^2}{T}}}$$

3.7 Data Analysis Procedure

Figure 3.9 Steps of Data Procedure



Source: Own Development

Step 1: Searching and Reviewing the Journals.

Numbers of journal with the relation of the 4 different feeds system, age and profitability on chicken total weight gain had been reviewed and found on the database of Google Scholars, Science Direct, Scopus and others reliable database. The journal that been reviewed and selected are mostly from around the world, almost 100 journals or articles had been reviewed for this study.

Step 2: Fixing Dependent Variable and Independents Variables.

Dependent variables and exogenous variables will be fixed by the discussion on the summaries of the journals and articles that been summarised. Weekly data will be used in this study as Bintang Maju Agri Full Nature Fresh Sdn Bhd. will provide the data of the total weight gain of the chicken that feed in 4 different feeds systems.

Total weight gain of the chicken will be the dependent variables while 4 different feeds systems, profitability of the farmers and the age will be the independent variables.

Step 3: Data Collection.

The data of both dependent variable and independent variables will be collected by Bintang Maju Agri Full Nature Fresh Sdn Bhd.

Step 4: Arranging, Checking, Editing and Computing Data.

The data is arranged in an excel file after it has been collected. The data were double-checked to ensure that they were in the correct order and in column form. After that, edit the names of the dependent and independent variables in proxy from. When an error occurs, data editing will be used as well. Finally, through diagnostic checking, compute data to see if there is any error in the empirical model. If econometric issues arise, data editing or E-views 12 can be used to resolve them.

Step 5: Running Data to Get Empirical Results by Using Eviews 12.

After ensuring the model has no problem, then using E-views 12 to run descriptive analysis, correlation coefficient, multiple linear regression, unit root test, VAR, granger causality, residual diagnosis and model evaluation to get the empirical results. So that, the test can be run and R-squared and Adjusted R-squared can be obtained.

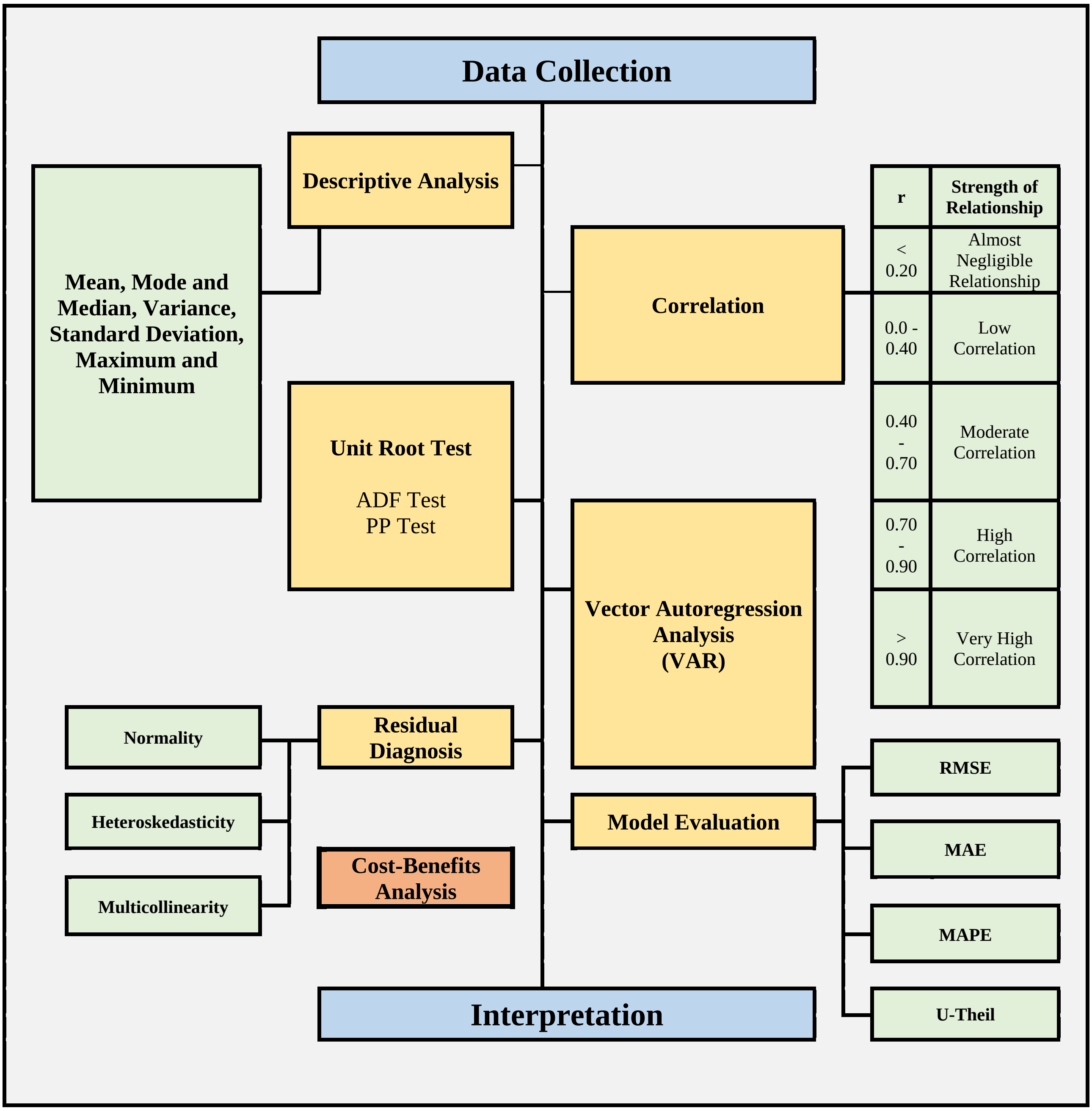
Step 6: Analyzing, Interpreting and Reporting the Findings and Empirical Results.

Individual exogenous variables and the entire model's significance are verified. After that, it is interpreting the significances of the exogenous variables and the entire model, as well as R-squared and Adjusted R-squared. In addition, comparing these findings to those of previous researchers and determining whether the findings are consistent with the hypothesis presented in Chapter 3.

Step 7: Discussion, Conclusion and Implications.

After interpreting the results, the results will be disccuesd compared with previouse study. Conclusion will be make after the disscussion and suggestion will be provided at the end of the study.

Figure 3.10 Data Estimation Procedure of Total Weight Gain, Age with the Different Chicken Feed Systems and Profitability of Farmers of the Organically Farmed Chicken Production in Malaysia.



Source: Own Development

3.8 Conclusion

Research Methodology were used for collecting, analyzing, and interpreting the data that been gathered. Software that will be used are Eviews 12 to assist in doing analysis and interpreting the results that been ran.

This chapter clearly discussed the research design, data sources and data collection. All data are collected by Bintang Maju Agri Full Nature Fresh Sdn Bhd. The research methodology applied in this research is also clearly stated in this chapter. Every result of the empirical test will be carried out by using empirical tool Eviews 12. The empirical result will be discussed in the following chapter.

CHAPTER 4: DATA ANALYSIS AND RESULTS

4.0 Introduction

This chapter will present the findings of the empirical results of the relationship between the Total Weight Gain of the Different Chicken Feed Systems of the Organically Farmed Chicken Production in Malaysia that explained in Chapter 3. The tests that present in this chapter included the Descriptive Analysis, Unit Root Test, Correlation, VAR Model Analysis, Residual Diagnosis, Model Evaluation, Diagnostic Test and Cost-Benefits Analysis.

4.1 Descriptive Analysis

Table 4.1 Descriptive Statistics of Body Weight, Age and Different Diet Systems.

	Body Weight	**Age**	**T1**	**T2**	**T3**	**T4**
Mean	64.9364	52.5000	0.2500	0.2500	0.2500	0.2500
Median	63.5700	52.5000	0.0000	0.0000	0.0000	0.0000
Maximum	129.0700	98.0000	1.0000	1.0000	1.0000	1.0000
Minimum	4.4400	7.0000	0.0000	0.0000	0.0000	0.0000
Std. Dev.	43.7842	28.4733	0.4369	0.4369	0.4369	0.4369
Skewness	0.0591	0.0000	1.1547	1.1547	1.1547	1.1547
Kurtosis	1.5018	1.7877	2.3333	2.3333	2.3333	2.3333
Obse	56	56	56	56	56	56

Source: Eviews Output

For this study, 56 observations (4 different diet system x 14 weeks for average body weight for 50 chicken = 56 observations) will be included, comprises of time-series data. The total body weight of 50 chickens, we will take it average body weight for a total of 14 weeks. 14 weeks of production cycle will be multiplied by 4 different diet systems as it will get 56 observations.

Based on Table 4.1, the results indicate that the average body weight is 64.9364. The median shows that the middle value of body weight is around 63.57. In addition, the maximum and minimum value of body weight is from 4.44 to 129.07. Besides, the mean value for age and the median of age shows that the middle value is around 52.5. Furthermore, the maximum and minimum value of age is from 7 to 98. Lastly, the average value for all the treatment 1 (T1), treatment 2 (T2), treatment 3 (T3) and treatment 4 (T4) is 0.25 and for the median value are 0.

4.2 Correlation Analysis

Table 4.2 Correlation Analysis for Body Weight, Age and Different Diet Systems of Chicken Meat Production.

	Body Weight	**Age**	**Normal (T1)**	**SK Gold (T2)**	**CPKO (T3)**	**Organic Acid (T4)**
Body Weight	1.0000	0.9918	-0.0159	0.0177	-0.0087	0.0068
Age	**0.9918**	1.0000	0.0000	0.0000	0.0000	0.0000
Normal (T1)	**-0.0159**	0.0000	1.0000	-0.3333	-0.3333	-0.3333
SK Gold (T2)	**0.0177**	0.0000	-0.3333	1.0000	-0.3333	-0.3333

CPKO (T3)	**-0.0087**	0.0000	-0.3333	-0.3333	1.0000	-0.3333
Organic Acid (T4)	**0.0068**	0.0000	-0.3333	-0.3333	-0.3333	1.0000

Source: Eviews Output

Based on Table 4.2, the correlation between the variables in the original data. From the table above, the correlation of the variables shows that there is very high positive relationship between body weight and age with the value of 0.9918. That means when age increases, body weight will also increase within the 14 weeks of production cycle. Next, the correlation results between body weight and treatment 1 is negatively almost negligible correlation with the value of -0.0159. Where the chicken is feed with treatment 1 within the 14 weeks, the chicken body weight will increase. But when it exceeded the 14 weeks like we feed using treatment 1 on week 15, the body weight of chicken will decrease by 0.3044. Furthermore, the correlation between body weight and treatment 2 are positively related but almost negligible correlations with the value of 0.0177. When the chicken is feed under treatment 2 more than 14 weeks, the body weight of chicken will still increase by 0.3393.

However, the results also show that between body weight and treatment 3 (T3) are also negatively related with almost negligible correlation of -0.0087. When the chicken feed under treatment 3 for 14 weeks, it will show the body weight will increase weekly. But when it reached week 15, the body weight will not increase anymore even it will decrease about 0.1658. Lastly, the relationship between treatment 4 and body weight are positively related but it almost negligible correlation with the value of 0.0068. So, when the chicken is feed under treatment 4 for more than 14 weeks, the body weight will still increase. The reason of the body weight increase and decrease over the 14 weeks of production cycle are when the age increased weekly, the chicken will adapt to the suitable treatment to grow so that the tissue and muscle could grow. But if the chicken does not adapt to the treatment after 14 weeks, the tissue and muscle of the chicken will not increase the body weight of the chicken anymore. it will lead to decrease n body weight.

4.3 Unit Root Analysis

Table 4.3 Results of Unit Root Test for Body Weight, Age and Different Diet Systems of Chicken Meat Production.

Variables	ADF Statistics			PP Statistics		
	Level	1st Diff	2nd Diff	Level	1st Diff	2nd Diff
Body Weight	-2.7178**	-7.0046***	-7.9516***	-2.8526**	-7.0044***	-45.7335***
Age	-3.1809**	-7.6485***	-8.5732***	-3.1809**	-7.7138***	-12.3693***
T1	-1.7433*	-7.3485***	-8.5732***	-1.7420*	-7.3485***	-12.3693***
T2	-1.6331*	-7.2111***	-8.5732***	-1.6985*	-7.2111***	-12.3693***
T3	-1.6331*	-7.2111***	-8.5732***	-1.6985*	-7.2111***	-12.3693***
T4	-0.5528	-7.3485***	-8.5732***	-0.5528	-7.3485***	-12.3693***

Note: ADF and PP test t-statistics significant at α level 0.10 *, 0.05**, 0.01 ***.

Source: Eviews Output

Based on Table 4.3 the unit root test, all the variables are stationary at the level data (original data) except Treatment 4 (T4) is non-stationary at the level data for both Augmented Dickey-fuller (ADF) and Phillips-Perron (PP) tests. All the variables turned stationary as a result of transforming into first differencing and second differencing data. At the level data, both ADF and PP test shows that body weight and age are at α level 0.05** statically significant, while treatment 1 (T1), treatment 2 (T2) and treatment 3 (T3) are at α level 0.10* statically significant. Besides, both tests also shows that all the variables are significant at α level 0.01 *** for first differencing and second differencing data. Overall, since most of the variable is stationary at the level data (original data). Therefore, this study will be conducted the Vector Autoregression estimation procedure (VAR). If all the variables of the study are stationary at the first differencing and second differencing data, this study will be tested the Vector Error Correction Procedure (VECM) and Co-integration equation.

4.4 Vector Autoregression Model (VAR)

Ln Body Weight $_t$ = 2.6444 **+ 0.0416 Age$_{t-1}$ + 0.2589 ln BodyWeight$_{t-1}$** + 0.2867 εt **(4.1)**

t-statistics = [1.5091*] [3.2247**]

R^2 = 0.3194 Adjusted R^2 = 0.2932

Based on the Ln Body Weight model Equation (4.1), the explanatory variables accounted for about 32 percent of the variation in the Body Weight equation. Estimation reveals that the explanatory variables, namely the age and lagged of the Body Weight were the important explanatory variables with statistically significance at the α 0.10 level and at the α 0.05 level. Therefore, 1 day increases in age, on average, has a positive effect on increasing in the body weight by 0.0416 kg with statistically significance at the level 0.10 level, holding other variables constant. Moreover, the lagged of the Body Weight was statistically significance at the α 0.05 level, therefore, age and Body Weight was short-term relationship within production cycle in this study.

Ln Body Weight $_t$ = 2.6736 **+ 0.0640 T1 $_{t-1}$ + 0.3121 ln BodyWeight$_{t-1}$** + 0.2917 εt **(4.2)**

t-statistics = [2.2937**] [4.4032**]

R^2 = 0.3178 Adjusted R^2 = 0.2916

According to the Ln Body Weight model Equation (4.2), the explanatory variables accounted for about 32 percent of the variation in the Body Weight equation. Estimation reveals that the explanatory variables, namely the treatment 1 (T1) and lagged of the Body Weight were the important explanatory variables with statistically significance at the α 0.05 level. Therefore, 1 unit increases in treatment 1, on average, has a positive effect on increasing in the body weight by 0.0640 kg with statistically significance at the level 0.05 level, holding other variables constant. Moreover, the lagged of the Body Weight was statistically significance at the α 0.05 level, therefore, T1 and Body Weight was short-term relationship within production cycle in this study.

$$\text{Ln Body Weight}_t = 2.6666 + \mathbf{0.3079\ T2_{t-1}} + \mathbf{0.3122\ ln\ BodyWeight_{t-1}} + 0.2906\ \varepsilon t \qquad \textbf{(4.3)}$$

t-statistics = [3.1863**] [4.4046**]

$R^2 = 0.3173$ Adjusted $R^2 = 0.2910$

Based on the Ln Body Weight model Equation (4.3), the explanatory variables accounted for about 32 percent of the variation in the Body Weight equation. Estimation reveals that the explanatory variables, namely the treatment 2 (T2) and lagged of the Body Weight were the important explanatory variables with statistically significance at the α 0.05 level. Therefore, 1 unit increases in treatment 2, on average, has a positive effect on increasing in the body weight by 0.3079 kg with statistically significance at the level 0.05 level, holding other variables constant. Moreover, the lagged of the Body Weight was statistically significance at the α 0.05 level, therefore, T2 and Body Weight was short-term relationship within production cycle in this study.

$$\text{Ln Body Weight}_t = 2.6711 + \mathbf{0.5381\ T3}_{\mathbf{t-1}} + \mathbf{0.3121\ ln\ BodyWeight}_{\mathbf{t-1}} + 0.2911\ \varepsilon t \quad \mathbf{(4.4)}$$

t-statistics = [3.2654**] [4.4037**]

$R^2 = 0.3177$ Adjusted $R^2 = 0.2914$

Based on the Ln Body Weight model Equation (4.4), the explanatory variables accounted for about 32 percent of the variation in the Body Weight equation. Estimation reveals that the explanatory variables, namely the treatment 3 (T3) and lagged of the Body Weight were the important explanatory variables with statistically significance at the α 0.05 level. Therefore, 1 unit increases in treatment 3, on average, has a positive effect on increasing in the body weight by 0.5381 kg with statistically significance at the level 0.05 level, holding other variables constant. Moreover, the lagged of the Body Weight was statistically significance at the α 0.05 level, therefore, T4 and Body Weight was short-term relationship within production cycle in this study.

$$\text{Ln Body Weight}_t = 2.6120 + \mathbf{0.2728\ T4}_{\mathbf{t-1}} + \mathbf{0.3131\ ln\ BodyWeight}_{\mathbf{t-1}} + 0.2923\ \varepsilon t \quad \mathbf{(4.5)}$$

t-statistics = [3.7922**] [4.4166**]

$R^2 = 0.3253$ Adjusted $R^2 = 0.2994$

Based on the Ln Body Weight model Equation (4.5), the explanatory variables accounted for about 33 percent of the variation in the Body Weight equation. Estimation reveals that the explanatory variables, namely the treatment 4 (T4) and lagged of the Body Weight were the important explanatory variables with statistically significance at the α 0.05 level. Therefore, 1 unit increases in treatment 4, on average, has a positive effect on increasing in the body weight by 0.2728 kg with statistically significance at the level 0.05 level, holding other variables constant. Moreover, the lagged of the Body Weight was statistically significance at the α 0.05 level, therefore, T4 and Body Weight was short-term relationship within production cycle in this study.

4.5 Cost-Benefits Analysis

Table 4.4 Calculation of BCR ratio and Profit or Loss.

ITEM	T1 (Control)	T2 (CPKO)	T3 (Organic Acid)	T4 (SK Gold)	Overall
Small chicken - 50pcs x RM3.50	175	175	175	175	700
feed for 100 days - 100g x cost of feed (RM15 per day)	1470	1470	1470	1470	5880
CPKO	-	100	-	-	100
Organic Acid	-	-	150	-	150
SK Gold	-	-	-	100	100
Effective microorganic - 3 bottles x RM40	-	-	-	-	120
Antibiotic (flushing)	-	-	-	-	150
Labour - RM1500 x 3 months	-	-	-	-	4500
Isotop & vitamin	-	-	-	-	150
Weight mechine	-	-	-	-	150
	-	-	-	-	-
	-	-	-	-	-
	-	-	-	-	-
Total Cost (For 3 months' Cost)	-	-	**Total Cost =**	-	**12000**
	-	-	-	-	-
Total Revenue	-	-	-	-	-
	RM/Kg	50 Chicken Body Weight (Kg)	-	-	-
Treatment 1, Control	25	125	-	-	3125
Treatment 2, CPKO	30	130	-	-	3900
Treatment 3, Organic Acid	30	130	-	-	3900
Treatment 4, SK Gold	30	130	-	-	3900

	- -	- -	- **Total Revenue =**	- -	**14825**
Profit/Loss (For 3 months' Cost)	- -	- -	**Net Profit =**	- -	**2825**
BCR Ratio (For 3 months' Cost)	- -	- -	**BCR Ratio =**	- -	**1.2354**
	-	-		-	

Source: Eviews Output

BCR Ratio = TR / TC

BCR = RM 14825/ RM 12000

BCR = 1.2354

Profit or loss

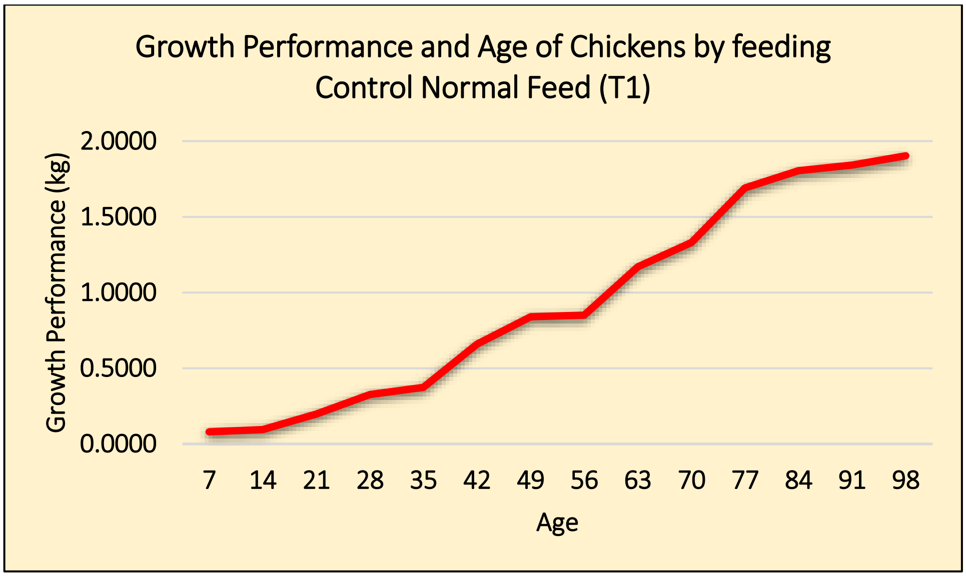
Total profit – total cost = RM 14825 – RM 12000 = RM 2825

As Table 4.4, it shows the calculation for the profit and loss and the BCR ratio of the entire project. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors. If a project's BCR is less than 1.0, the project's costs outweigh the benefits, and it should not be considered. Besides that, if the profit is greater than the loss, the project is acceptable as the expenses can be covered. Then the project is considered as success and acceptable. But if the expenses are greater than the profit, then the farmers are not recommended to continue the business as the debt will accumulate even higher when they operate in the long run.

4.6 Total Weight Gain for Treatment

Based on Figure 4.1, it shows the relationship of age and growth performance (Kg). The graph shows that there is positive relationship between age and growth performance where the chicken is feed by using normal feed for 14 weeks. In this study, *normal feed* will be categories as Premium Stater Feed (as control farm/ *Treatment* 1). As the age increase day by day, the growth performance of the chicken – body weight will also increase.

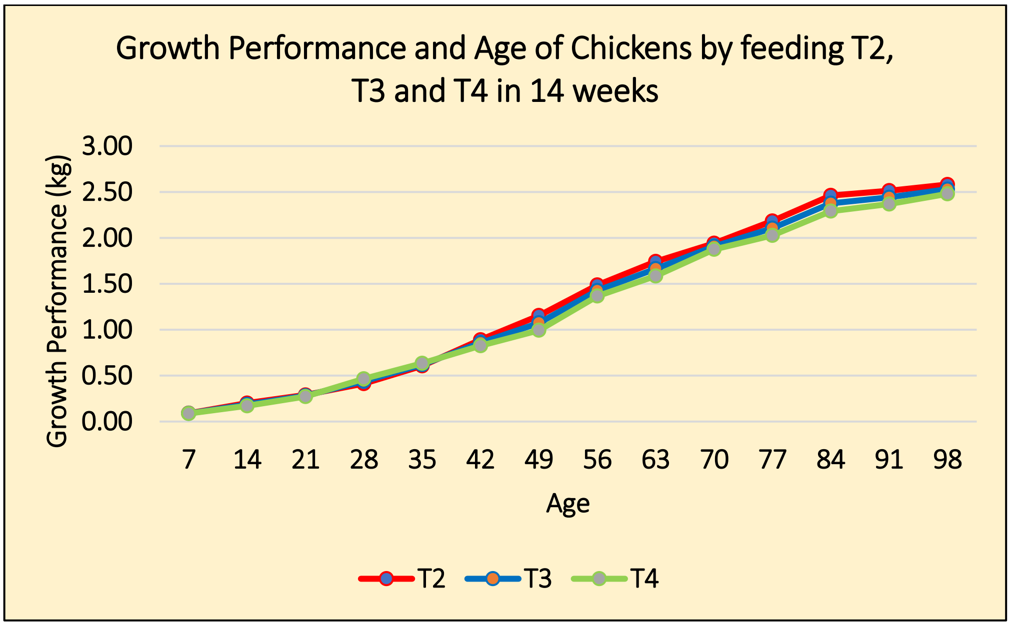
Figure 4.1 Growth Performance and Age of Chickens by feeding Treatment 1



Source: Bintang Maju Agri SDN. BHD (2021)

Based on Figure 4.2, the data show that the relationship of the body weight gain and age are positively related. The diet systems that been used are *Treatment 2* (Normal Feed with SK Gold), *Treatment 3* (Normal Feed with Crude Palm Kernel Oil) and *Treatment 4* (Normal Feed with Organic Acid, Pfi-7). According to graph below, it shows that the growth performance for *Treatment 2* is slightly higher than *Treatment 3* and *Treatment 4*.

Figure 4.2 Growth Performance and Age of Chickens by feeding T2, T3 and T4 after 98 days feeding.



Source: Bintang Maju Agri SDN. BHD (2021)

4.7 Hypothesis Testing

Table 4.5 Hypothesis Testing Body Weight, Age and Different Diet Systems of Chicken Meat Production.

Hypothesis	Description	Support/Reject
HA_1	There is a significant relationship between Chicken Feed Systems Treatment 1 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.	Support
HA_2	There is a significant relationship between Chicken Feed Systems Treatment 2 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.	Support
HA_3	There is a significant relationship between Chicken Feed Systems Treatment 3 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.	Support
HA_4	There is a significant relationship between Chicken Feed Systems Treatment 4 and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.	Support
HA_5	There is a significant relationship between Chicken Age and Total Weight Gain of the Organic Farm Chicken Production in Malaysia.	Support
HA_6	There is a significant relationship between Profitability and Total Weight Gain related with the 4 different Chicken Feed Systems of Famers of the Organic Farm Chicken Production in Malaysia.	Support

Source: Own Development

Therefore, based on Table 4.5, hypotheses of body weight, age and different diet systems of chicken meat production are reject HOs and supported to HAs.

4.8 Residual Diagnosis

Table 4.6 Residual Diagnosis **Body Weight and Age** of Chicken Meat Production.

Diagnostic Tests	Results	Hypothesis	Decision
Normality Test (Jarque-Bera)	JB Statistics: 3.4599 Prob Value: 0.1773	H0: Residuals are normally distributed. Ha: Residuals are not normally distributed.	P-value > α 0.05 **Do not reject Ho.**
Heteroscedasticity Test (White test)	F Statistic: 3.5554 Prob value: 0.0356	H0: Residuals are no heteroscedasticity. Ha: Residuals are heteroscedasticity.	P-value < α 0.05 **Do not reject Ho.**
Multicollinearity Test (Variance Inflation Factor – VIF)	$VIF = 1 / (1 - R^2)$ $VIF = 1/ (1 – 0.1183)$ VIF = 1.1342	H0: Residuals are not multicollinearity. Ha: Residuals are multicollinearity.	VIF < 10 **Do not reject Ho.**

Source: Eviews Output

Based on Table 4.6, in the Ln body weight and age model, the residual is normally distributed as the p-value is greater than α level 0.05. Not only that, in this model there is also serial correlation and heteroscedasticity problems as the p-value are smaller than α level 0.05, where the value is 0.0356 and 0.0004, respectively. Lastly, the model also having multicollinearity issues as the sample size is big.

Table 4.7 Residual Diagnosis **Body Weight and Treatment 1** (Normal) of Chicken Meat Production.

Diagnostic Tests	Results	Hypothesis	Decision
Normality Test (Jarque-Bera)	JB Statistics: 5.2699 Prob Value: 0.0717	H0: Residuals are normally distributed. Ha: Residuals are not normally distributed.	P-value > α 0.05 **Do not reject Ho.**
Heteroscedasticity Test (White test)	F Statistic: 0.0530 Prob value: 0.8188	H0: Residuals are no heteroscedasticity. Ha: Residuals are heteroscedasticity.	P-value > α 0.05 **Do not reject Ho.**
Multicollinearity Test (Variance Inflation Factor – VIF)	$VIF = 1 / (1-R^2)$ $VIF = 1/ (1 – 0.0010)$ $VIF = 1$	H0: Residuals are not multicollinearity. Ha: Residuals are multicollinearity.	VIF < 10 **Do not reject Ho.**

Source: Eviews Output

Based on Table 4.7, in the Ln body weight and treatment 1 model, the residual is normally distributed as the p-value is greater than α level 0.05. Not only that, in this model there is also serial correlation problems as the p-value are smaller than α level 0.05, where the value is 0. Lastly, the model does not have multicollinearity and heteroscedasticity issues.

Table 4.8 Residual Diagnosis **Body Weight and Treatment 2** (SK Gold) of Chicken Meat Production.

Diagnostic Tests	Results	Hypothesis	Decision
Normality Test (Jarque-Bera)	JB Statistics: 5.2728 Prob Value: 0.0716	H0: Residuals are normally distributed. Ha: Residuals are not normally distributed.	P-value > α 0.05 **Do not reject Ho.**
Heteroscedasticity Test (White test)	F Statistic: 0.0791 Prob value: 0.7798	H0: Residuals are no heteroscedasticity. Ha: Residuals are heteroscedasticity.	P-value > α 0.05 **Do not reject Ho.**
Multicollinearity Test (Variance Inflation Factor – VIF)	$VIF = 1 / (1-R^2)$ $VIF = 1/ (1 – 0.0015)$ VIF = 1	H0: Residuals are not multicollinearity. Ha: Residuals are multicollinearity.	VIF < 10 **Do not reject Ho.**

Source: Eviews Output

In addition, based on Table 4.8, in the Ln body weight and treatment 2 model, the residual is normally distributed as the p-value is greater than α level 0.05. Not only that, in this model there is also serial correlation problems as the p-value are smaller than α level 0.05, where the value is also 0. Lastly, the model does not have multicollinearity and heteroscedasticity issues.

Table 4.9 Residual Diagnosis **Body Weight and Treatment 3** (CPKO) of Chicken Meat Production.

Diagnostic Tests	Results	Hypothesis	Decision
Normality Test (Jarque-Bera)	JB Statistics: 5.2710 Prob Value: 0.0717	H0: Residuals are normally distributed. Ha: Residuals are not normally distributed.	P-value > α 0.05 **Do not reject Ho.**
Heteroscedasticity Test (White test)	F Statistic: 0.01356 Prob value: 0.9077	H0: Residuals are no heteroscedasticity. Ha: Residuals are heteroscedasticity.	P-value > α 0.05 **Do not reject Ho.**
Multicollinearity Test (Variance Inflation Factor – VIF)	VIF = 1 / $(1-R^2)$ VIF = 1/ (1 – 0.0003) VIF = 1	H0: Residuals are not multicollinearity. Ha: Residuals are multicollinearity.	VIF < 10 **Do not reject Ho.**

Source: Eviews Output

Furthermore, based on Table 4.9, in the Ln body weight and treatment 3 model, the residual is normally distributed as the p-value is greater than α level 0.05. Not only that, in this model there is also serial correlation problems as the p-value are smaller than α level 0.05, where the value is also remain 0. Lastly, the model does not show multicollinearity and heteroscedasticity issues.

Table 4.10 Residual Diagnosis **Body Weight and Treatment 4** (Organic Acid) of Chicken Meat Production.

Diagnostic Tests	Results	Hypothesis	Decision
Normality Test (Jarque-Bera)	JB Statistics: 5.2699 Prob Value: 0.0717	H0: Residuals are normally distributed. Ha: Residuals are not normally distributed.	P-value > α 0.05 **Do not reject Ho.**
Heteroscedasticity Test (White test)	F Statistic: 0.0530 Prob value: 0.8188	H0: Residuals are no heteroscedasticity. Ha: Residuals are heteroscedasticity.	P-value > α 0.05 **Do not reject Ho.**
Multicollinearity Test (Variance Inflation Factor – VIF)	VIF = 1 / (1-R^2) VIF = 1/ (1 – 0.0001) VIF = 1	H0: Residuals are not multicollinearity. Ha: Residuals are multicollinearity.	VIF < 10 **Do not reject Ho.**

Source: Eviews Output

Last but not lease, based on Table 4.10, in the Ln body weight and treatment 4 model, the residual is normally distributed as the p-value is greater than α level 0.05. However, in this model there is serial correlation problems as the p-value are smaller than α level 0.05, where the value is 0. Lastly, the model does not have multicollinearity and heteroscedasticity issues.

4.9 Model Evaluation

Table 4.11 Model Evaluation of Original Data.

Body Weight	Age	Treatment 1	Treatment 2	Treatment 3	Treatment 4
RMSE	5.5484	43.3861	43.3847	43.38992	43.3905
MAE	4.9232	39.2932	39.2932	39.2932	39.2932
MAPE	25.4064	206.3750	206.3552	206.3427	206.3540
U-Theil Statistics	0.0356	0.3033	0.3033	0.3033	0.3034

Source: Eviews Output

Table 4.12 Model Evaluation of Ln Data.

Ln Body Weight	Age	Treatment 1	Treatment 2	Treatment 3	Treatment 4
RMSE	**0.3239**	**1.0238**	**1.0238**	**1.0238**	**1.0238**
MAE	**0.2654**	**0.8661**	**0.8661**	**0.8661**	**0.8663**
MAPE	**8.8251**	**30.5145**	**30.5143**	**30.5137**	**30.5183**
U-Theil Statistics	**0.0413**	**0.1326**	**0.1326**	**0.1326**	**0.1326**

Source: Eviews Output

From the Table 4.11 and Table 4.12, we have chosen Ln result of model evaluation as it shows the smaller value of RMSE, MAE, MAPE and U-Theil compared to normal data. The value for Root Mean Squared Error (RMSE) is 0.3239 for age and 1.0238 for all the treatments. Besides, the value for Mean Absolute Error (MAE) is 0.2654 for age, 0.8661 for treatment 1, treatment 2 and treatment 3 while for treatment 4 the value is 0.8663. Furthermore, the Mean Absolute Percent Error (MAPE) value for age is 8.8251 and for treatment 1, treatment 2, treatment 3 and treatment 4 the value is 30.5145, 30.5143, 30.5137 and 30.5183, respectively. Lastly, the Theil Inequality Coefficient (U-Theil) value for age is 0.0413 and all treatment have the same value of 0.1326. The value in Ln model is smaller than the original model. So, Ln model will be more suitable to run the test.

4.10 Conclusion

Several tests have been conducted to meet research objectives which are descriptive analysis, correlation analysis, unit root test, VAR model, hypothesis testing, residual analysis, model evaluation and cost-benefits analysis. In Chapter 5, it will present the summary of the study, major findings and discussions that been analyzed in Chapter 4 and the implications of the theoretical and practical from this research.

CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATIONS

5.0 Introduction

This chapter will first present the summary of statistical analyses which discussed in the previous chapter and followed by the detail discussion on major findings to validate the research objectives and hypotheses. Furthermore, implication of research study and limitations will also be discussed in this chapter. Lastly, recommendations will be suggested for future researchers of the relevant topics.

5.1 Summary of Statistical Analyses

The aim of this study is to discover the total weight gain and age with the different chicken feed systems and profitability of farmers in Malaysia. The data was collected from Bintang Maju Agri Full Nature Fresh SDN. BHD. The time range for this study is 1 production cycle, around 3 months from October 15th, 2021, to January 14th, 2022. Otherwise, the total number of observations for this study is 56 (14 weeks x 4 different diet feed systems).

From chapter 4, correlation analysis, this study shows that age, Treatment 2 and Treatment 4 are positively related but almost negligible correlations where the body weight will still increase after week 14, while Treatment 1 and Treatment 3 are negatively related but almost negligible correlations where the body weight will decrease after week 14.

In unit root test results, it shows that the results using Augmented Dickey-Fuller (ADF) or Phillips-Perron (PP) tests for entire variables are mostly stationary in level data (Original Data). Hence, a Vector Autoregression (VAR) estimation procedure will be conducted. The VAR Ln Model Analysis shows that all the independent variables are positively related to total weight gain. Age is statistically significant at the 0.10 level, while Treatment 1, Treatment 2, Treatment 3, and Treatment 4 are statistically significant at the 0.05 level. When the independent variables increase by one unit, the body weight of the chicken will also increase, holding other variables constant.

In Residual Diagnosis testing, all the variables do not have heteroscedasticity issues as the p-value is less than the level of 0.05. Not only that, but there is also no multicollinearity issue for all the residuals where the VIF is less than 10. However, all the residuals are normally distributed as the p-value is higher than the level of 0.05.

In this study, in model evaluation analysis, Ln data is appropriate as all the forecast values where RMSE, MAE, MAPE, and U-Theil tests have the lowest value compared to the original data. Moreover, after rearranging and analyzing the data provided by Bintang Maju Agri Farm, I found out that Treatment 2 (Normal Feed + SK Gold) has the highest average total weight gain among other treatments. Treatment 1 will be the basis value to determine the growth of the chicken for treatments 2, 3, and 4. Treatment 2 increased 1.03 percent on average, Treatment 3 increased 1.01 percent, and Treatment 4 increased 1.023 percent.

Last but not least, for cost-benefits analysis, this project should be taken into consideration and continue as this will bring profits to the farmers because, for 1 production cycle minimum, the farmers could earn up to RM 2825 per production cycle. Not only that, the BCR ratio for this project as precalculated is 1.2354, which is higher than 1. Hence, farmers are recommended to continue this project as the chicken production in Malaysia is currently in a shortage situation and the price of the chicken will be expensive as some of the chicken meat is imported from other countries.

5.2 Discussion of Major Findings

Based on table 4.7, for treatment 1, HA1: there is a significant relationship between chicken feed systems treatment 1 and total weight gain of the organic farm chicken production is supported by Weimer et al. (2020). In their study, they also found out that even they are using the same amount of stater feed for the chicken in 2 difference stocking densities, the weight gain is the same. This shows that treatment 1 are positively related with body weight.

Besides, for treatment 2, the HA2: there is a significant relationship between chicken feed systems treatment 2 and total weight gain of the organic farm chicken production is supported by JF Nutritech (2021). Carotenoids are important as they could help the poultry feed additive as it could help the chicken to achieve the category of yellow skin and good quality egg yolks.

Furthermore, for treatment 3, HA3: there is significant relationship between chicken feed systems treatment 3 and total weight gain of the organic chicken production is also supported by Usman Zamani et al. (2017). They found out that the chickens that were fed using crude palm oil and enzymes showed higher body weight gain. This shows that the use of crude enzymes in broiler diets has been shown to improve broiler growth performance, but with little effect on meat quality, especially pH, texture, and colour.

In addition, for treatment 4, HA4: there is significant relationship between chicken feed systems treatment 4 and total weight gain of the organic chicken production is supported by Archana et al. (2019). In the authors' study, organic acids added into the treatment will help to reduce the bacteria and pathogens that could prevent the bacteria from attacking the epithelial cells of the chicken. Organic acids improve the growth performance and quality of broiler carcasses, increase nutrient utilization and growth, and feed conversion efficiency. The addition of organic acids to the broiler diet can increase weight, increase food consumption, and improve feed efficiency.

For Age, the HA5: There is a significant relationship between chicken age and total weight gain of the organic farm chicken production in Malaysia is supported by Murawska (2017). The researchers also found out that the carcass lean content in broiler chickens grows approximately 49-fold between 1 and 10 weeks of age. During this time, the percentage of muscle cells increases from 30.9 to 51.3 percent of total weight gain, by 16.5 percent until week 6, and by about 4 percent between weeks 6 and 10. In this study, the results also show that age and body weight have a positive relationship. As the chicken's age increases, the body weight will also increase.

Lastly, for profitability, if the BCR ratio is more than 1 and the total profit is greater than the total cost. So, this project is acceptable as the BCR ratio is greater and the profit are covered the total cost used in the entire project. This is supported by Geo et al. (2020) where their study found out that the revenue cost ratio is more than 1 and the profits are higher than the cost, so, it is suitable to keep it running.

As a result, based on the hypothesis testing shown above in table 4.7, it can be concluded that there is a relationship between the sources of Treatment 1, Treatment 2, Treatment 3, Treatment 4, Age, and the profitability on the total weight gain of the farmers.

5.3 Implications of the Study

5.3.1 Implication of Study in Theoretically

Findings in this research showed that the total weight gain of chickens is significantly influenced by the independent variables of four different feed systems and age, while the profitability of farmers has a significant relationship with the body weight of the chicken. The results of this study would contribute greatly to the various theories as follows:

5.3.1.1 Theory of Growth Performance

In this study, it could contribute towards the theory of growth performance in broiler chickens. The result of the study shows that as the feeds are given to the broiler chickens in the production cycle, the body weight of the chickens will increase according to their daily consumption. Every living culture will require food and water in order to survive and thrive. Chickens are one of the most independently raised animals, fully capable of obtaining food independently if there is any. Yet, like any confined animal, they need regular food to survive and grow (Fleming, 2020). Generally, a chicken can live up to 4 or 5 days without a regular diet, because after that, they will become quite thin. Chickens are usually self-sufficient, but although they will always seek out worms or insects to eat if they are allowed to forage, they still need a nutritionally balanced diet to grow and live long and healthy lives. Lack of proper nutrition can lead to poor health and lower body weight.

5.3.1.2 Theory of Poultry Production

Poultry farming has been a feature of human civilization for thousands of years. To guarantee that agriculture continues to contribute positively and sustainable to a stable human civilization, production and marketing must be tailored to local circumstances and value chains, optimize nutrient cycles and product use efficiency, and preserve genetic variety. To optimize the advantages of smallholder poultry production, it should be accompanied by improved local health services and holistic programming emphasizing the connection between chicken production, human health and nutrition, and sustainable ecological services. In this study, the production of chicken could be sustained in the long run as the farmers could control the amount of feed given to the chickens and it could increase the number of chickens from 50 to an even higher number of chickens to raise.

When poultry production can increase and sustain the market supply, it will contribute towards Goal 12 of the Sustainable Development Goals, which is under responsible consumption and production. The amount of poultry production will sustain the domestic market and could increase the export of poultry meat to foreign countries. So, if domestic production of chicken satisfied the supply of chicken in the domestic market, the government would decrease the import of chicken, where the price of chicken in the market would be lower compared to imported chicken. When the price of chicken is reduced, it will be affordable for nations to purchase and consume chicken for their daily meals. As a result, it would be good to keep food safe and secure, which is one of Malaysia's national priorities (NPAs).

5.3.1.3 Theory of Profitability and Cost-Benefits Analysis

Like other companies, poultry farming is only as profitable as the effort and principles it uses. To set up a chicken farm, you need hundreds of birds, delicious food, and shelter. If we are looking for an entrepreneurial opportunity, a chicken farm can give us more opportunities. Starting a chicken farm from scratch will prove to be a safe and beneficial investment in the long run. Over time, consumer preferences for meat protein sources have grown from beef to chicken. Chicken is said to be healthier and cheaper than beef. Poultry production is considered to be one of the most lucrative sectors of the economies of many countries. Even with the huge growth in poultry products and the corresponding growth in poultry farms, there is still a lot of commercial potential. Global demand for poultry and other poultry products is likely to continue to grow in the next decade. Profitable poultry farms exist because almost everything has value and is available. As in this study, profitability and cost-benefit analysis are important in terms of body weight. When the chicken body weight is high, the profits per chicken for the farmers will also increase. The results also show the revenue is greater than the cost, and the BCR ratio is more than 1. Hence, this will contribute towards the theory.

5.3.2 Implication of study in Practically

As a practical contribution to this study, the findings show that all treatments and independent variables have positive effects on the chicken's body weight. As for age and the 4 different feed systems on body weight, if the age of a chicken increases, the chicken will consume more as their body tissue is growing. This leads to the body weight increasing together with their age. If the chickens did not consume enough food on a daily basis, their body weight would not increase or decrease significantly over time. With insufficient food provided, the chicken will be hungry or even die in a few days' time. So, with sufficient food and an increase in age, the chicken will grow in a healthy environment, and the body weight of each chicken will also increase.

Lastly, in this study, it also contributed towards organic chicken meat production and cost-benefits analysis, where both are significant and have a positive relationship between each other. This was supported by many researchers like Cobanoglu et al. (2014), Sherpa (2020) and other researchers. If this project cost is higher than the revenue, it is not recommended for farmers to continue, since the results of the study show that the farmers will gain profits at least in 1 production cycle and the BCR ratio of the study is more than 1.

5.4 Limitation of Study

This research has contributed useful information for the farmers, private investors, and government agencies that are willing to get involved in this business sector. However, there are some limitations throughout this research that need to be optimised for future research in order to become ideal research. As well, it is rare to perform perfect research.

Firstly, there is a limited number of journals that can be found to support the treatment 2 analysis. Some research in the past did not prove that the yellow pigment would increase the body weight of the chicken, as we know that yellow pigment will increase the skin colour of the animal, and for chickens, yellow pigments will increase the yellowness of the skin colour. Bright-yellow-skinned chicken is more popular in many countries. Not only that, as SK Gold is a nearly developed product by JF Nutritech, So, this product will not have much study that has been used by other researchers. According to JF Nutritech, the SK Gold products are derived from other products produced by a company specializing in the production of fish and shrimp or prawn. After they succeed in aquaculture, they now plan to get involved in the poultry sector.

Besides that, there are limitations on the time frame, as in this study there is only 1 production cycle, which lasts around 3 months, for a total of 98 days. Due to the limited time given for this study, it has to shorten the time frame to 1 production cycle. The shortened time frame will reduce the observations time of the study and cause a decrease in sample size. If the study remains with the different diet feed systems and compare with the two-production cycle, it is more effective for the chicken meat production industry.

Lastly, in this study, it only focuses on one breed of chicken, which is the ayam kampung. Some breeds have different performance compared to each other. Some consumers or business entities prefer some other breed compared to ayam kampung. We do not know how the performance of the chicken will be affected by giving the same amount of feed and environment as in this study. Different breeds of chickens need different amounts of feed that they consume daily. Some chickens need a certain amount of feed more than others in order to gain more weight, but some breeds might need a lesser amount of feed to gain more weight.

5.5 Recommendation for Future Research

This chapter was written to remedy the limitations encountered throughout the research project. Recommendations will be given regarding the limitations mentioned above to avoid the same limitations occurring in future research.

Firstly, it is recommended that the study include other types of chicken in the research, such as Malay chicken and Serama chicken. This is inappropriate if the study merely focuses on only one breed of chicken. Farmers are recommended to raise more than one breed of chicken, as some consumers would prefer other breeds of chicken than Ayam Kampung. If the farmers only focused on one breed of chicken, they could not gain much of the market share, as other farmers might have a higher possibility of gaining higher market shares due to the supply of different breeds of chicken to the markets. Incorporating another breed into the equation increases the likelihood of farmers making more money while also allowing farmers to determine which breed is best for them. Not only that, it is also recommended to increase the amount of feed given to the chicken. The amount of feed increased; the body weight might increase as well but the cost of feeds will also increase. However, the profits gained from selling off the chicken might cover the expenses used during the production cycle.

Secondly, it is recommended to increase the production cycles. At least 2 production cycles should be done for these experiments, and they could compare the data on body weight and the cost-benefits of the farmers for a longer time frame. If the study is limited to one production cycle, it will be unable to predict the situation in the next production cycle because the majority of the research will be limited to one production cycle. We could adjust the time frame if there are any changes that happen during the longer production cycle. If the production cycle is extended, we might not know what to expect in the future. The chicken's body weight may increase, and farmers may gain more than in the current cycle. Hence, it is recommended to extend the production cycle.

Lastly, the journals available online via UTAR's Library E-Resources, Ebscohost, and Google Scholar may not be sufficient to support the study. Researchers may need to scan as many study papers and journals as possible in order to get further empirical data. For instance, some websites provide subscription-based journals with limited access; researchers should work to get access to these publications to create higher-quality research results. By collecting other journals, it may be possible to add more evidence and be surer that the study is correct.

5.6 Conclusion

This research studied the total weight gain of the different chicken feed systems of the organically farmed chicken production in Malaysia. The feeds included Treatment 1 (Normal Feed), Treatment 2 (Normal Feed + SK Gold), Treatment 3 (Normal Feed + CPKO), and Treatment 4 (Normal Feed + PERFAT Pfi-7). Not only that the age and profitability of farmers are also taken into consideration as independent variables. The results show that all the independent variables have positive relationships with body weight. As the age increases and sustainable feed is given, the body weight of the chicken will increase. Moreover, the BCR ratio of 1.2354 has proven that the project should continue as it brings profits for the farmers. Next, based on the findings among the 4 treatments, Treatment 2 has the highest average total weight gain along the production cycle.

In conclusion, this research has fulfilled the objective of developing a model for total weight gain and age with the different chicken feed systems and profitability of farmers in the organically farmed chicken production in Malaysia. The limitations that were faced during the study were presented and recommendations were provided to help future researchers that are interested in this topic. Furthermore, this finding provides relevant information to governments in order for them to implement policies for food safety, food security, and responsible consumption and production for sustainable development goals 12 of the 18 SDGs to transform the world. Moreover, it also provides information on promoting the contributions of society and industry from MOSTI. This halal and organic food intake is designed to foster innovation and creativity in the field of food safety and security research. Research team members need to explore ways to improve the impact of various dietary systems on the cost, taste, and performance of chickens. This move will allow them to continue to promote green technologies and raise awareness of the importance of environmental protection while providing human beings with the necessities of life. Lastly, this research could provide useful information to governments, policymakers, investors, or farmers in performing their responsibilities, duties, and trading activities.

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Appendices