# DEVELOPMENT AND FABRICATIN OF PRODUCTION MECHANISM FOR SMALL AND MEDIUM ANIMAL FEED PRODUCTION PLANT

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## DEDICATION

*I would like to dedicate this thesis to my beloved mother and father*

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## ABSTRACT

Livestock production levels are currently unable to meet market demand. This is because the method used to produce livestock feeds is unproductive and efficient, beside lack of technology to process livestock feed. Therefore, some improvements should be made to ensure the sustainability, speed, and quality of feed stuffs with the complete specifications. Normally, livestock production process involves the following process processes which are crushing of raw materials, drying of raw materials that have been crushed, blending of feedstuffs with certain additives, and production of the products either in the form of pellets or pads. The main objective were to develop and fabricate the improvement component in processing the animal feed, increase the production rate and increase the chef life of the animal feed. So, towards the steps to improve the livestock production, industry A was selected the design 1 for their fabrication. The components contained in design 1 are the feeder machine, roller conveyor, weight balance, and packaging system. For feeder machines, several simulated has been tested to identify the stress and strength of the feeder machine in the real situation. After feeder machine modifications have been passed all the simulation tests, an agronomic features has been applied to the design, in addition to help solving the problem of agronomic conditions to the workers. After fabricated, the feed processing machine is tested to determine the extent to which the productivity and efficiency of the food feed can be improved. With the improvement toward the machine compared to existing, the production rate of the industry shows double increment from its original state. For the packing system, to ensure that the feed product can last a long time, the plastic that should be used is a plastic with thickness of 0.8mm, and the air contained in the plastic should be removed by using industrial vacuum. With this method the livestock feed will be long lasting.

## ABSTRAK

Kadar pengeluaran haiwan ternakan pada masa kini tidak mampu untuk menampung keperluan pasaran. Hal ini kerana, kaedah dalam penghasilan makanan ternak tidak produktif dan kurang kecekapannya, selain dari kekurangan teknologi dalam pemprosesan makanan ternakan. Oleh itu, penambahbaikkan perlu dilakukan bagi memastikan kemapanan, masa pemprosesan, dan kualiti yang mengikut syarat. Kebiasaannya, pemprosesan makanan ternakan melibatkan beberape proses seperti penghancuran bahan mentah, pengeringan bahan mentah yang telah dihancurkan, percampuran bahan mentah dengan bahan tambahan dan yang terakhir memproses bahan tersebut dalam bentuk pellet atau dedak. Tujuan utama penylidikan ini dilakukan adalah untuk membangun dan membina komponen tambahan yang diperlukan, meningkatkan kadar pengeluaran dan memanjangkan tempoh hayat makanan ternakan. Sebagai langkah permulaan dalam pembaharuaan, industri A telah dipilih dan rekabentuk 1 sebagai model pembaharuaan. Komponen yang terkandung dalam rekabentuk 1 adalah mesin suapan, sawat jenis bergolek, penimbang berat dan sistem pembungkusan. Untuk mesin suapan beberapa simulasi telah dijalankan bagi mengenal pasti kekuatan dan ketahanan mesin dalam keadaan sebenar. Setelah dikenalpasti beberapa pentambahbaikan dijalankan tehadap mesin suapan bagi menyelesaikan masalah argonomik dalam persekitaran para pekerja. Setelah siap difabrikasi, keseluruhan mesin diuji bagi membandingkan keadaan sebelum dan selepas. Hasil dapatan menunjukkan dengan menggunakan mesin ini, kadar pengeluaran telah berganda sebanyak 2 kali berbanding dengan yang sebelum. Bagi sistem pembungkusan pula, untuk memastikan makanan ternakkan mampu bertahan lama adalah dengan cara menggunakan plastic dengan ketebalan 0.8mm, udara dalam pembungkusan perlu dibuang dengan menggunakan hempagas jenis industry. Dengan kaedah ini makanan ternakan akan lebih tahan lama.

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| Notations | Descriptions |
|---|---|
| AAFCO | Association of American Feed Control Officials, Official Publication |
| CM | Combustion Method |
| DOA | Department of Agriculture Malaysia |
| DOS | Department of Statistics Malaysia |
| GDP | Gross Domestic Products |
| IAASTD | International Assessment of Agriculture Science and Technology Development |
| JAIP | Perlis Islamic Religious Department |
| KM | Kjeldahl method |
| MARDI | Malaysia Agriculture Research and Development Institute |
| MOA | Malaysia Ministry of Agriculture |
| PKC | Palm Kernel Cake |
| POME | Palm Oil Mill Effluent |
| SCM | Supply-chain Management |
| SME Corp. | Small and Medium Corporation |
| SSF | Solid Substrate Fermentation |
| UAE | United Arab Emirates |

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

In this chapter, the background of the study, objectives and scope are discussed. In this study, the basic info were accumulated from problem statements received or acquired from the entrepreneur and farmers. The significant of study, the limitation and the thesis arrangement are also part of this chapter.

## 1.2 Background of the study

Every year tonnes of agriculture waste have been recognized as an ecological burden for the society, (Bhatnagar, 2015). This statement is supported by Sarkar *et al.*, (2011) who also recognized agriculture waste as cost-effective, renewable and abundant. Besides that, agricultural waste can be the most suitable raw materials that can provide the highest promising profit to the farmer if the wastes are converted into benefit. The aim of this study is to utilized agriculture waste processes and various agricultural potential for animal forage. It is a known fact that many agricultural wastes are left alone be wasted. Table 1.1 shows the type of economic activity that contributes to Malaysia economy from year 2012- 2016, Booklet of Crops Statistics 2017 (Food Crops Sub-sector) - Department of Agriculture Malaysia (DOA).

Table 1.1: Type of economic activity that contribute to Malaysian economy, Department of Statistics Malaysia (DOS,2016)

| | | | | | Millions |
|---|---|---|---|---|---|
| **Kind of economic activity** | **2012** | **2013** | **2014** | **2015** | **2016** |
| ***Agriculture*** | 89,406 | 91,181 | 93,048 | 94,249 | 89,465 |
| Rubber | 8,614 | 7,759 | 6,288 | 6,797 | 6,366 |
| Oil palm | 41,402 | 42,521 | 43,539 | 44,119 | 38,538 |
| Livestock | 8,315 | 9,086 | 9,806 | 10,039 | 10,407 |
| Poultry | 4,964 | 5,477 | 6,029 | 6,231 | 6,500 |
| Cattle | 890 | 975 | 996 | 912 | 899 |
| Other livestock | 2,461 | 2,635 | 2,781 | 2,896 | 3,007 |
| Other agriculture | 13,879 | 15,031 | 16,247 | 16,628 | 17,468 |
| Paddy | 2,002 | 2,073 | 2,158 | 2,136 | 2,176 |
| Vegetables | 5,159 | 5,707 | 6,152 | 6,377 | 6,763 |
| Fruits | 3,323 | 3,636 | 3,958 | 4,140 | 4,374 |
| Food crops | 2,747 | 2,956 | 3,242 | 3,240 | 3,364 |

Based on the table above, the agriculture sector contributes around 89 to 94 million Ringgit annually to the Malaysian economy. As the agriculture sector increases, the remainder of the sector will also increase. These waste materials is regarded to be a burden to the society and should be utilized as animal feed. Besides helping in removing the burden it will also benefit the farmer (Charles *et al.*, 2010). This is supported by Small and Medium Corporation who have found that agriculture sector contributed 45.2% of SMEs GDP to overall GDP for the year 2013. Figure 1.1 shows the statistic of SMEs contribution.

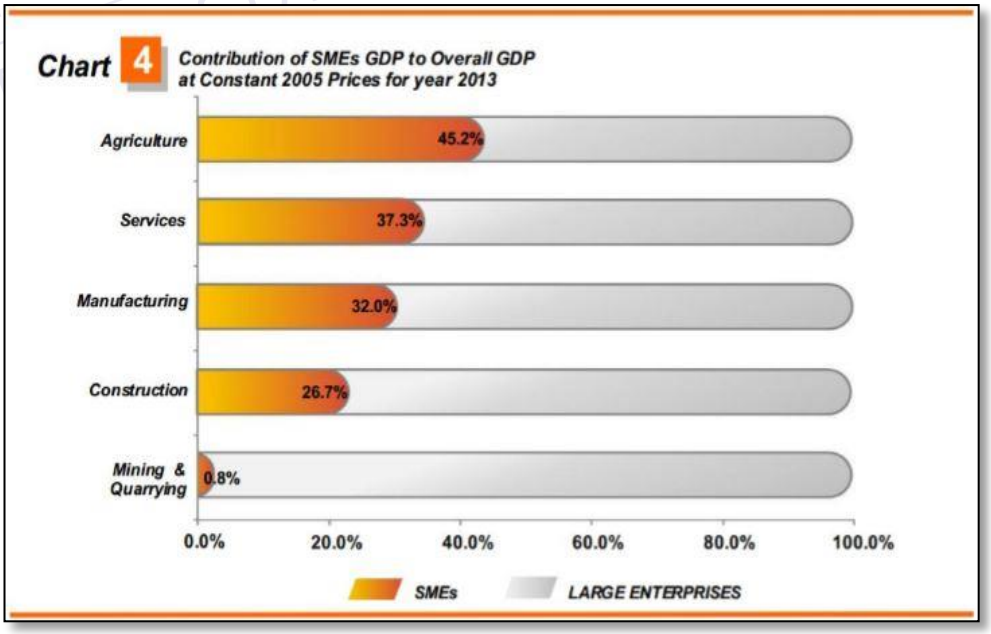


Figure 1.1: Contribution of SME's GDP to overall GDP (SME's corp, 2013)

In 2016, the world's population had reached 7.4 billion of which 4.4 billion of the total population derived from Asian countries (Population Reference Bureau 2016). In 2016, total population of Malaysia was estimated at 31.7 million persons with 0.5 million increased compared to 31.2 million persons in 2015 with 1.5% population growth rate for the same period (Department of Statistics Malaysia, 2016).

According to the International Assessment of Agriculture Science and Technology Development (IAASTD) in 2009, the explosive demand for livestock and livestock products have been happening in most country especially in developing countries. Statistics of food demand per capita consumption growth rates for meat and milk show a great different for developing and developed countries as depicted in Figure 1.2. Due to this occurrences, the authorities and also Malaysian communities need to take seriously this issues as to ensure adequate food supply in the market.

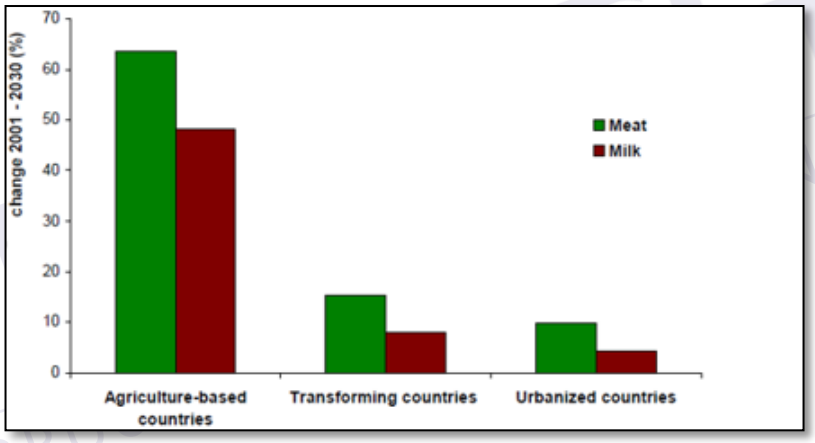


Figure 1.2: Changes in demand for livestock products, 2001- 2030 (IAASTD, 2007)

Majority of livestock feeds in the world market are imported from United State, Brazil and Argentina, where the Malaysian government has allocated about 20 billion for the feedstock as refer to (Ministry of Agriculture and Agro-based Industry , 2014). The issue of halal and non-halal in feedstock production has been debated. There has been major progress for livestock industry over the years between the non-ruminants (poultry and swine) and the ruminant's sectors. The details of status is depicted in Figure 1.3 (Shanmugavelu and Quaza, 2014).

| Commodity | Quantity (M. tonne) | | SSL (%) | Per Capita (kg, nos) |
|---|---|---|---|---|
| | Production | Consumption | | |
| Chicken / Duck Egg (mil. eggs) | 10,358 | 8,800 | 117.7 | 299 |
| Pork | 231,000 | 229,820 | 100.5 | 7.8 |
| Chicken / Duck Meat ('000) | 1,334.47 | 1,041.38 | 128.1 | 35.3 |
| Beef | 48,835 | 168,273 | 29.0 | 5.7 |
| Mutton | 2,744 | 24,331 | 11.3 | 0.8 |
| Milk (mil. litres) | 70.87 | 1,416.04 | 5.0 | 48.1 |

Figure 1.3: Status of the livestock industry in Malaysia 2013/2014 (Shanmugavelu and Quaza, 2014)

According to the Malaysia Ministry of Agriculture (MOA) in 2014, farmers spend almost 60-70% of the cost to invest for livestock feed and this has contributed the total annual purchases of livestock at about seven million tonnes. However, the extensive and semi-intensive system of the ruminant industry still depends on pasture and locally available feedstuff. Therefore, there is a need to create an innovative system in order to fulfill the requirement of animal feed and to decrease animal feed import rate as shown in Table 1.2. Currently, the feed milling industry produce five million tonnes of compounded feed annually but the ingredient of animal feed were mostly imported from various countries at approximately of 70-80% and local ingredient such as Palm Kernel Cake (PKC) and agro-industry products at only 20-30%. This may attributed to many factors including the lack of incentives, uneconomic production systems and inadequate marketing strategies (Shanmugavelu and Quaza, 2014).

Table 1.2: Import and export rate of animal feed (MOA, 2010)

| **Item** | **2007** | **2008** |
|---|---|---|
| | Quantity (tones) | Quantity (tones) |
| Import | 3,886,218 | 3,531,990 |
| Export | 2,256,824 | 2,199,686 |

As a result, Malaysia will be become highly demanding on chicken meat, beef, lamb and aquatic fish to fulfil the nutrition of human body (Yulianto and Saparinto, 2014). In recent decades, the concept of sustainable agriculture includes the additional

goals of safeguarding natural resources, promoting a clean environment and improving both producer and animal well-being as well as reducing the total cost of animal feed production through the discovering of new sustain and affordable substance as raw materials (Connor , 2014). These problems can be tackled by providing an alternatives solution which should be taking into consideration to overcome the difficulties. One of the solutions is to provide an affordable cost of feedstock since it contributes the most cost of overall farming costs. To solve the feedstock problems, the development of production mechanism system for animal feed production plant should be executed. According to Sirajuddin *et al.,* (2018) the success of beef cattle breeding depends on the ability of the farmer to manage their livestock. Factor such as the education, experience and scale of business were considered to play a major role in the study. This study aimed to educate the farmer the importance of production of animal feed so that the farmer can produce their own animal feed simultaneously and reduce their cost of buying the animal feed. Besides reducing the cost of feedstock purchases, the clean and pure status for the feedstock can also be determined.

## 1.3 Research gap

Research gap or novelty for this research is determined by reviewing previous studies. Some finding have been achieved and tested but there are limitation on animal feed production. The summary of previous studies are tabulated in Table 1.3 to show the differences.

Table 1.3: Review of literatures showing the research gap

| No | Author | Fabrication/testing | | | |
|---|---|---|---|---|---|
| | | Crusher | Mixer | Conveyor | Packaging |
| 1 | Ploj *et al.,* 2006 | √ | - | √ | √ |
| 2 | Chikwado, 2013 | - | √ | √ | - |
| 3 | Barzegar *et al.,* 2015 | - | - | - | √ |
| 4 | Kuppusamy *et al.,* 2015 | - | √ | - | - |
| 5 | Balami *et al.,* 2015 | - | √ | - | - |
| 6 | Martin *et al.,* 2016 | - | √ | - | √ |
| 7 | Surendra *et al.,* 2016 | √ | - | - | √ |
| 8 | Gomez *et al.,* 2016 | - | √ | - | √ |
| 9 | Syafiq 2016 | √ | - | √ | √ |

## 1.4 Problem statement

In 2017, the population in Malaysia was estimated at 32.0 million of which 28.7 million are citizens and 3.3 million are non-citizens. This statistic showed that the population growth rate of citizens and non -citizens in 2017 had decreased by 1.1% and 2.9% respectively in contrast to 2016 where the population growth rate for overall was 1.3%. As of now, the current population of Malaysia for the year of 2018 is estimated by the United Nation to be at 31.855 million. According to the Department of Statistics Malaysia, Malaysia population is equivalent to 0.42% of the total world population (Population Reference Bureau, 2016). In order for systemic management of the livestock sector, the Malaysian government has increased its initiative to gain people interest toward the sector to support the demand for chicken, mutton and beef. Figure 1.4 illustrates, the total number of people engaged in livestock sector (Department of Statistic Malaysia, 2017).

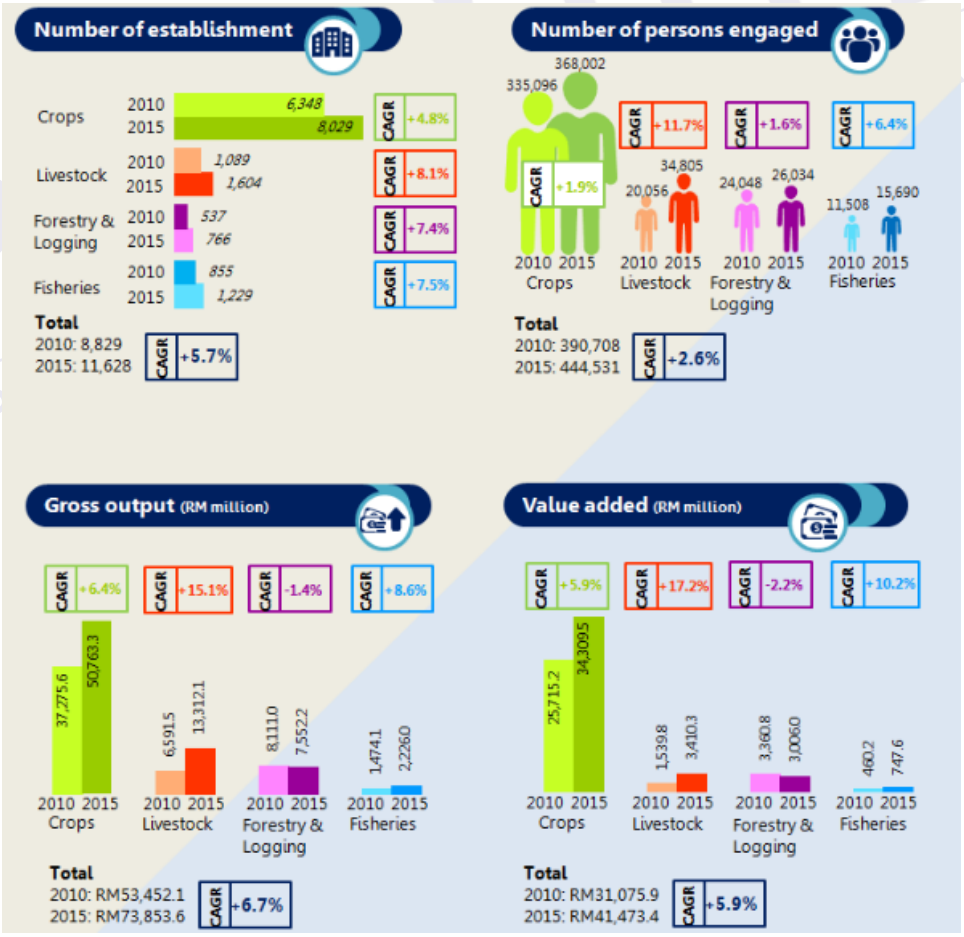


Figure 1.4: Number of people engaged in livestock sector
(Department of Statistic Malaysia, 2017)

The historical changes in the demand for livestock products have been largely driven by human population growth, income growth and urbanization. The production response in different livestock systems has been associated with science and technology as well as increases in animal numbers to meet the growing demand. Table 1.4 shows the statistic gathered from the Malaysia Department of Veterinary Service (2017). Smallholders play multiple roles and this is largely depending on the stage of development of their countries, whether in agriculture based, transforming or urbanized which a typology found in the World Development Report 2015 (World Bank, 2014). Organic farming is a practice in 160 countries and 37.2 million hectares of agricultural land are managed organically. It is one of the growing fields today for providing nutritious food to humans and livestock (Nelson, 2008 and San Mantin *et al.,* 2016). Global sales of organic food and drink reached US$54.9 billion in 2009.

Table 1.4: Statistics of animal population from year 2012-2016
(Department of Veterinary Services, 2016)

| **Region** | **Year** | **Types of lives stock** | | | | |
|---|---|---|---|---|---|---|
| | | **Cattle** | **Buffalo** | **Goats** | **Sheep** | **Swine** |
| **Malaysia** | 2012 | 744,317 | 124,985 | 462,510 | 131,923 | 1,851,842 |
| | 2013 | 751,497 | 123,646 | 434,202 | 141,918 | 1,842,953 |
| | 2014 | 746,783 | 121,259 | 429,398 | 142,435 | 1,844,103 |
| | 2015 | 742,338 | 118,269 | 431,651 | 147,033 | 1,886,823 |
| | 2016 | 748,842 | 118,608 | 446,854 | 145,999 | 1,879,803 |
| **Peninsula Malaysia** | 2012 | 663,563 | 65,858 | 394,905 | 127,671 | 1,437,354 |
| | 2013 | 667,869 | 64,218 | 368,774 | 137,718 | 1,425,310 |
| | 2014 | 662,818 | 61,687 | 363,768 | 138,127 | 1,425,317 |
| | 2015 | 661,005 | 60,198 | 364,946 | 142,153 | 1,413,597 |
| | 2016 | 664,310 | 59,512 | 378,115 | 141,188 | 1,406,863 |
| **Sabah** | 2012 | 65,694 | 51,850 | 53,010 | 2,070 | 87,700 |
| | 2013 | 67,997 | 52,369 | 50,584 | 2,089 | 82,472 |
| | 2014 | 68,105 | 52,450 | 50,650 | 2,050 | 82,552 |
| | 2015 | 70,493 | 52,975 | 52,342 | 2,069 | 77,630 |
| | 2016 | 72,965 | 53,792 | 54,091 | 2,095 | 76,686 |
| **Sarawak** | 2012 | 15,120 | 7,277 | 14,595 | 2,182 | 326,788 |
| | 2013 | 15,631 | 7,059 | 14,984 | 2,111 | 335,171 |
| | 2014 | 15,860 | 7,122 | 14,980 | 2,258 | 336,180 |
| | 2015 | 10,840 | 5,396 | 14,363 | 2,811 | 395,956 |
| | 2016 | 11,207 | 5,304 | 14,608 | 2,716 | 396,254 |

Malaysian livestock industry is an important and integral component of the agricultural sector, providing gainful employment and producing useful animal protein

food for the population (Loh *et al.*, 2010). In 2016, a total of 16 agriculture and livestock projects worth RM69.4 million in 2016 were approved (Malaysian Investment Development Authority, 2016) and were expected to create 529 employment opportunities. This is a strong evidence to show that the livestock sector globally is highly dynamic. In developing countries, it has evolved in response to rapidly increasing demand for livestock products. In developed countries, demand for livestock products is stagnating, while many production systems are increasing their efficiency and environmental sustainability (Mohammad Nor and Rosali, 2016). Table 1.5 exhibits the record of slaughter for livestock for the period of 2012-2016 (Department of Veterinary Sources, 2016).

Table 1.5: Recorded slaughter of livestock from year 2012-2016
(Department of Veterinary Services,2016)

| **Region** | **Year** | **Types of lives stock** | | | | |
|---|---|---|---|---|---|---|
| | | **Cattle** | **Buffalo** | **Goats** | **Sheep** | **Swine** |
| **Malaysia** | 2012 | 119,536 | 11,003 | 37,653 | 10,343 | 1,735,352 |
| | 2013 | 125,436 | 8,264 | 64,368 | 15,690 | 1,716,119 |
| | 2014 | 138,066 | 8,725 | 67,858 | 17,126 | 1,533,564 |
| | 2015 | 150,922 | 8,654 | 69,748 | 17,232 | 1,609,980 |
| | 2016 | 150,545 | 8,198 | 69,448 | 17,628 | 1,571,965 |
| **Peninsula Malaysia** | 2012 | 117,491 | 9,920 | 37,406 | 10,406 | 1,381,833 |
| | 2013 | 123,496 | 7,219 | 64,097 | 15,665 | 1,363,611 |
| | 2014 | 136,225 | 7,715 | 67,586 | 17,082 | 1,181,978 |
| | 2015 | 149,174 | 7,678 | 69,449 | 17,193 | 1,259,230 |
| | 2016 | 148,883 | 7,254 | 69,120 | 17,594 | 1,221,965 |
| **Sabah** | 2012 | 1,189 | 419 | - | - | 124,634 |
| | 2013 | 1,106 | 391 | - | - | 121,655 |
| | 2014 | 1,029 | 366 | - | - | 118,748 |
| | 2015 | 957 | 342 | - | - | 115,910 |
| | 2016 | 891 | 319 | - | - | 113,140 |
| **Sarawak** | 2012 | 856 | 664 | 247 | 28 | 228,885 |
| | 2013 | 834 | 654 | 271 | 25 | 230,853 |
| | 2014 | 812 | 644 | 272 | 44 | 232,838 |
| | 2015 | 791 | 634 | 299 | 39 | 234,840 |
| | 2016 | 771 | 625 | 328 | 34 | 236,860 |

However, Malaysian small and medium scale farmer in the production of beef and mutton in Malaysia are experiencing some problems such as suffered from a lack of pasture, low production through reduced food intake by animals as a result of the hot and humid climate, and the high import costs of animals (Ariff *et al.*, 2015). Improving of production efficiency has always been the goal for animal agriculture to

ensure an abundance food and fiber supply (Connor, 2014). The production of animal feed in Malaysia is still outdated in quality, hygiene and also clean status. Moreover, the production of animal feed cannot afford the amount of feedstock consumed by the animal. Thus, this situation has pushed the farmer to take such an unethical method, so that the growth of their animals can meets the market demand. As for the supplier side, they have to produce even more animal feed because lack of technology in terms of animal feed processing machine to produce large amount of animal feed. Due to these problems, production of animals feed is very slow and required some improvement so that the production of animals feed could be speed up to support the market demand. To support the projects, the problems faced by Industry 1 should be identified, analyzed and whether any necessary actions are required to solve the problems. Before that, a little bit of information about the company should be discussed

Industry A was identified as small and medium industry that produced animal feed for ruminant. The raw materials used by the company were stem and corn leaf. Industry 1 was identified to be experiencing the following problem:

(i) Very slow production rate.
(ii) High Operating cost due to cost of unproductive labor.
(iii) High possibility for the processed raw materials to be contaminate due to lack of method to handle the raw materials.
(iv) Limited shelve life of the product because of the packaging method.
(v) Company layout was not in orderly manner.

## 1.5 Research objective

Objectives of this study are:

(i) To develop and fabricate the mechanism production of animal feed plant.
(ii) To analyze the production rate of existing and new fabrication machine (initial technique, approached system and machine improvement).
(iii) To test the reliability and the life span of the animal feed after packaging.

## 1.6 Research scope

The scopes of this study are:

(i) In this study only animal feed will be taken into consideration after discussing with the respected industry.

(ii) The raw materials used in this study were agriculture waste such as sago waste, coconut waste and corn waste only.

(iii) The design and drawing only involve in AutoCAD and solid works software.

(iv) Plastic thickness used for the testing was according to the availability of the market which were 0.4, 0.6 and 0.8 mm.

(v) The layout of Industry A were rearranged after approval from the company had been granted

(vi) Fabricating of the machine should follow the company requirement.

(vii) Any improvement towards the machine should receive approval from the company

(viii) The testing of the machine durability and strength were only simulation from solid works simulation.

## 1.7 Significant of the study

This study will contribute to the following three institutions, government, industry and community.

(i) Government.

By creating the current technology in the manufacture of animal feed industry, a good quality at local forage production can be produced, thereby reduces the state subsidies allocation for imported animal feed for livestock. Furthermore, Malaysia can compete with other developed countries in exporting forage to other countries.

(ii) Industry

The design and development of production for animal feed is also important to the industry. This is due to the available equipment in the manufacturing animal feed factories in this country could be improved in order to increase

the efficiency and effectiveness in the management and production of animal feed.

(iii) Community

The community will be more confident about the status of forage as the farmers are using locally produced animal feed.

## 1.8 Thesis arrangement

The thesis arrangement of this study consists of five chapters and is as follow:

**Chapter 1**

This chapter provides the general information about the idea of the research as a whole, including related problems and issued. This chapter also highlights the main aims and objectives of the research, besides emphasizing on the research contribution.

**Chapter 2**

This chapter provides a review of the literature related to the aims and objectives of the study. Areas where further research were required and identified were positioned as the aims of the study. Topics reviewed include Malaysia agriculture sector, livestock demand in developing countries, animal feed industry in Malaysia, current issue of animal feed production and facilities, mechanism of animal feed production and the production process. Previous studies by other researches were also evaluated. The summaries of the previous study were tabulated to ensure the revolution and the current situation related to the animal feed mechanism.

**Chapter 3**

The methodology of the study was depicted in the form of flow chart and steps. The framework of this project was designed step by step to ensure that the project were executed orderly.

**Chapter 4**

In this chapter, the results and the discussion of the production mechanism for animal feed plant were interpreted. The comparison of the previous fabrication and the current fabrication regarding to animal feed processing were also reported in this chapter. The

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