# LIVESTOCK BREEDING PRACTICES IN DIFFERENT REGIONS OF MALAYSIA

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DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEFREE OF BACHELOR OF AGRICULTURE SCIENCE WITH HONOURS

LIVESTOCK PRODUCTION PROGRAMME
FACULTY OF SUSTAINABLE AGRICULTURE
UNIVERSITY MALAYSIA SABAH
2017

# UNIVERSITI MALAYSIA SABAH

## BORANG PENGESAHAN TESIS

JUDUL: AMALAN PENTERNAKAN DI KAWASAN- KAWASAN YANG BERLAINAN DI MALAYSIA

IJAZAH: SARJANA MUDA SAINS PERTANIAN (PENGELUARAN TERNAKAN) H436

SAYA: MD NOR SHAHRAN BIN MD NOR SHAHRIN (HURUF BESAR) SESI PENGAJIAN: 2013/2014

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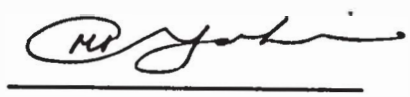

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**ACKNOWLEDGEMENT**

Alhamdulillah praise to Allah for His guidance and blessing I had managed to complete this paper. With His guidance, even with the setback of not being able to continue with my original work due to insufficient samples, this dissertation was still manage to be completed. I would like to express my deepest gratitude and appreciation to my supervisor and mentor Prof. Dr. M.A.M. Yahia Khandoker, whom with his guidance and care, nurtured me to be involve with this field of livestock production. I would like to thank him for all his time and effort in bringing me up to where I am now and also guiding me to finish this research.

I would also like to thank my family especially my parents, Md Nor Shahrin bin Md Ismail and Jayoni Abdul Jalil, for giving me the permission to come to Universiti Malaysia Sabah to further my degree in livestock production. Thank you for all the du'a and care that had made it all possible for me to complete all my work here in the faculty.

Furthermore, I would also want to express my gratitude to Alissa Nabilla binti Zamri for supporting me through my study and constantly wanting me to improve both academically and socially. I hope that this dissertation would to serve to help you when it is your turn to write one.

Lastly, I would like to express my regards and appreciation for those who helped and supported me either directly or indirectly during the completion of this project and dissertation. Without all the help, I might have not finished this research.

## ABSTRACT

This experiment was conducted to investigate the livestock breeding practice in different regions of Malaysia. The objective of this study was to find out the general information on livestock breeding prevailed across different regions of Malaysia. The study was carried out under the umbrella of Faculty of Sustainable Agriculture (FSA) Universiti Malaysia Sabah (UMS) and covers almost every state in Malaysia except Labuan, Perlis, Putrajaya, and Kuala Lumpur. The states were divided into four regions; Northern peninsular, Southern Peninsular, Sabah, Sarawak. The data collection sheets were distributed to the second year students of the Livestock Production (HG36) program of UMS in conjunction to their Animal Breeding class. In total, there were 59 data collection sheet being distributed and collected from various regions of Malaysia. Two types of variables were involved in this study. These variables were the independent (age, education, family size, and occupation) and dependent variables (involvement in animal rearing, type of breeding practice, and breeding facility service availability). Descriptive statistics were performed and analysis was done with the help of Microsoft Excel 2013. The distribution of respondent's location were 37%, 34%, 20%, and 9% for S. Peninsular, Sabah, N. Peninsular, and Sarawak respectively. It was also found that the pooled ration of bull to cow was 1:34, whereas the pooled ratio for buck to doe was 1:9, and lastly for ram to ewe ratio was 1:2. Study found that the number of farms practicing natural mating was 77.8% and the remaining 22.2% practiced artificial insemination (AI). In natural mating, 22% of the farm mentioned that the male for service was available at more than 3 kilometers away and for the farms that were practicing AI, 31% of them mentioned that the service availability was difficult. These findings suggested that the number of breeding male was insufficient. This could lead to inbreeding. It was suggested that with proper systematic breeding and the utilization of AI, performance of livestock could greatly improve. The scope of extension work should also be re-evaluate in order to improve efficiency. Research institution should focus back to the basics with these farmers to help them keep up with larger scale farmers of the world. This research would be a preliminary work for execution of systematic breeding of future pragmatic research on animal breeding.

**AMALAN PENTERNAKAN DI KAWASAN-KAWASAN YANG BERLAINAN DI MALAYSIA**

**ABSTRAK**

Eksperimen ini telah dijalankan untuk mengkaji amalan penternakan di kawasan-kawasan yang berlainan di Malaysia. Objektif kajian ini adalah untuk mengetahui maklumat umum pada ternakan yang terdapat di seluruh kawasan yang berlainan di Malaysia. Kajian ini telah dijalankan di bawah naungan Fakulti Pertanian Lestari (FPL) Universiti Malaysia Sabah (UMS) dan merangkumi hampir setiap negeri di Malaysia kecuali Labuan, Perlis, Putrajaya, dan Kuala Lumpur. Negeri-negeri yang terlibat telah dibahagikan kepada empat kawasan; Utara Semenanjung, Selatan Semenanjung, Sabah, dan Sarawak. Lembaran pengumpulan data telah diedarkan kepada pelajar-pelajar tahun kedua program Pengeluaran Ternakan (HG36) UMS sempena kelas Penternakan Haiwan mereka. Secara keseluruhan, terdapat 59 data lembaran koleksi diedarkan dan dikumpul dari pelbagai negeri di Malaysia. Dua jenis pembolehubah terlibat dalam kajian ini. Pembolehubah bebas (umur, pendidikan, saiz keluarga, dan pekerjaan) dan pembolehubah bersandar (terlibat dalam penternakan haiwan, jenis amalan pembiakan, dan ketersediaan perkhidmatan kemudahan pembiakan). Statistik deskriptif digunakan dan analisis telah dilaksanakan dengan bantuan Microsoft Excel 2013. Agihan lokasi responden adalah sebanyak 37%, 34%, 20%, dan 9% untuk S. Semenanjung, Sabah, U. Semenanjung dan Sarawak masing-masing. Kajian kemudiannya mendapati bahawa nisbah terkumpul untuk lembu jantan ke lembu betina adalah 1:34, manakala nisbah terkumpulkan untuk kambing jantan dan kambing betina ialah 1: 9, dan akhir sekali untuk berbiri jantan dan berbiri betina adalah 1: 2. Kajian mendapati bahawa jumlah ladang mengamalkan mengawan semula jadi adalah 77.8% dan baki 22.2% yang diamalkan permanian beradas (AI). Dalam mengawan semula jadi, 22% daripada ladang mengamalkannya menyebut bahawa pejantan untuk mengawan boleh didapati lebih daripada 3 kilometer jauhnya dan bagi ladang-ladang yang mengamalkan AI, 31% daripada mereka menyebut bahawa ketersediaan perkhidmatannya sukar. Penemuan ini mencadangkan bahawa bilangan jantan pembiak adalah tidak mencukupi. Ini boleh membawa kepada *inbreeding*. Kajian telah mencadangkan bahawa dengan pembiakan sistematik yang betul dan penggunaan AI, prestasi ternakan boleh meningkat dengan ketara. Skop pekerja lanjutan juga perlu dinilai semula untuk meningkatkan kecekapan. Institusi penyelidikan perlu memberi fokus kembali kepada asas dengan penternak ini untuk membantu mereka bersaing dengan penternak skala yang lebih besar di dunia. Kajian ini akan menjadi kerja-kerja awal bagi pelaksanaan pembiakan sistematik dan kajian pragmatik masa depan kepada pembiakan haiwan.

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| | |
|---|---|
| AEZ | Agro-ecological zones |
| AI | Artificial insemination |
| EM | Effective microorganism |
| FCR | Feed conversion ratio |
| FSA | Faculty of sustainable agriculture |
| GPS | Grandparent stock |
| IVM | Veterinary Institute Malaysia |
| KK | Kedah-Kelantan |
| km | Kilometers |
| LAI | Laparoscopic artificial insemination |
| LPS | Livestock production system |
| N. Peninsular | Northern Peninsular |
| PS | Parental stock |
| S. Peninsular | Southern Peninsular |
| SPM | Sijil Pelajaran Malaysia |
| SSL | Self-sufficiency level |
| STPM | Sijil Tinggi Pelajaran Malaysia |
| TAI | Transcervical artificial insemination |
| UMS | Universiti Malaysia Sabah |
| VAI | Vaginal artificial insemination |

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Since the dawn of time, mankind has been hunting off animals to fulfil their daily nutritional requirements. As hunting results in the decreasing population of the animal, and also hunting requires a specific set of skills, mankind started to change their mind set instead of hunting them, why not raise them. When raising an animal, you not only eliminate the need of hunting, but you also ensure a constant supply of food and other necessity (such as leather and milk) easily available (Diamond, 2002). As the daily requirement of mankind were substantially provided, they continue to grow in both numbers and also needs. Livestock and poultry species were first domesticated approximately 10,000 years ago for meeting mankind requirement (Hayes *et al.*, 2013).

The size of earth itself is of course not expanding but looking into the population of mankind, it is expanding at an incredible rate since the past century. This directly increase the number of mouth need to be fed and also increases the demand of food need to be supplied to them. As currently the human population stands at 7 billion, and of course this number will continue to rise exponentially. Not only that, the world is also being exhausted with mankind need for food, water, and energy, the limited arable land for food production, and increasing pressures on natural resources (Jones *et al.*, 2016). Not to forget that all these factors are severely affected by the climate the world is experiencing (Wheeler and Von Braun, 2013). Due to these factors that we are experiencing now, scientists around the world are working on the clock to create new knowledge and techniques to further improve our position in overcoming this peculiar matter. Not only the scientists, but farmers worldwide will need to step up

their work to increase food production and their activities with all the constraints we are now facing with utilization of technologies such as precision farming and assisted reproductive technology.

Malaysia is a country that is situated just above the equator, which makes it experience tropical climate throughout the year. It is also a country where the livestock industry is the third generator of growth for Malaysian economy (Sakawi and Ismail, 2015). The livestock industry especially in the country provides employment and also useful animal protein for the nation population. The livestock industry mainly started with the influence of colonization and was mainly (and still is) focused on the rural areas. Since then, the industry has shown steady growth especially in the poultry, eggs, and pork production (Loh, 2004). This is mainly due to the cultural aspect of Malaysian people favours them and the versatility of the animals. Basically the Malaysian livestock industry can be divided into the non-ruminant sector and the ruminant sub-sectors (Loh, 2004). Although the poultry and pork department easily pass the nation self-sufficiency level (SSL), it was and still is a different story for the ruminants in the country. Despite all the government emphasis, it still shows slow growth when compared to their counterparts. Based on report (DVS, 2015), the SSL for both beef, and mutton has never even surpass the 30% mark since 2006. This shows that the country supply of ruminant meat heavily relies on imports of foreign countries.

To improve the productivity of an animal it all depends on reaching the full potential of the animal. An animal phenotype or its physical traits and appearance is dependent on two major factors (Berglund, 2008; Kolmodin *et al.*, 2002); 1) its genetic potential, and 2) its environment. The environment of an animal depends on the farmer's ability to provide a suitable habitat to rear the animal to its maximum potential. This includes housing, bedding, feed, care, climate and many more. The genetic potential on the other hand, is something that can only be influence by the breed genetic characteristic and could only be improve through a systematic breeding plan. As environment is mainly control by the individual farmers, the genetic potentiality play a vital role in the animal fitting in perfectly to the environment. For an example, a Friesian cattle is a temperate cattle and when introduced to a tropical environment, it could not perform as well as it was in the temperate environment. In this situation, either a different breed of cattle is used or produce a Friesian cross bred that can cope to the tropical environment that will also utilize its great milking ability.

Proper breeding practice is a must in order for this to happen. Through selective breeding, a particular disease tolerance can be establish, the feed conversion ratio (FCR) of an animal can be achieve, a specific trait of an animal can be emphasize. Over time, the trait variant will become more prevalent in a particular population (le Roex *et al.*, 2015) and thus improving the general performance of the animal.

Various tools and technology can be incorporated into genetic improvement of livestock such as selective breeding using natural mating and artificial insemination (AI). Natural mating is the natural way of introducing semen or the male germ cell into the ovum or female germ cell, whereas AI is the act of introducing the semen to ovum via artificially with the help of specific tools and procedures (Haubrich, 1999). These tools mainly serve the function of improving reproduction efficiency and introducing new genetic traits in the herd (Bó *et al.*, 2006). Farmers usually are not interested in pro-actively manage their livestock's reproduction rate (Seegers, 2006) and are preferring to cope passively with what will happen as it is the cheaper alternative. Reproductive performance also ensures that the farm is continuously in the profitable and breakeven cost of farm production. Both natural mating and AI has their pros and cons in terms of economic feasibility and farmer's preferences. By managing and improving reproductive performance within the farm, farmers could avoid any unnecessary cost that is related to poor livestock reproductive ability and extra veterinary costs.

## 1.2 Justification

By utilizing proper breeding management, a farmers could improve the overall performance of their animals. Some local breed of goat such as the Katjang goat and the Kedah-Kelantan (KK) cattle are local Malaysian indigenous breeds with a small frame and low production performance respectively for their species and they are of this size naturally. Some breeds are small because they were developed and adapted to the given region and isolated by geographical constraints from expansion into wider markets (Biscarini *et al.*, 2015). As the demand of the country meat supply is mainly fulfilled by imports, further development in local breed performance will ensure the future of the local supply. Various products such as milk and other dairy products by ruminants especially in the country also heavily relies on import. It is dangerous to rely on imports as the future of the nation food supply is not dependent on domestic

factors but international factors such as the exporting country willingness to export to our country. The first and most important step to create a proper breeding plan is to ensure that proper records of animals is taken and from these records specific breeding can be done. A proper breeding plan helps generate a continuous stream of revenue and will contribute to better health and nutrition management within the farm. Research in this field investigates the limits to productivity. Selection for increased productivity characteristics has increasingly come at the expense of reproduction, overall health and natural behaviour. Knowledge is still limited about how these characteristics are biologically related to productivity. Breeding organizations are therefore in urgent need of new insights and methods that could lead to more balanced selection methods and the production of robust animals, without sacrificing animal welfare.

## 1.3 Objective

The objective of this study was to find out the general information on livestock breeding prevailed across different regions of Malaysia.

## 1.4 Hypothesis

$H_o$: There is no systematic livestock breeding practices being performed by the farmers in different regions of Malaysia

$H_a$: There is systematic livestock breeding practices being performed by the farmers in different regions of Malaysia

# CHAPTER 2

# LITERATURE REVIEW

There were several researches that have been carried out over the world related to studying livestock breeding practices. The related findings of the research work carried out in different countries of the world are reviewed in this chapter.

## 2.1 Animal production system

Animal production systems involve a variety of systems that are found across the continent to include the arid and semi-arid, humid and sub-humid, and highland and temperate regions (Devendra, 2007). Animals are found within these various agro-ecological zones (AEZ) and this involves a great diversity in land use patterns and a wide range of biophysical environments, animals and animal production systems play a most important role in food production, and not to mention contribute towards income generation, food security and livelihoods of the poor. Also according to other journals (Chantalakhana, 1990 and Devendra, 2007) animals are consistently and widely owned by small farmers for reasons such as:

- Diversification in the use of production resources and reduction of socio-economic risks
- Promotion of linkages between system components (land, crops and water)
- Generation of value-added products (e.g. meat, milk, eggs and skins)
- Income generation, investment, insurance and economic security
- Supply of draught power for crop cultivation, transportation and haulage operations
- Contribution to soil fertility through nutrient cycling (dung and urine)
- Contribution to sustainable agriculture, and environmental protection
- Prestige, social and recreational values, and
- Development of stable farm household

Animal production has come a long way since it first began, nowadays it is being done in multitude of ways across the planet, providing large variety of goods and services, all this in a wide spectrum of agro-ecological and socio-economic conditions. The production system have a major impact on the various aspects such as the total output of the farm, the animal health management, and also the genetic improvement of the animal. As to its wide variety of production, there are certain patterns that have been categorized in various livestock production system (LPS) that can be recognize (Steinfeld *et al.*, 2006). These production system could be from the very least input (animals grazing on communal lands and receive minimum care) to the most intensive such as those of big commercial farms (and also big investment in both money and labour).

In Asia, the most common animal production system can be either one of these three categories (Devendra, 2007). These systems are; (i) "landless", (ii) crop based and, (iii) rangeland-based. Animal production involves both non-ruminants (poultry, pigs, etc) and ruminants (cattle, goats, etc) and a variety of systems that are or not even integrated with crops. The systems vary as a function of agro-ecological zone and intensity of farming operations in which each farmer has their own objectives in terms of production. The development of these systems has considerable potential, the benefits being associated with the complementary interactions of the subsystems in which the products are additive.

### 2.1.1 "Landless" production system

This system can be further classified into two categories which are urban "landless" system and rural "landless" system (Devendra, 2007). The former system is basically a large, industrial, highly intensive and vertically integrated in which the amount of output being produce by this type of system are very high and have a major economic impact in the agricultural sector. The high output of this system is also due to its high input cost in which generous investments are always being made in the feeds, supplements, medication and technologies of animal production. This type of production systems are usually run by the private-sector and found concentrated in semi-urban areas which have a close infrastructure connection to the processing facilities and also local markets. There are also some concern related to the intensity of this production system. Concerns are mainly on the use of mainly maize and protein

supplements which are imported always suffer with the cost rise of importing them. Also not to forget that this system is always related to serious problem in pollution (Tamminga, 2003).

Rural "Landless" livestock production system as stated in its name, focuses in rural area and mainly on ruminants (Kumar and Deoghare, 2003). The term "landless" refers to zero grazing practices and extensive systems that are associated with resource-poor nomads, agricultural labourers and seasonal migrations with small ruminants, cattle and camels (Devendra, 2007). Movements of the system are usually based on annual cycles that influence feed, water supplies, and market opportunities. The common problems for this system are overgrazing and degradation due to "slash and burn" practice of agriculture.

### 2.1.2 Crop based animal production system

The integration of crop production and also animal production is a newly developed trend in which is practiced due to the limited number of land being available for agriculture due to urbanization (Young, 1999). This system is very important in terms of managing the land area involved, food security and exploiting potential opportunities for increased food production. Example of some major crop-animal interaction are shown in table 2.1 Diversification and integration of the production resources are common (Devendra, 2007). In this category, both ruminants and non-ruminants are involved, the choice of one or more species depends on the interaction target between crop and animal, preference, and even the market. A study by Steinfeld (1998) mentioned that mixed farming systems grew half as fast (2.2% per year) compared to industrial systems (4.3% per year) and these data suggest that mixed farming systems will continue to be important in the future.

Table 2.1 Interaction between crop and animal production

| Crop production | Animal production |
|---|---|
| • Crops provide a range of residues and by-products that can be utilised by ruminants and non-ruminants. | • Large ruminants provide power for operations such as land preparation and for soil conservation practices. |

| Crop production | Animal production |
|---|---|
| • Native pastures, improved pastures and cover-crops growing under perennial tree crops can provide grazing for ruminants.<br><br>• Cropping systems such as alley-cropping can provide tree forage for ruminants. | • Both ruminants and non-ruminants provide manure for the maintenance and improvement of soil fertility. In many farming systems it is the only source of nutrients for cropping. Manure can be applied to the land or, as in Southeast Asia, to the water which is applied to vegetables whose residues are used by non-ruminants. |

Source: Devendra *et al.*, 1997

### 2.1.3 Rangeland-based animal production system

Rangeland is a type of land that is occupied by indigenous vegetation, comprising grasses, forbs, and usually shrubs, with an uneven spatial distribution (Farrié *et al.*, 2015). Animals are usually left on the rangeland to scour feed for themselves or also known as grazing. In some region, society rangeland are provided as a means for helping small-scale farmers feed their animals. Securing or even increasing the animal production and ecosystem services provided by rangeland-based livestock systems requires maintaining or restoring (if they have been degraded, *e.g.* by shrub encroachment) rangeland conditions, although rangeland-based grazing management is very complex (Farrié *et al.*, 2015). Main concern on this system is that animals have to rely with the uncertainty of the effects of climate on rangelands. Thus they require particularly adaptive management strategies (Berkes *et al.*, 2000; Farrié *et al.*, 2015; Havstad *et al.*, 2007).

## 2.2 Breeding practices

As mentioned before, livestock animals were first domesticated approximately 10 000 years ago because they had the capacity to turn forage not suitable for human consumption (e.g., grass) into meat, milk, and eggs, all sources of high-quality protein,

lipids and micronutrients that enabled humans to survive in wide-ranging environments (Hayes *et al.*, 2013). As over the years the population has grown exponentially and so does the demands for all the food products that have been mentioned (Delgado, 2005). To keep up with the raise of demand, livestock farmers have to improve in terms of quantity and quality of animal productions.

Animal breeding is the science that involves with maximising the desirable genetic traits such as producing animals with leaner meat. In the developing world, it has always become a challenge to meet the increasing demand for livestock product while conserving animal genetic resource diversity and maintaining environmental integrity (van Arendonk, 2011). Breeding is not simply the parturition of animal, but actually parturition of an improve youngling from the parental animal. Developing a breeding schemes aim at utilisation of the between and within breed genetic diversity. Genetic improvement implies change for the better good of the production. For the genetic change to be an improvement, the overall effects must bring benefits to the owners of the animals. The desired direction of change of a particular breed depends on the social, economic and environmental context in which livestock production takes place (van Arendonk, 2011). Within breed genetic improvement programmes, two activities need to be distinguished (Nicholas, 1996; van Arendonk and Bijma, 2003). Firstly is the selecting of animals based on their estimated breeding value for the relevant traits, this is for the creation of genetic improvement. Secondly, is the dissemination of superior genetic material from the genetically elite animals to the commercial population. Therefore proper planning and execution of a well thought breeding practice, will help improve the production of animal and increase the quality that is being produced.

The activities in a genetic improvement programme can be summarized in six major steps:

1. Analysis of production system: what kind of animal is "desired"?
2. Choice of breeding system: pure breeding or use of crossbreeding.
3. Definition of breeding goal (desired direction of change).
4. Evaluation of selection candidates (estimating breeding value).
5. Selection of best animals as parents for next generation.
6. Use superior animals to produce (crossbred) animals in the target population.

### 2.2.1 Breeding practices in Malaysian context

The Malaysian livestock industry can be divided into ruminant and non-ruminant sector, in which for the case of Malaysia, the latter strive much more than that of the former. The ruminant sector currently consists of beef and dairy cattle, dairy buffaloes, sheep and goats that are still raised in small-scale (Arshad *et al.*, 2007). As this sector is still well below the SSL as mentioned before, Malaysia imports most of the needs of beef mutton and dairy products from abroad especially India, Australia and New Zealand to cater for the shortage (Mohammad and Rosali, 2015).

To overcome this situation, the government took several action. According to 2013 Malaysian livestock breeding policy (DVS, 2013), government farms were set up to function as breeding stations, to disseminate genetic material in the form of live animals to farmers, for example the Veterinary Institute Malaysia (IVM) in Kluang, Johor. The current breeding practices in Malaysia are outlined for beef cattle, dairy cattle, buffaloes, meat goats, dairy goats, sheep, pigs, chicken, ducks, quails, and deer.

To increase efficiency in livestock production and reduce the dependency on imports, research and development on animal breeding and nutrition is strengthened, particularly for the local cattle and goat breeds and the use of local raw materials in non-ruminant feed formulation (Kementerian Pertanian dan Asas Industri Tani Malaysia, 2011). To increase production, researches on ruminant breeding are conducted that include restructuring the breeding system, the development nucleus herd, the integration production system and reproduction animal (breed lot) system for a multiplier herd (DVS, 2013). Productive ruminant population was also enhanced through more impressive breeding services such as the use of reproductive biotechnology and the active involvement of the private sector. For non-ruminants, breeding activities will continue to be strengthened by encouraging the use of modern technologies and in compliance with good farming practices such as closed house and automation. In addition to that, use of effective microorganisms (EM) products will be promoted as natural biological control agents (Mohammad and Rosali, 2015).

In the case of beef cattle in Malaysia, back in 1980, the Committee on Cattle Breeding Policy stipulated that pure-line breeding of indigenous KK cattle be continued for long-term selection and as a base for future crossbreeding programs.

Crossbreeding of beef animals was also recommended for commercial beef production using imported exotic breeds such as Angus and Hereford (DVS, 2013). Going on to dairy cattle, the dairy production system is classified into a medium-input system and high-input system. According to the 2013 Malaysian livestock breeding policy (DVS, 2013), both type of system utilizes foreign breeding animals and in general, about 60-70% of the farmers practice natural mating while the rest use AI as compared to almost 10% for dairy cattle in develop country. In the goat department, continuous purebreeding work using AI and natural mating to improve the genetic quality of the local Katjang goat is carried out. Breeder farmers over the years have also resorted to importing Boer, Kalahari Red, Australian Feral, and Jamnapari-based breeds for purebreeding and crossbreeding (DVS, 2013). Breeding methods include natural mating and AI.

Going on to non-ruminant sector, all pig breeding stock are imported from overseas. The breeding companies multiply purebred imported stock and sell them to local farmers. The use of AI to produce porkers to be marketed at 6 months of age is also being practiced (DVS, 2013). Usually large scale pig farmers that keep their livestock records are the one that always practiced AI. The Malaysian Poultry Industry (comprising chicken and ducks) adopts a policy of continuous importation of germplasm, where grandparent stock (GPS) are imported and managed. Local breeding companies multiply imported breeding stock and use them for commercial production (DVS, 2013). Some parental stock (PS) are also imported mainly from Europe and the United States. No breeding work is done here in Malaysia except crossing for production of PS and commercial broilers. For the layer industry, there is no GPS farm. There are only PS farms and all grandparent stock are imported. No local breeding programs are available to produce our own local breed due to the high cost and technologies involved.

## 2.3 Natural mating and artificial insemination (AI)

The purpose of this study was to find out whether farmers in Malaysia are practicing systematic breeding method in their farm. Systematic breeding of domestic livestock for enhanced disease resistance is becoming more common throughout the world (Stear *et al.*, 2001). When the animals are left to breed by themselves without any supervision or restriction, they would mate randomly and will some sort of breeding

problems might occur (such as inbreeding within herd). The most plausible mechanism of inbreeding depression is that through an increased level of homozygosity, deleterious recessive alleles are unmasked (Frommen and Bakker, 2006). This leads to various disadvantages for the inbred progeny and thus to a reduced fitness of parents. In exploiting the genetic potential of the parents there are several breeding tools that need to be discussed. These tools are natural mating and AI.

### 2.3.1 Natural mating

Natural selection is aimed at increasing the survival chances of a species. In natural selection, animals with favourable traits (those best suited to the environment) make the largest contribution to the next generation. Natural mating is the mating of the male and female animal of the same species occurring naturally. In natural mating, the male animal must physically meet with the female counterpart in order for insemination to occur. Factors such as the male libido and also the male spermatozoa quality highly influence with the conception rate. Natural mating has a lower success rate of the sperm actually reaching to the uterine track (Acritopoulou-Fourcroy *et al.*, 1982) and subsequently merge with the female gamete. A farm that practices natural mating depends on male animal to assume the role of both inseminator and detector of heat thus hugely reducing the cost of worker for the same task (Overton, 2005). Take note that using bulls (for the case of cattle) probably doesn't improve fertility and they cost more than using AI, the main reason for using bulls is making herd reproductive management easier. This makes it even more essential that bulls are managed well as otherwise even this advantage can disappear. Additionally, the farm also bears the cost of having to manage the number of male animals, as if the farmer were to practice AI the cost of rearing male is eliminated entirely. Not only that, without proper breeding management, natural mating can result in inbreeding among animals and inbreeding is a costly loss in animal performance (Mpofu and Rege, 2002). High level of inbreeding can result in poor performance in various traits of animals such as parturition, feed conversion, and also milking capacity.

## Reference


Acritopoulou-Fourcroy, S., Pappas, V., Peclaris, G., Zervas, N., & Skoufis, V. (1982). Synchronization of œstrus in ewes with Provera sponges/PMSG, prostaglandin F2α or the prostaglandin analogue, ICI 80996, and fertility following natural mating or artificial insemination. *Reproduction Nutrition Développement*, *22*(2), 345–354.

Arshad, F. M., Abdullah, N. M. R., Kaur, B., & Abdullah, A. M. (2007). *50 Years of Malaysian Agriculture: Transformational Issues, Challenges and Direction*. Universiti Putra Malaysia press.

Berglund, B. (2008). Genetic improvement of dairy cow reproductive performance. *Reproduction in Domestic Animals = Zuchthygiene*, *43 Suppl 2*, 89–95. Journal Article, Review. doi:10.1111/j.1439-0531.2008.01147.x

Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, *10*(5), 1251–1262.

Biscarini, F., Nicolazzi, E. L., Stella, A., Boettcher, P. J., & Gandini, G. (2015). Challenges and opportunities in genetic improvement of local livestock breeds. *Frontiers in Genetics*, *6*, 33. doi:10.3389/fgene.2015.00033

Bó, G. A., Cutaia, L., Peres, L. C., Pincinato, D., Maraña, D., & Baruselli, P. S. (2006). Technologies for fixed-time artificial insemination and their influence on reproductive performance of Bos indicus cattle. *Society of Reproduction and Fertility Supplement*, *64*, 223–236. JOUR.

Chantalakhana, C. (1990). Small farm animal production and sustainable agriculture. In *The 5 th AAAP Animal Science Congress* (Vol. 2, pp. 39–58).

Davis, N. T. (1965). Studies of the reproductive physiology of Cimicidae (Hemiptera)—II. Artificial insemination and the function of the seminal fluid. *Journal of Insect Physiology*, *11*(3), 355–366.

Delgado, C. (2005). Rising demand for meat and milk in developing countries: implications for grasslands-based livestock production. *Grassland: A Global Resource*, 29–39.

Devendra, C. (2007). Perspectives on animal production systems in Asia. *Livestock Science*, *106*(1), 1–18. doi:10.1016/j.livsci.2006.05.005

Devendra, C., Thomas, D., Jabbar, M. A., & Kudo, H. (1997). Improvement of livestock production in rain-fed agro-ecological zones of South-East Asia. *ILRI, Nairobi, Kenya*, 107.

Diamond, J. (2002). Evolution, consequences and future of plant and animal domestication. *Nature*, *418*(6898), 700–707. JOUR.

DVS. (2013). Malaysian livestock breeding policy 2013, 1–42.

DVS. (2015). MALAYSIA : KADAR SARADIRI HASILAN TERNAKAN (%), 2006-2015 Malaysia : Self-Sufficiency In Livestock Products (%), 2006-2015.

Farrié, B., Jouven, M., Launay, F., Moreau, J. C., Moulin, C. H., Piquet, M., ... Martin, G. (2015). Rangeland Rummy - A board game to support adaptive management of rangeland-based livestock systems. *Journal of Environmental Management*, *147*, 236–245. doi:10.1016/j.jenvman.2014.08.018

Flint, A. P. F., & Woolliams, J. A. (2008). Precision animal breeding. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *363*(1491), 573–590. JOUR. doi:10.1098/rstb.2007.2171

Fresco, L. O. (2014). Some thoughts about the future of food and agriculture. *South African Journal of Science*, *110*(5–6), 1–2.

Frommen, J. G., & Bakker, T. C. M. (2006). Inbreeding avoidance through non-random mating in sticklebacks. *Biology Letters*, *2*(2), 232–5. doi:10.1098/rsbl.2005.0432

Goddard, M. G., & Smith, C. (1990). Optimum number of bull sires in dairy cattle

breeding. *Journal of Dairy Science*, *73*(4), 1113–1122. JOUR.

Gourley, D. D., Gourley, D. N., Kloostra, D. D., Middle, G. H., Banys, A. R., & Freiman, A. G. (2000, September 12). Artificial insemination system. GEN, Google Patents. Retrieved from https://www.google.com/patents/US6117068

Haubrich, M. A. (1999, May 4). Device and process for artificial insemination of animals. GEN, Google Patents.

Havstad, K. M., Peters, D. P. C., Skaggs, R., Brown, J., Bestelmeyer, B., Fredrickson, E., … Wright, J. (2007). Ecological services to and from rangelands of the United States. *Ecological Economics*, *64*(2), 261–268.

Hayes, B. J., Lewin, H. A., & Goddard, M. E. (2013). The future of livestock breeding: Genomic selection for efficiency, reduced emissions intensity, and adaptation. *Trends in Genetics*, *29*(4), 206–214. doi:10.1016/j.tig.2012.11.009

Jones, J. W., Antle, J. M., Basso, B., Boote, K. J., Conant, R. T., Foster, I., … Wheeler, T. R. (2016). Brief history of agricultural systems modeling. *Agricultural Systems*. doi:http://dx.doi.org/10.1016/j.agsy.2016.05.014

Kaur, S. P. (2013). Variables in Research Designs. *Measurement*, *3*(4), 36–38.

Kementerian Pertanian dan Asas Industri Tani Malaysia. (2011). Dasar Agromakanan Negara 2011 - 2020, 135.

Khandoker, M., Apu, A. S., Husain, S. S., & Notter, D. R. (2011). A baseline survey on the availability of Black Bengal breeding bucks in different districts of Bangladesh. *Journal of the Bangladesh Agricultural University*, *9*(1), 91–96.

Kolmodin, R., Strandberg, E., Madsen, P., Jensen, J., & Jorjani, H. (2002). Genotype by environment interaction in Nordic dairy cattle studied using reaction norms. *Acta Agriculturae Scandinavica, Section A-Animal Science*, *52*(1), 11–24. JOUR.

Kumar, S., & Deoghare, P. R. (2003). Goat production system and livelihood security of rural landless households. *Indian Journal of Small Ruminants*, *9*(1), 19–24.

le Roex, N., Berrington, C. M., Hoal, E. G., & van Helden, P. D. (2015). Selective breeding: The future of TB management in African buffalo? *Acta Tropica*, *149*, 38–44. doi:http://dx.doi.org/10.1016/j.actatropica.2015.05.012

Loh, T. C. (2004). Livestock production and the feed industry in Malaysia. In *FAO Animal Production and Health Proceedings (FAO)*. FAO.

Martinez, E. A., Vazquez, J. M., Roca, J., Lucas, X., Gil, M. A., Parrilla, I., … Day, B. N. (2002). Minimum number of spermatozoa required for normal fertility after deep intrauterine insemination in non-sedated sows. *Reproduction*, *123*(1), 163–170. JOUR.

Mohammad, A. A., & Rosali, M. H. (2015). The Development and Future Direction of Malaysia ' s Livestock Industry. *Malaysian Agricultural Research and Development Institute (MARDI)*, 1–7. Retrieved from http://www.utusan.com.my/sains-teknologi/sains/transformasi-industri-ruminan-1.166523

Mpofu, N., & Rege, J. E. O. (2002). Monitoring of Sahiwal and Friesian cattle genetic improvement programmes in Kenya. JOUR.

Nicholas, F. W. (1996). Genetic improvement through reproductive technology. *Animal Reproduction Science*, *42*(1), 205–214.

Nordin, A. F. (2014). Cadastral Template 2.0 Malaysia. *The Centre for Spatial Data Infrastructures and Administrations*, 1–13. Retrieved from http://www.cadastraltemplate.org/

Overton, M. W. (2005). Cost comparison of natural service sires and artificial insemination for dairy cattle reproductive management. *Theriogenology*, *64*(3), 589–602. JOUR.

Sakawi, Z., & Ismail, L. (2015). Managing odour pollution from livestock sources in Malaysia : Issues and challenges. *Malaysian Hournal of Society and Space*, *11*(13), 96–103.

Seegers, H. (2006). Economics of the reproductive performance of dairy herds. *Proc World Buiatrics Congress*, 292–302.

Stear, M. J., Bishop, S. C., Mallard, B. a, & Raadsma, H. (2001). The sustainability, feasibility and desirability of breeding livestock for disease resistance. *Research in Veterinary Science*, *71*(1), 1–7. doi:10.1053/rvsc.2001.0496

Steinfeld, H. (1998). Livestock production in the Asia and Pacific region: current status, issues and trends. *World Animal Review (FAO)*.

Steinfeld, H., Wassenaar, T., & Jutzi, S. (2006). Livestock production systems in developing countries : status , drivers , trends Global drivers of the livestock sector, *25*(2), 505–516.

Tamminga, S. (2003). Pollution due to nutrient losses and its control in European animal production. *Livestock Production Science*, *84*(2), 101–111.

van Arendonk, J. A. M. (2011). The role of reproductive technologies in breeding schemes for livestock populations in developing countries. *Livestock Science*, *136*(1), 29–37. doi:10.1016/j.livsci.2010.09.004

van Arendonk, J. A. M., & Bijma, P. (2003). Factors affecting commercial application of embryo technologies in dairy cattle in Europe—a modelling approach. *Theriogenology*, *59*(2), 635–649. doi:http://dx.doi.org/10.1016/S0093-691X(02)01245-1

Wheeler, T., & Von Braun, J. (2013). Climate change impacts on global food security. *Science*, *341*(6145), 508–513.

Wikler, D., & Wikler, N. J. (1991). Turkey-baster babies: the demedicalization of artificial insemination. *The Milbank Quarterly*, 5–40. JOUR.

Young, A. (1999). Is there really spare land? A critique of estimates of available cultivable land in developing countries. *Environment, Development and Sustainability*, *1*(1), 3–18.