CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Agriculture by definition from several dictionaries refers to the production of food and fiber, and other goods through farming and forestry. Agriculture was a key development that led to the rise in human civilization raising of domesticated animals. Agriculture encompasses a wide variety of specialties. Cultivation of crops on arable land and the pastoral herding of livestock on rangeland remain at the foundation of agriculture. In the past century a distinction has been made between sustainable agriculture and intensive farming. Selective breeding and modern practices in animal husbandry such as intensive pig farming (and similar practices applied to poultry) have similarly increased the output of meat.

Livestock production (farming) is defined as domestic animals, such as cows, goats, cattle or horses, raised for home use or for profit (Bellaver, 1999). Farming has been practiced a long time ago with continuous transformations along the industry, consider as activity with a large impact on the environment. The long-term land use for a variety of outputs in the low ground has affected the quality of water, soils, air, biodiversity and landscape. In other words, livestock contribute to food production at the expense of resource degradation such as water pollution and deforestation (Bellaver, 1999). The situation leads government to impose new policies to improve livestock promotion in terms of safe food, animal welfare and sustainable environment.

Most governments in the world have subsidized their agriculture sector to ensure adequate food supply. These agricultural subsidies are often linked to the production of certain commodities such as poultry meat, beef, goat meat, rice, soybeans, and milk. In the past century, agriculture has been characterized by enhanced productivity, the use of synthetic fertilizers and pesticides, selective breeding, mechanization, water contamination and farm subsidies. While practice in agriculture lay dormant for decades, as environmental awareness has increased in the 20th century there has been a movement towards sustainable agriculture by some farmers, consumers and policymakers. In recent years there has been a backlash against perceived external environmental effects of mainstream agriculture, particularly regarding water pollution (The World Bank, 1995), resulting in the organic movement. One of the major forces behind this movement are the European Union (EU), which first certified organic food in 1991 and began reform of its Common Agricultural Policy (CAP) in 2005 to phase out commodity-linked farm subsidies (European Commission, 2003), also known as decoupling.

Malaysia is one of the developing countries where the population was 27.7 million in 2008 and the number increases by year. In developing countries, livestock production is being submitted to great pressure to satisfy the demand for animal protein required and also to meet trading market needs with the most developed countries. The growing appetite of the urban populations for animal products such as meat, milk and eggs frequently causes environmental damage and disturbance to traditional family farming (Bellaver, 1999).

On July 24, 2008, the Food and Agriculture Organization (FAO) has conducted a meeting for farmers to join the ongoing “Greener” revolution represented by Conservation Agriculture. This farming system aims to produce larger livestock for human needs in this world more sustainably by improving soil ecosystems and to mitigate the soil disturbance. The current farming is practicing a solely technical or economics approach where they have to change to a more socially, ecologically and market-embedded approach. A sustainable farming is needed not only for active production and cost-effective benefit but it is also to prevent any threat towards environment with good management practice by farmers.

This work aims to give an overview of current practices which focuses on activities (environmental aspects and associated impacts) at each selected farm and to propose an improvement or solutions at identified impacts based on environmentally sound management for livestock production development on farm.

1.2 EVOLUTION OF LIVESTOCK PRODUCTION IN MALAYSIA

The development of livestock production is tremendously increasing because it plays an important role in the agriculture socioeconomic development of Malaysia, which provides employment for about 16% of the population (MOA, 1999) and accounts for about 12% of the national gross domestic product. The importance of agriculture sector in the country has received a new dimension where this sector will be revitalized to become the third engine of economical growth. This has been reflected in the Third National Agricultural Policy (1998-2010) and the momentum is increasing since Malaysia has become a source of safe and quality *halal* food products. As a premium standard for *halal* food, Malaysia government has introduced a certification standard MS1500:2004, consists of General Guidelines on the Production, Preparation, Handling and Storage of *Halal* Foods. Today, Malaysia has been acknowledged as a regional hub and the centre for the certification of *halal* product. This phenomenon gave impacts to all subsectors of agriculture especially livestock production which driven by the utilization of new technologies, shift to large-scale commercial production and increased market accessibility. The improved output from the agriculture sector has also contributed to better income and standard of living, particularly for farmers in rural areas.

As for today, the demand for goat meat in the world has been increasing rapidly, and the same pattern can be seen in Malaysia. Table 1.1 shows livestock statistics on production, demand, % self-sufficiency level and per capita consumption in Malaysia for year 2007 and 2008. The statistics show the production in mutton has increased by 9.71% over a year, however, Malaysia is still importing goat meat since the statistic shows, the total demand of mutton (goat) is higher than the total of production for both year 2007 and 2008.

Table 1.1 : Production, Demand, % Self Sufficiency Level and Per Capita Consumption 2007, 2008

Commodity	2007 (estimated)	2008 (forecasted)
Chicken Meat		
Production (`000 mt)	1,095.50	1,157.94
Demand (`000 mt)	902.46	952.41
Local Market Value (RM million)**	4,499.67	4,756.14
Total Population	27,173,500	27,728,700
% Self Sufficiency Level	121.39	121.58
Per Capita Consumption (Kg)	33.22	34.35
% Growth		5.7
Chicken Eggs		
Production (million eggs)	8,200.00	8,714.00
(`000 mt)	492	522.84
Demand (million eggs)	7,362.25	7,631.14
(`000 mt)	441.73	457.87
Local Market Value (RM million)**	1,804.02	1,917.10
Total Population	27,173,500	27,728,700
% Self Sufficiency Level	113.79	114.19
Per Capita Consumption (eggs)	271	275
Per Capita Consumption (Kg)	16.26	16.51
% Growth		6.3
Beef		
Production (`000 mt)	34.29	37.5
Demand (`000 mt)	137.82	144.9
Local Market Value (RM million)**	624.55	683.02
Total Population	27,173,500	27,728,700
% Self Sufficiency Level	24.88	25.88
Per Capita Consumption (Kg)	5.07	5.23
% Growth		9.4
Mutton (Goat)		
Production (`000 mt)	1.75	1.92
Demand (`000 mt)	20	20.98
Local Market Value (RM million)**	45.58	50.01
Total Population	27,173,500	27,728,700
% Self Sufficiency Level	8.75	9.15
Per Capita Consumption (Kg)	0.74	0.76
% Growth		9.7
Pork		
Production (`000 mt)	216.5	222.56
Demand (`000 mt)	186	183.31
Local Market Value (RM million)**	1,406.90	1,446.28
Total Pork Cons (40% of population)	10,869,400	11,091,480
% Self Sufficiency Level	116.4	121.41
Per Capita Consumption (Kg)	17.11	16.53
% Growth		2.8
Milk		
Production (million Litres)	51.07	56.48
Demand (million Litres)	1,088.91	1,179.12
Local Market Value (RM million)**	69.25	76.58
Total Population	27,173,500	27,728,700
% Self Sufficiency Level	4.69	4.79
Per Capita Consumption (Kg)	40.08	42.52
% Growth		10.6

Note:

** - from base year 2000

Sources : Department of Veterinary Services, Malaysia (2008)

This could be due to the standard of living and awareness among community that requires good nutritional healthy food. In 2008, 9.15% self sufficiency shows the level of production in mutton (goat) over the demand compared to 8.75% in 2007. However a big comparison can be seen between mutton (goat), chicken meat, beef, pork and milk in per capita consumption (kg). Mutton shows the lowest consumption per capita 0.76kg compared to 34.35kg in chicken meat, 5.23kg in beef, 16.53kg in pork and 42.52kg in milk. The differences in consumption can be caused by the lifestyle and market in Malaysia where the majority community highly eats chicken meat due to local cuisine requires it while pork and beef are the popular choice in home cooking.

Table 1.2 shows a comparative value in goat meat nutrition between other livestock. Goat meat has the lowest calories, fat, saturated fat and cholesterol compared to chicken, beef, pork and lamb. Due to this, the price of meat (goat) is selectively higher than others and supply is limited compared to demand. Goat meat has an important source of protein, minerals and vitamins in human diets. Nonetheless for a majority of the world's population meat is a valuable source of these nutrients and contributes to the total food energy supplies.

Table 1.2 : Goat meat nutrition comparative chart

Trait	**Per 3 oz. Cooked**				
	Goat*	**Chicken****	**Beef*****	**Pork******	**Lamb*******
Calories	122	162	179	180	175
Fat (g)	2.6	6.3	7.9	8.2	8.1
Sat Fat (g)	0.79	1.7	3	2.9	2.9
Protein (g)	23	25	25	25	24
Cholesterol (mg)	63.8	76	73.1	73.1	78.2

Note:

*	Game meat, goat, cooked roasted
**	Chicken, broilers or fryers, meat only, roasted
***	Beef, composite of trimmed retail cuts, separable lean only, trimmed to 0" fat, all grades, cooked
****	Pork, fresh, composite of trimmed retail cuts (leg, loin, and shoulder), separable lean only, cooked
*****	Lamb, domestic, composite of trimmed retail cuts, separable lean only, trimmed to ¼" fat, choice, cooked

Source : USDA (2001)

1.3 THE ENVIRONMENTAL IMPACT FROM LIVESTOCK PRODUCTION

As part of the Ninth Malaysia Plan, main strategies have been planned to ensure development of the national food-agro sector to transform into a modernized, profitable and competitive commercial entity. Better quality livestock especially selected for superior production qualities and quantities, extensive use of chemical agents (such as fertilizers, drugs), better farming practices and veterinary medical care all contributed to increased food production. Although these methods contribute to the production, some of the current practices such as in-feed antibiotics and other banned substances came at a great environmental damage. Most nations in the world are approaching the consequences of neglecting the environment in agriculture. Prominent among these are topsoil depletion, groundwater contamination, and increasing costs of production.

1.3.1 Livestock

Henning Steinfeld, Chief of FAO's Livestock Information and Policy Branch detailing in United Nation (UN) report that livestock are one of the most significant contributors to today's most serious environmental problem. Livestock production occupies 70% of all land used for agriculture or 30% of the land surface of the planet (FAO, 2006). It is one of the largest sources of greenhouse gases and considering the entire commodity chain, it is estimated that livestock is responsible for 18% of the world's greenhouse gas emissions as measured in CO_2 concentration. By comparison, all transportation emits 13.5% of the CO_2, where transportation produces 65% of human-related nitrous oxide (which has 296 times the global warming potential of CO_2), and 37% of all human-induced methane (which is 23 times as warm as CO_2). The livestock also generates 64% of the ammonia, which contributes to acid rain and acidification of ecosystems. Livestock expansion is cited as a key factor driving the deforestation through land degradation and is also driving reductions in biodiversity.

Continued growth in livestock production will exacerbate pressures on the environment and natural resources, calling for approaches that allow for increased production while lowering the environmental burden.

1.3.2 Climate Change

Climate change has the potential to affect agriculture through changes in temperature and moisture regimes. Agriculture can either mitigate or worsen global warming (Chrispeels and Sadava, 1994). Some of the increase in CO_2 in the atmosphere comes from the decomposition of organic matter in the soil, and much of the methane emitted into the atmosphere is due to the decomposition of organic matter in wet soils such as rice paddies. Further, wet or anaerobic soils also lose nitrogen through denitrification, releasing the greenhouse gas nitric oxide. Changes in management can reduce the release of these greenhouse gases, and soil can further be used to sequester some of the CO_2 in the atmosphere.

1.4 OVERVIEW OF EMS IN FARMING

There is much that farmers can do, and are doing, to achieve sustainable use of natural resources in agriculture. Implementing an Environmental Management System (EMS) that incorporates all these programs potentially gives farmers an internationally credible means of safeguarding trade and improving the sustainability of agricultural production. An EMS will help prepare farmers to meet current and future challenges, whether from government regulation, consumer market preferences, or communities concerned about their local environment.

EMS is a management tool for evaluating any activities involved in farming by identifying the environmental aspects and impacts associated with those activities and managing resources to reduce those impacts. It involves the search for management tools and policy instruments to develop solutions by understanding the whole picture, managing significant impacts and help farmers stay in compliance with environmental requirements. The key concepts are intended to understand the full range of its environmental impact, prioritize and effectively manage its programs, track and document its progress.

Addressing these, the government expects to bring out safe and sustainable agriculture, intensify agriculture production and be competitive in the agri-food trade. Implementation of good agricultural practices, formulation and implementation of standards and strengthening professionalism of the market players and entrepreneurs are needed. Ministry of Agriculture, Malaysia (MOA), has produced Good Animal Husbandry Practice (GAHP), which specify requirements for the code of good agricultural practices (GAP) for farmers.

This GAHP is a guideline for all farmers in managing their livestock production from all aspects which include: management of livestock and farm; food safety; premise and environment; bio-security; effective herd health program; sanitation facilities; rubbish disposal and waste treatment. A good disposal system for litter and proper waste treatment has to be adequate and proper to meet the Department of Environment, Malaysia (DOE) standards.

Animal husbandry is referring not only to the breeding and raising of animals on a continual basis, but also in taking care of the animals by knowing how to breed them with artificial insemination techniques, make use of the newest technology to milk or to feed animal. Grassland based livestock production relies upon plant material such as rangeland and pastures for feeding ruminant animals. Outside nutrient inputs is used by certain farmers that practice the intensive system which animals are being kept in the feedlot. Approximately 68% of all agricultural land is permanent pastures used in the production of livestock (FAO, 2006).

1.5 OBJECTIVES OF THE STUDY

i. To identify the overall farm operation especially on livestock production system and waste management via various environmental aspects and impacts.

ii. To identify a sustainable and environmentally sound goat farming management practice.

iii. To determine and propose a Good Farming Practice (GFP) from identified environmental aspects and associated impacts study, and comparing it with the current management practices.

1.6 BENEFIT OF THE STUDY

Environmental Management System (EMS) is a study that covers the whole system of livestock production from all aspects and impacts. By building internal awareness of environmental issues, farms (that adopt an EMS) can attain a sustainable farming and substantial improvements in environmental performance (Wells and Galbraith, 1998; Kestemont and Ytterhus, 1997). However, the large majority of research relates to the role of EMSs in the industrial sector and relates to their use by corporations. Far less is known about the effectiveness of such systems when applied to agriculture.

Good Farming Practice (GFP) can be also achieved from the study of EMS application and it is practical to implement in goat farming.

CHAPTER 2

LITERATURE REVIEW

2.1 CHALLENGE ON SMALL-RUMINANT PRODUCTION IN MALAYSIA

Today, the livestock sector of Malaysia has been less important to the economy and accounts for only 10% of the gross value of agriculture production and 3.3% of the gross domestic products (Vidyadaran et al. 1988). We have been relying on imported small-ruminant meat from other countries due to poor production locally. 20 years ago, small-ruminant farming in livestock industry was a neglected sector and almost entirely raised by small number of farmers on smallholdings with poor management systems. Somehow within last 5 years, Malaysian government has came up with many incentives and policies to improve our agriculture sector which include: increasing agriculture production with greater private sector participation; enhancing income of smallholders, farmers and fishermen; giving out incentives, loans, subsidies, information and training; and improving the delivery service system.

A local newspaper, the Berita Harian on November 23, 2006, reported that Perak will be the next hub for goat type Boer farming. It was understood that the state governance is allocating land and place for the young generations especially universities graduates to start on their livestock farming. As one of the effort, Chenderiang Industry Zone has been established and developed by Perak State Development Body (PKNP). This project was fully supported by Tan Sri Muhyiddin Yassin who was the Agriculture and Agro-based Industries Minister back then. In August 24, 2007, another report has stated on raising output of goat meat locally. An effort to see Boer goats being bred at an accelerated rate is conducted.

However, the small-ruminant production challenges of managing sustainability are immense. The ‘green’ farmer must be a creative visioner, fully in grasp of the environmental issues facing the world, with a moral character that is infused with values that are humanistic, noble and benign towards nature. Ultimately modern small-ruminant farming requires the active participation of all stakeholders that includes everybody within the production chain - farmers, processors, retailers, regulators, consumers and the concerned public. Another issue involved in operating a farm within the residential areas is to ensure that the immediate community is free from health hazard and disease outbreak.

Contributions of small-ruminant to the people and economies of Malaysia is underestimated, basically because their production is considered as small in scale, and small-ruminant products seldom enter a formal marketing system. Recently, the market value is competitive to newly established farms due to the rise on total production of small-ruminant. The competition can be seen clearly on the price whereby imported goat meat is cheaper than local product. For these reasons, most of the farmers had changed the patterns instead focusing on the local market, they produced the small-ruminant products for international trading purpose. Due to this factor, food safety and animal welfare especially in small-ruminant products are taken seriously in trading system. Palasuberniam et al. 2005 has stated that the backbone of the international trading system is the set of rules that national governments have agreed to follow to ensure trade is nondiscriminatory, fair, predictable and transparent.

The agreement on Sanitary and Phytosanitary (SPS) under the World Trade Organisation (WTO), seeks to protect a country's consumers by providing the basic rules for food safety and animal health thus ensuring that consumers are being supplied with food that is safe to consume and with an appropriate level of standards and quality accepted by international community. In the European Union (EU) for example, a series of EU directives were issued that culminated in the banning of in-feed antibiotics since 2003 in the interest of public health. Numerous land bills in most developed countries also incorporate a clause on sustainable water and soil management requirements, whereas guidelines against odour pollution remain a critical component in many legislations that enable society and their farms to co-exist (Palasuberniam et al., 2005).

2.2 SUSTAINABLE LIVESTOCK PRODUCTION PRACTICES

The consequences of irresponsible farming highlighted in the earlier part definitely necessitate new approaches to livestock (small-ruminant) production. Sustainable livestock production would involve harmonising environmental health with economic profitability while addressing social responsibilities admirably. In other word, sustainable livestock production focuses on farmers' profit in the short run, while preserving rural communities and natural resources in the long run.

Good animal husbandry practices (GAHP) is a call for farmers to use the right animals compatible to their production, a routine management to be conducted, ensure good welfare of the animals, prevent environment degradation, and undertake responsibilities that create an economical system of productions of highest quality products. Consumers are very concerned with the quality and safety level of the food they consume.

Most the consumers are curious on how the products are produced or free from any contamination and disease that may affect human health particularly the effect of long-term consumption. Questions are raised on the impact of livestock farming on environmental degradation.

The issues had never been raised before until today, of the occurence of deadly zoonotic diseases due to the consumption of infected products of animal origin or coming into contact with the infected animals and surrounding environment. As an example, in Malaysia, Japanese Encephalitis (JE) proved fatal to the farm operators and has caused massive losses to the swine production. In other parts of the world, the Mad Cow Disease infected cattle and caused death to consumers. While Avian Influenza (AI) has also killed farm operators or people close to the farming areas.

Disease reduce the animal's productivity, cause total loss of the animals, make the product unwholesome, need a long recovery period and prevent movement of animals for sale during the course to control the diseases. These issues should be addressed by improving the current farming practices that include the EMS; whereby farmers are prepared with adequate knowledge of small-ruminant husbandry and technical knowledge; a proper training on effective disease prevention and control program; introducing of good production practice program for farmers; a continuously health and physical check-up on animal conducted by assigned government officer; and waste handling management. Improved livestock production can also be realized through the adoption of breeding technologies and better utilization of local feed resources in a sustainable integrated livestock farming system.

In countries employing advanced technologies in animal husbandry, GAHP is a mandatory requirement for farming. Farmers are sensitive to the issues in livestock production and are determined to meet the consumers' demand. Furthermore, strict law enforcements related to GAHP, make the farmers fully responsible for the animals and the products they farm. Farming standards are high to ensure high quality farm output with high economic values so that the farming business remains sustainable.

2.2.1 Animal Husbandry System

In general, animal husbandry practices fall into any of the following three systems of management:

- Free range System

  This is a common system practices in Peninsular Malaysia by traditional farmer whereby the animal are let loose to graze in the morning and are kept at night in simple shelters with little or no fencing at all. Workers are sometimes employed.

- Semi-Intensive Systems

  Under this system, the animals are released during the day and housed at night. Supplementary feeding may be given when necessary. Proper shed with necessary facilities are provided to accommodate large flock size. Fencing is necessary for open pasture. Shepherds are needed to monitor the flock movement if integrated with other crops such as coconut, oil palm or rubber plantation. This type of animal husbandry practice is good as the flock health could be monitored daily in the morning before releasing and in the evening when they come back.

- Intensive System

  In this system, the animals are always kept in-door and stall-fed with concentrate feeds, fodder or other agricultural by-products. They are provided with good housing facilities and require only minimum land size. This system is not encouraged as the main aim of sheep rearing is integrated with perennial crops and to fully utilize all the forages under crops trees. Concentrate feeding is very expensive. However, this type of management can be recommended for a fattening project as well as for lambs from birth till 3 months old to ensure good health care and better growth rate.

2.2.2 Housing

Small-ruminant needs protection from weather even though they can tolerate cold, especially when it rains, they will seek shelter to avoid getting wet. While goats are generally more tolerant of the heat and humidity than sheep, it is important to provide a proper housing with adequate air circulation. Flies should be controlled for health and sanitation. The primary need for housing is during kidding because of several reasons; where doe can miscarriage during the pregnancy due to high-density of community pens, or newborn small-ruminants can be easily affected with diseases when they are exposed and mixed with the adults. It is recommended for the doe and newborns of small-ruminants to be moved to individual kidding pens for milking duration. Once the immature small-ruminants reach weaning period, they are transferred back to the normal pens with the adults. Weaning is a process of complete withdrawal of milk feeding as soon as the immature reaches a specific age and physical maturity. One pen is recommended for every 10 does in the herd. Confinement housing is necessary to allow close supervision of does.

2.2.3 Ventilation

Ventilation is an important aspect in goat housing, particularly in intensive system. Poor ventilation can be detrimental to animal health and performance. Harmful gases and dust can cause respiratory problems, while temperature extremes can reduce oat productivity. The purpose of ventilation is to provide the desired amount of fresh air, to maintain temperatures, to maintain relative humidity, and to maintain ammonia levels below specified levels. Ventilation system can be natural by movement of air through fixed openings, such as vents and doors or it can be mechanical ventilation system by incorporating fans.

2.2.4 Handling Equipment

Handling equipment is useful when performing routine management tasks such as catching, sorting, drenching, vaccinating, weighing and loading. Without proper equipments, these jobs often get neglected. A boot and gloves are important for worker's hygienic purpose.

2.2.5 Feeders

Good feeders are essential to the meat goat operation. Feeding on the ground results in considerable feed wastage and contributes greatly to the spread of disease, especially internal parasites. If goats are able to stand in their feed, they will defecate and urinate and will contaminate the feed. Feeders need to be raised off the ground and constructed in such a way to keep goats out. There should be enough feeder space for all goats to eat at once. Mineral feeders usually hang higher at the center of the pen.

2.2.6 Water

Clean, fresh water is a daily necessity for goats. A goat will consume anywhere from 2 to 15 liters of water per day, depending on its age and stage of production. Requirements increase greatly during late gestation and lactation. Goats will consume more water when the temperature increases or when the forage is dry. Goats will consume more feed if they drink more water and conversely, eat less feed when they consume less water. Water sources should be kept clean and free from hay, straw and fecal matter.

2.2.7 Feed Storage

All feedstuffs – hay, grain, salt and minerals – need to be kept dry and protected from rodents. Ample feed storage can result in considerable cost savings if feed ingredients can be purchased and stored in bulk on the farm. Unprotected hay deteriorates in quality. Hay should not be left uncovered. Hay and straw bales should not be placed in a barn unless they are thoroughly dried; otherwise there is a risk of overheating and fire. Salt and minerals and smaller amount of grain can be stored in barrels.

2.2.8 Dead Animal Disposal

In a typical scenario, approximately 10 percent of the kids die before weaning (Schoenian, 2006). A mortality rate of 5 percent is common among adult animals. Dead goats can be buried, incinerated, or composted. In Malaysia, the most common method of disposal that can be seen is burial. Usually farmers will conduct a post-mortem check on dead goat or sheep to identify cause of the death. Once the cause is identified, the dead body will be buried. Carcasses should be buried deep (4 to 8 ft. depth) and never in areas where leaching is known to occur.

Incinerators eliminate carcasses and destroy pathogens but are expensive to buy and operate, therefore not a viable option for most farmers. An increasingly popular method of dead animal disposal is composting.

2.2.9 Manure Storage

Goats will produce about 5 percent of their body weight in manure (60-70 percent moisture) daily, thus proper housing with well manure handling must be designed (Schoenian, 2006). Flies and odors from stored manure can be reduced if good management is practiced. Manure can be handled following the steps below:-

- Keep the manure as dry as possible. Composted manure is an excellent soil amendment.
- Remove manure from the farm regularly.
- Manure can be collected with a shovel, fork, or power equipment and can be removed with a front end or skid loader to save labor.
- Soil and manure tests should be conducted before applying manure to the land to avoid any soil and groundwater degradation.
- Manure storage is needed to protect from any runoff situation and reduces odors and fly problems.
- Farmer needs to familiarize themselves with local, state and national nutrient management laws and comply accordingly.

2.3 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

Environmental management can assist an organization to meet its increasingly heavy burden of responsibility for the future condition of our world environment. In many cases, the introduction of an environmental management can also aid cost savings, and reduction of environmental liability. Environmental management first was introduced in Netherlands in the early 1980s, aimed at implementing environmental management of an organisation by setting environmental policy and identifying significant environmental aspects. Introduction of environmental management to the organization's management system was mutually beneficial to both industry and government. The environmental management practice eventually evolved into a system called Environmental Management System (EMS). During the Earth Summit in Rio in 1992, the Business Council for Sustainable Development emphasised the need for business and industry to develop comprehensive tools to help measure environmental performance and develop powerful environmental management techniques (Wang, 2001).

EMS is suitable for firms or organizations that want to achieve sustainability in meeting the needs of both current and future generations. Usually new technologies are developed to more efficient methods, but at the same time increasing the cost. However, attitudes change is needed towards both consumption and production in providing the goods and services demanded by the consumer (Welford & Gouldson, 1993). The continuing ability of environment to supply raw materials and assimilate waste while maintaining biodiversity and a quality of life is being increasingly undermined. As an ultimate objective, sustainability concept is very valuable and strategies are needed to achieve it.

EMS may assist farmers to improve farm profitability, better manage the natural resources and improve their environmental management. Farmers can adopt sustainable farming practices through EMS process and examine potential for market advantage. EMS integrates management of broad range of issues that present challenges and includes the impact of production method on land and water, business and risk management, meeting legal requirements and the integration of catchment management objectives into farm management.

An Environmental Management System is a framework to assess, manage, review and improve the environmental aspects of a business's operations. It is simply a plan, do, check & act exercise, aimed at ensuring that food is produced with a minimal impact on the environment. In other words, it is the design and implementation of a strategic process to minimize the impact of farm operations on the environment. It ensures sustainable production of clean and green food, improved soil health, clean waterways and underground water, conservation of biological diversity in the landscape and a minimal impact on the environment. Adoption of EMS can demonstrate to domestic and international consumers' markets that environmental considerations have been taken into account during production of any farm produce. This provides assurance to buyers that the food has been produced sustainably.

The EMS establishes procedure; work instructions and controls to ensure that implementation of the policy and achievement of the targets can become a reality. Communication is a vital factor, enabling people in the organization to be aware of their responsibilities, aware of the objectives of the scheme, and able to contribute to its success.

ISO 14000 is an international standard specification for an environmental management system (EMS). In the ISO 14000 series are the environmental management standards; ISO 14001 that specifies the requirements for an EMS against organization may be certified by a third party and ISO 14004 is developed to provide additional guidance for organizations on the design, development and maintenance of an EMS.

2.3.1 Overview of Principles and Elements

The ISO14001 standard, which lays out requirements for establishing an EMS, is the centerpiece of the series. ISO14004, on the other hand, is an informative standard providing guidance related to how to implement ISO14001 (Harrington & Knight, 1999). The EMS is designed to continually improve system and environmental performance. The ISO14001 embraces five principles and 17 elements, which can be summarized that ISO14001 is a complete guideline for firm in achieving EMS. It consists of: a commitment by the management to adhere to the policy, planning by identifying the environmental aspects to set up baseline studies, ensure the access of laws and regulations, establish environmental management programs (EMP) to achieve the objectives and targets, implementation of the EMP, monitoring of key activities to track and evaluate the performance, followed by periodic management reviews for a continuous improvement.

2.3.2 Initial Environmental Review, IER

The ISO14000 environmental management standards exist to help organizations minimize how their operations negatively affect the environment (cause adverse changes to air, water or land) and comply with applicable laws and regulation.

On the other hand, ISO is leading a strategic approach by developing environmental management system standards that can be implemented in any type of organization in either public or private sectors.

Within a corporate environmental management system (EMS), the identification and evaluation of environmental aspects and impacts is the first step whereby a company begins to systematically consider its environmental concerns. Furthermore, environmental aspects play a crucial role in the formulation of effective environmental policy, definition objectives and targets, thus laying the basis for the whole environmental management system. The evaluation of the impact significance can be facilitated by considering environmental concerns (scale, severity, probability and duration of impact) and business concerns (legal exposure, difficulty and cost of changing the impact, effect on other activities and processes, concern of interested parties, effect on the public image of the company).

Since the very beginning, the identification and evaluation of environmental aspects and impacts have been regarded as one of the most difficult requirements of ISO14004 implementation (Jackson, 1997), the methodological issues of the aspects evaluation have been largely overlooked. Then again, there is still no comprehensive method and absolute rules concerning what to measure and assessing the environmental impacts significantly. Because no two organizations are alike, the aspects they will manage are dissimilar, neither will the methods employed be similar.

The organization is responsible for devising its own criteria and needs to decide on measurement areas, levels and priorities based on the formal environmental review or simply good judgment.

While the criteria, measurement, levels and prioritties may work for one organization, it may not accurately reflect the enviornmental considerations for another. In many cases the measurement is not an easy task, especially when issues are not directly quantifiable. Measures should always be consistent to a baseline so that comparisons can be made between time, sites and activities. Most of the organizations that have conducted and certified with ISO, measurements were concentrated on certain requirements by setting priorities and targets such as: probability of occurence, frequency, scale, severity, cost, regulation and public image.

ISO14001 implementation guidebooks (e.g. Jackson, 1997, Kinsella and McCully, 2003) have taken a quite restricted approach to this issue, each presenting just one assessment scheme without discussion. Earlier, only Block (1999) had made an attempt to provide a more general description of the evaluation process, illustrated by some case studies with different assessment schemes, whereas Johnston and others (2000) proposed a risk-matrix based approach.

2.3.3 Identifying environmental aspects and impacts

The identification and evaluation of environmental aspects and impacts is an ongoing process and the first step whereby a company begins to systematically consider its environmental concerns (Poder, 2006). Furthermore, environmental aspects includes the identification of potential regulatory, legal and business exposure, which is an important role in the formulation of effective environmental policy, definition of objectives and targets, thus laying the basis for the whole environmental management system. An environmental aspect refers to an element of an organization, activity, product or service, which can have a beneficial or adverse impact on the environment.

For example, it could involve a discharge, an emission, consumption or reuse of a raw material, or noise. An environmental impact refers to the change, which takes place in the environment as a result of the aspect (Harrington & Knight, 1999).

The identification of environmental impacts in a systematic way that is relevant to various aspects of the process on a site is described in ISO 14004. The identification of impacts should not be limited to current impacts, but should consider the potential for future impacts. Welford and Gouldson, 1993, stated that it is necessary to assess the impacts on the baseline data collected. Impacts should be assessed not only in terms of the effects on buildings, flora, fauna and geology, land, air and water, but also in relation to the social and economic, raw material and energy inputs and emissions during the production process, wastes generated and distribution of the output.

An assessment of socio-economic impact will require predictions relating to positive as well as negative impacts on the local economy, cost to the producer of organization and public image. Consideration is important in specific regulations, which apply to permissible sound or emissions in scientific assessment. The scale of impacts is concentrated too because it can determine the seriousness of certain aspects of the activities conducted whether within the boundary or extend. For an example in UK Environmental Protection Act (EPA) builds on previous legislative measures, where any organizations that have all ‘prescribed processes’ as defined by the Act must apply authorization to the relevant regulatory authorities in order to emit into the environment (Welford and Gouldson, 1993). In a simple understanding, assessment should include not only scientific assessment but also the social and economic impacts.

The ISO 14001 standard does not prescribe a method for determining the significance of an environmental impact. The organization has the authority to develop criteria and procedures in determining significance of the impacts because ISO must respect the right to national sovereignty enshrined in the WTO (World Trade Organization) agreements (Harrington & Knight, 1999). Judgment of significance can be subjective to the organization due to its operation especially if there is no legal or tangible requirement.

A register of environmental aspects and impacts is therefore, necessary, to identify all the environmental aspects and the associated existing and potential impacts, which may be associated with the organization's activities or operations. The advantages of identifying significant environmental aspects and associated impacts are to determine where control or improvement is needed therefore priorities can be set for management action. It is also an ongoing process that enhances an organization's understanding of its relationship with the environment and contributes to continual improvement of its environmental performance.

2.4 CASE STUDIES

2.4.1 Environmental Aspects and Impacts

A case study conducted by Hermansen, 2004, stated that the most common outdoor systems used for intensive organic production of pigs and poultry have significant environmental impacts, including increased risk of nitrogen leaching and ammonia volatilization, as well as negative consequences for animal welfare, such as nose-ringing of pigs. Consider some of the problems associated with common outdoor systems used for intensive organic production of pigs. Pigs spend a great deal of their time foraging, exploring and engage in rooting as part of these behaviors. Pigs that are kept outdoors will also wallow in mud or water to utilize evaporative cooling to thermo regulate in hot weather (Culver, 1960; Huynh, 2005). Rooting and wallowing behaviors result in bare, compacted ground in pastures, intensifying nutrient leaching (Hermansen, 2004; Eriksen, 2006). These natural behaviors have environmental consequences when pigs are kept on pasture, including increased risk of nitrogen leaching and ammonia volatilization.

All agricultural production systems, even those in bucolic pasture settings, have impacts on the environment including nutrient loading and leaching, air emissions and pathogen transfer. The environmental impacts of extensive, pasture-based systems may be different than those of confined operations. The intensity of resource use relates total consumption of a resource to the amount of output enabled by its use; higher resource intensity implies greater inputs of energy, water, and nutrients are required to provide a unit of product. When these inputs are scarce or associated with toxic, hazardous, or otherwise detrimental processes or by-products, resource intensity can be linked to environmental damages.

As reported farm that practice EMS or considering environmental elements in their management practice will understand the effects on their farm activities towards environment, organization and consumers. Even the consumers and government organization become more interested in the ecological footprints left by animal-based agriculture and the consequences for animal and human welfare. Therefore, EMS is an opportunities for improved environmental and ethical management. It also illustrates the need for better understanding of how these concerns and benefits will be manifested under existing and future animal production. It will also be imperative to develop measures of product and system level performance given environmental, ecological and social sustainability requirements to assess and compare the ability of conventional, organic and other extensive systems to meet the needs of the animal and human populations.

2.4.2 Farming Management

Livestock production has developed over the last decades on account of the fact that the economic margins between costs and income had become smaller, a process of intensification coupled to the application of new technologies and housing systems was started to increase productivity (Noordhuizen and Frankena, 1999). At the same time, side-effects such as the chances of disease spread and loss of attention for individual animals increase with an increasing intensification and animal density. The consequence is that animals may become more susceptible to disease (Broom, 1996). Disease causes direct economic losses for the farmer, a major anxiety especially affecting the health of consumer, which gives a potential loss of value to a consumer interest in production methods and environmental issues as well as a public health issue on food safety.

Feeding of livestock influences nutrient flows and pollution sources at farm level in many different ways. Nutrients found in the manure emitted to the air and water, originate from the fraction of the feed, which is not retained by the animals. An approach that can be tried is to formulate diets that improve the efficiency of nutrient retention by animals, decrease their excretion in urine and feces. Consequently this will reduce the import of nutrients in feeds and mineral mixtures from outside the farm. According to Dourmad and Jondreville (2007), results demonstrate that the dietary supply of protein, phosphorus and trace elements can be drastically reduced, resulting in decreased fecal and urinary excretion without compromising animal health or welfare. Moreover, diet manipulation could also be a way to modify odor production (Le, 2006), suggested that crude protein and fermentable carbohydrate may play a major role in the production of odor nuisance from pig production.

Vu, Tran and Dang (2007) asserted that in Vietnam, commercial pig production is increasing rapidly and tends to be concentrated on larger production units, which also implies changes in animal production technology (feeding, housing, manure collection etc.). This trend increases the risk of air, water and soil pollution (An et al., 1997; Gerber et al., 2005). Recent reviews on the current status of parasitic diseases in Vietnam, including those of foodborne trematode zoonoses and cysticercosis, have highlighted the risks of disease transmission through animal manure and human excreta (De et al., 2003). Livestock manure contains many microorganisms, protozoa and viruses that may spread through effluent into waterways and pose a risk to human and animal health. The increased risks of environmental pollution and spreading of disease can be mitigated through an efficient recycling of manure on cropland. Costs of treatment and manure spreading may be reduced by a reduction in mineral fertilizers usage and decreased disease in livestock.

In Chile, Good Agricultural Practices (GAP) has addressed proper guideline for farmer to manage daily on-farm activities and alert the procedures that promote safe handling of animal. A judgment call has to be made in response to changes and challenges that farmer may not have seen or anticipated. As an example, farmer can minimize the contamination from pathogen sources such as water supply is tested for indicator organisms, records are maintained of location and maintenance of on-farm septic systems. Manure storage and handling is covered to ensure there is no opportunity for liquid runoff, and also compost storage is secured prior to land application. Workers hygiene is important by giving them a proper training like hand-washing before/after handling the animal and feedlot, sanitization and regular medical health examination in their welfare. Good management in farm will help farmer make good calls to ensure the safety of workers, consumer, animals and environment.

CHAPTER 3

METHODOLOGIES

3.1 INTRODUCTION

To conduct this study, observation and identification of environmental aspects and impacts at goat farm is taken as the core data. A scope of the study covers only on farm site activities for the observation and identification purposes. The selected sites were different from one another based on the type and population of the small-ruminant. The selected farms are shown in Table 3.1 below. From the guideline prepared by Department of Veterinary Service, Malaysia (DVS), type of farm is categorized by number of heads (population of goat). Farm that has less than 300 heads is categorized as small-scale and farm with more than 300 heads is commercial type. However, not all of the identified environmental aspects and impacts are used in this study. A significant issue of concern that present on all these four farms is taken from the list of environmental aspects and impacts register. The entire study is carried out independently and unbiased to avoid any internal conflict interest.

Table 3.1 : List of selected farms and the characteristics

Farm	Area (acres)	Goat Population (heads)	Type of Farm	Management System
A	5	< 100	Small-scale	Intensive
B	7	300 < heads < 500	Commercial	Semi-Intensive
C	12	500 < heads < 1000	Commercial	Intensive
D	205	> 1000	Government farm (Breeding Centre)	Intensive
E	800	>1000	Government farm (Breeding Centre)	Intensive

3.2 RAW DATA ANALYSIS

All the raw data obtained from the method conducted will be analyzed. From all the data, we can identify sources of environmental pollution as air, water and soil. The identification of pollutant sources or activities (aspect) that has high probability lead to the major impacts on environment is conducted using the significance assessment matrix, (SAM). With the variation of data, the critical studies are needed to make sure all the objectives are successfully carried out.

3.3 METHODOLOGIES TO CONDUCT IER

The Initial Environmental Review (IER) findings are reviewed in order to have a complete understanding and baseline information of the farm's current position with respect to the environment during the initial stage of EMS development. In order to understand exactly the IER, data on input and output of raw materials, activities, products and services in each area of goat farming will be determined.

This process will enable us to understand which aspects of goat farming that can have significant environmental impact. It will ensure that other elements in farm environmental management system such as policy, objectives, targets and the management program can be focused on those areas where the farm can gain the most benefits. These are tools that were used in order to conduct an IER in goat farm, :

3.3.1 Environmental Review Observation

A personal communications with top management, managers or the person involved with farm's activities has been conducted minimally due to avoid any internal conflict of interest and bias view. This communication is to get the basic information on selected goat farm as well as to identify the current management practice.

Farms were observed based on their routine activities and the environmental aspects were identified at the same time. Questionnaires involved with existing facilities and activities, legal and regulations compliance, welfare of the goats and staffs for the farm were reviewed. All information obtained will be used as an additional data and for better understanding of the current management, activities and practices on the farm.

3.3.2 Register of Environmental Aspects and Impacts

Once eco-mapping and observation on farm is conducted, environmental aspects and impacts were listed in order to assess and register the priority of each aspect. All farm activities were listed within the scope of the EMS that could have an environmental impact. Day-to-day operations included, infrequent operations such as lagoon cleaned-out, and activities related to accidents or emergencies. (Example: lagoon waste management, livestock care/clean-up). The activities and impact had interacted with the environment were questioned (Example: activity = lagoon waste management; a potential aspect of that activity would be lagoon flooding and the corresponding impact to the environment would be water pollution).

3.3.3 Significance Evaluation on Environmental Aspects and Impacts

There is no guideline or “right” way to determine significance, although many firms choose a combination of systematic evaluation and gut feeling. By referring to aspects evaluation model (USEPA, 1999), a simple but systematic approach to prioritizing environmental issues has been applied in identifying the significant aspects.

Once activities and related aspects and impacts have been identified, criteria were developed in determining the significance of each impact.

Different criterias were chosen in assessing the significance, where the criterias were reflected the values and current situation of the farm. Legal requirements, severity of impact, concerns of interested parties, and likelihood of occurrence are suggested criteria. The criteria were assigned with an alphabetically score for ranking the impact. Table 3.2 shows the criteria with the ranking for evaluating the significance of environmental aspects on farm.

Table 3.2 : Significant Ranking Criteria for animal farm

Criteria	Lowest (L)	Medium – Low (ML)	Medium (M)	Medium – High (MH)	High (H)
Scale of Impact	None	Insignificant	Minor impact	Moderate – within farm	Large scale – catastrophic
Frequency of Occurrence	None	Unlikely – accidentally	Light	Serious	Serious and Repeated
Cost of Addressing Impact	No cost	Minimum	Low cost to farm	High cost to farm	Excessive cost to farm
Regulatory Compliance	None	Not regulated	Regulated	Regulated and notification of warning	Regulated and can be penalized for violation
Public Concern / Reputation	None	Not of interest	Little interest	Great interest	Strong public reaction

Sources : USEPA (1999)

There are five key criterias to be determined in order to assess the significance:

i. Scale of Impact
   The coverage of impacted areas. Is it within the farm boundaries or extend outside the farm?

ii. Frequency of Occurrence
   How frequent does an aspect occur?

iii. Cost of Addressing Impacts
   Cost of managing occurring impact or economic viability on applying other alternative technology.

iv. Regulatory Compliance

Is the aspect regulated under any law or regulations apply to the farm's operation? Does the farm know the compliance status due to the lack of monitoring data?

v. Public Concern or Reputation

What kind of damage could be done to the reputation of the organization should the impact occur. Community is defined as the employee and community within a 3km boundary of the farm.

One way to determine significance was that any aspect that has two H's (applies only to: 2 MH's equal to 1 H, and 2 M's equal to one MH) or more is significant (Table 3.2). Table 3.3 shows the probability criteria to identify the significant aspects on farm.

Table 3.3 : Significance Assessment Matrix

Environmental Aspect	Environmental Impact	Scale	Frequency	Regulatory	Cost	Public	H/M/L	Significant	Priority
Vehicle emissions	Air pollution	ML	MH	ML	L	M	M	N	4
Water Consumption	Water resources depleted	MH	M	M	M	M	H	Y	3
Manure runoff	Land and water contamination by manure spillage	MH	M	M	MH	H	2H (MH)	Y	1
Food consumption (raw resources)	Solid waste (feces) generation	MH	H	ML	M	M	2H (ML)	Y	2
Energy consumption	Global warming	ML	L	M	L	ML	M	N	5

Sources : USEPA (1999)

In this hypothetical example on farm, manure runoff and food consumption were both found to be most significant. Priority is given in numerical, as a ranking from 1 – 10 (1 is the most significant and 10 is the least significant), to show which environmental aspects should be considered and evaluated further. Hence there is no standard guideline in EMS to evaluate the significance of environmental aspects, the approach here is not an absolute judgments. Instead, judgment should base on both scale of the potential impact and the frequency. Additionally, judgment is made with best knowledge and relative to one another even if its score isn't enough to classify, as "significant" to address a particular aspect is very important (USEPA, 1999).

The identification of aspects and impacts is necessary for the development of an environmental management plan and control programs to manage those aspects consistent with ISO 14001. However, the identification aspects and impacts list can be modified from year to year, as the processes change to achieve continuous improvement.

CHAPTER 4

RESULTS

4.1 INITIAL ENVIRONMENTAL REVIEW (IER) FINDINGS

Generally, five farms were selected, observed and compared on their daily activities in managing the small-ruminant feedlot. IER was conducted within project boundary (only at feedlot area) due to variability in farm sizes, small ruminant type and population. Each farm has different land area and layout design, as some is attached with producer or worker's house and some has more than one feedlot to accommodate different types of livestock. The daily activities in the farms such as ruminant feeding can determine the environmental aspects and impacts by focusing on the input and output criteria flow. As an example, to feed the wholly small ruminant population in the feedlot, a large amount of grass has to be transported from the cultivated area using a truck that requires fuel. The grass then has to be grinded into small pieces using a diesel grinder machine. The process of feeding activities can potentially lead to consumption of natural resources, fuel spillage, and soil contamination or emission of greenhouse gaseous (GHGs).

Based on the information collected during preliminary visits, identifying environmental aspects and impacts in all farms were standardized by formulating criteria and the scoping process was concentrated on the input and output flow of small ruminant activities in the feedlot area of the farm as shown in Figure 4.1. The reviews were concentrated on (1) small ruminant production related to farm land, (2) feeding practices and housing systems, (3) methods of manure management (Vu et al., 2007) and manure flows, (4) methods on wastewater management, and (5) farmer's perceptions in relation to manure management, and (6) Good Agricultural Practice (GAP).

All surveyed farms were located in rural areas where there is sufficient land to accommodate feedlot, workers' houses, grassland area for fodders and wastewater treatment plant. The government and big scale commercial producers have advantages, as they have bigger land base compared to medium or small-scale producers. Consequently, different farm-scale categories had different patterns of manure disposal flow. Small ruminant population densities in small and medium scale farms were much lower but they share similarities in problems with manure handling.

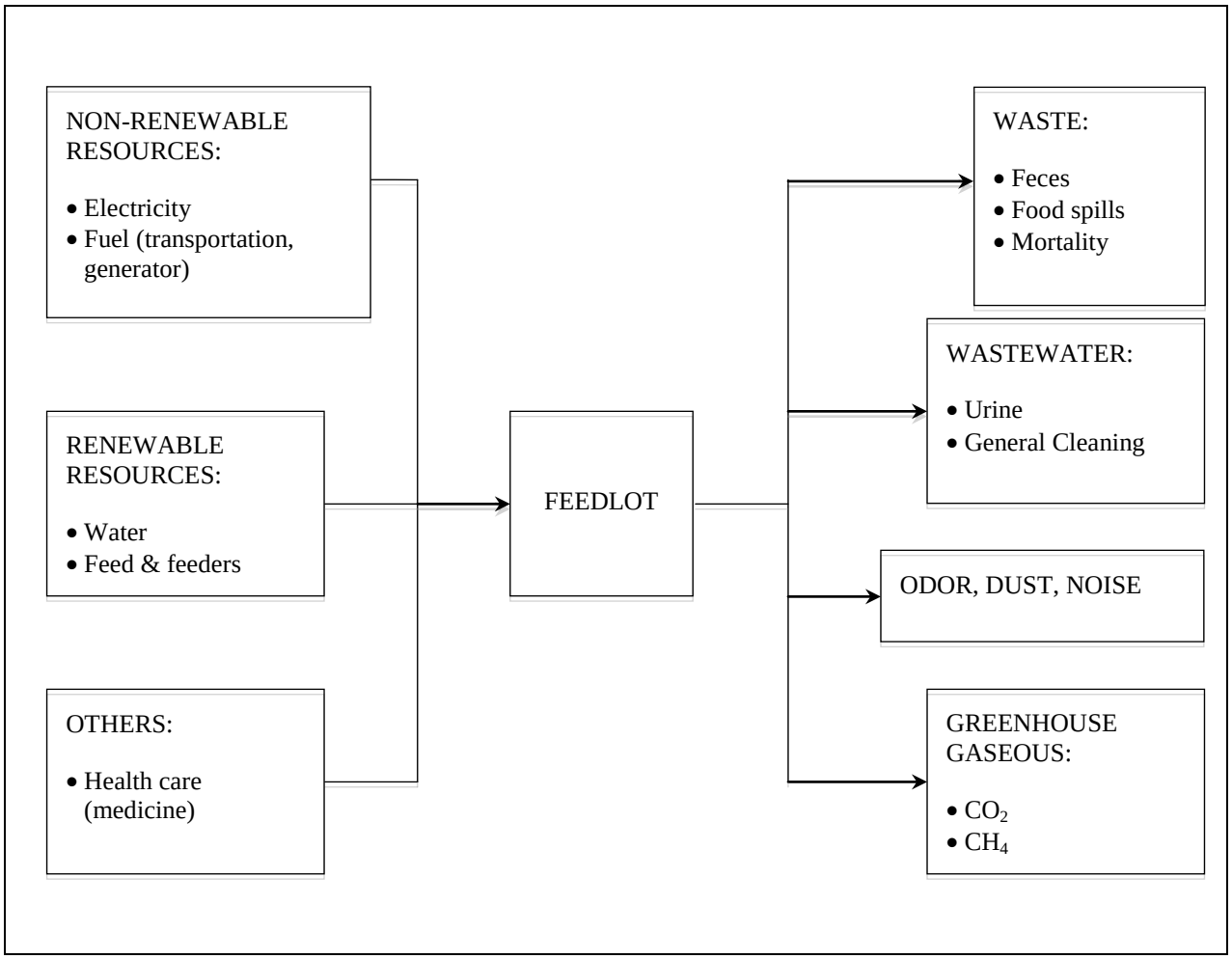

Figure 4.1 : Input and output flow in the feedlot area.

Every activity was observed within the feedlot areas in all selected small ruminant farms. Reviewed activities were based on a checklist that identifies any environmental aspects and impacts allowing action to be taken where it is most required. The reviewed activities results were recorded, analyzed and summarized into a comparison table among the five farms operation (Table 4.2). The comparison table showed which farms practiced the activity or otherwise, concerned on environmental impacts and has potential in improvements. Environmental impacts were predicted from any activity/product/service observed and referred to the terminology as follows,

Terminology for Aspects and Impacts Identification Worksheet

According to MS ISO 14004:2004;

Environmental Aspects – any elements from the farm's activities, products or services that can interact with the environment. For example: wastewater discharges, air emissions, resource consumption, energy usage, ecosystem alterations).

Environmental Impacts – any change to the environment, whether adverse or beneficial, wholly or partially resulting from the farm's activities, products or services (based on the aspects, for example: air emissions impacts the air by degrading the air quality).

a) Impacts on air

The most common impacts identified at livestock farm activities are air pollutant, odor and dust. Air pollutant is any compound released into the air that has a potential to adversely impact the environment. As an example, ammonia (NH_3) emission is of particular concern because of its potential to create odors. Odor respectively is an objectionable smell present in the ambient air. It could be a pleasant or unpleasant smell derived from various factors.

Dust is a fine particle of any matters that are suspended in the air and can cause irritation, affect breathing or cause other health problems to humans and animals. Table 4.1 is a description on various emissions from the animal feeding operation (AFO) and the effects that has been used in registering the environmental aspects and impacts in the study.

Table 4.1 : Scientific Evaluation of the Potential Importance of AFO Emissions at Different Spatial Scales

Emissions	Scale of Concern		Primary Effects of Concern
	Global, National and Regional	Local-Property Line or Nearest Dwelling	
NH_3	Major	Minor	Atmospheric Deposition, Haze
N_2O	Significant	Insignificant	Global Climate Change
NO_X	Significant	Minor	Haze, Atmospheric Deposition, Smog
CH_4	Significant	Insignificant	Global Climate Change
(Volatile Organic Compounds) VOCs	Insignificant	Minor	Quality of human life
H_2S	Insignificant	Significant	Quality of human life
Odor	Insignificant	Major	Quality of human life

Source : NRC (2002)

b) Impacts on water

Water is a very sensitive issue nowadays. Any activities on the farm will directly or indirectly give an impact on water bodies. A pollutant is any compound released into water that has a potential to adversely affect the quality of the water. Pesticide is one of the pollutants derived from substance usage to cultivate plants for feeding purposes. Another impact is lagoon solids loading where fecal matter is added to lagoon and lagoon volume loading adds liquids to lagoon. Groundwater contamination is derived by any nutrient, pollutant, pathogen or other agent that has the potential to contaminate groundwater.

c) Impacts on land

Soil contamination is one of the impacts caused by any nutrient, pollutant or other agent that has the potential to contaminate surrounding soils and nearby surface water. Activities such as grading, water runoff from feedlot cleaning and through natural means (wind and rain) can be a loss of beneficial surface soil.

d) Impacts on resource consumption

A non-renewable resource is a natural resource that cannot be produced, re-grown, regenerated or reused on a scale, which can sustain its consumption rate. These resources often exist in a fixed amount, or are consumed much faster than nature can recreate them. Fossil fuels (such as coal, petroleum and natural gas) and nuclear fuel are some examples. In contrast, energy derived from the sun, wind and water, resources such as timber (when harvested sustainably) or metals (which can be recycled) are considered renewable resources.

e) Impacts on waste stream

Waste in farm is defined with any item that leaves the farm and is destined for a landfill or incinerator. It may include but it is not limited to: discarded packaging; recyclables; sharps; biohazards; used oil/fluids and paper. There are also recyclables in waste (and is not considered a product) that is collected and sent to a facility that will remanufacture, reuse or reprocess the item. This may include cans, bottles, glass, paper, used oils/fluids and animal waste (feces).

Table 4.2 : Summary on Initial Environmental Review (IER) findings on all farms.

	Activity / Product / Service	Environmental Aspects	Environmental Impacts	Farm				
				A	B	C	D	E
1.	Animal Environment	Cooling / ventilation purpose by using an electrical fan	Dusts and odor to the surrounding, consumption of electric as non-renewable resources	+	+	+	+	+
		Electricity use	Consumption of natural resources and global warming	+	+	+	+	+
2.	Biosecurity	Clothing, boots	Consumption of non-renewable resources	+	+	+	+	+
		Disinfectant, soaps	Pollution to water, soil and groundwater contamination	+	+	+	+	+
3.	Birthing	Bottles, gloves waste	Solid waste	-	+	+	+	+
		Medication, Needles disposal	Solid waste	+	+	+	+	+
		Mortality	Burial site	+	+	+	+	+
4.	Drinking Water	Pipes – water use	Consumption of natural resources	+	+	+	+	+
		Well - groundwater use	Consumption of natural resources	+	-	-	-	-
5.	Facility Management	Diesel generator	Air Pollution	+	+	+	+	+
		Electric motor failure / spilled oil	Potential degraded air quality	+	+	+	+	+
		Record-keeping-production	Good track record for public image	-	-	+	+	+
6.	Feed and Feeders	Molded or expired	Potential degraded animals' health	-	+	-	-	-
		Consumption	Manure generation or renewable by composting	+	+	+	+	+
7.	Fuel	Fuel use	Consumption of natural resources	+	+	+	+	+
		Spillage	Soil Contamination	-	-	-	-	-
8.	General Cleaning	Water Use	Consumption of renewable resources	+	+	+	-	+
		Cleaning with equipments brooms, buckets, products	Solid waste / landfill, soil and groundwater contamination	+	+	+	+	+
		Wastewater discharge	Water, groundwater and land pollution	+	+	+	-	+
9.	Health Care	Identification – Ear tags, ink	Solid waste	-	-	-	-	-
		Antibiotics use - oral	Potential resistance, potential increase in animal health	+	+	+	+	+
10.	Mortality	Catastrophic burial site	Potential degraded air and groundwater quality	+	+	+	+	+
11.	Manure Management	Lagoon level and integrity management	Potential surface water contamination	-	+	+	-	+
		Land application to reduce commercial fertilizer use, increases organic matter in soil	Conserves natural resources	-	+	+	-	+
		Scraping and manure collection	Degraded air quality by odor and ammonia emissions, attracts fly	+	+	+	+	+
		Excess sludge	Potential increase in odor / air degradation	+	+	+	+	+
12.	Wastewater Treatment	Treatment lagoon	Potential in degrading groundwater and soil quality	-	+	+	-	+
13.	Transportation	Delivery or receiving goats	GHGs emissions to air, consumed on non-renewable resources	+	+	+	+	+
		Delivery or collection of food, manure or compost	Degraded air quality, GHGs emissions, natural resources depleted	+	+	+	+	+
14.	Work Environment	Restrooms	Wastewater	+	+	+	+	+
		Laundry	Wastewater	+	+	-	-	-

Note:

+ Farm is conducting the activity/product/service.
- No activity/product/service occurred in the farm.

All activities were observed and registered as shown in Table 4.2. The environmental aspects and impacts related to each activity were identified and compared among the five farms. Although the activities observed were quite similar among the farms, there are varieties on how farms are being managed. For example; on the record keeping for facility management activity, farm C, D and E are practicing a proper record keeping on small-ruminant production. According to the farmers; weight, height, age and disease are the most important data need to be recorded and updated at least once a month. A proper record keeping is an important material in animal welfare, likewise to assess the production patterns and can also be a source of references when any unusual behavior or stress condition occurs indirectly. Unusual behavior or stress condition is referred based on scientific research in FAO report in 2001, where warm-blooded animals feel pain and the emotion of fear and from the study observation on all farms, these condition can be described when the small ruminant acts; less or more making sounds, loss of appetite, isolate themselves from the others over a period of time, fall sick continuously, or exhibited less movements. When this condition occurs, the production patterns will change where the animals will be isolated from the others, medication will be given, food and nutrition is controlled to ensure the recovery of the animal. The changes in production pattern can be a factor in the farm where the amount of waste generated is dissimilar in terms of quantity and quality, and which can affect the whole herd and could lead to mortality.

Significance of impacts has been evaluated based on the IER findings in this study and will be discussed further. A list of activities with their corresponding environmental aspects and impacts from Table 4.2 were selected for the evaluation. The selection represents mostly main activities found in all five farms.

4.1.1 Farm A

Figure 4.2 : Feedlot area located in Farm A.

Figure 4.3 : A man-made pond located nearby and can be seen from Farm A.

Farm A is a private farm with total population less than 100 heads of goat and total land area is 5 acres. Categorized by the Department of Veterinary Service, Malaysia (DVS), as a small-scale type due to production rate that is less than 300 goats/year. They implement an intensive management system because the farm is located at hillside area equipped with good ventilation system, electricity and untreated fresh water supply from groundwater. There is a riverbank within 2km boundary, a man-made pond at the lowland area and a groundwater source located nearby the feedlot. According to the farmer, groundwater source is used mainly for washing and cleaning activities.

Farm A has a simple manure management and handling. Due to feedlot layout design, feces is gathered by scraping activity and collected once a week. However from the observation, the feedlot has improper drainage system and it led to manure and wastewater runoff, causing a contamination on the soil, air, surface water and groundwater. The collected manure was gathered at a specific area for drying process, while dried manure is then packed and sold to other farmers.

Figure 4.4 : A pile of manure collected being exposed for drying process at Farm A.

Figure 4.5 : Improper drainage system without end-point in feedlot area at Farm A.

An evaluated significance of environmental aspects and impacts were conducted on farm A and the evaluation showed there are two activities with significant environmental aspects (Table 4.3). Transportation was significant in farm A because the vehicle consumed non-renewable resources and emits potent GHGs. The transportation activities showed high frequency on repeating trips for delivery/receiving small ruminants, feeders and manure that leads to air quality degradation within farm boundaries, and non-renewable resources consumption give major impacts globally.

Feed and feeders activity was also considered significant in farm A, due to the impacts scale on long term period and high frequency of its occurrence. The cost involved in addressing the problem such as land contamination is high for small-scale commercial type like farm A. Food poisoning was also predicted as one of the feed and feeders impacts because a contaminated food or additional supplement such as palm kennel waste can cause Pasteturellosis or Coccidiosis disease. Scale is considered moderate, MH (medium-high) because the activity and impacts are predicted to occur within the farm. The impacts of small ruminant mortality in farm A can bring huge losses to the farmer not only in terms of total head production in a year but also to the financial aspect where money has been invested but with no returns.

Table 4.3 : Significance Assessment Matrix on Farm A.

Activities	Environmental Aspect	Environmental Impact	Scale	Frequency	Regulatory	Cost	Public	H/M/L	Significant	Priority
Animal Environment	Cooling / ventilation purpose or any electricity use	Dust, odor, and consumption of electric as non-renewable resources and global warming	ML	MH	L	L	ML	L	N	8
Biosecurity	Clothing, boots	Consumption of non-renewable resources	ML	M	L	L	L	3L	N	9
	Disinfectant, soaps	Pollution to water, soil and groundwater contamination	M	ML	ML	H	ML	M	N	7
Drinking Water	Pipes – water consumption	Consumption of natural resources	MH	M	M	M	M	H	Y	4
Feed & Feeders	Food consumption (raw resources)	Solid waste, death due to food poisoning	MH	H	ML	H	M	2H	Y	2
Wastewater	Wastewater discharge	Water, groundwater and land pollution	MH	H	ML	M	M	2H	Y	3
	Lagoon level and integrity management	Potential surface water contamination	-	-	-	-	-	-	-	-
Manure Management	Scraping, feces collection and manure runoff	Degraded air quality (odor and CH4 emissions, attracts fly), land and groundwater contamination	M	H	L	ML	M	M	N	5
	Land application to reduce commercial fertilizer use, increases organic matter in soil	Conserves natural resources	-	-	-	-	-	-	-	-
Transportation	Delivery/receiving goats Delivery/collection of feeders, manure	GHGs emissions and consumed non-renewable resources	MH	H	M	H	M	3H	Y	1
Facility Management	Diesel generator, motor failure / spilled oil	Air, soil and groundwater pollution	MH	L	M	MH	ML	M	N	6

Note:

- Environmental aspects and impacts were not evaluated due to no sign of activity conducted.
- H : High; MH : Medium-High; M : Medium; ML : Medium-Low; L : Low

4.1.2 Farm B

Figure 4.6 : Feedlot area located in Farm B.

Figure 4.7 : A riverbank located next to Farm B.

Farm B is a private farm with a total population nearly 500 heads of small ruminant (goat and sheep) and total land area of 7 acres. There is a river located 0.5km buffer zone in farm B area, and the feedlots are fully equipped with electricity and fresh treated water supply. The farm is categorized as a medium-scale commercial type and implements a semi-intensive management system for the small ruminant. The farmer managed the livestock by keeping them under feedlots during morning and night, and let them free for grazing during evening. Somehow, producer of farm B has to ensure vaccines are given every 3-4 months as scheduled for worm and parasite control. The preventive measure is to avoid any disease among the small ruminants that can cause mortality.

Farm B has a proper manure management and handling compared to farm A. Basically, scraping and collecting is routine to all small ruminant farmers due to the feedlot layout design. Farm B practices recycling of livestock waste which includes manure and food waste, where the feces together with food waste are used back to produce compost, then reused as a fertilizer for the grass and some of the vegetables crop in the farm area. Indigenous microorganisms (IMO) are used in composting technique in waste management implemented by farm B.

According to farm B producer, the collected wastes (feces, dried leaves, oil palm waste, feed waste) should be left at least three weeks to dry before shredding and adding them to IMO 4, the stage of IMO before reaching to final compost. This drying process is for releasing the toxic from the waste. The compost heap or IMO 5 after 10 days can be readily used and applied to grass as a fertilizer.

Farm B showed the same significant environmental aspects activities with farm A, but there are additional significant aspects and impacts on wastewater management (Table 4.4). Farm B has a lagoon for collecting wastewater from the feedlot. Nevertheless, wastewater overflows causing the feces to escape through filtration net and settled in that lagoon. It was considered significant due to the scale that is catastrophic and frequency of its occurrences. This can lead to bad odor, contamination on land surface and attracts flies in any condition.

Figure 4.8 : A proper drainage system that flows the wastewater into a retention pond.

Figure 4.9 : Feces are separated by the filter before the wastewater enters the pond.

Table 4.4 : Significance Assessment Matrix on Farm B.

Activities	Environmental Aspect	Environmental Impact	Scale	Frequency	Regulatory	Cost	Public	H/M/L	Significant	Priority
Animal Environment	Cooling / ventilation purpose or any electricity use	Dust, odor, and consumption of electric as non-renewable resources and global warming	M	MH	L	L	ML	M	N	8
Biosecurity	Clothing, boots	Consumption of non-renewable resources	ML	M	L	L	L	3L	N	11
	Disinfectant, soaps	Pollution to water, soil and groundwater contamination	M	ML	ML	H	ML	M	N	9
Drinking Water	Pipes – water consumption	Consumption of natural resources	M	M	M	M	M	H	Y	5
Feed & Feeders	Food consumption (raw resources)	Solid waste, death due to food poisoning	MH	H	ML	H	M	2H	Y	3
Wastewater	Wastewater discharge	Water, groundwater and land pollution	MH	H	ML	M	M	2H	Y	4
	Lagoon level and integrity management	Potential surface water contamination	H	H	L	ML	ML	2H	Y	2
Manure Management	Scraping, feces collection and manure runoff	Degraded air quality (odor and CH4 emissions, attracts fly), land and groundwater contamination	M	H	L	ML	M	M	N	6
	Land application to reduce commercial fertilizer use, increases organic matter in soil	Conserves natural resources	MH	MH	L	L	M	M	N	10
Transportation	Delivery/receiving goats	GHGs emissions and consumed non-renewable resources	MH	H	M	H	M	3H	Y	1
	Delivery/collection of feeders, manure									
Facility Management	Diesel generator, motor failure / spilled oil	Air, soil and groundwater pollution	MH	L	M	MH	ML	M	N	7

Note:

- Environmental aspects and impacts were not evaluated due to no sign of activity conducted.
- H : High; MH : Medium-High; M : Medium; ML : Medium-Low; L : Low

4.1.3 Farm C

Figure 4.10 : Feedlot area located in Farm C.

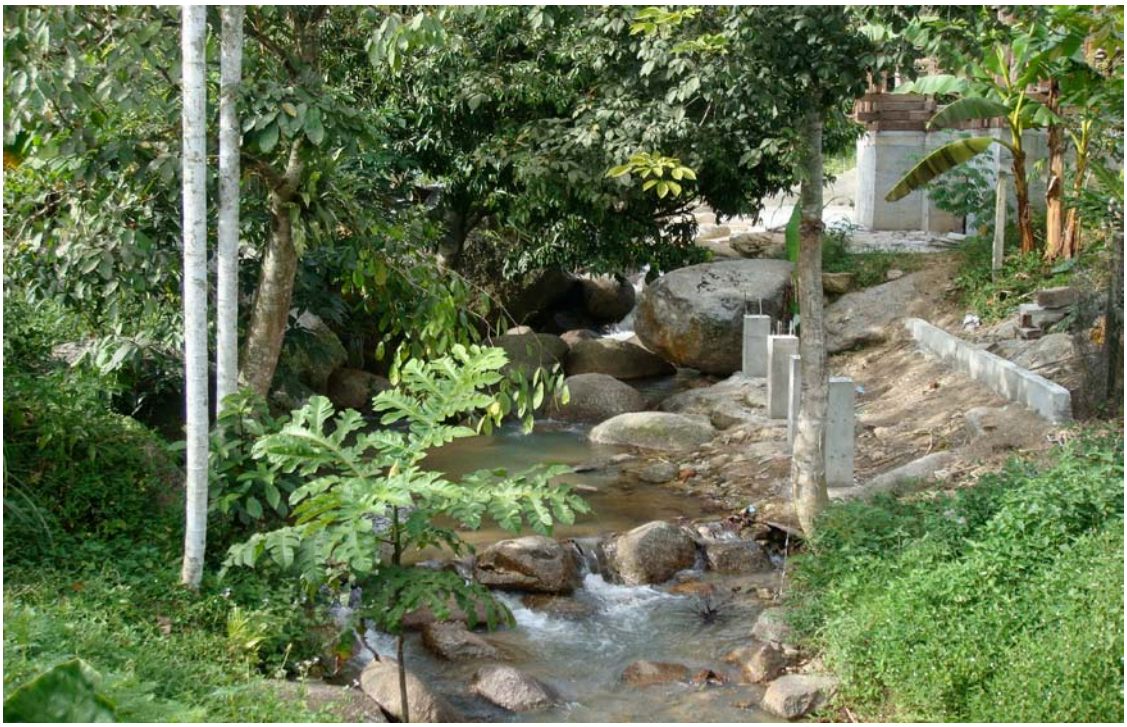

Figure 4.11 : A stream flowing within Farm C area.

Farm C is a big-scale commercial private farm with total population between 500 to 1,000 heads of small ruminant and total land area of 12 acres. The farm implements an intensive management system for the small ruminant. Farm C is located near a small village area, equipped with electricity and fresh treated water supply. There is a natural small stream flowing from upper hillside through the farm area that separates the feedlots from workers' hostel, office and few chalets for visitors that have been built by the farm owner. According to the farm manager, 'Zero Waste Management' has been practiced where every input such as food and water is fully utilized, waste from it is being recycled as fertilizer, reused of treated wastewater to water the grass and currently they are working on the biogas technology treatment. Farm C manager also stated that the feeding system has been manipulated on the dietary, which resulted in less odor emitted from both small ruminant and waste.

Nevertheless, big-scale commercial farm with large numbers of head populations has potential adverse impact on currently practiced management system. Feces are seen scattered on the soil surface, which causes uneasy odor to the surroundings, overcrowded population due to high density in pens, which leads to limited space for small ruminants to perform exercises and noise caused by small ruminants. Apart from that, farm C is quite similar to farm B in terms of managing its manure but differs in wastewater management. There is a drainage system in the farm, which directs the wastewater to a holding pond. Although there is drainage system, but improper design at some feedlots area, caused manure and wastewater flow beyond the feedlot area.

Farm C manages and treats wastewater derived from the feedlots area by channeling the flow into a treatment pond. Drainage system surrounding the feedlots leads the flow to a holding pond that contains *Eichhornia crassipes* or known as "Keladi Bunting". *E. crassipes* is a filtered plant used in the pond to absorb any heavy metals such as Ferum (Fe) and Copper (Cu) present in the wastewater. The filtered plant is specifically chosen due to its capability to absorb and store heavy metals in the roots. After 3-4 weeks, the filtered plant will be cut; other ruminants will feed on the leaves of the plant while roots that absorbed the heavy metals will be used in composting.

Figure 4.12 : Wastewater runoff caused by improper drainage system in Farm C

Figure 4.13 : *E. crassipes* covering the wastewater in collection pond at Farm C

Figure 4.14 : Grass planted and watered with treated wastewater in Farm C.

Table 4.5 showed an evaluated significance of environmental aspects and impacts of farm C. The evaluation resulted in three activities that have significant environmental aspects; transportation, feed & feeders and manure management. Manure management considered significant due to excessive amounts of wastes produced by higher numbers of population. Not only that, continuous manure runoff will leads to catastrophic scale because the odor and attraction of flies can lead to unhealthy environment to high density of small ruminant (contamination on soil, groundwater and nearby stream can also occurred).

Table 4.5 : Significance Assessment Matrix on Farm C.

Activities	Environmental Aspect	Environmental Impact	Scale	Frequency	Regulatory	Cost	Public	H/M/L	Significant	Priority
Animal Environment	Cooling / ventilation purpose or any electricity use	Dust, odor, and consumption of electric as non-renewable resources and global warming	MH	MH	L	L	ML	M	N	9
Biosecurity	Clothing, boots	Consumption of non-renewable resources	M	M	L	L	L	3L	N	11
	Disinfectant, soaps	Pollution to water, soil and groundwater contamination	M	ML	ML	H	ML	M	N	10
Drinking Water	Pipes – water consumption	Consumption of natural resources	M	M	M	M	M	M	N	4
Feed & Feeders	Food consumption (raw resources)	Solid waste, death due to food poisoning	MH	H	ML	H	M	2H	Y	2
Wastewater	Wastewater discharge	Water, groundwater and land pollution	M	MH	ML	M	M	M	N	5
	Lagoon level and integrity management	Potential surface water contamination	M	ML	ML	M	M	M	N	8
Manure Management	Scraping, feces collection and manure runoff	Degraded air quality (odor and CH4 emissions, attracts fly), land and groundwater contamination	MH	H	L	ML	M	H	Y	3
	Land application to reduce commercial fertilizer use, increases organic matter in soil	Conserves natural resources	M	M	ML	L	L	M	N	6
Transportation	Delivery/receiving goats Delivery/collection of feeders, manure	GHGs emissions and consumed non-renewable resources	MH	H	M	H	M	3H	Y	1
Facility Management	Diesel generator, motor failure / spilled oil	Air, soil and groundwater pollution	MH	L	M	MH	ML	M	N	4

Note:

- Environmental aspects and impacts were not evaluated due to no sign of activity conducted.
- H : High; MH : Medium-High; M : Medium; ML : Medium-Low; L : Low

4.1.4 Farm D

Figure 4.15 : One of the feedlots area located in Farm D.

Figure 4.16 : A river located within Farm D boundaries.

Farm D is a small ruminant breeding centre owned by the Ministry of Agriculture, Malaysia. Located at rural hillside area and has higher density with more than 1,000 heads of population with a total land area of 205 acres. From the observation, the farm has 9 feedlots with soil based underneath, properly managed by a team consisting of farm manager and sufficient numbers of worker where each feedlot was managed by 3 workers. The farm implements an intensive management system provided with electricity and fresh water supplied by Jabatan Bekalan Air Negeri Sembilan. Farm D has advantage on existing good ventilation area due to the hillside location and far from community housing area. There are also few abandoned man made pond in the farmland and a river channel within the farm boundaries is also discovered.

Based on the interviews with official person in charge of the farm, the existing manure management is quite similar to farm A. Scraping, gathering, and collection of waste is being practiced like others. The collected manure is left for drying purpose before being sold to other farmers. The only difference in farm D is a cleaning method in feedlots, where dust or feces were swept off on the wooden floor to maintain the hygienic and cleanliness of animal surroundings.

Animal welfare is well taken care of by the group in charge, sufficient available amount of feed & feeders, and a routine vaccines program is conducted to all animals. A scenario on high mortality rate among newborns was found at farm D. According to the person in charge of the farm, the scenario is common because of high densities in each pen. The mortality rate is usually high for the first time birth in goat, or due to improper weaning process. They are satisfied with the current birth rate in farm D where for each female goat will give 3 births in 2 years.

Figure 4.17 : Soil-based under the feedlot house at Farm D.

Figure 4.18 : Soil-based surrounded by cement concrete border at Farm D.

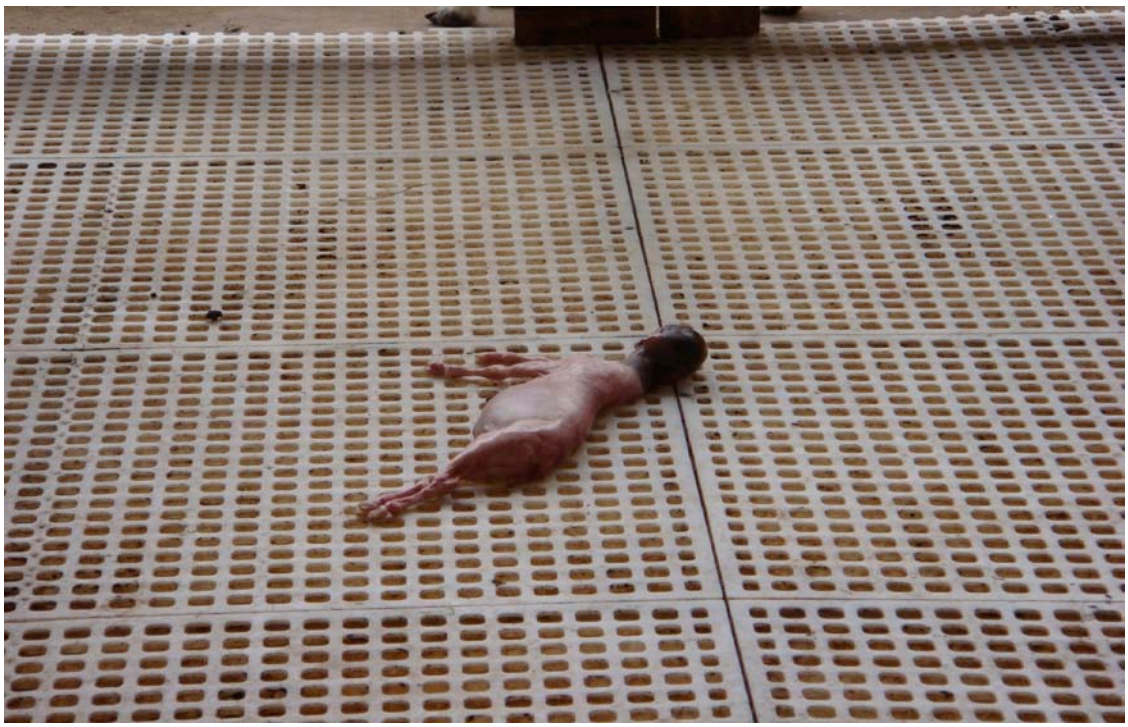

Figure 4.19 : A newborn goat died in one of the crowded pens in farm D.

However for farm D, most significant environmental aspects derived from activities that consumed natural resources or energy. Transportation activity for delivery and collection of feeders showed significant value due to large numbers of small ruminant population that requires a repetition of traveling for feeding purpose. For full efficiency in farm management, fuel as non-renewable resources is highly consumed by transportation. The high density of animal population also resulted in high demands of food intake, utilization of raw resources, feed & feeders and drinking water. Table 4.6 shows a significance assessment matrix in evaluating the environmental aspects and impacts in farm D.

Table 4.6 : Significance Assessment Matrix on Farm D.

Activities	Environmental Aspect	Environmental Impact	Scale	Frequency	Regulatory	Cost	Public	H/M/L	Significant	Priority
Animal Environment	Cooling / ventilation purpose or any electricity use	Dust, odor, and consumption of electric as non-renewable resources and global warming	M	MH	L	L	ML	M	N	6
Biosecurity	Clothing, boots	Consumption of non-renewable resources	M	MH	L	L	L	M	N	7
	Disinfectant, soaps	Pollution to water, soil and groundwater contamination	L	L	L	ML	L	L	N	9
Drinking Water	Pipes – water consumption	Consumption of natural resources	MH	MH	M	M	M	H	Y	3
Feed & Feeders	Food consumption (raw resources)	Solid waste, death due to food poisoning	MH	H	ML	H	M	2H	Y	2
Wastewater	Wastewater discharge	Water, groundwater and land pollution	M	H	ML	M	M	M	N	4
	Lagoon level and integrity management	Potential surface water contamination	-	-	-	-	-	-	-	-
Manure Management	Scraping, feces collection and manure runoff	Degraded air quality (odor and CH4 emissions, attracts fly), land and groundwater contamination	M	H	L	ML	M	M	N	5
	Land application to reduce commercial fertilizer use, increases organic matter in soil	Conserves natural resources	-	-	-	-	-	-	-	-
Transportation	Delivery/receiving goats Delivery/collection of feeders, manure	GHGs emissions and consumed non-renewable resources	MH	H	M	H	M	3H	Y	1
Facility Management	Diesel generator, motor failure / spilled oil	Air, soil and groundwater pollution	MH	L	M	MH	ML	M	N	8

Note:

- Environmental aspects and impacts were not evaluated due to no sign of activity conducted.
- H : High; MH : Medium-High; M : Medium; ML : Medium-Low; L : Low

4.1.5 Farm E

Figure 4.20 : A concrete-base at the feedlot area on Farm E.

Farm E is another breeding centre for livestock owned by the Ministry of Agriculture, Malaysia. Total goat population is approximately more than 1000 heads with 800 acres of total land area. The farm is properly managed and has good agricultural practice. This is because farm E is well established government farm and they have group of expertise in livestock, engineering and veterinary to manage the farm. Waste management in farm E is similar to farm B and C, where the manure is being collected, dried and composted to fertilizer. Here in farm E, a better wastewater management for small ruminant is being implemented.

The wastewater treatment is an anaerobic plant consisting of three retention ponds, which collect both urine and feces, and water from the cleaning activity. The feedlot area is surrounded by a proper drainage system that flows into the anaerobic treatment plant.

However, the plant is not well maintained even though there is a holding pond for the wastewater before entering the treatment plant. Excessive growth of grass resulted in trapped feces, overflow and uncollectable at the area, solids floating on the surface of first pond and wastewater were released to main drainage without a complete treatment.

Figure 4.21 : Holding pond was not maintained at feedlot area in Farm E.

Figure 4.22 : First sedimentation pond at anaerobic wastewater treatment plant.

Figure 4.23 : Third retention pond at anaerobic wastewater treatment plant.

Table 4.7 : Significance Assessment Matrix on Farm E.

Activities	Environmental Aspect	Environmental Impact	Scale	Frequency	Regulatory	Cost	Public	H/M/L	Significant	Priority
Animal Environment	Cooling / ventilation purpose or any electricity use	Dust, odor, and consumption of electric as non-renewable resources and global warming	M	M	L	L	ML	M	N	9
Biosecurity	Clothing, boots	Consumption of non-renewable resources	M	MH	L	L	L	M	N	6
	Disinfectant, soaps	Pollution to water, soil and groundwater contamination	L	L	L	ML	L	L	N	11
Drinking Water	Pipes – water consumption	Consumption of natural resources	MH	MH	M	M	M	H	Y	4
Feed & Feeders	Food consumption (raw resources)	Solid waste, death due to food poisoning	MH	MH	ML	H	M	2H	Y	3
Wastewater	Wastewater discharge	Water, groundwater and land pollution	M	H	ML	M	M	M	N	5
	Lagoon level and integrity management	Potential surface water contamination	H	H	MH	M	M	3H	Y	1
Manure Management	Scraping, feces collection and manure runoff	Degraded air quality (odor and CH4 emissions, attracts fly), land and groundwater contamination	M	M	L	ML	M	M	N	8
	Land application to reduce commercial fertilizer use, increases organic matter in soil	Conserves natural resources	M	M	L	L	L	M	N	10
Transportation	Delivery/receiving goats	GHGs emissions and consumed non-renewable resources	MH	MH	M	H	M	2H	Y	2
	Delivery/collection of feeders, manure									
Facility Management	Diesel generator, motor failure / spilled oil	Air, soil and groundwater pollution	MH	L	M	MH	ML	M	N	7

Note:

- Environmental aspects and impacts were not evaluated due to no sign of activity conducted.
- H : High; MH : Medium-High; M : Medium; ML : Medium-Low; L : Low

Table 4.7 showed evaluated significant environmental aspects and impacts at farm E. Wastewater has the most significant environmental impacts on the farm due to improper management where the anaerobic treatment plant was not well maintained. The wastewater from the third pond was being released without any lab conducts and tests done on it. The second most significant is the transportation activity, the non-renewable resources consumption is high due to repetition on delivery of animals, feeders and manure. Drinking water and feed are also considered as significant because of high population on small ruminant that consumed big amount of natural resources.

CHAPTER 5

DISCUSSIONS

5.1 ANALYSIS OF INITIAL ENVIRONMENTAL REVIEW FINDINGS

The environmental aspects and associated environmental impacts were identified and predicted in those five farms based on terminologies stated in previous chapter. Five major environmental issues that commonly take place in small ruminant production are considered in this study. As mentioned in terminologies, the main issues of concern identified are as follow:

- Impacts on air;
- Impacts on water;
- Impacts on land;
- Impacts on resource consumption; and
- Impacts on waste stream.

Overall, the selected farms are similar in managing the farm's operation. Basic needs like proper housing for animal environment, biosecurity, water supply, facility management, transportation and animal welfare were seen in all farms. However, total population of animal in farm can affects the current farm's operation, especially the feeding system, waste handling, and also animal environment. Total population in animal rearing was identified as one of the factors that determined the impacts on environment. Table 5.1 shows the environmental impacts predicted on farm based from the observation and IER findings. The environmental impacts were predicted based on daily activities on farm under normal and abnormal condition.

Table 5.1 : Results on the identified environmental impacts in five farms

Farm	Air	Water	Impacts land	Resource	Waste
A	√	X	√	√	√
B	√	√	√	√	√
C	√	√	√	√	√
D	√	X	√	√	√
E	√	√	√	√	√

Note:

√ Potential impact predicted due to the current practice in farm management.

X No sign of potential impact on the farm.

As tabulated in Table 5.1 above, results from the IER findings can be concluded that animal farming can potentially impact the air, water, land, resource consumption and waste generation direct or indirectly. Because of impacts could be either adverse or beneficial, significance evaluation on the aspects is important in this study.

Only few activities were selected for the next stage of assessing the significance environmental aspects. Determining the significance in farm incorporates both the environmental and business concerns. The environmental concerns involve scale and frequency. Scale is a criteria considering the issue of farm's location whether located nearby community or within the river buffer zone. Not only that, scale can determine the impacts whether it can effect the environment at all, locally or regional. Frequency is another criteria that consider on period of occurrence or continuously repetition.

However, the business concerns are more to financial, legal and reputation. Financial or cost for addressing impacts are considering the recovery for tackling impacts from activities.

For example, the farm has to bear losses on feeding activity that give death impact due to food poisoning. The regulation aspect however, is a key guidelines set by the government to ensure farmers conduct the rearing activity wisely. Agriculture regulation basically highlighted on animal rearing, conducts on animal and transportation. All five farms found to comply with the regulation because business is mainly trading within local and not involving import livestock. Reputation is important because potential buyers will overlook details on how the animal are managed, kind of food they feed the animal, a good record keeping and diseases control.

5.1.1 Evaluated Significance on Environmental Aspects

Virtually livestock production process contributes to air pollution and emission into the atmosphere. The main issue here only involves transportation and manure management on farm. Greenhouse gases are emitted from fossil fuel used in the production process such as transporting or delivery of goats, feeders and manure to processing and marketing of livestock products. This is a concern where local authorities should give a consideration by conducting on farming activities involving transportation. From the observation, all farms use truck whether big or small to transport the small ruminant, food and manure. Sometimes the repetition of journey is needed in commuting or transferring the animal or food when total heads of small ruminant population becomes larger. Due to this, transportation activities were evaluated as significant in environmental aspects and impacts because it consumed non-renewable resource, cause impacts on air, and potential of spilled oil, which could lead to soil contamination.

Based from the criteria developed in significance assessment matrix (SAM), transportation gives high value on scale and frequency. For long-term effects, GHGs can contribute to global warming and depleted in non-renewable resources.

Waste in the farm can be divided into solid waste and wastewater. Solid waste in the farm could be feces generated by the small ruminant, uneaten food, gloves and boots from the biosecurity. Wastewater basically generated by animal in the form of urine, animal house cleaning involving water and hand washing. Waste is considered significant in environmental impacts on farm because it gives impacts on water, air, land and groundwater. Due to tremendous growth in livestock population and industry, the impacts caused by waste generation will be more long-term. Indirectly, untreated waste can bring about unhealthy environment to the animal because odor created attracts flies, which can carry vector pathogens that can cause diseases. The odor sometimes stretches over entire landscapes around livestock facility is partly due to ammonia emission. The odor can give impacts to public community at nearby area and affect worker's health. Even though there was no complaint made before, the impacts will be more significant if the issues are not solved and mitigated as necessary.

The IER findings are complete baseline information of the farm's current position with respect to the environment during the initial stage of EMS development. The information on input and output of raw materials and activities of small ruminant farming interact with the environment was conducted and analyzed. Basically there is no activity involving hazardous chemicals in animal farm. The main concern here is waste disposal method applied in managing the waste (as discussed in results).

The IER finding can help in setting up or improving farm's environmental policies, objectives, targets and programs by focusing the highlighted issues here.

5.2 GOOD AGRICULTURAL PRACTICES TOWARDS SUSTAINABLE FARMING

Today's agricultural producers have to make judgments calls in response to changes and challenges that they may not have seen or anticipated before on the farm. In the area of food safety, changes are acceptable and occur rapidly. The current GAPs set by DVS, Malaysia, address daily on farm activities and alert farmers to procedures that promote safe handling of production. While the occurrence of food borne illnesses resulting from on farm handling are still rare, a single outbreak where death occurs is a tragedy and can also devastate a business and entire sectors. However, there are few suggestions on certain husbandry system in improving the current GAPs in Malaysia, which are:

5.2.1 Feeding Ruminant

Goats/sheep are ruminants because they have four-compartment stomach to digest large quantities of forages. The ruminant gets their name from the rumen, which is the largest compartment of the stomach and serves as a fermentation vat. The health and productivity of the goat (as with all ruminants) depends on the rumen function, where microorganisms in the rumen digest fiber and carbohydrates and protein to supply the animal with nutrients. Without those microorganisms, the goat will become unhealthy and will die. Therefore, it is of paramount importance that the animal to be fed appropriately so that the ruminant organisms stay healthy. The rumen microorganisms are "healthiest" when goats are eating good-quality forages, such as vegetative pasture.

These rumen organisms require fiber, nitrogen (protein) and energy (carbohydrates). Roughages (forages – pasture or hay) have higher fiber content than grains. More mature forages contain more fiber and are less digestible.

They are usually consumed 5kg/day/head of forages. However, it is difficult to provide good quality forages year-round. Therefore, supplementation such as husk rice can be given, as much as 0.6kg/day/head if the forages feeding are limited (DVS, 2008). Other than husk rice, there is palm kennel waste and copra waste that can be used as an additional supplement.

A study was conducted where the goats are growing with 71g/day in an intensive system and were fed with forages of palm kennel or copra waste (Rahman & Khusahry, 1982). In the same study, the goats kept in a semi-intensive system showed a 51g/day growth. Additional supplement of forages can increase small ruminant reproduction performances as well and indicates that a female goat fed with additional supplement will get 55% twin kids while without additional supplement will only get 33%.

5.2.2 Health Concerns

Few diseases afflict goats, and most producers find even fewer health problems when they practice intensive management system. Keeping goat as stress-free as possible keeps their immune systems functioning properly. A healthy immune system is the best disease preventive. Conversely, periods of stress, such as weaning or transporting, may trigger disease.

Therefore, preventive management is fundamental to maintaining health. Proper nutrition, sanitation and ventilation, as well as timely treatment or culling of problem animal, helps keep the herd in good health and reduces health care costs. For example, the teats of milking does are usually dipped in disinfectant after milking, while the teat opening is dilated, because bacteria entering the teat can cause mastitis. Likewise, regular foot-trimming helps prevent foot-rot and lameness. Table 5.3 shows specific diseases among the goat in Malaysia while Table 5.4 shows common diseases among the goat.

On top of that, veterinarians recommend vaccination for tetanus and enterotoxaemia (overeating disease). Additional vaccines or injections several times a year may be necessary for other diseases or deficiencies.

5.2.3 On-Farm Manure Sources, Storage and Handling

During storage the organically bound nitrogen in feces and urine starts to mineralize to NH_3/NH_4^+. Considering first N_2O emissions, generally only a very small portion of the total nitrogen excreted is converted to N_2O during handling and storage of managed waste. For N_2O emissions to occur, the waste must first be handled aerobically, allowing ammonia or organic nitrogen to be converted to nitrates and nitrites. Then it must be handled anaerobically allowing the nitrates and nitrites to be reduced to N_2. These emissions are likely to occur in dry waste-handling systems and contain pockets of anaerobic conditions owing to saturation.

Farm manure will also contain heavy metals that have been added in drinking water or have been ingested with bedding materials such as straw. Corrosion of the galvanized metal used to construct feedlot, and the animal's licking or biting of metal feedlot component is a potential source of Zn in some manures. Footbaths containing Cu or Zn may be used as hoof disinfectants for sheep and these may be disposed of into manure stores, thus contributing to the heavy metal content of manures spread to land.

Currently, storage and treatment are considered as potential methods to reduce contaminants in livestock manures. However, conventional storage of solid manures in heaps or by composting will not remove heavy metals (Peterson et al., 2007). Thus, stored or composted farm manure can actually contain higher concentration of heavy metals when spread to land compared to fresh or untreated manure.

Table 5.2 : Specific diseases that occur among goat rearing practice in Malaysia

Disease	Factors	Signs	Control Measures / Treatment
Pasteturellosis Can cause mortality or decrease in weight	Caused by contaminated breathing air, contaminated food and kid/weaner milking from a mastitis mother. Factored by high parasites, stress, malnutrition, weather.	Starts with shocking death, breathing problem (Dyapnea), cough, and nasal discharge.	1. Antibiotic – penicillin, oxytetracycline, streptomycin, ampicilin. 2. Multivitamins, liquid for dehydration.
Pregnancy Toxaemia	Lack of glucose to fulfill twin kid needs, lack of glycogen in heart and caused ketonemia.	Unconscious, circling walk, head pressing, no reflects on the eyes, intermittent movement around the ear and eyes, nasal discharge, paralysis.	1. Glucose vaccination 2. Glycerine,glycerol 3. Ensure enough feed (quality & quantity) 4. Control stress 5. Control worms
Enterotoxaemia Also known as pulpy kidney and an acute toxaemia disease to the ruminants. Sometimes called 'overeating' disease.	Caused by bacteria known *Clostridium perfringens type D.* In normal condition, a small amount of these bacteria alive, it reproduces faster and releases poison when goat feeds high quality feeders.	1. Kids (2-12 hours) – shocking death, no appetite, seizures, Diarrhea, recumbent. 2. Adult (24 hours) – unstable and knuckling, chomping of jaw, teeth grinding, fast breathing, tremor and convulsion, flatulent (last stage).	Difficult to control, 90% death. Early treatment by vaccination – anti-toxin, sulphadimidine, antihistamine, Calcium borogluconate. Can be prevented by avoiding feeding excess milk and forages.
Coccidiosis High morbidity disease and contagious, normal among kids/weaner 3-6 months	Contaminated food and drinking water due to overcrowded in a pen, unclean and humid environment in the pen, worms problem and less quality food.	Diarrhea, strongly smell & blood stained on feces, anorexia & anemia, weak & dehydration, 'nerves attack', loss of weight and dead.	Sulphamezathine vaccine everyday (3-5 days), Vitamin B complex. Hygienic pen & fewer crowds in pen, adding anticoccidia in the drinking water.
Melioidosis	Caused by a bacteria *Pseudomonas pseudomallei* through water-borne infection and infected feces. Can infected human (Zoonotic)	Anorexia, loss of appetite, lie down, fever, dyapnea, cough, nasal discharge, convulsion, swollen on testis & lymph node.	Isolate or remove goat, vaccination on Terramycin antibiotic, disinfectant on goat house, treat drinking water.

Table 5.2, continued

Disease	Factors	Signs	Control Measures / Treatment
Brucellosis Transmissible to humans.	Caused by a *Brucella ovis* (sheep) and *Brucella melitensis* (goat) from the food/drinks intake, open cuts, eyes, teats, infected male during mating,	Miscarriage among the pregnant female, infertile, male – orchitis, epididymitis	Terramycin vaccine, remove goat, disinfectant or clear the pen for 3 months, improve management practice.
Foot & Mouth Disease Viruses – Serotype O, A, C, SAT 1, SAT 2, SAT 3, ASIA 1	Caused – milk, feces, urine, blood, saliva, any vesicles liquid. Can be transferred by air, touch, contaminated food, goats/human movement, virus from the raw meat.	Fever, anorexia, stress, swollen gum/mouth, difficulties in chewing food, saliva drooling, collapsed, dead, decrease in milk production.	Avoid slaughter in the same area, control on in/out goat movement, quarantine, vaccination, disinfectant

Sources : Department of Veterinary Services, Malaysia (2008)

Table 5.3 : A common diseases occur among the goats or sheep in Malaysia

Disease	Factors	Signs	Control Measures / Treatment
Pneumonia	Caused by virus, bacteria, parasites, chemical compound. Factored by stress/extreme cold, inequality feeding, stomach worms, poor ventilation system and overcrowded.	Starts with breathing problem (Dyapnea), high fever, cough, sneeze, nasal discharge, weak, loss of weight and appetite.	Antibiotic as a treatment. Preventive by controlling stress, ensure enough colostrum for wean, isolate sick goat, improve ventilation, vaccination for Pasteurellosis.
Helminthiasis	*Not stated*	Skinny, weak, diarrhea, bottle jaw, dehydration. Feces analyzation results are high total in egg worms.	Give suitable anthelmintics via oral, vaccine or pour-on. Fecal Egg Count (FEC) program, which has anti-worms drugs.
Contagious Ecthyma Also known as sore mouth is contagious to sheep and humans.	Caused by a virus and occurs among kids. Kids will become skinny and weak due to loss of appetite.	Water bubbles in mouth area, gum and lips. Bleeding when the bubble break. A muzzle even on fingers and teats.	Clean and treat the affected area with iodine, violet or acriflavin/mepyramine cream. Isolate the affected and early treatment at isolation pen.
Diarrhea Unsuitable food, unclean water supply, feedlot and equipment.	Caused by parasites, worms, chemical material (poison) and disease (coccidiosis).	Abdomen pain, dehydration, a change in color and odor on the feces, loss of appetite, weak and dead.	Anti-diarrhea, antibiotic, anthelmintics, coccidiostat. Improve feeding system, disinfectant feedlot area, anti-worms program and isolate affected goats.
Footrot Occurs when goats are kept on wet land, contagious.	Caused by a bacteria *Fusiformis nodosus, F. necrophorus, Sprirochaetes.*	Necrotic, dead tissues at fingers area, swollen, reddish, pain when touch, fever, loss of appetite, toxaemia, death.	Clean affected area with antiseptic, severe trimming, remove necrotic/dead skin, and treat exposed parts with formaldehyde, isolation until free of disease, disinfectant the area.
Caseous Lymphadenitis (CLA) A disease that occurs as sheep increase in age form from lambs to old animals.	Caused by a bacterium *Corynebacterium pseudotuberculosis* that grows in lymph glands.	Large development of caseous material or pus (thick, cheeslike accumulation) to form.	Infected goats should be culled and isolated from non-infected goats. Disinfectant the area and vaccination.

Sources : Department of Veterinary Services, Malaysia (2008)

5.2.4 Hygiene and pathogen control

Concerns over health risks from manure handling include: (a) direct transfer of zoonotic pathogens to farm staff and neighbors, (b) the cause and spread of disease affecting farm animal, (c) the contamination of water, and (d) the contamination of food supply. The real fears of neighbors can often be the main reason for revising manure management practices. Contamination of water is also a major concern, especially if surface water is used within the local community. Even if, as in most European countries, spreading of manure close to surface water and on frozen soil is prohibited by law, accidental releases of farm wastes to water has resulted in outbreaks of serious illness, including some deaths from disease (Guan et al., 2003).

From a whole-farm perspective the recycling loop of manure back into food production should be as short as possible to minimize environmental impact and ensure high nutrient use efficiency. If manure from livestock is used on the same farm, the epidemiological risk for the animal does not increase. A hygienic precaution must be taken in livestock production because the livestock agriculture sector is shifting to larger units and longer food transport distances, the risk for spreading of both new and well-known diseases increases. Following good agricultural practices can minimize the risks.

Monitoring of herd health and manure management in the framework of HACCP (Hazard Analysis Critical Control Points) concept could be a key measure. The monitoring must also include microorganisms that do not affect the health of livestock, but that of human.

Such pathogens may be transmitted to human via the environment if shed into the manure. In a herd the primary risk of transmitting diseases is between the individual animals, and risks associated with manure management are secondary. However, once the disease has been treated, manure can be an important source of re-infection if not properly disinfected. Petersen, 2007, also stated that for safe recycling of manure, material coming to the farm should be treated in a validated process for removal of potential pathogens following recommendations such as the European regulations.

Proper treatment that sanitizes livestock manure and other residues in a controlled way, both when it is produced on the farm and when imported, would increase the biosecurity in food production, resulting in healthier animals, higher food production and food safety.

5.2.5 Health and safety of workers

Modern technologies, mechanization and the proper management of animal in the production system are becoming more professional every day. Workers have to enjoy a pleasant environment when taking care of animal. It was indicated by Gustafsson (1997) that workers in confined systems are exposed to a number of potential risk and health hazards. Among the risks are those related to ergonomics where a workplace is designed to fit and optimize the worker, odor, dust, gaseous, noise, temperature and humidity. It is recommended to imposed on health checks every two years, technical orientation with farm visiting by specialist veterinary every second year and consultation on health and safety at any time.

5.2.6 Record Keeping

Farm records demonstrate adherence to SOPs and scheduled protocols, such as monitoring product coding, animals' ear tagging and sanitation. When variations in protocols occur, they are noted in the records. Product identification is in place for each piece or container of produce shipped from the farm. It is coded to allow tracing back from field or origin to the distributor if any problem regarding livestock health occurs. Records of results of annual self-assessments, including livestock monthly weight, action plans and dates of implementation are kept on file.

A written recall plan should be updated and reviewed regularly by farm manager and employees. The written recall plan should include names of employees and emergencies contact list for the key farm personnel, produce buyers and distributors, and farm support agencies. The systematic practice of record keeping will help in future additional numbers of livestock and maintenance of the housing system.

5.3 GREENHOUSE GASEOUS

5.3.1 Impacts of growing livestock populations and intensifying production

As can be seen in results shown in chapter 4 and tabulated in Table 5.1, the tremendous growth in livestock production caused impacts on air, land, resource and waste. All selected five farms showed that livestock contributes to climate change by emitting GHGs, whether directly or indirectly. Greenhouse gas emissions arise from the main steps of the livestock production cycle. Emissions from feed-crop production and pastures are linked to the production and application of composted manure, to soil organic-matter losses and to transport. When forest is cleared for pasture and feed crops, large amounts of carbon stored in vegetation and soil are also released into the atmosphere.

Due to the increase in livestock populations and intense production, farm facilities tend to produce more manure than can be used as fertilizer on nearby cropland (FAO 2005b), manure is instead “distributed to a small, local landmass resulting in soil accumulation and runoff of phosphorus, nitrogen and other pollutants” (Thorne 2007). Methane and nitrous oxide are emitted from enteric fermentation and manure. The small ruminant, microbial fermentation in the rumen converts fiber and cellulose into products that can be digested and utilized by the animal. Methane emissions are affected by a number of factors, including the animal’s age, body weight, feed quality, digestive efficiency and exercise. These animals exhale methane as a by-product of the process and nitrous oxide is released from manure during storage and spreading, and methane is also generated when manure is stored in anaerobic and warm conditions. Finally, the processing and transportation of animal products cause emissions mostly related to fossil fuel.

5.3.2 Reducing ammonia emissions from livestock farming

Ammonia can be emitted at several different stages of livestock production. Although ammonia losses will vary significantly among farms due to differences in management practices, a recent estimate suggested that the greatest ammonia losses are expected to be associated with land application of manure (35-45%) and housing (30-35%). Significant losses can also occur during grazing (10-25%) and manure storage (5-15%) (Meisinger et al., 2000).

There are multiple opportunities to reduce the loss of ammonia. One approach is to reduce the amount of ammonia that is generated in the first place. Another approach is to reduce the transfer of ammonia that is produced from livestock operation to the environment.

The approach is a dietary manipulation of manure pH that has been shown to reduce manure ammonia emissions. This is accomplished through the addition of acidogenic phosphorus sources and/or calcium salts to feed in order to counteract the pH increases that occur as a result of urea hydrolysis.

Thus far, most mitigation and prevention strategies undertaken by the livestock agriculture sector have focused on technical solutions. For example, researchers are investigating the reformulation of ruminant diets to reduce enteric fermentation and some methane emissions (Connolly, 2007). One such remedy is a plant based bolus, formulated to reduce excessive fermentation and regulate the metabolic activity of rumen bacteria to reduce methane emissions from both the animals and their manure. Changes in feeding strategy may have impact on GHG production.

In general, the entrepreneurs and producers' target is to obtain maximum returns on investments. All these pressures on the environment are the result of the role of livestock changing, due to rising demands for livestock commodities and to a different role for the environment. The conflict between livestock and the environment is an argument between human needs and values.

5.4 Waste (Manure) Management

A wide range of treatment systems exists for handling the various types of manure from livestock farming (Burton et al., 2003). The manure management among five farms were observed and basically all of them practice the same method in the collection of manure. However, different method in treating and managing the manure were seen and discussed in the previous chapter.

For many farms, the first consideration in manure management lies with easier handling and thus avoiding problems of collection and transport. Removal and collection of manure from goat feedlots' base are usually a scrapping method. A scrapper is used in scrapping involving the pushing and pulling techniques. It requires a lot of labor's energy, time and risking their health due to feces and urine discharged directly to the feedlot base. For this activity, an alternative system using a hydraulic transport such as hand hosing or automated flushing technique is practiced in America, Vietnam and Thailand.

The hydraulic transport system offers several advantages such as low numbers in labor requirement, good odor control and ease of operation but it also poses some problems such as high water usage, possibility of excess discharge of effluent to land, groundwater and streams, additional facilities for pumping and solids removal, and additional lagoon capacity to maintain an acceptable retention time for treatment (Watson et al., 1975). Both systems have pros and cons in implementing it as a routine practice. The alternative technique gives a balance between high costs on equipment and less costs of labor. The implementation of this technique can also be mitigated in long-term environment impact in manure storage and workers' health. Even though it can be adaptable by bigger farms with high funding but the excessive usage of water could cause impacts such as water and land contamination.

As been discussed in previous chapter, manure management conducted by five farms was also observed. Farm A and D has the same approach in managing the manure, while B, C and E are quite similar. Farm B, C and E have better approach in managing their manure.

They treat the solids by recycling them to be composted so that the fertilizer can be used back to their grass field while the liquid is being retained in lagoon or handling pond for quite some time before reusing it in grass watery or discharging it.

Farm B and C has better method in manure management mainly because fund is not an issue to them, the farm is well established and has been operating for more than 3 years. On the other hand, farm A, which was newly established and small, the disadvantages could be caused by lack of fund, expertise and knowledge. Similar with farm A, farm D did not treat the solid waste but instead sell them to others. According to the person in charge of farm D, the reason for not treating the waste is due to lack of labors, limited time and high volume of waste produced.

The government labors has a standard working hours, which require them to work only in the daytime. So, the labors are limited to maintain 9 feedlots in the area. The daily schedule is really tight on feeding the ruminants, weighting, keeping records, vaccination and scrapping waste.

Waste management is an issue to livestock agriculture sector. A technique to approach the issue is already adapted by some of the farms. Mainly, fund and technical expertise in managing the waste are the issues. However, the farms without any approach in handling the issues are not a major problem to this industry because they practice in selling the animal waste to compost producer. This approach can reduce the amount of waste generated and at the same time support business income.

5.5 SUMMARY OF IMPROVING ENVIRONMENTAL MANAGEMENT ON FARM

Overall, all the farms visited had implemented a management based from course attended and provided by Department of Veterinary Service, Malaysia. Governments had introduced Good Husbandry Animal Practice guidelines for the farmers to conduct their farms. However, a sustainable farming practice is hard to achieve if environmental criteria were included in the practice. Farm producers are advised to play their role not only to focus on economic incomes but also to focus on the environmental impacts. Due to increasing numbers of new farmers in Malaysia, environmental problems caused by farming can become significant and effects the global indirectly.

This study proved that waste management is an issue when total population of animal in the farm is huge. Table 5.5 below is a summary for current management on the selected farms. As proposed previously, private farm producer can improve their existing waste management by adapting other farms management.

Table 5.4 : A summary on existing management implemented in five selected farm

Farm	GAP	Manure Management	Wastewater Management
A	No	No	No
B	No	Compost using IMO	Retention lagoon
C	Yes	Compost using IMO & Biogas (future)	Retention lagoon with filtering plant
D	Yes	No	No
E ▪ Small ruminant	Yes	Compost	Anaerobic treatment with 3 sedimentation ponds
▪ Dairy livestock	Yes	Compost	Proper anaerobic treatment with 3 sedimentation ponds

A new farmer can also adapt all the above management mentioned parallel to their needs. Some farmer with lack of fund, expertise, knowledge and labor can adapt a simple farming practice like farm A.

Farmers with sufficient fund, can improve their farm by implementing the proper GAP, manure management and wastewater management as observed in farm C, D or E. However, farmers are advised to change the current practice implemented due to increasing total population of livestock.

Review based on the baseline information on farm need to be made periodically because problems can be addressed once the environmental aspects are highlighted. Total population of livestock in feedlot should accommodates with the size of housing, so that the animal environment provided by the farmer is comfortable and suitable to avoid high density and over crowded in each pens.

CHAPTER 6

CONCLUSION

6.1 SUMMARY OF MAIN FINDINGS

Livestock productions' influence on the environment created a new and important area of studies, which is the environmental preservation. As widespread confinement of livestock increases in comparison to range animals, more problems with the safety of the environment are evident. Large numbers of animal on a limited area of land create more environmental problems. Current standard proposed building has to take into consideration not only the animal but also its waste and the impact of waste on nature. A control of waste is possible but it takes economic resources to put it into practice. With current price of livestock and primary products on the market and without government help, it is difficult for the producer to maneuver the cost-benefit of such actions to improve the environment.

This study on environmental aspects and associated impacts was conducted to get an overview of current management practice by selected farms. The Initial Environmental Review (IER) is an early stage of Environmental Management System (EMS) development and was adapted as methodology to this study. IER findings gave overall information of the farm because the method consist of: data collection via interview with management or person involve in farm operation, observation on daily activities including input and output of raw materials on farm, identification and register of environmental aspects, and evaluation on identified activities to determine the significance of potential impacts towards environment.

As a conclusion, the findings of environmental aspects and associated impacts on overall farm operation have resulted the study to success and achieved all three objectives stated in Chapter 1. All selected farms operation on livestock production system and waste management was identified via various environmental aspects and associated impacts as discussed in Chapter 4. Most of the farm producers operate and manage their farm followed the guidelines and training courses provided by Department of Veterinary Service, Malaysia (DVS). The basic needs such as food, water, supplement, healthcare and proper housing that meets the requirement of animal environment were seen in all farms. Differences among all the selected farms can be seen only in their operation on managing waste.

A sustainable and environmentally sound goat farming management practice was also identified among the selected farms. Two of the selected farms had taken the initiatives towards sustainable farming practice by considering the potential environmental impacts from daily activities in farm. As showed in Table 5.4 in previous chapter, the other three farms followed the guidelines provided by DVS in farm operation. However, the three farms' operations focus on livestock production system but not on waste management and neglecting the environment concern.

The identified environmental aspects and associated impacts in this study gave baseline information of each farm. Good Farming Practice (GFP) is determined from the baseline information and proposed better management on highlighted activity that has significant environmental impacts among the farms. An example, all the farms had the same most significant activities, which are: transportation, feed & feeders, drinking water, wastewater or manure management.

The significant impacts derived from activities as highlighted, should be considered for a further investigation. An example in transportation, a repetitive usage on lorry in delivery/receiving/collection/distribution of goats, feeders and manure can potentially give a significant impact. The impact predicted is GHGs emissions from non-renewable resources and considered significant because impacted area could be bigger, frequent occur could worsen the impact, fuel runoff from unknown leakage and non-renewable resources consumption. So, GFP will proposed on transport maintenance by servicing periodically and reduce the repetitive usage/travel, so that the fuel is conserved, efficient performance and less GHGs emissions.

It is important to consider pollution control strategies for a farm in the framework of local and regional pollution control planning. A whole-farm perspective is necessary to ensure that the solutions adopted are cost-effective. Investments in environmental technology should be made and subsidized by government where the impact on air and water quality is most required to encourage the implementation of controlling the pollutions.

6.2 IMPLICATION OF FINDINGS

The implication of this study is that it provides a few guidelines on assessing IER findings for significance evaluation. Those criteria used in SAM and discussed, at a minimum, were included and specified on farm related. Not only that, due to variable farm size, type of livestock rearing and main interest of farmers, this study had to standardize by a boundary system, which focused on the animal feedlots.

6.3 LIMITATIONS OF THE STUDY

This study is limited to observe and review only five farm's current management practices due to the difficulty of getting approval from more farms. Another reason was because of fund that complicates and limits this study to be conducted.

Hence, the findings might not be convincing enough to prove the current GAP in Malaysia is neglecting the environmental consideration. In addition, the comparison of waste management by farms cannot be done because the result will be biased to the well-established producer or government owned farm. Consequently, this study is not fully comprehensive since it only hypothesized certain key issues based on the available information and limited numbers of farm visited.

6.4 RECOMMENDATION

This study had observed an agriculture management system conducted by five various types of small ruminant farms. The five small ruminant farms have a similarity in practicing the normal routine rearing activity such as housing, feeding, hygienic control, health care and birthing. However, there are differences in the environmental concern, which are on waste and wastewater management system. Both issues have to take into consideration to not only the animal but also their wastes and the impact of these wastes on nature. A control of waste is possible but it takes economic resources to put it into practice (Bellaver et al., 1999).

A system of lagoons, mechanical aerators, solid/liquid phase separators, filtering plants, energy production, other species feeding or correctly treated/distributed fertilizer can contribute to lowering the pollution of the environment (Bellaver et al., 1999).

A small wastewater treatment plant can be built at livestock farm. An example of anaerobic wastewater treatment plant designed specifically for dairy livestock's was observed at farm E (Figure 5.1).

The wastewater treatment plant consists of three ponds, which collect wastewater includes both urine and waste, and water from washing activities derived at the main dairy feedlot area. The feedlot is surrounded by a proper drainage system that leads to retention ponds where wastewater is being collected and retained approximately for 45 days. There is a separator system tank placed in between the feedlot area and the pond to control the wastewater flow. According to farm E manager, untreated wastewater from washing activities and rainfall are release directly to a dam via other drainage while wastewater from dairy is flowing to the retention ponds for treatment. Wastewater that flows into the pond will go through an anaerobic treatment. In first retention pond, wastewater is treated with a sedimentation process (physical treatment) where solid particles including total dissolved solids (TDS), suspended solids (SS) and feces are settled as sludge underneath the pond. After a few days, the wastewater will have two different layers due to the sedimentation process. The upper layer is a wastewater while the bottom layer is sludge that has settled. The upper layer of wastewater from sedimentation process will overflow to the second pond through a connected concrete pipe. In the same process, sedimentation will continue for any unsettled solid and fine particles to settle. In the second pond, the wastewater showed a slight change in color.

From the second pond, the physically treated wastewater flows to the third pond via another concrete piping connector.

The connector at the second pond area is equipped with grit to avoid any plants or bigger particles passing through to enter the third pond. In the third pond, sedimentation is repeated again for any unsettled solid and fine particles to settle. Here, the treated wastewater showed big change in color and treated waste become odorless. The farm manager has put few fishes in the first and third pond as part of his experiment to determine the treated wastewater quality. Finally, the treated wastewater is flowing to another retention area equipped with sand-bed before being released to the main drainage that leads to nearby river. The sand-bed acts as a filter system and this resulted in colorless treated wastewater.

Other private farms can adapt the same anaerobic wastewater treatment plant practiced at farm E. However, a simple modification can help in getting better end-result. For example, the farm manager of farm E said in future, grit to separate both solids and liquid should be installed at the inlet right before the wastewater flow enters into the first sedimentation pond.

Another modification that can help is by putting a filtering plant such as *Eichhornia crassipes* or reed-bed to absorb any heavy metals present in the wastewater. It is advisable to screen the solids from the liquid. The amount of solid waste generates by the small ruminant is big and the solids are in small sizes. Screener and grit should be installed at the inlet of retention pond to collect the solids and it is easier and more efficient way to treat wastewater.

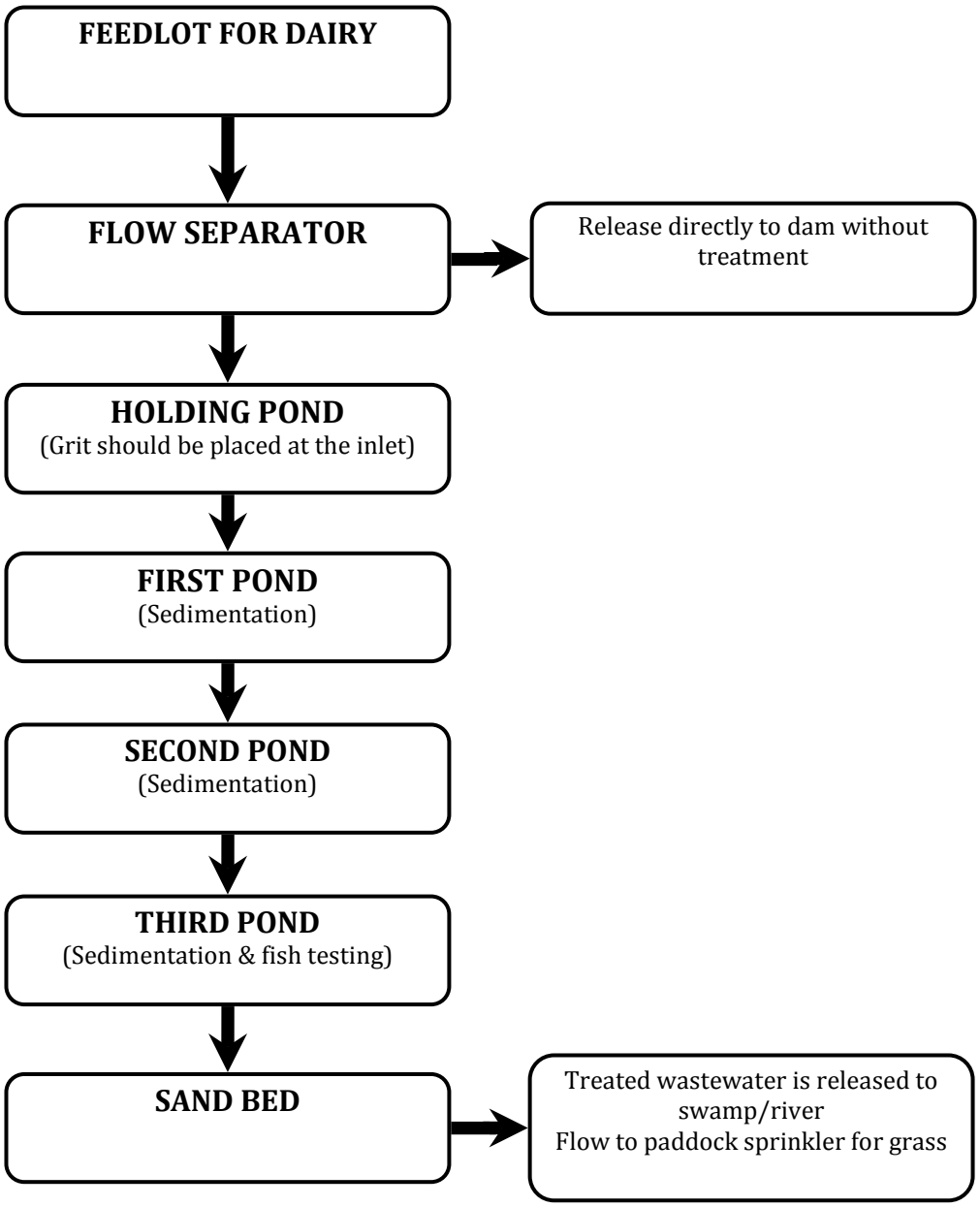

Figure 6.1 : Flow chart of anaerobic wastewater treatment for dairy livestock in Farm E

Figure 6.2 : The main feedlot area for dairies with proper drainage system.

Figure 6.3: Equipment for milking activities with sensor detection located in the feedlot.

Figure 6.4 : Separator tank that separate the wastewater for release or treatment pond.

Figure 6.5 : Drainage that leads to treatment ponds from the separator tank.

Figure 6.6 : Wastewater in holding pond before entering the inlet for treatment process.

Figure 6.7 : Wastewater flowing from the holding pond through the concrete pipe.

Figure 6.8 : Wastewater in the first pond undergone for sedimentation process.

Figure 6.9 : Sedimentation process continuously take place in the second pond.

Figure 6.10: The third pond of anaerobic treatment pond before flowing out to sand bed.

Figure 6.11 : Grass (feeders) area receives treated wastewater via sprinkler.