UNIVERSITI PUTRA MALAYSIA

FINANCIAL AND ECONOMIC ANALYSIS OF STINGLESS BEE FARMING IN MALAYSIA

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By

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Thesis Submitted to School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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FINANCIAL AND ECONOMIC ANALYSIS OF STINGLESS BEE FARMING IN MALAYSIA

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August 2018

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As a reason factor affecting the present problematic advancement of beekeeping industry in Malaysia, the issues of high interest in rearing stingless bees (*Trigona*) is alternatively emerged by the local beekeepers. The Ministry of Agriculture and Agro-based Industry stated that the stingless honey bees may be a national super food due to its benefits to human bodies as there is a high demand in honey. Hence, the government tries to find ways to increase production in meeting the local demand as well as making it possible for export. Nevertheless, the recent information about financial, economic and policy approaches of stingless bees farming, are still limited. Therefore, the study initially aims to investigate socio-economic and cost-benefit analysis; financial appraisal; and level of competitiveness, comparative advantage and government policy of stingless bees farming in Malaysia. The study used primary data as input-output accounting figure from the existing farms and employed 124 stingless beekeepers as number observation. The data analysis applied cost-benefit analysis, capital budgeting techniques and Policy Analysis Matrix (PAM).

The finding showed the stingless bees farming' benefits outweigh its costs, while labor cost constituted as a predominant concern in the cost of production and a high capital expenditure was expended by hive investment. Then, the Peninsula beekeeping farm generated highly profitable business, whilst Sarawak region showed efficient cost in the input-output, cost-benefit ratio and break-even analysis. Based on long term project assessment, the project was financially viable and swiftly recovered up its initial investment. The project also may sustained any possible risks in changing of certain micro-economic variables. Furthermore, the result of PAM model concluded that the industry achieved considerable competitiveness level at domestic and international market; indeed the resource use domestically was inexpensive. However, the government still did not intervene and let the industry run independently. Even though, some policies have been affected to some parts in Peninsular Malaysia, the effect on the market liberalization was not highly visible to the whole stingless bees farming in Malaysia. Therefore, the assistance from the government through a policy intervention is urgently needed.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

ANALISIS KEWANGAN DAN EKONOMI PADA PENTERNAK LEBAH KELULUT DI MALAYSIA

Oleh

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Faktor yang memacu kemajuan dalam perkembangan industri penternakan kelulut di Malaysia bermula dari minat yang tinggi dalam menternak lebah tanpa sengat / kelulut (*Trigona*) oleh penternak lebah madu tempatan. Kementerian Pertanian dan Industri Asas Tani menyatakan bahawa madu kelulut merupakan super food negara kerana manfaatnya kepada manusia dan mempunyai permintaan yang tinggi dikalangan masyarakat Malaysia. Oleh itu, pihak kerajaan cuba mencari alternatif untuk meningkatkan pengeluaran dalam memenuhi permintaan tempatan serta membolehkan eksport. Walau bagaimanapun, masih tiada maklumat baru mengenai pendekatan kewangan, ekonomi dan kajian dasar bagi peternakan lebah kelulut. Oleh itu, kajian ini pada mulanya bertujuan untuk mengkaji analisis sosio-ekonomi dan kos-faedah; penilaian kewangan; dan tahap daya saing, kelebihan perbandingan dan kajian dasar penternakan lebah kelulut di Malaysia. Kajian ini menggunakan data primer sebagai input dan output angka perakaunan dari ladang-ladang sedia ada dan seramai 124 penternak terlibat dalam kajian ini. Analisis data menggunakan analisis kos-faedah, teknik penganggaran modal dan Matriks Analisis Dasar (PAM).

Penemuan kajian ini menunjukkan faedah penternakan lebah kelulut melebihi kosnya, manakala kos buruh merupakan masalah utama dalam kos pengeluaran.Selain itu, modal permulaan yang tinggi dibelanjakan dalam pembelian sarang. Kemudian, ladang penternakan kelulut dapat menghasilkan perniagaan yang lumayan, terutamanya di kawasan Semenanjung Malaysia, manakala Sarawak menunjukkan kos yang cekap dari segi input dan output, nisbah kos-faedah dan titik pulang modal. Berdasarkan taksiran projek jangka panjang, projek ini secara kewangan berdaya maju dan mampu meraih keuntungan dari pelaburan awal dalam jangka masa yang singkat. Projek ini juga mampu menanggung sebarang kemungkinan risiko dalam perubahan pembolehubah mikro-ekonomi tertentu. Tambahan pula, kesimpulan dari hasil model PAM menunjukkan bahawa industri telah mencapai tahap daya saing yang tinggi di pasaran domestik dan antarabangsa; sehubungan dengan penggunaan sumber dalam negeri yang murah. Walau bagaimanapun, industri penternakan kelulut masih berjalan secara bebas tanpa campur tangan kerajaan. Beberapa polisi telah terjejas di beberapa bahagian di

Semenanjung Malaysia, walau bagaimanapun kesan ke atas liberalisasi pasaran tidak begitu ketara kepada penternakan lebah. Oleh itu, bantuan kerajaan melalui campur tangan polisi sangat diperlukan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy.

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LIST OF ABBRIVIATIONS

BOT	Balance of Trade
CBA	Cost-Benefit Analysis
NPV	Net Present Value
IRR	Internal Rate of Return
PI	Profitability Index
PBP	Payback Period
PS	Pioneer Status
ITA	Investment Tax Allowance
ACA	Accelerated Capital Allowance
PAM	Policy Analysis Matrix
PBCR	Private Benefit Cost Ratio
PCR	Private Cost Benefit Ratio
DRC	Domestic Resource Cost
SCB	Social Cost Benefit
NPCI	Nominal Protection Coefficient Input
NPCO	Nominal Protection Coefficient Output
EPC	Effective Protection Coefficient
FOB	Free on Board
CIF	Cost, Insurance and Freight

CHAPTER 1

INTRODUCTION

This chapter focusses on explaining the beekeeping industry in Malaysia along with the production and potential trade of honey. The specific background of stingless beekeeping in Malaysia is also elucidated. This information includes the potential and market value of stingless honey bees. Then, the predominant descriptions of problem statement, research question and research objective are explained. Furthermore, this chapter also describes the significance of the study, the contribution of the study, the organization of the study and summary.

1.1   Beekeeping in Malaysia

Honey bees in Malaysia emerged as the epicentre of biodiversity in the world (Mardan et al., 1988). Malaysia possesses abundant natural resources in sustaining beekeeping activities to produce bee products and convert into high value-added which has rich enzymatic and non-enzymatic antioxidants. Beekeeping industry contributes essential influences in the development of socio-economic and forest conservation in Malaysia. The product of the beekeeping industry not only focusses on honey production but also other beneficial outputs as pollen, brood, propolis, bees-wax and bee venom. Moreover, the industry may also generates additional source of income, since it was estimated by selling bees' product, millions of revenue may provide into the industry (Ismail and Radam, 2010). Hence, it is necessary to generate income with the high potential activity in the beekeeping industry.

Based on potential area of bees production in Malaysia, majority the beekeepers were existed in the forest area in Sarawak, Sabah, Johor and Melaka. The common species of bees are *Apis cerana* and *Apis mellifera*. The annual yield from the *Apis cerana* or local bees is roughly about 5-9 kg, while *Apis mellifera* or the imported bee is tend to produce up to 50 kg per colony in a year. However, this species is prone to pests and diseases. Then, the *Trigona* or stingless bees emerged as a new activity in the beekeeping industry that it expected to complement natural honey production and pollination services in Malaysia (Ismail, 2014).

Malaysia encountered the deficits tendency of Balance of Trade (BOT) over the years (Figure 1.1). However, there was a positive trend, that the country recorded a surplus of balance of honey trade in 2009. Then, it was at a peak profit by increasing more than 200% in 2010. This surplus indeed could further increase, if Malaysia sets its own natural honey standards and meets the criteria of importer's country standards. Nevertheless, from 2011 to 2017, Malaysia depends dramatically on imported honey to cater to the high local demand. It is not surprising if the trade balance for this commodity is always negative. This situation, however, should not be occurred since Malaysia is blessed with natural resources such as tropical rainforest and huge agriculture land areas.
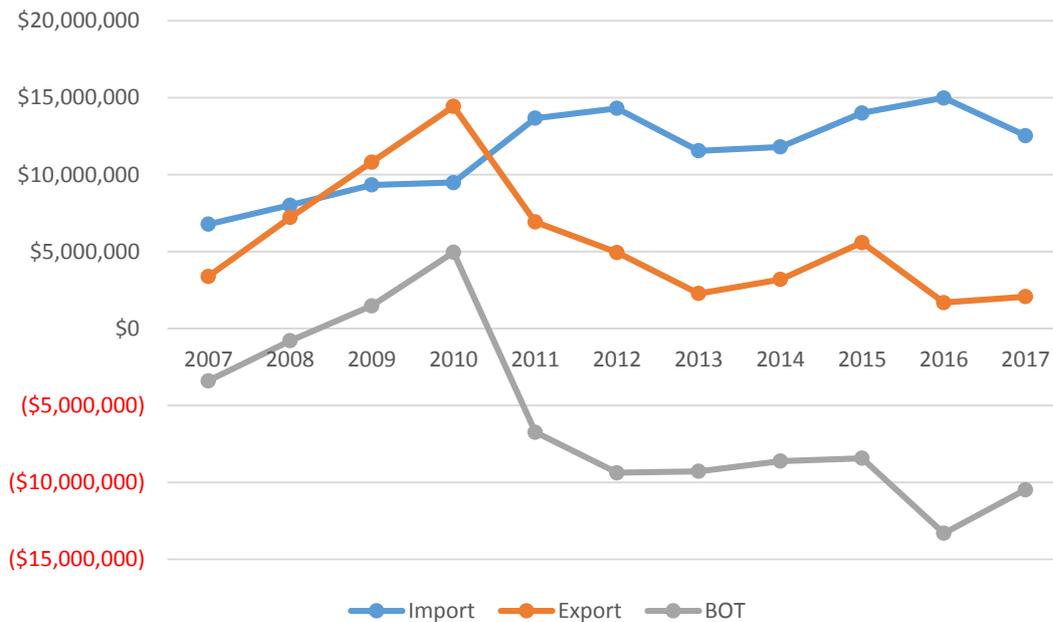
Figure 1.1: Trade Statistics of Honey in Malaysia
[Source: United Nations Comtrade (2018)]

Then, after declining high export production in 2010, the quantity of honey export was dramatically decreased about 10.94 Mt in 2011 and continued gradual decline till the year of 2017, although there was an increase in 2015 (Figure 1.2). This circumstance assumes that domestic resource of honey in Malaysia may not meet the existing honey's demand and low yield in the local beekeepers. According to Ismail (2014), in order to sustain the export of honey, Malaysia needs stringent quality control to meet the standard requirement posted by the importer's country. Traceability is very crucial in ensuring honey adulteration or high antibiotic content. This could be studied through honey content analysis. Moreover, the participation of new beekeepers should be improved to increase honey production. Hence, the development of new products or species will also help to increase the production of local honey and attract society to involve in the farm. The alternatively local honey may be introduced as *Trigona* or Stingless bees.
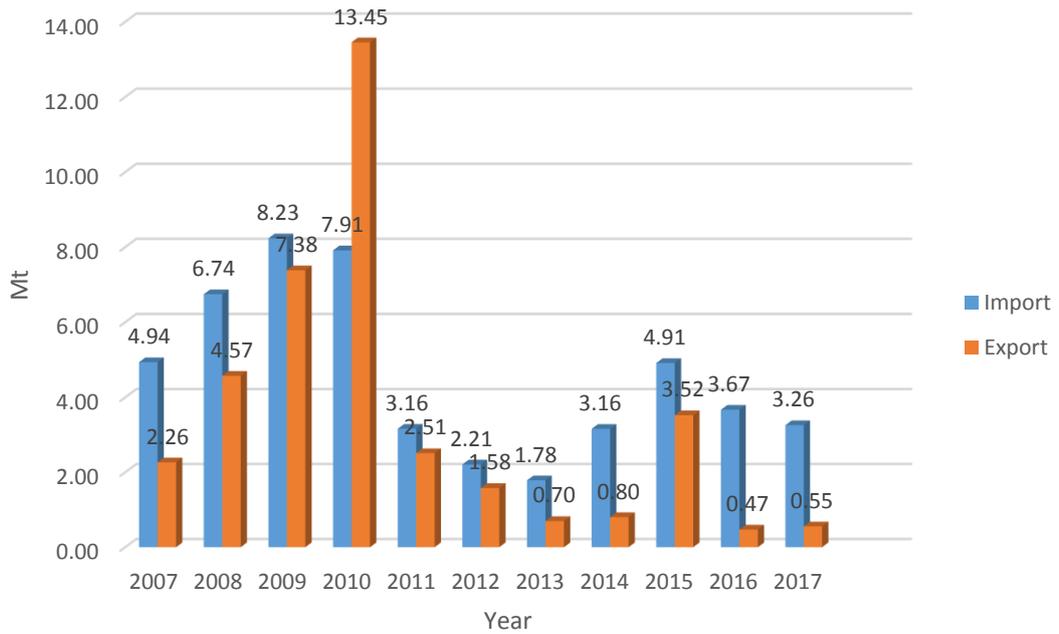
Figure 1.2: Quantity of Honey Export-Import in Malaysia
[Source: United Nations Comtrade (2018)]

The Minister of Agriculture and Agro-Based Industry Malaysia started the project of Meliponiculture or stingless bees farming as one of the industrial crops along with Apiculture or *Apis* (common natural honey) in 2017. Based on Figure 1.3 showed that the planted and harvested area of Meliponiculture were larger than Apiculture, indicating the project of stingless bees farming requires a huge area in deploying the hives. It also assumes the project of Meliponiculture concentrated in the forest area and the effectiveness of adapted technology was still limited, while the project of Apiculture was efficient in using land resource. Then, In terms of production, the Apiculture produced about 7.7 Mt, while Meliponiculture yielded 23.8 Mt. Hence, the total honey production was about 31.5 Mt in 2017. In this circumstance, the introduction of Meliponiculture or stingless bees to the beekeeping project in Malaysia highly contributed the total honey production in 2017, since the increment of export was presented and the import of natural honey decreased in 2017 (Figure 1.2).

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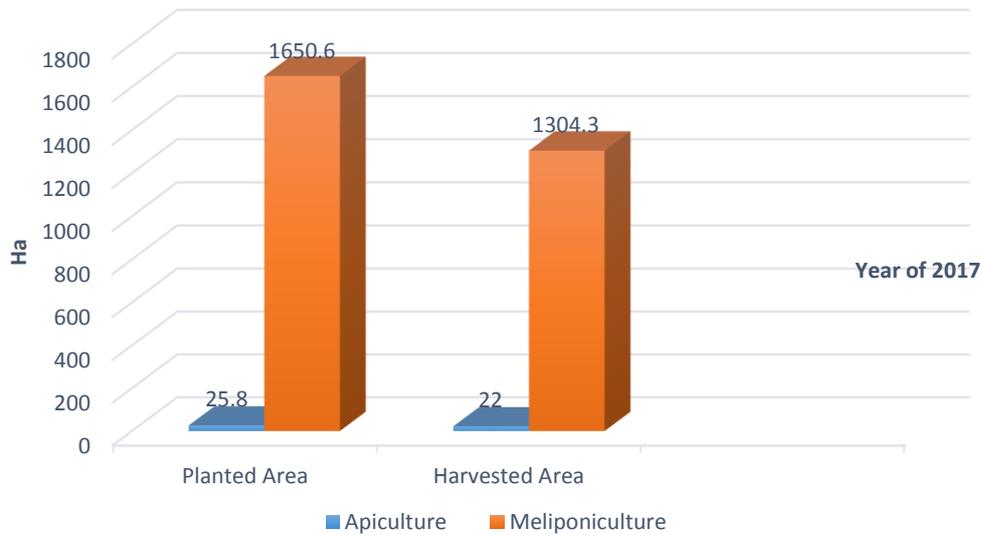
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[Source: Department of Agriculture, Ministry of Agriculture and Agro-Based
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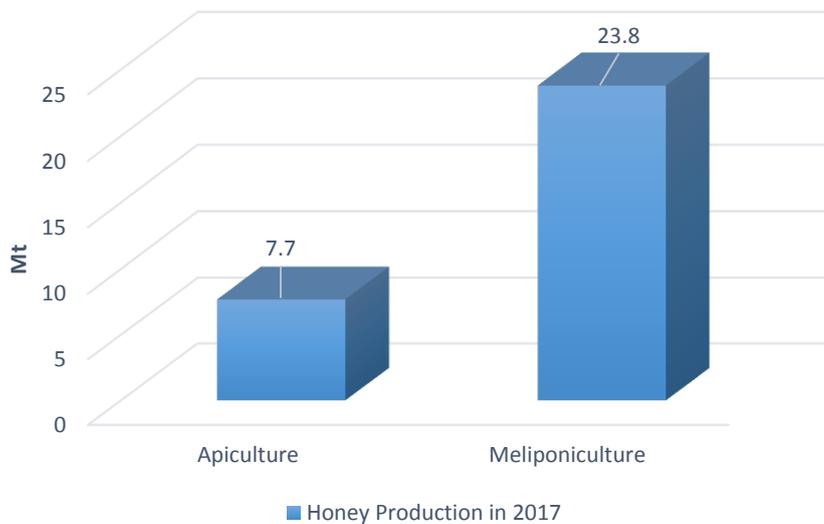
Figure 1.4: Malaysia's Honey Production in 2017
[Source: Department of Agriculture, Ministry of Agriculture and Agro-Based
Industry Malaysia (2018)]

1.2 Meliponiculture or Stingless Bees in Malaysia

Stingless bees are active all year round; they do not sting but will defend by biting if
their nest is disturbed. They usually nest in hollow trunks, tree branches, underground
cavities or rock crevices nevertheless they have also been encountered in wall cavities,
old rubbish bins, water meters and storage drums. They are widely distributed in the

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tropical and temperate regions of the world (Roubik, 2006). As the Figure 1.3 below, the red line illustrated the inhabit area of stingless bees, wherein the bees are existed in all regions of Malaysia. Moreover, there are about 700 species that have been recorded worldwide. According to Heard (1999); Schwarz (1939); Sakagami et al.(1985); Osawa and Tsubaki (2003) the species of stingless bees commonly are *T. itama, T. thoracica, T. apicalis, T. terminata, T. respani, T. melanocephala, T. valdezi, T. collina, T. atripes, T. canifrons, T. iridepennis* and *T. rufibasalia*. However, Jalil and Roubik (2016) stated that the species of *T. itama* becomes a common species of stingless bees in Malaysia.
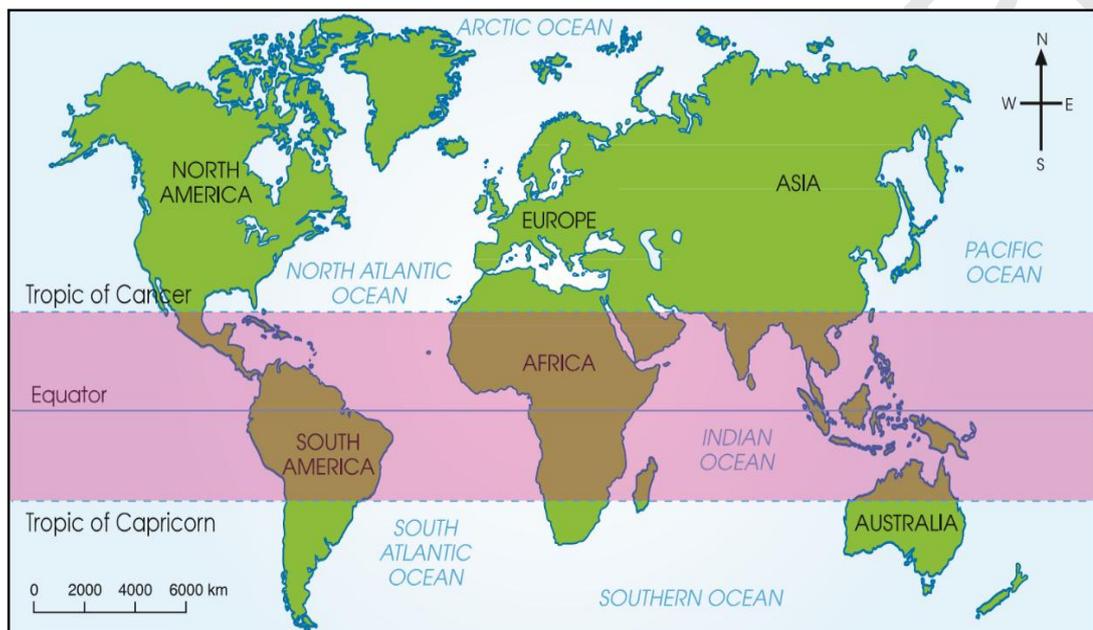
Figure 1.5: Stingless Bees Zone
[Source: Kwapong et al. (2010)]

In terms of the total population of stingless beekeepers in Malaysia, the official lists of stingless beekeepers are about 717 farms (Table 1.1). This number population was obtained by the Department of Agriculture, Minister of Agriculture and Agro-based Industry Malaysia. Most of the beekeepers are young agro entrepreneur and they are associated with the government project in promoting stingless bees in Malaysia. Then, the majority of beekeepers are existed in the state of Terengganu, constituting about 194 farms and following by Kelantan, Pahang and Kedah. Indeed, there are some existing beekeepers in Sabah area. Nevertheless, the Sabah farms are not yet officially listed from the Department of Agriculture in Malaysia. Furthermore, the number of colonies or hives of stingless bees in Malaysia has reached to 58,293 colonies and this number will be gradually increased since the government are still attempting to enlarge the stingless beekeepers in Malaysia.

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Table 1.1: Meliponiculture (Stingless Beekeepers) Population in Malaysia

No	States	No. of Farms	No. of colonies
1	Perlis	8	420
2	Kedah	79	6,821
3	P. Pinang	22	285
4	Perak	34	2,217
5	Selangor	47	1,860
6	N. Sembilan	6	2,640
7	Melaka	17	1,571
8	Johor	36	5,254
9	Pahang	88	4,704
10	Terengganu	194	5,992
11	Kelantan	115	8,247
12	Labuan	5	984
13	Sabah	-	-
14	Sarawak	66	17,298
	Total Farm	**717**	**58,293**

[Source: Department of Agriculture, Minister of Agriculture and Agro-Based Industry Malaysia (2017)

1.3 The Potential Value of Stingless Bees

The development of stingless bees for sustaining human livelihood is new aspect. However, bees are identically referred to honey. Likewise in Malaysia, the emphasis of most farmers is only on the production of honey (Jalil & Roubik, 2016). Eventually, many studies have indicated that honey is a potential product for health purposes. Specifically, the stingless honey bees have a similar content to alternative medicine. Study by Norowi et al. (2012) analysed the medicinal value of stingless honey bees, indicated that the major source of *phenylpropanoid acid, protocatechuic acid* and *4-hydroxyphenylacetic acid* are free *phenolic acid*. This is due to the fact that the total is more than 300 mg/g dry weight of *phenolic acid* found in stingless honey bees, which is higher than other types of honey such as *Apis Cerena* and *Malifera*. While free phenolic acids are absorbed by the human body compared to flavonoids. According to Ozcan et al. (2014), *phenolic acids* provide antioxidant components, antimicrobial properties, and anti-mutagenic components that are useful for preventing pathologies such as infectious diseases, degenerative diseases, cardiovascular heart diseases, and cancer. Additionally, Andualem (2014) studied that stingless honey bees are widely used for traditional treatment like respiratory ailments, surface infection and other diseases. It might also be effective to treat different infectious diseases with that are low concentration. Stingless honey bees also has better medical potency than common honey, while the antimicrobial activity of stingless honey bees against tested pathogens is better than other types of honey.

Furthermore, stingless bees are common pollinators in the Malaysian agricultural ecosystem, their contribution to human's socio-economy has yet to be quantified or even appreciated. In fact, there has yet to be a complete study carried out on using stingless bees to enhance crop or horticultural production (Jalil & Shuib, 2014). Studies in Australia, Japan and Mexico showed very promising results (Kukutani et

al., 1993; Blanche et al., 2006; Palma et al., 2008) showed that stingless bees pollinate strawberries as well as honeybees. Table 1.1 indicated potential value of pollination services for some of agricultural crop in Malaysia. Many agricultural crops in Malaysia such as starfruit, mango, durian, watermelon, guava and coconut are also pollinated by stingless bees (Slaa et al., 2006). Furthermore, Stingless bees are known to be important pollinators in tropical rainforests (Eltz et al., 2003) and good candidates for providing pollination services in agricultural ecosystems (Heard, 1999; Slaa et al., 2006).

Table 1.2: Potential Value of Pollination Services in Major Malaysian Fruits

Commodities	Production Value (USD)	Pollinator Ratio	Values (USD)
Starfruits	5,218,071.08	0.65	3,391,746.20
Guava	481,445.14	0.65	312,939.34
Citrus (Mandrin)	143,078.11	0.05	7,153.91
Mango	911,512.43	0.65	592,483.08
Watermelon	9,970,436.22	0.95	9,471,914.41
Durian	4,781,793.24	0.65	3,108,165.61
Coconut	9,026,651.35	0.25	2,256,662.84
Total	**30,532,987.57**		**19,141,065.38**

[Source: Samejima et al. (2004)]

1.4   Stingless Honey Bees Market

In Malaysia, the business emphasis of stingless bees focuses on the honey production. Majority of the farm management still applies the conventional approach without employing a huge number of labour and applying sophisticated technology (Jalil & Roubik, 2016). Due to tremendous benefits of stingless honey bees and price competition in the honey market, the demand of stingless honey bees for the local consumption was increased. However, the supply of honey is still limited. According to Jalil (2016), the price of the stingless honey bees is more expensive than the common honey (Table 1.2). The selling price at the farm gate is commonly between RM 150 – 200 per kilogram, while the price of honey in the market is between RM 200– 500 per kilogram.

Table 1.3: Price Comparison between Stingless Honey Bees and Common Honey Bees

Attributes	*Trigona* Honey Bees	*Apis* Honey Bees
Price of hives / colonies	RM 500-1,500	RM 700-900
Producer price/kg	RM 150 - 200	RM 30 – 40
Domestic market price per kg	RM 200 - 500	RM 60 – 90
Production per hive	0.5 – 1 kg / month	4 – 6 kg / month

[Source: Jalil (2016)]

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Moreover, there have been complaints lodged because of the price, and farmers should pay attention to the sustainability of industrial stingless bees' homeland for additional income. However, farmers must also strive to reduce production costs. According to Jalil and Roubik (2016), the pricing issue has been long discussed. The issue involves many factors, including:

a) Cost of capital expenditure.
   In order to start up the stingless bees project, the cost of initial investment is being a burden since the hive price is expensive.

b) Cost of maintenance or operating expenditure.
   Several tools in assisting the process of collecting or harvesting honey are frequently required to be maintained and repaired, because of the life span of the product, namely chainsaw and battery.

c) Preparation of sources for optimal production.
   In order to attain optimal production in stingless bees project, the farm needs additional crop plants and sophisticated technology for vacuum pump. These preparations are costly enough.

d) Care colony of harassment and threats.
   Stingless bees farms must protect the colony from the threats of pests, monkeys and human. Hence, there is additional cost in preventing the colonies as purchasing the pesticides and building the fences.

e) Increase of colony without purchase by the rules of the best.
   A new method to increase the colony has been recently introduced and adapted without lodging or purchasing trees. The approach uses technologically modern hive that is more expensive than applying log or traditional hive.

f) Breeding crop plants.
   Once the crop plants are deployed in the surrounding area of bee farm, beekeepers should pay attention to spend some cost in breeding the plants. Some crop plants necessitate frequent supply of food in order to grow rapidly, thus the operation cost will be considerably expensive.

Then, many other factors may also be reasonably fruitful. Further methods and strategies should be viewed as a whole and competitive while maintaining to receive reasonable return (Jalil, 2017).

1.5 Problem Statement

Factual evidence showed that the trade balance of honey had been deficit from 2011 to 2017 in Malaysia, indicating the domestic demand of honey is too high but the domestic resource is limited. According to Ismail, (2014) the deficit of honey export in Malaysia is due to a problem in rearing the common bees namely *Apis cerana* and *Apis mellifera*. Hence, it prompts the honey industry to develop new species as Meliponiculture or stingless bees.

In this circumstance, therefore, the Ministry of Agriculture and Agro-based Industry in 2016 tried to promote and focus on enlarging stingless bees farming in Malaysia. The project had been started officially under the industrial crops, Department of Agriculture in 2017. Indeed, there was an evidence that the existence of Meliponiculture or stingless bees supplied higher proportion than the apiculture honey in 2017 and it led the improvement to the balance of trade as the country may increase export and decrease imported honey, although the result was still negative.

Initially, there are considerable gaps in order supply more stingless honey bees to meet the local demand without a dependency of imported honey. The government should find ways to increase the production of stingless honey bees by increasing the involvement of stingless beekeepers in the country. However, the issues of high interest in rearing Malaysian stingless beekeeping were emerged by many local Malay countryside (Resnick, 2014). The fundamental aspects of stingless bees farming in post-harvest management and downstream processing remains untouched. Then, the honey produced by stingless bees is slightly expensive, due to high price of hive investment. It is about 20 times costlier than the honey produced by other bees (Kumar et al., 2011). Therefore, the selling price of stingless honey bees at the consumer's level is more expensive than Apiculture honey. Moreover, the honey production per hive of stingless bee is slightly less than other common bees. If the existing production problem is remain unsolved, lack of participation from the society will be noticeable.

Furthermore, any literatures about financial and economic studies of stingless bees farming are insufficient. Financial and economic information are highly essential to assess the future appraisal of the project and solve the production problem. If the project of stingless bees is financially feasible, highly profitable, economically sustainable and socially competitive, this implies the attractiveness from society to participate in the industry. Then, new stingless beekeeper will enlarge and the total domestic supply will systematically contribute to the total natural honey. Hence, it will improves the country's food trade balance.

By elaborating the present problem, a study on the financial and economic aspects of commercializing stingless honey bees is urgently needed to complement the existing production problem of natural honey in the industry. Then, through research and development as well, the species of stingless bees in Malaysia has room for improvement in promoting higher yields and a sustainable industry. Moreover, since the stingless bees recently emerged as an infant industry, the role of government protection is highly recommended. If the government does not provide policy to the project of stingless bees farming, the tendency of local beekeepers in participating the commercialized farm will not improve. Hence, the country will still depend on supply of imported honey.

1.6 Research Questions

This study addresses seven research questions. The questions focus on understanding the financial and economic aspects as implemented across stingless bees farming in Malaysia.

a) What are the results of financial and economic analysis for stingless bees farming in Malaysia?
b) What are the outcomes of socio-demographic profile and cost-benefit analysis from stingless bees farming in Malaysia?
c) Is the stingless bees project financially feasible in Malaysia?
d) What are the effects of tax, government tax incentives and risk analysis to the future appraisal of stingless bees project in Malaysia?
e) Does the stingless bees industry perform comparative advantage in domestic and international market?
f) Is there government protection in the market policy of stingless bees industry in Malaysia?
g) What are the impacts of market distortion in policy analysis for stingless bees industry in Malaysia?

1.7 Research Objectives

The research concentrates on the financial and economic approaches to investigate the existing problem of stingless bees farming. Furthermore, the study will conduct the following objectives:

1.7.1 General Objective

To examine the financial and economic analysis of stingless bees farming in Malaysia.

1.7.2 Specific objectives

a) To describe the socio-demographic profile and cost-benefit analysis of stingless bees farming in Malaysia.
b) To investigate the financial feasibility of stingless bees project in Malaysia
c) To simulate the impact of tax, government tax incentives and risk analysis for the future appraisal of stingless bees project in Malaysia
d) To analyse the economic analysis of comparative advantage at the private and social market price
e) To identify the role of government protection to the stingless bee industry in Malaysia
f) To simulate market distortion in policy analysis for stingless bees industry in Malaysia

1.8   Significance of the Study

The study on the financial and economic analysis of stingless bees farming in Malaysia attains various beneficial outcomes, mainly in the concept of financial and economic findings. The description of farm background provides good information in the production of stingless bees farming as a socio-economic attribute and cost-benefit analysis. The study assesses the financial viability of the project's appraisal of stingless bees farming in order to determine whether the project may financially sustain in the long term. Furthermore, the model of policy analysis matrix contributes to the level of competitiveness, comparative advantage and government protection.

1.9   Contributions of the Study

The finding of the study will provide beneficial contribution for Malaysian society who needs to find an alternative income in the stingless bees farming if viability of the project is feasible. The existing beekeepers will as well attain useful information in order to achieve lucrative production and become more efficient in allocating the resource used. Besides, the finding of this research can assist the Malaysian government to encourage numbers of stingless beekeepers to be involved. Thus, the production will enhance the country's supply of honey. Moreover, the research is expected that the industry leads to be comparative advantage, sustain any risks from market distortion, hence it may replace imported honey and possibly for exports.

1.10   Organization of the Thesis

The thesis is organized in the following order. In Chapter 1, the predominant background information on stingless bees farming and the study are given. Chapter 2 summarizes the theory linked to the cost and benefit; capital budgeting approach; investment appraisal; concept of comparative advantage; risk analysis; and market distortion. This chapter also elucidates the summary of previous studies which having similar approaches from the study. Chapter 3 explains the conceptual framework, type of data, sampling techniques and data analysis. Chapter 4 presents the result from financial analysis namely cost-benefit finding and capital budgeting techniques. Then, Chapter 5 describes the outcomes from economic analysis, representing by Policy Analysis Matrix. Chapter 6 provides a conclusion of the study by summarizing the findings, policy implications, suggestions and limitation of the study.

1.11   Summary

This chapter introduced the background of beekeeping industry in Malaysia and the species of stingless bees along with its potential value and market. The existing problems and gaps identified in the beekeeping industry in Malaysia have been summarized above. Then, the research objective, contribution and organization of the study have been elucidated.

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