PROFITABILITY OF STINGLESS BEEKEEPING PRODUCTION AND BEEKEEPERS' PERCEPTION OF EXTENSION AGENTS' PERFORMANCE

IBRAHIM ALIYU ISAH

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By

IBRAHIM ALIYU ISAH

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

December 2018

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DEDICATION

This thesis is dedicated in memory of my late Mother Zainab Yaya Balu, my late father Mal. Ali Inusa, and my late Uncle Isa Tata Yusuf, May Allah (SWT) have mercy on them and grant them jannatul Firdausi. Also, to my wife Ma'asuma Aminu Suley, and our children Sadiya, Naseem and Mufeeda. Morever, Special dedication to Rabiya Umar, may Allah (SWT) give them long life and prosperity. AMEEN.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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December 2018

Chairman : Professor Mohd Mansor Ismail, PhD
Faculty : Agriculture

In business start-up a feasibility study is necessary to determine the profitability of the venture. Stingless beekeeping production has been found to be a profitable venture in Malaysia and to boost the production to a profitable level, knowledge and skills of the extension agents is very important for effective and efficient delivery of beekeeping technology and human resource development. Despite various government support in Malaysia, natural honey production is still insufficient to meet domestic demand. The trend lead to huge importation to satisfy the increasing demand for consumption. The study aimed at determining the profitability and level of stingless beekeeping production through technology transfer, human resource development and extension agents' work performance, to examine relationship between technology transfer, human resource development and work performance, and to identify the most contributing factors to work performance of extension agents among stingless beekeepers in Malaysia. This research used quantitative research method. The questionnaires were analysed using capital budgeting analysis, descriptive statistics, correlation and regression coefficient analysis. Slovin formula was used to determine the sample size and Purposive sampling method was used to select 54 stingless beekeepers from ten stingless beekeeping state in Malaysia. The findings of the study indicate that the actual value of NPV in stingless bee project is positive, indicating the project may generate lucrative earnings in terms of assessment and bring more yield on investment when combined with the incentive schemes. In addition, the findings revealed that internal rate return (IRR) values indicating efficient yield of investment. Furthermore, the Profitability index revealed (PI) indicating the most profitable investment as it carries higher PI values and profit of more than RM1 from a single Ringgit invested in the stingless bee project. Also, the analysis on Pay Back Period (PBP) revealed the possible period within which to recover the initial money invested. Similarly, a sensitivity analysis was done to determine business risk analysis, the result

indicate that even if there is increase in the hive cost and labour cost by 10%, 20% and 30% the project would remain profitable for investment and on the other hand, decrease in the selling price by 30% of the viability of stingless bee venture at the marginal value and still remain a lucrative venture and a feasible project. Results reveal two levels among stingless beekeepers on technology transfer, human resource development and work performance of extension agents; moderate (technology of stingless bee, dissemination of technology, evaluation of technology, leadership development, decision making and) and high (social skill). However, the work performance was at moderate level. The technology transfer and human resource development competencies all have positive correlation with work performance. The interpretation reads improvement in technology transfer and human resource development competencies of extension agents will lead to better work performance and will probably improve level of stingless beekeeping production and profitability among stingless beekeepers. However, three level of strength of relationship, dissemination, evaluation, decision making and leadership have strong positive correlation, whilst, social skill and technology have very strong and moderate positive correlation respectively. Respondents' estimate coefficients performance model highlighted the significance of three variable of human resource development on extension agents' work performance as shown by the score, Adj.R^2 of 57.5%. Social skill was identified as the most contributing skill that influence extension agents' work performance. This study contributes to a better understanding of the relationship of technology transfer and human resource development to work performance as they are genuinely important for any meaningful improvement in stingless beekeeping production in Malaysia.There is the need to create future development plan to improve the competency of extension agent in the Department of Agriculture particularly in the area of technology transfer and human resource development. Research institutes and Universities should embark on more research in the area of stingless bee technology and made available to farmers.

Key words: stingless beekeeping, beekeepers, extension agent, profitability, transfer of technology, human resource development, Malaysia

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENENTUAN KEUNTUNGAN PENGELUARAN PENTERNAKAN LEBAH KELULUT DAN PERSEPSI PENTERNAK TERHADAP PRESTASI EGEN PENGEMBANGAN

Oleh

IBRAHIM ALIYU ISAH

Disember 2018

Pengerusi : Profesor Mohd Mansor Ismail, PhD
Fakulti : Pertanian

Dalam permulaan perniagaan kajian kemungkinan diperlukan untuk menentukan keuntungan bidangusaha. Pengeluaran madu kelulut telah terbukti sebagai bidang usaha menguntungkan di Malaysia dan untuk meningkatkan pengeluaran ke tahap yang menguntungkan, pengetahuan dan kemahiran egen pengembangan adalah sangat penting untuk menyampaikan teknologi pemeliharaan kelulut dan pembangunan sumber manusia yang berkesan dan efisien. Walaupun terdapat pelbagai sokongan kerajaan di Malaysia, pengeluaran madu asli masih tidak mencukupi untuk memenuhi permintaan domestik. Keadaan ini membawa kepada pengimportan madu asli yang besar untuk memenuhi permintaan yang semakin meningkat untuk penggunaan domestik. Kajian ini bertujuan untuk menentukan tahap keuntungan dan tahap pengeluaran lebah melalui pemindahan teknologi, pembangunan sumber manusia dan prestasi kerja egen pengembangan, untuk mengkaji hubungan antara pemindahan teknologi, pembangunan sumber manusia dan prestasi kerja, dan untuk mengenal pasti faktor yang paling menyumbang kepada prestasi kerja egen pengembngan di kalangan pemelihara lebah kelulut di Malaysia. Kajian ini menggunakan kaedah penyelidikan kuantitatif. Soal selidik dianalisis menggunakan analisis belanjawanmodal, analisis deskriptif, analisis koefisien korelasi dan regresi. Rumusan Slovin digunakan untuk menentukan saiz sampel dan kaedah pensampelan Purposif digunakan untuk memilih 54 penternak lebah dari sepuluh negeri di Malaysia. Penemuan kajian menunjukkan bahawa nilai kini bersih (NPV) dalam projek lebah tanpa rangsangan kerajaan adalah positif, menunjukkan projek itu boleh menjana pendapatan lumayan dari segi penilaian projek dan membawa lebih banyak hasil pelaburan apabila digabungkan dengan skim insentif kerajaan. Di samping itu, penemuan menunjukkan bahawa nilai kadar pulangan dalaman (IRR) menunjukkan hasil pelaburan yang cekap. Di samping itu, indeks keberuntungan (PI) menunjukkan pelaburan yang paling menguntungkan kerana ia membawa nilai PI yang lebih tinggi dari RM1 bagi tiap satu Ringgit

dilaburkan dalam projek ini. Juga, analisis mengenai Tempoh Bayar Balik (PBP) mendedahkan tempoh yang pendek untuk mendapatkan balik pelaburan awal. Begitu juga, analisis kepekaan dilakukan untuk menentukan analisis risiko perniagaan, hasilnya menunjukkan walaupun terdapat kenaikan kos sarang dan biaya buruh sebanyak 10%, 20% dan 30%, projek ini akan tetap menguntungkan untuk pelaburan dan di sisi lain penurunan harga jualan sebanyak 30% masih lagi berdaya maju dan masih lagi menjadi usaha yang menguntungkan. Hasil kajian juga mendapati pemindahan teknologi, pembangunan sumber manusia dan prestasi kerja egen pengembangan; adalah sederhana (teknologi pemeliharaan lebah, penyebaran teknologi, penilaian teknologi, kepimpinan, membuat keputusan) dan kemahiran sosial adalah tinggi. Walau bagaimanapun, prestasi kerja berada pada tahap sederhana. Pemindahan teknologi dan pembangunan sumber manusia semuanya mempunyai korelasi positif dengan prestasi kerja. Tafsiran ini menunjukkan peningkatan dalam pemindahan teknologi dan kecekapan pembangunan sumber manusia bagi egen pengembangan akan membawa kepada prestasi kerja yang lebih baik dan berkemungkinan meningkatkan tahap pengeluaran dan seterusnya keuntungan penternak lebah kelulut. Walau bagaimanapun, tiga tahap kekuatan hubungan, penyebaran teknologi, penilaian teknologi, membuat keputusan dan kepimpinan mempunyai korelasi positif yang kuat, manakala kemahiran sosial dan teknologi masing-masing mempunyai korelasi positif yang sangat kuat dan sederhana. Model prestasi koefisien anggaran responden menonjolkan kepentingan tiga pemboleh ubah pembangunan sumber manusia dalam prestasi kerja egen pengembangan seperti yang ditunjukkan oleh nilai $Adj.R^2$ sebanyak 57.5%. Kemahiran sosial dikenal pasti sebagai kemahiran yang paling menyumbang yang mempengaruhi prestasi kerja agen pengembangan. Kajian ini menyumbang kepada pemahaman yang lebih baik tentang hubungan pemindahan teknologi dan pembangunan sumber manusia dengan prestasi kerja kerana ianya benar benar penting untuk peningkatan yang bermakna dalam pengeluaran madu kelulut di Malaysia. Terdapat keperluan untuk membuat pelan pembangunan masa hadapan untuk meningkatkan kecekapan egen pengembangan di Jabatan Pertanian terutamanya dalam bidang pemindahan teknologi dan pembangunan sumber manusia. Institusi penyelidikan dan universiti harus memulakan lebih banyak penyelidikan dalam bidang teknologi lebah kelulut dan menyebarkan maklumat tersebut kepada petani.

Kata kunci: kelulut, peternak kelulut, egen pengembangan, keuntungan, pemindahan teknologi, pembangunan sumber manusia, Malaysia.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

GDP	Gross Domestic Product
FAO	Food and Agriculture Organization
DOA	Department of Agriculture
MARDI	Malaysian Agricultural Research and Development Institute
MBRDT	Malaysian Beekeeping Research and Development Team
ToT	Transfer of Technology
HRD	Human Resource Development

CHAPTER 1

INTRODUCTION

The study is aimed at determination, identification and correlate between Profitability of stingless beekeeping, Transfer of technology, Human resource development and the performance of extension agent in Peninsular Malaysia and Sarawak (East) Malaysia. The chapter consists of different sections that include background of the study, problem statement, objectives of the study, hypothesis, significance of study, research questions, scope of the study, and definition of terms.

1.1 Background of the Study

1.1.1 Agriculture in Malaysia

Agriculture is the gate way to the economic development of Malaysia; the country is the leading palm oil producer and the third largest exporter of natural rubber globally (Wong, 2007). Therefore, the country's economy is agriculturally based, hence indicated growth of 5.5% in 2003 within the agricultural sector, that followed by manufacturing, and services (Rahman, 2012). Malaysian government declared agricultural sector as third indices of growth in the country in 2004. Food self-sufficiency, food production, and exportation were the driving forces for most of the government's policy in the country (FAO, 2004).

Abdul Hamid, A.S (2006) revealed that contribution of 9% to the GDP was recorded from the agricultural sector, 4% on exports tax, 6% of export earnings, and the sector employed 13% of total labour force in 2005. Rice production was a major food crop enterprise; however, production of palm oil, rubber and coconut are the most preferred around Sarawak and Sabah, Peninsular Malaysia for all seasons, which account to 0.67 million hectares in the year 2001 (Ministry of Agriculture and Agro-Based Industry Malaysia , 2003). However, coconut, durian and rubber were found to make up large scale productivity for the country. Ministry of Agriculture and Agro-Based Industry, Department of Agriculture, Malaysia, (2003) reported that, in the year 2001, there were 3.63, 1.57, 0.15 and 0.12 million hectares of oil palm, rubber, coconut and durian respectively under cultivation in 2001. Together with paddy, these crops constituted 97% of the cultivated agricultural land in Malaysia. These crops were complements to beekeeping in providing pollen and nectar sources (Ismail, 2014). The two sub-agricultural sectors in Malaysia are industrial commodities and food commodities thus, industrial commodities include forestry and logging, palm oil, cocoa, and rubber and food commodities includes livestock, fisheries, vegetables, pepper, fruits, and tobacco. Chen, and Hasnah Mohd. Zain, (2006), reported that in 2005, food commodities represents about 16% of the total agricultural exportation in the country. However, the agricultural land usage accumulates about 12.5% for food commodities while palm oil plantation covers 63.4%.

According to Department of statistics, Malaysia (2018), selected Agricultural indicators in Malaysia 2017, are very clear, for example, in 2016, Agricultural sector contributed 8.1% or RM89.5 billion to the Gross Domestic Product (GDP). In the sector, oil palm was a major contributor to the GDP at 43.1%, followed by other agricultural products (19.5%), livestock (11.6%), fishing (11.5, forestry and logging (7.2%), and rubber (7.1). Moreso, in 2016, exports and import of agricultural sector amounted to RM115, 844 million and RM84, 673 million respectively with a balance of trade at RM31, 172 million. Exports and Imports increased by 5.4% and 0.9% respectively as compared to 2015. This is further subdivided into: Crop, livestock and fisheries sub-sectors. As with Crop sub-sector, the production of staple food namely paddy increased by 768.9 thousand tonnes or 28.2% in 2016 as compared to 2015. Similarly, the production of cocoa, beans and pepper also increase by 5.9% and 3.3%. Meanwhile, fresh fruits bunches (oil palm), natural rubber and kenaf (dried stem) showed declined. Similarly, with livestock sub-sector, the highest number of livestock was chicken at 305.06 million, an increase of 6.4%. The number of duck, goat, cattle and buffalo also increase while swine and sheep declined. Furthermore, as for fisheries sub-sector, the total marines landings in 2016 was 1,583.8 thousand tonnes as compared to 1,486.1 thousand tonnes in 2015, an increase of 6.6%. Meanwhile, the production of freshwater aquaculture decrease by 4.8% to 106.7 thousand tonnes and the production of brackish water aquaculture decreased by 2.7% to 383.7 thousand tonnes.

As with the employment opportunities, the number of employed persons in the agriculture sector was 1,609.9 thousand persons, a decrease of 8.2%. The number of non-citizens employed in the agricultural sector was 600.4 thousand persons, a decrease of 7.1% as compared to 2015. The percentage of males working in this sector was 76.9% in 2016 while the remaining was females (Department of statistics Malaysia, 2018).

Thus, the Malaysian government is trying to encourage production in the food sector for export and to develop and expand the market for agricultural produce and agro-based product globally in order to balance the trade, especially in agriculture by 2010. For that purpose, the third National Agricultural Policy (NAP3) was launched on 22 February 1999. In this policy, agriculture is recognized as the third engine of growth, after the manufacturing and service sectors and has been given more emphasis (Salleh, M. M., 2007).

However, 90% of the farmers in the food sector are smallholders with uneconomic-sized farms. The cost of production of these smallholders is high, with low yield and poor quality produce. Thus, the government launched several good agricultural practice (GAP) schemes in order to improve the quality of produce and income of farmers. These smallholders are the target for the GAP schemes (Mohamed Mohd. Salleh, 2007) and the mission statement of the Department of Agriculture currently includes provision of consultancy services to these small holders (Farrington, Christoplus, Kidd & Beckman, 2002), taking into cognizance the challenges and to

ensure that the new Agricultural Policy meets the guidelines of good agriculture. A GAP approach to agricultural practices involves the establishment of guidelines or standards for agricultural producers and post-farm handlers, the monitoring of these standard, and the communication of these standards through credible quality signals to downstream firms, consumers and the public in general (FAO, 2003). Normah Othman (2006) defined the Good Agriculture Practice as an integrated system to manage the harzards associated with the elements of land, input, processes and output of agricultural production to achieve productivity, quality and safe produce.

As the focus of this study is on Determination of Profitability of Stingless Beekeeping Production and the Beekeepers Perception on Extension Agents work performance through transfer of technology and human resource development (Developing capacity building and potentials among Stingless Beekeepers) or any new technology needs motivation and encouragement. A series of training throughout the country were held by the Department of Agriculture (DOA) to explain the nature and rationale for beekeeping program to farmers with emphasis on the benefits it brings.

According to Normah Othman (2006) The Department of Agriculture plays a lead role in the extension programme in Malaysia. In order to achieve the objective of the good Agriculture and rural development, one of the major parts of the extension programme is training the farmers or implementers. In essence, Agriculture remains an important sector in Malaysia. The agricultural sector still plays an important role as food providers, create employments and generate earnings from export products. The development of the agricultural sector is generally governed by a comprehensive and market driven agricultural policies. The formulation of agricultural policies has enabled the agricultural sector to grow and contributed to economic development in Malaysia. The agricultural policy set the direction for the agricultural sector, and as a result, this sector has been transformed from a conventional and passive sector that focused on single commodity to a dynamic, diversified and modern sector (Dardak, 2015).

Beekeeping is one of the significant area in the agricultural sector of Malaysia. For Malaysia a food security objective is translated into a self-sufficiency target at 65% under the Ninth Malaysia Plan (2006-2010) and 70% under Tenth Malaysia Plan (2011- 2015), Agro-Food Policy (2011-2020). The inclusion of honey as a new Agro-resource and service in RMK10 demonstrates the importance of beekeeping and its related activities in Malaysia's national agenda (Resnick and Mann, 2014). According to Ismail, (2014), Malaysian beekeeping industry is an important and integral component of the agricultural sector, providing additional income to farmers and indirectly producing food for the population through pollination services. The contribution of the beekeeping industry to regional development in Malaysia depends to a considerable extent on its competitive potential in terms of producing and marketing of bee products and by-products efficiently.

Beekeeping plays a major role in socio-economic development and environmental conservation in Malaysia. It is an important income generating activity especially for communities leaving close to the tropical forests and forest reserves (*Acacia* spp), and coastal areas where gelam and mangroves are found. Beekeeping also plays a major role in enhancing biodiversity and increasing crop production through pollination and beekeeping became source of healthy food, such as, royal jelly, honey, pollen and propolis, and some of the benefits of honey includes raw material to many industries such as beeswax, candles and lubricants (Ismail, 2014).

The industry is not something recent in Malaysia as many farmers and individuals have ventured into this lucrative project as early as in the 1980s. Already, the Malaysian Beekeeping Research and Development Team (MBRDT) is promoting the beekeeping industry in Malaysia since then. The industry can thrive well because Malaysia not only has abundant species of nectar and pollen sources, but it also has indigenous species of honey bees. The government of Malaysia has designated apiculture as one of the promoted agriculture projects that qualify for existing incentives and on a partial capital recovery program (MOA, 2005), the return on investment for beekeeping projects under the incentive scheme is higher than the independent project. With other incentives in the list, the potential investors could realize a good return from beekeeping projects. Generally, honey production enterprise attract the attention of a greater percentage of the populace these days because of its profitability and it is a viable complementary activity for rural people and requires very little investment and in addition, produces quick returns.

In terms of honey production in Malaysia, according to research conducted by Ismail, (2014) reported that there was insufficient production of natural in Malaysia, right from the year 2000 up to 2010, as compared to the level of consumption as indicated in Table 1.1. However, by the year 2010 and beyond, Malaysia experienced a significant increased on production level of local natural honey. In a similar findings Ismail and Ismail (2016) reported that there was an increase of natural honey production from 2011 to 2015 as shown in table 1.1, but it also showed a gradual increase in importation of honey from the period under review but the overall production level of natural honey was insufficient to meet up with domestic requirements of natural honey in Malaysia. They concluded that there is the need to continue to encourage more local production of natural honey to meet up with the domestic demand. Stingless beekeeping production has been found to be a profitable venture in Malaysia, therefore, boosting the output to a profitable level in stingless beekeeping production requires, among others, the effective and efficient services of extension agent through the dissemination of knowledge and skills in beekeeping production.

For the farmers to venture in beekeeping and operate a good production systems, the government assistance is vital. The Department of Agriculture (DOA) provides extension services to transfer new technologies to participants. The role of extension Agents is to ensure farmers follow the set standard operating procedure (SOP) in order

to maintain production. The farm SOP will set a good agriculture practices among participants, and hence, producing high-quality honey that are safe for consumption and fetches high market prices (Ismail, 2016).

1.1.2 Beekeeping

Beekeeping also known as Apiculture, is the acts or science and it is also referred as management of honey bees business to produce honey products for both export and domestic consumption and industrial use. The most important component in beekeeping industry is the bee as it referred to as the primary source of all the honey products. The four global honeybee species are namely: *Apis Mellifera, Apis dorsata, Apis cerana and Apis florae*. Merti, (2003) urged that *A. mellifera* are found *in* Europe and Africa, while the rest are natives of Asian continent. The honeybee *A.mellifera* is one of the most successful specie in animal's kingdom for its ability to adapt to wide range of climatic conditions and highly productive. Although they are vicious and aggressive bees, they are good producers (Matavele, 2007). Previous studies postulated that beekeeping activity provides benefits of employment among youths and adult, pollination of crops and conservation of biodiversity, (Didas, 2005). Beekeeping also generates income through hive products and renting bee colonies to pollinates crops (Gates, 2000). Ecological condition and floral composition, queen quality and resource management were found to be influencing profitability of beekeeping enterprises (de Jong 2000, Cobey 2001, Tucak, Periškić et al., 2004). Generally, honey production enterprise attracts the attention of a greater percentage of the populace these days because of its profitability. It is also a viable complementary activity for rural people which requires very little investment and in addition, produces quick returns, (Onyekuru, 2004).

Ayeni, (2003) pointed out that honey and beeswax are in high demand by households, hospitals, commercial outlays, pharmaceuticals and cosmetic industries as a good supplement, medicinal or complement in the production of other products. Honey can be used for treatment of wounds, burns, cataracts, skin ulcer and scabies. Honey production should be promoted as a component of integrated rural development approach and its effectiveness should be elevated with a well-organized extension service to act as a link between apiculture specialists and rural beekeepers (Onyekuru, 2004). The adoption of improved beekeeping technology by farmers as an aspect of agricultural enterprise is essential and critical to meet the culinary and industrial demands for bee honey and its products (Anyaegbunam, Emerole et al., 2006).

1.1.3 Beekeeping Industry in Malaysia

According to Ismail, (2014), Malaysian beekeeping industry is an important and integral component of the agricultural sector, providing additional income to farmers and indirectly producing food for the population through pollination services. The contribution of the beekeeping industry to regional development in Malaysia depends

to considerable extent on its competitive potential in terms of producing and marketing of bee products and by-products efficiently. Beekeeping plays a major role in socio-economic development and environmental conservation in Malaysia. It is an important income generating activity especially for communities leaving close to the tropical forests and forest reserves (*Acacia* spp), and coastal areas where gelam and mangroves are found. Beekeeping also plays a major role in enhancing biodiversity and increasing crop production through pollination (Ismail, 2014).

Malaysia is the epicentre of biodiversity for bees and honeybees of the world. Thousands of bee species, ranging from honeybee, carpenter bee, sweat bee, alkali bee, orchid bee to stingless bee, and also their natural enemies, are aplenty and thrive well in rainforest ecosystem. In the context of viable development, the rainforest assumes a critical or important role in carbon sequestration or global carbon sink in the Climate Change era. In that regard, we can consider that bees as important to the conservation of genetic biodiversity of the rainforest flora species (Mardan et al. 1988). The ecosystem of the rainforest is teeming and well-endowed with great diversity of flora-fauna interaction of species that it yields tremendous fractal niches and habitats that enable five (*A. dorsata, A. andreniformis, A. cerana, A. koschevnikovi,* and *A. nuluensis*) out of the eight the world's honeybee species to co-exist in the tropical rainforest of Malaysia (Mardan et al. 1988).

Natural Honey and other Bee By-products *(beeswax, propolis, royal jelly, etc)*

Surprisingly, Malaysia produces a paltry estimate of less than 5% (98mt /yr) of her honey needs in 2000 but the country manage to increase its self-sufficiency level to 284% producing a total of 8548 mt in 2010 (Table 1.1). This is a great achievement for the beekeeping industry and for Malaysia as a whole. The importing countries are mainly from the temperate countries, such as Australia, New Zealand, China, Iran, etc. In industry, honey is mainly used as ingredients or sweetener or additives in the confectionary, bakery, medicinal and pharmaceutical industries. Tropical honeys are by nature to contain high moisture (even up to 23%) and HMF contents (Hydroxymethylfufuraldehyde), which can easily turns dark when exposed to sunlight and easily ferments. Apart from honey, there are other bee by-products and bee related services, such as, beeswax, propolis, royal jelly, pollination services, beverages, etc. which are associated with the beekeeping and honey hunting industries.

The pollination services from honeybees in the USA is estimated to worth more than USD $ 200 billion annually and it worth more than the honey production. No estimates are available for Malaysia. The orchid industry is worth less than RM 50 million/yr to Malaysia but more than RM 300 million to Singapore. However, the beekeeping industry will complement well with the fruit and vegetable industries in Malaysia (Ismail, 2014). Beekeeping became source of healthy food, such as, royal jelly, honey, pollen and propolis, and some of the benefits of honey includes raw material to many industries such as beeswax, candles and lubricants, It also act as a source of medicine like bee venom, beeswax, propolis and honey (Gill, 1996) .

The honeybee colonies are either hunted or kept or raised in boxes mainly for natural honey. There have been established, deep traditions and cultural relics associated with the honey hunting tradition practised by the Malays in harvesting *Tualang* honey from the colonies of Giant honeybees (*A. dorsata*) from bee trees in the tropical rainforest, as evidenced from their beliefs, folklores and legends, mantra and incantations being practised by the honey hunters (Mardan *et al.* 1988). This traditional art is deemed to be viable in its practice, but this traditional activity is under threat due to deforestations of the rainforest. Honey and beeswax are considered as the major by-product potentials to be derived from honey hunting activities. Tourism activities (nature tourism) can be package with honey expeditions to bring additional values to the honey hunting activity. Honey from the rainforest can be best promoted as organic honey by virtue of the non-chemicals being found or used during harvesting in the rainforest. Promoting honey hunting will secure the rainforest biodiversity in that bees promote genetic and biodiversity conservation through the cross-pollinating activities of the bees (Ismail, 2014).

Outside the rainforest areas, modern beekeeping with *A. cerana* and the introduced *A. mellifera* are currently being employed by beekeepers and farmers in the coconut, pineapple and star fruit holdings in the fruit areas. The lack of development of the orchard industry is equally linked to the non-growing beekeeping industry which consequently affects the pollination services by the industry. Introduction of the genetically-bred and improved *A. mellifera* honeybees into the Malaysian agriculture serves well to the development of the beekeeping industry because the species is docile and the associated technologies are easily available to any entrepreneur to begin with. However, *A. mellifera* is susceptible to major pestilence from the indigenous natural enemies, such as, mites (*Varrao jacobsoni*) and several bee eaters (*Merops* spp). The use of chemicals to control the mites have become a major contentious trade issue of honey to be exported into Europe and the US, and hence rendering the honey product to become non-organic and subject to meet *HACCP* compliance for food health. It is a monumental task to comply for *A. mellifera* honey for public consumption in importing countries (Ismail and Mardan, 2010).

The industry is not something recent in Malaysia as many farmers and individuals have ventured into this lucrative project as early as in the 1980s. Already, the Malaysian Beekeeping Research and Development Team (MBRDT) is promoting the beekeeping industry in Malaysia since then. The industry can thrive well because Malaysia not only has abundant species of nectar and pollen sources, but it also has indigenous species of honey bees. Colonies of indigenous species (*Apis cerana, Apis dorsata* and *Apis florea*) multiply abundantly in Malaysia, and can easily be found in coconut kilns and dwellings. The fact that they are there and can readily hived into boxes without any cost make the industry more favourable (Ismail, 2014). In terms of production, most of the honey produced in Malaysia is from Perak, Johor, Selangor, Melaka, Sabah and Sarawak and the bees are from the species of *Apis cerana* (the local bees) and, recently from *Apis mellifera* (the imported bees). The annual yield from local bees is about 5-9 kg per colony and the imported bees is expected to produce up to 15 kg per colony, the country imported honey from the temperate

countries, mainly from Australia, New Zealand, China, Iran, etc and more importantly, beekeepers prefer to sell their honey from home, that is, direct selling because by doing so they can ensure the honey quality. (Ismail, 2014).

In order to promote the industry, the government has designated apiculture as one of the promoted agriculture projects that qualify for existing incentives. Based on a partial capital recovery program (MOA, 2005), the return on investment for beekeeping projects under the incentive scheme is higher than the independent project. With other incentives in the list, the potential investors could realize a good return from beekeeping projects. The return here was based on selling honey only. If other benefits such as pollination services, bee venom and bees wax were included, the returns would have been even greater. In order to promote beekeeping projects in pineapple and other smallholdings, the government should provide specific incentives targeting participants, especially smallholder pineapple farmers and potential investors in other plantations (Ismail, 2014). The Malaysian government has supported Beekeeping enterprise through seven ministries right from developing appropriate technologies and its delivery, advisory services (developing capacity building and potentials of the beekeepers), Good farm management aspects, Trade and marketing, food safety and better use and conservation of natural resources. Government supports towards encouraging and development of beekeeping Industry in Malaysia is a step in the direction and seven ministries involved are as follows:

- Ministry of Agriculture & Agro based Industry - Department of Agriculture, MARDI, and FAMA.
- Ministry of Technology & Innovation - SIRIM, INSTITUT GENOM MALAYSIA, Nuklear Malaysia.
- Ministry of High Education – USM, UPM, UTM, UMP, UTHM, UMK, UiTM, UKM, UMK
- Ministry of Domestic Trade Cooperatives & Consumerism, KPDNKK – MKM, Enforcement Division,
- Ministry of Health – Food safety and Quality Division- Food Act 1983 Food Rule 1985
- Ministry of Rural & Regional Development – RISDA, FELCRA, FELDA, JAKAO, KETENGAH
- Ministry of Natural Resources & Environment – Department of forestry.

All these parastatals are geared towards the development and enhancement of beekeeping industry in Malaysia. The supports from the seven ministries was to assists in research and development of beekeeping industry in Malaysia through transferring appropriate technologies and developing capacity and potentials of stingless bee farmers to improve the production level of natural honey (Mian, 2018).

However, the production of natural honey in Malaysia is insufficient to cater for domestic requirements. The balance of trade for natural honey is always negative until

2008. In 2009 the country recorded its first trade surplus in natural honey. The declining exports and the increasing imports from the period 2000 to 2009 reflects increased in consumption of natural honey and thus, reflecting insufficient local supply to meet the domestic demand for natural honey; therefore, the need to increase local production to meet up the domestic demand is paramount (Ismail,2014). The research conducted by Ismail, (2014) reported that there was insufficient production of natural in Malaysia, right from the year 2000 up to 2010, as compared to the level of consumption as indicated in Table 1.1. However, by the year 2010 and beyond, Malaysia experienced a significant increased on production level of local natural honey. Still one would argue that the production is not enough to cater for domestic demand.

In a similar findings, Ismail and Ismail (2016) reported that there was an increase of natural honey production from 2011 to 2015 as shown in Table 1.1, but it also showed a gradual increase in importation of honey from the period under review, but the overall production level was insufficient to meet up with domestic requirements of natural honey in Malaysia. They concluded that there is the need to continue to encourage local production of natural honey to meet up with the domestic demand. Furthermore, Comtrade data of the United Nations (2016) reported Export and Import of honey in Malaysia for a period of 2000 to 2015 as indicated in Table 1.2. In the year 2000, Malaysia exported 108.53mt of honey with a Trade value of US$212.39. This is significant. In the same year 2000, Malaysia imported 2,292.38mt with Trade value of US$ 3,641.29. However, in 2010, the country manage to increase its production level to 13,453.57mt with Trade value US$14,445.94 as shown in Table 1.2. This is significant and a great achievement for beekeeping industry and for Malaysia as a whole. This implies that, with increasing total trade and the domestic demand, the production of natural honey can contribute to the improvement of the country food trade balance. Therefore, from the foregoing, one would argue that the production level of natural honey was inadequate to cater for domestic demand/requirements of Malaysia and therefore, there is the need to continue to encourage and develop production of natural honey to cater for the increasing demand for the country.

Table 1.1: Total Natural Honey Produced and Consumed in Malaysia, 2000-2015

Year	Production (metric ton)	Export Quantity (metric ton)	Import Quantity (metric ton)	Quantity Consumed (metric ton)
2000	98	109	2294	2283
2001	60	20	1940	1981
2002	60	1338	2432	1153
2003	60	3829	4940	1135
2004	60	322	2319	2057
2005	60	83	2194	2172
2006	63	239	2483	2307
2007	90	2182	4927	2835
2008	1228	4969	6749	3008
2009	2120	7383	8233	2970
2010	8548	13452	7915	3011
2011	9403	2509	3,160	10,054
2012	10343	1579	2,207	10,971
2013	11377	696	1,784	12,465
2014	12515	802	3,157	14,870
2015	13767	3521	4,913	15,159

Source: Ismail, (2014) and Ismail and Ismail, (2016)

Similarly, according to Comtrade report, which indicates exports and imports values of natural honey in Malaysia from 2000 – 2015, the production was inadequate to cater for domestic demand/requirements of Malaysia, therefore, call for increase in the level of honey production to meet the demand of the product in Malaysia.

Table 1.2: Value of Exports and Imports, and Balance of Trade of Natural Honey in Malaysia. (US$'000) 2000-2015

	Export		Import		Balance of Trade	
Year	Quantity (Ton)	Trade value (US$ '000)	Quantity (Ton)	Trade value (US$ '000)	Quantity (Ton)	Trade value (US$ '000)
2000	108.53	212.39	2,292.38	3,641.29	2,183.85	3,428.90
2001	20.35	50.82	1,956.55	3,287.88	1,936.20	3,237.06
2002	1,338.37	1,382.03	2,421.08	4,252.87	1,082.71	2,870.84
2003	3,828.74	4,689.61	4,902.15	6,382.70	1,073.41	1,693.09
2004	321.69	638.51	2,318.58	4,647.05	1,996.89	4,008.54
2005	88.44	213.23	2,167.35	4,058.36	2,078.91	3,845.13
2006	238.72	486.03	2,482.82	4,246.53	2,244.10	3,760.50
2007	2,263.40	3,387.17	4,935.51	6,781.79	2,672.11	3,394.62
2008	4,572.63	7,223.92	6,744.85	8,016.33	2,172.22	792.41
2009	7,382.46	10,826.25	8,232.90	9,340.22	850.44	(1,486.03)
2010	13,453.57	14,445.94	7,913.57	9,491.50	(5,540.00)	(4,954.44)
2011	2,508.56	6,934.71	3,159.62	13,672.35	651.06	6,737.64
2012	1,578.91	4,946.04	2,207.09	14,319.65	628.18	9,373.61
2013	696.28	2,293.02	1,783.79	11,562.52	1,087.51	9,279.50
2014	801.88	3,199.47	3,156.85	11,810.79	2,354.97	8,611,32
2015	3,521.27	5,592.28	4,913.35	14,022.56	1,392.08	8,430.28

Source:(United Nations, 2016)

Some of the challenges of beekeeping industry include among other things, susceptibility of *A. mellifera* to major pestilence from the indigenous natural enemies, such as, mites (*Varrao jacobsoni*) and several bee eaters (*Merops* spp). Similarly, the use of chemicals to control the mites have become a major contentious trade issue of honey to be exported into Europe and the US, and hence rendering the honey product to become non-organic and subject to meet *HACCP* compliance for food health. For *A. mellifera* honey, compliance to the best practices for public consumption in importing countries is a monumental task (Ismail and Mardan, 2010). Furthermore, others include insufficient knowledge in proper bee management; Low-use of beneficial technology applications; inadequate support in terms of knowledge-transfer from local research bodies to maintain the industry (Resnick and Mann, 2014). Morever, Malaysian beekeepers are faced with myriads of challenges including the absence of an umbrella body i.e. cooperatives to do business with ease, such as purchase of inputs; insufficient organised marketing outlets; inadequate research on new products and better quality products. Inadequate information on Contract farming and contract marketing, good promotion, location, pricing and the traditional activity of beekeeping is under threat due to deforestations of the rainforest, are among some of the challenges facing the stingless beekeepers presently.

1.1.4 Meliponiculture or Stingless Beekeeping in Malaysia

The huge amount of imports suggests that local demand for honey is increasing. Since Apis spp. cannot fulfil the local demand, in 2004/2005 stingless beekeeping was introduced in Malaysia (Ismail 2014). Stingless bee beekeeping is known as meliponiculture. This activity, which is generally undertaken by traditional communities, has local characteristics according to regional and traditional knowledge. In Australia, interest in the production and marketing of Australian honey is expanding. Although the total annual honey production in Australia is currently small (i.e., with probably less than 100kg), there is potential for rapid growth. At present, the market wholesale price of honey is about AU $50 per kg (Kelly, et al., 2014). In Asia, stingless bee beekeeping for pollination purpose is only beginning to take root in southern Asia, India and in SE Asia including Malaysia, Indonesia, Thailand and the Philippines (Cortopassi-Laurino et al. 2006).

Stingless bee farming has a high growth potential booming industry in Malaysia especially in the state of Kelantan, which commercialized three types of stingless bee products, namely honey, bee bread and propolis. The current market price for stingless bee honey is RM35 per 300g, RM30 for 200g of bee bread and RM25 for 10ml of propolis, depending upon consumers' demands. At the moment, however, the stingless bee species of economic value and its external nest characteristics in Malaysia remain unexplored (Kelly, et al. 2014).

Prior to the introduction of stingless bee, local beekeepers already reared Apis spp. such as A. cerana and A. mellifera for beekeeping activities. The problems of rearing A. cerana and A. mellifera prompted the industry to search for new species, that is,

Heterotrigona species (Ismail, 2016). The research and development on the technical, financial and economic aspects of commercializing Heterotrigona species needed in order to promote the project to potential beekeepers in Malaysia. Through research and development, apiaries in Malaysia have room for improvement which can lead to a higher yields and to a viable industry. There are about 50 species of stingless bees in Malaysia. While addressing technical problems like better breed and queen rearing and on a longer term objective, selections of new species like Heterotrigona species need to be done to obtain good colony such as pest tolerant strains (Ismail 2016).

The five common species were Trigona (Geniotrigona) thoracica, Trigona (Heterotrigona) itama, Trigona (Lepidotrigona) terminata, Trigona (Lisotrigona) scintillans and Trigona (Tetragonula) laeviceps. In particular, T. itama were highly preferred by bee farmers and this species contributed 83.2% of the total colonies in the Malaysian farms. Bee farmers extracted wild colonies nesting in the tree trunks before they transferred the colony into a bee box and subsequently sold (Kelly, et al. 2014).

A similar study conducted by Ab Hamid, S., Salleh, et al (2016) found out that the Balik Pulau (forest) had the most diverse stingless bee species (5 species) compared to other selected sites. They also found that there were significant difference for H. itama body length and appendages between samples collected from urban and forest areas. The result revealed that H. itama in forest areas have larger body size compared to those in the urban area and they also found the stingless bees in urban areas was less diverse compared to forest area.

Each species of the stingless bees has specific nest requirements according to their sizes, population and habitat quality (Fonseca, 2012). Thus, the tree trunks represent the preferences of the species towards specific nesting site. It was recorded that *T. thoracica* and *T. laeviceps* preferred tree trunk circumferences ranging from 82 cm to 129 cm, whereas *T. itama* and *T. terminata* preferred tree trunk circumferences ranging between 71 cm and to 164 cm. Majority of the tree trunks are of rubber trees with a few forest hardwood trees; extraction of the wild colonies requires experience and a good estimation of the location of the brood within the tree trunks to avoid damages to the brood (Kelly, et al. 2014). The purpose of the nest entrances are related to defense, foraging (Biesmeijer, et al. 2005) and physio-chemical regulation (Roubik 2006). Meliponiculture in Malaysia is limited to two species of stingless bees, namely *T. itama* and *T. thoracica* (Kelly, et al. 2014).

Morever, 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 all wall cavities, old rubbish bins, water meters and storage drums. They are widely distributed in the tropical and temperate regions of the world (Roubik, 2006). The bees existed in all regions of Malaysia. Moreover, there are about 700 species that have been recorded worldwide. According to 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, Roubik (2016) stated that the species of T. itama becomes a common species of stingless bees in Malaysia.

In terms of the total population of stingless bees in Malaysia, the official lists of stingless beekeepers are about 717 farms (Table 1.3). This population was obtained by the Department of Agriculture, Minister of Agriculture and Agro-based Industry Malaysia (2017). Most of the beekeepers are young agro entrepreneurs and they are associated with the government project in promoting stingless bees in Malaysia. Majority are found in the state of Terengganu, constituting about 194 farms and followed by Kelantan, Pahang and Kedah. Indeed, there are some existing beekeepers in Sabah area. Nevertheless, the Sabah farms are not yet officially listed by the Department of Agriculture in Malaysia. Furthermore, the number of colonies hives of stingless bee in Malaysia has reached up to 58,293 colonies and this number will be gradually increased since government are still attempting to enlarge the stingless beekeepers in Malaysia as shown in Table 1.3.

Table 1.3: Showing Meliponiculture (Stingless Beekeeper Population) in Malaysia

	Meliponiculture				
No	States	No. Farm	No. Colony	Honey (Kg)	Honey (RM)
1	Perlis	8	420	175.60	45,500.00
2	Kedah	79	6,821	15,504.80	2,723,080.00
3	P. Pinang	22	285	-	-
4	Perak	34	2,217	2,409.00	355,115.00
5	Selangor	47	1,860	2,141.18	425,507.00
6	N. Sembilan	6	2,640	3,067.20	484,020.00
7	Melaka	17	1,571	1,624.03	252,217.00
8	Johor	36	5,254	19,157.40	285,400.00
9	Pahang	88	4,704	4,717.70	571,109.00
10	Terengganu	194	5,992	8,455.00	1,745,278.00
11	Kelantan	115	8,247	12,731.00	2,030,586.00
12	Labuan	5	984	2,118.00	178,800.00
13	Sabah	-	-	-	-
14	Sarawak	66	17,298	66,479.80	7,891,696.00
Total Farm		717	58,293	138,580.71	16,988,308.00

Note: There are some existing stingless beekeepers in Sabah. However, the farms are not yet officially listed from the Department of Agriculture Malaysia.
Source: Department of Agriculture, Minister of Agriculture and Agro-Based Industry Malaysia (2017).

Similarly, according to Resnick, and Mann, (2014), Meliponiculture is a potential source of income revenue that is readily accessible to the majority of the Malay population irrespective of regional factors or income levels. Another attractive feature of meliponiculture is that the meliponine bees are ‘stingless’. Unlike the situation in

keeping the European Honeybee, beekeepers need not purchase expensive, protective clothing in order to manage and handle hives or to harvest and collect products (honey, propolis, and beebread) with Melipona. Thus, meliponiculture can be viewed as both a compliment and advancement of the honey bee industry (Apiculture) in Malaysia. Malaysia has about 33 species of stingless bee, several of which could be domesticated for honey, propolis and other bee bread production. This activity could be exploited and enjoyed by the vast majority of the population leading to creation of infrastructure, new jobs, new products, increased tax revenue, and a dramatic increase in educational and cultural levels in Malaysia (Resnick and Mann, 2014). The demand for natural honey from Trigona species is very high. The ongoing researches and clinical tests at the USM Kubang Kerian and UITM Puncak Alam have shown positive results for Trigona honey to cure serious illnesses like cancer (Ismail, 2014).

Moreso, in Malaysia at this time, small and commercial beekeeping continues to garner interest among the people with this being directly attributable to the longstanding desire for honey and related consumable products. Factors that present problematic and recalcitrant as setbacks that hamper advancement of the beekeeping industry in Malaysia are as follows: Insufficient knowledge in proper bee management; Low-use of beneficial technology applications; Inadequate support in terms of knowledge-transfer from local research bodies to main the industry (Resnick and Mann, 2014). Despite these issues there is much interest in the native, Malaysian stingless bee (Apis Trigona, in the same family as the European Honeybee) by many locals who reside in the more rural regions of the Malay countryside. Interestingly, even though meliponiculture, or stingless bee rearing is quite new and just started to be embraced by the locals, it is rapidly advancing in both curiosity and consideration as a potentially-viable source of secondary income streams. Perhaps this is due to the unique character and nature of the melopine bee hive, which, in Nature, occurs in the trunk of a diseased tree (tree-trunk) and is easily accessible by persons with fewer disposable resources or funds used to culture other bee species requiring specially-built, expensive bee hives. Thus, meliponiculture could result in advancements in Socio-economic status for many stakeholders (Resnick and Mann, 2014).

Abd Razak, et al., (2017) asserted that many people have ventured into stingless beekeeping because it does not sting, easy to manage, the honey and other products are high in medicinal values/properties and command higher price (than Apis honey). Morever, flavonoid content (proximate analysis) have revealed a very interesting findings: Flavonoid content (antioxidant) in propolis of two stingless bee species i.e. Heterotrigona itama and Geniotrigona thoracica is 200 and 80 time higher as compared to the other 20 species of stingless bees. Furthermore, an average stingless bee honey retail price RM250-300/kg (57 – 70 USD/kg) and also, an average stingless bee honey yield in kg. Jabi, Terengganu (9kg/m/yr – RM1812.40/417 usd/m).

Morever, according to Resnick and Mann, (2014), in Malaysia, research in honeybee farming has been carried out sparsely. In review of the literature published documents were found, yet few directed to study of the meliponine (stingless bee) species. The

potential benefit from Api-Meliponiculture (honey bee and stingless bee) can be tapped if a concerted effort is moved toward developing a viable approach to beekeeping in Malaysia. Several ways in which this could be accomplished is through attainment of a proper understanding of the meliponine life cycle, development of bee calendar, discovery of new ways to increase honey yield improvement and through better bee management, including sanitary practices. Secondary benefits from bee products, proteomic and genomic studies to support the taxonomy of stingless bee, selected environment as well as control of pests and diseases could be gained. A non-destructive approach in breeding, propagating and relocating of bees using pheromone technology will ensure environmental safety.

For Malaysia, food security objective is translated into a self-sufficiency target at 65% under the Ninth Malaysia Plan (2006-2010) and 70% under Tenth Malaysia Plan (2011- 2015), Agro-Food Policy (2011-2020). The inclusion of honey as a new Agro-resource and service in RMK10 indicates the importance of beekeeping and its related activities in Malaysia's national agenda. In view of the healthy and robust condition of feral bee populations in Malaysia, it is anticipated that availability of plentiful supplies of natural propolis will be available throughout Malaysia for many years to come. Furthermore, it is anticipated that through establishment of new and better beekeeping practices, as well as educational programs, the beekeeping industry and underlying infrastructure in Malaysia will lead to creation of many new products requiring employment of skilled, semi-skilled and highly-skilled workers and thousands of new jobs (Resnick and Mann, 2014).

According to the Malaysian Industrial Development Authority (2006), enterprise firm with paid up capital of RM 2.5 million charge tax obligation from 18 to 25%. However, the government introduced several tax policies in order to promote investment in sectors with high growth potential such as manufacturing, tourism, environmental activities and agriculture. The predominant incentives for the agricultural sectors are generally offered to the schemes as Pioneer Status (PS), Investment Tax Allowance (ITA). Pioneer status where a company enjoys a partial exemption from income tax. A company pays tax on 30% of statutory income only for five years, commencing from its production day (defined as the day of first sale of products); however, there also exist many agricultural activities including processing that are tax free and an investment tax allowance (ITA); a farm granted an Investment Tax Allowance (ITA) is eligible for an allowance of up to 70% of its qualifying capital expenditure incurred within five years from the date on which the first qualifying capital expenditure is incurred. In addition, besides Pioneer Status and Investment Capital Allowance, the Malaysian government also offers Accelerated Capital Allowance (ACA), which is related to a different procedure that provides an initial allowance of 60% in the first year and about 20% for annual allowance. Normally, the Accelerated Capital Allowance (ACA) recommends the conjoined package between Pioneer Status with Accelerated Capital Allowance of Investment Tax Allowance with Accelerated Capital Allowance to maximise proper profit for agricultural companies, especially the small and medium enterprises. The implementation of government tax incentives in this study was applied simultaneously on the capital budgeting

calculation. The body calculation of capital budgeting includes income/revenues, fixed-variable and depreciation costs, earning before tax, earning after tax, net profit, and cash flow.

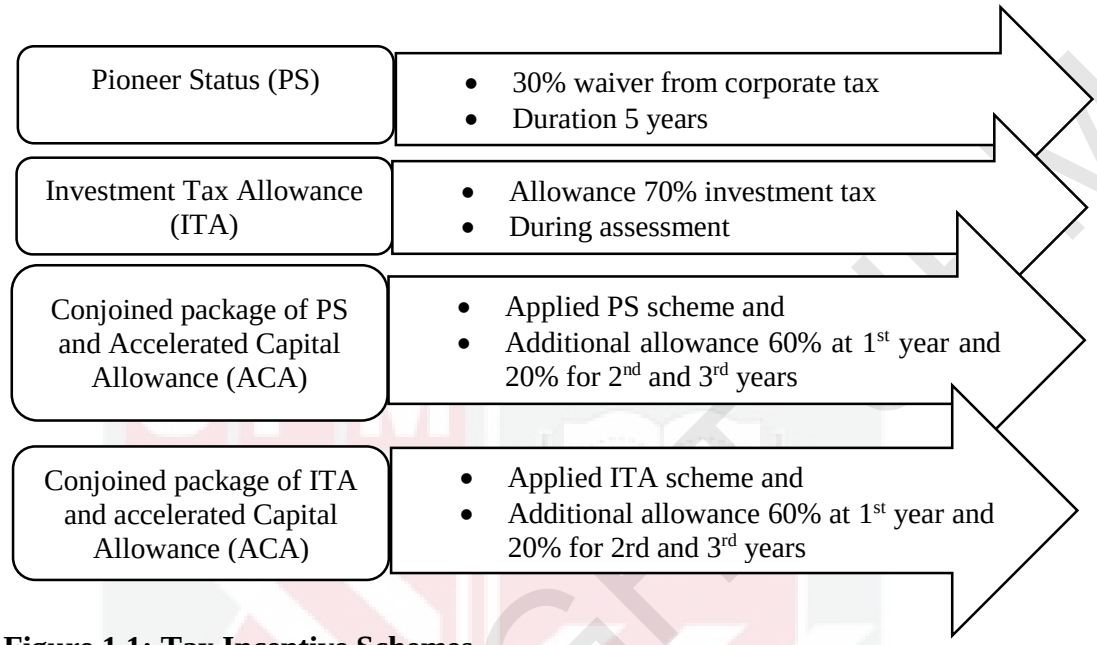

Figure 1.1: Tax Incentive Schemes.
(Source: The Malaysian Industrial Development Authority (2006).

1.1.5 Historical Development of Beekeeping in Malaysia

Hassan and Omar, (2003) predated Beekeeping in Malaysia right from Malacca sultanate which is believed to have been practiced for a long time. The locals who are the honey hunters collected the natural honey directly from hives of wild bees. (Apis dorsata), which have its nest on Tualang tree in the deep forest (Mardan, 1988). Thus the honey name 'Tualang honey', harvesting took place in the middle of the night, where special ceremony was performed using traditional apparatus including a bamboo ladder, a cow-bone knife and a cow-skin container (Mardan and Ismail, 1988, Mardan, 2008, FINAS & Discovery Networks Asia-Pacific, 2014). Honey collection is done when it is available, with no specific method, such as in Terengganu (Ismail, 2008).

1.1.6 The Importance of Beekeeping in Malaysia

1.1.6.1 Bees and the Ecosystem

The beekeeping industry has great prospects to be expanded, but except for honey production, other opportunities are seldom recognised. The major function of bees is for pollination to conserve the ecosystem. A recent tragic issue was the death of a two-

month-pregnant tigress that was struck on the road due to the disturbance of its ecosystem (Harian, 2016). The natives found stingless bee from the deep forest suddenly appeared around the forest (Samejima, et al., 2004, Brown and de Oliveira, 2014).

Bees and ecosystem are interconnected through pollination of trees and shrubs in biodiversity. It is common practice for the farmers to protect the forest where beekeeping is practiced, especially the tall trees preferred by the bees. This accelerates the regeneration of trees and the conservation of the forest's biodiversity (Heard, 1999, Liow, et al., 2001). Other herbivorous animals like bats, birds, monkeys and bears are also connected with bees through food production, via bee-pollination; and the bee itself. Thus, bees and trees are interdependent, and many species of plants and animals would not survive if bees were removed from the ecosystem. Separate studies conducted by Prof. Dato' Dr. Makhdzir Mardan and Prof. Dr. Ruth Kiew and their team showed that *A. dorsata* plays a major role in supporting the forest at Pedu Lake, Kedah, and also in pollination activities for various plants (Kiew and Muid, 1991)

1.1.6.2 Bees and Food Security

Food security is a critical issue globally, hence in Malaysia approximately RM13 billion per year is expended in importation of food (United Nations, 2002; Ismail, 2014). Ismail, (2008b) reported that the BOT for honey was negative from 2005 to 2008 due to Colony Collapse Disorder (CCD) problem mentioned earlier. DOA and MARDI reveal in their findings that coconut and pineapple productions were increased after bee pollination was introduced to the farms (Mian, 2009, Jaafar, 2011a, Department of Agriculture, 2012). The employed bee-pollinator approach on all farms in Malaysia increased domestic agricultural productivity and reduced dependency on imported foods, that increased country's GDP. The approach was established and accepted globally and practiced widely in US, Australia and New Zealand (Abrol, 1993, Robertson, et al., 1999, Kato and Kawakita, 2004, Rader, et al., 2009, Klatt, et al., 2014).

1.1.6.3 Bees and the Economy

Few areas that have been identified for beekeeping as a source of income generation to national economy are:

1.1.6.4 Tropical Rain Forest of Peninsular Malaysia

Diversity of floras in tropical rain forest stand as valuable natural resource to be preserved. However, conservation and maintaining of rain forest involve huge expenses and require the cooperation of different authorities. Thus, effective approaches such as conservation through bee pollination is very vital (Härtel and

Steffan-Dewenter, 2014). The state of Sarawak in Malaysia implemented such method that proven successful in rainforest zone of the state (Momose, et al., 1998, Roubik, et al., 2005).

1.1.6.5 Agriculture Sector of Peninsular Malaysia

Natural pollinating agent as bee can be manipulated in large scale in agricultural sector. Bees can readily locate with abundant nectar and pollen sources as food, farmers provided sufficient pollinating services to a large scale farms so as to increase yield as observed on a pineapple farm in Johor, and was monitored by the DOA (Mian, 2009, Department of Agriculture, 2012). Similar practice was implemented and reported successful in an apiary from Besut, Terengganu, Malaysia (Azmi, et al., 2015).

1.1.6.6 Side Income in Peninsular Malaysia

"Honey is money." This adage referred to a single by-product of beekeeping that influences income but many other by-products, such as propolis, bee pollen, beebread, beeswax, royal jelly, and bee venom were driven from the business. These can either be marketed raw or in a different package or brand. Hitherto, honey was sold as fresh, raw produce, or hydrated for long term use (Ismail, 2016).

Different plant sources of nectar such as Gelam, pineapple, mango, coconut or Kelulut gives different content of honey. Bee pollen, beebread and royal jelly can also be consumed fresh and raw which has medicinal value. Propolis and bee venom used as antibacterial agents while Beeswax was used as an ingredient of soap making, lotion and candles. Honey bee by-products and hives can be turn to 'downstream' products that can be used in baking, confectionery, nutraceuticals, health and body care, cosmetics, and for household uses (Crane, 2009). Beekeeping also offered stocks of queen bees, larvae, and beekeeping apparatus for a successful and viable honey bee farming. A plant nursery may be developed to supply plants for nectar and pollen sources for the bees.

1.1.6.7 Medicinal Value of Honey

Most people preferred honey as either food or natural sweetener, or as energy booster (Bogdanov 2014). In Malaysia, honey was regarded as medicine for curative purposes of different ailments (Ismail, 2014, Sulaiman, 2014). Thus, it consumption was considered low compared to other countries such as the US, the UK and other European countries. Though, local supply was insufficient to meet the local demand in the country hence daily consumption was in the increase.

The known medicinal value of honey include dressing for healing wounds, and contains antimicrobial agents and strong antioxidant properties, it is also potent enough to treat obesity, diabetes and cancers (Bogdanov, 2014). Other honeybee by-products that includes propolis, bee pollen, beebread, royal jelly and bee venom have specific medicinal characteristics and are valued as anti-inflammatory agents, a source of nutrition, and for increasing male and female fertility. Thus, they maintain human health (Ürünlerinin, 2012).

1.2 Organization of the Thesis

The thesis is organise into five chapters. Chapter one deals with the Background of the study, Problem statement, Objectives of the study, Research questions and Significance of the study Chapter two presents the literature review on Profitability and concept of profitability. The chapter also discusses the concept of Agricultural extension, role of extension agents, Goals of extension and extension policy, work performance and concept of work performance of extension agent. It also features extension in relation to Transfer of Technology and Human resource development and competency model. Finally, it also captured capital budgeting techniques, Investment appraisal techniques, cash flow estimation, discount rate, and sensitivity analysis.

Chapter three outline the methodology employed for the study. It also covers research framework, population of the study. It also outline the data and sampling method/techniques employed and information about the study area. Methods of data analysis used include capital budgeting techniques, descriptive and economic analysis, and correlation and regression analysis. Chapter four presents the results and discussions with respect to each objective, descriptive of socioeconomic characteristics of the respondents. It also present the financial analysis of beekeeping as well as correlation and regression analysis were used. Finally, chapter five presents summary, conclusion and recommendation of the study.

1.3 Problem Statement

Malaysia is largely covered with forest having indigenous honeybees' species and plenty of nectar and pollen sources, there is high propensity for beekeeping to prosper rapidly since the demand for local natural honey is more than the supply in the country (Ismail, 2014). However, insufficient production of local natural honey has been reported in a research conducted by Ismail (2014) where he revealed production trends of natural honey in Malaysia, indicating inadequate local production right from the years 2000 to 2008 compared to the level of consumption as indicated in Table 1.1. The balance of trade for natural honey is always negative until 2008 and in 2009 the country recorded its first trade surplus in natural honey. The declining exports and the increasing imports from year 2000 to 2009 reflects increased domestic consumption of natural honey, thus reflecting insufficient local supply to meet the domestic demand for natural honey. Surprisingly, Malaysia produces less than 5% (98mt/year) of natural

honey in 2000 but the country boosts its production level to 284% by producing a total of 8548mt in 2010. This is significant and a great achievement for the beekeeping industry and for Malaysia as a whole. In addition, Table 1.1 also indicated that there is gradual increase in importation of honey in Malaysia specifically from year 2007 to 2010 with 4,927mt to 8,233mt.

Therefore, profitability of beekeeping production does not have a direct relationship with agricultural extension, the relationship is indirect. Profitability is defined as the ability of a given investment to earn a return from its use or Profitability referred to as ability to make gains from business activities of a particular organization, company, firm, or an enterprise. On the other hand, Extension is a non-formal educational function that applies to any institution that disseminates information with the intention of upgrading knowledge, attitudes, skills and aspirations of the farmers which bring an increase in farm productions and result in higher farm income and improve living standard. Extension lead to increase in production level of the farm. This increased in farm production result in improved farm income when sold. The higher the farm produce and the demand for it, the higher the income and the higher the profit realised.

Similarly, Ismail and Ismail (2016) reported that there is a gradual increase in production of natural honey in Malaysia from 2011 to 2015 compared with consumption level which continue to rise especially between 2013 and 2015 with 15, 159mt. Still, one would argue that the production level is not enough to cater for domestic demand. Furthermore, Comtrade data of the United Nations (2016) reported Export and Import of honey in Malaysia for a period of 2000 to 2015 as indicated in Table 1.2. In the year 2000, Malaysia exported 108.53mt of honey with a Trade value of US$212.39. This is significant. In the same year, Malaysia imported 2,292.38mt with Trade value of US$ 3,641.29. However, in the 2010, the country manage to increase its production level to 13,453.57mt with Trade value US$14,445.94 as shown in Table 1.2. This is a significant achievement for beekeeping industry and for Malaysia as a whole.

However, the production of natural honey in Malaysia is still not insufficient to cater for the needed domestic consumption. The balance of trade for natural honey is always negative until 2008. In 2009 the country recorded its first trade surplus in natural honey. Ismail (2014) reported that there is decline in exports and the increase in imports from the period of year 2000 to 2009 and reflects increased in consumption of natural honey, leading to insufficiency in local supply to meet the domestic demand for natural honey. Therefore, there is need to increase local production to meet up with the domestic demand (Table 1.1). In Malaysia at this time, small and commercial beekeeping continues to receive interest from the peoples and this is attributed to longstanding desire for honey and related consumable products. Some of the reported factors that serves as setbacks towards the advancement of beekeeping industry in Malaysia are as follows: Insufficient knowledge of proper bee management; Low-use of beneficial technology applications; Inadequate support in terms of knowledge-transfer from local research bodies to maintain the industry (Resnick & Mann, 2014).

Therefore, from the foregoing, one would argue that the production level of natural honey was insufficient to cater for the level needed and demanded domestically. This research was intended to determine profitability of stingless beekeeping production and the perception of beekeepers on extension agent performance through technology transfer and developing the capacity and potentials of stingless bee farmers which will ultimately boost the production level of natural honey in the study areas. Agricultural extension services are important to the development and enhancement of stingless beekeeping production in the country. It facilitates diffusion and adoption of innovative technologies and practices through effective transfer from innovation producers (such as research institutes and universities) to its users such as clientele (Koutsouris, 2018). It also aims to develop and empower the farmers through availing them with information and enabling their decision-making process for enhanced livelihood using transfer of technology and human resource development approach (Kanté et al., 2016; Rahim. M. Sail, 1995; Benet, 1993). These aspects of extension need to be further investigated in the context of stingless beekeeping in Peninsular Malaysia and Sarawak, East Malaysia, thereby leaving a knowledge gap that needs to be filled.

Furthermore, there is the need to understand the competencies of extension agent in both aspects and determine which of the two is most important in determining their work performance. Once there is improvement in the natural honey production level, this will reduce importation of honey into the country and save foreign exchange. Efforts of enhancing stingless beekeeping production by the Malaysian government through various tax incentives schemes for agricultural sector particularly beekeeping industry is a step in the right direction. Despite various government support in Malaysia, stingless bee natural honey production is still insufficient to meet domestic demand. The trend lead to huge importation to cater for the increasing demand.

1.4 General Objective of the Study

The general objective is to determine profitability of stingless beekeeping production and the perception of beekeepers on extension agents work performance through technology transfer and human resource development Malaysia. However, the following are specific objectives.

1.4.1 Specific Objectives

1) To determine the profitability of Stingless beekeeping production in the study area.
2) To determine the competency level of extension agents in the transfer of technology, human resource development and work performance among Malaysian Stingless Beekeepers.

3) To determine the relationship between transfer of technology and human resource development with the work performance of extension agent among Malaysian stingless beekeepers.
4) To identify the most contributing factor to work performance among Malaysian stingless beekeepers.

1.5 Research Questions

1) Is stingless beekeeping production profitable in the study area?
2) What is the competency level of extension agents in the transfer of technology, human resource development and work performance among Malaysian stingless bee farmers
3) What are the relationship between transfer of technology and human resource development with work performance among Malaysian stingless bee farmers
4) Which of the variables contributes most to work performance among Malaysian stingless bee farmers.

1.6 Significance of the Study

The study is significant to government, as it can help policy formulation regarding Beekeeping extension in Malaysia. The findings of the study would assist policy makers and administrators in increasing the performance of extension agents. The skills that have been identified in this study can be incorporated into the pre-service and in-service training of extension agents. The study can be relevant to farmers/Beekeepers in their Stingless beekeeping practices, as issues raised from the findings, if properly and effectively addressed will improve on their knowledge, skills and favourable attitudes which will eventually increase their production performance. The study is significant because it will add to body of knowledge regarding beekeeping extension in Malaysia.

The findings of the study established the relationship between profitability of stingless beekeeping and extension services, this new knowledge the relationship between the profitability and extension services will help would-be beekeepers appreciate the service of extension to beekeeping business. Lastly, the study will be of great importance to future researchers as the results serve as good source for future reference.

1.7 Scope of the study

The scope of the study is to determine if stingless beekeeping production is profitable to venture into based on the perception of beekeepers as it is related to the activities and work performance of extension agents through technology transfer and human

resource development in Malaysia. This study covered nine states of Peninsular Malaysia and one state in east (Sarawak) Malaysia as its scope of the study.

1.8 Operational Definition of Key Terms

For proper understanding, the terms used in this research are duly defined, in the context of this research and the definitions are provided below:

1) **Extension agent**: An extension agent is a person who is technically trained with excellent skills. They work with people in a humble manner, and help people to solve their complex problems technically, therefore, the extension workers are versatile in problem solving, excellent thinking and knowledge conveyance (Samuel, 2000, Karbasioun, et al., 2007). However, in this research, an extension agent refers to a person who directly deals with stingless bee farmers that help them on how to develop their farming activities, and improved their productivity.
2) **Stingless Beekeepers (Clients)**: According to Merriam-Webster Dictionary, (2016), the word "client" has been defined as a person who is under the protection of another person. In addition, the word has also been used to refer to a person who engages the professional services or advice of another trained person. However, in the present research the term "client" has been used to refer to stingless beekeepers (farmers) who produce honey in study area.
3) **Competency**: the ability to apply or use a set of related skills, Knowledge, tasks, critical work functions in an appropriate place is termed Competency (Wagenaar, 2014). However, in this research the word "competency" refers to the ability of an extension agent to transfer technology and develop the human resources of the stingless beekeepers in Malaysia.
4) **Extension agent's work performance**: In this study, extension agents work performance refers to the overall work performance outcomes, as he educate the stingless bee farmers which result in improvement in their knowledge, skills and favourable attitudes towards stingless bee farming.

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