ADOPTION OF INTEGRATED CATTLE AND OIL PALM FARMING SYSTEM IN MALAYSIA

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ABSTRACT

Malaysian government had encouraged the adoption of integrated cattle and oil palm farming system (ICOFS) since the year 1998. This is due to large areas of land suitable for ICOFS in Malaysia that can be well utilised. Rising up the participation in ICOFS is one of the effort in facing the increasing demand of meat nationwide and growing dependency on imported meat. Apart from that, Malaysia needs to increase the self-sufficiency level of national meat production to 32.7% by 2020 as stated in the National Agri-Food Policy 2011-2020. Despite this, only a small number of farmers have adopted ICOFS in Malaysia and less is known so far about the farmer's attitudes towards the ICOFS in Malaysia. Therefore, this study aimed to explore the current practice as well as factors affecting and constraints to the adoption of ICOFS in Malaysia. Interviews of four selected experts in ICOFS were held to examine the current practice of ICOFS in Malaysia. Results from the interviews and literature review have been cross-compared to develop questionnaire instruments. Then, the survey questionnaire was carried out to 153 adopters and non-adopters of ICOFS in Johor, Malaysia to identify the key factors that influence the adoption of ICOFS. The study found that information and know-how and availability of skilled labour are the significant factors that encourage farmers to adopt ICOFS. On the other hand, government support and policy constraint and production and on-farm constraint are the significant constraints hindering the adoption of ICOFS. Based on the findings of this study, one of the measure to increase the rate of adoption of ICOFS are by helping the farmers to hire extra labour and to have skills needed. Furthermore, rate of ICOFS could also be increase by helping the farmers to have better control on weed, pest and diseases on farm as well as not interrupting their oil palm production. In addition, it is suggested to provide them with more opportunity towards incentives, training and technical support from the field officers. It is suggested for future research to explore the effect of factors affecting adoption and constraints to adoption on other attitudinal and psychological outcomes such as satisfaction, successfulness, involvement and degree of use.

ABSTRAK

Malaysia telah menggalakkan penyertaan dalam sistem ladang integrasi lembu dan kelapa sawit (SLILK) sejak tahun 1998. Ini kerana terdapat tanah yang luas di Malaysia yang sesuai untuk SLILK untuk dimanfaatkan. SLILK merupakan salah satu langkah untuk mengatasi isu pertambahan permintaan terhadap daging lembu di dalam negara dan isu kebergantungan kepada daging import. Selain itu, Malaysia juga mensasarkan untuk meningkatkan kadar sara diri dalam pengeluaran daging lembu negara kepada 32.7 peratus menjelang 2020 seperti yang tercatat di dalam Dasar Agromakanan Negara 2011-2020. Justeru, kajian ini dijalankan bertujuan untuk meneroka praktis semasa dan faktor-faktor yang mempengaruhi penyertaan dalam SLILK di Malaysia. Temubual bersama empat pakar dalam SLILK telah diadakan untuk mengkaji praktis semasa dalam sistem ladang integrasi ini. Dapatan daripada temubual dan kajian literasi telah dibandingkan untuk menghasilkan instrumen soal selidik. Kemudian, kajian soal selidik telah dijalankan keatas 153 orang peserta dan bukan peserta SLILK di Johor, Malaysia untuk mengkaji faktor-faktor utama yang mempengaruhi penyertaan mereka. Hasil kajian mendapati faktor utama untuk peladang menyertai dalam SLILK ini adalah faktor informasi dan pengetahuan serta factor ketersediaan pekerja mahir. Manakala kekangan dalam bantuan dan dasar kerajaan serta kekangan dalam pengeluaran dan aktiviti di ladang merupakan kekangan utama dalam menyertai sistem ladang integrasi ini. Berdasarkan dapatan kajian ini, cara terbaik untuk meningkatkan kadar penyertaan dalam SLILK adalah dengan membantu para peladang untuk mampu menggaji pekerja tambahan dan memiliki kemahiran-kemahiran yang diperlukan. Selain itu, kadar penyertaan juga boleh ditingkatkan dengan membantu peladang untuk mengawal rumpai, binatang perosak dan penyakit di ladang, juga tidak mengganggu pengeluaran kelapa sawit. Tambahan pula, lebih banyak peluang terhadap insentif, latihan dan sokongan teknikal daripada pegawai lapangan juga perlu disediakan untuk mereka. Untuk kajian di masa hadapan, dicadangkan supaya dikaji semula kesan faktor-faktor yang mempengaruhi penyertaan dan kekangan-kekangan terhadap pernyertaan ini terhadap faktor sikap dan psikologi yang lain seperti kepuasan, kejayaan, tahap penyertaan dan tahap penggunaan.

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DOI	-	Diffusion of Innovation
DV	-	Dependent Variable
DVS	-	Department of Veterinary Services
ETP	-	Economic Transformation Programme
EPP	-	Entry Point Programme
FAO	-	Food and Agriculture Organization of United Nations
ICLFS	-	Integrated Crop-Livestock Farming System
ICOFS	-	Integrated Cattle and Oil Palm Farming System
IV	-	Independent variable
NKEA	-	National Key Economic Area
MARDI	-	Malaysian Agricultural Research and Development Institute
MPOB	-	Malaysian Palm Oil Board
QUAL	-	Qualitative
QUAN	-	Quantitative
RO	-	Research objective
RQ	-	Research question
SPSS	-	Statistical Packing for Social Science
TAM	-	Technology Acceptance Model
TAQ	-	Target Area Concentration
TPB	-	Theory of Planned Behaviour
TRA	-	Theory of Reasoned Action
UPM	-	Universiti Putra Malaysia
UTAUT	-	Unified Theory of Acceptance and Use of Technology

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter gives an overview of this study. It starts with the introduction and the research background that provide clear insight of this research in the aspect of the current situation related to ICOFS. Plus, this chapter clearly defines and discusses the problem associated with this farming system that will act as a backbone for the development of research objectives and research questions. This chapter also explains the significance of this study and provides a brief discussion about the methodology used, scope of the study, limitations and definitions of operation used in this research.

1.2 Research Background

ICOFS is one of the strategies that is seen promising to boost up the local beef production and to increase the self-sufficiency level of the Malaysian local beef (Gabdo & Abdlatif, 2013; Saad & Azhar, 2015). This farming system is a method of farming in which the grazing animals are reared simultaneously on land used for crop production (Awalludin *et al.*, 2015; Ismail & Abdul Wahab, 2014). This concept is developed to reduce dependency on pasture land. It is suitable for Malaysia's environment as this country has a limited area allocated for pasture production and livestock grazing.

Integrated cattle and oil palm farming system (ICOFS) is not only a solution for limited availability of grazing land, but also the answer for the lack of local meat supply in Malaysia. Besides, it maximises the use of available resources of land and

capital, thus reducing the cost in production. In Malaysia, ICOFS is considered as the most successful and sustainable integrated farming system in Malaysia that could help boosting up Malaysian beef industry in comparison to other cattle-crop integrations such as rubber and coconut trees (Ismail & Abdul Wahab, 2014; Sharif & Mohamed, 2005) This is mainly because of the huge area of land were planted with oil palm trees in Malaysia. Thus, this study was focused particularly on the adoption of integrated cattle and oil palm farming system. According to Gabdo and Abdlatif (2013) and Tohiran *et al.* (2017) cattle integration in oil palm estate could increase the return for both enterprises: cattle farming and oil palm production. This farming system can reduce the maintenance cost of oil palm estate especially in weeding and increase its production due to the natural supply of nutrients from the cow manure.

The Agriculture National Key Economic Area (NKEA) is the initiative done by Malaysia government to transform the traditional small-scale farming, production-based sector towards large-scale agribusiness industry that contributes to the economic growth and sustainability in developing Malaysia towards developed nation by 2020. There were several Entry Point Projects (EPP) already planned and implemented to achieve the target particularly where Malaysia needs to elevate the Gross National Income to US$ 15000, attracting US$ 444 billion investments and providing 3.3 billion jobs throughout the country (PEMANDU, 2011b). One of the EPP in agriculture sector was EPP 5; Cattle Integration in Oil Palm Estates, which focuses on integrating cattle in the oil palm plantation. It was designed to increase the local meat supply through the implementation of integrated crop-livestock farming system (ICOFS) (PEMANDU, 2014). This EPP could maximise the resources available in Malaysia as this country has a large area of oil palm plantation covering 5,849,330 hectares in 2018 (MPOB, 2019). However, there were some problems emerged in the current implementation of ICOFS as reported in ETP 2014 report. There was lack of participants from large oil palm companies due to the inadequate interest to integrate livestock production in their core business. Meanwhile, Ismail (2016) reported that there was a huge need of participation from oil palm plantations to support the local meat production as there are 3.84 million hectares of oil palm land suitable for cattle and oil palm integration. This could hold up to 767,440 heads of cattle which is exceeded the estimated number of national cattle population in 2019 that sat at 683501 (Department of Veterinary Services, 2019a). Apart from that, private plantations are the biggest sector among other types of farm sectors that could occupy a total of

468,139 heads of cattle. In comparison, sectors such as smallholders, state agencies, FELCRA, FELDA, and RISDA can only hold around 300,000 heads of cattle, but their participations are encouraging compared to those of private plantations (Ismail, 2016).

ICOFS is one of the strategies that is seen promising to boost up the local beef production. However, there are several challenges Malaysia must face to move forward in the beef production. One of the challenges of Malaysian beef production is Malaysia has relatively small area allocated for pasture and ruminant farming, which is only 17 983 hectares (Ministry of Agriculture and Agro-Based Industry Malaysia, 2015a). This is the reason why most of the livestock farmers in Malaysia are comfortable with traditional farming in which they rear their animals in a small scale with almost zero area of grazing land (Hashim, 2015). Another challenge for beef production in Malaysia is that large-scale farming is still not yet well established. Although there have been many strategies plotted to intensify the production of meat in Malaysia such as open-improved pasture land, intensive feedlot systems and extensive system of smallholders, the results were still uncertain. By considering the challenges of beef production and to fully utilise the locally available resources, ICOFS was introduced in Malaysia. This system is a part of integrated crop-livestock farming system (ICLFS) that is well established worldwide. In this farming system, livestock are integrated into plantation crops such as oil palm, rubber, acacia, cocoa and coconut plantation (Ismail & Abdul Wahab, 2014). In other countries, ICLFS are being practiced such as in Brazil, the United States, Australia, and Indonesia, but with different types of crop integrated such as maize and soya (Bell *et al.*, 2014; Gil *et al.*, 2015; Paris, 2002; Sulc & Franzluebbers, 2014).

Ruminant production in Malaysia has been in the limelight due to the shortage of local meat supply. Demand for meat in Malaysia was 205 082.2 tonnes in 2018, which far outweighed the local meat supply at 46 923.6 tonnes that year. The demand has been estimated to increase from year to year. However, the local meat supply projected was unable to meet the local massive demand. For instance, the self-sufficiency level of beef in 2017 was 22.2% (Department of Veterinary Services, 2017). Thus Malaysia has to depend on imported meat supply from other countries such as India, Australia, New Zealand, Uruguay, Argentina and Brazil (Ministry of Agriculture and Agro-Based Industry Malaysia, 2015c). The volume of imported meat in 2014 was 149 296 tonnes (Ministry of Agriculture and Agro-Based Industry Malaysia, 2015b), then increased to 153 289 tonnes in 2017 (Department of Veterinary

Services, 2016). In the National Agri-Food Policy, Malaysia aimed to increase the self-sufficiency level (SSL) of meat to 32.7% by 2020 (Ministry of Agriculture and Agro-Based Industry Malaysia, 2011). While in Ruminant Industry Development Plan targeted to increase the SSL of meat from 22.2% in 2017 to at least 30% in five years (Ministry of Agriculture and Agro-Based Industry Malaysia, 2019b). In light of this, it is crucial for Malaysia to boost up its meat production through ICOFS to achieve the targeted self-sufficiency level.

Another issue that needs highlight is the limited area allocated for pasture production. It is land reserved for grazing so that farmers can rear their livestock including cattle, buffalo, and goat (Hashim, 2015). The reserved grazing land was 17,983 hectares, which comparatively lower than the areas allocated for primary agricultural products: 322,863 hectares of paddy field, 1,191,901 hectares of rubber estate, and 3,178,173 hectares of oil palm plantation (Ministry of Agriculture and Agro-Based Industry Malaysia, 2015a). Ultimately, these restricted grazing areas will become inadequate to accommodate the growing number of livestock. One of the solutions to the land issue is to fully utilize the available land resources through the implementation of the integrated farming system (Ismail & Abdul Wahab, 2014; NST, 1999). Abdulla et al, 2016 (Tohiran et al, 2019) However, most of the farmers in Malaysia are very comfortable with the traditional farming method. Thus, traditional farming needs to transform into integrated livestock farming with permanent crops such as oil palm and rubber trees. This alternative could prevent livestock from roaming on the roads and public areas (NST, 1999).

However, there was lack of participation among farmers who are willing to adopt integrated cattle and oil palm farming system (ICOFS). This issue emerged as early as its first introduction, seen by the lack of response from plantation companies during the time the government encouraged them to participate in this farming system. The companies had not given any solid reasons for not participating in it (Hayatudin, 1998a). Some of the farmers claimed that ICOFS could give negative impact on oil palm production such as damaging the immature oil palm, causing soil compaction and spread of genoderma fungi (Silalahi *et al.*, 2018). However, 3 years research done by Indonesian-Australian Commercial Cattle Breeding (IACCB) and Indonesia's Technology Application Research Agency (LIPI) shows no sign of soil compaction and the spread of genoderma fungi resulted from ICOFS adoption (Bisnis Indonesia, 2018). Nevertheless, the problem remained unsolved and resurfaced during the latest

project of ICOFS under the Economic Transformation Programme (ETP) as large oil palm plantation companies were uninterested to give participation (PEMANDU, 2012, 2013). Thus, although there are many benefits could be gained through the integration of cattle and oil palm, the adoption rate of this farming system in the plantations are still underrated.

The increasing pressure on land, as well as the growing demand for livestock products, makes it increasingly important to ensure effective use of feed resources in the beef industry. In support of this circumstance, ICOFS offered a series of resource-saving practices to preserve the environment and minimise the adverse effects of intensive farming, apart from increasing the profit and maintaining its production level. Therefore, it is emphasized here that there is a need to review the current practice of cattle and oil palm plantation farming system adoption in Malaysia and what are the factors and constraints influencing farmers' decision to adopt this farming system in Malaysia.

1.3 Problem Statement

The critical role of the ICOFS is to overcome beef production insufficiency. Committed to increase its self-sufficiency level (SSL) of meat to 32.7% by 2020, several strategies have been planned and executed by the government including the ICOFS (Ministry of Agriculture and Agro-Based Industry Malaysia, 2011). This system has been selected to be one of the projects under the Economic Transformation Programme (ETP) run by the agricultural sector. It has begun since 2010 with the aim to transform the Malaysia agricultural sector (PEMANDU, 2011a). Even so, the annual report of ETP showed evidence of disinterest amongst the large oil palm companies since its early introduction in 1998, despite enormous encouragement by the government (PEMANDU, 2012). No solid reason was presented by the companies to explain their refusal for the project (Hayatudin, 1998b; Zul, 1998). Nevertheless, some of the farmers claimed that ICOFS could give negative impact on oil palm production such as damaging the immature oil palm, causing soil compaction and spread of genoderma fungi (Silalahi *et al.*, 2018). However, 3 years research done by Indonesian-Australian Commercial Cattle Breeding (IACCB) and Indonesia's Technology Application Research Agency (LIPI) shows no sign of soil compaction and the spread of genoderma fungi resulted from ICOFS adoption (Bisnis Indonesia,

2018). As of October 2014, there were only 21 companies participated in EPP5, with a total of 6077 cattle integrated into the oil palm plantations (PEMANDU, 2014). Apart from that, in the latest Ruminant Industry Development Plan, it is aimed to increase the SSL to at least 30% by 2022 (Ministry of Agriculture and Agro-Based Industry Malaysia, 2019b). Therefore, it is crucial for the government to review the implementation of the ICOFS in the aspect of exploring the factors that could influence the farmers to participate.

Furthermore, little is known about the farmer's attitude towards the adoption of ICOFS or its state of adoption in Malaysia. Correspondingly, there were very few studies that have attempted to identify the prominent predictors utilizing the factors affecting the adoption of ICOFS and its constraints in Malaysia. Thus, this study seeks to discover what are the factors affecting the adoption ICOFS as well as its constraints. This study attempted to imply conceptual framework from the study of Gil *et al.* (2016), constraints to adoption from the study of Alarima *et al.* (2011b) and Wheeler (2008) by modifying certain variables from the study.

Much research had been conducted to study the factors of adoption on other agricultural technology or innovations such as on the adoption of best management practices, natural resources management innovations, conservation farming practices, integrated pest management and crop-livestock-forestry integration (Arslan *et al.*, 2014; Gil *et al.*, 2015; Jayasooriya & Aheeyar, 2016; Kabir & Rainis, 2015; Lamba *et al.*, 2008). Gil *et al.* (2016) developed a conceptual framework for the factors affecting the adoption of crop-livestock integration in Brazil. They proposed six constructs for the factors affecting the adoption including capital availability, cost of adoption, biophysical suitability, labour availability, information and know-how and willingness to diversify production. The theoretical background behind their study is from the study of agricultural innovation adoption by Mercer and Pattanayak (2003). Other agricultural technology adoption study also highlighted several other factors for adoption such as access to machinery, access to farming input, farm income and irrigation (Ashoori *et al.*, 2017). Meanwhile, the adoption of conservation farming practices highlighted the importance of extension group (Arslan *et al.*, 2014). Adoption of best management practices suggests education, age, income, and farm sales are the significant determinants of adoption (Lamba *et al.*, 2008). However, there are still lack of studies concerning the factors affecting the adoption of integrated farming system

(Dhakal *et al.*, 2015; Gil *et al.*, 2015; Lim *et al.*, 2019; Mercer & Pattanayak, 2003; Saiful Islam *et al.*, 2015; Simelton *et al.*, 2015).

There are also constraints to adoption as mentioned in previous studies that should be considered (Alarima *et al.*, 2011b). Alarima *et al.* (2011b) developed six constraints for adoption of rice production in Nigeria which includes land tenure, production and on-farm constraints, marketing and economic constraints, input, information, training and technology, and mechanization. Wheeler (2008) studied the barriers to the adoption of organic farming and the adoption of genetic engineering in Australia: they found public attitudes, media influences, and lack of scientific research as the significant constraints for the adoption of organic farming, whereas market issue, information needs, government policy, and on-farm issues as the constraints for the adoption of genetic engineering. Most of the previous studies on constraints to the adoption of agricultural technologies were derived from Guerin and Guerin (1994b), where they investigated several constraints to the adoption of technologies and innovations by farmers. They pointed out several significant constraints which include the complexity of the new technology, how readily observable the outcomes of adoption are, the farmer's attitudes towards the technology, the farmer's level of motivation and the farmer's perception of the relevance of the new technology. However, similar to the factors affecting the adoption, there were very limited studies on the constraints to the adoption of integrated farming system (Djalilov *et al.*, 2016; Gil *et al.*, 2015).

This study adopts mixed method approach. One of the reason why mixed method approach is there are many previous studies on agricultural technology adoption use this approach (Bussoni *et al.*, 2015; Dhakal *et al.*, 2015; Gil *et al.*, 2015; Viswanathan & Shivakoti, 2008a). In conjunction to this, Gil *et al.* (2016) suggested that using mixed method research on adoption studies will improve the validity of the result.

In addition, there are many previous on the adoption of integrated farming system viewed their dependent variables as a binary choice of "adopt" or "not adopt" (Feder *et al.*, 1985; Gil *et al.*, 2016; Kabir & Rainis, 2015; Lamba *et al.*, 2008; Skelton *et al.*, 2005). Thus, Dhakal *et al.* (2015) recommended that by using adoption index, one could see the adoption level of individual farmers and could be more appropriate to define the degree of adoption compare merely depends on the binary choice. In addition, the recent study related to ICOFS suggested constructing further research on

its degree of adoption as a pool of data, knowledge, and inspiration to enhance the conventional systems (Bonaudo *et al.*, 2014). Therefore, this study uses adoption score that is measured using likert scale on the qualitative part of this study to explore the farmers' degree of adoption.

Moreover, there were also recommendations by the previous studies to implement several strategies of adopting new technology and enhancing management practices to fully exploit the benefit of this farming system (Peyraud *et al.*, 2014; Rigolot *et al.*, 2015). While Gil *et al.* (2015) claimed that there are still very limited study on economic and environmental inputs and impacts and the challenges associated with their implementation of integrated farming system. Undoubtedly, further study should be conducted to utilise the full benefits of this farming system, as supported by previous studies.

Therefore, there is a need for research that focuses on the adoption of ICOFS in Malaysia to investigate the factor influencing the farmer's decision and the challenges that they will face to adopt it. Although several studies related to the adoption of ICOFS in Malaysia has been carried out, the findings were limited to the sustainability and technical side of the farming system (Devendra, 2009; Gabdo & Abdlatif, 2013; Ismail & Abdul Wahab, 2014; Md. Said & Man, 2014; Rosli & Shariffhuddin, 2003; Serin *et al.*, 2008; Slade *et al.*, 2014).

1.4 Research Questions

Based on the above statement, this study attempts to answer the research questions as follows:

1. How integrated cattle and oil palm farming system is being practice in Malaysia?
2. What are the factors affecting the adoption of integrated farming system of cattle and oil palm in Malaysia?
3. What are the constraints to the adoption of integrated farming system of cattle and oil palm in Malaysia?

1.5 Research Objectives

This research aims to contribute knowledge of integrated cattle and oil palm farming system in Malaysia. To answer the research questions above, three research objectives are identified as follow:

1. To identify the current practice of integrated farming system of cattle and oil palm in Malaysia.
2. To explore the factors affecting the adoption of integrated farming system of cattle and oil palm in Malaysia.
3. To examine the constraints to the adoption of integrated farming system of cattle and oil palm in Malaysia.

1.6 Significance of the Study

This study provided a significant opportunity to advance our knowledge of the livestock industry in Malaysia as there was lack of research related to the adoption of ICOFS in this country. To date, only a few studies have attempted to investigate the factors and the constraints of ICOFS adoption. The study is expected to explore the factors influence the adoption of ICOFS through a systematic process of empirical validation, testing and comparing variables from other countries which have done adoption studies upon agricultural technology. Previous studies also suggested to further explore the degree of integration of ICOFS as a source of knowledge and data, to enhance the conventional farming system.

Furthermore, this study should benefit farmers to decide on their adoption of ICOFS, at the same time could inspire other farmers to educate themselves of the reasons underlying its practice. Meanwhile, the study has paid close attention to any risks and challenges involved, so that careful measures could be carried out earlier to prepare for its adoption.

Besides, the findings are not only useful for the farmers but beneficial for the government in making effective decisions while evaluating its contribution, particularly in the beef industry. Following that, this study could assist policymakers in improving agricultural policies, should the need for revision arise in the future. Lastly, the study provided a framework for the ICOFS in Malaysia as well as a reference for future analyses of agricultural policies.

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