

# THE PRACTICES AND FACTORS AFFECTING THE IMPLEMENTATION OF INTEGRATED CATTLE AND OIL PALM FARMING SYSTEM IN MALAYSIA

Abd Rahman Ahmad<sup>1\*</sup>, Aini Syafiqah Mohd Nasir<sup>2</sup>

<sup>1,2</sup>Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, Malaysia.

Email: <sup>1\*</sup> [arahman@uthm.edu.my](mailto:arahman@uthm.edu.my), <sup>2</sup> [ainisyafiqah@gmail.com](mailto:ainisyafiqah@gmail.com)

Article History: Received on 25<sup>th</sup> July 2020, Revised on 16<sup>th</sup> August 2020, Published on 29<sup>th</sup> August 2020

## Abstract

**Purpose of the study:** The Malaysian government had encouraged the adoption of integrated cattle and oil palm farming systems (ICOFS) since the year 1998. This is due to large areas of land suitable for ICOFS in Malaysia that can be well utilized. The efforts made in increasing the demand for meat nationwide and growing dependency on imported meat are among the reasons that ICOFS has become significant to be implemented today. 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.

**Methodology:** 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.

**Main Findings:** 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.

**Applications of this study:** The study found that information and know-how and availability of skilled labor 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.

**Novelty/Originality of this study:** Based on the findings of this study, one of the measures to increase the rate of adoption of ICOFS is by helping the farmers to hire extra labor and to have skills needed. Furthermore, the rate of ICOFS could also be increased by helping the farmers to have better control over weed, pests, and diseases on the farm as well as not interrupting their oil palm production. In addition, it is suggested to provide them with more opportunities for 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, success, involvement, and degree of use.

**Keywords:** *Integrated Cattle, Oil Palm, Farmers, Farming System, Agricultural, Malaysia.*

## INTRODUCTION

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). 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; Tohiran et al., 2019). 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 (Romelah, & Niswati, 2017; Tohiran et al., 2017; Salendu et al., 2018).

Integrated cattle and oil palm farming system (ICOFS) is not only a solution for the limited availability of grazing land but also the answer for the lack of local meat supply in Malaysia. Besides, it maximizes 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 to boost up Malaysian beef industry in comparison to other cattle-crop integrations such as rubber and coconut trees (Ismail & Abdul Wahab, 2014; Sharif & Mohamed, 2005; Nur, Fadli, & Satriawan, 2018). 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 systems. 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.

This paper aims to contribute knowledge of integrated cattle and oil palm farming systems in Malaysia. To answer the research with the objective to identify the current practice of an integrated farming system of cattle and oil palm in Malaysia. Here, this will then further explore the current practice of ICOFS in Malaysia and further investigate the factors affecting the adoption and constraints to the adoption and their effects on ICOFS adoption. 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.

## LITERATURE REVIEW

### *Ruminant Production*

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 massive local 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, Malaysia must boost up its meat production through ICOFS to achieve the targeted self-sufficiency level ([Sadiq et al., 2018](#); [Melissa, 2016](#)).

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 a 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](#); [Ib, 1999](#); [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 ([Kumar & Kumar, 2018](#); [Altieri, & Nicholls, 2017](#)).

### *Integrated Cattle and Oil Palm Farming System*

Integrated cattle and oil palm farming systems (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 beef production. One of the challenges of Malaysian beef production is Malaysia has a 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 on a small scale with almost zero areas of grazing land ([Hashim, 2015](#); [Ahmad et al., 2018](#)). 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 an extensive system of smallholders, the results were still uncertain. By considering the challenges of beef production and to fully utilize the locally available resources, ICOFS was introduced in Malaysia. This system is a part of the integrated crop-livestock farming system (ICLFS) that is well established worldwide. In this farming system, livestock is 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](#); [Nur, Fadli, & Satriawan, 2018](#); [Maru et al., 2018](#)).

However, there was a lack of participation among farmers who are willing to adopt integrated cattle and oil palm farming systems (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](#); [1998b](#); [Agus, & Widi, 2018](#)). Some of the farmers claimed that ICOFS could give a negative impact on oil palm production such as damaging the immature oil palm, causing soil compaction, and the spread of Ganoderma fungi ([Silalahi et al., 2018](#)). However, 3 years of 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 Ganoderma fungi resulted from ICOFS adoption ([Bisnis Indonesia, 2018](#); [Zaimah et al., 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 that could be gained through the integration of cattle and oil palm, the adoption rate of this farming system in the plantations is still underrated ([Nazli et al., 2018](#); [Yusoff, Ismail, & Kamarulzaman, 2020](#); [Behera, & France, 2016](#)).

### ***A brief history of Integrated Cattle and Oil Palm Farming System in Malaysia***

The integration of cattle and oil palm farming system is one of the strategies designed to increase the local beef supply. There are many types of plantations that can be integrated with cattle, such as rubber trees, cocoa trees, and oil palm trees. However, the integration of beef cattle with rubber trees did not prove to be viable due to the absence of forage as the rubber trees mature. The area of rubber plantation in Malaysia is also decreasing, make it uneconomical for cattle integration. While integration with other crops such as coconut did not show any positive results and the result for cocoa integration is yet to be obtained ([Sharif & Mohamed, 2005](#)). Thus, only the integrated farming of cattle and oil palm farming system is seen suitable in the Malaysian context. Integrated farming of cattle and oil palm farming system promotes the harmonious ecological relationship between cattle, undergrowth, and oil palm. It allows the cows to move freely among the trees in controlled and specific areas.

As early as 1997, the Agriculture Ministry of Malaysia had encouraged farmers to implement integrated farming. In the following year, Datuk Dr. Sulaiman Daud, the former Agriculture Minister urged farmers to adopt the integrated farming system and emphasized the benefit of integrated crop-livestock farming. It was estimated that in the year 1998, out of 4 million hectares of oil palm estate in Malaysia, 1.2 million hectares are suitable for beef farming. Unfortunately, the call was not responded as well as expected. Many plantation companies were not willing to integrate cattle in their plantation and most of them not given any reasons for not participating ([Zul, 1998](#); [Ibragimov, Sidique, & Tey, 2019](#)).

However, in July 1998, FELDA and RISDA were two government-linked companies that willing to integrate cattle in their plantations. Almost 10,000 cattle from Australia, New Zealand, and Brazil were imported for the breeding purpose of the integrated crop-livestock farming system back then ([Hayatudin, 1998](#); [Azhar et al., 2017](#)). While in 1999, integrated farming had received encouraging response from estate owners in Terengganu. It was also an effort made by Veterinary Service Department to prevent cattle from wandering about on roadside and promote systematic cattle management ([Ib, 1999](#); [Paterson, & Lima, 2018](#); [Suzuki, et al., 2017](#)).

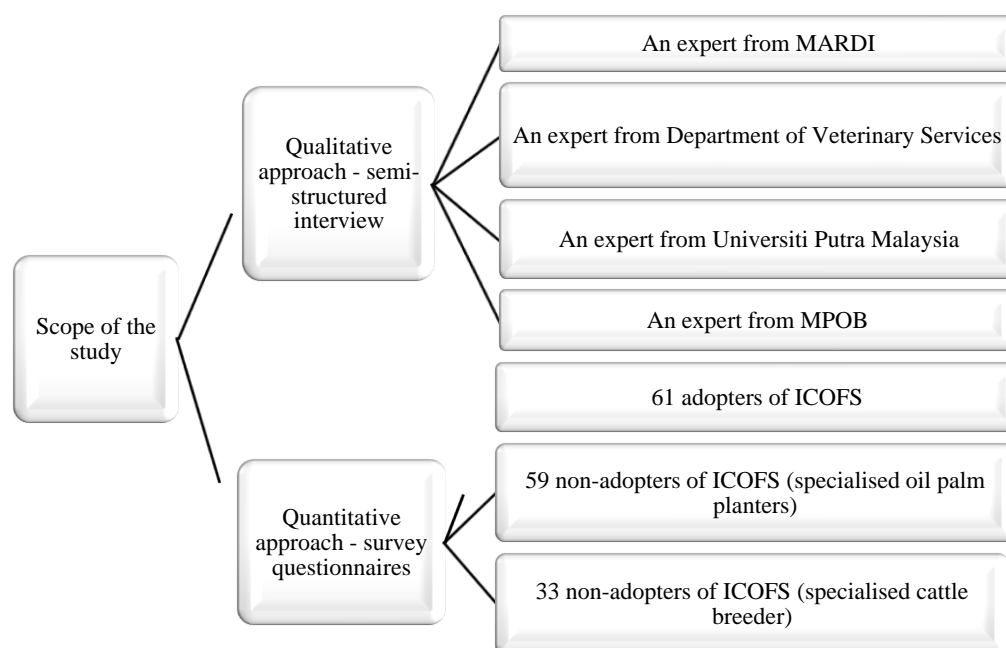
### **METHODOLOGY**

This study adopts a mixed-method approach to answer the research questions. The mixed-methods approach is used to gain an in-depth understanding of the integrated cattle and oil palm in Malaysia because there is a lack of a previous study related to this topic, particularly on adoption. Moreover, findings from previous research studies have shown the usefulness of a combination of qualitative and quantitative methods in investigating issues related to the integrated farming system ([Gil et al., 2015](#); [Rose et al., 2019](#)). Implementation of mixed-method approach in this study is to combine the advantages of both qualitative and quantitative approach and to offset each of their limitation ([Creswell, 2014](#); [Creswell & Plano Clark, 2011](#)) which could eventually provide stronger and better inference for the study ([Tashakkori & Teddlie, 2003](#)). One data source may be insufficient ([Creswell & Plano Clark, 2011](#)). Therefore, the other method can answer research questions that the other methodologies cannot ([Tashakkori & Teddlie, 2003](#)) and can explain the initial results of the study ([Creswell & Plano Clark, 2011](#)). For instance, the quantitative method can be used to generalize exploratory findings of qualitative data ([Creswell & Plano Clark, 2011](#)). Apart from that, mixed methods design also provides the opportunity for presenting a greater diversity of divergent views in a study ([Tashakkori & Teddlie, 2003](#)). According to [Creswell and Plano Clark \(2011\)](#), qualitative data provide detailed understanding of a problem by studying a few individuals and exploring their perspectives in depth. While quantitative data provides more general understanding of a problem by examining a large group of people and assessing responses to a few variables. In accordance with this approach, this research uses qualitative interviews to gain deeper understanding of the topic of this research and follow with quantitative survey for major data collection.

This research suit to be exploratory research as the topic is still new in Malaysia. The qualitative interview was performed to gain further understanding of the current practice of integrated cattle palm oil farming system and following the interview, a quantitative survey was conducted to generalize the factors affecting and constraints to the adoption of ICOFS. Both qualitative and quantitative analysis is expected to provide extra credibility to the results of this study. Figure 1 presents the scope of the study for each of the research approach. Participants of the interview are chosen based on their experience and knowledge needed to contribute additional information to enrich the results which include the experts in ICOFS from Malaysian Agricultural Research and Development Institute (MARDI), Department of Veterinary Services (Malaysia) under Ministry of Agriculture and Agro-Based Industry, Universiti Putra Malaysia (UPM) and Malaysian Palm Oil Board (MPOB). Interviews were planned using the practice framework of open-ended interviews.

From the data collected in the qualitative approach, the survey instrument was reviewed and formulated. This is where the primary data collection is taken place. The quantitative survey was conducted through survey questionnaires among 61 adopters and non-adopters which consist of 59 specialized oil palm planters and 33 specialized cattle breeders in Johor, Malaysia. A sample is taken from each of these strata using convenience sampling. Out of 30 experts, only four are available to be interviewed. Four types of participants of the interview are chosen which includes a person from an agricultural research institute, a person in an academic line, and two persons from government agencies. [Parse \(1990\)](#)

recommended using 2-10 participants of interviews in order to achieve 'redundancy or saturation'. Therefore, 4 number of respondents used in this study is adequate. Apart from that, this study also uses a quantitative study to support the data collected from this interview. Various background of the respondents also reduces the bias of the interview result.



**Figure 1:** Scope of the study

**Source:** Authors

To obtain the information required, data were collected from the Department of Veterinary Service in Johor. These farms were located in the state of Johor, the most southern state of Malaysia. Johor is chosen as the location of the study because Johor is among the states in Malaysia with a huge area planted with oil palm compare to other states. Johor also contributes to a large number of cattle populations in Malaysia ([Department of Agriculture, 2016](#)). The respondents consist of farmers which include smallholders, FELDA plantation, RISDA plantation, FELCRA plantation, private plantation, agricultural cooperation, group of farmers' enterprise, and state agencies located in Johor.

Data analysis was conducted based on the objectives of the study. After transcription is done, phrases in the interview were quoted and sentences were grouped according to themes or codes based on variables obtained in previous literature and additional variables if any. Meanwhile, reporting of data was done to communicate the findings of the study and the methods applied in a form that lives up to specific criteria. As mentioned by [Creswell \(2014\)](#), the report must be in a readable form. Meanwhile, the data obtained from the questionnaires were analyzed using the Statistical Package for Social Sciences (SPSS) 20 to collect and analyze all the results that had been obtained. Three methods were used to analyze the data. These methods are a descriptive statistic, coefficient correlation analysis, and multi-regression analysis.

## RESULTS AND DISCUSSION

Research question 1 was constructed to explore the current practice of ICOFS in Malaysia. There is additional information gain through the interview session regarding the implementation of ICOFS in Malaysia. The expert interview added extra information to the literature and give a better understanding of the current practice of ICOFS. It is gathered from the interview, that giving too much PKC will be costly for the farm, thus, it is suggested to give PKC merely at a certain amount. As mentioned by [Sharif and Mohamed \(2005\)](#), the cows will also be given supplements such as palm kernel cake (PKC), salt blocks, oil palm fronds (OPF), and palm press fiber (PPF). While for OPF, it is explained the expert that it will be produced during harvesting activity on the farm. The expert advised building the OPF factory close to the farm to fully utilize the basic facilities with the oil palm production. The expert also said that 40 million tonne metrics of OPF can be produced annually which could feed up to 5.2 million head of cattle.

There are not many differences between the information gathered in the literature and data from the interview regarding the farm equipment, but extra information is obtained through the interview. In [Sharif and Mohamed \(2005\)](#), the information about farm equipment is scarce, with outdated price lists available. However, from the interview, the expert explained that around RM10 000 to RM20 000 are required for ICOFS building materials. Mobile yards made up of light steel are also needed which could cost around RM20 000 to RM30 000, the expert said. Apart from that, it is gathered from the interview that if someone received the government scheme, they will be provided with shredding machines and



basic medicine for animal health care purposes. It is also recommended by the expert that every equipment on farm to be portable so that it could be transported elsewhere by trucks.

The data gathered from the literature and the expert interview do not show vast differences. The Kedah Kelantan breed, Brahman breed, and Yellow Cattle breed are suitable breeds for ICOFS in Malaysia as suggested by the expert. Out of these breeds, the best breed is KK and Yellow Cattle breed is also recommended by the experts as it is quite similar to KK. The suitability of breed depends on their adaptation and their ability to withstand the Malaysian climate. This is parallel with the literature ([Sharif & Mohamed, 2005](#)) which stated that some local breeds were selected for integration due to their hardiness, adaptability, and low mortality rate. However, the expert also mentioned that crossbred cattle were also suitable to be used such as those local breeds that have been crossbred with Draughtmaster breed. The expert also added that there is also Brahman breed, which is a high producer breed, thus they need to be handled by enthusiastic and high determination farmers or else they would not survive ([Salendu, et al., 2018](#); [Agus, & Widi, 2018](#)).

From the interview, it is suggested that carrying capacity for ICOFS is 1 cow to 4 hectares or 10 cows to 10 acres. The expert suggested that there are things that need to be considered to have good carrying capacity such as the number of calves and bulls' on-farm and how much grass do the farm has. The expert argued that it is difficult for smallholders to rear a large number of cattle because of the small farm size that they have. This is parallel with what had been mentioned by [Sharif and Mohamed \(2005\)](#), the lower the number of animals per hectare the greater the weight gains of the animals due to the reduced competition for feed. In addition, the farmers also have to consider that older palm trees (above 10 years after planting) will give less weight gain to the cattle since there is less grass under the heavier canopy as suggested by the expert in the interview.

The experts explained that there are several types of farms involves in ICOFS adoption in Malaysia which are Federal Land Development Authority (FELDA) Plantations, Rubber Industry Smallholders Development Authority (RISDA), Federal Land Consolidation and Rehabilitation Authority (FELCRA), private plantations, state agencies, and smallholders. For smallholders, FELDA settlers are the highest among them. These farm types are consistent with the farm type mentioned as mentioned by [Ismail, \(2016\)](#) and [Tohiran et al, \(2019\)](#).

The result gained from the interview were consistent with previous literature ([PEMANDU, 2012](#); [Sharif & Mohamed, 2005](#)) however, the expert gave extra elaborations upon the data gathered from the interview. As mentioned by the expert, two government agencies provide a platform for ICOFS adopters to seek assistance which is MPOB and DVS. MPOB has an integration unit in which their field officers are responsible to broaden the technology of good oil palm management as well as providing information on good ICOFS adoption. MPOB has staffs thus they can cover a small number of farms that involve in ICOFS. While for DVS, they give advice, technical support, consultation, and encouragement to the farmers. They also offer tax exemptions to adopters for 5 years. The expert also explained that DVS handles two ICOFS scheme, which is EPP5 and TRUST. EPP 5 focuses on cattle and oil palm integration, but there are some rules to be followed. TRUST scheme is for all types of the farm (free-grazing cows, green lot, and feedlot farm). In this scheme, the farmers need to return the cows to DVS when they receive the offspring and the calves need to be less than 18 months of age.

## CONCLUSION

This research gives a more detailed explanation in order to explore the current practice of ICOFS in Malaysia and the effect of factors of adoption and constraints to adoption on ICOFS adoption. The five dimensions of factors to adoption, i.e.; capital availability, cost of adoption, bio-physical suitability, labor availability and information and know-how, and four dimensions of constraints to adoption, i.e.; production and on-farm, marketing and economics, technology and mechanization, and government support and policy, had been explored in order to find the relationship between them. Thus, theoretically, the relationship could be an important finding for theory related to ICOFS adoption. Practically, the factors and constraints to adoption could display and the undiscovered key to increasing the adoption of ICOFS among farmers.

## LIMITATION

Although the background of this study has offered a significant research design, some limitations did occur. A number of limitations need to be addressed when using the findings derived from this research. First, the quantitative research conducted focuses only on the context of ICOFS in Johor Malaysia, which means that the size of the respondent is limited. This study is only limited to farmers in Johor and may hinder the generalizability of the findings. Therefore, the quantitative results obtained will only represent ICOFS in Johor Malaysia and it is uncertain whether the findings of this research can be generalized or represented general populations of other ICOFS in Malaysia. However, this is compensated with the qualitative findings which are collected from experts from throughout Malaysia.

Secondly, it has to be noted that the next possible limitations could be derived from distractions factors such as different levels of understanding among respondents. This might result in bias during the process of filling in the questionnaire by the respondent. Thirdly, this study conducted the interviews only on four ICOFS experts. Though it is adequate ([Parse, 1990](#)), it is quite a small number of respondents for interviews. This also might create bias in the answer.

## STUDY FORWARD

The first suggestion is the replication of this study within the greater domain by utilizing different groups of farmers and organizations for providing more generalization of outcomes. Additional studies can be conducted to develop the model of ICOFS adoption and outcomes in all states in Malaysia reflecting all adopters and non-adopters. Further research could be done to estimate the adoption score by early adopters, middle adopters, and late adopters of ICOFS. In addition, it is suggested that further research is done to survey the model of ICOFS adoption in other developing countries for comparison of results.

The dependent variable of this research was minimized concerning only the adoption score of ICOFS, hence further research can be done to establish the effect of factors affecting adoption and constraints to adoption on other attitudinal and psychological outcomes such as satisfaction, success, involvement, and degree of use.

## ACKNOWLEDGMENT

The authors would like to thank you to Research Management Office (RMC), Universiti Tun Hussein Onn Malaysia for allowed this paper to be presented by covering fees by using research funds (E15501) UTHM.

## AUTHORS CONTRIBUTION

The authors affirmed that there is no conflict of interest in this article. Both authors Abd Rahman Ahmad and Aini Syafiqah Mohd Nasir have contributed to the overall writing of this paper. Indeed Aini Syafiqah Mohd Nasir has done good jobs in preparing the overall work.

## REFERENCES

1. Ahmad, A. R., Nasir, A. S. M., Soon, N. K., Isa, K., & Yusoff, R. M. (2018). Adoption of Integrated Farming System of Cattle and Oil Palm Plantation in Malaysia. *Advanced Science Letters*, 24(4), 2281-2283. <https://doi.org/10.1166/asl.2018.10935>
2. Agus, A., & Widi, T. S. M. (2018). Current situation and future prospects for beef cattle production in Indonesia—A review. *Asian-Australasian journal of animal sciences*, 31(7), 976. <https://doi.org/10.5713/ajas.18.0233>
3. Altieri, M. A., & Nicholls, C. I. (2017). The adaptation and mitigation potential of traditional agriculture in a changing climate. *Climatic Change*, 140(1), 33-45. <https://doi.org/10.1007/s10584-013-0909-y>
4. Awalludin, M. F., Sulaiman, O., Hashim, R., & Wan Nadhari, W. N. A. (2015). An overview of the oil palm industry in Malaysia and it's waste utilization through thermochemical conversion, specifically via liquefaction. *Renewable and Sustainable Energy Reviews*, 50: 1469-1484. <https://doi.org/10.1016/j.rser.2015.05.085>
5. Azhar, B., Saadun, N., Prideaux, M., & Lindenmayer, D. B. (2017). The global palm oil sector must change to save biodiversity and improve food security in the tropics. *Journal of environmental management*, 203, 457-466. <https://doi.org/10.1016/j.jenvman.2017.08.021>
6. Bell, L. W., Moore, A. D., & Kirkegaard, J. A. (2014). Evolution in crop-livestock integration systems that improve farm productivity and environmental performance in Australia. *European Journal of Agronomy*, 57: 10-20. <https://doi.org/10.1016/j.eja.2013.04.007>
7. Behera, U. K., & France, J. (2016). Integrated farming systems and the livelihood security of small and marginal farmers in India and other developing countries. In *Advances in Agronomy* (Vol. 138, pp. 235-282). Academic Press. <https://doi.org/10.1016/bs.agron.2016.04.001>
8. Bisnis Indonesia. (2018, 21 November 2018). *Cattle in Oil Palm Plantation, Why Not?* Bisnis Indonesia, from <http://www.redmeatcattlepartnership.org/news-detail/16/cattle-in-oil-palm-plantation-why-not>
9. Creswell, J. W. (2014). *Research Design: qualitative, quantitative, and mixed-method approaches* (4th ed. ed.). California, USA: SAGE Publications, Inc.
10. Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed method research* (2nd ed. ed.). California, USA: SAGE Publications, Inc.
11. Department of Veterinary Services, D. (2016). Malaysia: Imported Livestock and Livestock Products 2012-2016. [http://www.dvs.gov.my/dvs/resources/user\\_1/DVS%20pdf/perancangan/2018/Perangkaan%202016%202017/4.Muka\\_Surat\\_16-17\\_.pdf](http://www.dvs.gov.my/dvs/resources/user_1/DVS%20pdf/perancangan/2018/Perangkaan%202016%202017/4.Muka_Surat_16-17_.pdf)
12. Department of Veterinary Services, D. (2017). Malaysia: Livestock Statistics 2011-2017, from [http://www.dvs.gov.my/dvs/resources/user\\_1/DVS%20pdf/perancangan/2018/Perangkaan%202016%202017/3.Muka\\_Surat\\_1-15\\_.pdf](http://www.dvs.gov.my/dvs/resources/user_1/DVS%20pdf/perancangan/2018/Perangkaan%202016%202017/3.Muka_Surat_1-15_.pdf)
13. Gabdo, B. H., & Abdlatif, B. I. (2013). Analysis of the Benefits of Livestock to Oil Palm in an Integrated System: Evidence from Selected Districts in Johor, Malaysia. *Journal of Agricultural Science*, 5(12): 47-55. <https://doi.org/10.5539/jas.v5n12p47>
14. Gil, J. D. B., Garrett, R., & Berger, T. (2016). Determinants of crop-livestock integration in Brazil: Evidence from the household and regional levels. *Land Use Policy*, 59, 557-568. <https://doi.org/10.1016/j.landusepol.2016.09.022>
15. Hashim, F. A. H. (2015). *Strategies to Strengthen Livestock Industry in Malaysia*, from [http://ap.fftc.agnet.org/ap\\_db.php?id=477](http://ap.fftc.agnet.org/ap_db.php?id=477)

16. Hayatudin, H. (1998, 25 August). *Private firms are not keen on integrated farming*. New Straits Times.
17. Hayatudin, H. (1998a, 25 August). *Private firms are not keen on integrated farming*. New Straits Times.
18. Hayatudin, H. (1998b). *Private firms are not keen on integrated farming*. New Strait Times.
19. Ib, A. O. (1999, 9 November). *Good Response for Integrated Cattle Farming*. Bernama News.
20. Ibragimov, A., Sidique, S. F., & Tey, Y. S. (2019). Productivity for sustainable growth in Malaysian oil palm production: A system dynamics modelling approach. *Journal of Cleaner Production*, 213, 1051-1062. <https://doi.org/10.1016/j.jclepro.2018.12.113>
21. Ismail, D. (2016, 15 December 2016). *Sistem Integrasi Ternakan Lembu*. Utusan Malaysia.
22. Ismail, D., & Abdul Wahab, K. H. (2014). Sustainability of cattle-crop plantations integrated production systems in Malaysia. *International Journal of Development and Sustainability*, 3(2): 252-260.
23. Kumar, R. R., Sanjeeva, P., & Kumar, B. V. (2018). Transforming Traditional Farming into Smart Farming Using Drones. In *Proceedings of the Second International Conference on Computational Intelligence and Informatics* (pp. 589-598). Springer, Singapore. [https://doi.org/10.1007/978-981-10-8228-3\\_54](https://doi.org/10.1007/978-981-10-8228-3_54)
24. Maru, Y., Sparrow, A., Stirzaker, R., & Davies, J. (2018). Integrated agricultural research for development (IAR4D) from a theory of change perspective. *Agricultural Systems*, 165, 310-320. <https://doi.org/10.1016/j.agsy.2016.09.012>
25. Melissa, A. Y., Norsida, M., & Nolila, M. N. (2016). Socio-economic factors in relation to small ruminant farming potential in Malaysia: Ranchers' perspective. *International Journal of Agriculture, Forestry and Plantation*, 2, 72-76.
26. Ministry of Agriculture and Agro-Based Industry Malaysia, M. (2015c). *Kenyataan Media : Pengimportan Daging Kerbau dari India*, from [http://www.moa.gov.my/web/guest/siaranakhbar\\_april3](http://www.moa.gov.my/web/guest/siaranakhbar_april3)
27. Ministry of Agriculture and Agro-Based Industry Malaysia, M. (2011). *Dasar Agromakanan Negara 2011-2020 (DAN)*, from <http://www.moa.gov.my/web/guest/dasar-agromakanan-negara-2011-2020-dan>
28. Ministry of Agriculture and Agro-Based Industry Malaysia, M. (2019b). *Hala Tuju Kementerian Pertanian dan Asas tani 2019-2020: Prioriti dan Strategi*. Putrajaya.
29. Ministry of Agriculture and Agro-Based Industry Malaysia. (2015a). *Guna Tanah Pertanian Semenanjung Malaysia*. Retrieved 30 September 2015, from <http://www.data.gov.my/data/dataset/c2a3e12b-64a4-457f-ba23-d8bf5719ecc4/resource/23fb0ff7-9adf-41bd-8722-4db95c51b17d/download/jad9210.4.xlsx>
30. Ministry of Agriculture and Agro-Based Industry Malaysia. (2015b). *Maklumat Ternakan Lembu 2009-2014*. Retrieved 30 September 2017, from <http://www.data.gov.my/data/dataset/595b6cb0-60b4-4b9e-98b0-a881f5b1422f/resource/42d7953b-e9fd-485e-85b6-60d5aaf4c2e6/download/jad424.1.1.xlsx>
31. Nazli, M. H., Halim, R. A., Abdullah, A. M., Hussin, G., & Samsudin, A. A. (2018). Potential of feeding beef cattle with whole corn crop silage and rice straw in Malaysia. *Tropical animal health and production*, 50(5), 1119-1124. <https://doi.org/10.1007/s11250-018-1538-2>
32. Nur, T. M., Fadli, C., & Satriawan, H. (2018). Analysis of the Potential Integration of Palm Oil-Cattle in Bireuen Regency, Aceh Province. *AGRARIS: Journal of Agribusiness and Rural Development Research*, 4(2), 69-80. <https://doi.org/10.18196/agr.4262>
33. Paris, T. R. (2002). Crop-animal systems in Asia: socio-economic benefits and impacts on rural livelihoods. *Agricultural Systems*, 7: 147-168. [https://doi.org/10.1016/S0308-521X\(01\)00041-5](https://doi.org/10.1016/S0308-521X(01)00041-5)
34. Parse, R. R. (1990). Parse's Research Methodology with an Illustration of the Lived Experience of Hope. *Nursing Science Quarterly*, 3(1): 9-17. <https://doi.org/10.1177/089431849000300106>
35. Paterson, R. R. M., & Lima, N. (2018). Climate change affecting oil palm agronomy, and oil palm cultivation increasing climate change, require amelioration. *Ecology and Evolution*, 8(1), 452-461. <https://doi.org/10.1002/ece3.3610>
36. PEMANDU. (2012). *ETP Annual Report 2012*. Putrajaya.
37. PEMANDU. (2013). *ETP Annual Report 2013*. Putrajaya.
38. Romelah, S., & Niswati, A. (2017). Improvement of Physical and Chemical Soil Quality of Oil Palm Plantation through the Integrated Farming System of Cattle and Oil Palm to Achieve Sustainable Agriculture. *Journal of Tropical Soils*, 22(2), 113-123. <https://doi.org/10.5400/jts.2017.v22i2.113-123>
39. Rose, D. C., Sutherland, W. J., Barnes, A. P., Borthwick, F., Ffoulkes, C., Hall, C., ... & Dicks, L. V. (2019). Integrated farm management for sustainable agriculture: Lessons for knowledge exchange and policy. *Land Use Policy*, 81, 834-842. <https://doi.org/10.1016/j.landusepol.2018.11.001>
40. Sadiq, M. B., Syed-Hussain, S. S., Ramanoon, S. Z., Saharee, A. A., Ahmad, N. I., Zin, N. M., ... & Mansor, R. (2018). Knowledge, attitude and perception regarding antimicrobial resistance and usage among ruminant farmers in Selangor, Malaysia. *Preventive veterinary medicine*, 156, 76-83. <https://doi.org/10.1016/j.prevetmed.2018.04.013>
41. Sharif, Z. A., & Mohamed, W. Z. (2005). *Beef Production for Malaysian Entrepreneurs*. Malaysia: Malaysian Agricultural Research and Development Institute (MARDI).
42. Silalahi, F. R., Rauf, A., Hanum, C., & Siahaan, D. (2018). *The characteristic and problems of beef cattle-palm oil integration in Indonesia*. Paper presented at the IOP Conference Series: Earth and Environmental Science. <https://doi.org/10.1088/1755-1315/205/1/012016>

43. Salendu, A. H. S., Elly, F. H., Osak, R. E. M. F., & Lumenta, I. D. R. (2018). Cattle Farm Development by Forages Cultivation on Coconut Land Based on Carrying Capacity in West Bolangitang, Indonesia. *International Journal of Environment, Agriculture and Biotechnology*, 3(3). <https://doi.org/10.22161/ijeab/3.3.54>
44. Sulc, R. M., & Franzluebbbers, A. J. (2014). Exploring integrated crop-livestock systems in different ecoregions of the United States. *European Journal of Agronomy*, 57: 21-30. <https://doi.org/10.1016/j.eja.2013.10.007>
45. Sulc, R. M., & Tracy, B. F. (2007). Integrated crop-livestock systems in the US Corn Belt. *Agronomy Journal*, 99(2): 335-345. <https://doi.org/10.2134/agronj2006.0086>
46. Suzuki, K., Tsuji, N., Shirai, Y., Hassan, M. A., & Osaki, M. (2017). Evaluation of biomass energy potential towards achieving sustainability in biomass energy utilization in Sabah, Malaysia. *Biomass and Bioenergy*, 97, 149-154. <https://doi.org/10.1016/j.biombioe.2016.12.023>
47. Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social and behavioral research*. Thousand Oaks: Sage Publications, Inc.
48. Tohiran, K. A., Nobilly, F., Zulkifli, R., Ashton-Butt, A., & Azhar, B. (2019). Cattle-grazing in oil palm plantations sustainably controls understory vegetation. *Agriculture, Ecosystems & Environment*, 278, 54-60. <https://doi.org/10.1016/j.agee.2019.03.021>
49. Tohiran, K. A., Nobilly, F., Zulkifli, R., Maxwell, T., Moslim, R., & Azhar, B. (2017). Targeted cattle grazing as an alternative to herbicides for controlling weeds in bird-friendly oil palm plantations. *Agronomy for sustainable development*, 37(6), 62. <https://doi.org/10.1007/s13593-017-0471-5>
50. Viswanathan, P. K., & Shivakoti, G. P. (2008b). Adoption of rubber-integrated farm-livelihood systems: contrasting empirical evidence from the Indian context. *Journal of Forest Research*, 13(1): 1-14. <https://doi.org/10.1007/s10310-007-0047-3>
51. Viswanathan, P., & Shivakoti, G. P. (2008a). Adoption of rubber-integrated farm-livelihood systems: contrasting empirical evidence from the Indian context. *Journal of Forest Research*, 13(1): 1-14. <https://doi.org/10.1007/s10310-007-0047-3>
52. Yusoff, H. H. M., Ismail, N. W., & Kamarulzaman, N. H. (2020). Assessing the comparative advantage of integrated farming and feedlot production system of the ruminant sector in Malaysia: A policy analysis matrix approach. *Asian Journal of Agriculture and Rural Development*, 10(1), 227.
53. Zaimah, R., Sarmila, M. S., Lyndon, N., & Hussain, M. Y. (2018). Agriculture Integration Practice among the Oil Palm Smallholders. *International Information Institute (Tokyo). Information*, 21(6), 1857-1864.
54. Zul, R. M. (1998, 24 August). *Plantation Companies Say No to Integrated Livestock Farming*. Bernama News.