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Factors Contributing to China's Intake of Palm Oil

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ABSTRACT

China, a country with the largest population of over 1.3 billion was identified as a region with huge potential for export market. Currently, China is one of the largest palm oil importers and has shown an increasing trend over the years, with CAGR of 7.87 from 1.40 million tonnes to 6.37 million tonnes between 2000 and 2020. This translated into a scenario of a growing palm market in China. Thus, this study aims to investigate factors influencing the demand for palm oil in China using Autoregressive Distributed Lag (ARDL). Annual time series data from 1980 to 2019 has been used for the analysis. The bound test indicates that there is a long run relationship among the studied variables. The empirical results showed that gross domestic products, both in producing and importing countries; consumer price index; palm oil consumption; the population of China; palm oil and soyabean oil prices are the significant determinants of Malaysian palm oil demand in China.

Keywords: ARDL, bound test, CPI, error correction models, palm oil.

INTRODUCTION

China is the world's largest consumer of oils and fats (Oil World, 2021). As the world's most populous country with a population of over 1.3 billion, China consumed more than 38.6 million tonnes of oils and fats and is becoming one of the leading importers of oils and fats in the world market which amounting to about 13.9 million tonnes per year (National Bureau of Statistics of China, 2021). Due to land constraints and shortages in domestic oils and fats production, as well as competition in grain production, China has continued to rely on imported oils and fats to meet their country's demand for oils and fats (Ooi and Yoong, 2011).

With China's diversity in population, the type of oil consumed somewhat follows the regional patterns that can be explained by climatic conditions, land conditions for growing oil crop, cultural taste and preference as well as consumers' socioeconomic standards (Sheng and Song, 2019). As the per capita income increases, the pattern of vegetable oil consumption in this country has also increasingly diversified. The consumption pattern of vegetable oils in China has been changing through time. In 2000, the major vegetable oil consumed in China was rapeseed oil, which accounted for 25% of the total oils and fats consumption. This was then followed by groundnut oil, butterfat, palm oil and soyabean oil. However, in 2020, the five major vegetable oils consumed in China were soyabean oil, palm oil, sunflower oil, rapeseed oil and groundnut oil (*Figure 1*). The shift and increase in consumption of soyabean oil and palm oil in China since 2011 can be attributed

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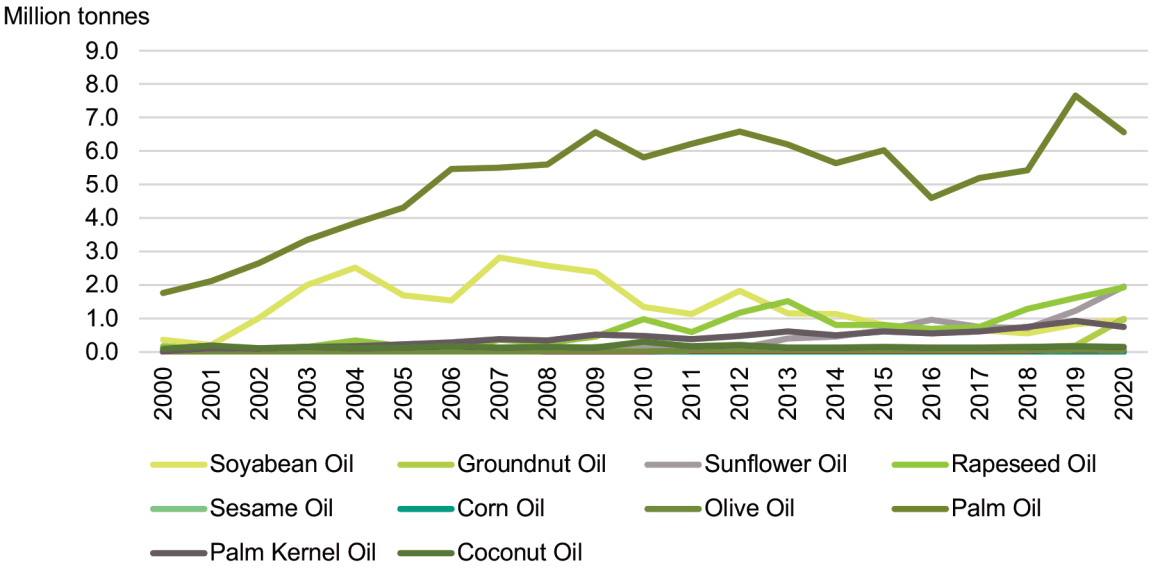


Sources: Oil World 2004; 2008; 2012; 2017 and 2020.

Figure 1. China oils and fats imports.

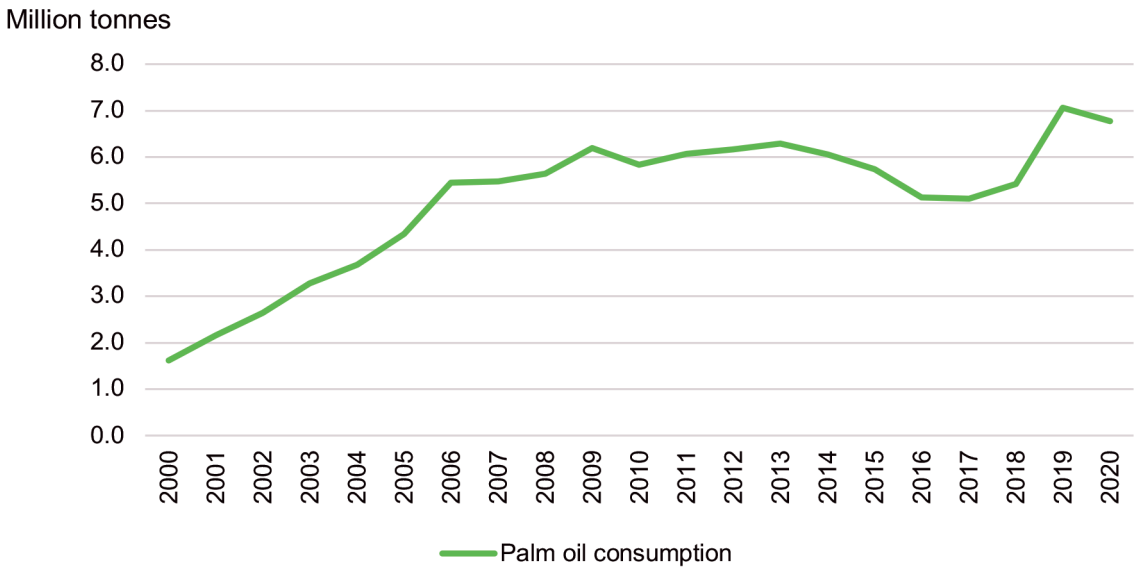
to various factors, including high economic growth, huge demand for animal feed and rising demand for processed foods (Guolin *et al.*, 2017).

In particular, soyabean and palm oil markets in China fluctuated up and down depending on the situation. The major disruption of soyabean's trade flow from the United States (US) to China trade war in July 2018 stretching to 2019 has triggered a major, but a temporary shift in China's reliance on the United States (US) soyabean to palm oil in order to meet its edible oil needs (Palmoil Update, 2020). A booming animal feed market against a flat domestic production of soyabean have increasingly turned China to be heavily dependent on the soyabean import, which is subsequently crushed to meet local demand for the animal feed industry but intensifying the supply of soyabean oil as a by-product from soyabean meal. The hike in tariff led China's soyabean import in 2017 from the United States (US) to fall by 49.4% or 16.2 million tonnes to 16.6 million tonnes in 2018. The drop in soyabean imports reduces soyabean crushing activities, which led to a reduction in soyabean oil production. The reduction in crushing was also exacerbated by lower domestic demand for meal arising from the African Swine Fever (Palmoil Update, 2020).

Nonetheless, understanding the China's market demand and buying patterns of palm oil is important as palm oil ranked second behind soyabean oil, which accounted for 42.0% of China's oils and fats consumption (Oil World, 2021) *Figure 2*. China also ranked fourth as the major palm oil consuming countries after Indonesia, India and the European Union, with the main competitors to palm oil in China are soyabean oil, rapeseed oil, sunflower oil and groundnut oil (MPOB, 2021). According to Oil World (2021), the main sources of China's palm oil import are from Indonesia and Malaysia, with these two largest producers commanding 99% of the total China's palm oil demand. In 2020, Malaysian palm oil export to China was 2.73 million tonnes, an increase of 9.6% from 2.49 million tonnes in 2019 (MPOB, 2021), China's palm oil consumption is mainly in the form of refined, bleached, deodorised palm olein and is often blended with other oils to meet its domestic consumer taste preference (Schleifer, 2018).

The world has also witnessed a tremendous growth in the consumption of palm oil. Over the years from 2010 to 2020, the global palm oil consumption was increased by 7.37% compound annual growth rate (CAGR) from 1.62 to 6.72 million tonnes (Oil World, 2020). This is due to the fact that palm oil is competitively priced as compared to other vegetable oils, is widely available throughout the year, unlike seasonal crops, and has ubiquitous application from edible to the oleochemicals sectors (Murphy, 2014).

Despite the fact that the information related to palm oil demand in China is very important for policy makers and exporters in Malaysia to understand the factors that shape the importing and buying pattern of edible oils and fats in China, published literature on the demand for palm oil in China is very limited and need further exploration. Thus, this article aims to investigate factors influencing



Sources: Oil World 2004; 2008; 2012; 2017 and 2020.

Figure 2. China palm oil consumption.

the demand for palm oil in China. The rest of the article is structured as follows: brief discussion on the literature review with references to palm oil consumption and trade, particularly in China. The third section describes the research methodology, followed by results and discussion. Finally, the conclusion and policy implications in the last section of the article.

LITERATURE REVIEW

Being the fastest growing vegetable oil consumed in the world, the rising importance of palm oil for global consumption has encouraged lots of research being conducted in this area. Hameed *et al.* (2016) explored factors influencing palm oil import in six Asian countries, namely China, India, Bangladesh, Japan, Pakistan and Korea by using the ARDL model. The study found that, palm oil prices, substitute oil prices and the national income of the importing countries represented the most significant determinants of palm oil demand across the studied countries. It has some similarities with that of Awad *et al.* (2007), which also found that price of substitute oils plays an important role in influencing palm oil demand. Each country has different palm oil substitute such as in Saudi Arabia and Libya, the palm oil substitute is corn oil, in Sudan is rapeseed oil, in Syria it is sunflower seed oil and in Algeria, Egypt, Iran, Jordan, Morocco, and Turkey is soyabean oil (Awad *et al.*, 2007). According to a study conducted by Zakaria *et al.* (2017) on the relationship between palm oil and soyabean oil, there is a positive influence arising from the difference in the price of soyabean oil and palm oil on China's palm oil demand, and it shows that in China, soyabean oil is a substitute for palm oil. Besides that, a study by Parveez *et al.* (2019) also showed that there is a relationship between soyabean and palm oil demand in China, where in Malaysian palm oil exports to China increased by 33.9% due to lower import of soyabean for domestic crushing because of the African swine fever and the trade war between China and the United States (US). However, in terms of price, palm oil is more competitive as compared to other competing oils (Nambiappan *et al.*, 2018).

Demand for palm oil in China remains stable as it is competitively priced over that of soyabean and rapeseed oils. The strong demand is also due to the blending of palm oil with other vegetable oils for the use as cooking oil. The demand for processed food, such as instant noodle, snacks and biscuits also contributed to the demand for palm oil (Hao and Keat, 2015). The study by Weuxun and Xiaoshu (1995) found that palm oil is mainly used in the food manufacturing industry in China, especially in the production of instant noodles and snack foods as well as in the manufacturing of margarine and shortening. In addition, this study also noted that in China, palm oil never being used as domestic cooking oil directly, yet it is used as one of the components in the blended cooking oil. According to Hao *et al.* (2018) in Southern China, palm oil is used as a major component in blended cooking oil. China also uses palm oil as an ingredient for personal care, such as facial, shower, and other liquid preparations (Pheng, 2002). In China, every region has their own food taste preference depending on

their culture (Reedy and Anitha, 2015). Study by Fang and Beghin (2002) using urban household survey from 1992 to 1998 found that the demand for edible oils and fats in three regions in China have positive income elasticity, indicating that an increase in income would lead to an increase in the demand for edible oils and fats expenditure. The study found that 1% increase in income would lead to an increase of 0.47%, 0.29% and 0.45% of edible oils and fats expenditure for the Northeast, Middle, Western and Southern regions, respectively. The study concluded that income is a determinant for edible oils consumption in China.

China's palm oil imports mainly comes from Indonesia and Malaysia. There are several studies carried out on Malaysian and Indonesian palm oil competitiveness. Rifin (2009) analysed the export competitiveness of the Indonesian palm oil products over that of Malaysia in the Asia, Africa and Europe regions. Results from the study showed that palm oil exported from Indonesia is more competitive than that of Malaysia in the studied countries. Rifin (2013) constructed an import demand equation using Almost Ideal Demand System (AIDS) to study the competitiveness between the Indonesian and Malaysian palm oil products in China and India. The study found that Indonesian palm oil is close to a unitary elastic on both compensated and uncompensated elasticities. Meanwhile, Malaysian palm oil was found to be non-sensitive to price changes as compared to that of Indonesian palm oil. Additionally, the study also found that instead of competing with each other, the Indonesian and Malaysian palm oil imports in China are actually complement to each other in order to increase the world demand for palm oil in the future. Salleh *et al.* (2016) also studied the comparative advantages of Malaysia and Indonesia in crude palm oil (CPO) and processed palm oil (PPO) exports to five major markets namely China, India, the European Union (EU), Pakistan and United States (US) over the period 1999 to 2014 found that Indonesia has more comparative advantages in exporting palm oil to China.

From other perspectives, there are studies discussed on the decision making of edible oils consumption. Narayanasamy and Ramasamy (2011) found that, one of the determinants influencing customer choice in buying edible oils in the market is age. Customers, who are in the age category of below 25 years, tend to make the decision to purchase edible oils based on the retailer's suggestion. With regards to the customers, in the age group of 31 to 40 years, newspaper advertisements help them to make decisions when purchasing edible oils. For those who are in the age category of above 40 years they were influenced by television advertisement. It showed that, age is one of the factors that could influence the demand for oils and fats. Besides that, Kumar (2014) found that there are also other factors influencing consumer decision in making edible oil purchases, which are brand image, price, health, consciousness and quality.

METHODOLOGY

The annual data on China's palm oil import, and vegetable oils consumption from 1980 to 2019 were collected from Oil World

TABLE 1. LIST OF VARIABLES

Variables	Source	Justification of variables
China's palm oil import	Oil World 1985, 1990, 1995, 2000, 2004, 2008, 2012, 2017 and 2020	This study used China's palm oil import as a proxy for China's intake of palm oil
China's palm oil consumption	Oil World 1985, 1990, 1995, 2000, 2004, 2008, 2012, 2017 and 2020	This study used China's palm oil consumption as a proxy for China's market
Prices of palm oil	UNCTADSTAT	This study used palm oil price to measure the impact of its price (followed by demand theory)
Price of soyabean oil and sunflower oil	UNCTADSTAT	This study used price of soyabean oil and sunflower oil to measure the impact of substitute price (followed by demand theory)
GDP of Malaysia and China	World Development Indicator (WDI)	This study used GDP as a proxy for income
China's population	World Development Indicator (WDI)	This study used population to measure the market of the countries
China's CPI	World Development Indicator (WDI)	This study used CPI as a proxy for purchasing power of the country

report 1985, 1990, 1995, 2000, 2005, 2010, 2015, 2019 and 2020. Data on prices of palm oil, soyabean and sunflower oil were annual data from 1980 to 2019, which were sourced from United Nations Conference on Trade and Development (UNCTADSTAT) and annual data for Malaysian GDP, China's population, Consumer Price Index (CPI) and Growth Domestic Product (GDP) from 1980 to 2019 were sourced from World Development Indicator (WDI). The summary of variables used in the study are as shown in *Table 1*.

Autoregressive Distributed Lag (ARDL) Analysis

Autoregressive Distributed Lag (ARDL) method is used to deal with the variables that have a stationary series mixture of I(0) and I(1). ARDL model is superior to the other cointegration model and provides reliable results even with a small sample size. Autoregressive Distributed Lag (ARDL) model having problem of endogeneity during estimations. Endogeneity problem can be solved by taking lags of variables and make the model dynamic as in Pesaran *et al.* (2001). Thus, this study employed the Autoregressive Distributed Lag (ARDL) bound testing approach to cointegration developed by Pesaran *et al.* (2001) to verify the long run relationship between variables. The Estimated ARDL model is as follows:

where,

α, β and δ	:	Parameters to be estimated
POimport	:	Palm Oil Import by China
CHNGDP	:	Gross Domestic Product of China
CHNCPI	:	Consumer Price Index of China
POP	:	Population of China
PCPO	:	Palm Oil Price
PSOY	:	Soyabean Oil Price
POCON	:	Palm Oil Consumption
MYSGDP	:	Malaysian Gross Domestic Product
ε_t	:	Error term

Once cointegration is established, the conditional ARDL long run model can be estimated as follows:

$$lnPOimport_t = \alpha_0 + \delta_1 lnCHNGDP_{t-1} + \delta_2 \Delta lnCHNCPI_{t-i} + \delta_3 \Delta lnPOP_{t-i} + \delta_4 \Delta lnPCOP_{t-i} + \delta_5 \Delta lnSOY_{t-i} + \delta_6 \Delta lnPOCON_{t-i} + \delta_7 \Delta lnMYSGDP_{t-i} + \varepsilon_t \quad (2)$$

Finally, the study looked at the short run dynamic parameters by estimating an error correction model associated with the previously determined long run estimates. ARDL error correction model is expressed with the following equations:

$$\Delta lnPOimport_{it} = \alpha_0 \sum_{i=1}^{p} \beta_{1i} \Delta lnCHNGDP_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnCHNCPI_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPOP_{t-i} + \sum_{i=0}^{s} \beta_{4i} \Delta lnPCPO_{t-i} + \sum_{i=0}^{t} \beta_{5i} \Delta lnSOY_{t-i} + \sum_{i=0}^{u} \beta_{6i} \Delta lnPOCON_{t-i} + \sum_{i=0}^{v} \beta_{7i} \Delta lnMYGDP_{t-i} \quad (3)$$

$$\Delta lnPOimport_{it} = \alpha_0 \sum_{i=1}^{p} \beta_{1i} \Delta lnCHNGDP_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnCHNCPI_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPOP_{t-i} + \sum_{i=0}^{s} \beta_{4i} \Delta lnPCPO_{t-i} + \sum_{i=0}^{t} \beta_{5i} \Delta lnSOY_{t-i} + \sum_{i=0}^{u} \beta_{6i} \Delta lnPOCON_{t-i} + \sum_{i=0}^{v} \beta_{7i} \Delta lnMYGDP_{t-i} + \delta_1 lnCHNGDP_{t-1} + \delta_2 \Delta lnCHNCPI_{t-i} + \delta_3 \Delta lnPOP_{t-i} + \delta_4 \Delta lnPCPO_{t-i} + \delta_5 \Delta lnSOY_{t-i} + \delta_6 \Delta lnPOCON_{t-i} + \delta_7 \Delta lnMYSGDP_{t-i} + \varepsilon_t \quad (1)$$

Where β_1, β_2, β_3, β_4, β_5, β_6, and β_7 are the short-run dynamic coefficients of the model's convergence to the equilibrium, γ^* is the speed of adjustment parameter and ECM is the error correction term that is derived from the estimated equilibrium relationship of Equation (1).

RESULTS AND DISCUSSION

Autoregressive Distributed Lag (ARDL) Analysis

The result of the bound test for cointegration is shown in *Table 2*. This test is based on the Wald test or F statistic and is conducted against the null hypothesis of the existence of a long run relationship between the variables. The result of the bound test indicated the existence of a long run relationship between the variables. This is because the F statistic result is higher than the upper bound critical value at the 1% level of significance (Pesaran *et al.*, 2001).

Long Run Estimations

The empirical results of the long run models are presented in *Table 3*. The results indicated that income as measured by China's GDP has a long run positive influence on China's palm oil import. The finding also found China's GDP is elastic, indicated that palm oil is perceived by China as a normal product. The model showed that in the long run, the every 1% increase in China's GDP would increase demand for

TABLE 2. COINTEGRATION TEST BASED ON THE BOUND TEST RESULT

Significant level (%)	Upper bound value	Upper bound value
90	3.800	5.643
95	2.797	4.211
99	2.353	3.599
	4.4990**	

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

TABLE 3. ESTIMATED LONG RUN COEFFICIENTS USING ARDL APPROACH

Variable	Coefficient	t-statistic	Probability
CHNGDP	0.1107	2.8083	0.0121**
CHNCPI	0.1812	9.9397	0.0000***
POP	9.9959	5.6293	0.0000***
PCPO	-7.3135	-8.7023	0.0000***
PSOY	7.2361	7.4649	0.0000***
POCON	-2.0535	-2.4889	0.0235**
MYSGDP	-7.201	-4.68361	0.0002***

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

palm oil in China by 0.1%. The positive relationship between GDP and demand for palm oil is in line with several other studies (Talib and Zaimah, 2002; Awad *et al.*, 2007; Egwuma *et al.*, 2016; Zakaria, 2019). Furthermore, GDP also reflects to market size (Sahoo, 2012; Bahri *et al.*, 2018), market size is an important factor in determining the potential for local sales (Wang and Swain, 1995).

Since CPI represents the purchasing power of the consumers, China's CPI also has a significant influence on the demand for palm oil with positive relationship. The finding also found that the elasticity is very small. For every increase of 1% in China's CPI will lead to an increase of 0.2% on demand for palm oil. This finding is aligned with that of Papi and Lim (1997) and Abidemi and Malik (2010), which indicated that import has a positive association with CPI.

Another factor that positively influenced the demand for palm oil in China is population of China (POP). This study showed that POP has provided a long run positive influence on China's palm oil import and its elasticity is greater than one (1). It indicates that the percentage of POP is high. For every 1% increase in China's POP, demand for palm oil in China would increase by 9.9%. The result is in line with the USDA (2016) findings, which indicated that growth in China's population has increased the demand for oils and fats. It also supported by MPOC (2009) which found that one of the reasons for the increase in palm oil consumption in China is the country's population.

Next are soybean oil price (PSOY) and palm oil prices (PCPO). PSOY also has a positive and significant relationship with the demand for palm oil. The results show that PCPO and PSOY prices are elastic and the elasticity is greater than one. It indicates that China palm oil demand is highly sensitive to price changes. When PSOY increases by 1%, it will lead to an increase of 7.2% on palm oil demand. Meanwhile, PCPO had a negative and significant influence on the demand for palm oil. For every 1% increase in PCPO, it will lead to a decrease of 7.3% in the demand for palm oil. The results are in line with the demand theory, that substitute price has a negative relationship with own price. In the vegetable oils market, PSOY is a substitute to palm oil. This finding is similar to that of several other studies, such as Amiruddin *et al.* (2005); Awad *et al.* (2007) and Zakaria (2019).

Besides that, palm oil consumption (POCON) and Malaysian GDP also have a negative influence on the demand for palm oil in China. The study also shows that the POCON and Malaysian GDP are elastic, which indicates that the percentage of POCON and Malaysian GDP is high. Any changes in these two variables will have a significant impact on China's palm oil consumption. The model indicated that in the long run, every 1% increase in POCON and Malaysian GDP, China's palm oil import will decrease by 2.05% and 7.3%, respectively. This result is in line with that of several studies conducted regarding the relationship between income and demand for palm oil such as study by Hameed *et al.* (2007), which found that income of Algeria, Egypt, Iran Jordan, Morocco and Turkey is a significant determinant of palm oil demand. Meanwhile, a study by Egwuma (2016) found Nigeria's income significantly influence demand for palm oil and study by Zakaria (2019) also found that income of Bulgaria and Greece significantly influence demand for palm oil in these countries.

Short Run Error Correction Models

The short run error correction model (ECM) from ARDL model is presented in *Table 4*. Most of the variables were found to be significant in the short run. It is found that, lagged palm oil import, consumer price index of China, population of China, and soyabean oil price had positive relationships with palm oil import for China. Lagged palm oil price, population of China and palm oil consumption had negative relationships with palm oil import for China. The error correction terms (ECT (-1)) are negative and highly significant. It showed that there was causality in at least one direction. The ECT coefficient is -0.6, which indicated higher rate of convergence to the equilibrium.

Table 5 shows the result of Breusch-Godfrey and Breusch Pagan Godfrey test for serial correlation and Heteroskedasticity respectively. The Breusch Godfrey test result indicates that there is no problem of serial correlation in the data because the P Value of F statistics is higher than 0.05 and the results of Breusch Pagan Godfrey P value is also greater than 0.05, which confirms the validity of Heteroskedasticity in our data.

CONCLUSION

Factors such as price, population, income, and preference influenced the demand for palm oil. This study focussed on the China's market. The empirical results demonstrated that there are long run relationships among the variables. GDP of China, consumer price index of China, price of soyabean oil and population of China have long run positive influence on China's palm oil import. Meanwhile, other factors in the study showed negative significant influence on China's market for Malaysian palm oil imports is palm oil price, palm oil consumption and the Malaysian GDP. The information gathered is very important for industry players towards planning their market strategies in terms of expanding their market share in China. The findings of this study could also assist the government in terms of strategic planning for palm oil exports, especially to China.

TABLE 4. ERROR CORRECTION REPRESENTATION FOR THE SELECTED ARDL MODEL

Variable	Coefficient	t-statistic	Probability
ΔPOimport(-1)	0.1325	1.4151	0.1751
ΔPOimport(-2)	0.0793	1.0100	0.3266
ΔPOimport(-3)	0.4912	6.0126	0.0000***
ΔCHNGDP	0.0194	1.2507	0.2280
ΔCHNCPI	0.0710	6.4645	0.0000***
ΔPOP	50.1468	5.0112	0.0001***
ΔPOP(-1)	-26.2654	-2.6023	0.0186**
ΔPCPO	-2.4192	-7.8193	0.0000***
ΔPSOY	2.7358	8.0012	0.0000***
ΔPSOY(-1)	-0.3361	-2.6797	0.0158**
ECT	0.5605	-9.4955	0.0000***
Diagnostic test			
R-squared	0.919467		
R-bar squared	0.885911		
Durbin Watson	2.616313		
Schwarz criterion	-0.552725		

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

TABLE 5. SERIAL CORRELATION AND HETEROSKEDASTICITY TEST

Variable	Coefficient	t-statistic	Probability
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	1.719068	F-statistic	0.2127
Obs* R-squared	6.526407	Obs* R-squared (2)	0.0383**
Heteroskedasticity Test: ARCH			
F-statistic	1.711889	F-statistic	0.1977
Obs* R-squared	3.380368	Obs* R-squared (2)	0.1845

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

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Risk Response Strategies of Malaysian Oil Palm Estates for the Downturn in CPO Prices

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ABSTRACT

Being traded in the Bursa Malaysia Derivative market, the price of crude palm oil (CPO) is volatile, which brings uncertainty to the profitability of the palm oil industry players, particularly to the oil palm growers. Lower CPO prices also causes the fresh fruit bunch (FFB) price to decline. Hence, the purpose of this study is to identify the risk mitigation strategies applied by the Malaysian oil palm estates during the low CPO prices environment to remain profitable in businesses. The study aims to examine the best risk mitigation measures practiced by the estates faced with a situation of low CPO prices environment and provides some guidelines to the relevant organisation to prioritise the mitigation measures in order to minimise the risk associated with low CPO prices. Primary data were collected through an online survey to 769 plantations throughout Malaysia. A descriptive and inferential statistical analysis was conducted using the Statistical Package for Social Science (SPSS) version 20. The study also provides various responses from the experienced oil palm players on the most crucial component in mitigating the price risk arising from the downturn in CPO prices. The measures include management of business assets, business diversification and the financial management found to be significant to reduce the risk of price volatility. Meanwhile, elements under the operational business decisions were the least preferred measures to minimise the risk during low CPO prices.

Keywords: oil palm, price volatility, price uncertainties, risk mitigation.

INTRODUCTION

Driven by strong global demand for oils and fats, the palm oil industry particularly in Malaysia has grown rapidly for the past few decades. Today, oil palm dominates the agricultural landscape of the country with the total oil palm planted area at 5.87 million hectares (Parveez *et al.*, 2021). This is accounting for 17.8% of the Malaysian total land area of 33.05 million hectares (DOSM, 2021a). Being the dominant crop in the agricultural landscape of Malaysia, this industry has contributed significantly to the Malaysian economy with the total export revenue of RM73.25 billion in 2020 (DOSM, 2021b).

Apart from its contribution to the national economy, oil palm through its products namely crude palm oil (CPO) and crude palm kernel oil (CPKO) is also

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known to be the only agricultural products that has been traded in the Malaysian derivatives market. Being the most liquid and the most actively traded in the Malaysian derivative market, the crude palm oil future (FCPO) contract is known to be the most successful FCPO contract in the world market, thus, put Malaysia's position as the global price benchmark for the palm oil industry. In view of its liquidity (the frequent change in demand and supply dynamic) and the potential exposure to natural disasters, the commodity market is always known to be more volatile than other asset classes such as equity (stocks), fixed income (bonds) and other types of assets (Dwyer *et al.*, 2011; Chakraborty and Bordoloi, 2012). The volatility of commodity prices might erode return of its players.

Realising the risk of price volatility in the palm oil industry, this study aims to examine the risk mitigation strategies undertaken by the Malaysian oil palm estates particularly during the low CPO prices environment. Unlike annual crops, the decision on when to plant the crop which generally depending on its potential profitability (as the case of soybean) is limited for oil palm. Oil palm is a perennial crop, of which once it is planted, the crop will live up to 30 years and more. Hence, any risk occurs throughout the lifespan of the tree needs to be addressed properly so as not to jeopardise the profitability of the grower.

Landscape of the Malaysian Oil Palm Sector

The oil palm sector in Malaysia is divided into two categories of ownership namely estates (including private estates, government/state agency estates and organised smallholders) and the independent smallholders (ISH). This ownership is defined according to the total area owned by growers as well as the management factor. Growers with oil palm area of 40.46 ha and above will be classified under estates while growers who are individual farmers with oil palm area of less than 40.46 ha and manage the holding themselves or employ workers is known as ISH (Senawi *et al.,* 2019). It is important to note that the scope of this study is confined only to growers in the estate category.

Estates earned revenue by selling fresh fruit bunch (FFB) to the mill. Unlike millers, estate's income is not directly influenced by CPO prices. Their main income is subjected to the movement in FFB prices. As FFB is the main input in the production of CPO, the price of CPO is more important to the estates. The movement in CPO prices determines the movement in FFB price, hence affecting the profitability of estates. *Figure 1* shows the average CPO and FFB prices movement from 2000-2020.

Risks and Mitigation Strategies for Price Risk

Higher CPO prices is always preferable by estates as it is positively associated with profits (Hafizuddin-Syah *et al.*, 2018). However, due to the nature of commodity, which is more volatile against other asset classes, a continuous trend of favourable prices is very less likely to happen in the long run. In the environment of low CPO prices, estates management usually review their strategy towards reducing the production costs in order to ensure satisfactory cash flow and adequate profit for the short term and medium term (Jean-Pierre *et al.*, 2001). One of the strategies in minimising the total cost of risk is by managing the movement of raw materials into the business. This strategy which is also known as supply management approaches suggests businesses to buy input in small quantities but more frequently so as to mitigate the fluctuation in prices (Gaudenzi *et al.*, 2018).

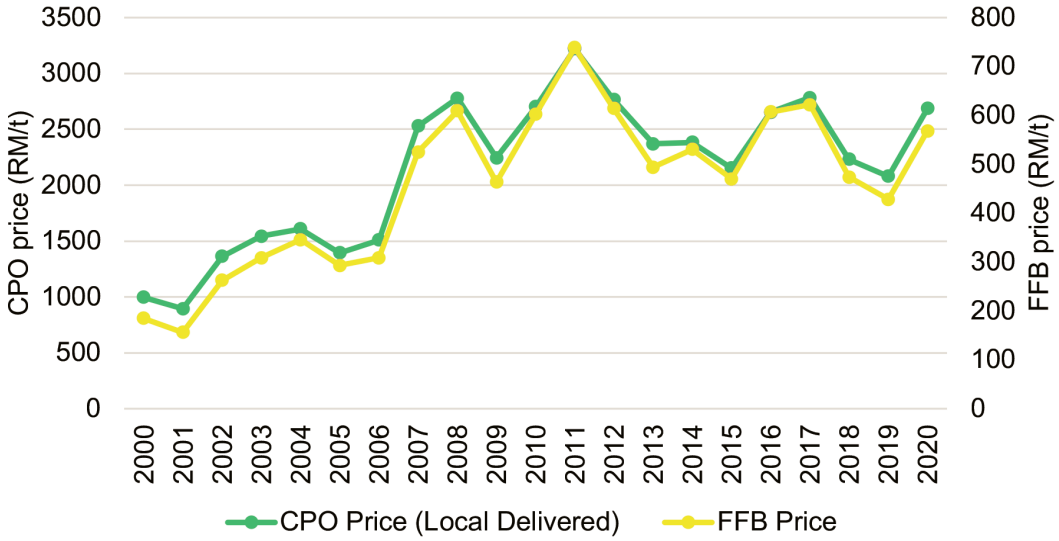
This kind of approach also influences the operational decision of businesses. For instance, the fluctuation in agricultural prices might cause oil palm growers with limited financial capacity such as smallholders and small-sized estates to compromise on the agricultural practices. Among agricultural practices, fertiliser application is the most easily compromised as the decision for fertiliser application is closely associated with the financial condition of the growers (RSPO, 2011). Growers with stable financial capacity scored better in term of fertiliser used (RSPO, 2013).

Apart from reviewing the operational costs, diversification in production was also found to be effective in mitigating the risk in income, caused by the fluctuation in the agricultural prices (Novickytė, 2018; Rahman *et al.*, 2017; World Bank, 2018). In the study on the oil palm plasma smallholders in Jambi, Indonesia, Rahman *et al.* (2017) stated that the diversification of income by the integration of crops and livestock is often found in agricultural areas in Indonesia. However, the integration with either other crops or livestock have some drawback that might require higher expenditure, thus affecting the bottom-line of the growers. For example, the integration with livestock requires good access to other services as it is susceptible to diseases and difficult to control (Devendra, 2005).

METHODOLOGY

Research Design

This study employed a survey methodology by using a questionnaire as an instrument for data collection. Questionnaire



Source: MPOB (2021).

Figure 1. The average crude palm oil (CPO) and fresh fruit bunch (FFB) prices, 2000-2020.

were distributed to estates in order to identify the preferred mitigation strategies of estates during the low CPO prices environment.

Respondents

The respondents of this study consisted of estates licensed with Malaysian Palm Oil Board (MPOB) nationwide. The minimum number of respondents was 352 estates and was based on the formula from Cochran (1977). In totality, there were 4152 estates licensed with MPOB as of February 2019.

Research Instruments

This study employed questionnaire as the instrument to obtain information and data. The use of questionnaire helps to facilitate the data collection in a short span of time and helps respondents to easily understand the elements that are assessed based on their experience in estates. Items in the questionnaire were formulated based on the literature review related to risk management in the plantation and agricultural industries. The questionnaire was divided into three parts and was distributed to the respondents via e-mail.

The first part of the questionnaire consists of estates profile such as license number, estate's name, contact details and parent company (if any). The licensed number is the most important item as it is the proxy for the study in getting the size of the estates. In applying for the license, estates are obliged to declare their oil palm planted area accordingly.

The second part of the questionnaire is on the details of the reporting officer such as the demographic profile, which also include the term of service in that estate. This will help the researcher to return to the respondent if clarification on the information provided is needed. The third part of the questionnaire is the gist of this study. In this part, estates were presented with a list of pre-specified risk management strategies and asked to rate their agreement on each strategy during low CPO prices environment. The 7-point Likert scale was used in this part as it reflects respondent's true subjective evaluation of a usability questionnaire item than a 5-point item scale (Finstad, 2010). Score 1 is to indicate strong disagreement while the higher scores represent higher level of agreement until score 7 which represents the highest level of agreement.

The risk mitigation elements in this part were grouped into four themes namely the operational decision of businesses, management of the business assets, diversification strategies that may help to reduce the risk and the financial management. The details of the elements are as follows:

a) Elements under the operational business decisions
   - Reducing the frequency of fertiliser applied (A1)
   - Reducing the amount of fertiliser (A2)
   - Reducing the frequency of weeding (A3)
   - Reducing the expenses on pest and diseases controls (A4)
   - Purchasing of agricultural input in small quantities (not bulk purchases) (A5)
   - Reducing the harvesting round (A6)
   - Reducing the maintenance cost for road and bun gate (A7)

- Reducing the salary of workers (A8)

b) Elements under the managements of business assets
   - Reducing/freezing the purchase of heavy machines for estates use (B1)
   - Reducing/freezing the purchase of vehicles for office use (B2)
   - Terminating the existing business insurance such as fire or theft (B3)

c) Element under the business diversification strategies
   - Conducting crop and livestock integrations (C1)

d) Elements under the financial management
   - Stable financial allocation (D1)
   - Efficient debt management (D2)
   - Entering into sales contract with palm oil mills (D3)

Pilot Study

Before the actual study took place, a pilot study involving 20 estate managers with vast background in oil palm businesses was conducted. For validity and reliability of the study instrument, the data of this questionnaire were analysed using Cronbach Alpha to obtain the value of the reliability coefficient. According to George and Mallery (2003) for an instrument to be reliable, Cronbach Alpha coefficient value must be at least 0.70. Alpha values less than 0.60 are considered low and not acceptable, while Alpha values between 0.60 and 0.80 are acceptable (Sekaran, 1992). Reliability analysis for the instrument of this study has obtained an average Alpha value of 0.84. The value of above 0.80 indicates the items in this instrument has a high reliability to proceed with the actual analysis.

Data Analysis Procedures

For this study, the data obtained were analysed using Statistical Package for Social Science (SPSS) version 20. Descriptive statistical methods were used to analyse the data as it simplifies the interpretation of the data. The data obtained from the questionnaire were analysed according to the size of the estates. Aforementioned that the minimum size of planted area for estate category is 40.46 ha. Hence, following the classification of Ismail (2019), estates with the size of 40.46 ha of up to 499 ha were classified as small-sized estates, medium-sized is between 500 ha and 1999 ha and large-sized is estates with area of and more than 2000 ha.

RESULTS AND DISCUSSION

Profile of Estates and Reporting Officers

A total of 769 respondents was involved in this study of which, 216 respondents are from large-sized estates. The other 276 respondents were from medium-sized estate and 277 respondents were from small-sized estate (*Table 1*).

Out of the total respondents, 696 or 90.5% of them were male. For large-sized estates, the responses were dominated by male respondents at 95.4%. For medium and small-sized estates, the percentage of male respondents was at 93.5% and 83.8%, respectively (*Table 2*).

In general, respondents were mostly in the middle-aged group of 31 to 40 years old. For large and medium-sized estates, respondents were in the middle-aged group of 31 to 40 years old but for small-sized estates, most of them were in the older age group of more than 50 years old (*Table 3*).

Table 4 shows the number and percentage of respondents by education level. Generally, respondents were dominated by those with higher education background (diploma and degree). For large-sized estates, 51.4% of them were degree holders and 33.8% were diploma holders. Meanwhile for medium-sized estates, the percentage of diploma and degree holders were at 38.4% and 37.3%, respectively. For the small-sized estates, the breakdown of the education level between SPM, diploma and degree was fair at 30.0%, 30.7% and 32.5% respectively.

In terms of position, in totality, the survey was filled up by senior managers and managers with the total percentage of 69.2%. Only 30.8% of the respondent were in the others category as either assistant managers or non-executive level (*Table 5*).

Based on respondents' experience as shown in *Table 6*, 49.2% of the respondents have more than 10 years of experience managing oil palm estates. For large estates, only 20.8% of the respondents have less than five years' experience. Meanwhile 26.8% and 27.4% of the respondents have less than five years' experience for medium and small estates, respectively.

Mean Score Analysis of Risk Mitigation Strategies

Thereafter, a descriptive analysis with mean score was conducted with interpretation as shown in *Table 7*. The details of the mean score used to demonstrate the agreement of the estates towards risk mitigation elements or measures taken during the low CPO prices environment according to their estate size was summarised in *Table 8*.

TABLE 1. NUMBER AND PERCENTAGE OF RESPONDENT

Total	(%)	Large	(%)	Medium	(%)	Small	(%)
769	(100.0)	216	(28.1)	276	(35.9)	277	(36.0)

TABLE 2. NUMBER AND PERCENTAGE OF RESPONDENTS BY GENDER

	Gender			
	Male	(%)	Female	(%)
Total respondents	696	(90.5)	73	(9.5)
Large estates	206	(95.4)	10	(4.6)
Medium estates	258	(93.5)	18	(6.5)
Small estates	232	(83.8)	45	(16.2)

TABLE 3. NUMBER AND PERCENTAGE OF RESPONDENTS BY AGE

	Age group							
	< 30	(%)	31-40	(%)	41-50	(%)	> 50	(%)
Total respondents	50	(6.5)	327	(42.5)	170	(22.1)	222	(28.9)
Large estates	11	(5.1)	131	(60.6)	42	(19.4)	32	(14.8)
Medium estates	25	(9.1)	117	(42.4)	62	(22.5)	72	(26.1)
Small estates	14	(5.1)	79	(28.5)	66	(23.8)	118	(42.6)

TABLE 4. NUMBER AND PERCENTAGE OF RESPONDENT BY EDUCATION LEVEL

	Education level							
	SPM	(%)	Diploma	(%)	Degree	(%)	Others	(%)
Total respondents	170	(22.1)	264	(34.3)	304	(39.5)	31	(4.0)
Large estates	27	(12.5)	73	(33.8)	111	(51.4)	5	(2.3)
Medium estates	60	(21.7)	106	(38.4)	103	(37.3)	7	(2.5)
Small estates	83	(30.0)	85	(30.7)	90	(32.5)	19	(6.9)

TABLE 5. NUMBER AND PERCENTAGE OF RESPONDENTS BY JOB POSITION

	Job position					
	Senior manager	(%)	Manager	(%)	Others	(%)
Total respondents	108	(14.1)	424	(55.1)	237	(30.8)
Large estates	31	(14.4)	111	(51.4)	74	(34.3)
Medium estates	34	(12.3)	160	(58.0)	82	(29.7)
Small estates	43	(15.5)	153	(55.2)	81	(29.2)

TABLE 6. NUMBER AND PERCENTAGE OF RESPONDENTS BY EXPERIENCE

	Years of experience							
	<2	(%)	2-4	(%)	5-10	(%)	>10	(%)
Total respondents	56	(7.3)	139	(18.1)	196	(25.5)	378	(49.2)
Large estates	18	(8.3)	27	(12.5)	55	(25.5)	116	(53.7)
Medium estates	26	(9.4)	48	(17.4)	72	(26.1)	130	(47.1)
Small estates	12	(4.3)	64	(23.1)	69	(24.9)	132	(47.7)

Table 8 shows that the highest mean score achieved was in the D2 element, which referred to the financial management whereby the overall mean score was 5.91 for their agreement regarding the efficient debt management during low CPO prices environment. The lowest overall mean score was 1.87 recorded for the agreement towards A6 element, which referred to reducing the harvesting round. The results also suggested that the financial management plays an important role in reducing the risk of CPO price volatility. During the low CPO prices, the mean score suggested that estates in general agree that good management of debt is important in ensuring the sustainability of the operation. In measuring the performance of firms within the Malaysian palm oil industry, Ramasamy *et al.* (2005) stated that a highly leveraged firm represents a greater financial risk than a firm with relatively low debt. The level of debt and profitability of the company are negatively related. As the firm increases its debt financing, it will lead to decreasing profitability of the firm (Raheman and Nasr, 2007). Apart from debt management, among the pre-specified risk mitigations presented to estates, the least likely measures that estates would opt is to reduce the harvesting round. The overall mean score of 1.87 suggested that estates disagree to reduce their harvesting round during the low CPO prices environment. This implies that the gain in harvesting is always outweigh its costs.

For the size-based analysis, it was also found that large-sized estates mostly agree on the debt management element with a mean score of 5.92, followed by stable financial allocation with a mean score of 5.88 and the third rank is with mean score of 5.29

TABLE 7. INTERPRETATION OF MEAN SCORE

Mean score	Agreement level
1.00 - 1.86	Strongly disagree
1.87 - 2.71	Disagree
2.72 - 3.57	Somewhat disagree
3.58 - 4.43	Neither agree nor disagree
4.44 - 5.29	Somewhat agree
5.30 - 6.14	Agree
6.15 - 7.00	Strongly agree

TABLE 8. MEAN SCORE OF RISK MITIGATION ELEMENTS BY ESTATE SIZE

Elements	Large estates	Medium estates	Small estates	Overall mean score
Operational business decisions				
Reducing the frequency of fertiliser applied (A1)	3.65	3.83	3.76	3.75
Reducing the amount of fertiliser (A2)	3.68	3.86	3.93	3.83
Reducing the frequency of weeding (A3)	3.78	3.86	3.84	3.83
Reducing the expenses on pest and diseases controls (A4)	3.40	3.60	3.74	3.59
Purchasing of agricultural input in small quantities (A5)	3.17	3.46	3.63	3.44
Reducing the harvesting round (A6)	1.62	1.86	2.09	1.87
Reducing the maintenance cost for road and bun gate (A7)	4.03	4.36	4.46	4.30
Reducing the salary of workers (A8)	2.03	1.93	2.06	2.01
Management of business assets				
Reducing/freezing the purchase of heavy machines for estates use (B1)	4.84	4.99	5.04	4.96
Reducing/freezing the purchase of vehicles for office use (B2)	5.29	5.29	5.41	5.33
Terminating the existing business insurance such as fire or theft (B3)	2.15	2.33	2.36	2.29
Business diversification strategies				
Conducting crop and livestock integrations (C1)	3.37	3.70	3.23	3.43
Financial management				
Stable financial allocation (D1)	5.88	5.85	5.89	5.87
Efficient debt management (D2)	5.92	6.04	5.77	5.91
Entering into sales contract with palm oil mills (D3)	4.41	4.79	4.76	4.67

which represents those large estates somewhat agree to reduce/ freeze the purchase of vehicles for office use. The study also found that estates disagree with few elements under the operational business decisions, which requires estates to compromise some of the agricultural practices. For large estates, despite the low CPO prices environment, estates somewhat disagree to reduce the expenses on pests and diseases control. This can be shown by the mean score of 3.40 for element A4. Pests and diseases control is important to estates as the reduction in the expenses may increase the spread of diseases such as *Ganoderma*, rhinoceros beetles and leaf eating caterpillars, thus affect negatively to the yield (Kushairi *et al.,* 2017). However, for the medium and small-sized estates, both categories neither agree nor disagree with that pre-specified risk mitigation strategies. The economic constraint of medium and small-sized estates contributed to this preference. This finding is also similar with the finding in the eastern of the United States where the financial constraints in the production of apples limit the adoption of new integrated pest management technologies (Rosenberger, 2003).

For the purchases of agricultural inputs (A5), the estates in large and medium-sized category somewhat disagree that continuous purchases, in a small quantity of agricultural inputs is the best risk mitigation strategy in facing with low CPO prices environment.

Meanwhile, the small estates neither agreed nor disagreed with this statement. These results might be driven by the financial capacity of the estates or due to the need of the estates themselves. The small estates might purchase their agricultural inputs as and when needed regardless of the price situation as due to limited resources. This is equivalent to the case of smallholders in Indonesia where the inefficiency in productivity was found to be contributed to inadequate fertiliser application resulted from the limitation of resources (Webb *et al.*, 2011).

Other differences in agreement between the large, medium and small-sized estates is found to be under the business diversification strategies. In view of low CPO prices, the large and small-sized estates somewhat disagreed to conduct crop and livestock integrations with their oil palm. This can be seen by the mean score of 3.37 and 3.23 for large and small estates, respectively. There is no clear agreement from the medium-sized estates on this pre-specified risk mitigation strategies. Crop and livestock integrations require high commitments in the financial capital and human resources capital. The openness of the estates towards the integration is important to ensure the success of the program. The huge proportion of respondents in small-sized estates with low academic qualification coupled with the financial limitation might cause the small estates disagree with the crop and livestock integrations as the measures to reduce low CPO prices. Abdullah *et al.* (2021) found that farmers with high education level are more ready to accept new knowledge and practices, hence they are more prepared to accept any changes in the farming system.

The differences in the level of agreement between the estates size were also found on the element of sales contract with palm oil mill. Unlike the medium and small-sized estates, the large estates did not indicate their clear agreement on this element. Large estate neither agree nor disagree that entering into sales contract with palm oil mill could help to minimise risk. Both medium and small-sized estates agreed that entering into sales contract with palm oil mill helps to provide stability to the bottom line of the estates. This strategy is in line with the practices of other agricultural farmers in some EU countries that always considered to fix the transaction price of their agricultural products as the short-term measures to reduce the volatility in agricultural prices (Assefa *et al.*, 2017). In Ghana, the concept of contract farming was implemented whereby farmers can always sell the FFB harvested to the contracted company at the specified price and this has provided stability to the farmers' income (Ruml and Qaim, 2020).

In general, regardless of the size, all estates studied unanimously agreed on the following risk mitigation strategies during low CPO prices. These agreed mitigation strategies with the overall mean score of more than 4.44 are as follows:

i. B1 - Reducing/freezing the purchase of heavy machines for estates use;
ii. B2 - Reducing/freezing the purchase of vehicles for office use;
iii. D1 - Stable financial allocation; and
iv. D2 - Efficient debt management.

To further validate the overall results derived from the mean score, an additional multiple regression analysis of all the risk mitigation elements against CPO price was conducted. The hypothesis for the regression is as follows:

H_0: The elements of operational business decisions, managements of business assets, business diversification and financial management are not the significant strategies of risk management during low CPO prices environment.

H_a: The elements of operational business decisions, managements

of business assets, business diversification and financial management are the significant strategies of risk management during low CPO prices environment.

Table 9 shows that only four risk mitigations elements were found to be statistically significant in reducing the risk of CPO price volatility and the remaining elements, which are insignificant had automatically been excluded by the software. Based on this result, the null hypothesis is rejected and it is reported that 50% (r = 0.23) of the variance from these four variables are correlated with CPO price. Since there are no elements under the operational business decisions are found to be significant, it can be concluded that the strategies of compromising the operational activities such as reducing the frequency of fertiliser applied, reducing the amount of fertiliser, reducing the frequency of weeding, reducing the expenses on pest and diseases controls, purchasing of agricultural input in small quantities, reducing the maintenance cost for road and bun gate and reducing the salary of workers are not helping the estates in reducing the price risk.

CONCLUSION

The pre-specified risk mitigation strategies presented in this study is limited to experience of the oil palm growers within the three estate sizes. It is worth to note that the fluctuation in CPO prices is posing risk to all the industry players throughout the supply chain. Being the upstream players, the impact of fluctuation in CPO prices to the estates is significant. The dynamic in prices particularly the downturn in CPO prices would negatively affect the performance and the productivity of the estates, consequently spill over the effect to the other midstream and the downstream players within the oil palm industry. In minimising the probability of this situation, estates were found to opt for better financial management particularly on the debt management. Estates also agreed that stable financial allocation is a good buffer from the price shock. In the event of lacklustre commodity prices, estates tend to review and prioritise their assets purchases to ensure that their profit margin remain intact. The operational activities are the least to be compromised by the estates in ensuring that the businesses are able to survive within that period of low CPO prices. With the above elaboration on the preferred risk mitigation measures taken by plantations, the findings of this study are expected to assist the relevant organisation to prioritise the mitigation measures in order to minimise the risk associated with low CPO prices.

TABLE 9. REGRESSION ANALYSIS

	Unstandardised coefficients	Standardised coefficients		t	Sig.
	B	Std. error	Beta		
(Constant)	499.259	19.542		25.548	.000
1. Reducing/freezing the purchase of heavy machines for estates use	-6.564	2.379	-.101	-2.759	.006
2. Terminating the existing business insurance	-5.574	2.629	-.077	-2.120	.034
3. Conducting crop livestock integrations	-4.582	2.111	-.080	-2.171	.030
4. Efficient debt management	-9.295	2.819	-.121	-3.298	.001
F Statistic				10.147	0.00
R square				0.050	

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The Readiness of Secondary School Teachers for Sustainable Oil Palm Themed-based Teaching and Learning

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ABSTRACT

Numerous educational programs were introduced to create awareness and interest in Malaysian oil palm industry among students. However, to date, those programs were only conducted informally via campaigns run by the industry players. For that reason, this study is being carried out to identify and ascertain whether school teachers are prepared to introduce a new education program on 'Sustainable Oil Palm Industry' to be implemented as part of formal education in lower secondary schools. Following this, 421 lower secondary school teachers were surveyed with questionnaires distributed online through media social. The collated information and data were studied descriptively to establish its frequencies, percentages and mean values. The findings of this analysis show that the level of preparedness of the teachers in terms of related knowledge is considered at 'moderate level'. It was also found that to be successful in the implementation of this program, teachers need to be provided with sufficient information and knowledge in this particular subject. In addition, adequate trainings and teaching aids should also be provided in line with the requirements of the existing school curriculum.

Keywords: knowledge, pedagogy, sustainable oil palm industry, teachers' readiness.

INTRODUCTION

The United Nations summit has initiated the 2030 Agenda for Sustainable Development which outlined 17 Sustainable Development Goals reflecting the ambitious global vision towards creating a sustainable future (United Nations, 2015). Specifically, this agenda focuses on five areas: People, Planet, Prosperity, Peace and Partnership. According to Lim (2017), the oil palm industry has achieved seven out of seventeen goals. These goals include, (i) Goal No. 1: No Poverty – by reducing rural poverty in top producing countries, (ii) Goal No. 2: Zero Hunger – by increasing income to buy better food, (iii) Goal No. 3: Good Health and Well-being – by bringing crucial development into rural areas, (iv) Goal No. 4: Quality education - by increasing the quality of education especially in the rural area, (v) Goal No. 8: Decent Work and Economic Growth – by creating

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jobs in palm oil processing, R&D, trading and logistics (vi) Goal No. 10: Reduced Inequalities - between urban and rural populations, and (vii) Goal No. 13: Climate Change – by storing and sequestering carbon which helps to mitigate climate change.

Since the first oil palm plantation was established more than 100 years ago, the oil palm industry has played an important role in Malaysia's economic and socio-economic development (Moslim, 2018). Oil palm has been widely grown throughout the country, where its total plantations in 2020, occupied an estimated 5.87 million hectares of land, equivalent to 17.89% of the country's land area (Arshad, 2021). Over the years, Malaysia has become the second-largest exporter of palm oil after Indonesia, contributing 33% of the value of world palm oil exports (MPOC, 2019). However, the Malaysian oil palm industry is often challenged by other vegetable oil-producing countries. Furthermore, the industry has also received intense criticism from western countries claiming that the Malaysian industry is not sustainable. The most serious allegation claim is oil palm plantations have caused environmental problems, such as deforestation and serious air pollution due to open burning (Hafizuddin-Syah *et al.*, 2018).

In 2020, several non-governmental organisations (NGOs) have filed petitions to the United States Department of Customs and Border Protection (USCBP) over the claim of forced labour in the Malaysian plantations. Over the last few years, Malaysian oil palm plantations have been involved in several controversial issues involving foreign workers, such as the increased risk of social problems, illegal settlements, excessive working hours, occupational safety and health hazards, and the trafficking of migrant workers, which raised doubts over the sustainability of the Malaysian oil palm industry (Maros *et al.*, 2019). As a result, palm oil products produced by several large plantation companies in Malaysia have been subjected to export restrictions due to the forced labour issues (Arshad, 2021). These restrictions have tarnished the image of the Malaysian palm oil industry.

In the meantime, although Malaysia is well known for its oil palm industry, the level of knowledge and awareness among Malaysians, especially the younger generation, on this industry is still relatively low. This situation invites various negative perceptions about the industry, either from within the country or abroad. Most Malaysians have limited knowledge and exposure about careers in the industry as they consider the industry is only about hard labour in the field (Jusoh *et al.*, 2017; Maros *et al.*, 2019; Saad *et al.*, 2016). Studies have found that school students show moderate interest in careers in the oil palm industry (Jusoh *et al.*, 2017), while Maros *et al.* (2019) found that teenagers perceive working in the industry as non-ideal. In this light, Saad *et al.* (2016) stressed that more exposure to the oil palm related sector is important in shaping a positive attitude about this industry among youths. Selvadurai *et al.* (2012) also suggested that proper steps should be taken by the authorities to change the perception of youth towards this industry to reduce dependence on foreign labours.

Adequate and accurate information regarding career prospects in the oil palm industry would help motivate students to engage in the agricultural field, especially oil palm plantation (Jusoh *et al.*, 2017). Therefore, access to education and new forms of agriculture-based enterprises can boost youth's participation in farming innovations that could increase family income and improve the livelihood of farmers and local communities (Saad *et al.*, 2016). Past studies suggest that oil palm industry themed educational programs to be implemented in schools to provide students with comprehensive exposure to the industry.

To date, several educational programs related to the oil palm industry were provided by the stakeholders focusing mainly for students. However, similar programs tailored for the teachers have not been given emphasis. To accomplish the aspirations of an excellent educational program, each step in the planning and implementation must be based on vision to create a constant change or paradigm shift in the thinking processes and how things get done. These actions require the involvement of the entire organisation including the educators. Being the chief support of the education system, teachers are the backbone to implement and succeed in any educational reform or changes made in policies. As such, efforts should be carried out to improve the professionalism of educators in order to achieve specific goals in educational program implemented (Said and Talib, 2000).

In line with the 21st century education skills requirements, teachers should familiarise themselves in culture knowledge environment. The teachers are the role models and should set good example by practicing lifelong learning as an ongoing pursuit of knowledge to enhance themselves. They are also in the best position to similarly encourage their students to acquire knowledge as life skills instead of acquiring knowledge just for the sake of knowledge or passing examinations. The country needs teachers with great wisdom and able to organise teaching and learning strategies that can nurture the culture of problem solving among

their students. In line with these requirements, relevant training should be given periodically and continuously by the administration to ensure that teachers have sufficient knowledge and skills to achieve any goal in educational program organised (Abdul Ghani *et al.*, 2019).

With regards to the above, this study is also aimed at ways to obtain views and inputs from teachers in several aspects of developing an effective teaching module on this specific theme; Malaysian Sustainable Oil Palm Industry. This theme will cover various aspects related to the sustainable oil palm industry including the history of the Malaysian oil palm industry, sustainability, economy, biodiversity, palm oil products, agencies and careers related to this industry. In the end, it is envisaged that the development of this module would be able to assist the teachers in introducing the subject matter to the lower secondary level students effectively and successfully.

In this light, this study aims to address questions like 'are teachers ready to implement sustainable oil palm-themed teaching and learning? 'What is the level of teachers' knowledge of the sustainable oil palm industry?' 'What are the teachers' suggestions for implementing the industry themed teaching and learning in schools?' and 'What are the possible challenges teachers faced in implementing teaching and learning activities related to the industry in schools? In this light, this study aims to identify secondary school teachers' readiness to facilitate sustainable oil palm industry-themed teaching and learning activities.

METHODOLOGY

This study used survey which is part of the quantitative research method. Data were collected using a survey questionnaire distributed through the Google Form application. According to Creswell (2014), an online survey could collect vast data quickly and ensure a high rate of responses. Studies also posited that a web-based survey research is cost-effective and helps researchers gather data faster from a widerpool of respondents. Furthermore, web-based surveys allow researchers to transfer survey responses directly into a database, eliminating transcription errors and preventing changes by survey respondents (Andrews *et al.,* 2003).

Population and Sample

The study population comprises lower secondary school teachers, who are involved in teaching lower secondary students of Form 1, Form 2 and Form 3. The questionnaires are only distributed specifically to teachers who teach lower secondary level only because at the lower secondary level there was more breakdown of subjects related to the theme of sustainable oil palm industry compared to the primary school level. Questionnaires were distributed randomly through social media platforms like WhatsApp, Telegram and Facebook. According to Fricker (2012), the simple random sampling method is most suitable for online survey studies involving large homogeneous groups. After being online for a month, only 421 teachers from all over Malaysia have responded. The number of samples in this study fulfilled with the minimum number recommended by Krejie and Morgan (1970) of at least 384 samples for a survey study of a population of over 100 000 people (Chua, 2012).

Research Instrument

The research instrument is a set of questionnaires containing four sections. Part A contains five items on the respondents' demographic information; Part B contains 20 items on teachers' readiness regarding their knowledge of the Malaysian oil palm industry. Meanwhile, Section C contains 12 items on teachers' readiness based on oil palm-themed teaching and learning pedagogical aspects. Items in Sections B and C used a 5-point Likert scale to measure teachers' level of readiness. The 5-point Likert scale was chosen because of its high reliability value. The scale could also help the respondents make the right choice based on the extent of their agreement with the statement in each item (Mohd Majid, 2005). Finally, section D contains two open- ended questions on teachers' suggestions and challenges in implementing oil palm-themed teaching and learning activities. This questionnaire has undergone review and refinement and has obtained language validity and content validity from three panels of experts in related fields. The findings of the pilot study analysis found that the reliability value referring to the Cronbach's Alpha value is 0.96 which indicates that the instrument is in very good condition and effective with a high level of consistency and can be used in real research (Bond and Fox, 2015).

Data Analysis

The data obtained from this study were analysed descriptively using Microsoft Excel software and the Statistical Packages for the Social Sciences (SPSS) version 25.0. All the findings are presented in the form of frequency, percentage, mean and standard deviation.

RESULTS AND DISCUSSION

The findings of this study are divided into four parts, namely the respondents' demographic information, the level of teachers' readiness, perceived challenges and proposed teaching activities.

Respondents' Demographics

The sample of this study consists of 421 lower secondary school teachers from all over Malaysia. 78.6% of the respondents are female teachers, while only 21.4% are male teachers. On the other hand, 52.7% of the respondents are from urban areas, and the majority of respondents (67.7%) have been teaching for more than ten years. *Table 1* shows the respondent's demographic profile. The highest number of respondents are from the Middle Zone, namely from Selangor, the Federal Territory of Kuala Lumpur and the Federal Territory of Putrajaya (*Figure 1*).

The Level of Teachers' Readiness

This study aims to identify the level of readiness of teachers from their knowledge of the Malaysian oil palm industry and their readiness to implementeducational programs related to the sustainable oil palm industry (*Table 2*). Findings show that teachers' readiness in terms of knowledge is at a moderate level (Mean = 3.27, Standard deviation = 0.75). Similarly, teachers' level of readiness from the pedagogical point of view is also at a moderate level (Mean = 3.38, Standard deviation = 0.77).

Teaching is a knowledge-rich profession, and teachers play the role of 'learning specialists.' As professionals, teachers are expected to process and evaluate new knowledge relevant to their core professional practices and regularly update their knowledge to improve their practice and meet new teaching demands. Empirical research on teachers' knowledge in decision-making asserted that to make informed pedagogical decisions. Teachers must be able to analyse and evaluate specific learning episodes in combination with contextual and situational factors and connect all this information to their pedagogical and content knowledge to guide subsequent teaching actions. Thus, making good pedagogical decisions

TABLE 1. RESPONDENTS' DEMOGRAPHIC PROFILES

Item	Factors	Features	Frequency	Percentages (%)
A1	Gender	Male	90	21.4
		Female	331	78.6
A2	School location	Urban	222	52.7
		Rural	199	47.3
A3	Teaching experience	Less than 1 year	7	1.7
		1-5 years	57	13.5
		6-10 years	72	17.1
		More than 10 years	285	67.7
A4	Teaching field	Language	97	23.0
		Science and Mathematics	157	37.0
		Humanity	123	29.0
		Technic and Vocational	44	10.0

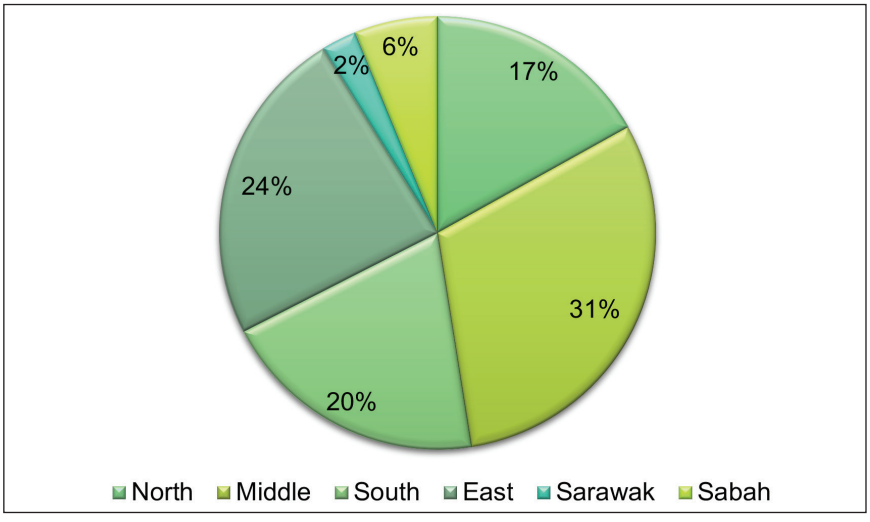

Figure 1. Percentage of respondents by zone.

TABLE 2. LEVEL OF TEACHERS' READINESS IN TERMS OF KNOWLEDGE AND PEDAGOGY

Factors	Mean	Standard deviation	Mean interpretation
Knowledge	3.27	0.75	Moderate
Pedagogical	3.38	0.77	Moderate

hinges on the quality of the level of teachers' pedagogical knowledge. In other words, what teachers do in classrooms is very much dependent on what they know and believe about and on what they understand about the teaching and learning process (Anthony and Walshaw, 2007).

Successful teachers are those with both the intention and the effect to assist students (Jaworski, 2004). A teacher with merely the intention of developing student understanding will not necessarily produce the desired effect. However, what is clear is that repertoires of sound content knowledge and pedagogical knowledge will provide the means to achieve targeted goals. The argument above states that teachers' conceptual understanding and knowledge in sustainable oil palm industry is critically important at any level to ensure the effective delivery of knowledge. Teachers who are unclear about particular concepts may struggle to teach these concepts and may resort to examples that hinder, rather than help, students' development. Teachers' limited knowledge could also create a misunderstanding among students, which could eventually cause them to give inappropriate or unhelpful feedback to students. In short, teachers' poor subject knowledge could be the main barrier to effective learning activities, hindering students' understanding of the issue. Thus, teachers should be flexible and be on the lookout for opportunities to improve students' understanding. When teachers use their knowledge to enhance student learning, they are engaging in effective practice. In addition to building students' understandings, teachers could also add value to the wider community of individuals.

Six difference themes of questions on sustainable oil palm industry were asked for the purposes of identifying the levels of knowledge and understandings of the teachers in this study. The analysed data as shown in the *Table 3* reveals that the teachers have sufficiently high knowledge and ideas about the importance of oil palm industry from economic point of view. While the level of knowledge on oil palm superiority and other relevant issues are relatively lower, or at moderate high. The findings however, indicates that the level of awareness in the history and the sustainability of Malaysian oil palm industry is considerably low. Notwithstanding that, the overall results of this study would still be a valuable source of reference for the researchers to determine the most suitable topics to be introduced in the process of developing a program related to sustainable oil palm industry, later on.

Teacher Challenges in Implementing Thematic Teaching and Learning related to Sustainable Oil Palm Industry in Schools

This study also focused on the challenges faced by teachers in implementing sustainable oil palm themed teaching and learning activities in schools. The findings indicated that 39.7% of the respondents stated that the lack of knowledge related to the sustainable oil palm industry as the major challenge. This is followed by time constraints, infrastructure, curriculum content, school location, students' interest, teachers' interest and school administrators' involvement. *Table 4* shows challenges in implementing teaching and learning related to sustainable oil palm in schools. These findings support the study that was conducted by Retnawati *et al.* (2017) who stated that among the challenges of teachers in implementing thematic teaching is the teacher's understanding of a theme, curriculum implementation and assessment methods according to the proposed theme. In this regard, exposure during undergraduate studies, pre-service teacher training, and in-service professional development could help improve knowledge. This finding open up opportunities to look into these factors as the knowledge outcomes of these three phases of teacher growth have been under-examined, especially concerning the articulations between them.

Recommended Teaching and Learning Strategies

The questionnaire also asked teachers about the recommended

TABLE 3. LEVEL OF TEACHERS' KNOWLEDGE BY THEME

Themes	Mean	Standard deviation	Mean interpretation
Economic interests	4.02	0.84	High
Advantages of oil palm	3.74	0.61	Moderately high
Relevant agencies	3.56	1.02	Moderately high
Issues related to Malaysian oil palm	3.29	1.05	Moderately high
History of the Malaysian oil palm industry	2.91	1.11	Moderately low
Sustainability	2.88	1.08	Moderately low

TABLE 4. CHALLENGES IN IMPLEMENTING THEMATIC TEACHING OF SUSTAINABLE PALM OIL INDUSTRY IN SCHOOLS

Statements	Frequency	Percentage (%)
Lack of teachers' knowledge on the sustainable oil palm industry	167	39.7
Time constraints to implement teaching and learning of major subjects	107	25.4
The lack of school infrastructure and facilities	42	10.0
Topics on palm oil/ oil palm are not aligned with the curriculum content of the main subject	41	9.7
The location of the school is far from an oil palm plantation	31	7.4
Students are not interested in learning about oil palm/ palm oil	19	4.5
Teachers are not interested in implementing sustainable oil palm themed teaching and learning activities	13	3.1
School administrators give less emphasis on oil palm-related teaching and learning	1	0.2

approaches to implement sustainable oil palm-themed education programmes in schools. There are two teaching and learning strategies that are the main choice of respondents, namely teaching outside the classroom and project-based learning. The results showed that 33.7% of the respondents chose learning outside the classroom as the most appropriate strategy for implementing sustainable oil palm themed education programs (*Table 5*).

Learning outside the classroom refers to the use of places other than the schoolfor teaching and learning. This concept concerns getting children and young people tolearn outside the classroom and providing them with challenging, exciting, and different experiences to make the lesson memorable. Learning could be done in various locations to provide students with concrete understanding. Furthermore, this approach provides real-world learning experiences that will set them up for success inlife beyond school. On the other hand, learning outside the classroom experiences differs from conventional teaching methods. Students are encouraged to engage a broader range of soft skills such as teamwork, leadership, and understanding of theirlearning environment. Studies have advocated that learning outside the classroom lead to a deeper understanding of challenging concepts and provide a context for learning in many areas. The results of Andjelkovic and Prnjat (2017) study show the benefits of integrated teaching implemented outside the classroom increase knowledge retention and improving the quality of student knowledge and creating an adequate social climate for sustainability, interdisciplinary studies and the use of natural and social contexts as teaching and learning resources. Students who experience learning outside the classroom benefit from increased self-esteem and become more involved in their learning. Lastly, evidence suggests learning outside the classroom can help improve achievement, classroom behaviour and students' engagement, including those facing difficulty engaging in the learning activities (Idros, 2011).

Nevertheless, 33% of respondents chose project-based learning (PBL) strategies as an appropriate strategy for implementing these learning activities in schools. PBL is a type of approach that requires students to deal with problems in the production of products as learning artifacts. Through the production of these artifacts,the student acts as a problem solver, decision maker, inventor and researcher. It is atype of inquiry learning that is open-ended and motivated by a student's curiosity (Mioduser and Betzer, 2008). Through project-based learning, students seek toanswer questions involving a principle or theory of a discipline (Thomas, 2000).

TABLE 5. RECOMMENDED TEACHING AND LEARNING STRATEGIES

Statements	Frequency	Percentage (%)
Outside the classroom	142	33.7
Project based	139	33.0
*STEM approach	53	12.6
Fun learning	30	7.1
Inquiry based	27	6.4
Cooperative	18	4.3
Problem based	7	1.7
Case study	5	1.2

Note: * STEM - Science, Technology, Engineering and Mathematics.

Many studies have proven the advantages of PBL over conventional learning methods, among which students involved with PBL are more responsible for their learning (Boaler, 1997; Penuel and Means, 1999). PBL also increases student attendance to school (Thomas 2000) because PBL activities motivate them which in turn can improve student achievement (Geier *et al.*, 2008; Gültekin, 2005; Thomas, 2000). PBL can be applied by teachers to encourage the active involvement of students because the PBL approach is student-centered where students are fully involved to succeed in project assignments. Through PBL also students gain more exposure to high-level thinking, problem solving skills, cooperation and communication skills (Chanlin, 2008; Mioduser and Betzer, 2008). *Table 5* shows the recommended teaching activities for implementing sustainable oil palm thematic teaching in schools.

CONCLUSION

This study suggests that early exposure to the oil palm industry, particularly at the school level, is essential to attract the younger generation to venture into the industry's sustainability. Accordingly, teachers need to be equipped with knowledge related to the sustainable oil palm industry to effectively facilitate oil palm-based learning activities. Chen (2012) states that teachers should have strong and powerful materials, they should realise ideas and topics that will be implemented in the teaching and learning processes and they should understand how well they teach concepts to their students. The findings of this study has contributed to the researchers ideas in developing an appropriate teaching module on this theme to be implemented in secondary school. The teachers in the survey are of the view that, the teaching module should be equipped with as much information as possible relevant to the industry's theme. The development of the module should also be in line with content of the existing school curriculum as the teachers are required to achieve the relevant Content Standard and Learning Standard sets by the Ministry of Education. This is to ensure the dissemination of information is effective and meaningful. Based on the Curriculum and Assessment Standards Document, there are five main potential subjects which this module can be incorporated in. They are Geography, History, Science, Health Education and Moral Education. The teachers also suggested to apply the outside classroom learning method for this particular module. The implementation of project-based strategies, on the other hand, are suitable to be applied in or outside classroom. Providing training programs for teachers and making teaching aids related to the sustainable oil palm industry accessible are equally important due to teachers' role in improving the students' perception of the industry in Malaysia.

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