Malaysian Journal of Business and Economics
Vol. 4, No. 2, 2017, 49 – 64
ISSN 2289-6856 (Print), 2289-8018 (Online)

An Empirical Study of Malaria Incidence and Land Use Change of Palm Oil Industries in Malaysia

Felorisca Binti Singkong[a]& Sarma Binti Aralas[b]

ab Faculty of Business, Economics and Accountancy, Universiti Malaysia Sabah

Abstract

Malaria is considered among dangerous infectious diseases on a global scale. There are three hundred to five hundred million cases of malaria disease every year, of which one million result in deaths as reported by the Center of Disease control and Prevention. The World Health Organization estimates that in 2010 there were 219 million cases of malaria and 660,000 resulted in deaths. This paper examines the relationship between malaria incidence and land use change of palm oil, population and gross domestic product of Malaysia for the years 1986 to 2012. Regression results show that the variables land use change of palm oil, population, and gross domestic product are jointly significant in explaining the total cases of malaria incidences in Malaysia. Land use change of palm oil is shown to be not statistically significant as a determinant of the number of malaria incidences in Malaysia. Cointegration analysis suggests that the determinants, land use change of palm oil, population, and gross domestic product, have a long-run relationship with the total cases of malaria in Malaysia. On the other hand, vector error correction analysis shows that there is no evidence to suggest of a short-run effect of the three variables on Malaysian cases of malaria incidence.

Keywords: *Malaria incidence, land use change of palm oil, cointegration analysis, vector error correction analysis, gross domestic product, Malaysia.*

1 Introduction

Today, palm oil has become a major contributor to Malaysia‘s export earnings, particularly during the 1997/98 Asian financial crisis. This is because palm oil production has been driven by strong and increasing global demand for oils and fats. This has led to the opening of large tracts of land for palm oil cultivation. The expansion in recent years increased especially in East Malaysia, as the availability of suitable land in Peninsular Malaysia diminished. The spread of palm oil has caused the clearing of many lowland forests, such as the Lower Kinabatangan floodplains in Sabah, which have been known to be ecologically sensitive (Land Use and the Oil Palm Industry in Malaysia, n.d.). When palm oil becomes important to a country, palm oil plantations causes the opening of huge land area for the purpose of planting it. In the year 2013, the land used or opened is about 5.23 million hectares; out of this total, the increase in

**Corresponding author* *E-mail address:*

Sarawak of planted palm oil is about 7.9% or 84,660 hectares. However, Sabah still has the Palm oil planted in the state. With 1.48 million hectares, or 28%; this is followed by Sarawak‘s 1.16 million hectares or 22%, and the remaining is in Peninsular Malaysia with 2.59 million hectares or 50% (May, 2013). The number of areas where palm oil is planted increases every year, meaning the total number of forest area in Malaysia also decreases with every consecutive year as an impact of palm oil plantation.

Malaria is rated the fifth most dangerous disease that occurs in Malaysia. Malaria started to be identified as a serious disease since the beginning of the nineteenth century. During that period, malaria posed a formidable problem in the Straits Settlements. In 1944, 40% of deaths in Peninsular Malaysia were attributed to malaria. However, after World War II, the number of mortalities caused by malaria began to decline because of various anti-Malaria measures (Maqsudur Rahman,n.d.).

This study proposes to examine the impact of land use change on the rate of infectious disease incidence in Malaysia as an effect from cleared habitats due to econometric development. This analysis looks at the data’s from Malaysian Land and Survey Department and from Malaysia’s Statistics Department. The study is important for the awareness of negative impact due to human activities that involves clearance of the land without control. The rate of infectious disease incidence in Malaysia may be able to help the country to create new policies and regulation to reduce the rate of infectious disease in Malaysia. However, results from the past research show that there is a relationship between land use change and infectious disease. Most of the researchers used different methods based on either time series data, cross sectional data and panel data. The current study uses secondary data to investigate whether there is a relationship between the rate of infectious incidence in Malaysia and land use change.

2 Literature Review

There are a number of studies related to the rate of malaria disease with other economic variables in the literature. Malaria disease is considered as one of the reliable measures of the environment in the global economy, therefore malaria is used in studies in the fields of environmental science and environmental economics by many researchers. For example, Lindblade et al., (2000) investigate how land use change alters malaria transmission parameters by modifying temperature in a highland area of Uganda. The aim of the study was to investigate the effect of land use change on malaria transmission in the south-western highlands of Uganda. Also, they investigated the differences in temperature, humidity and saturation deficit between natural and cultivated swamps. They found elevated malaria transmission risks in cultivated areas when replacement of natural swamp vegetation is replaced with agricultural crops because it led to increased temperatures, which may be responsible for elevated malaria transmission risk in cultivated areas. This means that land use change and malaria incidence has a positive relationship.

Pluess, Mueller, Levi, King, Smith, and Lengeler, (2009a) found positive results for malaria as a major health burden of the Higaturu palm oil plantation, posing a high risk for company staff and their relatives, including expatriates and other non-immune workers. The same result was obtained by Lindblade et al. in 2000. Pluess et al., (2009a) in their overview on the malaria epidemiology in Oro province tried to quantify the problem of malaria within a commercial palm oil plantation, its implications for the company, and the potential for control. The researcher used the method of cross-sectional study within six company villages, that included the determination of parasite rates by conventional microscopy, recorded interviews, and conducted haemoglobin measurements. The data were collected from the 13 company aid posts for the years 2005 and 2006.

Vanwambeke, Lambin, Eichhorn, Flasse, Harbach, Oskam, and Butlin. (2007) showed similar finding that land use change has a positive relationship with malaria disease. Vanwambeke et al., (2007) explored the impact of land use change on dengue and malaria vectors and dengue transmission in northern Thailand based on conceptual modelling that linked the landscape, people, and mosquito. The researchers collected data over a 3 year period. The result from this research is that land use changes have detectable impact on mosquitoes and on infectious disease.

David (2011) discussed and assessed the role of fish farming within malaria infested Kabale in his article. He conducted studies using primary and secondary data sets and the results were analysed qualitatively and quantitatively. The result of this study shows that fish farming, a form of land use change, is only one of the factors that contribute to malaria prevalence in Kabale. He also found that there are other land uses that influence malaria incidence in Kabale: brick-laying, sand mining and stone quarrying, wetland and swamp reclamation for arable land, changing climatic conditions, ignorance, susceptibility, compromised immunity. Therefore, his results support the notion that the land use change is a definite cause of Malaria disease.

There are relationship between the population and the rate of malaria diseases. For example, researchers examined the distribution of host-seeking malaria vectors of households within two villages in rural Tanzania (Russell, Lwetoijera, Knols,Takken, and Killeen. 2013). The result from the study highlights that complementary vector control tools could be most effectively targeted to the periphery of villages where the households potentially have a higher hazard (mosquito densities) and are subject to vulnerability (open eaves and larger households) to malaria infection.

Hay, Guerra, Tatem, Noor, and Snow (2004), had the same idea as previous researchers, that there are connections between population and malaria. In their study, the researchers shared information about geographic information systems in combination with historical maps to quantify the anthropogenic impact on the distribution of malaria in the 20th century. The study indicates that although population growth does not substantially change the regional distribution of people from malaria risks, around 400 million births would occur within the boundary of current distribution of malaria by 2010, the date by which the Roll Back Malaria initiative was challenged to halve the world‘s malaria burden.

Goenka, Liu, and Nguyen. (2014), discuss infectious diseases and economic growth with the purpose of finding out whether the best way a society can control disease transmission is by taking into account the externality associated with its spread. The study developed a framework to study the economic impact of infectious diseases by integrating epidemiological dynamics into a neo-classical growth model. There is a two way interaction between the economy and the disease. First, the incidence of the disease affects labour supply, and second, investment in health capital can affect the incidence and recuperation from the disease. The finding shows that there can be non-linear and non-monotonic changes in steady state outcomes, this is usually invoked to justify fixed savings behaviour.

Orem, Kirigia, Azairwe, Kasirye, and Walker. (2011), focused on the impact of malaria morbidity on gross domestic product in Uganda. In this study, the impact of malaria morbidity on the gross domestic product (GDP) of Uganda was estimated using the double-log econometric model. In the 1997-2003 time series, macro-data was used in the analysis were for 28 quarters, that is, seven years times four quarters per year. This data was obtained from national and international secondary sources. The research implies that malaria morbidity results in a substantive loss in GDP of Uganda. The high burden of malaria leads to decreased long-term economic growth, and works against poverty eradication efforts and socioeconomic development of the country.

3 Research Methodology

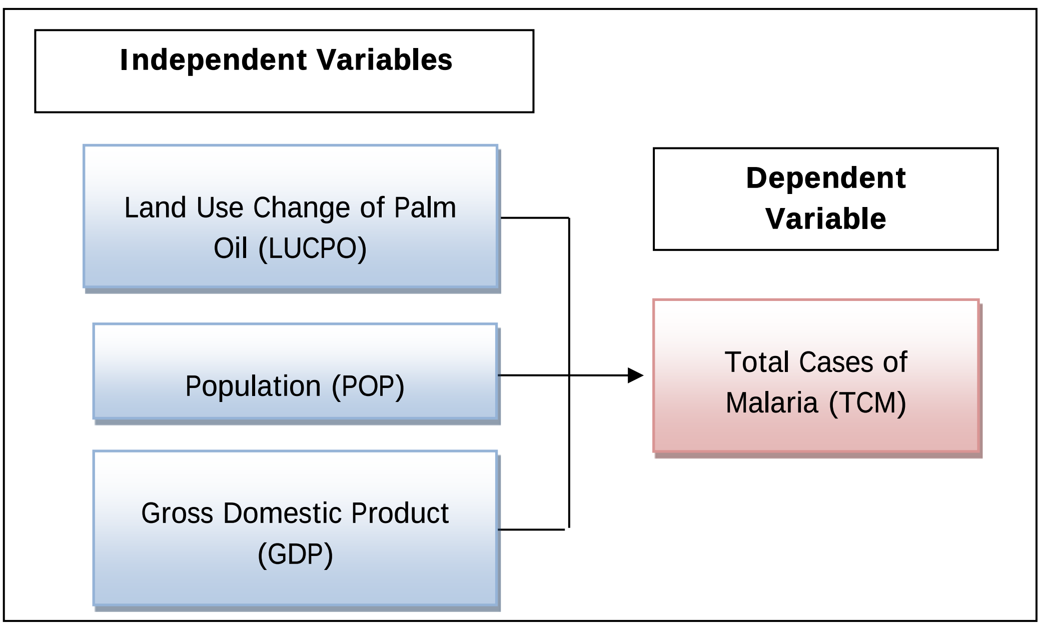
Based on the literature reviews from previous research, a conceptual framework was developed in the current study. Initially, the relationship between total cases of malaria and its determinants is discussed extensively. The analysis begins with the identification of total cases of malaria as a dependent variable and land use change of palm oil as an independent variable. First, the model was established and tested using the Ordinary Least Square (OLS). The multiple coefficients of determination of R-squared is used to analyze how well the sample line fits the data. Next, the F-test is conducted to measure the estimated regression‘s overall significance. Then, T-Test is used to verify the truth of the null hypothesis of this study. In order to detect the autocorrelation in the Least-Square

Regression (OLS), the Durbin-Watson (DW) will be estimated first. Autocorrelation exists if the value of R-squared is high, although the variables were found to be not significant. The Unit Root Test is employed to determine the stationarity of the variables at the following levels: level form, first difference, and second difference. This is followed by the co-integration test in order to establish the long-run relationship among variables. The short-run relationships between variables is established using the Vector Error Correction (VEC) modelling. The Granger Causality method is used to determine if the total cases of malaria causes land use change of palm oil or if the land use change of palm oil causes malaria incidence in Malaysia.

3.1 Conceptual Framework

The conceptual of framework is the basic of study structure, and essential in order to identify the direction or relationship among the variables. In this framework the dependent variable is the total cases of malaria per 100,000 people. The independent variables are land use change of palm oil plantation area (ha), population (in '000), and gross domestic product (in RM million).

Figure 1: Conceptual Framework of the study



Adopted based on: Ping (2013)

3.2 Econometric model

$$TCM_t = \beta o_t + \beta_{1t} LUCPO_t + \beta_2\, POP_t + \beta_{3t}\, GDP_t + \varepsilon_t$$

Eq.1

TCM_t = Total cases of malaria that being predicted or explained, $LUCPO_t$ = Land use change of palm oil is first independent variable, POP_t = Population of Malaysia (POP) second independent variable, GDP_t =gross domestic product third Independent variable, β_{ot} = the constant/intercept, β_{1t} = Slope (coefficient) for Land use change of palm oil, B_{2t} = Slope (coefficient) for Population of Malaysia (POP), B_{3t} = Slope (coefficient) for Gross Domestic Product (GDP), ε_t = the disturbance term.

There are three hypothesis of two-sided test :

$$H_0: \beta=0$$

$$H_A: \beta\neq 0$$

The six hypotheses developed for this study are adopted based on Ping (2013)). The hypotheses are as follow: Hypothesis 1: Land use change of palm oil can influence the total cases of malaria in Malaysia, Hypothesis 2: Population can influence the Total cases of malaria in Malaysia, and Hypothesis 3: Gross domestic product can influence the Total cases of malaria in Malaysia.

3.3 Source of Data

The time frame for this study is set from the year 1986 to the year 2012 with a sample duration of 27 years. The data are extracted from the Ministry of Health (2013), World Malaria Report (2013), Statistics on Commodities Malaysian Oil Palm Statistics (2010), Overview of the Malaysian Oil Palm Industry 2010, Overview of the Malaysian Oil Palm Industry 2011, Overview of the Malaysian Oil Palm Industry 2013, Department of Statistics Malaysia (2012) and Economic Planning Unit (2012).

4 Empirical Results

Table 1 (see Appendix A) shows the descriptive statistics including the total number of observations, mean, median, standard deviation, skewness also the minimum and maximum of the data for each variable. For example, the standard deviation for variables Gross domestic product (LOG (GDP)) is the highest variation with (1.026736), followed by total cases Malaria (LOG (TCM)) (0.984771), then land use change of palm oil (LOG (LUCPO)) (0.365300), and the last is population (LOG (POP))(0.184792). The series of land use change of palm oil (-0.332560), population (-0.177457), and gross domestic product (-1.598773) have negative skewness (symmetry of the distribution). In addition, the total cases Malaria (0.094927) has positive skewness, which means the value of variable either has a long tail to the right, large values, or a positive side (Agung, 2009).

4.1 Ordinary Least Square (OLS) Estimation Result

Table 2 (see Appendix B) shows the Ordinary Least Square estimation (OLS) results. The result indicate that independent variables can jointly explain the dependent variable (total cases of malaria). This is shown by the R-squared result, 88.0433 per cent that indicates goodness-of-fit. However, individually, the total population and gross domestic product are statistically significant, while the land use change of palm oil is not significant in explaining the dependent variable.

4.2 Unit Root Test

Table 3 (see Appendix C) shows the Unit Root Test for each series for both level and first differences using the Augmented Dickey Fuller (ADF) test. It is found that there are similarities between these two tests, where not all the variables are stationary at orders I(0) and I(1); however, when it comes to I(2), all the variables are stationary and there is no unit root. Thus, this variable can be used for the econometric model as the rule is that the entire variables should be stationary.

4.3 Johansen Co-Integration Test Result

Table 4 and 5 (see Appendix D) indicate the Johansen Cointegration test which show that there are 2 equations that can explain whether a relationship between the dependent variable and independent variables exists. The Max-Eigen statistic indicates that we can accept the null hypotheses of no Co-integrating equation because there are no co-integration in None*. Therefore, the trace statistic is chosen in the Johansen Cointegration test. Then, the Normalized Co-integrating Coefficients are obtained; it is found that the land use change of palm oil and gross domestic product have long-run relationships with total cases malaria. However, it indicates that population cannot influence a change in total cases of malaria incidence in Malaysia.

4.4 Vector Error Correction Model Test

Table 6 (see Appendix E) show the finding that all the independent variables are not statistically significant in short-run.

4.5 Discussion of Results

In this section we discuss the results of this study based on the Ordinary least square (OLS) and Granger Causality analyses.

Summary of Results

Table 7.1, 7.2 and 7.3 (see Appendix F) show that there is no evidence to suggest that land use change of palm oil (LUCPO) influences the total cases of malaria (TCM) in Malaysia as we cannot reject the null hypothesis that the land use change does not influence the total cases of Malaria. On the other hand, there is evidence that the variable Population (POP) does influence the total case of malaria (TCM) in Malaysia. The null hypothesis that population has no influence on the total cases of malaria is rejected, thus we accept the alternative hypothesis that population does influence the total cases of malaria. The Gross Domestic Product (GDP) is found to influence the total cases of malaria. The null hypothesis that gross domestic product cannot influence the total cases of malaria is rejected, the alternative hypothesis is accepted.

4.5 Granger Causality Test Results

Table 8 (see Appendix G) shows that the Granger Causality Test there is no causality between the total cases of malaria and land use change of palm oil in Malaysia. One explanaion could be that this is because Malaysia does not only clear the land for Oil Palm plantation, but also engage in other types of agriculture activities such as rubber and timber plantations., I addition, land is cleared for the development projects including for building facilities and opening new urban and sub-urban developments that also contributes to the increase of malaria incidences.

5 Conclusion, Contribution and Suggestion for Future Researcher

This study examines the empirically relationship between total cases malaria incidence, land use change of palm oil, population and gross domestic product of Malaysia from 1986 to 2012. Regression results show that all the independent variables (i.e land use change of palm oil, population and gross domestic product) are jointly significant in explaining the total cases of Malaria in Malaysia, but land use change of palm oil is not statistically significant in explaining the number of malaria incidences in Malaysia. Cointegration analysis suggests that the chosen determinants have a long-run relationship with the total case of malaria for Malaysia. The vector error correction analysis shows that there is no evidence to suggest a short-run effect of the independent variables on the Malaysian total cases of malaria. There is no causality relationship between the rate of malaria incidence and the land use change of palm oil.

For the future researcher, a data set that includes land use changes of other agricultural and devlepoment activities as well as a longer time frame of data are recommended to obtain further findings.

References

Agung, G. N.2009. *Time Series Data Analysis Using Eviews*. In *Time Series Data Analysis Using Eviews* (p. pages 593:10). singapore: John wiley & sons .

Conference, P. H., & Hotel, K. R.2013. *Battling Old Disease*.

David, K.2011. *Land use change and health: A case study of fish farming impacts on malaria prevalence in Kabale district, Uganda*. Thesis.

Goenka, A., Liu, L., & Nguyen, M. 2014. *Infectious diseases and economic growth*. Journal of Mathematical Economics, *50*, 34–53.

Hay, S. I., Guerra, C. A., Tatem, A. J., Noor, A. M., & Snow, R. W. (2004). *Reviews The global distribution and population at risk of malaria : past , present , and future,* 4(June), 327–336.

K. M. Maqsudur Rahman. (n.d.). *Epidemiology of Malaria in Malaysia*. Retrieved December 03, 2014, from http://www.jstor.org/stable/4452869

Land Use and the Oil Palm Industry in Malaysia. (n.d.).

Lindblade, K. A., Walker, E. D., Onapa, A. W., Katungu, J., & Wilson, M. L .2000. *Land use change alters malaria transmission parameters by modifying temperature in a highland area of Uganda*: ***5*(4)**: 263–274.

Martens, P., & Thomas, C. (n.d.). *Climate change and malaria risk: complexity and scaling* :3–14.

May, D. D. (2011). *Overview Of The Malaysian Oil Palm Industry 2011*. Malaysia: Malaysia Palm Oil Board (http://bepi.mpob.gov.my/images/overview/Overview_of_Industry_2011.pdf.

May, D. D. (2013). *Overview Of The Malaysian Oil Palm Industry 2013*. Malaysia: Malaysia Palm Oil Board (http://bepi.mpob.gov.my/images/overview/Overview_of_Industry_2013.pdf).

(MPOC), M. P. 2013. *Malaysian Palm Oil Council (MPOC).* Retrieved may 3, 2014, from http://theoilpalm.org/: http://theoilpalm.org/malaysias-story/history-of-the-industry/

Ping, Y. S. 2013. *The Health Care Expenditure and National Income: The Malaysian Case*. University Malaysia Sabah.

Pluess, B., Mueller, I., Levi, D., King, G., Smith, T. a, & Lengeler, C. 2009a. *Malaria--a major health problem within an oil palm plantation around Popondetta, Papua New Guinea. Malaria Journal*, :*8*, 56.

Pluess, B., Mueller, I., Levi, D., King, G., Smith, T. A., & Lengeler, C. 2009b. *around Popondetta , Papua New Guinea,* **11:** 1–11. doi:10.1186/1475-2875-8-56

Russell, Tanya L; Lwetoijera, Dickson W; Knols, Bart G J; Takken, Willem; Killeen, G. F. (2013). *Geographic coincidence of increased malaria transmission hazard and vulnerability occurring at the periphery of two Tanzanian villages*. Malaria Journal Vol. 1*2*, p. 24.

Vanwambeke, S. O., Lambin, E. F., Eichhorn, M. P., Flasse, S. P., Harbach, R. E., Oskam, L., Butlin, R. K. 2007. *Impact of Land-use Change on Dengue and Malaria in Northern Thailand. EcoHealth*, ***4*(1)**: 37–51. doi:10.1007/s10393-007-0085-5

(WHO), w. h. 2014. *malaria*. Retrieved october thursday, 2014, from media center: http://www.who.int/mediacentre/factsheets/fs094/en/

APPENDICES

Appendix A

Table 1: Descriptive Analysis

	LTCM	LLUCPO	LPOP	LGDP
Mean	9.745347	11.73869	10.02034	12.50826
Median	9.455637	11.78902	10.03065	12.61408
Maximum	11.14370	12.36852	10.28660	13.75495
Minimum	8.460623	11.05518	9.700698	8.876126
Std. Dev.	0.984771	0.365300	0.184792	1.026736
Skewness	0.094927	-0.332560	-0.177457	-1.598773
Kurtosis	1.319888	2.201121	1.751977	6.771313
Jarque-Bera	3.216173	1.215667	1.893965	27.50299
Probability	0.200270	0.544529	0.387910	0.000001
Sum	263.1244	316.9448	270.5492	337.7229
Sum Sq. Dev.	25.21412	3.469552	0.887851	27.40885
Observations	27	27	27	27

Appendix B

Table 2: Ordinary Least Square for the model
LOG(TCM)= f(LOG(LUCPO), LOG(POP), LOG(GDP).

Variable	Coefficient	t-statistic	P-value
C	70.94775	9.690812	0.0000
LLUCPO	0.193393	0.941211	0.3564
LPOP	-6.758650	-7.293810	0.0000
LGDP	0.339886	2.076311	0.0492
R-squared (R^2)	0.880433		
Adjusted R-squared	0.864838		
F-statistic	56.45382		
Durbin-Watson	0.776828		

Note:
Log Land Use Change Of Palm Oil = LLUCPO
Log Population = LPOP
Log Gross Domestic Product = LGDP

Appendix C

Table 3: Augmented Dickey Fuller (ADF) test result at Level form, First Difference and Second Difference.

	Augmented Dickey Fuller					
	Level Form		**First Difference**		**Second Difference**	
	No Trend	**With Trend**	**No Trend**	**With Trend**	**No Trend**	**With Trend**
LOG (TCM)	-0.782555***	-3.524784*	-4.358454	-4.258792**	-5.023549	-4.854442
LOG(LUCPO)	-3.967526	-4.197851**	-7.026977	-6.953732	-6.809152	-6.760640
LOG(POP)	-6.000667	2.99909***	2.628723***	-3.413290*	-7.918438	-5.212477
LOG(GDP)	-5.451497	-31.26638	-40.74565	-39.40927	-7.937065	-7.703399

(***) 1% Significance level, (**) 5% Significance level, (*) 10% Significance level

Note:

Log Total Cases of Malaria = LOG (TCM)
Log Land Use Change of Palm Oil = LOG (LUCPO)
Log Population = LOG (POP)
Log Gross Domestic Product = Log (GDP)

Unit Root Test Hypothesis:

H_o: t-test < critical value: Variable is not stationary (Have unit root)
H_1: t-test >critical value Variable is stationary (Do not have unit root)

Appendix D

Table 4: Cointegration Rank test (Trace) for the model LOG(TCM) =f (LOG(LUCPO), LOG(POP), LOG(GDP))

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.555984	51.54464	47.85613	0.0216
At most 1 *	0.483497	31.24724	29.79707	0.0338
At most 2	0.304307	14.73037	15.49471	0.0650
At most 3 *	0.202576	5.659204	3.841466	0.0174

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5: Cointegration Rank test (Max Eigen value) for the model LOG(TCM) =f (LOG(LUCPO), LOG(POP), LOG(GDP))

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value
None	0.555984	20.29739	27.58434
At most 1	0.483497	16.51688	1.13162
At most 2	0.304307	9.071162	14.26460
At most 3 *	0.202576	5.659204	3.841466

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix E

Table 6: Vector Error Correction for the model
LOG (TCM) =f (LOG(LUCPO), LOG(POP), LOG(GDP))

Variable	Coefficient	Standard Error	t-statistic
EC term 1	-0.081322	(0.07872)	[-1.03309]
D(LTCM(-1))	0.509628	(0.23094)	[2.20674]
D(LLUCPO(-1))	0.126846	(0.18641)	[0.68047]
D(LPOP(-1))	20.91361	(18.7424)	[1.11585]
D(LGDP(-1))	-1.502211	(1.23083)	[-1.22049]
c	0.155642	(0.35070)	[0.44380]
R-squared	0.482231		
F-statistic	1.448787		
Log likelihood	6.494122		

Note:

Log Total Cases of Malaria	= LOG (TCM)
Log Land Use Change of Palm Oil	= LOG (LUCPO)
Log Population	= LOG (POP)
Log Gross Domestic Product	= Log (GDP)

Appendix F
Table 7: Summary Hypotheses

Table 7.1:

	Hypotheses 1: Land Use Change of Palm Oil (LUCPO) can influence the Total Cases of Malaria (TCM) in Malaysia:	
Null Hypothesis H_o	Land Use Change of Palm Oil (LUCPO) can influence the Total Cases of Malaria (TCM) in Malaysia.	Accepted
Alternative Hypothesis H_A	Land Use Change of Palm Oil (LUCPO) cannot influence the Total Cases of Malaria (TCM) in Malaysia.	Rejected

Table 7.2

	Hypotheses 2: Population (POP) can influence the Total Cases of Malaria (TCM) in Malaysia	
Null Hypothesis H_o	Population (POP) can influence the Total Cases of Malaria (TCM) in Malaysia.	Rejected
Alternative Hypothesis H_A	Population (POP) cannot influence the Total Cases of Malaria (TCM) in Malaysia.	Accepted

Table 7.3

	Hypotheses 3: Gross Domestic Product (GDP) can influence the Total Cases of Malaria (TCM) in Malaysia	
Null Hypothesis H_o	Gross Domestic Product (GDP) can influence the Total Cases of Malaria (TCM) in Malaysia.	Accepted
Alternative Hypothesis H_A	Gross Domestic Product (GDP) cannot influence the Total Cases of Malaria (TCM) in Malaysia.	Rejected

Appendix G

Table 8 : Granger Causality Test Result between Total Cases of Malaria (TCM) per 100,000 people and the Land Use Change of Palm Oil (LUCPO) Oil palm plantation area (ha)

Null Hypothesis:	Obs	F-Statistic	Prob.
LLUCPO does not Granger Cause LTCM	26	2.65223	0.1170
LTCM does not Granger Cause LLUCPO		0.45173	0.5082

Note:
Log Total Cases of Malaria = LOG (TCM)
Log Land Use Change of Palm Oil = LOG (LUCPO)