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Article

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Impact of Climate Change on Agriculture Sector of Malaysia

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ABSTRACT

For the national economy, agriculture sector remains an important contributor in the national GDP with the provision of almost 16% employment. However, the problem of climate change is observed as a key challenge in the local market with its potential harmful effect on agriculture sector. The research task of this study is to test whether there is any relationship between climate change and agriculture sector of Malaysia. For research purpose, data was collected from different national and international databases during 1975-2015. Agriculture sector is defined with seven different factors and for the climate change, air pollution, greenhouse gas emission, and energy usage are added as main explanatory variables. Additionally, we tried to explore the effect of lagged predictors of explanatory variables on agriculture sector too. Our results depict that there is mixed effect of climate change and energy usage on agriculture economy. However, none of the lag predictor is found to be a significant determinantal variable for agriculture dynamics in Malaysia. In the last, study results are recommended for ministry of agriculture and agro-based industry, and department of environment Malaysia for developing any type of acts, rules and regulations for the environmental quality and agro-based industry. It is suggested that future research contributions should definitely consider the other economies in ASEAN and Asian region for some getting some different facts with more generatability.

Keywords: Climate Change, Agriculture Sector, Malaysia
JEL Classifications: Q54, N5, O13

1. INTRODUCTION AND BACKGROUND OF THE LITERATURE

Climate change is probable to demonstrate considerably the food insecurity while reducing food prices and increasing food production (Hanjra and Qureshi, 2010; Porter et al., 2017; Schmidhuber and Tubiello, 2007; Wheeler and Von Braun, 2013). As climate change outcome, food items become more expensive (Ford, 2009; Lake et al., 2012; Restrepo Zea and Ramírez Gómez, 2020; Ruiz, 2020). Due to increase in crop water usage and aridity, required water for food production may become deficient. For production, certain areas are going to become climatically inappropriate. In agricultural productivity, thrilling weather events accompanying climate change, causing sudden reduction in the overall output of this sector (Mittler and Blumwald, 2010; Sen, 2008). Meanwhile, it is leading towards the quick pricing. In 2010, Kazakhstan, Russia and Ukraine had faced a loss of huge volume of the crops due to the heat waves of summer (Lioubimtseva et al., 2013; Zampieri et al., 2017; Jiang et al., 2020; Kong and Zhao, 2020). This issue has forced a lot of community members to face the issue of poverty.

Since the 1950s, as per the findings of Intergovernmental Panel for Climate Change, it is believed that considerable climate change has been occurred (Lee, 2007). In the second half of this century, the temperature of air will increase by 0.4 to 2.6°C which primarily depends upon the emission of green house and other gases into natural environment (Panwar et al., 2011; Martín-Moya et al., 2020). The major source of greenhouse gas is agriculture and the wider food production system. Between 2005 and 2050, it is appraised that the demand of livestock crops will grow by +70% (Hunter et al., 2017). Increase the harvest of some crops, carbon dioxide may result in more favorable conditions. Because of climate changing during the 21st century, crop production is probable to decrease in many areas (Clair and Lynch, 2010; McMichael et al., 2007). However, the significance of agriculture in economic progress cannot be denied. For example, for the U.S economy, agriculture is an important sector. More than $300 billion to the economy, US contributes for the production of seafood livestock and crops each year. To the gross domestic product, food and agricultural sectors accord more than $750 billion.

On the climate, fisheries and agriculture sectors are highly hooked on. In some places, increases in carbon dioxide and temperature (CO_2) can cause an upward shift in some crops production. To conceive these benefits, soil moisture, nutrient level, water availability and other circumstances are necessary. Many fishes and shellfish species have to shift their habitat due to the warmer water temperature which has disturbed the ecosystem. In the same way, it could make more difficult to catch fish, raise animals and to grow crops in this climate changing situation.

On a global scale, agriculture and climate change are interrelated processes. Changes in sea level, changes in atmospheric carbon dioxide, and ground level ozone concentrations, changes in pests and related disease, and changes in average temperature are some of the issues created by global warming (Barnes, 2018; Dow and Downing, 2016). In different counties, future climate reaction will negatively affect the crop production and for northern latitudes this effect might be negative or positive. For some vulnerable groups like poor, climate change will indeed increase the risk of food insecurity (Baldos and Hertel, 2015; Martin-Urbano et al., 2020; Missaglia and Sanchez, 2020; Morantes Quintana et al., 2020). A percentage of the world's methane, animal agriculture is also responsible for CO_2 greenhouse gas production, displacement of local species and future land infertility.

Climate change could affect agriculture in many ways.

- In term of quantity and quality of crops, yield
- Through changes of water usage like irrigation and agricultural inputs such as insecticides, and fertilizers
- In particular, the frequency and intensity of soil drainage (leading to nitrogen leaching), decrease of crops diversity, environmental effect, soil erosion, reduction of crop diversity
- Through the loss and gain of cultivated land, environmental effect, land speculation, in relation of frequency, soil erosion, reduction of crops diversity and hydraulic amenities
- Organism, adaptation may become more or less competitive, flood resistant or salt resistant and many other varieties of rice, humans may grow more competitive organisms
- In pest insect population, global warming could lead towards a significant increase with the warmer temperature.

In addition, to measure the effect of warmer temperatures of soybean plant growth and Japanese beetle populations, the University of Illinois conducted studies for one field of soybean where warmer temperature and elevated levels were replicated while other factors were left as a control. It is found that soybean had higher yield, and grow much faster with elevated CO_2 levels. Changing climate is observed as an alarming challenge for various industries and sectors including agriculture. For this reason, researchers are trying to explore the diversified impact of climate change in different dimensions on agriculture sector and agro-based industries. Falco et al. (2019) observed the migration and the climate change collectively as climate change has its effect on the productivity of agriculture sector. Authors believe that migration and climate change are the two important challenge in the world economy and through climate change agriculture sector is affected the most. Both rainfall and temperature are defined by the change in the natural environment and climate. For accepting this impact of climate on agriculture, reserachers have collected the data during 1960 to 2010 from 108 countries in order to explore the association between change in agro-based productivity, weather variations, and migration at international level. It is found that due to negative shocks for the agriculture productivity which is defined by the variation in the climate has further explained the migration status in developing economies.

Huong et al. (2019) have analyzed the economic impact of climate change on the agriculture sector for the sustainable livelihood. For this purpose, they have applied Ricardian approach while exploring the trends in climate change and their impact on agriculture sector int eh Vietnam economy. Based on the secondary data from 1055 household which were observed through a survey during 2012. Their study findings reveal the fact that with the increase in the rainfall and temperature, there is a decline in the value of net revenue in the selected region. Chandio et al. (2020) investigated the short term and long term impact of climate change on the agriculture output in the economy of China. It is observed that climate change is significantly impacting the agriculture sector in the world economy and similar is case in China. For this purpose, they have collected the data from 1982-2014while applying the augmented dicky-fuller test along with ARDL bound testing approach to analyze the trends in study variables. It is observed that all the variables are stationary at the combination of 1(0), and 1(1) respectively. Meanwhile, there is a significant impact of carbon emission on agriculture sector both under short run and long run.

2. VARIABLES DESCRIPTIONS AND RESEARCH METHODS

The variables used in the study are measured as follows:

Under present study analysis, the statistical method used to test the impact of climate change dynamics on the agriculture sector is based on the regression analysis which is observed with the wider applicability in the present literature. For this purpose, various regression equations are developed and empirically tested. Equation I indicates the impact of selected explanatory variables on agriculture land as a percentage of land are which is the first dependent variable, Whereas Equation II-VII indicates the dependent variables as agriculture land in terms of square km, agriculture machinery, tractors, agriculture raw material imports, agriculture forestry and fishing value added, agriculture raw material exports, and employment in agriculture as a percentage of total employment. In addition, C represents the constant values of each of the dependent variable, while ∂,b,ρ and δ are representing the marginal coefficients as observed due to change in each of the explanatory variables of the study. Lastly, ϵ reflects the error terms of each model.

Title and measurement	Abbreviation of the variables
Agricultural land (% of land area)	AGA
Agricultural land (sq. km)	AGB
Agricultural machinery, tractors	AGC
Agricultural raw materials imports (% of merchandise imports)	AGD
Agriculture, forestry, and fishing, value added (% of GDP)	AGE
Agricultural raw materials exports (% of merchandise exports)	AGF
Employment in agriculture (% of total employment) (modeled ILO estimate)	AGG
PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total)	AIRP
PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)	AIRPEXP
Total greenhouse gas emissions (kt of CO_2 equivalent)	GHGE
Energy use (kg of oil equivalent per capita)	ENGUSE

$$\text{Agricultural land (\% of land area)}Y1=C+\partial 1(\text{AIRP})+b2(\text{AIRPEXP})+\rho 3(\text{GHGE})+\delta 4(\text{ENGUSE})+\epsilon \quad (1)$$

$$\text{Agricultural land (sq.km)}Y2=C+\partial 1(\text{AIRP})+b2(\text{AIRPEXP})+\rho 3(\text{GHGE})+\delta 4(\text{ENGUSE})+\epsilon \quad (2)$$

$$\text{Agricultural (machinery,tractors)}Y3=C+\partial 1(\text{AIRP})+b2(\text{AIRPEXP})+\rho 3(\text{GHGE})+\delta 4(\text{ENGUSE})+\epsilon \quad (3)$$

$$\text{Agricultural raw materials imports (\% of merchandise imports)}\ Y4=C+\partial 1(\text{AIRP})+b2(\text{AIRPEXP})+\rho 3(\text{GHGE})+\delta 4(\text{ENGUSE})+\epsilon \quad (4)$$

$$\text{Agriculture,forestry,and fishing,value added (\% of GDP)}\ Y5=C+\partial 1(\text{AIRP})+b2(\text{AIRPEXP})+\rho 3(\text{GHGE})+\delta 4(\text{ENGUSE})+\epsilon \quad (5)$$

$$\text{Agricultural raw materials exports (\% of merchandise exports)}\ Y6=\delta+\partial 1(\text{AIRP})+b2(\text{AIRPEXP})\rho 3(\text{GHGE})+\delta 4(\text{ENGUSE})+\delta \quad (6)$$

$$\text{Employment in agriculture (\% of total employment)(modeled ILO estimate)}Y6=C+\partial 1(\text{AIRP})+b2(\text{AIRPEXP})+\rho 3(\text{GHGE})+\delta 4(\text{ENGUSE})+\epsilon \quad (7)$$

3. RESEARCH RESULTS

Under this section, reserachers has expressed the results as observed through quantitative analyses. For this purpose, three major results are provided; descriptive results for dependent and explanatory variables, correlation among all the variables, and multiple regression wit lagged one addition in the results like other explanatory variables. Details of each results, values, their importance and trends are presented below. In the first step researcher has attempted to discuss descriptive values of the mean and standard deviation for dependent and explanatory variables under separate headings.

3.1. Descriptive Results for Dependent Variables

Agriculture variables are showing a reasonable trend in Malaysia when covered with the Mean and standard deviation (Table 1). The range of agriculture variables is starting from AGA and ending with AGG with each of the total 41 observations under their data patterns. This could say that over study period, missing value is not found for any one of agriculture factors. For exploring the mean and deviation, comparatively AGA, D, E, E, F, and G are providing lowest mean score of 1.64 and maximum mean score of 19.74. However, AGD is showing the standard deviation trend in .497, followed by AGA, AGE, and other variables. As agricultural land AGA is measured with square kilometer, so its mean and standard deviation is higher than other dependent variables. Same case is found for the agriculture machinery, and tractors.

3.2. Descriptive Results for Independent Variables

Climate change is reflected with four measures in Table 1 where air pollution is reflecting a mean value of −68.48, and AIREXP has an average score of −6.165. It would justify that higher mean reflects higher deviation and lower with lowest mean score; 253.246 for AIRP and 45.878 for AIRPEXP. For the greenhouse gas emission, a mean value is 204000 reflects higher this score

Table 1: for Descriptive Results (observations, Mean and Std. Dev.) of the variables

Variable	Obs	Mean	Std.Dev.
Dependent variables			
AGA: Agricultural land (% of land area)	41	19.74	3.369
AGB: Agricultural land (sq. km)	41	64857.38	11069.41
AGC: Agricultural machinery, tractors	41	52415.98	41313.36
AGD: Agricultural raw materials imports (% of merchandise imports)	41	1.647	0.497
AGE: Agriculture, forestry, and fishing, value added (% of GDP)	41	15.234	6.656
AGF: Agricultural raw materials exports (% of merchandise exports)	41	12.865	12.644
AGG: Employment in agriculture (% of total employment) (modeled ILO estimate)	41	12.865	12.644
Explanatory variables			
AIRP: PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total)	41	−68.483	253.246
AIRPEXP: PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)	40	−6.165	45.878
GHGE: Total greenhouse gas emissions (kt of CO2 equivalent)	41	204000	58008.28
ENGUSE: Energy use (kg of oil equivalent per capita)	41	1747.223	774.229

and deviation of 58008. For Energy usage in Malaysian economy, overall 1747 kg of oil equivalent per capita value is found for 41 years of this research work.

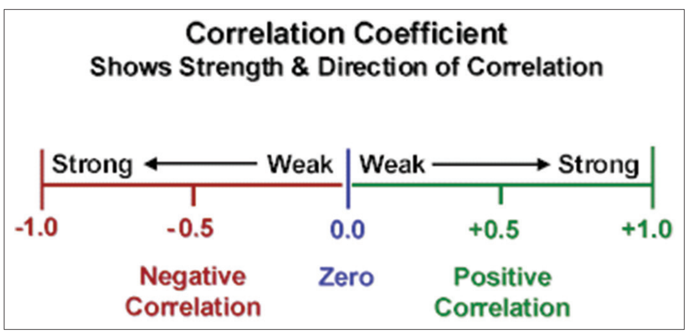
3.3. Correlational Analysis and Interpretation

This section has covered the interdepdency between the variables, which is calculated and presented through pairwise correlation coefficient. The highest value of the correlation coefficient may be 1 and lowest may be 0 or below 0 when it is in negative scale. Highest correlation means there is high level of interdepdency between the variables, hence problem of multicollinearity and vice versa. Table 2 covers the correlation coefficients between the variables with their relative significance below each of the coefficient. A proper understanding for the significant correlation between the variables may be availed while considering that *** means 1%, ** means 5%, and * means 10% level of significance. Readers are highly recommended to read the Figure 1 and Table 2 carefully in order to understand and explain the correlation at different levels. Figure 1 helps to understand each of the correlation level between the variables.

3.4. Impact of AIRP and AIRPEXP on Agriculture Sector

The causal impact of AIRP on AGA-AGC are starting the discussion under Table 3 where overall A-F models are showing different coefficients, and their significance level with ***,** and *. Model A, C, and E have provided that evidence how climate change with different factors is disturbing the agriculture sector without considering the lag values. Opposite to this, Model B, D, and F are not only providing the coefficients as a rate of change in agriculture factors through climate change and first lag for each of the explanatory variable. As observed, AIRP is not showing any statistical evidence to support that it has a significant impact on AGA, AGB, and AGC in all six models; A-F respectively. Opposing this insignificant impact of AIRP on all factors of agriculture sector in Malaysia, the influence of AIREXP on AGA-AGC is showing some interested facts which are explained as:

Figure 1: Correlation coefficient range



Unit change in the value of AIRPEXP causing a positive shift in AGA, where the evidence is provided through 0.0336 which indicates a positive impact.

Unit change in the value of AIRPEXP causing a positive shift in AGA with the effect of lag values of all of the explanatory variables is added in the model. However, significant impact of AIRPEXP has turned into positive but insignificant for AGA.

Unit change in the value of AIREXP causing a positive impact on AGB where the evidence is provided through coefficient of 110.3 with a significant level of 1%.

Unit change in the value of AIREXP causing a positive impact on AGB even when the effect of lag values of explanatory variable is added in the model (B). This effect is providing a marginal effect of 95.61.

Unit change in the value of AIREXP is causing a negative impact on AGC which is proved with the coefficient of −181.0. It means that higher the AIRPEXP lower the AGC.

Unit change in the value of AIREXP is causing a negative impact on AGC when the model is observed with the addition of lag

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) AGA	1.000										
(2) AGB	0.1200	1.000									
	0.000										
(3) AGC	0.868	0.868	1.000								
	0.000	0.000									
4) AGD	−0.322	−0.322	−0.012	1.000							
	0.040	0.040	0.938								
(5) AGE	−0.932	−0.932	−0.840	0.478	1.000						
	0.000	0.000	0.000	0.002							
(6) AGF	−0.934	−0.934	−0.822	0.494	0.981	1.000					
	0.000	0.000	0.000	0.001	0.000						
(7) AGG	−0.934	−0.934	−0.822	0.494	0.981	1.000	1.000				
	0.000	0.000	0.000	0.001	0.000	0.000					
(8) AIRP	0.294	0.294	0.472	0.110	−0.331	−0.350	−0.350	1.000			
	0.062	0.062	0.002	0.495	0.034	0.025	0.025				
(9) AIRPEXP	0.907	0.907	0.678	−0.573	−0.927	−0.943	−0.943	0.134	1.000		
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.410			
(10) GHGE	0.865	0.865	0.811	−0.217	−0.805	−0.811	−0.811	0.358	0.746	1.000	
	0.000	0.000	0.000	0.174	0.000	0.000	0.000	0.021	0.000		
(11) ENGUSE	0.906	0.906	0.981	−0.171	−0.912	−0.895	−0.895	0.472	0.766	0.851	1.000
	0.000	0.000	0.000	0.284	0.000	0.000	0.000	0.002	0.000	0.000	

Table 3: Relationship between climate change and agriculture sector

Variables	(A)	(B)	(C)	(D)	(E)	(F)
	AGA	AGA	AGB	AGB	AGC	AGC
AIRP	−0.000523	−0.000430	−1.718	−1.414	−6.487	1.611
	(0.000683)	(0.00119)	(2.243)	`(3.901)	(4.973)	(7.759)
AIRPEXP	0.0336***	0.0291	110.3***	95.61***	−181.0***	−154.5**
	(0.00535)	(0.0303)	(17.57)	(8.44)	(38.95)	(77.8)
GHGE	9.37e-06*	7.30e-06	0.0308*	0.0240	−0.00605	−0.0207
	(4.79e-06)	(5.73e-06)	(0.0157)	(0.0188)	(0.0349)	(0.0374)
ENGUSE	0.00193***	0.00275	6.336***	9.033	61.80***	31.17***
	(0.000423)	(0.00172)	(1.389)	(5.635)	(3.080)	(11.21)
AIRPL1		−0.000821		−2.698		−9.172
		(0.00120)		(3.934)		(7.824)
AIRPEXPL1		0.00135		4.445		−33.30
		(0.0291)		(95.62)		(190.2)
GHGEL1		3.50e-06		0.0115		0.0180
		(6.30e-06)		(0.0207)		(0.0411)
ENGUSEL1		−0.000636		−2.089		31.50***
		(0.00164)		(5.401)		(10.74)
Constant	14.60***	13.84***	47,956***	45,460***	−55,600***	−56,117***
	(0.865)	(1.055)	(2,843)	(3,465)	(6,303)	(6,891)
Observations	40	38	40	38	40	38
R-squared	0.841	0.543	0.741	0.553	0.879	0.585

AIRP: PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total), AIRPEXP: PM2.5 air pollution, mean annual exposure (micrograms per cubic meter), GHGE: Total greenhouse gas emissions (kt of CO_2 equivalent), ENGUSE: Energy use (kg of oil equivalent per capita), AIRPL1: Lag one of AIRP, lag one of AIRPEXP, GHGEL1: Lag one of GHGE, ENGUSEL1: Lag one of ENGUSE, AGA: Agricultural land (% of land area), AGB: Agricultural land (sq. km), AGC: Agricultural machinery, tractors, errors in coefficients in (), *** means 1%, ** means 5%, and * means 10% level of significance

predictors for each of the explanatory variables through L1 under last column of Table 3.

3.5. Impact of Green House Gas Emission on Agriculture Sector

As observed under Table 3, GHGE is showing a positive influence for AGA where it means higher GHGE means more AGA in Malaysia, opposite to this impact, when the lag predictors are added in the model B, the effect of GHGE is positive but it changes from significant to insignificant. For AGB, the influence of GHGE turns positive and significant at 10%. However, when the lag predictors are added it turns to insignificant by all means. For AGC, GHGE is showing negative but insignificant impact without and with the addition of lag predictors of all of the explanatory variables of the study. The lag predictor of GHGE is also showing the evidence that it is not affecting the agriculture sector when measured through AGA, AGB, and AGC respectively.

3.6. Impact of Energy Usage on Agriculture Sector

A common notion is that more usage of energy in any economy, means more economic activities with the production of goods and services. Different sectors in different economies are using diversified level of energy to contribute in the economy. From the findings under Table 3, ENGUSE is causing a direct impact on AGA where the coefficient of 0.00193 predicting that more energy usage means constructive impact on Agricultural land (% of land area). However, lag predictors are causing a turn of this positive and significant impact to positive but insignificant in the agriculture sector of Malaysia. For Agricultural land (sq. km) or AGB, NEGUSE is showing a result of 6.336 indicating a positive impact, hence proved that more energy usage means a good impact on agriculture land in Malaysia. For AGC energy usage is causing an influence of 61.80. It shows that one unit change in ENGUSE means 61.80 increase in AGC. Similarly, with the addition of lag one predictors in the model F ENGUSE is still causing a positive impact in AGC, where 31.17 is a key evidence. Overall research result shows that for AGA-AGC, lag one predictors of all the explanatory variables are showing that no evidence is found for their significant impression.

3.7. Impact of AIRP and AIRPEXP on Agriculture Sector (AGD-AGF)

For rest of the agriculture factors, impact of AIRP and AIREXP is provided in Table 4 where overall models are showing a range of A to H. As found, AIRP is showing only the significant but negative impact on AGF and AGG, however, without the addition of lag predictors in the models. It means that impact of AIRP and AIRPEXP is significant until the addition of lag one predictors of explanatory variables. On the other hand, for AIREXP following impacts are observed:

Unit change in the value of AIRPEXP causing a negative shift in AGD, where the evidence is provided through -0.0122 which indicates an adverse impact.

Unit change in the value of AIRPEXP causing a negative shift in AGD with the effect of lag values of all of the explanatory variables is added in the model. However, significant impact of AIRPEXP still remain significant for AGD.

Unit change in the value of AIREXP causing a negative impact on AGE where the evidence is provided through coefficient of −0.0872 with a significant level of 1%.

Unit change in the value of AIREXP causing a negative impact on AGE even when the effect of lag values of explanatory variable

Table 4: Relationship between climate change and agriculture sector

Variables	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
	AGD	AGD	AGE	AGE	AGF	AGF	AGG	AGG
AIRP	−9.48e-05	1.19e-05	−0.000874	−0.000943	−0.00479**	−0.000990	−0.00479**	−0.000990
	(0.000290)	(0.000506)	(0.00107)	(0.00172)	(0.00182)	(0.00282)	(0.00182)	(0.00282)
AIRPEXP	−0.0122***	−0.106***	−0.0872***	−0.256***	−0.191***	−0.107***	−0.191***	−0.107
	(0.00227)	(0.0129)	(0.00836)	(0.0437)	(0.0143)	(0.020)	(0.0143)	(0.0720)
GHGE	1.39e-06	−8.01e-08	1.22e-05	6.59e-06	1.19e-05	9.26e-06	1.19e-05	9.26e-06
	(2.04e-06)	(2.44e-06)	(7.49e-06)	(8.28e-06)	(1.28e-05)	(1.36e-05)	(1.28e-05)	(1.36e-05)
ENGUSE	0.000360*	−0.000215	−0.00459***	−0.00393	−0.00610***	−0.00167	−0.00610***	−0.00167
	(0.000180)	(0.000730)	(0.000661)	(0.00248)	(0.00113)	(0.00408)	(0.00113)	(0.00408)
AIRPL1		8.49e-05		−0.000328		−0.00285		−0.00285
		(0.000510)		(0.00173)		(0.00285)		(0.00285)
AIRPEXPL1		−0.00206		−0.0620		−0.0941		−0.0941
		(0.0124)		(0.0421)		(0.0692)		(0.0692)
GHGEL1		2.57e-06		1.24e-05		−5.13e-06		−5.13e-06
		(2.68e-06)		(9.10e-06)		(1.50e-05)		(1.50e-05)
ENGUSEL1		0.000491		−0.000558		−0.00356		−0.00356
		(0.000700)		(0.00238)		(0.00391)		(0.00391)
Constant	0.665*	0.653	20.20***	18.36***	19.69***	19.36***	19.69***	19.36***
	(0.368)	(0.449)	(1.353)	(1.524)	(2.309)	(2.509)	(2.309)	(2.509)
Observations	40	38	40	38	40	38	40	38
R-squared	0.503	0.546	0.963	0.968	0.970	0.978	0.970	0.978

AIRP: PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total), AIRPEXP: PM2.5 air pollution, mean annual exposure (micrograms per cubic meter), GHGE: Total greenhouse gas emissions (kt of CO_2 equivalent), ENGUSE: Energy use (kg of oil equivalent per capita), AIRPL1: Lag one of AIRP, lag one of AIRPEXP, GHGEL1: Lag one of GHGE, ENGUSEL1; Lag one of ENGUSE, AGD: Agricultural raw materials imports (% of merchandise imports) AGE: Agriculture, forestry, and fishing, value added (% of GDP), AGF: Agricultural raw materials exports (% of merchandise exports) AGG: Employment in agriculture (% of total employment) (modeled ILO estimate), tractors, errors for coefficients in (), *** means 1%, ** means 5%, and * means 10% level of significance

is added in the model (D). This effect is providing a marginal effect of−0.256.

Unit change in the value of AIREXP is causing a negative impact on AGF which is proved with the coefficient of −0.191. It means that higher the AIRPEXP, lower the AGF.

Unit change in the value of AIREXP is causing a negative impact on AGF when the model is observed with the addition of lag predictors for each of the explanatory variables through L1 under model F of Table 4.

For AGG, ARIEXP is showing a negative impact which turns to insignificant in H model where lag predictors are added in the regression equation.

3.8. Impact of GHGE on Agriculture Sector (AGD-AGG)

As shown in Table 4, none of the agriculture sector factor (AGD-AGG) are found to be significantly determined by GHGE. It accepts that greenhouse gas emission is not directly or indirectly impacting Agricultural raw materials imports (% of merchandise imports), agriculture, forestry, and fishing, value added (% of GDP), agricultural raw materials exports (% of merchandise exports), Employment in agriculture (% of total employment) (modeled ILO estimate) in Malaysia.

3.9. Impact of ENGUSE on Agriculture Sector (AGD-AGG)

Through energy usage, agriculture sector is providing the evidence that Agricultural raw materials imports (% of merchandise imports), Agriculture, forestry, and fishing, value added (% of GDP), agricultural raw materials exports (% of merchandise exports), and Employment in agriculture (% of total employment) (modeled ILO estimate) where all of these factors are significantly and negative affected by energy usage in Malaysian environment. In addition, none of the lag predictors under Table 4 is providing the evidence for significant relationship with AGD to AGG, hence reserachers have accepted their no impact on all the measures of agriculture sector.

4. CONCLUSION

This study has been carried out for the purpose of analyzing the climate change influence on agriculture sector of Malaysia. Overall study is covering a significant time period with quantitative data measurement technique. Three different findings like descriptive, correlation and multiple regression are found and presented with discussion through sub headings. Overall study results are showing that some climate change factors have their positive impact while some have their negative effect on agriculture sector dynamics ranging from GA to GG accordingly. It is believed that there is a good contribution of agriculture sector in the growth and progress of Malaysian economy and for this more attention is demanded by this sector. However, the fear from changing climate is one of the growing concern in agriculture sector which requires some immediate remedies.

One of the key issue in the economy of Malaysia is its environment is showing an increasing trend towards the changing climate, therefore, some fruitful measures are observed as need of time. For this reason, present research effort is showing its findings for helping those who are responsible to manage the growth of agriculture sector and at the same time securing it from changing climate. Future research studies may continue their efforts in a similar direction while applying advance statistical measures and may consider the Thailand, Indonesia as an expansion in the sample too.

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