THE EFFECT OF GREEN HOUSE GASES (GHG) ON INCOME GROWTH IN ASEAN COUNTRIES

Pornkul Suksod

Graduate School, Suan Sunandha Rajabhat University, Bangkok, Thailand

E-mail: pornkul.su@ssru.ac.th

Received 15 March 2019; accepted 29 November; published 30 January 2020

Abstract. Environmental pollution is the cause of reduction in production of man-made labor and capital and lead to reduce output as well. All such decaying nature of pollution leads to adverse impact on human being and economy for sure in case of long duration of it. The main objective for this paper is to analyze the link relating **CO₂** with economical development in 8 Asian countries. Data from 1965 to 2010 has been taken to scale out the income level income per capita and per capita GDP. For this study three simultaneous equations are used EKC relationship with indicator of CO₂ are air pollution, income and population density. And found a direct relationship between pollution and income initially and then start decreasing towards negativity and shows inverse impact afterwards. Also there is negative impact of pollution on population density.

Keywords: economic growth; emission of carbondioxide; endogeneity; Hausmen Test; Equation Simultaneity; Environmental Kuznets Curve (EKC)

Reference to this paper should be made as follows: Suksod, P. 2020. The effect of green house gases (GHG) on income growth in ASEAN countries. *Journal of Security and Sustainability Issues*, 9(January), 5-14. [http://doi.org/10.9770/jssi.2020.9.J\(1\)](http://doi.org/10.9770/jssi.2020.9.J(1))

JEL Classifications: O1, Q54

1. Introduction

Growth level of a country is dependent all the way on numerous factors. It may be related to a peaceful environment, quality education, cleanliness care, infrastructure and wide array of others (Baltgailis, 2019). Industrialization, transportation, population, poverty, soil abrasion, over-crowding of traffic and misuse of easily accessed resources that are not properly prescribed and other several environmental issues are basic factors that are leading to environmental destruction and it must have to be taken in notice to work for (Vegea, Malei, Trubovich, 2018; Tvaronavičienė, 2018; Lavrinenko, Ignatjeva, Ohotina, Rybalkin, Lazdans, 2019; El Iysaouy, El Idrissi, Tvaronavičienė, Lahbabi, Oumnad, 2019; Sriyana, 2019, Kormishkina, Kormishkin, Gorin, Koloskov, Koroleva, 2019; Zamil, Furqan, Mahmood, 2019). Economic growth as affected by pollutants in Asian countries (Haseeb, Kot, Hussain, & Jermisittiparsert, 2019; Haseeb, Wattanapongphasuk, & Jermisittiparsert, 2019). It is seemed like as economy grows used of carbon dioxide raises due to more inclusion in activities of industries. Environmental quality is not a bothering factor for industries and other agencies. The concern is only about to grow the economy by the mean of raising more production but industries must use such environmental friendly technologies that do not produce large amount of carbon dioxide gas. There are different mechanisms through which growth of economy can be promoted by using available resources in an efficient way. And growth leads to a generation of carbon dioxide in an excess amount that would give negative impact of produced gas on environment. And this is the major issue that number of countries is going through. Some developed and under developing countries ratio of carbon dioxide emission per capita are 4833.1 MT, 589.2 MT, 563.4 MT, 540.8 MT, 527.2 MT, 9056.8 of US, South Korea,

Iran, Canada, Saudi Arabia and China respectively. There is variety of indigent fragments that effect on environment unsatisfactorily (Jacobi, Wenger et al. 1998).

Carbon dioxide is colourless and odourless in case of less concentration and excess presence of it or higher concentration has acidic odor. There are some other names of carbon dioxide called carbonic acid gas, carbonic anhydride, carbonic oxide, carbon oxide and also called dry ice. Its molecular shape is linear and crystal shape is in trigon. That is the mixture of carbon and oxygen atoms. One of its properties is that it is water soluble. Its presence is also in natural gas called Sui gas and in petroleum. Carbon dioxide is such a kind of electromagnetic waves that emitted from the burning of fossil fuels, it actually produced by the aerobic organisms. If aerobic organisms are metabolite it turned into lipids and carbohydrates. Carbon dioxide returned back to water by the gill of fish, through human respiratory system, absorbing of carbon dioxide from plants, inhaling of animals and so on. In fossil fuels coal, peat, petroleum and natural gas are involved. In nineteenth century amount of carbon dioxide started increasing gradually due to large amount of burning of coal containing products and use of petroleum (Sharkey, Loreto et al. 1991).

Recently the ratio of methane and nitrous oxide also increased due to obvious advance era. It can be more unhealthful in case of trees and plants destruction. Wood destruction, fuel burning material and other objects that work with engines also lead to raise the emission of carbon dioxide. It is one of the main factors to generate impurities. In this age of advancement heavy machineries use will not avoided but to control on the ratio of carbon dioxide production can be controlled by other ways. As use of advance technology is less time consuming, more profitable and more efficient so its use could not be avoided. Three fourth part of global warming is just because of carbon dioxide. About 500 million years ago the ratio of carbon dioxide was 15 times less than now (Amanatidou, Smid et al. 1999). Amount of carbon dioxide in air was maintain for 20 million years initially after eighteenth century then human beings started increasing the use of carbon making products and its burning was usual and burning of fossil fuel and other objects causing generation of carbon dioxide. Due to anthropogenic emission (human caused emission) now it has been higher at such ratio that was not in any year of last 800,000 years ago. Such happening are occurred in just 200 years. If we go back to 1750 the ratio of carbon dioxide was 280 parts per million (ppm) that means in 1 million molecules of in air 280 were carbon dioxide molecules. On the other hand in 2008 there was an increase of 37.5% in ration that became 385 ppm (Talmage and Gobler 2010). There is another factor derived from carbon dioxide is carbon monoxide. Large ratio of carbon mono oxide causes headache, dizziness, nausea and vomiting for human beings. Higher level of it in space can lead people to faint or even die. Its exposure also raised the risk of heart disease. This gas is produced by driving vehicles, flaming in stoves, generator use, charcoal gas and many more objects.

The nexus to investigate the exhaling level of carbon dioxide is that human beings exhale about three billion tons of carbon dioxide annually and in average human beings exhale 2.3 pounds of carbon dioxide per day (Kramer 1981). The time we exhale the carbon dioxide is the time we inhaled the carbon dioxide. We inhale it with the consumption of plants and animals. Our body itself produced carbon dioxide through cellular respiration. The inhaled carbon dioxide then exhaled through the absorption of it in blood that reaches to our lungs where it has to exhale out from our nose. As it would be in our information that all the living things breathe (inhale) oxygen and breathe out (exhale) carbon dioxide. One of them is nitrogen that can be decreased economic growth. It has been proved that air impurity and its adverse impact are affected by earth's surface. At larger scale of Asian countries, India to china and Indonesia inclusion of air impurity was gradually increasing particularly in monsoon season that also covers the lower layer of space called stratosphere (Chaudhuri, Kirkham et al. 1990). Its long period destruction may have adversely effects on human beings as well as the economy. And such ramification of destructive level would gradually increase the health and social cost levying on people in economy (Gifford 1992).

This study was analyzed to find out the relationship between destructive natures of environment to economic growth of 8 different regions of Asia. This analysis would be undertaken by the mean of Environmental Kuznets Curve Analysis. The main objective is to scaling the level of environmental destruction caused by carbon monoxide (CO). This is a gas that does not produce its self. It also occurs in nature due to human activity. It generally occurs because of incomplete combustion. Incomplete combustion means when the supply of air is less. Carbon monoxide is much dangerous for human health and its higher concentration took place in homes and offices such like gas stoves, furnaces, fire places, gas water and also in cars (Ziska, Sicher et al. 1999). Carbon monoxide is also famous by the name as silent killer. Carbon dioxide (CO₂) is the natural gas that produces from the burning of fuel emitting from engines of machineries and from transportation movement. The basic emphasize is to recognize the relationship between CO₂ and environmental growth at first and then to make this model more advance by the mean of including synchronic variables. All such happenings lead towards a situation of reduction in total output by less creation of capital and labor opportunity. It means that as a result labor ratio and capital availability would become depressed and thus circumscribed production.

Due to invoking its adverse impacts on health (for all individuals working as labor) and also labor's depressed performance, raises water pollution and decaying of industrial instruments (Salahuddin, Gow et al. 2015). Thus unhealthy environment and diminished production level on way. Here pollution is aspect of negative externality. This would lead to cause higher firm cost that firm bear to decline the reduction of impure environment. This gas raises the amount of acidification that is alarm of danger for coral reefs and species to live. It causes suffocation in breathing process. Higher concentration of carbon dioxide will affect adversely but its normal ratio has no negative effects on health, quality of environment, atmosphere and growth of economy as well (Ahmed 2006). United State made a policy that introduced such measures and mechanics to hamper the excess amount of carbon dioxide by imposing taxes on use of fossil fuels and other aerobic organisms. Some states like Canada, Britain, and 40 other emphasized on imposition of taxes on aerobic objects that cause to emit carbon dioxide. Many economists propose to increase the cost of coal burning, oil and fossil fuel to control excess occurring of carbon dioxide.

This study is actually the improvement of EKC model by inclusion of synchronic variables that would be available and it also analyzes the usage of simultaneous equation techniques. This study based on endogenous variable as population density that having cons on health causing serious diseases like lungs cancer (Paffen and Roelofs 1991). There are numerous side effects and cons of use of such stuff which cause carbon dioxide to be produced. As well as on the other side its use is also benignant and somehow it also has numerous advance positive aspects of carbon produced items. And avoiding its use is quite tough and hard to say it for "no to use of carbon". The inclusion of use of carbon into space and atmosphere, in greenhouse, in ozone layer and obviously in global warming which results into a severe destruction, noisiness in air causing problems in inhaling, dust allergy, asthma, damaging of lungs (inhaling has direct effect on lungs because of poisonous particles that included in air which further can also cause lungs cancer). The temperature of the earth can be also increased by the burning of fossil fuels (Ertugrul, Cetin et al. 2016). If a gap created between ozone layer and in space it can damage the whole earth. Reason behind it is that ozone layer is precious for earth as it protects the earth from sun burn, damages and other harmful radiations and it would be disruptive for humanity.

2. Literature review

Lindmark (2002) was first to introduce the relationship between environmental decay and growth of economy. As it was found that at higher level income economic growth has decline. This declination has taken into account with per capita GDP. To express the relationship between these two variables statistical techniques were used for this

EKC model. According to Tester, Morrison et al. (1995) there was a significant link of income with decaying of environment variables that were main determinants for environmental degradation and economic growth. Moreover this model had taken advance steps by (Gill and Tan 1979). As a result found that this relationship between economic growth and environmental quality was poisonous per unit GDP. It was examined by (Reuveni and Gale 1985) that higher income and less scattering and disperse of manufacturing in all over the world would to more advance and develop the environmental improvements. Many developing countries has been improved and advanced their environment, according to Talmage and Gobler (2011). Same comments also reflected by (Gladstone, Fildes et al. 1935). Reduction in environmental degradation and economic growth leading to a opinion without any conflict that is analyzed by (Managi, Opaluch et al. 2006) in order for (EKC) Environmental Kuznets Curve hypothesis. An economy is linked in with less polluted environment after higher point of income. And it is suggested due to U-shaped relationship between economic performance and environmental impurity (Howard, 2017). It has been studied by (Markandya, Pedroso-Galinato et al. 2006) on link between GDP per capita and emission of known chemical sulfur on 12 different European countries. This study found the adverse consequences on income and air pollution schedule. There is an U-shaped relationship between pollution and income according to this research. The relationship between pollution and income was also researched in China, according to Lobell and Field (2008). In order to estimate the coefficients of water wastage it is found to have N-shaped inverse relationship and all impure determinants are opposite U-shaped.

One of the reasons of air impurity is carbon monoxide. That's why air impurity had to be measured by scaling the presence of carbon monoxide (Deudney, 1990). From 1965 to 2006 was the period when GDP per capita and level of income were measured. Environmental degradation can stimulates by level of income directly and indirectly. Pollution caused by industries is unstoppable because of working machineries, fog creating from engines generate a kind of pollution (Hung and Shaw, 2004). There are several kind of influences of impurities on output and industrial production as well. Different level of income has simple quadratic Environmental Kuznets Curve (Dean, 2007). This study is based on simultaneous equation. Wherever would be the presence of simultaneity effect the results obviously will be untrue and imprecise, according to Cines, Pollak et al. (1998). It would be more suitable and favorable to use the simultaneous equation for income and environment relationship. According to Snellen, Schilizzi et al. (2000) as it was quite tough to get reliable data that was required and model specification. In this case the relationship between environmental degrading and economic growth can not imply the results by using empirical data. Because of such reasons to get the reliable results between pollution in air and per capital GDP of 8 different Asian countries, it must have to add structural relationship of income and environmental quality. Income must be from simultaneity model.

3. Methodology

This section deals with the composition of three equations to find out the nexus between the variables used here. A system of method is used in this study through model imposition. Three kinds of equation are composed in this model are (1) pollution equation, (2) income equation and (3) population density equation. This model is advanced in its way by the mean of using simultaneous technique and incorporates of variables to formulate the conclusion that would be more accurate of 8 Asian countries (Boyce, 1994). And all it follows the Environmental Kuznets Curve. Here PD is representing population density and Y is economic growth. And in this way model can be formulated as:

$$CO = f(Y, PD)$$

It is used to suppose here as same directed effect of population and population density.

Equation-1 Air pollution (pollutants) = $f(\text{Income, Population density})$

Equation -2 Income (Y) = $f(\text{Pollutants, Labor, Government expenditure, Foreign Direct$

Investment, Fixed capital, Net export)

Equation-3 Population density (PD) = f (Pollutants)

Equations 1, 2, and 3 indicate the simultaneous equations for this model.

$$\log CO_{ti} = a_0 + a_1 \log y_{ti} + a_2 (\log y_{ti})^2 + a_3 (\log y_{ti})^3 + a_4 \log pd_{ti} + \beta_{ti} \dots (1)$$

$$\log Y_{ti} = \beta_0 + \beta_1 \log CO_{ti} + \beta_2 \log L_{ti} + \beta_3 \log G_{ti} + \beta_4 \log FDI_{ti} + \beta_5 \log K_{ti} + \beta_6 NX_{ti} + \beta_{ti} \dots (2)$$

$$\log PD_{ti} = \gamma_0 + \gamma_1 \log CO_{ti} + \gamma_2 \log Y_{ti} + \gamma_{ti} \dots (3)$$

i is limited for 46 years and t for time period. Equation (1) indicates the air pollution equation, where, CO_{ti} is Air pollutant in year t, Y_{ti} is GDP per capita in year t and PD_{ti} is Population density in year t. According to equation-1, there is negative relationship between Y and Y2 coefficient in pollution equation that is the indication of presence of EKC hypothesis. Equation-2 is showing the income equation, where L_{ti} is for labor in year t, G_{ti} for government expenditure in year t, FDI_{ti} for foreign direct investment in year t, K_{ti} for fixed capital investment in year t, NX for net export in year t. Equation-3 shows the population density equation.

There are several researchers who had used linear, quadratic and cubic equation in model of EKC (LaMarche, Graybill et al. 1984). Here quadratic equation Y2 is showing the movement in same direction as if GDP is going higher then it would also lead raise the environmental destruction And after some extent destruction would reduces with increase in GDP. Cubic equation Y3 is indicating the more would be increase in GDP the less will be the destruction in environment. So here if EKC model is using cubic equation then the nature of Y, Y2 and Y3 would be positive, negative and negative respectively. If model is using quadratic equation then same as Y would be positive in nature of coefficient and Y2 would be negative. Hausman test is a test that is used for income endogeneity if a model is using simultaneous equation. This test was used by (Ezcurra 2007) in their articles. If there is presence of multicollinearity and heteroskedasity it can be used and for further analysis some characteristic must be fulfilled (Lawson, 1995; Raleigh, 2007).

- A test used to cure the multicollinearity problem is multicollinearity correlation test.
- A heteroskedacity problem can be cure with use of white test.

If a model uses an independent variable as an endogenous variable then single equation can be the cause the unbiased and untrue predictions (Van den Berg and Ferrer-i-Carbonell 2007). That's why this paper requires Instrumental Variable (IV) technique. Hausman specification test can be implied in a case if in equation-1 external used variables are satisfied and convinced for it and therefore two stage least square technique is important to use here. At initial stage of EKC model first bit would be positive and then lead towards negativity. Positive relationship will be between income and per capita pollution and will become inversed at next level.

Table 1. Expected Signs of Independent Variables of the Models

Equation 1		Equation 2		Equation 3	
Independent variables	Signs	Independent variables	Signs	Independent variables	Signs

Independent variables	+	Log (impurity releasing)*	-	Log (pollutant emission)	-
Independent variables		Log (labor) (L)	+	Log (income)	
Independent variables		Log (Government expenditure) (G)	+		+
Signs		Log (Foreign direct investment) (FDI)	+		
Log (per capita GDP)* (Y)		Log (physical capital)* (K)	-		
[Log (per capita GDP)] ² * (Y ²)	-	Log (net export) (NX)			
Log(population density)* (PD)	+/-				

All the gathered data has been taken from secondary sources. It may be from articles, books, government departments etc. It is also constitutes on the data of 8 Asian countries from 1965 to 2010 of air pollutants and 8 Statistics data reports. Taking main year of 1987, CPI is used in case of GDP Physical capital, Foreign Direct Investment (FDI) and government expenditure.

4. Data analysis and Results

Fourth section is based on the interpretation and discussion of results for given model. Quadratic and cubic both kinds of equations have chosen for analysis in this model. An equation will chooses to ignore when it would be insignificant by using cubic equation. To find out the significance of equation t test would be used for equation 1 of log per capita GDP. By the use of regression analysis, cubic equations would be express as significant statistically.

There was no correlation among explanatory variable by using multicollinearity test to check multicollinear correlation. There is the existence of multicollinearity between explanatory variables if its value is equivalent or greater than 0.9 (Wulder, 2005).

According to Oh and Lee (2004) when white test is used to check heteroskedasticity then results expressing that there is no problem of heteroscedasticity. But it found that there is problem of homoscedasticity as well. As all the explanatory variables are indicating the variation with identical value. At decided confidence level of 5% coefficients were indicated insignificant. It means that value of variable is not lying within the value of level of significance. In this case the null hypothesis is rejected that is showed by using Hausman test for problem checking in a frame of Log equation of GDP per capita, quadratic equation, cubic equation and population density as shown in table 2. So, it is giving the sense that there is existence of simultaneous link income per capita and pollution per capita. There will be a link between income and pollution with each other. There is inclusion of more than one regress within the model and that's why f test is used (Kramer 1981). Hausman test is used to analyze the constant or varying impact of model would be choosing in case of using panel data. In this model constant effect model is used and paper further lead to use ratio test to determine what kind of model should be used fixed or pooled. Same way it is shown by to use fixed effect model. Results are shown in given table.

4.1 Results

All the results determination based on simultaneous equation techniques. Relationship between population density with CO₂ is positive and significant and its coefficients are coefficient of 5903189, t-statistic is equal to 23.14727.

Results are expressing that more the population density more will be pollution emission. As there is existence of CO₂ in air pollution and its coefficients value are coefficient of log Y is +23141576, logY2 is -76.86276 and log Y3 is -7.12000. Whenever income increases with level of 1% CO₂ increases by 23141576% and CO₂ is the indicator of air pollution and then it will be decreased by 76.86%, and further decreased by 7.12%. This is already discussed that with increment in income, pollution increases first and then start reducing at next stages. Increase in population density would lead to increase pollution as it also participates in pollution of 8 Asian countries.

Table 2. Regression analysis for Air pollution and Population Density (Equation-1)

	Dependent Variables
Explanatory Variables	Simultaneous equationsCO ₂
Intercept 1.680000(2.424626) **	1.680000(2.424626) **
Log Y(per capita GDP)	23141576 (8.070940) *** White 1.3258
Log Y2(per capita GDP)2	-76.86276 (-7.874545) *** White 1.0583
Log Y3 (per capita GDP)3	-7.120000 (-7.238231) *** White 0.5236
Log PD (population density)	5903189. (23.14727)*** White 0.8245
Adjusted R-square	0.837462
Use of Hausman Test to check exogeneity for GDP per capita (F-statistic)	68.42560***
Use of Hausman Test fto check exogeneity for GDP population density (F-statistic)	527.5233***

Note: 1. Value of t-statistics is in brackets. 2. “***” shows P is less than 0.01; “**”, P is less than 0.05; “*”, P is less than 0.1.

4.2 Results

There is inverse relationship between air pollution and income and coefficient of income value is equal to -2.2700 having significance characteristic with t value equal to 12.9476. Showing that increase in income lead to reduction in pollution and supported by theory. As higher income would leads to a healthy and conscious life style. There can be alternative ways to avoid carbon dioxide impurities and it all need advancement of era and high income. CO₂ is an indicator of air pollutant that causes income to decrease in 8 Asian countries. GDP is effected and linked by inputs labor (and its value of coefficient is 0.025132 and t value is 27.85949) and physical capital value (whose coefficient value is 0.190461 and its t value is 2.842211). These inputs are related directly and significant in nature with GDP. Human capital share is also significant whose t value is 27.85949 of income showing labor as significant indicator for production. On other side coefficient value of government expenditure is 0.1559 and expresses a direct relationship between income and government expenditure. While t value of income is 6.7033 showing significant effect. There is a direct relationship between income and FDI, higher the income higher would be the foreign direct investment where value of income coefficient is 0.538743 while t value of income is 13.94529 that are significant.

There is also a direct relationship between FDI and government expenditure where coefficient value is 0.5871 and t value is equal to 8.1197. If foreign direct investments are higher there will be the higher government expenditure as well. It indicated that government expenditure, net export and foreign direct investment (FDI) are key factors to increase income in 8 Asian countries.

Table 3. Regression analysis for Income and Air Impurities (Equation-2)

	Dependent variable
Independent variables	log Y (GDP)
Intercept	-153371.7 (-23.41941)***
Log CO ₂	2.270000(12.94762) *** White 0.0587
Log L (labor)	0.025132 (27.85949) *** White 0.1569
Log K (physical capital)	0.190461 (2.842211) *** White 1.3369
Log G (government spending)	0.155918 (6.703342)*** White 1.0059
Log FDI (foreign direct investment)	0.538743 (13.94529) *** White 0.4600
Log NX (net export)	0.587113 (8.119697) ***
Adjusted R-square	0.949133

Note: 1. Value of t-statistics is in bracket. 2. “***” shows that P is less than 0.01; “**”, P is less than 0.05; “*”, P is less than 0.1

4.3 Results

There is a significant coefficient of air impurity and the value of t statistic is equal to 21.4763 for CO₂ and showing inverse relationship which shows value equal to -1.250000 and expressing that greater pollution leads to lower population density. Higher will be the pollution and impure space lower will be the unhealthy mind and life style. As impurities include in air and make it unhealthy for respiration. Carbon dioxide is easily soluble in blood that combines with hemoglobin cells that cause problems for lungs to respire healthy. It would be in case of excess amount of carbon dioxide. There is a positive relationship between income and population density showing value of coefficient equal to 0.7521 and 6.2807 value of t statistic having significant value. It shows that in case of more income people may have more members of family and vice versa. More income would obviously ensure a person for better bringing up of their children and more confidence for better life style and education. On the other hand people with low income would have problems in good bringing up, education and numerous other issues they will face just because of less finance.

Table 4. Estimated Regression Results for Population Density (Equation-3)

	Dependent variable
Explanatory variable	Log PD
Intercept	23060.15 (2.265343)**
Log CO	-1.250000 (-21.47628) *** White 0.8723
Log Y	0.752107 (6.280713) *** White 1.9826
Adjusted R square	0.856978

Note: 1. Value of t-statistics is in brackets. 2. “***” represents P is less than 0.01; “**”, P is less than 0.05; “*”, P is less than 0.1.

By the mean of using econometric model and simultaneous equation technique for 8 Asian countries Air impurity level has been tested empirically. A hypothesis was made that in which it has to test those 8 Asian countries participate in air pollution and it follows EKC model theory or not. Hausman test has been implied to check the hypothesis empirically. And results of test showed that there is a simultaneous relationship between income and air pollution. More air pollution could be in a case of more production and more burning of fossil fuels that causes to generate more money and become the reason for more income. But this situation seems like quite strange to be happens. Two stages least squares method had been employed in this case. So, it has found that made hypothesis followed EKC model. And where results showed that there is an inverse relationship between air pollution and income and its value showed that the result is significant. It expressed that more the pollution less would be income as well. In this case people would be less efficient and their energy and potential will be affected due to pollution and cause to be lazy and unhealthy. So, a person could not be able to work actively and healthy and would get less income. In this case productivity also gets affected inversely by reducing production of capital and labor. Pollution leads to less quality capital instruments like machineries and unhealthy body lead to less labor. If we observe it to see in other words it is also about having larger amount of money even for a country. If a country is rich enough it can produce the products that will be less polluting through the use of more advance and different technologies. Effect of air pollution on population density is significant while CO₂ has inverse impact of population density. And in 8 Asian countries people causes death due to increase in pollution. It shows that higher pollution lead to lower population density. In a case of higher pollution people will initially face poor immune system, laziness, headache, nausea, anxiety and less potential in their body. This problem would turn slowly and gradually into a sever disease due to pollution and shortly cause death of people. As a department of World Health Organization (WHO) has put a light on air pollution and announced it a big risk for human health. There are numerous factors that cause pollution and all are hard enough to fix them.

References

- Ahmed, E. M. (2006). Carbon dioxide emissions, impact on Malaysia's manufacturing productivity growth. *World Review of Science, Technology and Sustainable Development* 3(1): 58-69. <https://dx.doi.org/10.1504/WRSTSD.2006.008763>
- Amanatidou, A., et al. (1999). Effect of elevated oxygen and carbon dioxide on the surface growth of vegetable-associated micro-organisms. *Journal of Applied Microbiology* 86(3): 429-438. <https://doi.org/10.1046/j.1365-2672.1999.00682.x>
- Baltgailis, J. 2019. The issues of increasing the effectiveness of teaching comparative economics. *Insights into Regional Development* 1(3): 190-199. [https://doi.org/10.9770/ird.2019.1.3\(1\)](https://doi.org/10.9770/ird.2019.1.3(1))

Boyce, J. K. (1994). Inequality as a cause of environmental degradation. *Ecological Economics* 11(3): 169-178. [https://doi.org/10.1016/0921-8009\(94\)90198-8](https://doi.org/10.1016/0921-8009(94)90198-8)

Chaudhuri, U., et al. (1990). Root growth of winter wheat under elevated carbon dioxide and drought. *Crop Science* 30(4): 853-857. <https://doi.org/10.2135/cropsci1990.0011183X003000040017x>

Cines, D. B., et al. (1998). Endothelial cells in physiology and in the pathophysiology of vascular disorders. *Blood, The Journal of the American Society of Hematology* 91(10): 3527-3561. <https://doi.org/10.1182/blood.V91.10.3527>

Dean, T. J. and J. S. McMullen (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of business venturing* 22(1): 50-76. <https://doi.org/10.1016/j.jbusvent.2005.09.003>

Ertugrul, H. M., et al. (2016). The impact of trade openness on global carbon dioxide emissions: Evidence from the top ten emitters among developing countries. *Ecological Indicators* 67: 543-555. <https://doi.org/10.1016/j.ecolind.2016.03.027>

Ezcurra, R. (2007). Is there cross-country convergence in carbon dioxide emissions? *Energy policy* 35(2): 1363-1372. <https://doi.org/10.1016/j.enpol.2006.04.006>

Pornkul SUKSOD is a Lecturer of Doctor of Philosophy Program in Development Administration, Suan Sunandha Rajabhat University, Thailand. Her research areas are Public and Private Administration, Development Administration, and Leadership.

ORCID ID: orcid.org/0000-0002-9667-3730

Register for an ORCID ID:

<https://orcid.org/register>

This work is licensed under the Creative Commons Attribution International License (CC BY).

<http://creativecommons.org/licenses/by/4.0/>

Open Access