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Carbon Footprints and Economic Growth: A Study of The Philippines Co2 Emissions

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ABSTRACT

CO2 emissions in every country is a known problem especially in developing countries in the South East Asia. Philippines is considered to be one of the major contributors of CO2 and the economic growth of the country is affected because of the CO2 and greenhouse gases. This study aims to determine how much CO2 emissions can affect the economic growth of the country in terms of the CO2 emissions from household, transportation, industry and agriculture. The data used in this study sourced from the World Bank – World Development Indicators from the year 1971-2014. The study used the Ordinary Least Square (OLS) in determining which factors has a significant effect on the CO2 emissions in the Philippines. Results have shown that manufacturing, agriculture, and transportation has a significant effect towards CO2 emissions in the Philippines. These determinants have p-values lower than the 5% significance level. New policy and preventive measures on CO2 can help lessen the CO2 emissions as well as governments help and suggestion. The study suggests for the decrease of material usage that emits greenhouse gases (GHG), lessen the factors that emits CO2, and conducting further research on how to greatly mitigate carbon footprints.

Keywords: *CO2 Emissions, Economic Growth, Household, Transportation, Industry, Agriculture*

I. INTRODUCTION

The Philippines is considered to be one of the significant contributors to CO2. There are many households in the Philippines, and households are contributors to the CO2 emissions, whether direct or indirect. Transportation also contributes to the CO2 emissions of the country as the household gets abundant, so does transportation. The Philippines is a developing country, and it is subject to building more infrastructure; this will significantly affect the CO2 emissions of the country as buildings, especially factories, produces greenhouse gases that will increase the CO2 emissions. The agricultural sector in the Philippines also contributes 8% of greenhouse gases to the economy.

The economic growth in the Philippines is also affected because of these greenhouse gases and CO2 emissions. The Philippines is one of the many countries with multiple sectors in the contribution of CO2 emissions, namely the household, transportation, industry, and agricultural sectors. A study by Khan (2017) stated that the Philippines GDP per capita is correlated with the country's poor environmental performance. In the face of probable increases in carbon dioxide emissions due to economic growth, both internal and external pressures call for care. The Philippines is now one of the world's fastest-growing economies, and the environmental repercussions of the long-awaited expansion should be investigated.

II. LITERATURE REVIEW

2.1 GDP Growth

According to Apergis and Ozturk (2015), the influence of economic expansion has been highlighted by the scattering of literature on carbon emissions and environmental degradation in many places. Khan and Dong (2017) highlighted that economic progress and environmental sustainability are two closely related concepts: most countries increase their economic development at the expense of poor ecological and human health performance.

In their empirical investigations, Khan et al. (2017) looked into the influence of GDP increase in environmental deterioration. They discovered that economic activities have no significant impact on environmental degradation in most industrialized countries.

Masron and Subramaniam (2019) proposed that governments take significant measures to combat poverty to achieve more remarkable environmental growth. Because emerging countries want to grow their economies instantaneously, government authorities in this scenario neglect ecological harm to some extent. (Khan et al., 2017).

Economists and environmentalists began working on a broader scale, in this case, an ecological footprint. (Shahbaz and Sinha, 2019). CO2 emissions and health expenditure are correlated with each other; Remuzgo and Sarabia (2015) discovered that the inequalities in CO2 emissions have expanded, and GDP growth is the main factor in the CO2 discrepancy. Isaksen and Narbel (2017), according to their analysis, the carbon footprint has increased dramatically as a result of rising per capita expenditure.

According to Ito (2017), changes in the climate are caused by environmental degradation, which causes the temperature to rise. Institutional quality reform was always oriented towards innovation and development of environmentally friendly technologies, or the competition among emerging countries also resulted in higher economic efficiency and subsequently less emission (Andersson, 2018).

According to Chen et al. (2018), energy consumption, economic expansion, and urbanization are the major determinants of CO2 emissions in many industrialized and emerging countries. Owusu and Asumadu-Sarkodie (2016) argued that human affairs, combined with labor, capital, and other production inputs, are responsible for global expansion. However, it is essential to note that greenhouse gas (GHG) emissions have significantly increased economic development in first and third-world countries. Compared to 2005, China plans to reduce carbon emissions per GDP by 60-65% by 2030.

Germany aims to reduce its carbon emissions in 2050 by 80%. In 2027, the Indian government plans to have 227 GW of renewable energy usage. (Gielenet al., 2019). Adams et al. (2019) added that CO2 emissions have contributed from renewable and nonrenewable energy, and in 28 Sub-Saharan African countries, urbanization has gradually increased their CO2 emissions.

In 2012, Renewable energy generation currently met 16% of global energy consumption, with 26% expected by 2020. As a result, there is a need to enhance its renewable energy generation in East African countries, as it is linked to economic growth and a reduction in CO2 emissions.

However, examining the influence of renewable energy consumption and economic population growth on CO2 emissions among the East African countries is required to provide an appropriate energy policy and income creation structures for the expanding population in this area.

Although several studies at the global and continental levels have examined CO2 emissions concerning renewable resources, economic and population levels, at the regional or country-level in East Africa, there are no definitive studies that support CO2 emissions and their drivers (economic and population growth, renewable energy).

Energy consumption rises in tandem with economic growth. Environmental issues occur as economies become more industry-intensive and less energy-efficient to boost growth. Thailand's increased production activity has resulted in higher CO2 emissions across all sectors, including both industrial and non-industrial, which results in a 78.25% increase in concentrations of greenhouse gas emissions. (2018) (TGO, 2019; Savaresi, 2016).

According to Kirikkaleli and Kalmaz (2020), increased urbanization and energy use contribute to significant CO2 emissions and enhanced economic growth. These could be attributed to the extensive misuse of energy resources in emerging and developing countries.

In certain countries, particularly emerging countries, economic expansion has accelerated urbanization. According to Odugbesan and Rjoub (2020), as the output of services and products increases, so does GDP. The construction of a country's economy encompasses the management of labor, energy, raw resources, and capital.

During the manufacturing process, raw resources like minerals, timber, water, and metals are extracted from the environment, causing massive harm (Alper and Oguz, 2016). Alper and Oguz (2016) analyzed the impact of economic advancement (GDP) on CO2 emissions using data from eight European member countries and discovered a substantial link between CO2 emissions and GDP. Rahman and Ahmed (2019) explored the association between gross fixed capital formation (GFCF) and CO2 emissions. The study showed a non-linear connection between GFCF and CO2 emissions by using Pakistan's data from 1980 to 2018.

2.2 Household

Asian Development Bank (2015) stated that the Philippines, alongside six nations, are responsible for primarily 90% of total GHG emissions. Khan et al. (2017) and the EPA (2018) also stated that the biggest drivers of environmental degradation are coal-fired power plants and unsustainable energy consumption, waste-burning manufacturing, and even the transportation industry.

As a result of the increased carbon emissions from residences, the risk of toxicities and illnesses, including pneumonia and other respiratory diseases, has grown. (Hanif, 2018). World Health Organization (2017) also stated that amplified carbon dioxide leads to various conditions, including cardiovascular and respiratory complaints.

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Even though houses are getting more energy efficient due to population trends, expanding use of digital technology, rising electricity prices, and other demand factors, US household energy use and accompanying GHG emissions are not decreasing. (US EIA 2020). Household budget surveys, which omit public consumption and investments, are frequently used to calculate personal carbon footprints. In nations with rapid urbanization, such as China, the difference between two consumption-based carbon footprints of the same area might be significant. (Ottelin et al. 2019).

Ottelin (2016) further believes that comparing the carbon footprints of rural and urban populations based on income is problematic, given that metropolitan areas have significantly more job opportunities and better salaries, which are the critical determinants of inhabitants' income.

According to previous studies, residential consumption accounts for 40% of total emissions in China across various urban units. (Zhang and Wang 2019), 42% is accounted for in the United States (Štreimikienė and Balezentis 2016), and more than half is accounted to Japan (Long et al. 2018). The residential sector consumes 27% of total energy and emits 17% of total CO2 emissions worldwide. (Nejat et al. 2015)

2.3 Transportation

Several research studies on CO2 emissions have been conducted in the Philippines. Sumabat et al. (2016) focus on greenhouse gas emissions, specifically CO2 from fuel combustion and energy generation, supporting climate-change legislation. In 2012, road transportation accounted for nearly 58% of total petroleum consumption in the Philippines. (Department of Energy, 2019). As a result, road transportation is an excellent choice for additional research into the reason for increased CO2 emissions.

According to Shebaz et al. (2016), economic activity contributes significantly to environmental damage. These growing economies must face the costs of ecological deterioration to achieve rapid economic expansion and increased production. According to the IPCC (2018) findings, economic activity is one of the significant contributors to rising global temperatures in Asian economies.

Carbon Dioxide (CO2), a gas that contributes to the greenhouse effect, which results in climate change, is continuously rising. Asia, a region of emerging economies, has contributed at least 30% of the Global CO2 emissions, with 22% coming from the transportation sector. The Philippines, as one of several developing countries in the region, is the sixth-largest contributor to road transport CO2 emissions. Asia is the world's factory for many manufacturing activities, and fostering sustainable growth while maintaining a low-carbon or CO2 emission profile is critical.

2.4 Industrial

Al-Mulali et al. (2015) argued that the main reasons for environmental degradation in underdeveloped countries are a lack of adequate ecological rules and regulations, instead of so-called per capita GDP, which is much higher on average in wealthier countries. The rising anthropogenic greenhouse gas (GHG) emissions, particularly carbon dioxide (CO2) emissions, coming from economic activities such as the burning of fossil fuels, industrial operations, and other activities, have been widely ascribed to the global warming phenomena. (Seriño and Klasen, 2015). Wang (2018) suggested that adopting green policies in manufacturing and commercial activities will promote environmental sustainability by reducing adverse effects on economic growth, which is also a statement backed up by Zaman and Shamsuddin (2017). Due to extensive deforestation and irresponsible natural resources, ASEAN countries, particularly the Philippines, cannot reach their environmental targets. (EPA 2016).

In measuring CO2 emissions, the spillover effects of human activities on water, land, and other ecological indicators were not considered. According to the United Nations Environment Program (2019), the over-exploitation of environmental assets has put the globe on an untenable growth trajectory, resulting in substantial biodiversity loss and a drop in human welfare. Kolcava et al. (2019), in their research, discovered that the burden of pollution has shifted from industrialized to developing countries as a result of trade expansion. We thought that engagement for nature conservation would be an initial target for contributions to protect and sustain the usage of biodiversity and ecosystems and their benefits to individuals, economies, and societies, often referred to as 'ecosystem services' (Costanza et al., 2017). A significant amount of carbon emission will lead to climate change, supported by Ongsakul and Sen (2019). They stated that the carbon emission of businesses is the main reason for climate change. Most firms concern more about economic performance rather than environmental (Irwhantoko and Basuki, 2016).

According to Wang et al. (2018) and Yu and Du (2018), progress in energy technology has significantly influenced CO2 emission reduction. In their study of 147 nations, Liobikien and Butkus (2019) found that GDP and urbanization only helped to reduce CO2 emissions through energy efficiency. According to Talbi (2017), energy efficiency is essential in reducing CO2 emissions. Its findings conflict with Liobikien and Butkus (2019) regarding noticing reductions in emissions due to economic progress and urbanization.

According to Wang et al. (2016), urbanization in Southeast Asian countries increases CO2 emissions. According to Saud et al. (2018), Trade liberalization reduces Greenhouse gas emissions. Balsalobre et al. (2015) suggest that energy innovation can help reduce CO2 emissions to have a solid energy strategy. Increased economic development could result in increased energy consumption and emissions. Hand innovation systems or processes, on the other hand, may use less energy and produce less pollution (Fernández et al., 2018). The EU's Renewable Energy Directive, for example, intends to achieve an RER target of 27% by the year 2030. (EU, 2018).

Asongu et al. (2016) stated that CO2 emissions have increased in 24 countries due to economic and population growth and increased energy use. On the other hand, renewable energy investments are rapidly rising worldwide. Al-Mulali and Ozturk (2015), between 1996 and 2012, researchers looked and examined the relationship between energy consumption, environmental footprint, urbanization, industrial development, trade openness, and political stability in 14 MENA nations. The findings revealed that these variables both cause and contribute to environmental degradation in the long and short term.

In Saudi Arabia, Mezghani and Haddad (2017) discovered that high energy demand instability harms oil between the GDP and CO2 emissions; in 2017, The International Energy Agency (IEA) stated in its Southeast Asia energy outlook that achieving steady economic development, meeting energy demand in a secure, affordable. A sustainable manner, as well as maintaining a low level of environmental deterioration at the same time establishing a pleasant condition, are all challenges that governments in Southeast Asian countries face. The majority of ASEAN countries have made significant attempts to address these concerns.

Lu (2017) implies that input availability drives economic expansion; as a result, over-exploitation of natural resources, animal devastation, and climate changes associated with industrialization can all contribute to significant environmental challenges. As a result, many governments are torn between continuing fossil-fuel-based energy and tying economic growth to sustainable energy. This is a complex problem to solve, especially when you consider that Dollar, Kleineberg, and Kraay (2016) suggested that the expansion of fossil fuel-based may enhance people's living standards. However, Di Fonzo et al. (2013) asserted that fossil fuel-related greenhouse gas emissions could impair living conditions. As a result, other energy sources must be investigated and considered.

According to the US EIA (2015), countries account for roughly 10% of global CO2 emissions. Ahmad et al. (2019) stated that investment harms the environment in emerging countries because carbon dioxide emissions rise early in the economic cycle and reduce income growth and the growth activity's stabilization. In particular research, urbanization was found to be strongly linked with energy consumption and environmental pollution. (Behera and Dash, 2017; Zi et. al. 2016).

These studies posit those urban spaces account for approximately 75% of world energy consumption and 60% of global carbon emissions. Fragiadakis et al. (2019) the impact of human labor on COE was researched, and it was discovered that there was a positive association between human labor and COE. Also, the study suggests that human labor was degrading the environment through travel. The current debate over the appropriate policies for lowering greenhouse gas emissions revolves around the link between greenhouse gas emissions and economic growth.

2.5 Agricultural

Agriculture, forest, and other land use (AFOLU) accounts for 24% of total greenhouse gas emissions and is the second-largest source of greenhouse gas emissions. According to Ahillen (2016), trees' assumption operates as a carbon sink, absorbing carbon dioxide from the atmosphere, which is widely held. On the other hand, Forests have a role in rising CO2 emissions in various ways.

Besides being one of the victims of CO2 emissions, agriculture is also one of the emitters responsible for at least 8% of these greenhouse gases emissions. Holly (2015) stated that nitrous oxide and methane from soil management and animal production techniques are the main sources of these emissions.

According to the World Bank (2018), agriculture accounts for around 20% of carbon dioxide emissions worldwide. Since the reform and opening-up policies in 1978, China's agriculture has developed fast. China's agricultural gross domestic product (GDP) increased from EUR 13.969 billion to EUR 825.831 billion with an annual rate of 4.373% between 1978 and 2019, following the data from the China Rural Statistical Yearbook (CRSY). On the other hand, China's agricultural practices, which are more significant than any other country, contributed significantly to CO2 emissions. (Huang et al. 2019).

Agricultural land is the primary source of CO2 emissions, as it is also the most valuable resource for agricultural economic growth (Chen and Xie 2019). Xiong et al. (2016) stated that the carbon emissions from 2005 to 2009 increased quickly due to the rapid development of distinctive forestry, fruit business, and fruit trees in the fruiting stage, which made the agricultural material inputs from the agricultural land operation in Hotan Prefecture, China to rise.

Zhao et al. (2018), to discuss the relevant elements on agricultural carbon emissions in China, utilize the Logarithmic Mean Divisia Index (LMDI) model. Chen et al. (2019) demonstrates that the factors affecting agricultural carbon emissions in Fujian, China are geospatially non-stationary and have shown a significant decrease from 2008 to 2017. The agricultural economic growth relationship between CEALU should have more emphasis and prioritization. Studies show that the gradual increase in agricultural CO2 emissions is due to the economy's agricultural advancement. (Liu and Xin 2014; Xu and Lin 2017).

According to relevant studies, the carbon emissions caused by agriculture have accounted for 1/4 of total carbon emissions due to the constant improvement in demand for energy consumption for agricultural expansion (Cui et al. 2018). According to Xia et al. (2018), the secondary and tertiary sectors are the leading sources of carbon emissions. However, in a predominantly agricultural country like China, where agricultural diesel, fertilizers, and pesticides are used in large quantities, the impact of agriculture on carbon emissions should not be overlooked.

III. RESEARCH METHOD

3.1 Theoretical Framework

This study is anchored by the work of Seriño and Klasen (2015) who found out that household characteristics such as transportation, household size, industrial, and agricultural, and other relevant characteristics significantly matter in explaining carbon emissions; the recent process of globalization of international markets has raised growing concern that the features of the globalization process may jeopardize the environmental sustainability. At the low level of income, environmental degradation tends to rise since people are willing to accept increasing environmental degradation in exchange for higher consumption. However, as individuals achieve higher living standards, they care increasingly about the quality of the environment. (Shahbaz et.al 2017).

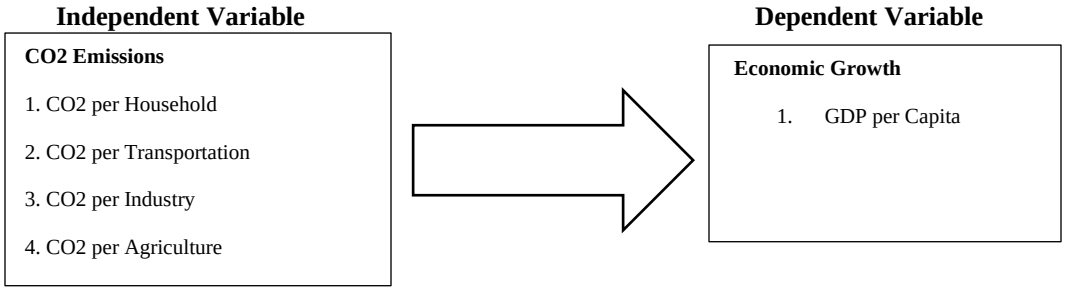

Figure 1. Conceptual Framework of the Study

3.2 Research Design

This study will use inferential statistics as it involves identifying the CO2 emissions and the economic growth in the Philippines. The study will also use the Quantitative Research Method. According to Bryman (2012), quantitative research is a research strategy that emphasizes quantification in the collection and analysis of data; it means quantitative research denotes amounting to something.

3.3 Data Collection

This study will utilize secondary data from the period 1971-2014. Data on CO2 emissions from the household, transportation, industrial, and agricultural sectors of the Philippines were obtained from World Bank – World Development Indicators. CO2 emissions from manufacturing industries and construction (% of total fuel combustion), Agricultural methane emissions (thousand metric tons of CO2 equivalent), CO2 emissions from transport (% of total fuel combustion), CO2 emissions (metric tons per capita). Economic growth measured by GDP per capita (current US$) is also sourced from World Bank – World Development Indicators.

3.4 OLS

This study will use the following model.

$$Y = (X1, X2, X3, X4)$$

Where;
Y = Economic Growth
X1 =Household
X2 = Transportation
X3 = Industry
X4 = Agricultural

The values of the parameters are estimated using the Ordinary Least Square (OLS) method. The sum of the squared residuals is minimized in the Ordinary Least Square approach, which provides the estimate (the difference between the predicted and the observed values). If the following assumptions are met, estimates are best linear unbiased estimators (BLUE).

a.) $E(\varepsilon) = 0$

This implies that the mean of the error terms is zero.

b.) $Var(\varepsilon) = \sigma 2$

This is the property of homoscedasticity, i.e., that the errors have a common variance.

c.) $Cov(\varepsilon i, \varepsilon j) = 0$ where $i \neq j$. This is the property of no autocorrelation, i.e., no errors are serially correlated.

Regression analysis will be used to convert the economic model (1) into the empirical model, explaining the influence and relationship between explanatory variables and dependent variables. The statistical techniques will determine the effect of the explanatory variables on the dependent variable, holding other variables constant (Hill *et al.*, 1999).

When the regressors are exogenous, and there is no multicollinearity, the OLS estimator is consistent. When the errors are homoscedastic and uncorrelated, it is optimal in the best linear unbiased estimators (BLUE) class. When the errors have finite variance, the OLS method provides minimum-variance mean-unbiased estimate under these conditions. The greatest likelihood estimator, OLS, is based on the additional assumption that the errors are regularly distributed.

Problems such as multicollinearity, heteroscedasticity, and autocorrelation exist when any of these assumptions are violated. Adding more and more variables in the model would lead to a problem of multicollinearity because one variable might be related to other variables. In this case, there is no guarantee that the data will be "rich in information," nor that it will be possible to isolate the economic relationship or parameters of interest (Hall, Griffiths, and Judge, 1997). When we have time-series data, the observation follows a natural ordering through time. There is always a possibility that successive errors will be correlated. This correlation between errors is called autocorrelation, which violates the third assumption. Autocorrelation also might be identified by the residual plot or the Durbin-Watson (DW) exact statistic. The D of DW statistics is defined as follows:

Lastly, the problem of heteroscedasticity is also an important point to be considered, which is the violation of the second assumption. It usually occurs when we have cross-section data. If such problems exist, generalized least squares (GLS) procedure must be applied to transform the model to eliminate the cause of the said problems.

3.5 Empirical Model:

Equation (1) is the basis for the model of the study. The empirical model is expressed as:

$$\mathbf{GDPi = \beta 0 + \beta 1 Household + \beta 2 Transportation + \beta 3 Industry + \beta 4 Agriculture + \varepsilon,}$$

Where;

GDPi = GDP per Capita
Household = % of total consumption
Transportation= by % of total fuel combustions
Industry = % of total fuel combustions
Agriculture = thousand metric tons of CO2
εi = error term

IV. RESSULTS AND DISCUSSION

4.1 Graphical Presentation of the Variables

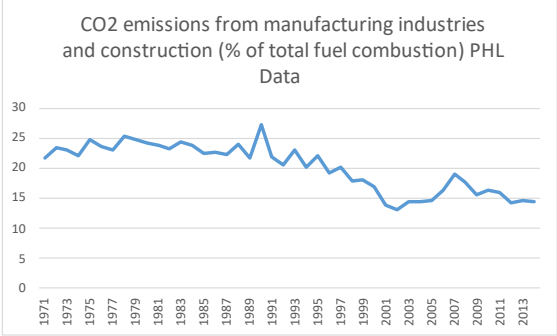

Figure 2. CO2 emissions from manufacturing industries and construction (% of total fuel combustion) of the Philippines from 1971 to 2014

Climate change affects ecological systems, human health, and vital socioeconomic sectors such as food production and services (agricultural, fishing, tourism, construction), water resources, coastal systems, and human settlements (IPCC WG I 2001).

Figure 2 shows that CO2 emissions from manufacturing and construction industries fluctuate each year, followed by the highest risk of it in the year 1990 with the value of 27.31%; In the manufacturing sector, GHG emissions are produced through the use of fuels and chemicals. Economic expansion in the industrial sector, notably in manufacturing and building, encourages economic harm by releasing greenhouse gases into the atmosphere (Tan et al., 2011). While it recorded its lowest point in the year 2002 with 13.06%, the usage of fuels such as oil, natural gas, coal, and electricity has increased due to urbanization, resulting in increased CO2 emissions in the atmosphere (Brown 2012; Kurniawan and Managi 2018). And it is still static until the year 2014.

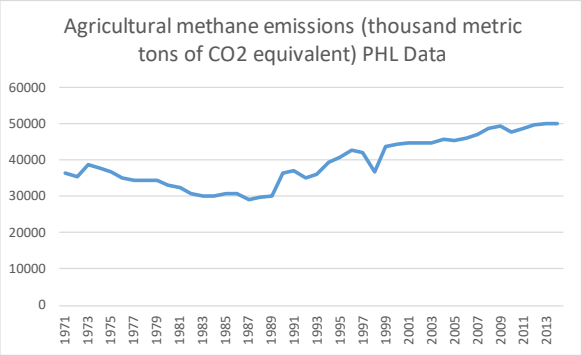

Figure 3. Agricultural methane emissions (thousand metric tons of CO2 equivalent) of the Philippines from 1971 to 2014

According to Mendelsohn (2003), tropical countries are projected to experience significant losses due to climate change. Many of the region's lands and inhabitants are exposed to the threats of more tremendous tropical storms and flooding due to the region's numerous islands and extensive coasts. Extreme weather events are becoming more frequent, resulting in poorer output in agriculture, fisheries, and tourism, the primary sources of income in most ASEAN countries. Lower productivity is vital industrial areas means less income, less food availability, and higher food prices for the rising ASEAN population.

Figure 3 presents the agricultural methane emissions; the graphs show that each year the methane emissions from agriculture were falling slowly in 1974. Pollution has become such an overwhelming problem in river systems and coastal zones this year that it is slowly killing the people in the communities. One of the significant sources of pollution in the nation is the country's largest corporation. The mining sector produced more than 63 million tons of mine tailings in 1987. When one of the major mining firms decided to start destroying the Boac and Makulapnit rivers and contaminating the Lala Bay in 1996, public outrage grew (Magallona and Malayang, 2001), which was followed by its massive fall of methane emission in the year 1998 with the value of 36750 tons. Typhoon Haiyan struck the Philippines in 2013 and was widely regarded as one of the most severe storms in the country's history. The coconut industry is the Philippines' second most important agricultural sector. After being hit by Typhoon Haiyan, the coconut industry has faced its worst challenge regarding percentage of agricultural exports and planted area (PSA, 2016). After the incident, the methane emission immediately rose again with 43800 tons in the year 2014.

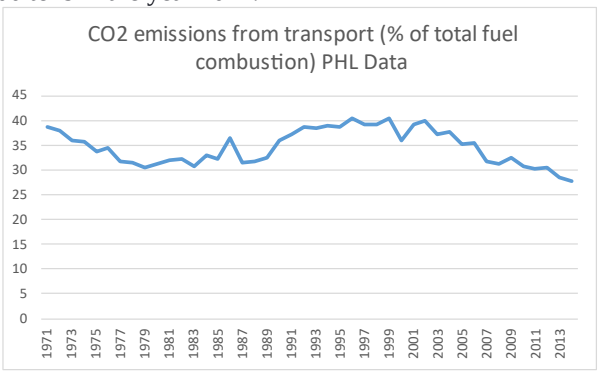

Figure 4. CO2 emissions from transport (% of total fuel combustion) of the Philippines from 1971 to 2014

Because trade involves the movement of products and services, it consumes more energy and emits more CO2 (Naranpanawa 2011). According to Anderson et al. (2009), cited by Hossain (2011), trade plays a substantial role in creating CO2 emissions in the transportation sector, with exports accounting for more significant emissions than imports.

As can be observed in figure 4, CO2 emissions from transport are fluctuating each year it released a considerable amount of fuel combustions in the year 1986 with 36.56% of CO2 emissions; however, it dropped down immediately in the year 1987 with 31.46% and is continually fluctuating in 1992. The significant boosts in resources for road maintenance in 2001 led to new reserved resources for safety and pollution control. In 1984, 1999, and 2003, three of the LRT lines began their operation. The Light Rail Transit Authority (LRTA) owned two of the rail transit lines, while the Metro Rapid Transit Corporation (MRTC) financed the third rail transit line, which the government runs, and agreed on a term to have a build-lease transfer (ADB 2012). In which the emissions from transport had its significant fall in the year 2000 with its lowest point at 36.10% which instantly rose again in 2001 at 39.24%, and since then it is still fluctuating until 2014.

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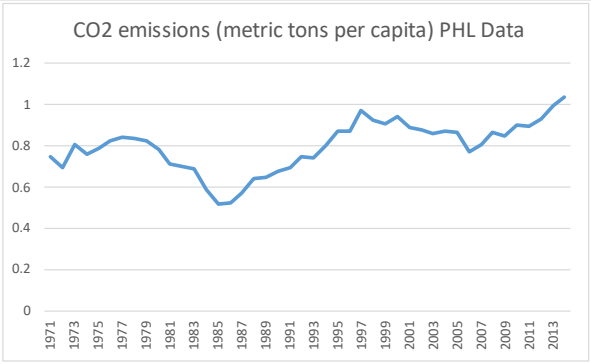

Figure 5. CO2 emissions (metric tons per capita) of the Philippines from 1971 to 2014

Even though ASEAN countries are not the world's largest CO2 emitters, accounting for only around 4% of global emissions in 2011 (US EIA 2011), (Lee et al. 2013) stated that their emissions are fast increasing due to increased economic activity.

Figure 5 exhibits the CO2 emissions, which had a significant downfall in the year 1985 at 0.51 metric tons, and it was gradually increasing until its second major downfall in 2006 at 0.77 metric tons. In the year 2007, it rose again to 0.80 metric tons and fluctuated for four years. The significant expansion in the use of coal as a source of energy, particularly in the electrical sector, is the primary reason for the rise in carbon intensity. Sumabat et al. (2016) assessed the factors that influenced variations in CO2 emissions in the Philippines from 1991 to 2014. The majority of the gains are related to economic activity due to population lifestyle changes. The results reveal that energy intensity has been steadily improving, owing primarily to the transition in the primary sector from manufacturing to service. Where it reached its peak in the year 2014 with its highest point at 1.03 metric tons.

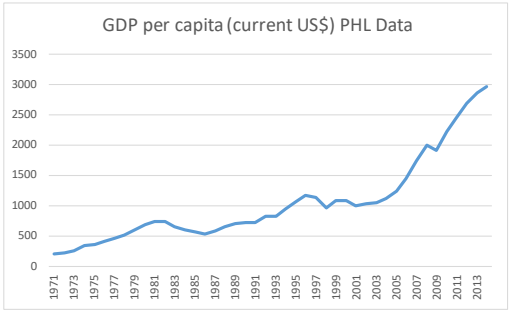

Figure 6. GDP per capita (current US$) of the Philippines from 1971-2014

ASEAN countries, particularly the Philippines, are now one of the fastest-growing economies and are also called the rising tiger of Asia. Its real GDP per capita nearly doubled between 2000 and 2011, rising from USD 2,882 to USD 5,581 (ASEAN 2012)

Figure 6 indicates the GDP per capita for CO2 emissions; the graph shows a massive increase since the year 1971, and also, during the year 1972-1985, the country is experiencing its debt crisis, the GDP per capita percentage per year at that time is at a rate of 0.82%. Still, it is now continually increasing since its last dip in the year 2003 with the value of 1048. Amidst the devastation caused by a series of natural disasters that devastated the country in the fourth quarter of 2013, the country's GDP increased to 6.5%. Its GDP per capita continues to rise, reaching a total of 2871.43, driven by the service sector, primarily in Renting, Real Estate and Trade, and Business Operations, and the accelerated performance on manufacturing. During 2014 the GDP per capita of the country is still rising, which has 2959.65 and will likely rise constantly in the following years.

Table 1. Results of OLS Regression Analysis

Variable	Estimated Coefficient	Standard Error	P-Value
Manufacturing	-45.01131	21.90369	0.047*
Agriculture	.0641678	.0161923	0.000*
Transportation	-84.95809	12.74228	0.000*
Household	-39.71763	617.7222	0.949
CONSTANT	2414.53	1058.788	0.028

*Significant at 5% NS=Not Significant R^2=0.8409

The estimated coefficients generated using the Ordinary Least Square (OLS) regression analysis are presented in Table 1. The following results demonstrated that among the factors on CO2 emissions, manufacturing, agriculture, and transportation can significantly affect the GDP.

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Moreover, based on the model, three variables have a negative coefficient sign. This implies that the GDP will decrease when manufacturing, household, and transportation increase. A 1% increase in manufacturing and construction will lead to a 45.01% decrease in GDP, a 1% increase in the household will lead to a 39.71% decrease in GDP, and a 1% increase in transportation will lead to an 84.95% decrease in GDP. Furthermore, the model registered an R2 of 0.8409, which indicates 84.09% of the output variation is explained by the model, and the remaining 15.91 percent is explained by the other factors that are not included in the study.

Dong et al. (2018) backed up our findings, claiming that economic and population growth play a significant role in increasing CO2 emissions on a global and regional scale. Many governments and organizations have established goals to develop renewable energy as a major source of carbon reduction. CO2 makes up the majority of greenhouse gases in the atmosphere, accounting for 65% from fossil fuels and industrial processes and 11% from forestry and other land usages, with methane (16%) and nitrous oxide (6%). as well as fluorinated gases (2%). (IPCC, 2014).

V. CONCLUSIONS

The study revealed that among the carbon footprints in the Philippines, manufacturing, construction, agriculture, and transportation significantly influence the CO2 emissions of the Philippines. According to (Gokmenoglu 2016; Cioca et al., 2015), The Intergovernmental Panel on Climate Change emphasized the importance of CO2 emissions as a significant contributor to greenhouse gas (GHG) emissions. The IPCC also stated that rising economies account for 76.6 percent of GHG emissions, with the goal of increasing their development rate and national production.

This study was conducted to evaluate the CO2 emissions in the Philippines from the year 1971 to 2014 using the OLS method. The following were the findings of the study:

1. Manufacturing and construction industries have a significant effect on the CO2 emissions in the Philippines. It has a p-value of 0.047, which is lower than the 5% significance level. In addition, a 1% increase in manufacturing and construction will lead to a 45.01% decrease in GDP.
2. Agricultural industries have a significant influence on the Philippine CO2 emissions. It has a p-value of 0.000, which is below the 5% significance level. In addition, a 1% increase in agriculture will lead to a .06% increase in GDP.
3. Transportation has a significant effect on the CO2 emissions in the Philippines. It has a p-value of 0.000, which is lower than the 5% significance level. In addition, a 1% increase in transportation will lead to an 84.95% decrease in GDP.
4. Household has no significant effect on the CO2 emissions in the Philippines. It has a p-value of 0.949, which is higher than the 5% significance level. In addition, a 1% increase in the household will lead to a 39.71% decrease in GDP.

5.1 Recommendations

Based on the findings and conclusion, the following recommendations are given:

1. Decrease the usage of materials that can cause CO2 emissions in manufacturing, construction, agriculture, and transportation.
2. Increase GDP for economic development and decrease the factors that emit CO2.
3. Conduct further research on how to lessen CO2 emissions and construct laws that can help mitigate the CO2 on the factors that can significantly affect the GDP.

5.2 Future Researchers

This study can give relevant information to future researchers, for they can use this study as their reference to further study CO2 emissions and economic growth.

5.2.1 Government

The Government could assist the public to reduce their carbon footprints by reducing their greenhouse gases emissions. Furthermore, they can promote policies and improve the existing ones that focus on reducing CO2 emissions.

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