

# Social Impacts Due to Carbon Dioxide (CO<sub>2</sub>) Emissions. Evidence From Sub-Sahara African Countries (SSA) Compared to Southeast Asian Countries (ASEAN).

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## Research

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# **Social impacts due to carbon dioxide (CO<sub>2</sub>) emissions. Evidence from sub-Saharan African countries (SSA) compared to Southeast Asian countries (ASEAN).**

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## **Abstract**

The recent climatic phenomena observed in developing countries since the 2000s have raised concerns, fears, and debates within the international community and economists. Human activities are largely responsible for atmospheric warming through their emissions of CO<sub>2</sub> and polluting substances with dramatic consequences and numerous losses of human life in some countries. Using panel data covering the 2000-2016 period, this study investigated the social vulnerability due to the CO<sub>2</sub> emissions through an empirical study of CO<sub>2</sub>'s determinants in selected countries of sub-Saharan African and Southeast Asian countries. The STIRPAT model gave out the result that; explanatory causes of carbon dioxide emissions are different in the two regions: the agriculture-forestry and fishing value-added, and human development index have a strong explanatory power on CO<sub>2</sub> emissions in the ASEAN countries, the per-capita domestic product has a positive and significant influence on carbon emissions in the SSA countries, *ceteris paribus*, but was statistically insignificant in the ASEAN countries. The growing population decreases carbon emissions in the SSA selected countries while is not statically significant in the ASEAN countries. There is therefore a kind of double penalty: those who suffer, and will suffer the most from the impacts of climate change due to CO<sub>2</sub> emissions, are those who contribute the least to the problem. These results provide insight into future strategies for the mitigation of climatic hazards already present in some places and potential for others which will be felt on different scales across the regions. Some of the inevitable redistributive effects of those risks can be corrected by providing financial support to the poorest populations hardest hit by natural disasters.

**Keywords:** CO<sub>2</sub>emissions, climate change, vulnerabilities,environment ,risk, regional analysis.

## 1. Introduction

In addition to the climate variability that has always affected society, anthropogenic climate change poses an additional challenge for vulnerable populations and their activities, especially in the regions of Africa and South East Asia; Serdeczny et al.(2017); Yuen & Kong (2009). The analysis of current or future vulnerability, under different climate scenarios, as well as the study of its causes at multiple scales is the starting point of adaptation planning processes. Climate issues are intrinsically bearing to economic inequalities: it is a crisis induced by the greenhouse gas explosion that hits the poorest (Singer, 2018). It is a factor in leading households to poverty (Elisa, 2017). One example would be climate-related disasters like floods, which can be life-threatening and also highly destructive, robbing people of homes and the few assets they have.

People living in poverty usually have assets of very low quality and tend to not have savings, or only very few, recovery from disasters can be brutal(Stéphane Hallegatte et al., 2020). Other instances include droughts, which not only lead to crop losses but also spikes in food prices. Since many poor people in the rural area depend on agricultural income, this leads to a vicious circle in which their income is decimated due to droughts affecting their crop yields and people not being able to buy food due to rising prices (Arora, 2019). Not only the poorest people on the planet the least responsible for climate disasters is generally the most vulnerable to its consequences and the least prepared to face the challenge (Stephane Hallegatte et al., 2016).

A recent World Bank study<sup>1</sup> showed that in the 52 countries reviewed, most people live in countries where poor people are at risk of suffering from disasters such as droughts, floods, heatwaves than the average of the population as a whole. This is even truer in many countries in Africa and Southeast Asia(Kesar, 2011). From this perspective, it is possible to identify policies and measures that reduce vulnerability and increase coping capacities. Importantly, the CO2 model gives a more realistic picture of the real emissions of citizens according to their level of income in a country(Oxfam, 2015). These new estimates also allow us to dispel some of the myths that have long circulated at United Nations climate conferences about who is responsible for climate change. It is important to stress, on the one hand, that the emissions due to the consumption pattern of

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<sup>1</sup> Posted by Statista Research Department, Dec 1, 2020

nationals of developing countries, even those of the G20, are much lower than those of their equivalents in the rich countries of the OECD and, on the other hand, that even within these latter countries, there are large variations in the carbon footprint due to consumption between the rich and the poor(Hubacek et al., 2017).

The increasing threat of global warming due to pollutants emissions has focused attention on human activities(Papalexidou et al., 2018). It has been argued that the propellers of environmental issues have been solar output, plate tectonics, volcanism, proliferation, and abatement of life, meteorite impact, resource depletion, changes in earth's movement around the sun, and transformation in the tilt of the earth on its axis (Gyles, 2019).

Home to nearly 10% of the world's population and experiencing one of the most dynamic economic growths in the world, Southeast Asia countries remains particularly exposed and vulnerable to natural disasters intensified by climate change (Mottet, 2020). The SSA region for its part has been pointed as one of the parts of the world most vulnerable to the impacts of climate change<sup>2</sup> (UN 2020; Serdeczny et al., 2017). Forecast results from Lioussé et al., 2014 on explosive growth in SSA showed African emissions made a significant contribution to global emissions. Disasters endanger human life and livelihoods(Bush et al., 2018). Vulnerability factors in that region include its heavy reliance on rain-fed agriculture, widespread poverty, and weak capacity. Chontanawat (2018) has analyzed factors affecting CO<sub>2</sub> emissions in ASEAN countries. The findings performed on IPAT/Kaya approach combined with the Variance analysis technique have indicated that population growth and increased income per capita have the largest contribution to emission growth. Deforestation and the use of fossil fuels have been the main causes of CO<sub>2</sub> emissions which have intensified to respond to increasing urbanization and rapid population growth(Houghton, 2010). However, the IEA reports (Southeast Asian Energy Outlook 2019) that the Southeast Asia economies are still to this day dependent on fossil fuels, which are the second major source of CO<sub>2</sub> emissions after deforestation. Ameyaw and Yao (2018)examine, based on a panel data model, the relationship between gross domestic product and CO<sub>2</sub> emissions in five West African countries. The causality results revealed a unidirectional causality running from GDP to CO<sub>2</sub> emissions. Furtherly, Al-mulali & Binti Che Sab(2012) investigated the impact of energy consumption and CO<sub>2</sub> emission on GDP growth and financial development in thirty Sub Saharan

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<sup>2</sup> Climate change UN news, October 2020

African Countries. The output has shown that energy consumption had played an important role to increase both economic growth and financial development in the investigated economies but with the consequence of high pollution. Unlike the ASEAN countries, this situation is not inevitable. The African Progress Panel's new report, Energy, People and Planet (APP 2015)<sup>3</sup> has shown that Africa does not have to choose economic growth and low-carbon development. It can reconcile the two and become the leader of the clean energy revolution. By promoting universal access to electricity and stepping up investments in renewable energies, African countries would avoid fossil-fuel-based development and succeed in reducing poverty.

In addition to several other determinants, the CO<sub>2</sub> emissions tend to keep increasing with income. Scholars have extended it beyond an exploration of the Environmental Kuznets Curve (EKC) which binds the environmental degradation and economic growth of countries, and households (Mao et al., 2013; Shahbaz & Sinha, 2019; Tsiantikoudis et al., 2019). The study of Aye & Edoja (2017) explored the effect of economic growth and CO<sub>2</sub> emission using the dynamic panel threshold framework of 31 developing countries has indicated that CO<sub>2</sub> emission varied across the countries based on their level of income and development. There was no support for the Environmental Kuznets Curve (EKC) hypothesis but a significant causal relationship between CO<sub>2</sub> emission, economic growth, energy consumption, and financial development. The tested EKC hypothesis by Demissew Beyene & Kotosz (2020) on 12 East African countries using the Pooled Mean Group (PMG) approach for the period from 1990 to 2013 attested that the economic activities in East African countries do not lead to CO<sub>2</sub> emissions. There was a bell-shaped relationship between per capita income and CO<sub>2</sub> emissions. Similarly, to previous environmental Kuznets curve studies, Baker & Mitchell, (2020) have insist that lower-middle-income countries have the most emission-intensive consumption baskets. The relationship is negative overall to high-income countries. This is purely descriptive and cannot be used to infer anything about how emissions will evolve as incomes grow. Yeh & Liao (2017) evaluated the CO<sub>2</sub> emissions due to population, economic growth in Taiwan from 1990-2014. The STIRPAT model on population and economic growth was tested statistically for the significance of each proposed model.

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<sup>3</sup> The Africa Progress Panel report, 2015

According to Singer (2018), climate change and inequalities are doubly linked. Costa et al.(201) has shown the relative time-dependent correlation of the Human Development Index (HDI) and per capita CO<sub>2</sub> emissions from the combustion of fossil fuels. In general, both at the country level and at that of individuals, the less rich is the most vulnerable to climate change, while the richest are responsible for the majority of gas emissions (GHG).

The above discussions confirm the strong correlation between CO<sub>2</sub> emissions and multiples effects dues to human activities. This concept has been studied through a social vulnerability assessment (Nomura, 2014). The theoretical models consider not only environmental factors but also social, political, economic, and institutional variables that can influence a population's social vulnerability to climate change due to CO<sub>2</sub> emissions. Our study aims to compare the level of social vulnerability due to CO<sub>2</sub> emissions in selected countries of two regions with variables derived from the econometric model. An effort has been made to find the empirical investigation on Carbon dioxide emission and six broad categories of environment variables i.e. agriculture value-added, GDP per capita, population growth, and human development index in the context of two different regions.

## **2. Methodology and data source**

The theoretical model used in this study is inspired by the STIRPAT approach originally developed by Ehelich & Holdeen (1971). The STIRPAT approach was developed to initially clarify the determinants of CO<sub>2</sub> emissions by involving human behavior in action. The foundation incorporates a recognition of the causal cycles between these two complex systems where human influences on ecosystems at one point in time foreshadow future human options. It is expressed by the equation  $I = PAT$  and means that the environmental issues (I) are the product of the size of the population (P), its level of wealth (A), expressed in income per capita, and a factor representing technology (T). This equation is equivalent for greenhouse gas (GHG) emissions to Kaya's equation, which decomposes the growth of GHG emissions into a sum of four growth rates: that of the population, of GDP per capita, energy intensity, and carbon intensity.

This paper incorporates some of the complexity of the linkages of ecological variables and other factors influencing environmental threats Knight (2009). To eliminate the low number of observations in time, we use panel data, and to technically observe the regional disparities, dummy

variables are applied. The LOG – LOG model form was not considered because some of the input variables are assigned in percentage.

To comprehensively analyze the effect of the population on carbon dioxide emissions, the STIRPAT formula model, after taking into account corresponding variables, can be written in the following initial form:

$$CO2_t = \alpha_0 G D P C_t^{\alpha_1} A G R I F_t^{\alpha_2} P O_t^{\alpha_3} H D I_t^{\alpha_4} \mu_t \quad (1)$$

Where  $CO2$  denotes the environmental impact,  $GDPC$  the overall output representing the level of wealth per capita,  $PO$  the size of the population. Affluence and technological factors are captured respectively by  $AGRIF$  (agriculture, forestry value-added),  $HDI$  (human development index),  $\mu_t$  is assumed to independently and identically distributed,  $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4$  are parameters. The index  $t$  represents the time. The function to be estimated which analyze the link between the emissions of  $CO_2$ , their restriction, and economic growth can be written as follows:

$$\ln(CO2)_t = \alpha_0 + \alpha_1 \ln(GDPC)_t + \alpha_2 (\ln PO)_t + \alpha_3 \ln AGRIF_t + \alpha_4 \ln(HDI)_t + \mu_t \quad (2)$$

Note:  $\alpha_0 = \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 1$  (Stachurski (2007) and Wang et al. (2013)).

These shapes allow a simple calculation of the elasticity of the environmental impact according to each anthropogenic factor.

### 3. Variables measurement and data source

The data used for the estimation of equation (1) cover the period 2000-2016 annually for the countries selected according to the availability of data. The countries considered are those of the Sub-Saharan Africa (SSA) region and the South East Asian Nations (ASEAN). The World Development Indicators, the United Nations, and Global Carbonate Atlas have been used for the data source.

The human development index adjusted for inequalities here helps us to better assess the environmental degradation which weighs heavily on the development of the least developed countries.

Table 1. Variables description used in the analysis, 2000-2016

Variables	Orientation	Measurement
<b>Dioxide carbon emissions (CO2)</b>	GHS variable-energy use Carbon dioxide	Kt
<b>Agriculture, forestry, and fishing, value-added (AGRIF)</b>	The net output of the agriculture sector, forestry, cultivation, and cultivation of crops and livestock production.	%GDP
<b>Population growth (PO)</b>	The evolution of the population in 1 the year.	%total population
<b>Per capita domestic product (GDPC)</b>	The prosperity of a country and its economic growth.	Constant 2005 US dollars
<b>Human development index (HDI)</b>	Assess the human development rate of countries around the world.	A unitless number between 0 and 1

#### 4. Empirical results

Empirical work frequently begins with an analysis of the stationarity of the series considered with the application of various unit root tests. In a multivariate context, the use of panel data thus makes it possible to work on samples of reduced size (in the time dimension) by increasing the number of available data (in the individual dimension), therefore reducing the probability of facing structural ruptures and overcoming the problem of the low power of small sample tests. This needs to test for stationarity of the data before the regression for going beyond the spurious regression. To ensure the efficiency and stability of data, we performed panel unit root test namely Levin-Lin-Chu (LLC) test (2002), Im-Pesaran-Shin (IPS) test (2003), Fisher-ADF test, and Fisher-PP test (Maddala & Wu, 1999).

Table 1. Results of panel unit root tests for ASEAN

UNIT TEST	ROOT	VARIABLES	LLC	IPS	FISH -ADF	FISH-PP
LEVEL		CO2	-0.29735	-0.29902	6.17491	6.34324
		GDPC	-0.13702	0.16647	3.77493	5.12082
		AGRIF	-0.12605	-0.10927	5.11877	7.15496
		PO	-0.32403	-0.87543	9.91477**	16.4744***

<b>FIRST DIFFERENCE</b>	HDI	-0.22125	0.03182	4.40202	4.56859
	CO2	-7.43754**	-9.97848	66.2173**	80.7582
	GDPC	-13.1714**	-11.1110**	73.5145**	73.7271**
	AGRIF	-13.4675**	-11.4917**	75.8621**	76.1556**
	PO	-1.48875***	-7.800122**	50.120**	80.0449**
	HDI	-14.3168**	-11.7962**	77.6522**	77.6543**

\*\*Indicates significant confidence at 5%.

\*\*\*Indicates significant confidence at 1%.

Consider Levin-Lin-Chu (LLC) test for example, which is an extension of the ADF test in the context of panel data, assumes that individual processes are cross-sectionally independent. The general equation takes the following form:

$$\Delta Y_{i,t} = \alpha_i + \theta_t + \delta_i t + \rho_i Y_{i,t-1} + \sum_{k=1}^n \phi_k \Delta Y_{i,t-k} + \mu_{i,t} \quad (3)$$

where  $\alpha_i$  represents the coefficients,  $\rho_i$  denotes the fixed effect cross-section and  $\mu_{i,t}$  the residual of the estimated panel. This equation is very general because it allows bidirectional fixed effects, one coming from  $\alpha_i$  (representing a fixed effect specific to the unit) and the other from  $\theta_t$  (temporal effects specific to the unit). It also includes distinct deterministic trends in each series across  $\delta_i t$ , and the lag structure,  $\Delta Y_{i,t-k}$  to remove the autocorrelation in  $\Delta Y_{i,t}$ .

The hypotheses tests are:

$$H_N: \rho_i \equiv \rho = 0 \quad \forall_i \quad (4)$$

$$H_A: \rho_i < 0 \quad \forall_i \quad (5)$$

Table 2. Panel unit root test for SSA

UNIT ROOT	VARIABLES	LLC	IPS	FISH -ADF	FISH-PP
<b>LEVEL</b>	CO2	-0.24819	0.9113	11.3376	11.8127
	GDPC	-1.83950**	0.45912	12.3556	9.28227
	AGRIF	0.61918	2.12672	9.54354	8.80124
	PO	-11.4057**	-7.42184**	84.8287**	15.2400
	HDI	-3.95528**	-0.12612	19.6567***	23.7731***
	CO2	-2.36911**	-3.36257**	38.9262**	82.6010**
	GDPC	-1.79984**	-2.30870**	35.2365**	51.0157**

<b>FIRST</b>	AGRIF	-1.98307**	-2.56356**	35.2365**	52.5123**
<b>DIFFERENCE</b>	PO	-5.46453**	-4.11725**	47.2688**	14.6425
	HDI	-0.58669	-1.47240***	22.4974	59.6950**

\*\*Indicates significant confidence at 5%.

\*\*\*Indicates significant confidence at 1%.

The results for all panel unit root tests in two regions are shown in tables 1 and 2. The unit root test for ASEAN countries (Table 1): all given variables, except PO which is tested stationary at the level in Fish -PP, are stationary at their first difference, trust to rejecting the null hypothesis of non-stationarity at the level of 5%. In the SSA countries (table 2), HDI is tested stationary at the level respectively in LLC and Fish-ADF test. Moreover, HDI is also stationary at its first difference in IPS and Fish-PP. All the rest of the variables are tested stationary significant at 5% level when the first difference was taken into account by relevant tests. Thus, we will conclude after a co-integration test a further relationship between CO2 and the other variables.

Table 3. Co-integration test results

<b>Statistic</b>	<b>SSA</b>	<b>ASEAN</b>
Panel V-Statistic	-1.808982	-2.320778
Panel rho-Statistic	0.079725	1.657602
Panel PP-Statistic	-4.698104***	-5.422439***
Group rho-Statistic	1.730707	3.197142
Group PP-Statistic	-3.313720***	-2.413265***
Group ADF-Statistic	-4.186132***	-2.579850**
Panel ADF-Statistic	-4.627545***	-3.928824***

The implementation of the various cointegration tests led to the results summarized in table 3 above. The above-conducted study has proved a stationary in the same order for all variables. Works to date have been based on a generalization of Engle-Granger single equation methods following the pioneering work of Pedroni (1999, 2004). Pedroni's approach is not particular but allows separate intercepts for each section of potentially cointegrating variables and distinct deterministic trends. In the most general case, according to different test strength of each statistic, it is described by the inner scale and the group scale and this may take the form:

$$Y_{i,t} = \alpha_i + \sigma_i t + \beta_{1i} X_{1i,t} + \beta_{2i} X_{2i,t} + \dots + \beta_{Mi} X_{Mi,t} + \mu_{i,t} \quad (6)$$

Note:  $m=1, 2, \dots, M$  are the explanatory variables in the potentially cointegrating regression  $t=1, 2, \dots, T$  and  $i=1, 2, \dots, N$ .

The autoregressive test for the estimated panel residuals is then subjected to a separate ADF-type test for each group of variables to determine whether they are  $I(0)$ . The test equation is:

$$\Delta \hat{\mu}_{i,t} = \rho_i \hat{\mu}_{i,t-1} + \sum_{j=1}^p \phi_{i,j} \Delta \hat{\mu}_{i,t-j} + \gamma_{i,t} \quad (7)$$

Note:  $\gamma_{i,t}$  represents the random error term.  $\rho_i$  is an autoregressive term of the estimated residuals. The null hypothesis is that the residuals from all of the test regressions are unit root processes ( $H_N: \rho_i = 0$ ), which indicates the absence of cointegration. For the dimension statistics, two possible alternative hypotheses have been proposed by Pedroni:

- a) The autoregressive dynamics are the same stationary process ( $H_A: \rho_i = \rho < 0 \forall i$ )
- b) The dynamics from each test equation follow a different stationary process ( $H_A: \rho_i < 0 \forall i$ )

Based on standardized versions of the usual t-ratio from equation (7), the Pedroni cointegration result tests presented in table 3 give out the acceptance of the null hypothesis that the Panel v-statistic, Panel rho-statistic, and Group rho-statistic present a cointegration relationship for all variables. The ADF is statistically significant at a 5% percent level and its test performs better than others (da Silva Lopes, 2006). We then conclude a co-integration among the variables during the given period.

Table 4. Hausman test result

Statistic	SSA	ASEAN
F-Stat	273.036964**	31.896082**

\*\*Means significant at confidence level 5%

The diagnostic tests indicate that the specifications adopted are generally satisfactory. The Jarque-Bera tests do not make it possible to reject the hypothesis of normality of the errors. The robust Hausman tests were employed to achieve the fixed-effect model (FE). The modified Wald and Wooldridge test has been used to examine the autocorrelation. The came out results showed a

heteroskedasticity and autocorrelation problem in the model. Further, we find no cross-sectional dependence in the model using a CD test. The Robust standard error estimation and Panel-corrected Standard Errors were performed to solve these problems. Moreover, the VIF values in the multicollinearity test, are all less than 10. There is no multicollinearity among our explanatory variables.

The outcome of estimation [table5] of ASEAN selected countries shows that agriculture, forestry, and fishing, value-added and human development index have a significant statistic at 5% level and increase CO2 emissions respectively with 1.85 and 208649.0. Worth noting that the effect of per -capita domestic product and population growth is not statistically significant at any level. In the case of SSA selected countries; the per capita gross domestic product shows a positive significant effect on CO2 emissions with 2.241854. The effect of agriculture, forestry, and fishing, value-added, population growth on CO2 emissions affects statistically significant but negative output in the region. While the human development index is not statistically significant to the emission of CO2.

Table 5. Presentation of the estimation of long-term coefficients.

Fix effect		
Variables	ASEAN	SSA
<b>C</b>	-45539.30 (0.26)	2.241854** (2.68)
<b>GDPC</b>	-0.0294076 (-0.05)	0.000204** (-3.59)
<b>AGRIF</b>	1.85e-06** (8.31)	-4.52e-12** (-3.59)
<b>PO</b>	-3191.144 (-1.35)	-0.371977** (1.26)
<b>HDI</b>	208649.0** (0.79)	-0.101992*** (-0.32)
<b>R-Squared</b>	0.97643	0.995438
<b>Cross-sectional dependance test, CD</b>	-1.1950	-1.6624
<b>Stat</b>		
<b>Multicollinearity (VIF)</b>	2.33	1.43
<b>Heteroskedasticity</b>	$\chi^2(8) = 7500414$	$\chi^2(8) = 4747.17$
<b>Observations</b>	136	136

One of the main challenges facing the world is to feed a growing world population while reducing the ecological footprint and preserving natural resources for future generations. There is still a lot to do to improve the environmental performance of the agricultural and fisheries sector that limit the negative effects on the environment and reinforce the positive effects to finally ensure the food security of a growing world population while improving environmental performance. However, global food needs are increasing and agriculture is expanding and occupying more and more space, resulting in significant land-use change. The conversion of those spaces massively destocks the carbon contained in soils and vegetation. The causes of CO<sub>2</sub> emissions due to the agriculture, forestry, and fishing in ASEAN countries can be justified by indirect energy consumption: agricultural systems need inputs to function (fertilizers, plant health products, animal feed, equipment, buildings, etc.). These inputs also require energy to be produced and are responsible for GHG emissions.

The consistent results of the SSA selected countries clearly show that CO<sub>2</sub> emissions are closely linked to the growth of national income during 2000-2016. The CO<sub>2</sub> emissions do not correlate with other key measures of human development, such as life expectancy and education. According to the 2019 Human Development Report (Rdh), inequalities and the climate crisis are intimately linked, whether it is emissions, effects, policies, or resilience. Countries with high human development tend to emit more carbon per person and have a larger ecological footprint overall. To achieve high standards of living, poor countries should not follow the example of the richest countries because the share of vulnerabilities seems different at all levels.

Table 6: Estimation for sample countries grouped in regio (LSDV)

<b>Independ. CO2</b>	<b>Coefficients</b>	<b>P-value (5%)</b>
<b>AGRIF</b>	2.08E-06	0.000**
<b>GDPC</b>	-3.243654	0.000**
<b>PO</b>	1809.494	0.666
<b>HDI</b>	230669.3	0.000**
<b>R1</b>	105136.7	0.000**
<b>R2</b>	-142482.5	0.000**
<b>R-squared =0.6786</b>		
<b>Root MSE =66337</b>		
<b>F (5, 266) =76.60</b>		

\*\* : Significant at 5%

The coefficient of the constant (-142482.5) represents the SSA region( $r^2$ ). It has been considered as a basic region by dummy variable (Andrews & Schank, 2006). Therefore, CO<sub>2</sub> is lower in SSA selected countries relative to ASEAN selected countries by 105136.7.

To better understanding CO<sub>2</sub> emissions disaster risk, the level of vulnerability helps to stipule the most groups susceptible to damage, loss, and suffering than others and likewise. According to the above studies, CO<sub>2</sub> emissions and inequalities are doubly linked both at the regional and individual levels. There is therefore a kind of double penalty: those who suffer, and will suffer the most from the impacts of climate change due to CO<sub>2</sub> emissions, are those who contribute the least to the problem. These climate changes are affecting human development in a multitude of ways, besides crop failure and natural disasters have already been felt in SSA countries. The Human Development Report (HDR, 2019) predicts that this may cause an additional 250,000 deaths per year from malnutrition, malaria, diarrhea, and heat stress, between 2030 and 2050. Hundreds of millions of people could be exposed to deadly heat by 2050, and in all likelihood, the geographic distribution of disease vectors (for example, mosquitoes carrying malaria or dengue) will change and expand.

## **5. Conclusion and policy implications**

Using panel data covering the 2000-2016 period, this study investigated the social vulnerability due to the CO<sub>2</sub> emissions through an empirical analysis of CO<sub>2</sub> determinants in selected countries of SSA and ASEAN. The outcome from the STIRPAT model showed a different influence -factor on carbon dioxide emissions in these two regions. The agriculture, forestry, and fishing, human development index have a significative explanatory power on CO<sub>2</sub> emissions in the ASEAN region. The per -capita domestic product has a significant influence on carbon dioxide emissions in the SSA selected countries, but not significant in the ASEAN selected countries. The population growth decreases CO<sub>2</sub> emissions in the SSA when is not statically significant in the ASEAN region. These findings make out insight into future policies for the mellowing of climatic hazards causing unequal vulnerabilities on the part of the population living in these regions.

Uncontrolled environmental degradation, from drought in sub-Saharan Africa to rising sea levels in low-lying countries as well as countries in Southeast Asia, could have many

consequences. The overall impact on habitats will depend on their exposure and vulnerability. These two factors are closely linked to inequalities in a vicious circle. They act as a brake on effective action because high levels of inequalities tend to make collective action more difficult, while it is essential to limit climate change in all countries and within each. of them. As climate change worsens existing social and economic divides, there are nevertheless possible solutions to tackle social/economic vulnerabilities and the climate crisis at the same time, which would move countries towards unhindered human development. exclusive and durable.

To help countries to improve the viability of their activities, a set of recommendations could be drawn up concerning the means to be implemented to design cost-effective environmental measures, face the challenges of climate change, preserve biodiversity and manage ecosystem services linked to agriculture, for example. We also need to think about carbon pricing, some of the inevitable redistributive effects of carbon pricing can be corrected by providing financial support to the poorest populations hardest hit by natural disasters. It is also important to consider a wider range of social measures that simultaneously address inequalities and the climate while facilitating income-generating activities in poor countries.

## **6. Declaration of competing interest**

No conflict of interest

## **7. Acknowledgment**

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