RELATIONSHIP BETWEEN PER CAPITA CO$_2$ EMISSIONS AND GDP IN IRAQ

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Abstract

Climate change is considered as the most important issue that controls on the climate system and phenomenon. Rapidly increase in CO$_2$ emissions lead to significant impact on global warming which affects all areas of life on Earth. The objective of this study investigates the aspect of the relationship between per capita CO$_2$ emissions and economic growth of Iraq. The two different of datasets were used; CO$_2$ emission and gross domestic population GDP for long period over 50 years extended from (1960) to (2010) over Iraq. The CO$_2$ emissions data came from Carbon Dioxide Information Analysis Center (CDIAC). The results showed that total CO$_2$ emissions had high increased in last decade to reach 1.8 times than total period. The high fluctuations for per capita CO$_2$ appeared in 2010. there was clear increased in CO$_2$ emission and GDP values with time, the relation between them provide increased trend along the study period, and the per capita GDP is proportional with CO$_2$ emission over time but with different behavior as compared with other countries because the trend is fluctuated with time. The relation between CO$_2$ emission with CO$_2$ emission per GDP become higher effective when the value of CO$_2$ emission is around (0.3) (kg per PPP $ of GDP), and become less when the ratio increased of CO$_2$ to the GDP.
Keywords: CO$_2$ emission, GDP, Iraq, per capita.

Introduction

The special report named global warming (1.5ºC) for Intergovernmental Panel on Climate Change (IPCC - 2018), refer to reduce global emissions of carbon dioxide within 12 years to where they before 41 years ago, to obviate reach increase average earth surface temperature to (1.5 °C) (Barry *et al.*, 2003).Obviously, the main reasons of this increase of earth surface temperature came from growth in industrialization and population distribution also increase carbon emissions (Hassan *et al.*, 2018). Carbon dioxide is one of most common greenhouse gases that emitted by human. Through the past several decades the combustion of fossil fuel has rapidly grown as main source of energy and it is related to emission of pollutants into the atmosphere. The global average of carbon dioxide concentration in (2017) was (405 ppm), while the concentration levels today are higher than any time before. Carbon dioxide concentrations emissions from fossil fuel combustion and cement manufacture in (2017) passed to 10 Giga tones (Gt) of carbon (Marland *et al.*, 2019). Global carbon emissions from fossil fuel use were (9.795 Gt) in (2014) (35.9 Gt CO$_2$ of carbon dioxide). Fossil fuel emissions were (0.6%) above emissions in (2013) and (60%) above emissions in (1990), while (40 Mt) on the early nineteenth century (Blanco *et al.*, 2014). Emissions per capita were (1.19 tones) of carbon per person in (1977), while in (2017) this had increased to (1.34 tones) (Solomon *et al.*, 2007). China considers as the largest consumer of energy in the world therefore it produce huge amount of CO$_2$ and its cities contribute in about (85%) of total emissions, that's mean china is very important to make adaptation with climate change (Yuli *et al.*, 2017).

The increase in global emission of carbon dioxide from fossil-fuel combustion and industrial processes contributed (78%) of greenhouse gases (GHGs) emission during (1970 to 2010), same this ratio contribution for the period (2000 to 2010). Agriculture and deforestation changes have been second largest contributor – the main cause of human – induced global warming, while the global average annual growth rate of (2.4 ppm) in atmospheric CO$_2$ concentration (2012) was rather high (Hashim *et al.*, 2016).

Some studies shows that the ratio of CO$_2$ emission is vary from country to another depending on luxury level of its people, where the rich countries is differ from poor countries by their emission behavior, because rich countries have a weak relation between GDP value and CO$_2$ emission value while the relation is stronger for poor countries (Janifar, 2015). Thus the urbanization and commercial openness lead to negative relation between per capita consumption and CO$_2$ emission (Susan, 2011). Many countries of the world competed to provide research on carbon dioxide emissions and the extent of their connection to the economic activity of countries in addition to the impact of human activity of the population, thus decadal analysis studies of carbon dioxide emissions for different state of fossil fuel in Iraq carried out over the last five decades. The case of gaseous fuel consumption increased 10 times since (1960), while decreased for solid fuel consumption four times (Hassan *et al.*, 2018). Another decadal studies focused on European Union member states use fossil fuels for electricity production at next two decades in terms of four greenhouse gases (GHG) include CO$_2$ emission. Analysis method cluster analysis agglomerative algorithm were used to determine GHG emissions for each EU member, and then merge homogenous countries emission in group depend on total emission level, and due to the level of their emissions per capita (Kijewska, *et al.*, 2016).

Many scientists like 'S. Boopen' tried to make analyses of the relation between GDP and CO$_2$ emission over Mauritius island depending on special analyses functions, and the result of his research presented to that the trend of CO$_2$ was highly correlated with GDP depending on EKC estimations for the period between (1975 -2009) (Boopen, 2010). Another study was about the relation between CO$_2$ emission and per capital GDP, and the result of this research showed that CO$_2$ emission of rich countries became less with time and it negatively correlated with per capita of GDP, also for several countries this relation was negative between the

amount of CO_2 emission and per capita GDP with non linear relation, that mean the intensity of CO_2 is less in rich countries as compared with poor countries (Justin *et al.*, 2019). however other studies reach to that the CO_2 emission showed increase because of rapid economic growths and the nature of life style for the people, this study examine the per capita of CO_2 depending on their family consumptions (including clothes, food, transportation and services) by the use of scanned data on china cities, and it found that there is a decreased relation traveling from east to west and from north to south (Kais *et al.*, 2015).

Egyptian scientist attempted to show the relation between environmental decay and economical development by comparing CO_2 emission with economical growth ratio depending on real per capita GDP using data of energy consumption for the period between (1980 and 2010), this research found that energy consumption was positively correlated with CO_2 emission, and the commercial openness as well as population number was negatively correlated with CO_2 emissions (Dalia, 2016).

UAE studied the relation between electrical consumption and CO_2 emissions depended on data for economical and financial growth of UA. The result showed that the energy consumption and CO_2 emission have long term relation with economical and financial growths indicators in UAE and it showed that there was a negative relation between energy consumption and CO_2 emission, then this country need to increase the consume of green energy to reduce CO_2 emission (Usama, 2018).

Material and Methods

As shown before, this study dealing with the amount of CO_2 and its correlation with other economical variables for the country as well as for each person in Iraq , because of the importance of this branch from its correspondence and effect on climate change by increasing the rate of temperature as compared with its general ranges. The study period extended from (1960 -2010) over Iraq, therefore it depended on data of CO_2 that obtained from data set of the world bank, the data of economical variables of gross domestic product (GDP) for Iraq that calculated by knowing market value to show the range of country health [8], and it obtained from the main source of the word bank. After that the study tested the relations between CO_2 emission and GDP, and calculated per capita GDP by the following relation:

$$GDP\,per\,capita = \frac{GDP\,of\,the\,country}{population\,of\,this\,country}$$

Then correlate it with CO_2 emission by the form of (Mega Tones) to make the relation between CO_2 and these economic variables.

Results and Discussion

CO_2 emission ranges are climate issue were analyzed and correlated with some economical factors in Iraq. This study attempted to discover the increasing trend of CO_2 emission a series for the period from (1960 - 2014). Results of figure (1) refer to that the time series of total CO_2 emission in Iraq was exponentially increased with time from the year (1960) where slowly increased, while fast increased occurred in last decade. The figure also shows three years had lower values of emission especially that happened in 1991 which Iraq witnessed abnormal political conditions, beside that the

years (2006) and (2007) had lower emissions too, that maybe because of dramatic events that occurred lead to negative affected on economy. In general figure (1) shows significant increased trend in CO_2 emission with three intervals and the first one was from (1960 -1990) show slowly increased and the second interval was steady fluctuated around the mean value from the period from (1991 - 2000), and the last interval showing rapid high increased from the year (2000) reach to the end of study time. The ratio of increased total CO_2 emissions per last 10 years equal to 5.4 Mt, while the total CO_2 emissions per whole study period (54years) equal to 2.9 Mt.

The growth in population distribution beside increased CO_2 emissions was still high from most of countries. So that used to compare the amount of CO_2 emission of every person (per capita CO_2) among countries as well as time. The per capita CO_2 emission for Iraq was at level of (4.81 Metric tons) in (2014) where (1.16 metric tons) in early (1960s) as shown in figure (2). Per capita CO_2 shown many fluctuations that happen in years (1988, 2004) and (2010) thereafter had trend increased. So this depends on per capita financial potential and purchasing power for each person.
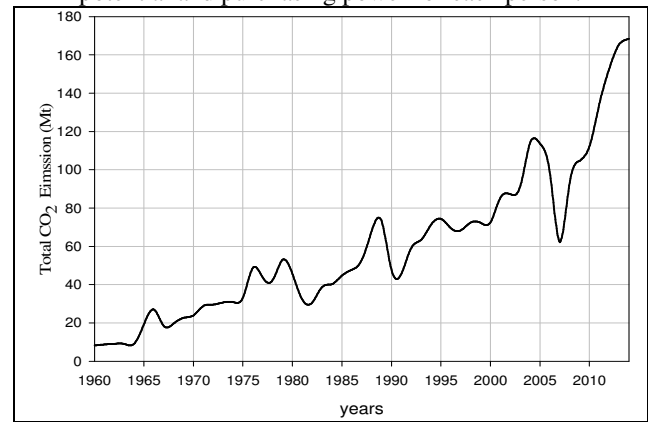

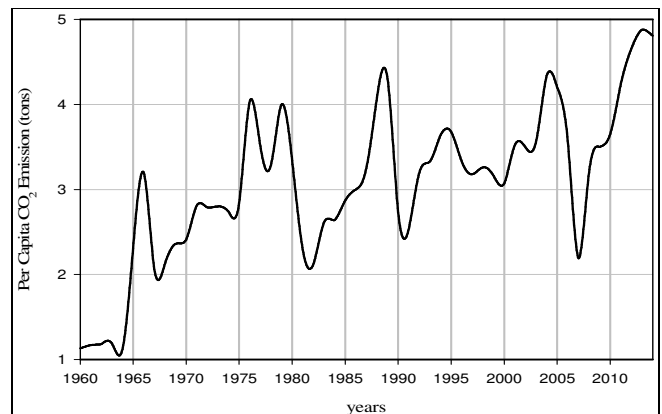**Fig. 1:** Trend of time series for total CO_2 emissions for 1960-2014 in Iraq.

Fig. 2: Trend of time series for per capita CO_2 emission for 1960 - 2014 in Iraq.

One of economic indicator for the growth is GDP, whereas it indicate for developed and developing country, and by comparing the amount of CO_2 emission divided by gross domestic product with time for the period from (1990) to (2014) on figure (3), it found that the general trend become lower with time and higher peak of the diagram after (1991) and the concave of the curve located on (2007), this mean that the CO_2 emission value depending on GDP was reduced

to lower value by increasing the gross domestic product GDP of Iraq at these periods as compared with previous periods, and it is very clear by comparing figure (3) with figure (4), these figures show decreased of this ratio for most of time series, and there are two reasons for that, first is by increased CO$_2$ emission per capita, and that is not clear according to figure (2), the second reason was decreased of PPP $ GDP.

The study analysis found that the relation between total CO$_2$ emission that depended on the gross domestic product GDP with CO$_2$ emission alone from other side, the result shows that the CO$_2$ emission per GDP having the higher effective value of CO$_2$ emissivity when the ratio was between (0.2) and (0.4), and we noted that when this value increasing 'either by increasing CO$_2$ or by decreasing GDP' then the CO$_2$ emission become lower on figure (5). Also the first period for 20 years was less than (60 Mt) of CO$_2$ emission while the second period until the year (2000) was with increased (20 Mt), but the largest CO$_2$ emission that more than (60 Mt) of CO$_2$ emission from the first and second period (from 1960 - 2000), so that the total emission for the last decade of this study was more than the previous period of it.

For the figure (6) the ratio of per capita CO$_2$ emission also have the same behavior on figure (5) and the relation ratio of CO$_2$ to the GDP become higher when the value of CO$_2$ emission around (0.3) (kg per PPP $ of GDP), and become less by increasing of CO$_2$ to the GDP, so it non-linearly correlated with PPP $ of GDP but must clustered at (0.3) as shown in figure (6). From all that the study reaches to that the CO$_2$ emission is less effective factor than economic factor in Iraq.
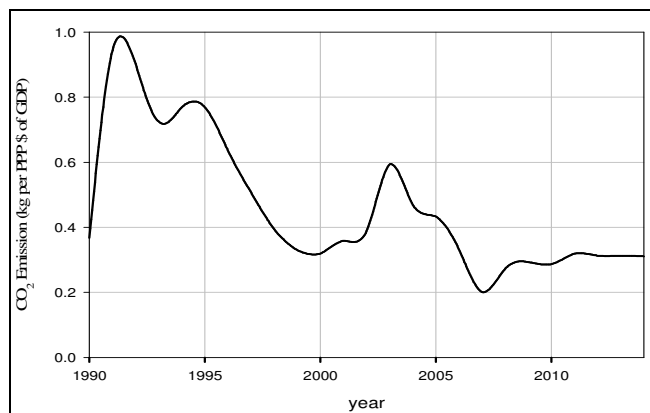

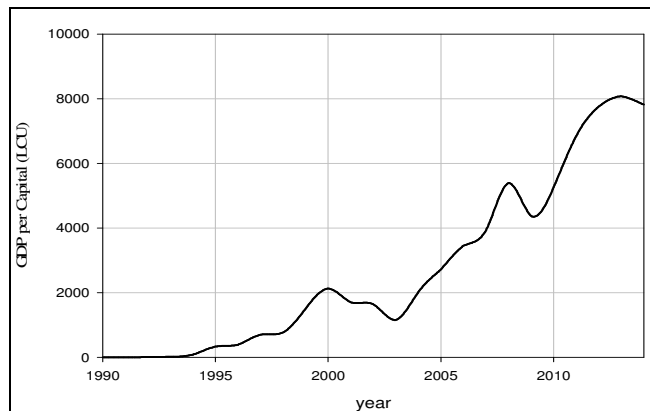**Fig. 3:** The series time for CO$_2$ emission (kg per PPP $ of GDP) in Iraq.

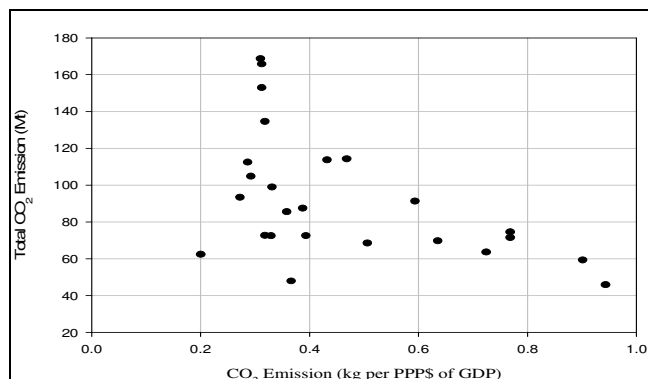**Fig. 4:** The time series for GDP per capita for Iraq.

Fig. 5: Scattered plot of total CO$_2$ emission (Mt) corresponding with CO$_2$ emission (kg per PPP $ of GDP) in Iraq.
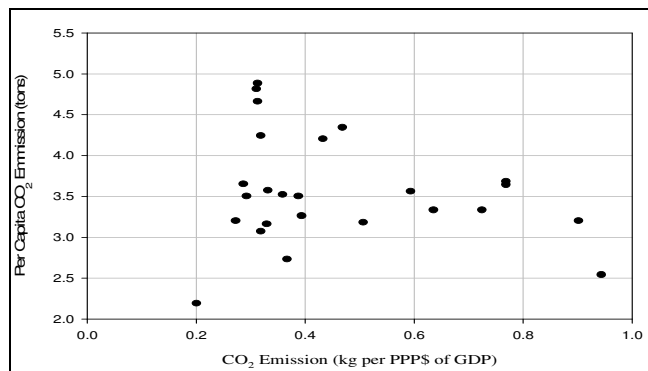

Fig. 6: Scattered plot of per capita CO$_2$ emission (tones) corresponding with CO$_2$ emission (kg per PPP $ of GDP) in Iraq.

Conclusions

Ratio of total CO$_2$ emissions was increased per last decade 1.8 times than same ratio for whole study period (5.4 Mt), this led to increased the effect of global warming by this ratio that increased for Iraq. The result showed that the economical growth of Iraq is highly correlated with the value of CO$_2$ emission, and the CO$_2$ emission is less effective factor than economic factor in Iraq and the relation between CO$_2$ emission and GDP is fitting softly over time in spite of some anomaly on the years (1991) and (2006). Per capita GDP also proportional with CO$_2$ emission but in general the Iraq country shows different behavior as compared with other rich or poor countries because of its fluctuated trend over time, and the result shows that the CO$_2$ emission per GDP having the higher effective value of CO$_2$ emissivity when the ratio was around (0.3), and we noted that when this value increasing 'either by increasing CO$_2$ or by decreasing GDP' then the CO$_2$ emission become lower.

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