# Influence of Population Growth on the Environment

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## Abstract

*In this paper, we will examine the impact of population growth on the environment, which has caused major concerns lately, living in a period of unparalleled population growth. An analysis of population evolution, temperature changes and carbon dioxide emissions per capita will be conducted over the last twenty-seven years. At the same time, two models of linear regression were made to determine the influence that the population has on the two indicators studied. Population growth has a significant influence on temperature change and carbon dioxide emissions. The paper ends with predictions, based on population data, on temperature and carbon emissions.*

**Key words:** population growth, environment, carbon dioxide emissions, temperature change, global warming
**J.E.L. classification:** Q54, Q56

## 1. Introduction

Exponential growth of the human population and food production can not continue forever on our planet (Ansell et al, 2018).

People and all living organisms rely on the basic resources found in the Earth's environment for their survival, and these resources are fertile, fresh water, energy and biodiversity (Pimentel et al, 1997).

Human activities change the environment in important ways, causing ever more severe damage to its components. Given the cumulative and irreversible nature of many of these processes, there is a real need to give greater priority to environmental concerns in development and economic policies (LeGrand, 2009).

People's views on the relationship between economic growth and environmental sustainability remain divided, population growth being considered incompatible with environmental objectives such as mitigating climate change, people being willing to prioritize environmental protection on economic growth in many European countries (Drews et al, 2019).

One of the consequences of the population's growing environmental impact is drought; it can be considered one of the natural hazards with the biggest disrupters affecting millions of people around the world each year and posing substantial challenges for the environment, the economy and society, more damaging natural disaster, due to its prolonged and extensive socio-economic impact (Ahmadalipour et al, 2019).

Another consequence of the influence of population growth on the environment is the carbon footprint. The relationship between everyday people's behavior, carbon emissions and global climate change is at the heart of understanding and tackling climate change. People are aware of the danger of climate change, but they are unable to understand and take action to combat them (Mulrow John et al, 2019).

Global warming and climate change are serious threats to sustainable development (Mufutau Opeyemi Bello et al, 2018).

Assessing the impact of human carbon emissions on the scientific environment has become a bigger and more important issue for us to reduce carbon emissions properly and to cope with global climate change. In order to clarify the serious consequences of carbon emissions for humans and their environment, the carbon footprint that quantifies the impact of carbon emissions from human energy consumption and regional development on the ecosystem at all spatial levels has been presented and widely recognized. Aligning global energy conservation and emission reduction efforts, rational assessment of global carbon footprint variation and distribution is essential to tackling climate change (Xing Li et al., 2019).

## 2. Literature review

Excessive use and abusive use of the physical resources of the environment has increased excessively due to the increase in human population. Population means more mouths to eat foods that require more agricultural production. Forest clearing has its own serious environmental effects as the population is growing and needs the availability of more consumer goods and more space to build homes. There is also a need for more transport, more fossil fuel consumption and more pollution of air, soil and water. Thus, population growth leads to pollution of air, soil and water. Different types of pollution cause a number of physical problems, which still affect the biological environment (Mittal et al, 2013).

Population growth and economic development contribute to many serious environmental problems including land pressure, soil degradation, forests, habitat destruction and loss of biodiversity, changing consumption patterns, increasing energy demand, air pollution, global warming and climate change and the deficit water and water pollution (Guria et al., 2015).

The impact of human activity is devastating for biodiversity, and urban growth pushes animals out of their habitats and becomes urbanized (Baus Doris, 2017).

The impact of population growth on economic development is a complex issue. Population growth, as one might imagine, has positive and negative effects on development (Walker J. R., 2012).

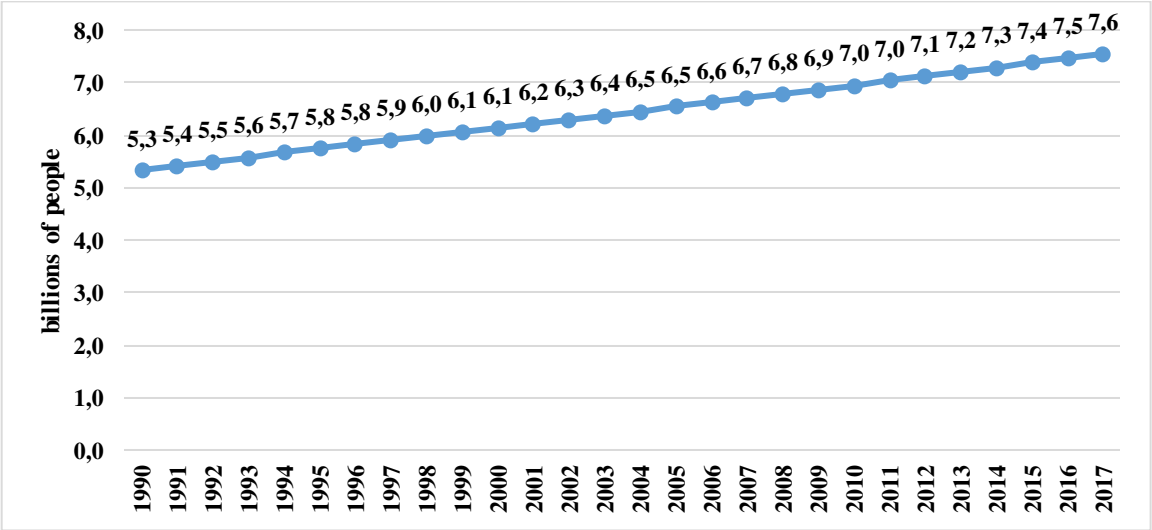
## 3. Material and method

In order to determine the impact that population growth has on the environment, quantitative and qualitative data, population change, temperature and carbon dioxide emissions per person have been analyzed from the world bases of data, respectively FAOSTAT and the World Bank. Following this analysis, to directly assess the impact of the demographic development on the two indicators, two linear regression models were developed to determine the equation between these variables and the correlation coefficients, this analysis being made using the program IBM SPSS Statistics 20.

## 4. Results and discussions

In order to analyze the impact of the population on the environment, it is desirable to analyze the statistical data over a longer period of time, so that the results are as conclusive as possible. Thus, the first part of the analysis will assess the current situation and population evolution, temperature changes and carbon dioxide emissions per capita.

*Figure no. 1. The evolution of the world population in 1990-2017*

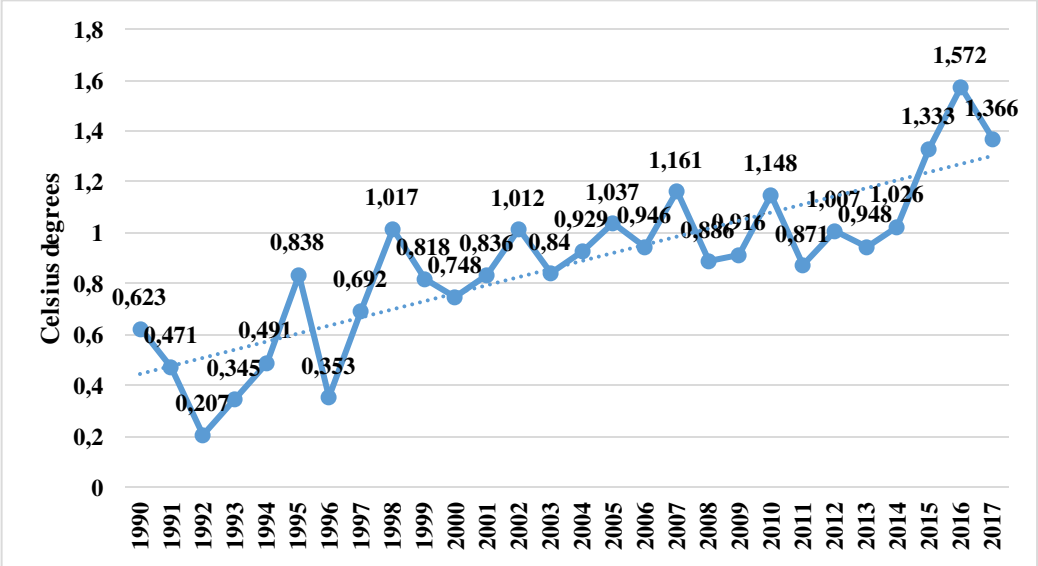



*Source*: own processing based on FAOSTAT data

As can be seen in Figure 1, and as is well known, the world's population has steadily grown over the past three decades. If in 1990 there were about 5.33 billion inhabitants, in 2017 they had reached the 7.5 billion (7.55 billion) threshold, which means an increase of 41.6%. On average, analyzing the annual growth rate, there is a population growth of about 1.3% each year.

As is well known, global warming is a very serious issue, for which solutions are still being sought and decisions are made to slow down this phenomenon. Global warming can be measured by the evolution of global temperature changes. One of the negative effects of global warming is the drought, which directly influences human activity through soil depreciation and, implicitly, agricultural crops, but not only.

*Figure no. 2. Evolution of temperature change*



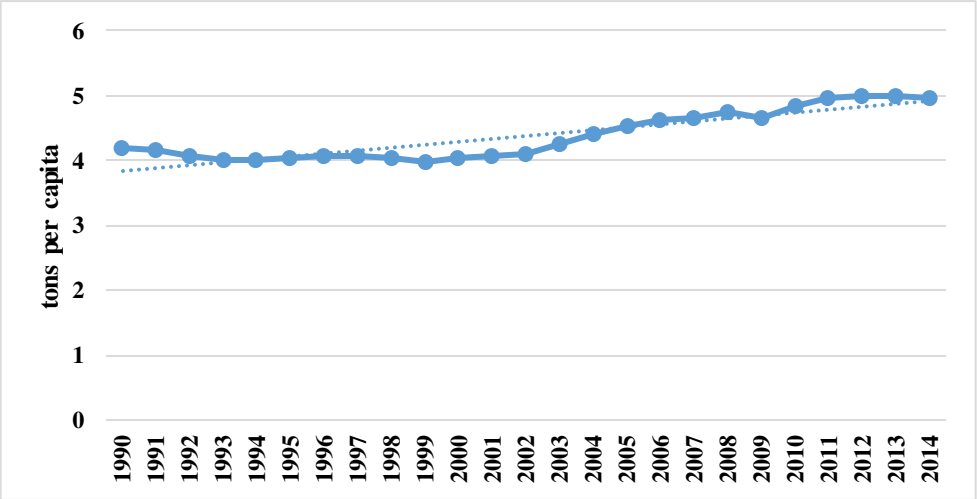

*Source*: own processing based on FAOSTAT data

According to the FAO specifications, the temperature change indicator contains data on observed mean surface temperature changes, while the data provides information on annual average temperature abnormalities over a reference period.

Figure 2 graphically represents the global temperature changes over the period 1990-2017, according to it, although the recorded data fluctuates from year to year and there is a general increase in these temperatures. In 1990, there was a temperature difference of 0.6 degrees Celsius, and in 2016 there was the highest difference of almost 1.6 degrees Celsius, decreasing in 2017 to 1.36 degrees Celsius. Thus, in 2016 there was a difference in temperature, more than 2.5 times the first year of analysis. Analyzing on average, each year, the temperature difference increased by about 3%.

Among the main effects of population growth is the increase in greenhouse gas emissions it produces, quantified in carbon dioxide emissions, being generically called carbon footprint. Figure 3 shows the carbon dioxide emissions of a single person globally, expressed in tonnes per capita, between 1990 and 2014.

*Figure no. 3. Evolution of carbon dioxide emissions per capita*

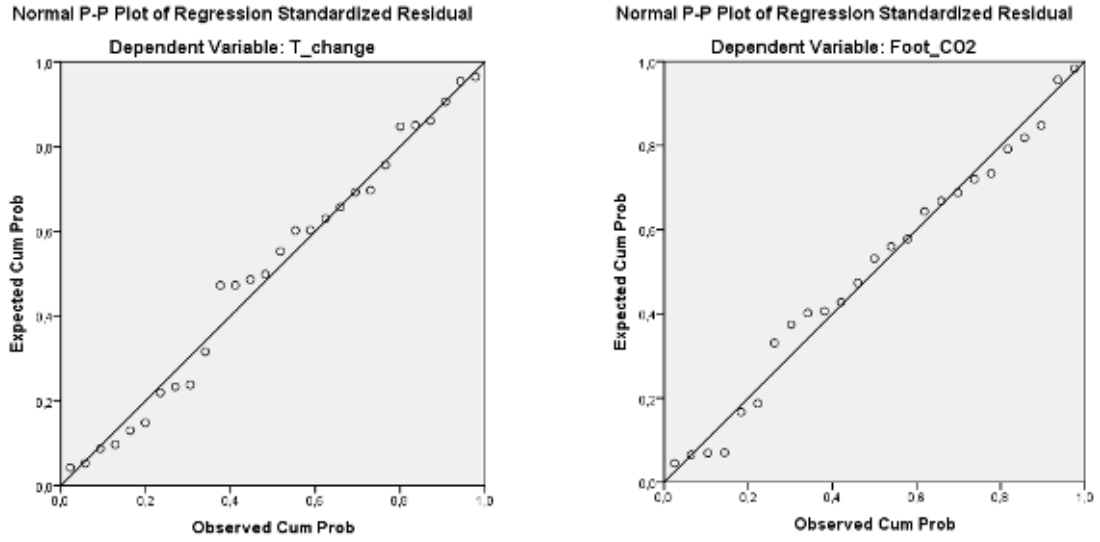



*Source*: own processing based on World Bank data

As can be seen in Figure 3, the amount of carbon dioxide emitted by one person increased during the analyzed period, which was easily anticipated given the continuing increase in population. In 1990, an average carbon footprint of 4.19 tonnes per capita was recorded, reaching about 5 tonnes per capita (4.97 tonnes / person) in 2014, with an increase between the ends of the range analyzed by 18.6%. On average, carbon footprint increased by 0.72% each year, rhythm being lower than population growth, so we can say that actions to slow down processes that have a negative impact on the environment are effective.

In order to determine concretely the influence of the population on the environment, an analysis of the impact of the population on the change of temperature and the amount of carbon dioxide with linear regression will be made; it will be possible to estimate these quantities in the next period, knowing that the world's population will exceed 9 billion in 2050.

*Figure no. 4. Correlation between population level and temperature changes (a), and between carbon footprint (b)*




**(a)** **(b)**

*Source*: regression model results (SPSS processing)

As can be seen in Figure 4, the graphical representation of the variables corresponds to the linear regression, given that the point cloud for the two variables analyzed make up the right equation. Thus, we can analyze the correlation coefficient between these variables and the function resulting from the regression model.

*Table no. 1 Influence of the population on temperature change and carbon dioxide emissions*

| Variable | Correlation coefficient (R) | Coefficient of regression function | Sig. |
|---|---|---|---|
| Temperature change | 0,835 | 0,390 | 0,000 |
| CO2 emissions per person | 0,895 | 0,564 | 0,000 |

*Source*: regression model results (SPSS processing)

The relationship between population level and temperature change is shown in Table 1, the correlation coefficient between these two variables is 0.835 which shows a close and positive relationship between the population level and temperature changes, so when the population grows, increases the temperature changes too. The linear regression model was able to determine its equation, namely how the dependent variable (change of temperature), independent (population) is influenced: y = 0.39x-1.634. Thus, as can be seen in the table, the population coefficient for correlation with temperature changes is 0.39, so if the population increases by one unit, the temperature change will increase by 0.39 units, therefore if the population increases with one billion, the temperature change will increase by about 0.4 degrees Celsius. The value of Sig. is 0.000, being less than 0.05, which means that the model is valid. The confidence interval for this model does not contain the value of 0, so again, the model is valid. The results are provided with a standard error of 0.05.

Analyzing the pattern of population regression and the amount of carbon dioxide emitted by each person, an even closer relationship can be observed, with a correlation coefficient of 0.895 being positive, indicating that these two variables are directly proportional, when the population increases, they also increase carbon dioxide emissions as expected. The linear equation that the model estimated, considering the population independent variable, and as a variable dependent on CO2 emissions, is: y = 0.564x + 0.818. Thus, if the population increased by one unit, carbon emissions would increase by 0.564 units, for example, if the population were to increase by one billion, there would be an increase in the amount of carbon dioxide emissions per person of 564 kilograms.

The model is validated on the one hand by the Sig value. (0.000), which is less than 0.05, and on the other hand that the value 0 is not included in the confidence interval values. The results are provided with a standard error of 0.059.

## 5. Conclusions

In this paper we wanted to analyze the impact of the population on the environment, namely on the change of temperature and carbon dioxide emissions. As is known, the world population is growing steadily, estimated to be 9.8 billion people in 2050. Although the analysis of the statistical data reveals that carbon dioxide emissions, but especially temperature changes, fluctuate from one year to the next, they show significant increases over the entire period.

The linear regression model analyzed the influence of population growth on these two dependent variables, so it was established that both temperature changes and carbon footprint are directly and closely related to population multiplication. If this rhythm of growth is maintained, based on the regression model equations, predictions can be made based on population data. Taking into account the figure above, if by 2050 there were 9.8 billion inhabitants, we could say that the climate change would rise to a difference of 2.19 degrees Celsius and the carbon emissions per person would be 6.35 tonnes per capita. With a population increase of about 30% from the current level, the temperature change will increase by 60% and the carbon dioxide emissions will increase by 28%.

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