

THE ECONOMIC CONSEQUENCES OF THE INCREASE OF THE WORLD OCEAN'S TEMPERATURE

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Abstract: Environmental pollution represents one of the problems that humanity is facing right now, problems that create a series of economic, ecologic and social consequences. This paper wishes to identify by presenting concrete data, some of the negative effects that occurred as a result of the increase of pollution on global scale, for example like the rise of global temperature. Starting with the industrial revolution but especially with the increase of the population's needs, desires, interests that occurred during the last decades, environmental pollution intensified to an extent that we could even consider alarming. A main effect which can be easily observed by each and every person without the need to perform measurements, is the climate warming which has a series of consequences, like for example: drought, natural disasters, decrease in agricultural production, fires (especially wildfires which reduce the population of wild animals), etc. So the effects of global warming are not just ecologic but also economic and social. Another aspect analyzed in this paper is the rise of the seas' and oceans' temperature which inevitably results in the decrease of the population of fish and aquatic animals. The melting of glaciers is another negative effect of the climate warming which is discussed in this paper, effect which is responsible for numerous floods that result from the rise of the sea levels causing numerous damages, the most affected people being those living in the vicinity of waters. During floods, phenomenon which occurs more and more often, drainage channels are overused many times not being able to handle the huge quantities of water, thus favoring the multiplication and spreading of rodents. There are evidences showing that the number of cases of diseases transmitted by rodents increases during natural disasters, which occur more and more often during the last decades.

Keywords: pollution, environmental degradation, climate changes.

JEL classification: Q54

Starting with the question „what is the connection between social theories and political practices”, John Barry (Barry, 2005:61) first of all defines the environment as the place where he will grow old, where his children and nephews will be born and raised continuing with an analysis of this environment in different stages: during his childhood, his teenage years, the present, and then ending it with a fantasy image about what his nephews and other future generations will see.

The most widespread problem caused by pollution is global warming. Global warming in our days is an intensely debated problem, and as a result two main theories are taking shape: in the first theory, analyzing the climate changes on a large scale, it is believed that the Earth is continually changing. Because the last completed stage of this change was the “ice age” it is normal for it to be followed by a period of warming like the one that we are currently in. The second theory claims that the responsibility for global warming belongs to humanity which affects the atmosphere and the entire environment with its extremely pollutant activities. We cannot say for sure which is the correct theory but we can say that our attention has been raised by the results of some measurements that show that the climate changes from the last 150 years have been just as intense as those that took place 10000 years ago (Farra, 2008:11-15).

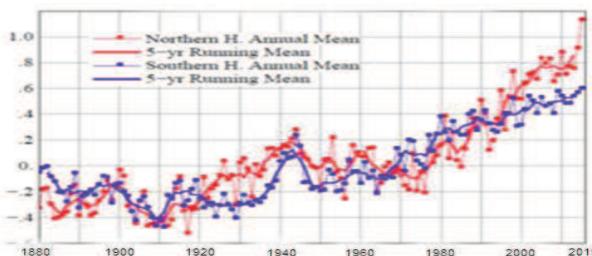


Figure 1: The Evolution of the Global Temperature Between 1880-2015

Source: Weart R. Spencer, *The Discovery of Global Warming*, published in the magazine created by the American Institute of Physics, Feb 2016, available online on the site <https://www.aip.org/history/climate/20ctrend.htm>, accessed on April the 13th, 2016

It is known that the mean annual temperature is rising continually. According to the latest data published by the National Climatic Center (www.ncdc.noaa.gov) in 2012, the temperature registered between January and July exceeded the average temperature of the last 100 years by 1.19 °C, and July of 2012 was the warmest July in the last 132 years.

Another effect of global warming is the rise of the oceans' temperature. The described climate models indicate that these will warm up before the atmosphere. In the past there were few measurements related to the evolution of the temperature of the oceans' waters but the information provided by the oceanographers show that between 1955-1995, between the surface of the ocean and a depths of 1.86 miles (3000 meters), there was a rise of 0.6 °C of the mean temperature of the waters of the Pacific Ocean, Atlantic Ocean and Indian Ocean in the North as well as in the South. This difference seems small but it is really not if we are to consider the fact that the oceans play a great role in capturing the solar radiations and the rise of the oceans' water temperature would result in the disappearance of some species of aquatic plants and animals (Marquita, 2010:188).

The first meteorological measurements took place in 1653, 53 years after the invention of the thermometer in the northern part of Italy, but only in the 19th

century the meteorological observations got to the point when they were performed with strictness in the entire world. In 1873 the International Meteorological Organization was established inspired by Buys Ballot's paper entitled "Suggestions on a Uniform System of Meteorological Observations", published in 1872. The successor of this organization was the World Meteorological Organization (WMO) which is performing its activities even in our days. The first researcher who observed the changes of the solar radiations and of the sunspots was Koppen between 1873-1881. Even if the original source of the data was a researcher called Dove, his data were insufficient and the results of his research were not conclusive. Koppen used the data collected from more than 100 meteorological stations located in different latitudes and altitudes in order to obtain as correct information as possible at a global level. Then he was followed by another researcher called Callendar who in 1938 published the results of observations performed with the help of 147 stations located all over the world. The results of his research contained data from the early 1800s till 1937. But the researches of Callendar did not stop there. In 1961 he published again the results of his research but this time he processed the data collected with the help of 600 meteorological stations located in different corners of the world (Solomon et al., 2010:11).

The one who continued the observations was a researcher of Russian origin Budyko, who in 1969 introduced a new method of analysis of the time series, based on a map that indicated the main observed anomalies. In addition to that, Budyko not only included in his research a higher number of stations throughout time (approximately 200), but he placed them in places that were never analyzed before that moment, respectively over the oceans.

The importance of ocean observations has increased significantly so in 2005 the organization named the International Comprehensive Ocean-Atmosphere Data Set – ICOADS was established, which is meant to collect, synthesize and transmit data provided by the meteorological stations as well as by the ship logs of merchant vessels. Regardless of the method that is used to observe the climate changes or the number of meteorological stations that are taken into account, the results of all the researchers were essentially the same, namely that: the climate is warming up!

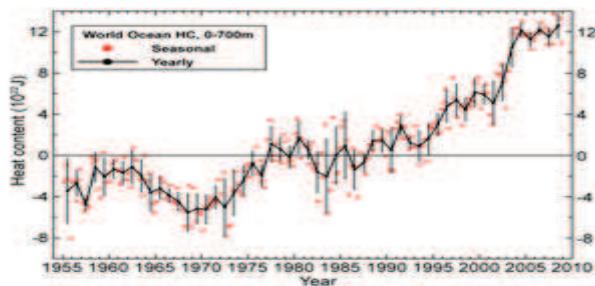


Figure 2: Global Upper Heat Content

Source: NOAA- National Center for Environmental Information. National Oceanic and Atmospheric Administration, available online on the site <http://www.ncdc.noaa.gov/indicators/>, accessed on April the 13th, 2016.

Compared to the mean temperature registered in the 20th century which was 15,8 °C, the mean temperature of the oceans registered between January – July 2012 has risen 0,62°C, that July becoming the forth hottest July from 1880 till the present day (⁶National Climatic Center, www.ncdc.noaa.gov). In the American state Alaska, the mean temperature has risen 3°C in the last 30 years, this increase being four times bigger than the average increase registered on global scale. This led to a melting of the glaciers of that area in a much faster pace than it had been anticipated. The research team made up of experts, professors and researchers of the University of Alaska, has performed a series of measurements. Their conclusion was that the melting of the glaciers in that area is happening faster than ever or anywhere before, contributing to the rise of the sea level of the Bering Sea with at least 9% of the increase registered in the 20th century (Marquita, 2010:196).

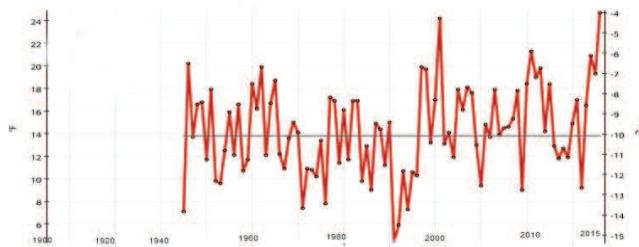


Figure 3: The Alaska's Temperature

Source: NOAA- National Center for Environmental Information. National Oceanic and Atmospheric Administration, available online on the site http://www.ncdc.noaa.gov/cag/time-series/us/50/0/tmax/ytd/3/1895-2016?base_prd=true&firstbaseyear=1901&lastbaseyear=2000, accessed on April the 13th, 2016.

As far as the melting of the glaciers of Antarctica is concerned, the latest scientific researches have shown that their sizes have decreased by approximately 42% within the last 100 years, which means that our planet is facing a series of serious ecological problems which affect the lives of the people as well as of the animals (Munasinghe, 2009:13). For example, the number of polar bears has decreased dramatically. For this reason in May 2008, the United States of America has made the decision to protect polar bears in accordance with the “Protection of Endangered Species Act”.

The measurements concerning the melting of the glaciers performed with the help of a satellite, have started 30 years ago. Since then, the artic region has lost more than 20% of its ice. This rate started to accelerate in 2002, to an extent that in the summer of 2007 the Canadian Northwest Passage became entirely navigable. More precisely, in 1850 in the northern part of Montana, Canada, there were 150 glaciers and by 2008 this number decreased to just 27 (Farra, 2008:11-15). Specialized studies have shown that if the annual melt rate of the glaciers is going to keep on rising, by the summer of 2030 Antarctica will be completely ice free.

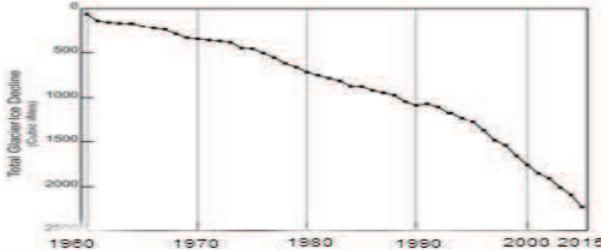


Figure 4: Total Glacier Decline

Source: NOAA- National Center for Environmental Information. National Oceanic and Atmospheric Administration, available online on the site <http://www.ncdc.noaa.gov/indicators/>, accessed on April the 13th, 2016

But not only the glaciers of Antarctica have started to melt but also the ones located on mountain peaks. For example, the Kalis Peru Quri glacier from Peru retreated 33 times faster between 1998 and 2000 than it did between 1963 and 1978. In Nepal and Bhutan many lakes located around glaciers are dangerously full. If their levels continue to rise, they will flood the nearby valleys causing numerous damages, the most affected people being those living in that area (Marquita, 2010:216).

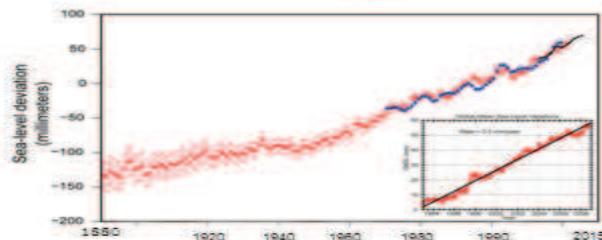


Figure 5: See Level Between 1880 and 2015

Source: NOAA- National Center for Environmental Information. National Oceanic and Atmospheric Administration, available online on the site <http://www.ncdc.noaa.gov/indicators/>, accessed on April the 13th, 2016

In July 2010, as we can observe in the diagram shown above, the melting rate of snow and glaciers was so high that it had only been exceeded the previous year. More precisely, another concerning phenomenon is the rise of the sea level. This accelerated increase rate has caused a rise of sea level with up to 20 cm within the last 100 years. The measurements performed with the satellite built for this purpose named “Jason”, have shown some of the negative consequences of this phenomenon, the most worrying of them being in Bangladesh where one billion people could end up homeless if the sea level rises by one meter (Marquita, 2010:196). Using numbers, we could say that within the last decade, the rise of the

sea level and the natural disasters have caused damages estimated to be over 608 billion dollars (Munasinghe, 2009:14).

Table 1: Environmental Changes Occurred in the Last Decades as a Result of the Excessive Pollution

Environmental Changes	Observed Changes	Analyzed Period	Analyzed Location
The size of the glacial lakes	The surface of the lakes increased by 0,23 km ² up to 1,65 km ²	1957-1997	Tsho Rolpa Lake Nepal, Himalaya
Floods caused by the glacial lakes	The frequency of floods rose by 0,38% per year till 1950 and by 0,54% per year till 1990	1934-1998	Nepal, Bhutan, Tibet
Decrease of the mountain snow	The decrease of the quantity of ice and snow in the mountains	1900-2000	Andes, Alps, Carpathians
Decrease of the areas designated for winter sports located at low altitudes	The decrease of the number of areas where winter sports can be practiced, due to the warming of the climate	1975-2002	New Hampshire, North-East of the United States of America
	The thinning of the snow layer at altitudes under 2200 m by almost 50%	1975-1999	Swiss Alps
	The thinning of the snow layer at altitudes under 1320 m by almost 50%	1960-2005	Chartreuse Mountains from the Alps
	The altitudes where the upper points of the ski lifts are located, have increased from 1400 m to 2935 m due to the lack of snow in the lower areas	1950-1987	The Andes
Decrease of the number of frosty days with snow	In the last 65 years spring started appearing 1-2 weeks earlier	2007	North America, Northern Eurasia
The level of carbon dioxide	The CO ₂ level rose by 25% compared to the pre-industrial period	1800-2007	The European Continent and USA
Decrease of the number of animals at the poles	Due to the retreat of the glaciers, it is very hard for polar bears to find food, which results in the decrease	1896-2007	Antarctica and Beaufort Sea

Environmental Changes	Observed Changes	Analyzed Period	Analyzed Location
	of their survival rates and the appearance of cannibalism among them		
The water levels	The river and lake levels have an annual increase rate of 5%	1935-1999	The Drainage Basin of the Arctic
	The water level in the glacier basin rose by 23%.	1998-2001	Yanamarey glacier river basin from Peru
	The water level in the glacier basin rose by 143%.	1953-1997	Lanqanuco glacier basin - Peru
	The water level in the glacier basin rose by 169%	2000-2004	Artesonraju-Cordillera Blanca glacier basin from Peru
Floods	The frequency of floods increased by almost 1% due to the massive ice melting and the heavy rains	2007	Rivers in Russia
Drought	Cases of droughts increased by over 29%	1847-1996	South Canada
Water temperature	The water temperature of the rivers and lakes increased by up to 1,5°C	The last 40 years	Europe, North America, Asia
	The water temperature of the rivers and lakes increased by 2°C - 7°C	The last 100 years	East Africa

Source: Table drawn up by the author based on the information provided by Solomon S., Quin D., Manning M., Chen Z., Marquis M., Averyt K. B., Tignor M., Miller H. L., *Climate Change 2007: The Physical Science Basis Contribution of Working Group I To The Fourth Assessment Report of The Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, New York, p. 88.

As a result of the rise of the temperature, the number of wildfires is higher every year. According to a report drawn up in order to measure the economic and social impact of the fires, published in 2007, only in the United States of America these fires have burned up over 1,6 million ares of pasture, destroyed 730 houses and damaged other 1320 buildings. The fires have caused the death of 19 people and over 10000 animals. According to the assessment performed for the report , the

damages have been estimated at over 628 million dollars (Clements B. et all., 2007:1-5) The first Forest Fire Prevention Service was established as expected, in the United States of America, the place where the highest pollution was encountered. Analyzing the reports drawn up by this service, our attention was drawn by a sentence which describes, maybe in the best possible way, the situation of the fires in our days, namely: "Currently, having fires burning up a surface of over 20000 ares a year is not uncommon at all" (New Jersey Forest Fire Services, 2006:7-8).

Just as the human body suffers because of the pollution, the bodies of the animals are affected just the same. The number of birds and animals is continually decreasing (Parry, M. L., et. all., 2010:396) due to the destruction of their natural habitats and to the increasing number of diseases which many times lead to their deaths. The climate changes are causing changes of the migratory behavior of certain bird species, showing an expansion towards the northern areas, just like the migratory phenomenon encountered among individuals due to the lower temperatures and food which can be found in larger quantities in those areas. Another aspect which can be observed with humans as well as with animals, is the decrease of the reproduction rate due mainly to the huge efforts which have to be made by humans or animals in order to adapt to the new conditions, efforts that have both physical and psychological consequences. Mosquitoes are also affected by the climate changes. Due to the rise of the temperatures and of the number of floods, their numbers are increasing which is not quite beneficial for humans because mosquitoes along with rodents, are the best carriers for diseases. During floods, phenomenon which occurs more and more often, drainage channels are overused many times not being able to handle the huge quantities of water, thus favoring the multiplication and spreading of rodents. There are evidences showing that the number of cases of diseases transmitted by rodents increases during natural disasters, which occur more and more often during the last decades. An example is the disease called leptospirosis which occurred in marginal urban areas in poor countries and hantavirus pulmonary syndrome (HPS) in Central America.¹⁶ Another example is the one offered by Lester Brown regarding the floods from the summer of 1998 which caused the Yangtze river to overflow. As a result of that disaster more than 120 million people have lost their homes (Brown, R. L., 2001:10).

Drought, another consequence of environmental degradation, in 1997 resulted in the appearance of several fires which burned up hundreds of kilometers of the tropical forests of Borneo and Sumatra having multiple economic, ecologic and social consequences.

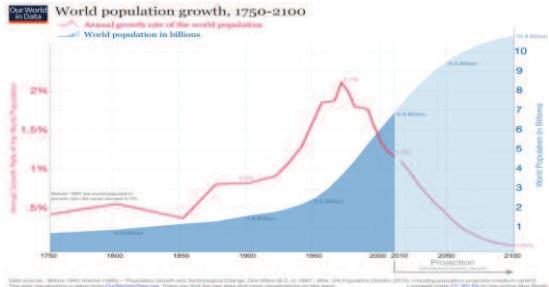


Figure 6: World population growth, 1750-2100

Source: *Our world in data*, Available [On-line] at <http://ourworldindata.org/gdp-growth-over-the-last-centuries/>, [22.04.2016]

In order to understand the relevance of these data it is absolutely necessary to interpret them from an economic approach. For this purpose the first variable which we wish to superpose over the increase of global temperature is the population. Statistics show an accelerated increase of the world population, but in the same time we have to consider the fact that as time goes by, the needs, desires and aspirations of the population are also increasing (Tont Daiana Maria, Tont Mihu Dan, Oradea Journal of Business and Economics, Volume I, Issues I, Published on 31 march 2016).

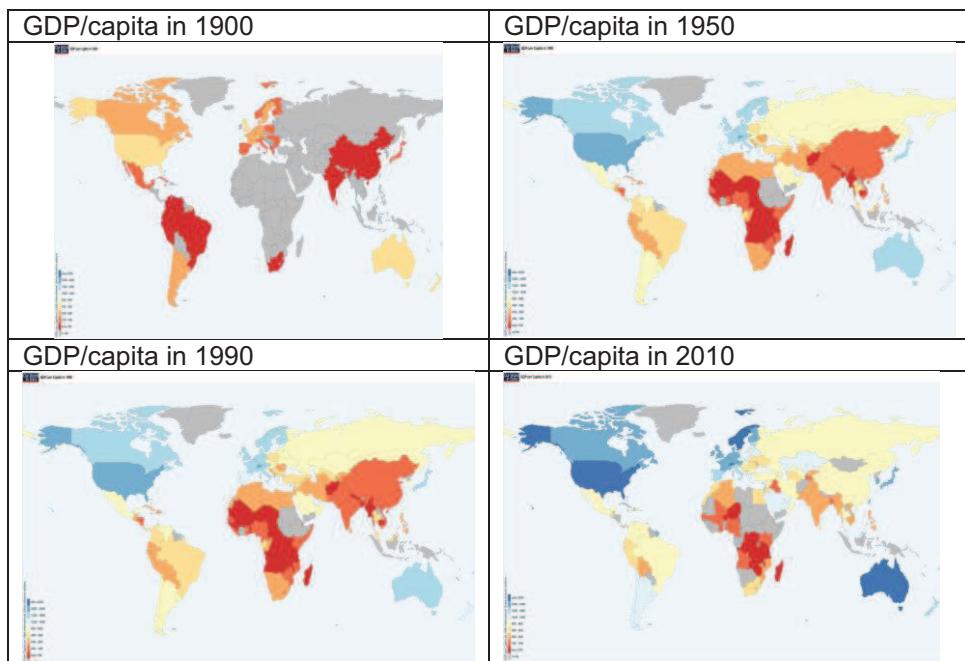


Figure 7: GDP per capita 1900-2010

Source: *Our world in data*, Available [On-line] at <http://ourworldindata.org/gdp-growth-over-the-last-centuries/>, [22.04.2016]

A person that lived on the Earth a hundred years ago had a different consumption structure. Besides the fact that today there are more people on Earth, they are also consuming much more than their ancestors, and in order for them to be able to consume more, the production has to increase using up more resources and generating bigger quantities of pollutant emissions. All this information confirms that the increase of the world population is directly proportional to the increase of the global temperature.

In conclusion we can say that all this information confirms that the increase of the world population is directly proportional to the increase of the global temperature. The same tendencies may be observed analyzing the evolution of GDP per capita in 1500, 1900, 1950, 1990, 2015. The ascending trend line is accompanied by the constant increase of global temperature, as it is used to satisfy the increasingly bigger and more complex consumption needs.

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