X INTERNATIONAL CONFERENCE

QUALITY SYSTEM CONDITION FOR SUCCESSFUL BUSINESS AND COMPETITIVENESS

PROCEEDINGS

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KOPAONIK, 18/05 -20/05/2022

ASSOCIATION FOR QUALITY AND STANDARDIZATION OF SERBIA

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CONTENTS

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CLIMATE CHANGE AND QUALITY OF LIFE

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Abstract: *In this century, humanity has faced numerous challenges such as the global financial crisis, a global pandemic, and wars. However, the challenge that has the most far-reaching consequences is climate change. The occurrence of extreme weather conditions such as hurricanes, floods, droughts, heat waves and other natural disasters is increasing and will become more frequent in the future. Climate change is causing rising sea levels, epidemics, wild fires, the destruction of the environment, the extinction of numerous plant and animal species, melting glaciers and many other effects. A large number of studies prove that climate change negatively affects economic growth and the Quality of Life. The most sensitive and vulnerable sectors are agriculture, water, energy, tourism and transport. Climate change greatly affects the general well-being, and especially the Quality of Life and living standards of people. Using the Eurostat methodology on the Quality of Life indicators (Financial and Material Living Conditions, Employment, Health, Education, Leisure and Social Activities, Economic and Physical Safety, Governance and Basic Human Rights, as well as, the Natural and Living Environment),this research shows that climate change negatively affects all of them to a greater or lesser extent.*

Keywords:*Climate Change, Quality of Life,Well-being, Standard of Living*

JEL classification:*F64, I30*

1. INTRODUCTORY REMARKS ABOUT CLIMATE CHANGE

Climate change is one of the greatest global challenges. However, a common misconception is that climate change has only recently become recognized. The greenhouse effect was first described by the French mathematician and physicist *Jean-Baptiste Joseph Fourier* in 1824 (Abramović et al., 2016). At the end of the 19th century, the Swedish Nobel Prize winner Svante Arrhenius (*Svante August Arrhenius*) published the paper "On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground", in which he investigated the connection between rising temperatures and rising carbon concentrations (Arrhenius, 1896). In the late 1930s, the British engineer *Guy Stewart Callendar* in his work "The artificial production of carbon dioxide and its influence on temperature" showed that the excessive combustion of fossil fuels had begun to affect the climate (Callendar, 1938).

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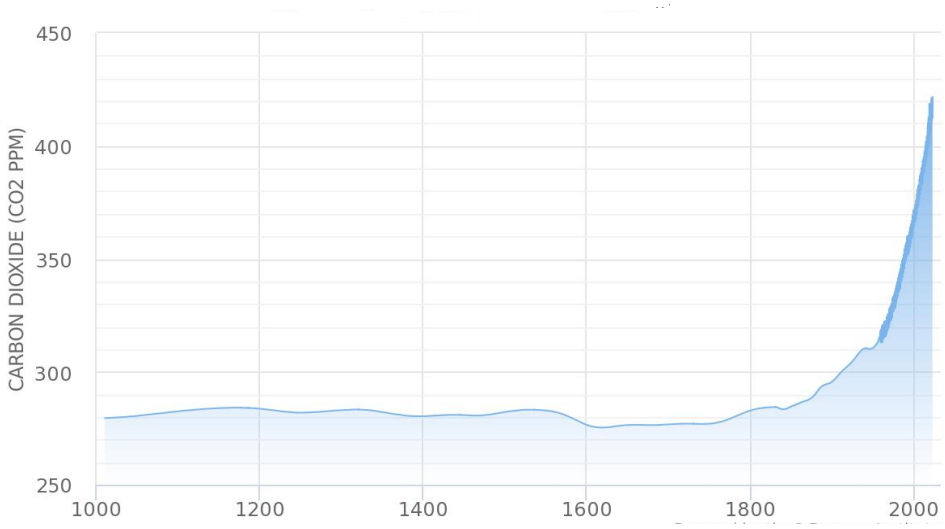
The fact that global warming is leading to climate change is becoming more visible. Extreme weather conditions, such as hurricanes, floods, droughts, and heat waves are much more prominent and with more damaging and further increasesto come in the future. They cause changes in sea levels, epidemics, the destruction of the environment and impact on biodiversity, create enormous wild fires, leading to significant economic damage and the loss of human lives. Currently, more than half of the world's population lives in cities, and it is estimated that two thirds will live in them by the end of 2050 and these cities produce more than 70% of greenhouse gases and consume 80% of the energy produced (UNDP, 2019).

Since the 1980s, the number of extreme weather events has more than tripled (Munich Reinsurance Company, 2018). The number of catastrophic events caused by natural disasters increased from 249 in 1980 to 820 in 2019 (Lagarde, 2020). Since the beginning of the 20th century, the global mean sea level has risen by 17-21 cm, and without action to limit global warming, sea levels will rise by another 80 cm before the end of this century (IMF, 2018). This could lead to the flooding of a large number of coastal cities, and even to the disappearance of some island states.

Global temperatures have reached unprecedented levels in the last half century. If the Earth continues to warm with the current intensity, estimates are that by the end of this century, the average temperature could increase by about 3.5 degrees Celsius. Estimates indicate that a relatively safe limit would be 1.5 degrees Celsius, and the upper acceptable limit would be 2 degrees. Even if we met all the existing international agreements and we have not, then the level of growth would still be 2.8 degrees, which is far from a safe level.

In the past, the climate of our planet changed because of natural factors such as solar activity, large volcanic eruptions, asteroid strikes and the like. However, since the growth in the population and the development of heavy industry, the situation has changed and human activity has taken precedence. The conclusions of the Intergovernmental Panel on Climate Change (2014),demonstrated that more than half of the increase in temperature after 1950 was a direct result of human activities. In addition, all indications are that further growth in global warming will largely depend on our ability to limit greenhouse gas emissions, which is a key source of this problem. In the last 140 years, the concentration of carbon dioxide in the atmosphere has increased by 43% (Milović, 2021), which is best shown in the following graph.



Graph 1 - Concentration of carbon dioxide in the atmosphere from 1010 to 2022
Source: CO_2 levels.org (2022) "Global CO_2 levels" retrived from https://www.co2levels.org/.

Even if there were now drastic reductions in greenhouse gas emissions, we would suffer from the effects of past emissions for many years to come (CCA forum, 2012).

The devastating effects of climate change are now globally recognized and there are a number of international initiatives aimed at limiting their impact, such as the United Nations Framework

Convention on Climate Change, the Vienna Convention for the Protection of the Ozone Layer, the Kyoto Protocol, the Montreal Protocol, the Paris Agreement and many others. However, despite all these initiatives, the results achieved so far in the fight against climate change remain unsatisfactory and a growing number of studies and scientists warn that an even greater acceleration of climate change will occur in the future.

2. THE IMPACT OF CLIMATE CHANGE ON ECONOMIC ACTIVITIES AND WELL-BEING

Climate change could have a major impact on limiting growth potential in the future by reducing labour productivity, and shifting resources away from productive investment to adapting to climate change (Fabris, 2021). An OECD estimate (2015) indicates that the consequences of climate change will have an increasingly negative impact on annual GDP, from up to 3.3% by 2060 to 12% by 2100. It also forecasts that developing countries will be the hardest hit, due to their more limited capacity to adapt to the changing climate.

Climate change affects economic well-being in many ways: by reducing agricultural yields, reducing the productivity of workers exposed to high temperatures, increasing health system costs, physically destroying capital through fires, floods and rising sea levels, biodiversity loss and so on. It also endangers macroeconomic and fiscal stability through the destruction of infrastructure, the increase in funds required for subsidies to the economy and social welfare, which all affect economic growth, employment, inflation, as well as public debt and the cost of financing it. In addition, all of this can lead to a significant increase in the prices of essential products such as food and water and important services like insurance among others (Fabris, 2021a).

Different industries and economic sectors have different degrees of sensitivity to climate change. The worst affected would be agriculture, tourism, energy, transport, as well as those branches based on fossil fuels due to the expected tightening of standards and the introduction of carbon taxes. The following table shows the potential impact of climate change on different sectors.

Table 1 - Impact of climate change on observed sectors

Sector	Economic impact
Agriculture	- Reduced yields - Loss of agricultural land - Accelerated development of pests and plant diseases
Fishery	- Lower fish catches
Health	- Increased medical expenses
Energy and industry	- Carbon taxes - Closing plants with large CO_2 emissions - Change in the structure of energy generation (green energy growth) - Influence of droughts on the operation of hydropower plants
Tourism	- Change in tourism flows -Total or partial endangerment of certain traditional tourist destinations due to insufficient snow or rising sea levels
Public sector	- Increased costs of investment in damaged infrastructure - Growth in subsidies to the economy - Growing social welfare expenses - Increased costs in order to adapt to climate change
Construction	- New standards aimed at increasing resilience to negative effects of climate change - Hazardous working conditions at elevated temperatures
Financial sector	- Increase in bad loans and write-offs

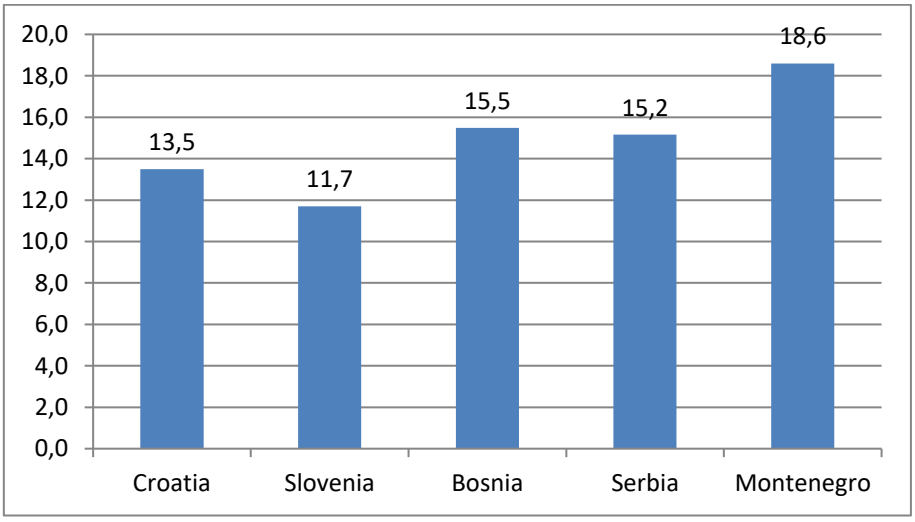
Sector	Economic impact
	- Growth in insurance premiums - Loss of value of individual financial instruments
Water supply	- Reducing water potential - Mixing sea water with fresh river water - Reducing the availability of drinking water
All sectors	- Capital losses due to floods and other weather-related disasters

Source: Modified fromFabris, N. (2021) Makroekonomski model razvoja Crne Gore: izazovi, zablude i ostvarenja, Podgorica, Centralna Banka Crne Gore.

A study by the OECD (2015) found that of 25 regions analyzed, 23 would suffer economic damage. However, the level of economic damage will vary from country to country and will largely depend on how much individual countries are affected by climate change. It also depends on how much they will be able to adapt to it through building protection systems, adapting production, consumer behavior and changes in international trade flows.

The largest producers of carbon dioxide are China, USA, India, Brazil and Russia. The countries from the region, although not significant producers of greenhouse gases, are among the areas that will be seriously affected by climate change. According to the IV report of the Intergovernmental Panel on Climate Change, Europe, as a region, is vulnerable to climate change, and the most affected parts would be the Iberian Peninsula, Northwestern Russia, the Baltic region and Southeast Europe. The UNDP, for example, estimates that countries in the region will face lower agricultural yields of between 10% and 30% because of climate change (Abramović et al., 2016).

Starting from the assumption that agriculture, water management, transport, tourism and energy are the sectors most endangered by climate change, we calculated the share of these "vulnerable sectors" in the GDP of the countries of the former Yugoslavia.[3] The latest available data on GDP, data for 2020, were used for the calculation.



Graph 2 - Share in GDP of climate change sensitive sectors (in%)

Note: The level of participation is actually higher because this uses data for 2020, when due to the pandemic the share of tourism was significantly lower than its long-term trend.

[3]The calculation did not include Macedonia, due to the different presentation of its GDP structure, which is not comparable with other countries.

3. THE IMPACT OF CLIMATE CHANGE ON QUALITY OF LIFE

Quality of life is a phenomenon that throughout its long history, and especially in recent times, has greatly changed in both form and meaning. It largely depends on the internal and external context, and especially on the level of development of the social community in which people live and work. In the last few decades, the indicators of Quality of Life have been more precisely identified as the basis for determining the level of each community. Bearing in mind that improving the Quality of Life is the goal of every individual and every society, this means the inclusion of a number of influential factors, and the full involvement of all stakeholders. From a research point of view, the Quality of Life is a very challenging and demanding interdisciplinary field, multi-layered, multidimensional and complex, containing numerous and specific sociological, economic, cultural and other influences (Luburić and Fabris, 2019).

The World Health Organization defines Quality of Life "as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns"(WHO, 2012). According to the Encyclopedia Britannica (2021), the main determinants of Quality of Life are the health of the individual, the comfort of life and the ability to participate and enjoy life events.

Measuring the Quality of lifeis possiblethrough various economic and non-economic factors, and relies on indicators of material living standards, as well as other various subjective factors influencing human life. The Quality of Life includes a range of influences that affect what people value in life, beyond the purely material aspects. As the Quality of Life is a multi-layered and multidimensional concept, Eurostat (2015) has designed and developed a set of eight basic indicators that make up the Quality of Life and overall satisfaction. These are Financial and Material Living Conditions, Employment, Health, Education, Leisure and Social Activities, Economic and Physical Safety, Governance and Basic Human Rights, as well as, the Natural and Living Environment (Eurostat, 2015).

Starting from the Eurostat indicators, we created the following table and outlined the impact of climate change on the Quality of Life. According to the estimated impact of climate change, we divided the Quality of Life factors into those on which climate change has a greater impact and those on which its effects are less.

Table 2 - The impact of climate change on Quality of Life

Quality of Life Indicators	The Impact of Climate Change
Greater Impact	
Financial and Material Living Conditions	Loss of jobs, reduction in income, destruction or reduction in the value of physical and financial assets, reduction in yields of agriculture, reduction in fish catches, increase in prices of certain products, and others.
Employment	Loss of jobs due to physical destruction and reduced activity resulting from increased costs and the like.
Health	Increasing number of heart attacks and strokes, mental health problems, suicides, vector-borne infectious diseases, the emergence of new diseases and the spread of existing diseases into areas not previously recorded, reduction in the available amount of drinking water and food, and the like.
Economic and Physical Safety	Loss of human lives, destruction of property, destruction of transport infrastructure, loss of jobs, reduction of general welfare, migration and others.

Quality of Life Indicators	The Impact of Climate Change
Natural and Living Environment	Extinction of numerous plant and animal species, soil erosion and habitat destruction, melting of glaciers, rising sea levels, more frequent wild fires and natural disasters.
Less Impact	
Leisure and Social Activities	Redirecting parts of free time to taking preventive action in the fight against climate change and overcoming its consequences, the destruction of physical infrastructure important for social activities and the like.
Education	Destruction of the physical infrastructure of educational facilities resulting from natural disasters and the resulting temporary suspension of educational institutions, and the like.
Governance and Basic Human Rights	Declarations of a State of Emergency and obligatory evacuations in cases of natural disasters, and the like.

As can be seen from the previous table, climate change affects all the determinants of Quality of Life, and this impact is somewhere greater on some and somewhere less on others.[4]Climate change can significantly affect the deterioration of material and financial conditions by destroying assets, reducing the income of organizations, increasing unemployment, reducing the volume of activities in many sectors, increasing fiscal expenditure for climate change adaptations and affecting other areas.

The negative impact of climate change on employment is also evident, in the reduction in the volume of activities of organizations, as well as a fall in the number of employees. This leads to an increase in the costs of activities, the physical destruction of organizations, a decline in the available space for sectors such as agriculture and tourism.

The "Father of Medicine", the ancient Greek physician Hippocrates (Ἱπποκράτης), long ago pointed out that meteorological conditions affect health. The impact of climate change on health will be reflected in the increase in diseases, deaths, increases in medical costs, and the loss of working hours due to absences for inpatient and outpatient treatment, the emergence of new and atypical diseases for certain regions and the like. Extreme heat, sudden changes in temperature, poor air quality, as well as stress due to extreme weather conditions have a particularly negative effect on health. The risk of an increase in the number of heart attacks and strokes, suicides, mental problems, asthma, allergies, as well as some vector-borne infectious diseases is particularly pronounced. Higher temperatures combined with favorable weather conditions can prolong the season of certain infectious diseases. The most vulnerable sections of the population will have greater health risks from climate change, such as the elderly, children, the chronically ill, homeless people and outdoor laborers.

Economic and personal security is under threat in various ways. Extreme weather disasters lead to human deaths, the destruction of property, migration, a feeling of general insecurity and helplessness in the face of these disasters. Natural disasters destroy the traffic infrastructure and prevent the normal free movement of people. The previous chapter explained how climate change is having a destructive effect on the economy. This, in turn, leads to declining general well-being, falls in income and job losses, all of which ultimately lead to declining living standards.

Climate change has a major impact on the environment. Floods, fires, soil erosion and other disasters lead to the destruction of the natural habitats of a large number of plant and animal species. Global warming leads to melting glaciers, rising world sea levels and changes in average sea temperatures, which on the one hand endangers many coastal cities, and on the other changes living conditions and

[4] The authors do not claim to list all the effects of climate change on the Quality of Life, just to list the key ones.

leads to the extinction of certain species. Estimates indicate that if climate change continues at this rate, all coral reefs will disappear by the end of the century. The growth of carbonic acid in the oceans and seas affects the living world in a similar way and negatively impacts on fisheries, an economic sector that is very important in a number of countries. Due to excessive heat, certain parts of some countries will become barren, dry, and unfit for life. Reduced rainfall will lead to less water in rivers, which on the one hand will reduce the possibilities for irrigation in agriculture, and on the other will lead to a reduction in water availability in general. Similar reductions in snowfall will endanger a large number of winter tourist centers and the local economies.

Climate change has less of an impact on leisure and social activities. This impact comes in the form of redirecting part of free time to preventive action to mitigate and remedy the consequences of climate change. The risk of destruction of physical infrastructure important for social activities (e.g. playing fields) increases, as well as the inability to perform certain social activities because of extreme weather conditions and the like.

When it comes to education, climate change can have a smaller, primarily indirect effect. Primarily, it can manifest itself in the destruction of educational infrastructure through extreme weather conditions such as hurricanes, floods and the like. In addition, these extreme weather conditions can lead to temporary interruptions in the work of educational institutions.

In terms of respect for basic human rights and freedoms, the effects of climate change are also relatively limited and they can primarily manifest themselves in declarations of a State of Emergency (which restricts certain freedoms), forced or voluntary evacuations and so on.

Climate change is already seriously affecting all the key indicators of the Quality of Life, and what is worrying is that with its expected acceleration, this impact will be even greater. Therefore, preventive measures focused on minimizing the negative effects of climate change and finding timely and adequate ways to adapt to them are of crucial importance.

4. CONCLUSION

Climate change is more and more apparent and its consequences are multiplying. This leads to natural disasters, the destruction of the environment, increasing threats to health, loss of general well-being, and the reduced availability of food and water. All current estimates indicate that climate change will continue to accelerate in the future.

Although the countries of the region are not significant producers of greenhouse gases, they belong to the group of countries endangered by climate change. The analysis showed that in the structure of GDP, the branches that are the most sensitive to climate change in 2020 created between 11.7% and 18.6% of GDP. This level would have been even higher if the global pandemic during 2020 had not forced a significant decline in the field of tourism.

The paper analyzes the impact of climate change on Quality of Life indicators. The analysis used Eurostat methodology based on eight indicators andclimate change negatively affects all of them.The key question is how to take preventive action to minimize the risks of climate change. Two directions of action are necessary, one related to slowing down climate change and the other related to adapting to it. Before this, of course, it is essential to understand and know the causes and consequences of climate change and raise the level of social awareness and fully respect international agreements.In order to slow down climate change, it is important to use renewable energy sources as much as possible, to limit the burning of fossil fuels, to preserve the existing forests, and to use land and produce food in a more sustainable way, including a reduction in the share of livestock in the diet. It is also necessary to abandon all technologies that use coal and have high CO_2 emissions, and to increase the level of energy efficiency in both industries and households.

Another important direction of action is to adapt to climate change and that involves finding ways to reduce the vulnerability of natural systems and human communities. These include employing various measures such as the cultivation of drought-resistant varieties of crops, the construction of flood

protection systems, the development of improved water treatment plants, the improvement of artificial snow systems in winter tourist centers, and the development of early warning systems for extreme weather events and others.

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