Applying Risk Management to Mitigate the Consequences of Climate Change

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Major climate changes have determined the increasing of disasters frequency, attracting the attention of international community to sometimes irreparable consequences, on the entire world. Institutions, governmental and non-governmental organizations worldwide have modified their approach regarding disasters, trying to identify methods to prevent and reduce their impact on the environment and humanity. This means identifying of new instruments for risk assessment, in order to lead to disaster prevention, by involving all stakeholders interested in disaster risk management activities (public authorities, non-governmental organizations, communities, business sector). It is noteworthy that the attitude of contemporary society to climate change has modified: thus, the allocation of material and human resources for preventing and mitigation the effects of disasters have been greatly increased.

Keywords: risk management, climate change, disasters, hazard, improvement measures

Climate changes, the consequence of global warming, represent phenomena that international scientific world recognizes, observations, data analysis over long periods of time being carried out on them. In connection with these, it is appreciated that the main factors are the natural ones (variations in solar radiation and volcanic activity) and also the changes in the composition of the atmosphere, consequence of human activities. These conjugate elements can explain changes in global average temperature over the last 150 years.

Forecasts carried out with different climatic models reveal an increase in global average temperature by 1.8-4 degrees Celsius, by the end of the 21st century (2090-2099) compared to 1980-1990. It is believed that the possibility of precipitations becoming even more abundant at high latitudes is great, as it is also *probable* they to diminish in most of the subtropical regions. It is also *very probable* that the trend of increasing the extreme maximum temperatures values and of increasing the frequency of heat waves to continue.

The first action to combat the phenomenon took place in 1992 in Rio de Janeiro by signing the United Nations framework Convention on Climate Change, ratified in our country by Law no. 24/1994, whereby the 194 signatory states agreed to act on long-term in order to stabilize the concentration of greenhouse gases in the atmosphere at a level that would prevent the dangerous influence of human on the climate system.

An example of global warming is the one offered by NASA GISS's, so the last January 2017 month's temperature was 0.20 degrees Celsius cooler than the warmest January in 2016. However, it was 0.92 degrees Celsius warmer than the average January temperature from 1951-1980. Two of the three January temperature anomalies have been in the past two years. 2016 was the hottest on record, at 1.12 degrees Celsius warmer than the January average temperature, followed by 2007 at 0.96 degrees Celsius warmer. January 2017 placed third.

The GISS team's monthly analysis is assembled from publicly available data from around 6,300 meteorological stations around the world, ship-and-buoy-based instruments measuring sea surface temperature and Antarctic research stations [1].

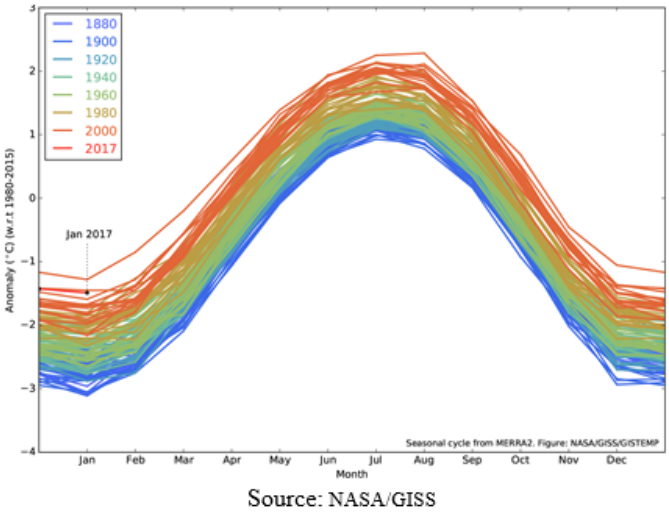

Fig.1 The GISTEMP monthly temperature anomalies superimposed on a 1980-2015 mean seasonal cycle

Climate changes, according to specialists, represents a possible irreversible threat for entire planet, therefore, the adoption of measures to reducing greenhouse gas emissions, which take into consideration respecting the objectives and principles of the United Nations framework Convention on Climate Change and of the Kyoto Protocol, is a fundamental component of national policy on climate changes domain.

Experimental part

The process of risks management

In order to understand this modern concept, of risks management, its defining and explaining it is necessary first in preventing and mitigating of climate changes.

Thus, risks management includes *all processes regarding risks identifying, evaluating assessing, setting responsibilities, taking measures of mitigation or anticipation of them, periodic review, and progress monitoring* [2].

The risk is any element that has a measurable probability to deviate from the plan. This, of course, suppose the existence of a plan. Strategies, plans and programs are

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elements that allow the prefiguration of reality and then the confrontation of concrete achievements with the expected results. In order to achieve the objectives set, it is necessary to develop some sets of activities. An activity, labeled (a), may be considered a risk element if the following two conditions are simultaneously met:

$$0 < P(a) < 1 \quad (1)$$

$$L(a) = 0 \quad (2)$$

where:

P(a) = probability of an event (a) to occurr

E(a) = the effect of the event (a) on the objectives

L(a) = monetary evaluation of E(a)

Risk management is a cyclical process, with several distinct *phases*: risk identification, risk analysis and reaction to risk.

During the risk identification phase, the potential hazards, the effects and probabilities of their occurrence are assessed, in order to decide which of the risks must be prevented. Practically, at this stage, all elements that satisfy conditions (1) and (2) are identified.

Also, the inconsistent risks are eliminated, meaning those risk elements with reduced probability of occurrence or with an insignificant effect. This means that those elements for which P (a) or L (a) tend to zero can be neglected.

Thus, according to the definition established in the domain, the risk can be defined as *a problem (situation, event, etc.) that has not yet occurred, but which may occur in the future, in which case the obtaining of previously results set is threatened or potentiated. In the first situation, the risk represents a threat, and in the second situation, the risk represents an opportunity. The risk represents the uncertainty in achieving the desired results and should be seen as a combination of probability and impact* [3].

To identify the risks related to climate changes, it is necessary to identify and inventory the activities that take place at the level of an entity, geographical area, economic branch, generally wherever there is an intervention that may have consequences.

There are several stages in identifying risks:

-inventory of activities (which requires a good knowledge of the domain under consideration);

-association of one or more risks for each activity;

-quantification of risks based on the two indicators: impact and probability;

-risk ranking: high, medium, low;

-risk analysis, especially those with high values.

For the preliminary evaluation of probability and impact, a scale with 3 levels will be used:

High	3 = major impact
Medium	2 = moderate impact
Low	1 = minor impact

High	3 = clear presence
Medium	2 = possible presence
Low	1=improb presence

PT = P x I where: PT = total risk score P = probability; I = impact [4], the matrix between two factors results the total of risk

In this context, based on the risk analysis carried out regarding the climate changes occurred, the identification of major risks has been realized:

Risks

-the earth globe is warming up, influencing the climate change,

-increasing global average temperature becomes dangerous and the major consequences are for our society and economies;

-the consequences of climate changes are: increasing average temperatures at global level, increasing the sea level, diminishing glacial calotte and the visible increasing in the frequency of extreme weather phenomena;

-according to studies, climate changes generate costs for every inhabitant of the globe at a level of about 14% of average consumption;

-climate changes are considered by many experts in the domain as the main threat for global stability and security;

-In Europe, is already observed an increase in the level and intensity of precipitation, waves of heat with a growing frequency and duration and the aggravation of the drought in southern Europe. At the same time, in central and northern Europe can be observed increasing precipitations, leading to intense flooding on the watercourses and the coastal area. Extreme weather events are increasingly related to climate changes [5].

Causes: The main responsibles for greenhouse gas emissions are people.

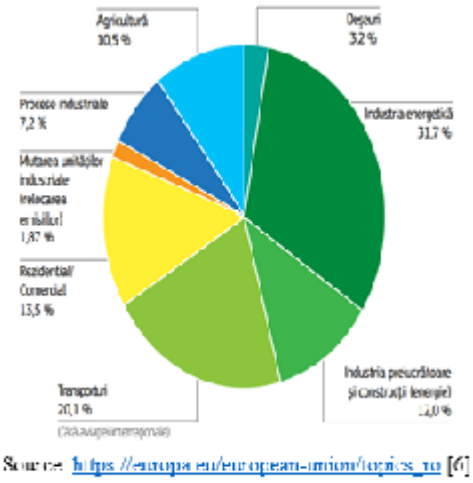


Fig.2 Total greenhouse gas emissions from the 28 EU Member States, in 2012

Source: https://europa.eu/european-union/topics_ro [6]

The possibility of an ante factum determination of potential major risks, in our situation, those referring to climate changes with the help of risk management, can help to preventing their production, through measures designed to mitigate or even eliminate the devastating effects of factors leading to climate changes at Earth level.

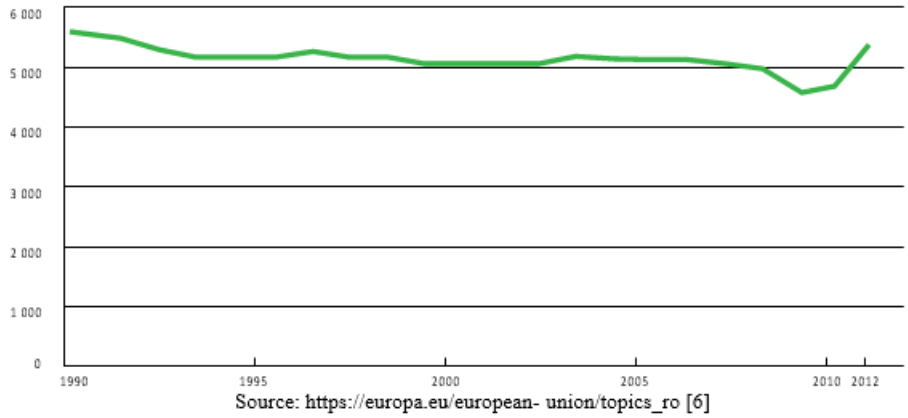
The stages of preventing risk

The response to risk involves a series of four steps: prevention, preparation, reaction and recovery from the occurrence of an event with major effects.

Prevention represents those activities designed to reduce the probability of occurrence of the risk events or the estimated negative effects. Here can be included the prevention of natural hazards through decisions and actions taken by authorities as a result of major events, in order to prevent their recurrence.

Preparation for an event with negative impact includes those actions taken before the impact, including plans of intervention in case of necessity. Natural risks [7].

Kreps (1991) distinguishes eight major principles that underlie an efficient management of crisis situations:



Source: https://europa.eu/european- union/topics_ro [6]

Fig.3 Total greenhouse gas emissions from the 28 EU Member States, excluding land use, land use change and forestry (in millions of tonnes)

- activities of preparing in order to prevent a disaster must be doubled by a high elasticity and capacity of improvisation, due to the multiple aspects of a stage of crisis, impossible to anticipate;

- preparing society to face natural disasters represents a continuous process;

- effective and continuous training determines reduction of unknowns in real situations case, by practicing multiple scenarios;

- preparing society to face disasters is also an educational activity in which everyone must know exactly its role and attributions;

- an effective training is based on scientific knowledge and specialty studies on the evolution of events and the human reaction;

- preparation involves a rapid action, in which the speed of response becomes a critical element in the effectiveness of the reaction;

- overcoming inertia by the local authority is to give time and attention to measures of preparation in case of disaster. Most of the time, it is erroneously assumed that routine procedures are sufficient to meet the requirements in situations of necessity;

- an emergency general plan, that provides flexibility in action and decision, is sufficient for events with low probability.

The reaction includes the measures taken during the initial impact and is mainly resumed at rescue actions for victims and goods.

The restoration refers to the activities that follow the actual impact, for the reinstatement of the normality of the collective life [8].

Results and discussions

Mitigating the climate changes as a result of risk analysis

- Besides the obvious benefits, of avoiding instability, insecurity and rising costs of climate changes, there are the economic and strategic benefits, but also major social benefits that may result from ambitious measures to reduce emissions of greenhouse gases.

- Applying on the global market of measures in the domains of green goods and services has led to low carbon emissions reaching over 4,000 billion euro and is in a continuous increasing with over 4% per year. These aspects turn it into one of the most dynamic and prosperous sectors globally.

- Ambitious measures in the domain of climate changes can assure a first place to Europe in terms of benefits obtained from this growing demand for green goods and services and with low content in carbon dioxide, at global level.

- Also, they will provide Europe with an advantage regarding innovation and development of cutting-edge technologies, thus maintaining the competitiveness of industry and business environment. This thing can be achieved by placing on the market the best-performing low carbon technologies worldwide.

- Establishing clear and early measures regarding policies of climate changes will end the current uncertainty that delays the investments in the energy sector that we need urgent and that will help boost our economies, as well as the development of a modern and competitive infra-structure with low carbon emissions.

- Ambitious measures in the domain of climate changes are also needed to strengthen energy security. We can see a decrease in fossil fuels resources in Europe, an aspect that transforms us in one of the most dependent areas of the imports of these fuels. Currently, Europe imports over 80% of the necessary oil and over 60% of the necessary natural gases. The forecasts of the International Agency for Energy show that by 2035 they will increase to 95% for oil and 80% for natural gases. Moreover, the global demand for energy is in continuous increasing, aspect that would leave Europe exposed to a volatile and rising evolution of the energy price due to the instability of some areas of the globe. Through climate change policies, we can develop clean internal energy sources and can use this energy more efficiently, thereby increasing energy security and new jobs.

- There are also other indirect benefits of these measures to reduce greenhouse gas emissions such as: by reducing the use of fossil fuels we can also ensure a reduction of air pollution and costs in the domain of health, reduce energy bills for the population by increasing the energy efficiency of houses. At the same time, we can increase the conservation degree of biodiversity, by protecting and maintaining the main carbon reservoirs, such as forests [9].

Conclusions

The impacts of climate change have been analyzed at national, regional and local level and the adoption of the response measures identified as a result of this analysis should be integrated into national development policies based on the principles of solidarity and social cohesion [10, 16].

As a result of the analysis of the climatic changes effects that are foreseen over 25-30 years as a result of global warming it is recommended:

- reducing of CO2, methane and other pollutant gases, by measures taken at the level of political leaders of the states, especially in highly industrialized countries;

- reducing the energy consumption based on fossil fuels and adopting conventional forms of energy (sun, wind, water, biological mass, underground heat);

- replanting destroyed forests and protecting the existing ones by creating national parks, protected by drastic laws;

- reducing paper consumption and recycling cellulosic waste to reduce the amount of wood resulting from cutting down forests;

- restoration of irrigation arrangements for agricultural crops as major measures in providing food for the population;

- reducing soil degradation because is a serious problem in Europe. It is driven or exacerbated by human activity such as inadequate agricultural and forestry practices, industrial activities, tourism, urban and industrial sprawl and construction works. These activities have a negative impact, preventing the soil from performing its broad range of functions and services to humans and ecosystems. This results in loss of soil fertility, carbon and biodiversity, lower water-retention capacity, disruption of gas and nutrient cycles and reduced degradation of contaminants [11];

- global poverty can be reduced only by applying measures capable to cope with climate change. Agricultural farms must therefore diversify production by adapting to climate change [12];

- reducing the emissions of gas on short term, by the large scale application of the modern technologies for state-of-the-art power plants; an increase in power plant efficiency by carrying on the technological development, as a result of the targets of reducing emissions on mid and long term (until 2020); preparing the modern technologies with zero emissions, enabling the introduction of CO2 capture and storage (on long term for climate protection > 2020) [13];

- the need to monitor the water courses that play an important role in anthropogenic understanding and prediction the natural impact of pollution sources that offer a important tools for managing natural ecosystems [14];

- regularization of watercourses through damming and unclogging works of the sewerage networks, that take over pluvial and accidental leaking [15].

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