



ECONOMIC AND SOCIAL IMPACT OF NATURAL DISASTERS ON EUROPEAN ECONOMIES. RISK MANAGEMENT LESSONS OF GOOD PRACTICE FOR ROMANIA

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Abstract *The research aims to identify and rank the greatest risks of natural disasters to which Romania will be the subject in the coming years and to emphasize the best practices for risk management of disasters in the European Union. The research on the economic and social impacts of disasters in Romania and Europe is based on disaster's typology in the last 100 years, to reveal the greatest and the most expensive risks of disasters. For prioritizing prevention measures and mitigation of hazards, this research study realized a multi-criteria ranking of natural disasters in Romania and an analysis of the European experience in the field of risk management of natural disasters, which may contribute to good practice lessons for Romania. The results may constitute the elements of a strategy for disaster risk management in Romania, as well as elements for a strategic move of investors in Romania, interested in some of 4 phases of European Integrated Risk Management (IRM) for disasters.*

Key words:
Natural disasters; global warming; Romania; Europe; risk management

JEL Codes:
Q54, O5, O210

1. Introduction

Major natural disasters are affecting the world's population every year, causing major damages with millions of victims and loss of material goods. Potential as a natural phenomenon produce disasters depends on the degree of vulnerability of communities to such phenomena: actions and risk management measures, if well implemented, can reduce the social and economic impacts of natural hazards, and if not, can increase exposure to risks and exacerbate the impact of dangerous natural phenomenon so that it becomes a disaster. There are a lot of studies based on evidence in the international literature that relate increasing frequency and intensity of the natural disasters with global warming caused by anthropogenic activities (excl. geophysical disasters). In the last 30 years, Europe is faced with a growing number of natural disasters and their social and economic impacts have enormous costs affecting the economies of European countries. The most recent statistical data relating to the registration of continents disaster shows that Europe is less affected by disasters than Asia but more affected compared to North America and South America, Africa and Oceania.

The year 2012, for example has been the 10th year with the highest temperatures and the 36th consecutive

year in which the global temperature was higher than the annual average of the 20th century. At the same time, 358 registered natural disasters worldwide have had devastating effects on human society from 120 countries, causing 123 million victims and a record level of material damage, by 157 billion USD.

In Europe the year 2012 has been one atypical for disasters, where extreme temperatures were dominant as the number of events (70% of the total), mainly as a result of the extreme temperatures and cold wave in the countries of Eastern, Southern and Western Europe. The data confirms that global warming is not uniform, either in time or in space.

2. Methodology of Research

The methodology of our research is comparative analysis and correlation, in dynamic and structure, of the natural disaster risk în Romania and Europe, as a function of disasters typology. The analysis is focused on the following disasters: floods, storms, drought, extreme temperatures and earthquakes. To estimate the future trend of natural disaster events emerging in Romania, the analysis relies on a long series of statistics which covering the period 1900-2013 (November) for the whole of Europe, including Romania. The data used in this report is derived from

international data base relating to disasters, EM-DAT, maintained to date by OFDA/CRED International Disaster Database [1].

In the comparative analysis of the economic and social impact of natural disasters on the European economies, we used the statistical data concerning direct costs thereof, not including the indirect losses and subsequent reconstruction costs. The paper is structured in two parts: a) the multi-criteria analysis of the natural disasters risk in Romania, compared with other European countries, and b) risk management of natural disasters in the EU, and the lessons of good practice for Romania.

3. Results

3.1. Multi-Criteria Analysis of the Natural Disasters Risk in Romania

3.1.1 The European and world context of the risk of natural disasters

Europe is less experiencing natural disasters than Asia, but much more compared to North America, South America, Africa or Oceania. The occurrence of natural disasters was different depending on the type of disaster and the continent. The largest number of events with a natural disaster character were: climatological (drought, extreme temperature) in Europe; geophysical (earthquakes) in Asia; hydrological (flooding) in Asia and meteorological (storms, tornadoes, cyclones) in Asia.

Between 1900 and 2013, about 1615 natural disasters in Europe caused over 4 million fatalities and affected other 75 million, with an overall loss of 347 billion USD. Since the 1980s, the reported number of disasters has witnessed an upward trend, with record high in the first decade of the 21st century. In 2012, the Europe was hit by 75 events of natural disasters, which accounted about 25% of the world disasters.

3.1.1.1 Romania: The Risk of Natural Disasters in the European Context

During the period 1900-2013, Romania reported 96 major events of natural disasters, with a similar typology as all countries of Europe: geophysical (earthquakes), hydrological (flooding), meteorological (thunderstorms, tornadoes) and climatological (temperature extremes, drought). These natural disasters caused about 4.900 deaths, affected over 2 million people and total material loss reported was almost 5 billion USD. Over the 113 years timeframe, Romania was affected by 6% of total number of reported natural disasters in Europe. The percentage itself does not say too much, if the incidence of disasters in Romania was less than or greater than in Europe. To be more specific, we have achieved some correlations between number of events in natural disasters and the areas of Romania and Europe, with average comparative outputs and having only a theoretical value, but who can give a better indication on the incidence of natural disasters in Romania compared with Europe.

Table 1. Correlation between the incidence of natural disasters in Romania and Europe

	Romania	Europe	Romania/Europe
Number of events in natural disasters 1900-2013	96	1615	6%
Surface km ²	238.391	10.180.000	2,3%
The affected area/ event km ² /eveniment	2.483	6.303	40%
Number of events/Total surface	0,0004	0,00015	266%

Source: authors ' processing, 2013, based on "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium, and Eurostat, 2013

The correlation between the incidence of natural disasters in Romania and Europe show a comparative higher incidence of natural disasters in Romania than the European average, as a) Romania holds 2.3% of the Europe's area, but is affected by 6% in the number of disasters in Europe (1900-2013), and b) the number of events of natural disasters associated to the area of Romania is over 2.5 times higher compared to the European average. We can assess that Romania is a bigger region of risk disasters than average Europe.

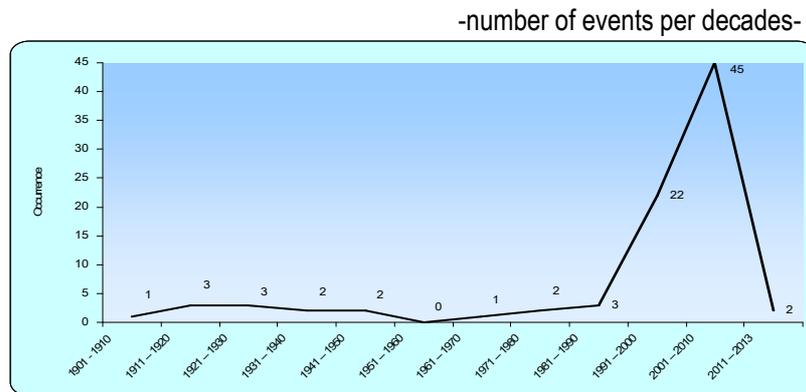
The occurrence of major natural disaster events in Romania

Analysis on decades of data reported reveals that in the first 80 years of the 20th century, Romania recorded a

1-2 events of decade. Since the 1980s has witnessed an accelerated growth of the disaster in Romania, which is doubled in the 1981-1990, then increased by 7 times in 1991-2000 and nearly doubles again in 2001 to 2010, when there was a record 45 events/decade.

Disaster dynamics correlates with accelerating global warming, caused by anthropogenic causes, as demonstrated by the authors in the study of IWE (2013) [2]. Reducing energy consumption and GHG during the global economic crisis and post crisis (2010-2013) led to the sudden decline in the occurrence of natural disasters in Romania, as in Europe, a similar level to the first 80 years of the 20th century.

Figure 1. Romania-trends in occurrence of natural disasters over decades, 1900-2013



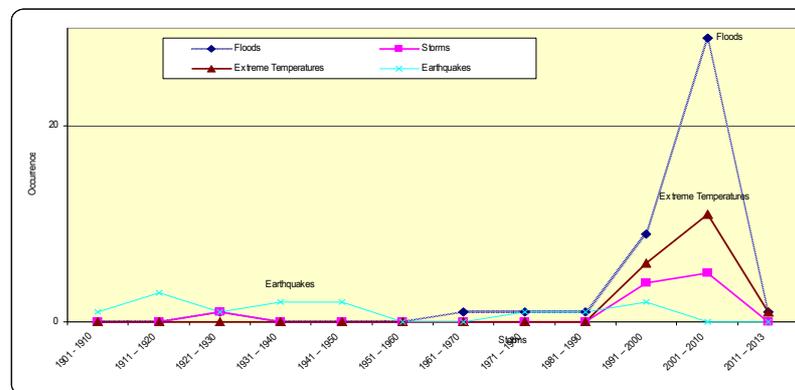
Source: authors' processing, 2013, based of "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium

Analysis of the evolution of natural disasters in Romania according to their typology per decades in 1901-2013, lead to the following conclusions:

- The frequency and number of hydro-meteorological disasters has accelerated in the last 30 years;
- New phenomena appeared: extreme temperatures, thunderstorms, tornadoes;

- Since 1991 prevailed disastrous floods and extreme temperatures;
- Low frequency of high-magnitude earthquakes:
 - 1-3 events/decade in the first 50 years;
 - 1-2/decade in 1970-2000;
 - No high-magnitude earthquakes in 1951-1970, and 2001-2013

Figure 2. Romania- trends in occurrence of natural disasters by typology per decades in 1901-2013



Source: authors' processing, 2013, based of "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium

1.2. Romania: Multi-Criteria ranking of natural disasters

1.2.1 Disaster ranking based on the number and frequency of events (1900-2013)

Between 1900 and 2013, hydro-meteorological events were the most important natural disaster (over 76% of the total number), reflecting growth of global warming. From this point of view there is similarity with disasters that characterize Europe (75%).

TOP 3 or the main three disasters with highest occurrence:

- The Floods is the main type of natural disaster that was manifested in Romania, with the

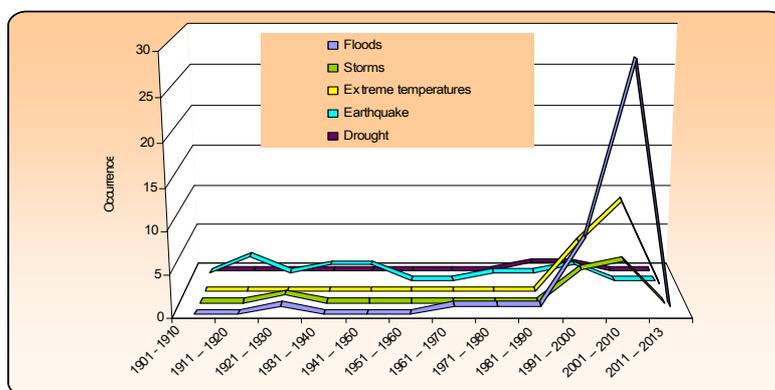
greatest frequency in 2001-2010 (29 of 43 events in the last 113 years).

- The extreme temperatures have been recorded for the first time in the decade 1991-2000, and in the next decade the number has doubled, so that, on the whole of the period 1900-2013 extreme temperatures have become the second significant after the flood disaster in Romania.
- In Romania, the earthquakes, which are geophysical type of disaster, totaled a number of 13 events during 1900-2013, representing 14% of the total number of events, a higher rate than at the level of Europe (10%), which

shows that Romania is an important seismic area of Europe. Latest earthquakes with the

character of the disaster have been recorded in the last decade of the 20th century.

Figure 3. Romania - The main types of natural disasters in Romania according to number of events/decades, 1900-2013



Source: authors' processing, 2013, based of "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium

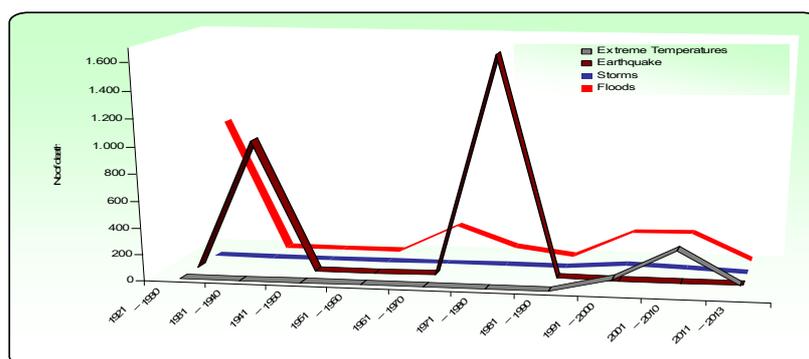
The analysis of the disasters' pattern per decades in Romania shows significant structural changes:

- The first 80 years of the 20th century were dominated by geophysical disasters like earthquakes;
- Since 1991, the floods are becoming the most frequent natural disaster in Romania simultaneous with the emergence of new natural disasters, as extreme temperatures and tornadoes;
- In the first three years of the present decade there have been a few natural disasters in Romania: floods, followed by extreme temperatures.

1.2.2 Disaster ranking based on the number of deaths (1900-2013)

Our analysis show 99% of the total death resulted from earthquakes, floods and extreme temperature. Two high-magnitude earthquakes events in 1900-2013 have caused more than 50% of the total number of deaths (2,600 people); other 35% of the total number of deaths were registered during the floods throughout the period with a pick during 1921-1930, and a slowing down trend after; extreme temperatures: have appeared in the last two decades and caused 11% of deaths, with maximum in 2001-2010; it is the only type of disaster that caused a continuously growing number of deaths in Romania and Europe over the last two decades.

Figure 4. Romania – The natural disaster ranking according to the number of deaths caused/decades 1901-2013



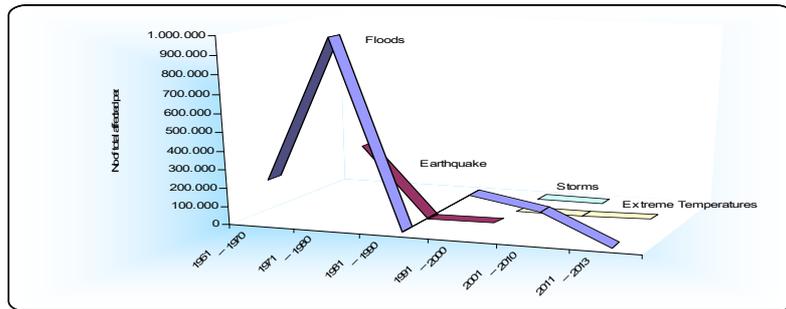
Source: authors' processing, 2013, based of "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium

1.2.3 Disaster ranking based on the number of people affected (1900-2013)

The floods and the earthquakes caused the largest part of people affected by natural disasters (99%). Only floods affected 1.6 million people (80% of the total), out of which a record number of 1 million in the years 1971-

1980. The earthquakes have caused most of the casualties in the years 1971-1980, in a single event, the strongest earthquake of the century, from the year 1977. However the number of people affected by this earthquake was only 1/3 of that caused by frequent floods in the same decade.

Figure 5. Romania- The natural disaster ranking according to the number of people affected by natural disasters/decades 1901-2013



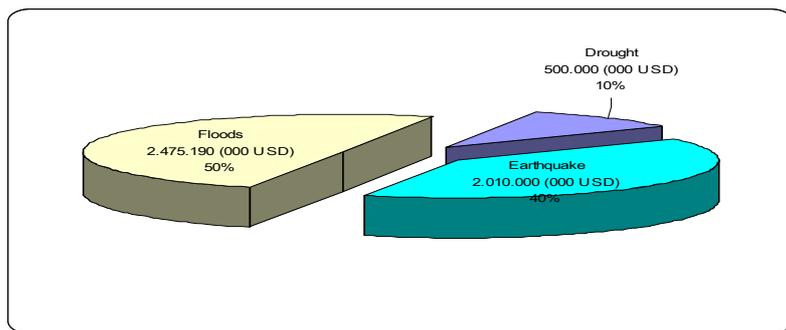
Source: authors ' processing, 2013, based of "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium

1.2.4 The ranking of natural disasters based on the cost of economic damages (1900-2013)

- The floods have caused material damage of 2.475 billion dollars or 50% of the total

material damage caused by disasters in 1900-2013, less above the level of damage caused by earthquakes (about 2 billion USD)

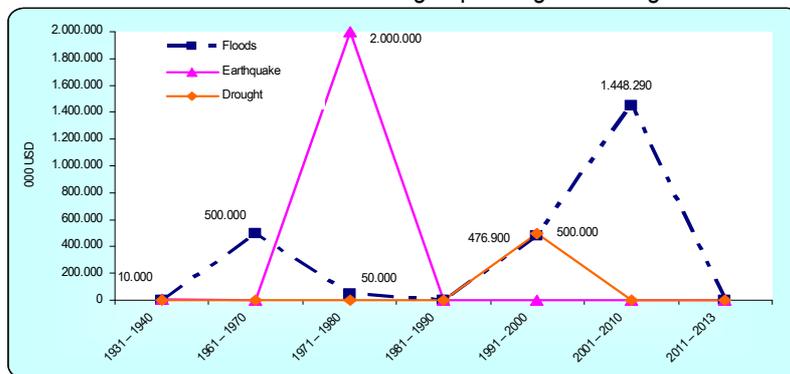
Figure 6. Romania – The natural disaster ranking according to the damages (1900-2013)



Source: authors ' processing, 2013, based of "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium

- The natural disasters in Romania in the recent last decades show an increase in terms of economic losses, especially caused by floods.
- The floods of 2001-2010 have generated economic losses of about 1.5 billion USD, or 3 times larger than in a previous decade.
- The record level of economic damages was registered in the case of 1977 earthquake.

Figure 7. Romania – The natural disaster ranking depending on damages/ decades 1901-2013



Source: authors ' processing, 2013, based of "EM-DAT": The OFDA/CRED International Disaster Database, Nov.2013, Université Catholique de Louvain – Brussels, Belgium

The natural disasters ranking in Romania, according to the social and economic impacts on the economy in the period 1900-2013, leads us to achieve TOP 3 of the main disasters depending on the two criteria, as follows:

a) TOP 3 disasters according to total social impact (number of victims= deaths + people affected):

Rank Social impact

1. Floods
2. Earthquakes
3. Extreme temperatures

Computing a theoretical average of the social impact/event (number of victims/ event= deaths + people affected/ event), ranking it is changed, but it is very important for risk managers of natural disaster events.

Rank Social impact/event

1. Earthquakes
2. Floods
3. Storms, tornadoes
4. Extreme temperatures

b) TOP 3 disasters according to economic impact:

Rank Economic impact

1. Floods
2. Earthquakes
3. Drought

Computing a theoretical average of the economic impact/event (damages/number of events), the ranking it is changed, but in this case is very important for risk managers of natural disaster:

Rank Economic impact/event

1. Earthquakes
2. Drought
3. Floods

2. Risk Management of Natural Disasters in the EU, and the Lessons of Good Practice for Romania

2.1. The Integrated Risk Management

Reducing the risk of disasters and Risk Management in Europe has gone from approach to disaster response, to The Integrated Risk Management (IRM), which includes 4 phases:

1. *Prevention*: includes activities designed to reduce the likelihood of events risk or adverse effects.
2. *Preparedness*: includes activities carried out before the impact, including the development of emergency plans in case of necessity
3. *Response*: measures taken during the disaster, rescue of the victims and goods.
4. *Recovery*: disaster' post activities for return to normality of the social and economic life

In Europe, the IRM is addressed to all types of disasters, developing early warning systems and public campaigns, to implement the escape procedures and decision support tools.

a) General measures at European Union level

- In 2009, the European Union has adopted a Communication on reduction of the impact of natural disasters and those caused by humans across the EU [3]. Policies to reduce or limit the risk of disasters there are in many EU Member States, but they are not harmonized.

- Some recent actions are harmonized only in the case of floods and droughts [4], but the European Union proposed common approaches instead the different approaches at the national level. "A common approach is more effective than separate national approaches, both in terms of knowledge development and the improvement of the performance of existing Community instruments for the prevention of disasters".[5]

- Prevention measures

- setting up an inventory at the community level, with existing information about good practices in the field;
- development of guidelines for mapping hazards and risks associated;

- improving access to early warning systems and
- more efficient targeting of Community funds

- Response measures

- provision of technical assistance by the various specialized agencies and organizations; the most important instrument is the EU Solidarity Fund

- EU rapid response capability [6]

- EU assistance in case of natural disasters for supporting local economy
- aid within 24 hours of the occurrence of a disaster;
- disaster-response training and disaster management
- developing initiatives taken during preparatory actions

b) Specific measures by type of disaster at EU level

- *Floods* are the most important type of disaster according to the criteria of social and economic losses in Europe and Romania

- Over the past decades, the concept of flood risk management went from defense systems to a more integrated approach, with *concerted action* at EU level

- *Floods Directive (2007)* has to be implemented in the Member States of the European Union in 3 stages:

- Preliminary assessment of flood risk (in 2011)

- Design of the regional maps of risk (2013)

- Risk management plans (2015)

- Strengthening links between EU Member States and existing alert systems, such *The European Flood Awareness System* (released by JRC)

- *Earthquakes* are the second most important type of disaster in Romania, both in the number of victims and the amount of economic losses (*the second place and respectively third in Europe*).
 - There is not a specific policy at EU level
 - Measures to limit the seismic risks applies to national level, due hazard seismic is different from one Member State to another
 - There are common methods and criteria at EU level for civil engineering anti-seismic: Eurocode 8/2004 relating to the Design of structures for earthquake resistance [7]
- *Extreme Temperatures* - third place as social impact in Romania and first place as the number of deaths in Europe
 - Plan of action to limit the impact of heat waves and cold waves
 - Focus on stage of prevention and preparation: alert in time of the population, work immediate prior to, and during event
 - Long-term measures for the reduction of population vulnerability on segments of age, preparing the infrastructure
 - New regional framework of action "*Health protection against climate change challenges*" [2010]
 - Actions for disasters management of extreme temperatures are getting more and more visible in Romania too.

3. Conclusions

- In Europe, the number of natural disasters is lower than in Asia, but higher as compared to each of the other continents.
- Since the 1980s, the number of events in Europe marked a continuing upward trend reaching a record in the first decade of the twentieth century.
- Romania holds 2.3% of the Europe area, but is affected by 6% of the European disaster numbers, resulting that in Romania the incidence of natural disasters is higher than the European average.
- Over the period 1900 – 2013, Romanian criteria ranking of natural disasters lead to the following results:
 - *According to the number and frequency of events*
 - ✓ *Floods* are the main type of natural disaster that hilted Romania.
 - ✓ New phenomena emerged in the 1990s, as extreme temperatures, which have become significant and lies in second place after the floods.
 - *According to the number of deaths*

The earthquakes lies the first place by this criterion, causing over 50% of the total number of deaths during 1900-2013; floods are on the second place (35% of the total); extreme temperatures (11% of the total) or 516 deaths during the past two decades.

- *According to the people affected*
 - *Floods* is placed on the top after this criterion (80% of the total people affected)
- *According to the cost of damages*
 - *Floods* have caused more damage than earthquakes in Romania over the 113 years analyzed (2.475 billion dollars or 50% of the total); earthquakes have caused damages of more than 2 billion USD (40%).
- Risk Management in Europe adopted a new paradigm to disaster response, The Integrated Risk Management, which includes prevention, preparedness, response and recovery measures.
- A lot of general and specific measures by type of disaster at European Union level are presented in the our analysis as good practice for Romania.

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