# INTERNATIONAL EVOLUTION OF CATASTROPHIC RISKS FREQUENCY

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**Abstract**

Over the past 20 years, there has been a significant increase in the frequency and impact of catastrophe events, which has generated concerns at the global insurance industry. Major losses (both material and human) were in the public eye, triggering government action to cover them, especially if the damage was not insured / insurable. Earthquakes, fires, landslides, or floods - all have a financial, social, economic and political impact on the affected regions. This article analyzes the experience of the latest catastrophic events (both insured and uninsured) to illustrate the lack of operational mechanisms or innovative solutions responding to such a type of exposure.

**Key words**: catastrophe, cat losses, mandatory insurance

**JEL classification:** G22, G28

## Introduction

Of all the research conducted so far by various empowered entities, it is clear that economic losses as a result of natural disasters are increasing both in terms of production frequency and financial impact and, of course, social. According to a study by Munich Re (1998) in the second half of the 20th century, humanity faced 243 catastrophic events, 38% of which were storms and hurricanes, 29% earthquakes and 27% floods. The cumulative value of the economic losses caused by these events is $ 960 billion (Munich Re, 2013).

Economic losses caused by earthquakes account for 35% of all losses, while economic losses due to storms and floods are 28% and 30% respectively. Of these, insured losses are only $ 141 billion, which represents an insurance coverage of about 14.68% - an insufficient amount for situations that have a significant social impact. 70% of the insured losses are related to the earthquake risk. These costs affect all regions of the world, both the developed and the least developed - the degree of development of the country also attracts the level of education of the population and, implicitly, the coverage of losses through insurance, which leads to a greater impact raised in underdeveloped or developing countries (see the example of the earthquake in Haiti or the floods generated by Katrina in the New Orleans area, a less developed area).

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The biggest financial losses have been recorded in developed countries because they have the most modern, modern and consequently expensive infrastructure in terms of financial values. More for these countries, even if the occurrence frequency is not always significant, the impact / severity of events is important due to human agglomerations but also the value of existing property / assets.

**Table no 1. The largest insured losses events, 1970-2017**

| No. | Date | Country | Event | Insured losses (bill. USD) |
|---|---|---|---|---|
| 1 | Aug. 25, 2005 | Mexico, USA | Katrina hurricane, storm | 62.2 |
| 2 | Mar. 3, 2011 | Japan | Earthquake (Mw 9.0), tsunami | 34.3 |
| 3 | Sep. 19, 2017 | Puerto Rico, Virgin Island, Carrabean Islands | Maria hurricane | 30 |
| 4 | Oct. 24, 2012 | Carrabean Islands, Canada | Sandy hurricane, storm | 29.5 |
| 5 | Sep. 6, 2017 | Puerto Rico, Virgin Island, Carrabean Islands | Irma hurricane | 32 |
| 6 | Aug. 25, 2017 | USA | Harvey hurricane | 30 |
| 7 | Aug. 23, 1992 | USA, Bahamas | Andrew hurricane, storm | 17 |
| 8 | Sep. 11, 2001 | USA | Terrorist attacks on WTC, Pentagon and other buildings | 31.6 |
| 9 | Jan. 1, 1994 | USA | Earthquake Northridge (Mw 6.7) | 15.3 |
| 10 | Sep. 6, 2008 | USA, Carrabean Islands, Mexico | Ike hurricane | 18.5 |

*Source: Swiss Re, sigma, No. 1/2018; Property Claim Services (PCS®), a Verisk Analytics® business, insured losses for natural catastrophes in the United States*

In all cases, however, these damages are due to human inability to prevent and absorb potential financial losses by properly constructed systems capable of taking over these shocks. Responsibility clearly lies with the governments of the exposed countries, who are not sufficiently responsible to understand and solve this type of problem. Similarly, there is also an individual responsibility that is in direct relationship with public responsibility.

## 1. Literature review

Preventing natural disasters is becoming an activity that concentrates more and more resources every day. That is why studying and understanding the concepts of natural

hazard, natural disaster, vulnerability or risk is a priority for the whole society, as only by understanding these concepts can measures be taken to reduce the effects (diminish) but also to rebuild events.

*Natural hazards* are geophysical events that occur on the planet and have a direct impact on society and the environment. Natural hazards are a form of interaction between man and environment, where certain adaptation thresholds of society are overcome (Bernaz et al., 2006). The extreme character of the events considered *hazard* in their forecasting or control was also noted in specialized studies (Scradeanu, 2014). What distinguishes a simple natural hazard from a disaster is precisely the impact that the former have on society as a whole and on the natural environment. Natural disaster refers to the situation where the hazard occurred and a response to the effects of the hazard occurs.

Natural hazards, such as earthquakes, landslides, floods or volcanic eruptions, have an impact on all social entities. This is not only the result of the event itself but is also the result of the human systems with which it interacts. We therefore have a natural vulnerability created by events that interact with the human vulnerability of human systems (Bălteanu et all, 2006). Natural disasters occur permanently in the world. The impact they have on an area or region is the result, on the one hand, of geophysical factors and, on the other hand, the degree of economic, political, social and cultural development of the region. The lower these degrees, the more vulnerable the area is.

As a consequence, vulnerability is the degree to which a community may be affected by a risk. This degree depends inversely on the level of resilience of the area, which in turn is an effect of the socio-economic-political system development (Berz et all, 2011). Vulnerability is dependent on the system's ability to adapt to changes in internal and external environment conditions, and involves major financial efforts to adapt to new conditions. Berz believes that relative disaster vulnerability is quantified by the Disaster Risk Index and calculated as a ratio between the number of people affected and the number of people exposed.

*Event risk* is the probability of occurrence of an event, according to Badea (2008). The *risk of damage* is the probable level of damage caused by a natural event in a given place and in a given period. These damages relate to both loss of life or injured persons and material loss to individuals or economic activities. *Risk* is a function of probability and the impact produced. In terms of extreme natural hazards, we can talk about tolerable events / risks and catastrophe, where the impact of the event is significant, far beyond the society / community, and the process of adapting to the new situation involves a financial effort considerable.

Natural hazards can be caused / influenced by the following factors (Naghi, 2007):

a) geological nature: earthquakes, volcanic eruptions, landslides, tsunami
b) hydrological nature: floods
c) climate change: storms, drought, fires, extreme temperatures
d) biological nature: epidemics

**Earthquakes**

They are part of the category of endogenous hazards and are sudden movements of the Earth's bark, which can have a devastating impact on human communities. Depending on their magnitude, as a result of these events, both loss of life and substantial economic losses can occur.

**Table no. 2 The worst earthquakes in human history, based on the number of deaths registered**

| Year | Country/Region | Losses of human lives (thousands) |
|---|---|---|
| 1556 | China, Shoanxi | 830 |
| 1850 | China, Sichuan | 300 |
| 1976 | China, Tangshan | 290 |
| 1920 | China, Gansu | 235 |
| 1303 | China, Linfen | 200 |
| 1923 | Japan, Tokyo | 143 |

*Source: authors'computations based on Munich Re Report*

**Volcanic eruptions**

These are also phenomena of an endogenous nature that are due to the accumulated energies in terrestrial underground reservoirs. The most devastating volcanic eruptions known to mankind sun (Bird, 2013):

a. 1815 - Indonesia, Sumbawa - 100,000 deaths
b. 1883 - Indonesia, Sumatra - vf. Krakatao - 36,000 deaths - this rash was followed by the tsunami
c. 1985 - Colombia, Armera - m. Nevada del Ruiz - 24,740 deaths and economic losses of 230 million USD

**Biological hazards**

Biological hazards are generally represented by epidemics that result in mass illnesses of the population. The worst are: malaria, yellow fever, exanthemous typhus, flu. Large-scale epidemics are called pandemics (bubonic plague). As assurance needs statistical data history, the modeling and charging of these events is extremely difficult, given that in the last century there were only 3 or 4 pandemics (Bernaz, 2006). Parametric assurance of such events may be easier but only based on a better understanding of risk (Kunreuther, 2006).

Without accurate understanding of risk mitigation or transfer measures, losses may intensify, which would result in a lowering of appetite for acceptance by insurance companies.

## 2. Research methodology

For the present paper, we have studied the statistical data on the volume and the structure of the losses incurred as a result of natural disasters over the last 70 years. The analysis of the data was aimed at identifying feasible solutions for damage management, based on past experience, a benchmark in stabilizing the types of solutions likely to be applied, in planning the actions / institutions empowered to be involved in a natural disaster to reduce the negative consequences, of significant social effects. The analyzed period was 1950-2018, the data related to the number of natural disasters recorded globally and the value of the damage caused by them being divided over 10 - decade series - for an easier analysis of them.

Analyzing the share of each hazard type in the total number of catastrophic natural events, we can easily see that while the total number of natural disasters that have occurred since 1980 and up to 2018 has steadily increased, the number of geophysical events - earthquakes, volcanic or tsunami remained relatively constant. What increases with these periods is the number of other types of meteorological, hydrological or climatological hazards. So, we can conclude that the increasing number of natural catastrophes and implicitly losses due to them are mainly due to climate change, hydrological and meteorological events, ie those types of events that are a consequence of human intervention on the environment.

In the case of geophysical events of an endogenous nature, they are related to the internal movements of the earth's crust and occur with an almost constant periodicity from the beginning of this planet to the present.

### 2.1. Analysis of economic losses and insured claims between 1950 and 2018

The same study by Munich Re combined with the AON 2018 Report reveals that only between 1988 and 1997 the costs that the global economy has recorded as a result of catastrophic events are somewhere around USD 700 billion, whereas in the last two (2000-2018) was about $ 4000 billion, reported in 2018 figures. Munich Re estimates that in the decade this number of natural disasters has been five times higher, while in terms of costs they have was eight times higher than in the previous decade from the 1960s to 1970s. In the second half of the 20th century, 250 natural disasters were recorded.

A disaster is considered to be of great magnitude when the affected community can not recover alone and needs regional or international assistance. Generally, in these situations, affected communities suffer substantial economic losses that depend on the degree of economic development of the community concerned, and last but not least, we are dealing with a significant number of victims - dead, wounded, people who are left without shelter.

Based on the data provided by Munich Re (1999) and AON (2018), we will continue to analyze how the number of catastrophic events, recorded economic losses and related insured losses evolved between 1950 and 2018.

**Table no. 2 Analysis of impact of natural disasters, on decades (bill. USD 2018)**

| | 1950-1959 | 1960-1969 | 1970-1979 | 1980-1989 | 1990-1999 | 2000-2009 | 2010-2018 |
|---|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* | *7* |
| **Number of events** | 292 | 547 | 839 | 1653 | 2577 | 3861 | 2988 |
| **Economic losses** | 6.058 | 18.445 | 17.181 | 53.845 | 746.015 | 892.312 | 1354.014 |
| **Insured losses** | 0.033 | 0.066 | 0.113 | 0.239 | 98.8 | 479 | 739 |
| **a. Coverage rate of economic losses (%)** | 0.54% | 0.36% | 0.66% | 0.44% | 13.24% | 53.68% | 54.58% |
| **b. Average loss/ event** | 0.0207466 | 0.0337203 | 0.0204779 | 0.0325741 | 0.2894897 | 0.231109 | 0.4531506 |
| **c. Average insured loss/ event** | 0.000113 | 0.0001207 | 0.0001347 | 0.0001446 | 0.0383392 | 0.1240611 | 0.2473226 |

*Source : authors'computations based on international reports*

In the table above, we calculate and analyze the following parameters (Safari, 2016) in order to make a more complete assessment of the evolution of the number of events, economic losses and insured losses recorded between 1950 and 2018, aggregated over ten years:

a. **Coverage rate of economic losses** $R_{ap}$, calculated as a percentage of the insured losses in the economic losses produced over a certain period of time, x:

This report tells us the extent to which economic losses are recovered as a result of insurance coverage (Kunreuther, 2006). We can observe that during the analysis period this coefficient registered a continuous growth (doubling its value), which means that the transfer method in the insurance sector has registered continuous growth, thus proving the

acceptance of the natural companies of the type catastrophe. Whether we are referring to mandatory national schemes to cover catastrophic natural risks (eg Turkey) or that we refer to voluntary initiatives at national markets (eg Germany), the growth of this indicator can be used as documentation / argumentation in the implementation new insurance solutions or changes to existing schemes but which have not proved their feasibility (for example, the compulsory insurance of the dwelling in Turkey, which, although implemented by law, did not increase penetration as a result of lack of penalties for non-law enforcement).

Increasing loss coverage can be a consequence of public awareness campaigns about the negative effects of catastrophes but also on the potential benefits of catastrophe insurance products. Linking these campaigns with real support from local authorities can result in similar growth rates in the coming decades.

b. **Average loss/ event**, $D_m$, calculated as the ratio between economic losses and the number of events produced in a given time span, x :

Analyzing the average damage on the event, we see an increase in it. This situation is possible as a result of the continuous increase in the economic loss generated by the economic development of society. This average damage measures the economic impact that catastrophic events have on a certain amount of time. An increase of 340% over the period under review is a normal outcome of a country's economic and social development. Of course, this indicator shows higher values in developed countries that have a greater exposure to existing properties / assets with significant values.

c. **Average insured loss/ event**, $D_a$, calculated as the ratio between insured losses and the number of events produced in a given time interval, x:

Analyzing this coefficient, we note that it has recorded rising values - the trend being + 730% - and we can deduce that once economic growth is expanding, the indemnities offered by insurers are starting to increase, with uncovered losses being less and less.

At the same time, from the point of view of the less developed countries, the average insured is moderate, although from the point of view of the social impact, the losses are unquantifiable (balls) - see the Haiti earthquake or tsunami in Indonesia.

In order to determine how the number of damage has evolved during these intervals, we calculate **the damage index**, $C_d$, (figure no. 1) as a ratio between the number of damages produced in a given time interval and the number of damage in the reference interval, in our case, the first considered interval (Stripple, 1998).

$C_{di}=N_i/N_1$, where N is the number of claims and i refers to period, i= 2, 3, 4, 5.

This continued rise in the $C_{di}$ index leads to the conclusion that, with the passage of time, there has been an increase in the number of natural events compared to the previous one. This was possible as a result of the economic development that each decade brought about. This economic development was the consequence of a more and more consistent involvement of man on the environment, which implicitly led to an increase in the number of exogenous disasters.

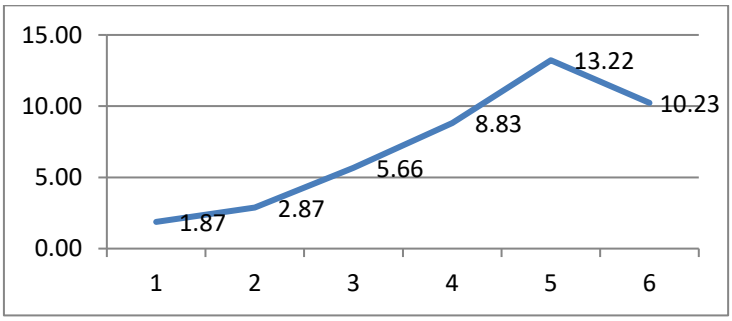



**Figure no.1 Growth index of the number of natural disaster events**

Analyzing the data above, there is a tenfold increase in the number of damage in the last decade compared to the first decade taken into account, ie in the period 2000-2018 compared to the interval 1950-1959. At the same time, with the increase in the number of damages, there was an increase in the volume of economic losses. In order to analyze this evolution, we calculate the Economic Growth Index, $C_{px}$, as the ratio of the economic losses within a certain range to the economic losses in the first reference period, 1950-1959.

$$\mathbf{C_{pi}} = P_{ei}/P_{e1}. \qquad (1)$$

As a result of the calculations, it results that the recorded economic losses had an increase of 223 times in the last interval, 2000-2018, compared to the initial interval 1950-1959. This growth rate roughly follows the increase in the number of damages, so we can conclude that for this period, economic losses are proportional to the number of damages.

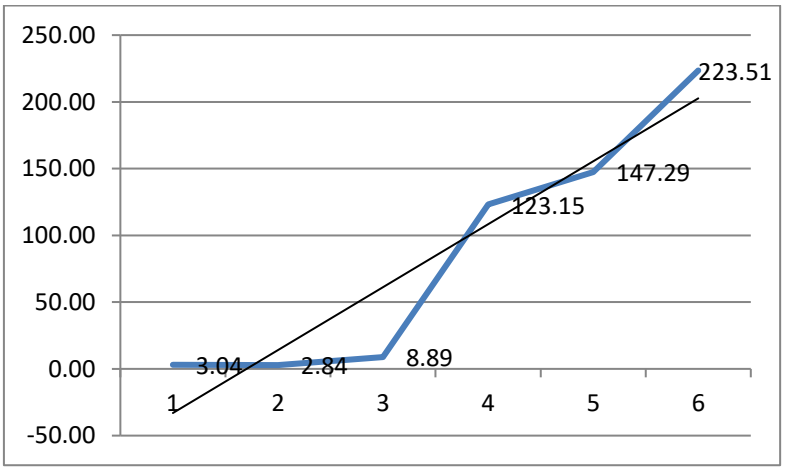



**Figure no. 2 Growth index of economic losses $C_e$**

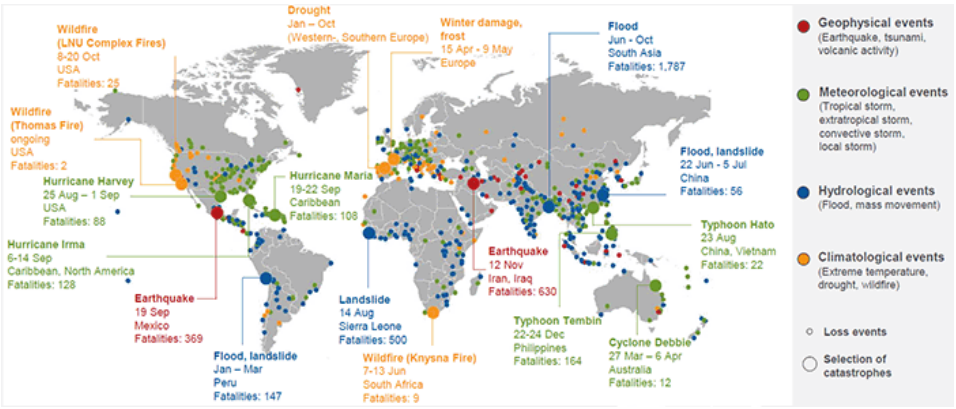
In order to study the evolution of the insured losses, we will calculate the coefficient of growth of the insured losses, $C_{a1}$, as the ratio between the insured losses reported over a period of time against the insured losses from the previous interval. $C_{ai} = P_{ai} / P_{ai-1}$, where $P_{ai}$ are the insured losses from a certain interval. By computing this parameter, we notice an impressive situation in the 1990-1999 decade compared to 1980-1989 where relative growth was about 313%, demonstrating the increase in the use of insurance as a method of damaging the damage.

This development, coupled with increased economic losses, leads us to the conclusion that within 70 years of analysis, the difference between insured losses and uninsured losses has declined steadily, a result that confirms that insurance has become and remains the main instrument by which these economic losses can be covered.

## 3. 2017 – the most expensive year for insurance industry as a result of natural disasters' losses

At international level, in the last 10 years, there has been a trend of intensifying the financial effects of natural disasters. As a result of human action or natural factors, the number and impact of natural disasters have recorded significant yearly increases (including the occurrence of catastrophic events in regions not experiencing such exposures) - in this context, 2017 is considered the most costly for society as well as for the insurance industry (World Bank, 2019).

The map of catastrophic natural events that occurred globally in 2017 (map no. 1) shows a distribution of economic losses of over 80% in North America, Central and Caribbean, where 44% of all events.




**Map no. 1 Global natural disasters events map in 2017**

*Source: Munich Re, Geo Risks Research, NatCatSERVICE*

The natural catastrophes that produced the biggest losses in 2017 were Irma hurricane with $ 32 billion in damage to the United States and the Caribbean, Hurricane Harvey, which caused US $ 30 billion in damage to the United States, and Hurricane Maria, which caused damage of 30 billions of dollars in the Caribbean.

Following the map of 2018 by Munich's NAT CAT Service, we find that in the year 2017, a total of 710 catastrophic events have been reported globally, causing total damage of $ 330 billion. By comparison, in 2016 the value of damages from the same causes was only $ 184 billion resulting from 780 events. While losses covered by insurance in 2016 were only 51 billion, in 2017 they were US $ 135 billion.

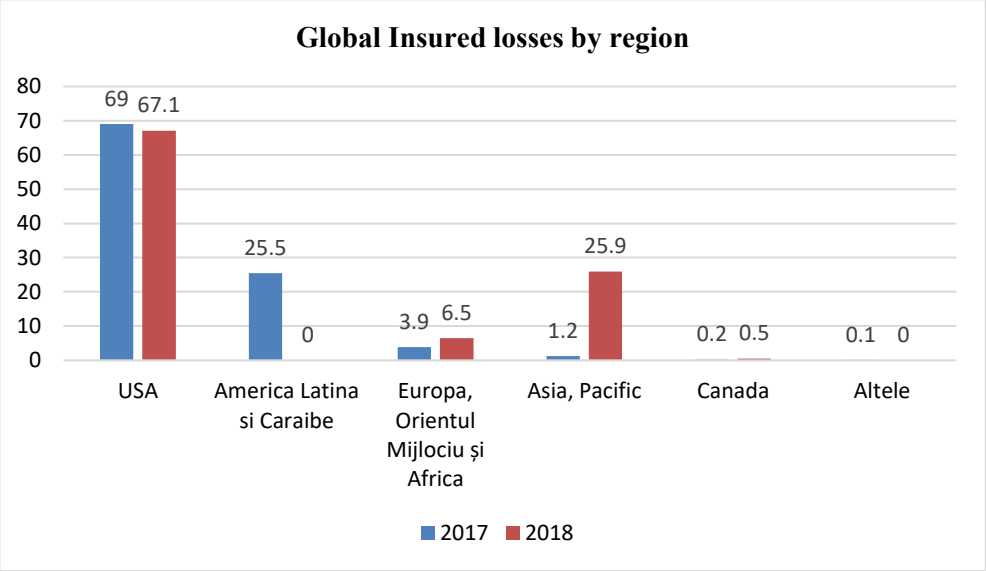



**Figure no. 3 Global insured losses 2017-2018**

In terms of economic losses due to natural catastrophes, but also losses for these events, 2017 was the most costly so far. As revealed by the Swiss Re study, in 1817 there were 183 major catastrophes that generated a total loss of $ 138 billion. Besides, there have been 118 large disasters produced from other causes than natural ones, generally caused by human errors. The resulting economic losses were only $ 6.2 billion.

As a result, such an event may become non-insurable and may cause the population to identify new financing solutions - either through active retention or through active involvement of the authorities (special budgets for such situations). On the other hand, as a consequence of such a consistent amount of damage, there is also the possibility for insurance companies to continue to accept these risks, despite their growth, in exchange for receiving a higher insurance premium, which would leads to significant social pressure especially in less developed countries.

As mentioned earlier, the natural disaster-type event of 2017 represented storms with 44.81% of all events. The causes of these events can be identified as a result of human action or as a result of climatic factors beyond human control. 30.05% of the events were floods - another situation generated by actions - deforestation, landslides as a result of non-compliant and abusive exploitation.

Regardless of the structure or the way of classification of natural disasters, regarding the natural disasters registered in 2017, one can observe the same tendency noted in the literature - there is a direct relation between the population density and the reduction of the consequences of these phenomena (Safari, 2016). In other words, the more carefully the proportionality of events and population density, the faster the negative consequences of national disasters can be reduced.

### 3.1. Study case – Romania

Romania ranks among the Southeast European countries with a high degree of exposure to natural catastrophic risks, especially earthquakes, landslides and floods. According to the World Risk Report, Romania ranks 87 out of 171 among the top countries with the highest risk of natural disasters.

The **earthquake** is far from the natural risk with the most significant impact that could affect Romania. Although this phenomenon is one with a low frequency, the severity these natural events can have in Romania is quite high. Romania is one of the European countries with the highest earthquake risk. Statistically, in Romania, an earthquake of 6 degrees on the Richter scale can occur once every 10 years, one of 7 degrees, once every 33 years, and one with more than 7.5 degrees can occur once every 90 years. With a duration of 55 seconds, the earthquake in 1977 caused the deaths of about 1,600 people, injuring 11,000 people and the collapse of 35,000 homes. In Bucharest, 33 housing blocks collapsed. Earthquakes that characterize seismic activity in Romania have the majority of epicenter in the Vrancea area and are characterized by the fact that they cause damage to a magnitude greater than 7 degrees.

According to statistics, Romania has been experiencing **catastrophic floods** ever since, but the first massive floods that we have information about occurred in the 16th century. This phenomenon has increased in intensity over the centuries so that the twentieth century has been one with many events and the 21st century can be said to have been a truly catastrophic one for Romania. Significant floods occurred in the 1970s and 1975s, 2001s, 2005s, 2006s. These floods resulted in loss of life and significant economic losses. According to the state secretary of the Ministry of Environment, Water and Forests in March 2016, the damage registered in Romania as a result of the floods produced between 2004 and 2016 amounted to 4 billion euros, representing 2.7% of GDP (PAID Romania, 2018a).

**Landslides** occur in Romania due to the existence of a sloping relief, hills, whose soil is formed by layers of clay, which has the property of absorbing water flowing on the slopes due to abundant precipitation and favoring the separation of those layers under the weight of water. The largest slippage of land produced in Romania occurred in 1971, when the Certej ore decanting pond prevailed and broke the dam. As a result, 300,000 cubic meters

of tailings practically covered Certej. At that time, 89 people were buried alive, 76 people were injured, 7 blocks and 20 households were destroyed. The root cause of this slippage was the loss of sterile bed stability over time as a result of its exploitation over time.

Considering Romania's high exposure to the three natural risks - earthquake, landslides and floods and to ensure that if there are such catastrophes in Romania, there will be money for the population to be compensated, the decision-makers politicians set up in 2008 the establishment of a compulsory housing insurance scheme against natural disasters. The compulsory insurance policy is concluded for all dwellings in Romania, both for those built of resistant materials type A and for materials made of less resistant materials type B and currently provides up to EUR 20,000 for dwellings type A and EUR 10,000 for Type B dwellings. The only exclusions are dwellings which, based on a risk inspection, were classified as seismic risk class 1. In completing this policy, to cover the full value of the dwelling by insurance, one can buy a voluntary policy.

At present, there are 8.98 million homes in Romania, according to the National Institute of Statistics, of which 1,707 million have concluded compulsory insurance policies at the end of 2018 (PAID Romania, 2018b). As a result, there is a penetration rate of 19% in Romania.

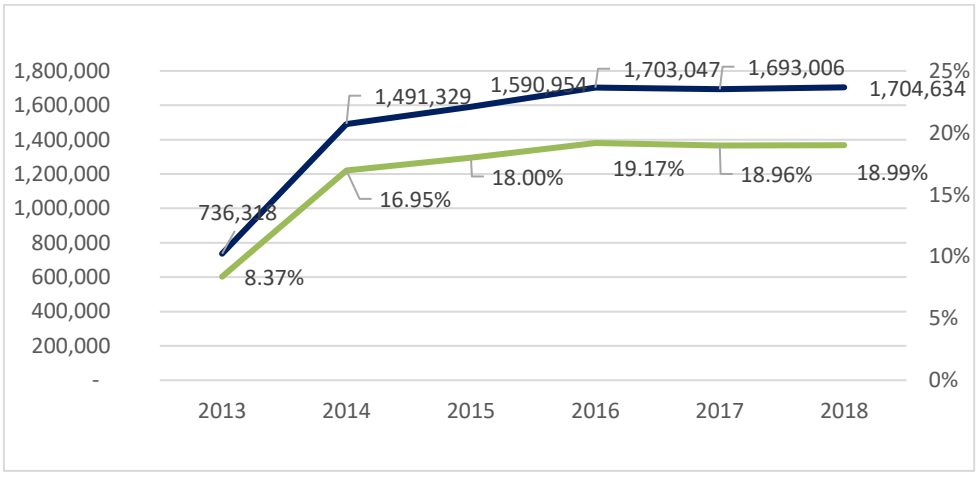



**Figure no.4 Evolution of contracts of mandatory insurance in Romania, 2013-2018**

On the model proposed by the World Bank and partially adjusted to local realities, the compulsory insurance policy has managed to convince a large part of the urban population in Romania to classically transfer the risks of natural catastrophe. The main problem of the still low penetration rate (18.99%) is the lack of enforcement of the legislation in the field by the persons responsible for it - local authorities who could use the reason for issuing payment orders for local taxes and local taxes to pay the mandatory insurance policy.
The evolution of the mandatory PAD policy portfolio has been positive over the past 5 years as a result of public awareness campaigns, caravan campaigns organized jointly with local authorities or mortgage loans requiring guarantees (implicitly presenting an optional policy with the mandatory one).

**Table no.3 Number of losses and paid claims for mandatory household insurance in Romania, 2013-2018**

| Anul | Număr dosare daune | Sume plătite (euro) |
|---|---|---|
| 2013 | 296 | 86.045 |
| 2014 | 1813 | 575.292 |
| 2015 | 1059 | 653.746 |
| 2016 | 2119 | 540.697 |
| 2017 | 642 | 620.095 |
| 2018 | 1844 | 712.414 |

*Source: authors'computations based on PAID Romania reports*

The capacity of the company to manage the payment of natural damage caused by natural events, PAID Romania, has increased from one year to another, following somewhat the evolution of damages paid to customers. The trend of the damages paid is totally positive, although for some years one can notice some cyclicality of them.

## 4. Conclusions

In recent years, catastrophic natural events have been making ever more losses to all world economies. Global climate change, such as global warming as a result of human or non-human intervention, as well as population density, especially in exposed areas, are the main causes of the increase in economic loss both in developed countries and in countries with emerging economies. The more a region's economy is more developed, the more catastrophic economic losses are more consistent.

The impact of these events is constantly increasing both in number and volume of economic losses, and what is worrying is that instead of this impact being diminished over time, there seems to be reason to believe that it will be amplified. The only feasible thing we can do with these exposures is to analyze what happened in the field of natural disasters and to use the knowledge we have accumulated in solving the problems we have faced in the past to lay the foundations for a safer future.

In this sense, governments are directly targeted when it comes to prevention. They also respond fully to disaster response as a consequence of prevention. Each state reacts differently to these external stimuli. More developed countries absorb and manage less these losses themselves, while less developed countries face major difficulties in managing both ante and post-disaster.

Regarding the ways in which the market can recover part of the economic losses, insurance, reinsurance and the capital market make a significant contribution. The insurance and reinsurance industry is therefore facing an enormous challenge - identifying solutions to manage the panel of issues that the increase in the impact of natural disasters has on the world.

This is why global public-private partnerships are encouraged, which, with a concerted effort, can act in a complementary manner so that states remain responsible for as little of the burden of damages, generally focusing on the public sector and on the category of the most vulnerable population.

In this context, Romania has taken proactive measures both in terms of prevention and post-disaster action. It is part of the countries fully aware of the risk it is exposed to, and therefore promptly responded to the challenge of having effective solutions to succeed in real time to reduce the cost of possible natural disasters. Although more and more prepared and resilient to disasters, states still have much to do to adapt to climate change and respond promptly to the catastrophic events that will follow.

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