Socio-economic Impact of Natural Disasters in the Republic of Serbia

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ABSTRACT

The rapid technological and economic development caused the emergence of new risks and influenced the change in the frequency and effects of those already known. Considering that characteristics of natural disasters vary in space and time, the aim of this paper is to perform a spatial and temporal analysis of their impact on the society and economic activities in the Republic of Serbia. For this purpose, data from the "DesInventar" database were used for the period from 1996 to 2019. Multidimensional data analysis shows that the effects of catastrophic risks are greater in less developed regions. Moreover, the effects of low-scale disasters, which are generally not regarded as relevant from a macroeconomic point of view, further affect sustainable regional development. These disasters cause social, economic and environmental problems especially in the region of Šumadija and Western Serbia. From the aspect of impact on economic activities, it can be concluded that these disasters significantly affect agricultural production in the entire territory of the Republic of Serbia. The results of this paper point to significant aspects of the effects of natural disasters, as well as potential ways to manage catastrophic risks in the Republic of Serbia. Therefore, they can be considered a notable input for policy makers, insurance companies and other relevant stakeholders in disaster risk management.

Key words: *natural disasters, socio-economic impact, sustainable development, multidimensional data analysis, OLAP, disaster risk management*

JEL Classification: Q01, Q15, Q54, G32, C55, C82

INTRODUCTION

Natural hydrological, lithospheric and atmospheric processes have always caused certain losses. Their transformation into extreme risks, or natural disasters, has taken place in parallel with the development of social, cultural, economic and political organization of the human society. The intensity of the extreme risk effects, both on the whole social-ecological system, and on the economic and financial subsystems, is determined by the vulnerability and exposure of the system to concrete risk. These determinants of extreme risks are dynamic and variable in space and time. Vulnerability and direct consequences of natural disasters on the biophysical system and economy are greater in underdeveloped and developing countries, characterized by low levels of economic development, unstable political situation, unfavorable educational structure and insufficient awareness of natural disasters (Alcantara-Ayala, 2002; Landeros-Mugica et al., 2016; Gu, 2019). However, if indirect and synergistic effects are taken into account,

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the intensity of the consequences of natural disasters in the most developed areas can take an enormous extent (O'Brien et al., 2006; Al Kazimi & Mackenzie, 2016), because development per se is not a guarantee of sustainability. Moreover, there is evidence that natural disasters can have a positive impact on human capital accumulation, total factor productivity growth and GDP per capita growth, and on the volume of knowledge, spillovers between developed and developing countries.

The socio-economic effects of natural disasters in Europe are expected to be higher and more frequent in the future as climate change intensifies (Naumann et al., 2015; Alfieri et al., 2015). When it comes to the Republic of Serbia, the estimates based on climate modeling point to an increase in annual temperatures that is expected to be up to 1.0°C on average in the near future from 2016 to 2035, with an increasing trend to the end of the century (Vukovic et al., 2018). These projections indicate the possibility of intensifying the present hazards, especially hydrological ones. Projected impact of floods and droughts may be greater both in scope and duration, causing social, economic and environmental problems. With 17.1% of the area and 17.5% of the population at risk of natural disasters, the Republic of Serbia belongs to the group of countries that are at relatively high risk of multiple hazards (Dilley et al., 2005). However, the intensity of natural hazards, typical of the territory of the Republic of Serbia, cannot be considered as dangerous. Nevertheless, small and medium-scale natural disasters should not be underestimated, as they mark the problem of local society disaster risk. The uneven regional development of the Republic of Serbia has caused significant differences in the level of vulnerability of certain areas. Vulnerability assessment on the basis of social and economic indicators shows that the largest number of municipalities in the Republic of Serbia can be characterized as low to moderately vulnerable. Urban areas, especially regional centers, may be considered more vulnerable to natural disasters, primarily because of population size and population density (Kovacevic-Majkic et al., 2014). The floods that hit the Balkan region in 2014 brought global attention to the high level of vulnerability and unreadiness of the Republic of Serbia and neighboring countries to manage such risks. According to the World Bank study (2015), economic sectors in Serbia, which are particularly vulnerable to natural disasters, are agriculture and production, transmission and distribution of electricity and heat.

The purpose of this study is to analyze the impact of damages and losses caused by natural disasters in the Republic of Serbia and to report their spatial distribution. We use the data available in the "DesInventar" database supported by the United Nations Office for Disaster Risk Reduction, which contain historical data on damage caused by various disasters. Taking into account the interdependence between the effects of natural disasters and the level of development of the society, we assume that less developed regions are more exposed to the effects of natural disasters. However, knowledge on the impact of natural disasters, as well as increased prevention measures should, over time, reduce the intensity of natural disasters, especially small- and medium-scale ones, which can be considered as seasonal risks. Adding to this the existing intensity of the effects of natural risks in the Republic of Serbia, it is presumed that during the observed period the socio-economic impact of natural risks will decline. Observing the social and economic effects of natural disasters in the period from 1996 to 2019, we pursue to reveal the changes in regional exposure to natural disasters as a solid direction to determine a potential strategy for managing catastrophic risks in the Republic of Serbia. Hence, the results of this paper can be considered as a significant input for policy makers, insurance companies and other relevant stakeholders. Considering its importance for economic and social development and sensitivity to climate change, special attention will be paid to the impact of natural disasters on agriculture. Therefore, the paper is structured as follows: the second part of the paper provides an overview of the most important studies of the economics of natural disasters. The methodology framework of this research is elaborated in the part 3. The obtained results are presented in section 4, while section 5 concludes the presented work.

THE ECONOMICS OF NATURAL DISASTERS – A LITERATURE REVIEW

Modern social-ecological systems are exposed to a large number of mutually correlated risks, which represent a potential threat to the survival of the entire global system. Despite the fact that risks can be categorized in different ways, the specificity of extreme risks is reflected in their intensity and frequency of occurrence. Therefore, extreme risks or catastrophes can be characterized as all risks whose probability of occurrence is very small and the consequences are sudden and enormous (Posner, 2004). Natural disasters can be defined in different ways (Lukic et al., 2013; Ranke, 2016), since there is no consensus on the threshold of loss according to which the risk can be considered extreme. Thus, natural disasters can be characterized as events caused by nature which consequences exceed the normal experiential range of each system individually. The significance of natural disaster risk reduction in the realization of strategies for sustainable development, which is highlighted in 25 targets of Sustainable Development Goals (UNDP, 2015), has raised the question of the criteria for classifying this risk. The classification of natural disasters was primarily based on the criteria of major damage records providers, such as: Munich Re's "NatCatSERVICE", Swiss Re's "Sigma", the "EM-DAT" database of the Center for Research on the Epidemiology of Disasters, the "GLIDE" of the Asian Disaster Reduction Center, as well as the "DesInventar" database of the Social Studies Network in Disaster Prevention in Latin America (Below et al., 2009). The databases were initially designed for reinsurance purposes. They contain highly detailed information about the occurred catastrophic events, so they could be used by researchers, institutes, national and international organizations and other interested stakeholders. Risks that arise from geophysical and geological, meteorological, hydrological, climatological, biological and extra-terrestrial events are recorded depending on different thresholds. In this way, databases like "Sigma" and "EM-DAT" set quantitative criteria for recording natural disasters. On the other hand, "NatCatSERVICE" and "DesInventar" do not have quantitative thresholds and record catastrophic events as soon as any damage or impact occurs (Kron et al., 2012). Due to the fact that economic damages caused by natural disasters during the previous seven decades have increased 14 times (Guha-Sapir et al., 2004, p. 13), detailed databases, which do not neglect small damages, provide the necessary information for defining a strategy to manage these risks.

The impact of natural disasters on agriculture is particularly significant. Namely, 22% of economic impact, caused by medium and large-scale natural disasters, especially in developing countries, refers to agriculture, while 42% is on the crop subsector (Baas et al., 2015, p. 5). These losses directly affect consumption, savings and investment in both developed and developing countries, but low-income countries are particularly vulnerable to these changes. At the same time, there is an ongoing debate among experts on whether and how natural disasters affect economic growth. Contemporary researchers have given conflicting opinions about the effects, so studies can be divided into two major groups: the ones confirming the negative impact and others that show the positive impact of natural disasters on economic growth. The results obtained from the studies depend on numerous factors: the size of the country, geographical location, type of natural disaster, the level of economic development, the group of countries considered, the term in which the consequences are analyzed (long or short term), etc. However, it cannot be neglected that natural disasters have effects on the long-run growth, influencing the technology and natural resources, as well as the process of human and physical capital accumulation as the main determinants of the long-run growth (Popp, 2006).

The negative impact of natural disasters on economic growth has been confirmed in recent studies of catastrophic events in developing countries conducted by Vigdor (2008), Noy (2009) and Strobl (2012). Cavallo et all (2013) come to conclusion that extreme disasters, especially the ones that preceded radical political revolutions, have a negative impact on GDP in the short and long term. Using a cross-country analysis, they provide records of large direct costs of natural disasters that do not significantly affect GDP in the short term. The GDP growth downtrend, in the short term, can be the result of transferring resources to sectors that largely depend on

natural resources, in order to recover losses (Sadia et al., 2013). Therefore, the reduced productivity in industry may be the result of conducted reconstruction activities (Sardar et al., 2016). However, in the long run (e.g. 10 years after the disaster) large natural disasters cause a 10% decline in GDP per capita, especially in developing countries (Cavallo et al., 2013). Toya and Skidmore (2007) find that countries with higher GDP per capita managed to reduce damages and monetary losses comparing to countries with lower GDP per capita. The authors show that the income increase made people more willing to invest in flood protection. The economic damage that a country could suffer from flooding depends on the frequency and severity of floods, the coastal area as well as the level of economic development (Jonkman et al., 2008).

On the other hand, there are studies that provide evidence of positive correlation between natural disasters and economic growth (Albala-Bertrand, 1993; Tol, 1999; Skidmore & Toya, 2002). The authors, in these studies, empirically confirm the hypothesis of creative destruction. Presenting the evidence that natural disasters provide opportunities for capital improvement and the adoption of new technologies, the authors evidence a long-term growing rate of GDP per capita in developing countries. These knowledge spillovers from one country, usually developed one, to developing, disaster-prone countries are conducted through trade channels (Cuaresma et al., 2008; Oh & Reuveny, 2010). Although creative destruction can boost economic growth in developing countries, the large-scale disasters may lead to a poverty trap (Halledatte & Bumas, 2009). By analyzing the impact of natural disasters on the annual GDP of Vietnam, Noy and Vu (2010) find that disasters that affected a greater number of people resulted in lower economic growth, while more costly disasters actually stimulated a greater impact on economic growth in the short term. However, the macroeconomic impact differs depending on the geographical region, the ability to generate government and non-government fund transfers and access to foreign direct investment.

In Europe the most frequent disasters are floods and they affect the most people and cause most of economic damage both in Western and Eastern parts of the continent (Banica et al., 2020). Heat waves and storms also affect large share of European population, but droughts have the greatest impacts on agriculture as well as well-being of the people. However, international disaster relief decreased disaster-related fatalities in European countries for more than 30% revealing strong regional differences in disaster coverage (Stromberg, 2007). The middle- and low-income countries closest to the large donors are located in Eastern Europe and they received around 2.5 times as much relief for a similar disaster in some Asian country. However, changes in national boundaries due to the break-up of the former Soviet Union and former Republic of Yugoslavia caused data ambiguities, which hinder the systematic regional analysis of natural hazards in transition economies (Guha-Sapir et al., 2014).

According to relevant studies, the overall effect of natural disaster will depend on the kind of disaster (type, intensity, frequency, etc.), geographical location and national economy characteristics. Contradictory results are obtained by Noy and Naulsri (2007), while some studies provide evidence that large-scale disasters have a negative impact on economic growth in the short term without clear effects in the long run (Kim, 2010). Moderate floods may even enhance annual GDP growth and agriculture growth in developing countries, while storms and droughts both moderate and severe have significant negative impact on economic growth (Panwar & Sen, 2019). Therefore, an increasing number of studies are focused on the analysis of the mechanisms and channels through which growing effects are exercised and less on whether there are effects or not. One of the analyzed indicators concerning the impact of natural disasters on economic growth is the level of savings. Natural disasters influence the behavior of economic agents in a different manner, so that individuals tend to be more conservative and increase savings after natural disasters or simply become self-indulgent and spend more at the expense of savings. Luo and Kinugasa (2018) identify two types of uncertainty in the post-disaster period that affect the behavior of economic agents: (1) after the disaster some people affected by the disaster will try to overcome the situation and recover in the long run using

savings and other methods of self-insurance, or (2) after catastrophic damage some people expect their lives to be shortened due to illness and other shortcomings, which will affect the change in their behavior and attitude towards saving and spending in favor of consumption on the long term. Researchers have shown that people who live closer to the epicenter of natural disasters live more comfortably, save less and invest more in alcohol, cigarettes and enjoyment (Berleman et al., 2015). This phenomenon is known as "mercy hazard". It is a consequence of government financial support in the process of asset reconstruction destroyed during catastrophic events, which discourage victims to save. Instead of promoting savings, it can be expected that natural disasters will have an impact on the country's fiscal cost in the medium and long term (Koetsier, 2017). Kellenberg and Mobarak (2008) detect a nonlinear relationship between GDP per capita and the cost of natural disasters. Studying the correlation between natural disasters and public debt on a sample of 163 countries, they provide evidence on public debt growth by 4.6 to 9.8% of GDP in the disaster recovery period. However, Cavallo and Noy (2010) show that due to the severe consequences of natural disasters, the poorest countries would have more difficulty adjusting their counter-cyclical fiscal policy to be able to finance the reconstruction of such damage.

The number of natural disasters in the previous one hundred years has been increasing rapidly (Cvetkovic & Dragicevic, 2014) and global climate change has contributed to this growing trend. Vulnerability of the Republic of Serbia to natural disasters is a consequence of geographical position, natural and socioeconomic features, so the trends in vulnerability variations reflect regional variability of vulnerability, an increase in vulnerability at a national level and increase in vulnerability differences between urban and rural areas (Kovacevic-Majkic et al., 2014). The most common natural disasters are floods, storms, earthquakes and droughts (Gavrilovic, 2007), as well as forest fires and landslides. These risks can cause huge damage and impact overall GDP growth, as well as agricultural production (Djuricin & Bodroza, 2013). Considering the fact that 80.60% of the municipalities are not capable of coping with these types of emergencies (Radovic et al., 2015), it can be concluded that natural disasters present a significant factor in the sustainable development of the Republic of Serbia. Therefore, in this paper we present spatial analysis of GDP and natural disaster occurrence and its influenza in order to provide a basis for the development of various instruments for disaster risk management in the Republic of Serbia.

RESEARCH DESIGN AND METHODOLOGY

The analyzes of natural disasters in this study are conducted on the territory of the Republic of Serbia. The territory of south-eastern Europe is exposed to diverse natural hazards due to its specific geographical location. However, the data on natural disasters that have occurred on the territory of the Republic of Serbia have not been systematically recorded in any national database. Partial information can be found in reports of relevant services such as the Republic Hydro-Meteorological Service of Serbia and the Emergency Management Sector of the Ministry of the Interior of the Republic of Serbia. In order to provide a consistent analysis of the socio-economic impact of natural disasters in the Republic of Serbia, we use data obtained from the international open access database "DesInventar". The "DesInventar" database was developed in 1994 by the Network for Social Studies in Disaster Prevention in Latin America (LA RED) as a conceptual and methodological tool for the construction of databases of losses, damages and effects caused by disasters. Under the UNDP/SEESAC project national registration of disaster losses and damages was first developed using the UNISDR tool "DesInventar". This database provides very detailed information on the effects of disasters describing the event by 140 attributes. The data on disaster events that took place in the Republic of Serbia are available for the 34-year period from 1986 to 2019, which makes a total of 1,928 data entries. Since economic loss data are recorded from 1996, we use annual data for the 24-year period from 1996 to 2019, which provides the available data set on natural disasters of 1,561 data entries. The structure of

this dataset enables us to perform multidimensional analysis using online analytical processing (OLAP) of data. The focus of OLAP is to provide a platform for analyzing data (e.g. effects of disasters) with multiple dimensions (e.g. disaster type, location, time) and multiple measures (e.g. people affected, number of houses destroyed or damaged). Therefore, we design a data cube in order to organize the data by grouping it into different dimensions, and enabling overview and analysis of data from a number of perspectives.

Multidimensional data analysis involves the implementation of several standard OLAP operations. We perform the analysis by interactively extracting a fraction of the data by selecting the appropriate values for one or more dimensions, pivoting and rolling the data representation, and applying drilling techniques to change the detail of the data representation (Reddy et al., 2010). The slice operation is the choice of a subset of a cube by choosing one particular value, or some range of values, for one of the dimensions of the cube. The dice operation represents the selection of one part of a cube by choosing one particular value, or some range of values, for multiple dimensions of the cube. The Drill Down/Up operation allows us to navigate within different levels of the hierarchy for a particular dimension. Drill Up shows information from the level above (more aggregated information), while Drill Down shows information from the level below, characterized by a higher level of detail. The roll up operation refers to the calculation of aggregated data for one or more dimensions. The Pivot operation presented in Figure 1 allows us to rotate the cube in space to allow different views of the data. This changes the orientation of the dimensions in a report or graph, thus changing the perspective from which the data is viewed.
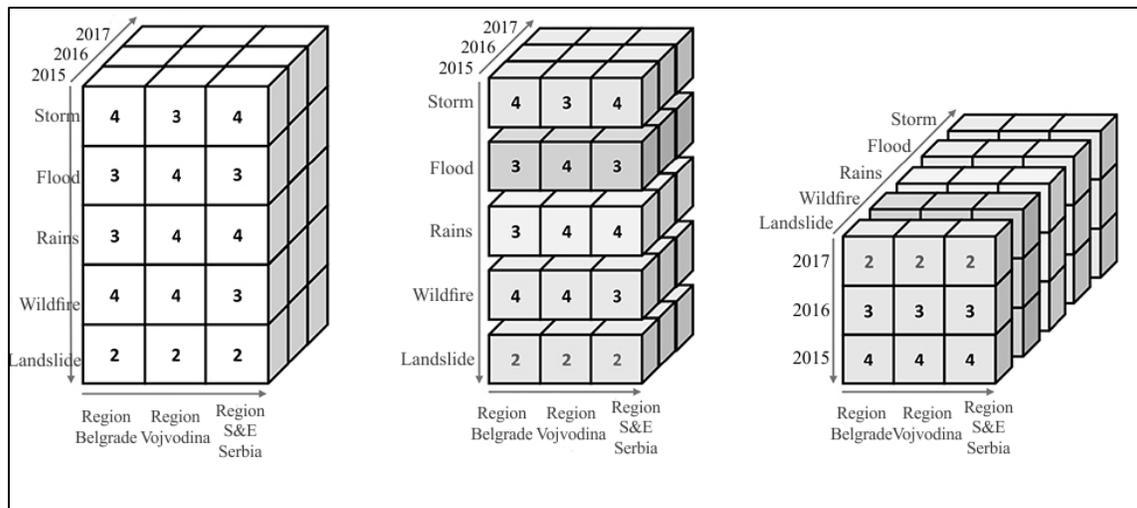

Figure 1. Pivot OLAP operation

Source: Adopted by authors based on Kimball and Ross (2015)

In order to create data cube, we create four hierarchical dimensions and fact table (Fact Disaster) as follows:

- geography dimension (Dim_Geography) with levels of country, region, and municipality,
- date dimension (Dim_Date) with levels representing year, quarter, month and day,
- disaster dimension (Dim_Disaster) for representing different types of disasters, and
- impact dimension (Dim_Impact) for representing effects caused by disaster, i.e. financial losses, material damages and people affected.

The damage records in this database provide information about location and municipality, but for the purposes of disaster analysis, they are observed at the level of the region to which the

disaster location belongs, such as: the regions of Belgrade, Vojvodina, Šumadija and West Serbia and the region of South and East Serbia. Damages and losses occurred in these regions are observed at five-yearly intervals, based on data recorded on a daily basis.

Considering the disaster dimension, we classify natural disasters according to the physical cause of an occurrence as well as quantitative indicators. The qualitative criteria of a natural disaster are classified into six groups: geophysical (earthquake, mass movement, volcanic activity), meteorological (storm, extreme temperature, fog), hydrological (flood, landslide, wave action), climatological (drought, wildfire), biological (disease, animal incident, insect infestation) and extra-terrestrial (impact, space weather). Quantitative criteria refer to the size of damages and losses. Since the recording of natural disasters in the "DesInventar" database does not imply the fulfillment of quantitative criteria, we use the criteria of the Center for Research on the Epidemiology of Disasters for this purpose. According to these criteria, for an event to be considered a natural disaster, at least one of the following criteria must be met: 10 or more people reported killed; 100 or more people reported affected; declaration of a state of emergency; call for international assistance. We use the number of casualties and the number of affected people as a criterion for the division of catastrophes by intensity, due to the fact that there is no evidence of economic damage for each event. For this reason, catastrophes, meeting at least one of the selected criteria, are categorized as large-scale disasters and the others as small- and medium-scale disasters. In this way, we create a new attribute (i.e. the scale of the disaster), allowing the effects of small- and medium-scale disasters and the effects of large-scale disasters to be compared.

Considering the purpose of this paper and the importance of particular attributes for assessing the socio-economic impacts of natural disasters, we use the following attributes to describe the intensity of disaster (impact dimension): the number of people affected (AP), the number of people died (DP), the number of damaged (DamH) and destroyed houses (DesH), damage in crops (DamC) expressed in hectares and economic losses expressed in local currency (EcL).
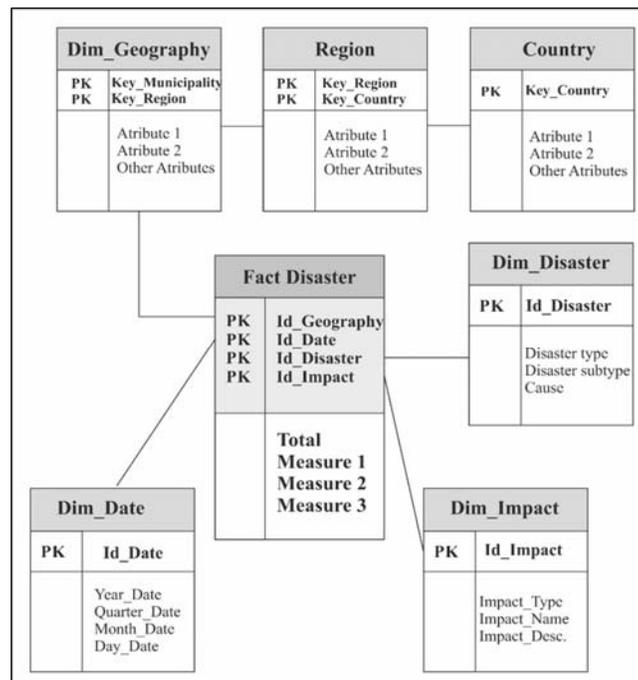

Figure 2. The star schema of the data cube

Source: Adopted by authors based on Kimball and Ross (2015)

The star schema of the data cube is presented in Figure 2. After selecting the required data attributes, cleaning and preprocessing data, and calculating new attributes, dimension tables are populated and disaster data are stored in fact table through Extract, Transform and Load process (ETL) for enabling data analysis.

RESULTS AND DISCUSSION

The vulnerability to natural disasters in the Republic of Serbia is certainly a consequence of geographical positioning. However, in addition to geographically conditioned factors, exposure and sensitivity to catastrophic risks are determined by socio-economic factors, such as population density, infrastructure quality and response capacity (Dilley et al., 2005). Due to the fact that natural risks of lower intensity mainly affect the livelihood of people in rural areas and smaller municipalities, we analyze the socio-economic impacts of natural disasters in the context of the observed regions development. Thus, based on the general data of the regions (Table 1), it can be concluded that the considered territorial units differ according to the area and number of inhabitants. The region of Belgrade is the most densely populated in relation to the others. According to the level of GDP per capita, the regions of Šumadija and Western Serbia and Southern and Eastern Serbia are less developed than the Belgrade region with a significant share of agricultural production in GDP. Thus, the impact of natural disasters in these regions can have multiple effects, both on people's lives and on economic activities.

Table 1. Regions in the Republic of Serbia – general data for 2018

Regions	Number of municipalities	Area (km²)	Number of inhabitants*	GDP per capita (000 RSD)	GVA agriculture, forestry and fisheries
Belgrade region	174	3,234	1,690,193	1,240	1.1%
Vojvodina region	446	21,614	1,861,863	705	14.9%
Region of Šumadija and Western Serbia	1,935	26,493	1,924,816	489	11.4%
Region of Southern and Eastern Serbia	1,967	26,248	1,505,732	476	8.5%

* Estimation made on June 30, 2018

Source: Authors' calculation, based on the data from the Statistical Office of the Republic of Serbia

Based on the data in Table 2, it can be noticed that natural disasters in the Republic of Serbia are most often caused by climatological (35.55%) and hydrological factors (34.79%), while 28.31% of all disasters occur under the influence of meteorological risks. The spatial distribution is such that the largest number of disasters in the observed period affected less developed regions: the region of Southern and Eastern Serbia (43.56%) and the region of Šumadija (39.59%). When it comes to the intensity of consequences, a similar trend can be observed in all regions - large-scale disasters participate with about 14 to 20% in the total recorded number of disasters, while the largest number of disasters (over 80%) can be characterized as small- and medium-scale (S&M).

Table 2. Classification of natural disasters in the Republic of Serbia in the period from 1996 to 2019

Type of natural disaster	Belgrade region		Region of Southern and Eastern Serbia		Region of Šumadija and Western Serbia		Vojvodina region	
	large	S&M	Large	S&M	large	S&M	large	S&M
Geophysical	-	-	-	-	1	1	-	-
Meteorological	1	11	47	89	32	199	3	60
Hydrological	10	33	44	130	83	164	22	57
Climatological	-	17	2	358	3	132	-	43
Biological	-	-	1	9	-	5	3	3
TOTAL	**72**		**680**		**618**		**191**	

Source: Authors' calculation, based on the data from the "DesInventar" database

If we analyze the time distribution of natural disasters in the Republic of Serbia, we can detect a growing trend in the previous decade. In fact, the largest number of disasters (about 65%) in all observed regions was recorded in the period from 2011 to 2015 (Figure 3). This period was also characterized by one of the greatest catastrophes recorded in recent history - the floods in 2014. However, such data should be taken with certain reserve, because the increase in the number of natural disasters may be a consequence of more up-to-date recording of catastrophic events in recent times.
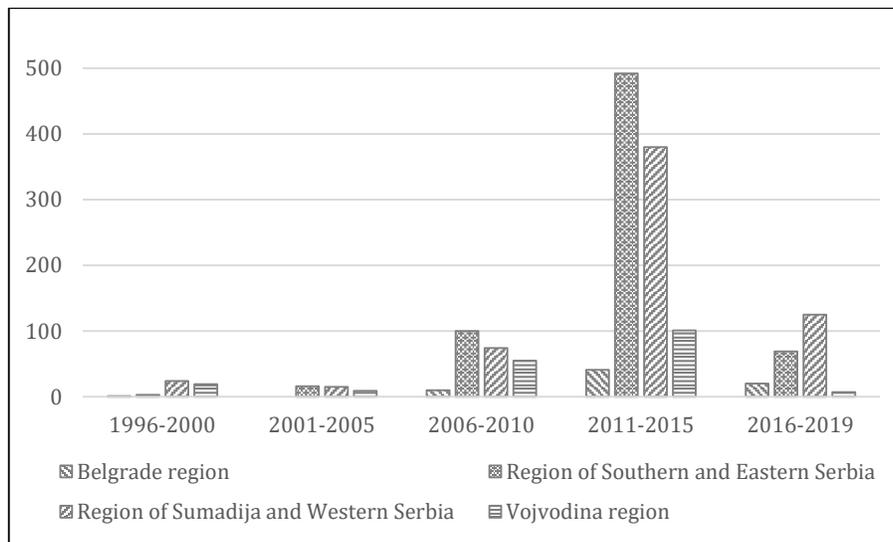
Figure 3. The time and spatial distribution of natural disasters in the Republic of Serbia in the period from 1996 to 2019

Source: Authors' calculation, based on the data from the "DesInventar" database

There are multiple effects of natural disasters. Direct effects are reflected in material damage and human casualties. Indirect effects can have an impact on the way of life and work of people, relationships and structures in society. It is therefore important to consider the impact of natural disasters on victims, but also on persons who under such circumstances have been denied access to public services, supplies, work or have had to be evacuated from their homes and relocated permanently or temporarily to other places. People who suffered such consequences are characterized as affected people in this paper, and in the entire observed period in the territory of the Republic of Serbia there were 686,860. We can conclude that

natural disasters affect the lives and work of 9.35% of the population, observed in relation to the average number of inhabitants in the Republic of Serbia in this period. Over 50% of affected people were located in the region of Šumadija and Western Serbia, while in the region of Southern and Eastern Serbia there were 25.39% and in the region of Vojvodina 18.12% of the total number of affected people. Large-scale natural disasters in Serbia, especially in Šumadija and Western Serbia region, are very intense and their impact, contrary to expectations, does not decrease (Table 3). During the last observed five-year period (2016 - 2019), a small number of large-scale disasters were recorded (6), as a result of which their impact on the population in the regions of Southern and Eastern Serbia and Šumadija and Western Serbia was much smaller. Small- and medium-scale natural disasters, although more frequent, had a much smaller impact on the population, so that on average the number of affected people generally did not exceed 10 per event. Therefore, we can conclude that every-day life and work of people are mostly affected by natural risks of high intensity, which hit 99.42% of the total number of affected people in the entire observed period. However, when it comes to the number of people killed, the data indicate a high mortality rate due to disasters of small and medium intensity.

Table 3. The number of affected people per natural disaster event in the Republic of Serbia

Period	Belgrade region		Region of Southern and Eastern Serbia		Region of Šumadija and Western Serbia		Vojvodina region	
	AP_L	$AP_{S\&M}$	AP_L	$AP_{S\&M}$	AP_L	$AP_{S\&M}$	AP_L	$AP_{S\&M}$
1996 – 2000	420.0	-	6,550.0	15.0	2,226.5	3.1	1,174.0	-
2001 – 2005	-	-	1,910.0	-	3,124.9	4.6	2,370.7	-
2006 – 2010	621.3	26.5	1,793.6	6.6	2,994.9	12.4	680.7	1.4
2011 – 2015	10,793.3	2.22	3,718.4	0.9	2,442.8	3.5	9,019.1	2.6
2016 – 2019	-	0.1	474.0	1.0	635.0	2.4	-	9.9

Note: AP_L - the number of people affected in large-scale natural disasters; $AP_{S\&M}$ – the number of people affected in small- and medium-scale natural disasters.

Source: Authors' calculation, based on the data from the "DesInventar" database

Due to the effects of natural disasters in the Republic of Serbia, 103 people died in the observed period, with 60% of people killed in large-scale disasters, and even 40% in small- and medium-scale disasters. The largest number of human victims is recorded in the region of Southern and Eastern Serbia (45.16%), while in the regions of Belgrade and Šumadija and Western Serbia this indicator of social impact of natural disasters is identical (27.42%). However, in the case of Šumadija and Western Serbia region, it can be noticed that large-scale disasters have almost identical impact in all observed time intervals, while in the region of Belgrade the extremely high value of this indicator is due to disasters that occurred during the period 2011-2015 (Table 4). Large-scale catastrophes do not take human victims only on the territory of the region of Vojvodina. Also, in this area the effect of small and medium catastrophes is the least. On the other hand, 46.34% of the total number of people who died due to small- and medium-scale disasters are recorded in the region of Šumadija and Western Serbia. In this region, consequences of these disasters are almost in the range of large-scaled ones. Fatal outcome most often occurs as a result of floods, but also frost and snowstorms.

Table 4. The number of deaths per natural disaster event in the Republic of Serbia

Period	Belgrade region		Region of Southern and Eastern Serbia		Region of Šumadija and Western Serbia		Vojvodina region	
	DP_L	$DP_{S\&M}$	DP_L	$DP_{S\&M}$	DP_L	$DP_{S\&M}$	DP_L	$DP_{S\&M}$
1996 – 2000	-	-	-	-	1.0	2.0	-	-
2001 – 2005	-	-	-	-	1.0	-	-	-
2006 – 2010	-	-	1.7	1.0	2.0	1.3	-	-
2011 – 2015	17.0	6.0	3.2	1.0	1.3	1.1	-	1.0
2016 – 2019	-	-	2.0	-	-	1.0	-	1.0

Note: DP_L - the number of people died in large-scale natural disasters; $DP_{S\&M}$ – the number of people died in small- and medium-scale natural disasters.

Source: Authors' calculation, based on the data from the "DesInventar" database

When it comes to material damage, it can be noticed that natural disasters in the Republic of Serbia cause significant damage to property. The total number of damaged houses in the entire observed period is 85,494, of which one third is damaged in small- and medium-scale disasters. However, if we consider the average consequences on this type of property, it can be concluded that even disasters of this scale can cause significant damage (Table 5). The damage is especially great in the region of Šumadija and Western Serbia, where even 59.26% of all damaged houses in the observed period in the Republic of Serbia are located. The most common cause of damage is flood, resulting in as much as 61% of all damage to houses in this region, and also earthquake (24%). Significant damages are recorded on the territory of Southern and Eastern Serbia during the entire observation period, and the greatest risk is again the risk of flooding. Extreme average damages on the territory of Belgrade region in the period 2011-2015 occurred due to major floods in 2014, while in the case of Vojvodina region, extreme average damages occurred in the period 2016-2019 due to hailstorms.

Table 5. The number of damaged houses per natural disaster event in the Republic of Serbia

Period	Belgrade region		Region of Southern and Eastern Serbia		Region of Šumadija and Western Serbia		Vojvodina region	
	$DamH_L$	$DamH_{S\&M}$	$DamH_L$	$DamH_{S\&M}$	$DamH_L$	$DamH_{S\&M}$	$DamH_L$	$DamH_{S\&M}$
1996 – 2000	124.0	-	270.0	850.0	341.5	454.3	210.0	-
2001 – 2005	-	-	439.5	169.0	294.3	65.0	298.3	-
2006 – 2010	165.7	135.0	401.6	29.6	338.4	348.3	91.7	64.1
2011 – 2015	5,067.0	39.9	352.6	31.5	323.3	81.2	89.0	169.3
2016 – 2019	-	8.0	-	89.2	195.0	66.4	-	3,434.5

Note: $DamH_L$ - the number of damaged houses in large-scale natural disasters; $DamH_{S\&M}$ – the number of damaged houses in small- and medium-scale natural disasters.

Source: Authors' calculation, based on the data from the "DesInventar" database

Due to the effects of natural disasters on the territory of the Republic of Serbia, a total of 5,677 houses were destroyed in the period from 1996 to 2019, out of which 63.22% were destroyed due to the effects of large-scale disasters. However, the analysis of damages indicates the fact that the small- and medium-scale disasters cause serious damage to human property, with their impact being particularly pronounced in the regions of Southern and Eastern Serbia and Šumadija and Western Serbia (Table 6). In the region of Southern and Eastern Serbia, the biggest risk, which leads to the destruction of houses, are floods (96.48%), while in the region of Šumadija it is the risk of earthquakes (68.24%), but also heavy rainfall (11.67%). As with other indicators, in this case, it can be presumed that the least developed regions in Serbia are most

exposed to the effects of both large, small and medium disasters, which have serious consequences for the livelihood of people in these areas.

Table 6. The number of destroyed houses per natural disaster event in the Republic of Serbia

Period	Belgrade region		Region of Southern and Eastern Serbia		Region of Šumadija and Western Serbia		Vojvodina region	
	$DesH_L$	$DesH_{S\&M}$	$DesH_L$	$DesH_{S\&M}$	$DesH_L$	$DesH_{S\&M}$	$DesH_L$	$DesH_{S\&M}$
1996 – 2000	8.00	-	-	-	5.00	650.00	37.60	-
2001 – 2005	-	-	-	-	-	-	207.33	-
2006 – 2010	50.00	-	35.00	17.50	202.61	66.00	42.00	11.50
2011 – 2015	180.00	-	12.00	13.83	10.93	2.56	20.00	1.00
2016 – 2019	-	-	300.00	4.00	77.00	72.50	-	-

Note: $DesH_L$ – the number of destroyed houses in large-scale natural disasters; $DesH_{S\&M}$ – the number of destroyed houses in small- and medium-scale natural disasters.

Source: Authors' calculation, based on the data from the "DesInventar" database

Taking into account the contribution of agriculture, forest and fishing to GDP creation, especially in the regions of Vojvodina and Šumadija and Western Serbia, one of the indicators of the impact of natural disasters on the economy of the Republic of Serbia is damage to crops. This indicator is expressed in the area where the damage occurred (Table 7). Due to the effects of natural disasters, damage affected over 1,251,328 ha under crops in the observed period on the territory of the Republic of Serbia. The spatial distribution of the damage is as follows: 47.11% was recorded in the region of Vojvodina, 28.83% in the region of Šumadija and Wester Serbia and 23.20% in the region of Southern and Eastern Serbia. In all these regions, extreme crop losses were caused by floods, while significant disasters caused by drought, hailstorms and floods can be identified as consequences of low- and medium-scale disasters. However, if we compare the average effects of these disasters, it can be seen that small- and medium-scale disasters can cause greater damage than large-scale ones. It is also concerning that these risks can be prevented, but that their impact on agricultural land is not reduced, especially in regions where this activity is of special importance for economic development. For example, in the territory of Vojvodina, these natural disasters have up to 7 times greater impact than large disasters, while in the territories of Southern and Eastern Serbia and Šumadija and Western Serbia their effect varies, but, contrary to expectations, it does not decrease significantly. Considering the fact that the area of agricultural land per farm in the Republic of Serbia is 6.16 ha (Kovacevic, 2018), the issue of introducing effective preventive measures for reducing damages in agriculture caused by natural disasters becomes of great importance for regional sustainable development.

Table 7. The damage in crops per natural disaster event in the Republic of Serbia (in ha)

Period	Belgrade region		Region of Southern and Eastern Serbia		Region of Šumadija and Western Serbia		Vojvodina region	
	$DamC_L$	$DamC_{S\&M}$	$DamC_L$	$DamC_{S\&M}$	$DamC_L$	$DamC_{S\&M}$	$DamC_L$	$DamC_{S\&M}$
1996 – 2000	-	-	-	-	1,959	910	5,400	39,707
2001 – 2005	-	-	3,603	14,885	-	1,865	-	22,509
2006 – 2010	150	-	1,519	137	812	759	2,660	18,142
2011 – 2015	-	274	978	1,258	2,364	626	300	4,982
2016 – 2019	-	650	200	438	1,021	2,166	-	8,363

Note: $DamC_L$ – the damage in crops due to the large-scale natural disasters; $DamC_{S\&M}$ – the damage in crops due to the small- and medium-scale natural disasters.

Source: Authors' calculation, based on the data from the "DesInventar" database

When it comes to economic losses, it should first be noted that the database records a loss in the local currency for only 30.17% of natural disasters in the territory of the Republic of Serbia. The largest number of economic losses was recorded in the region of Šumadija and Western Serbia (47.35%) and the region of Southern and Eastern Serbia (30.57%). On the territory of Vojvodina, data are available for only 17.83% of the total number of recorded economic losses. The most up-to-date estimates are available for flood damage (46.92%) and hailstorm (19.53%). This situation indicates a lack of transparency of information on economic losses due to natural disasters. However, even on the basis of such a small number of estimated claims, it can be seen that the amount of damages is large and reaches 0.76% of the GDP of the Republic of Serbia (Figure 4). The fact that damage assessments, caused by large natural disasters, are not widely available, is of particular concern because the assessment of economic losses is available for only 23.11% of damage caused by large-scale disasters, mainly floods (77.59%).
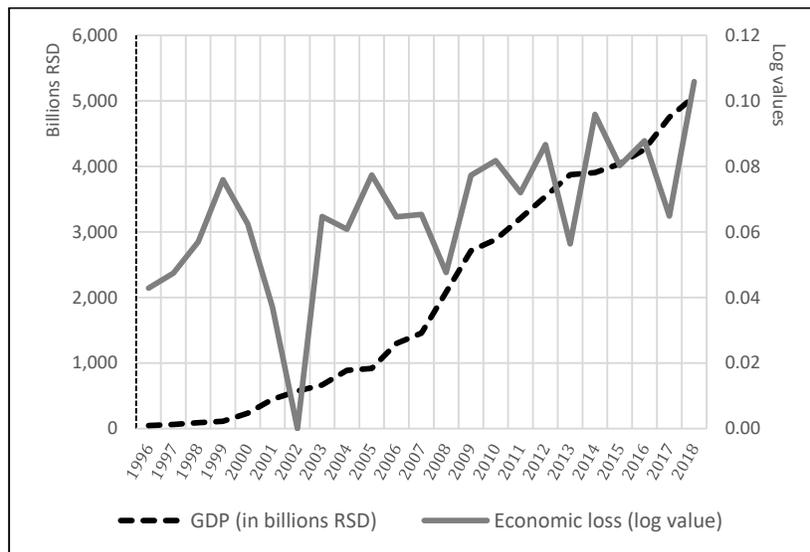

Figure 4. The value of GDP (in billions RSD) and economic losses (in logarithmic values) due to the natural disasters in the Republic of Serbia in the period from 1996 to 2018

Source: Authors' calculation, based on the data from the "DesInventar" database and the data from the Statistical Office of the Republic of Serbia

In the case of natural disasters of small and medium scale, the damage was recorded in 31.53% of the total number of disasters of this type, and the largest number refers to floods (42.62%) and hailstorms (22.03%). Due to the fact that the small number of losses is recorded, it is difficult to assess their impact on economic growth. However, if we compare the cumulative effects of these disasters in the entire period with the effects of only one extreme event, for example the extreme floods of 2014, it can be concluded that they can have a notable socio-economic impact. Thus, according to the records of the "DesInventar" database, in the floods of 2014, 19,605 houses were damaged and 420 were destroyed. The floods affected the lives and work of 162,672 people, while 23 people lost their lives. The impact on agriculture can be measured by the damage in hectares, which only during these floods amounted to 72,375 ha. On the other hand, the cumulative effects of seasonal risk manifestations, which can be characterized as small- and medium-scale disasters, are many times greater. During the observed twenty-four-year period, as a consequence of such risks, 2,088 houses were destroyed in the Republic of Serbia, and 13.67 times more were damaged. Moreover, 41 people lost their lives in these events, while 4,070 were forced to move permanently or temporarily out of their homes or suffered some other type of property damage. However, the greatest damage was done

to agriculture that suffered losses of even 1,112,891 ha. Taking into account the spatial distribution of these damages, it can be concluded that the least developed regions in the Republic of Serbia are most endangered. As the intensity of these risks does not decrease, it is obvious that more efforts and resources need to be invested in adapting to climate change in the Republic of Serbia in order to reduce the negative impacts on normal life and work and ensure the growth of agricultural production, which has strategic importance in Serbia.

CONCLUSION

The fact that crisis and emergency situations caused by natural disasters have become a part of everyday life is well-known. Their frequency and consequences increase and endanger the safety of people, critical infrastructure and sustainable economic development. The tendency of society to minimize or eliminate its exposure to risk, on the one hand, and increased volume of human activities that directly or indirectly increase the likelihood of a large number of risks, on the other, cause the paradox attitude of society towards risk. The overall effect will depend on the various factors. Some societies can be expected to learn from previous experiences of natural disasters to reduce vulnerability by better adaptation to risks. Others, due to inability to respond to climate change and to manage risks adequately, endanger the daily life and work of people. In order to increase the resilience of societies to risk and reduce the consequences of disasters, it is necessary to consider everyday hazards and seasonal risks, which cause disasters of small and medium scale. Such risks mainly affect less developed societies, creating a number of social, economic and environmental problems. The attention of institutions and the public is usually not focused on these types of disasters, although their cumulative effects may be equal to or greater than the effects caused by large-scale disasters. In contrast, the experiences gained from such disasters can be a good basis for defining a disaster management strategy.

Based on the data of the "DesInventar" global database on disasters, we can conclude that small and medium-scale disasters dominantly affect the territory of the Republic of Serbia. Their spatial distribution, despite the different geographical characteristics of individual regions, indicates the fact that natural disasters of lower scale cause greater damage to property and crops to people in less developed regions. Thus, the regions of Šumadija and Western Serbia and Southern and Eastern Serbia suffered the greatest damage. These regions are most exposed to the effects of meteorological and hydrological risks, which, compared to other regions, cause the greatest socio-economic effects in these areas. Bearing in mind that these are most often seasonal risks that have extreme manifestations in this area (such as floods, droughts, hail, and in some cases earthquakes), it can be concluded that a careful analysis of the effects of these risks over time could provide significant information on how to manage these risks, in order to prevent large-scale disasters. However, the time analysis of the natural disaster effects in the Republic of Serbia, especially small- and medium-scale disasters, indicates that their effects do not decrease over time. Despite expectations, the average consequences of natural disasters are increasing significantly, affecting the daily life and work of people in these areas and causing large material and economic losses, which in recent years has reached 0.76% of GDP of the Republic of Serbia. This situation shows the basic lack of solid empirical evidence regarding the economic consequences of natural disasters - inadequate choice of strategy for disaster risk management. Risk reduction strategies, as well as risk financing strategies, are equally important.

Considering the fact that environment and natural resources are the most vulnerable determinants of sustainability development in the Republic of Serbia (Djukic, 2012), the disaster management in the Republic of Serbia is comprehensively regulated by the Law on disaster risk reduction and emergency management ("Official Gazette of RS", No. 87/2018), while some areas that may have an impact on the environment and the safety of citizens are regulated by special laws. The Government of the Republic of Serbia defined the National Strategy for Protection and Rescue in Emergency Situations ("Official Gazette of RS", No. 86/2011), which defines certain

national coordination mechanisms and guidance programs to reduce natural disasters and the risk of accidents, protection, response and clean-up. In designing this strategy all relevant national and international documents and EU strategies are taken into account to ensure the implementation of recommendations for the development of systems for national protection. However, the conducted analyzes indicate a number of shortcomings of the existing system of protection and rescue, and the most important ones are (National Strategy for protection and rescue in emergency situations, 2011): (1) institutional and organizational, (2) material and technical, (3) cooperation, coordination and availability of information, and (4) human resources and level of education.

Institutional and organizational drawbacks refer to the lack of conditions for consistent implementation of regulations. The implementation of the preventive measures is inadequate, and an additional limitation is the lack of current specialized cadasters. The drawbacks of a material and technical nature are primarily reflected in the unsatisfactory level of traffic and other infrastructure, as well as the equipment, means and vehicles of the emergency response services, which according to recent estimates are outdated and unreliable. Strong cooperation of entities in the case of the protection and rescue system is lacking, both in the organization of preventive activities and in the organization of rescue activities in the Republic of Serbia. It can be said that the biggest drawback of the system is the insufficient cooperation of scientific and research institutions, as well as the insufficient cooperation among direct users of research. Adequate coordination and cooperation do not exist even between the subjects of the protection and rescue system during emergency situations, and the inclusion of the state, in international and global systems, implies more intensive cooperation with international institutions. Human resources and education are not at the expected level in terms of the number of staff, their specialization, qualifications and willingness to take an active role in the protection and rescue system.

This system is financed by the funds provided from the budget of the Republic of Serbia, budgets of territorial autonomy and local government bodies, and also from the Fund for emergency and other income in accordance with the Law on emergency situations. Allocated funds may be insufficient, especially when it comes to financing large-scale disasters such as the 2014 floods. For the purpose of creating effective development programs and its implementation, it is important that policy-makers completely understand the concept of sustainable development and measure its implementation in exact manner (Todorovic, 2018). The reduction of risk factors is conditioned by the development of systems for identification, assessment and monitoring of risks and early warning systems. Municipal governments are entitled to refine disaster risk management policies for regional risks implementing measures such as building policies, evacuation planning and emergency response. Companies and households can also contribute to the regional policies for natural disaster reduction through disaster-resilient building practices. Cost-benefit analyses of natural disaster risk reduction measures suggest that these prevention policies are economically desirable. Macroeconomic models and empirical literature suggest that policymakers should strive to promote economic resilience by maintaining a vibrant, flexible, and diversified economy that is able to cope with shocks (Botzen et al., 2019). Besides this, it is necessary to build a culture of security and resilience at all levels based on knowledge, innovation and education.

On the other hand, there are issues of modest offer of insurance against disasters. According to a special survey, which was carried out in the sectors of trade after the floods in 2014, only about 18% of industrial companies and 20% of retailers had insurance against natural disasters (RS Government, 2014). However, premiums paid were very low in comparison with the cost of replacing partially or totally destroyed equipment, facilities and products, so that the effects of insurance compensation of damage after the floods of 2014 were not significant, as in the previous cases of natural disasters (Jovanovic, 2014). This issue is caused by many factors, such as: lack of understanding of the need for such insurance and the benefits of providing disaster

insurance, unwillingness of local private insurers to offer this type of insurance, reinsurance absence due to high costs in relation to the risk modelling and insurance products against disaster development, as well as limited technical capacity of local insurers to meet the requirements of funding high-risk management against disasters. In an attempt to provide individuals, who cannot pay the premiums of insurance companies, insurance against catastrophic risks, creating innovative insurance products, such as index insurance, and involvement of various stakeholders in financing losses and damage recovery is necessary. Therefore, the future work will focus on the development of local disaster index and consideration of possible strategies for catastrophe risk management in developing country.

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