

CONTEMPORARY MODELS OF NATURAL DISASTER RISK MANAGEMENT

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Abstract: *The Agenda adopted by the Assembly of the United Nations in September 2015, entitled 'The 2030 Agenda for Sustainable Development', emphasizes as one of its major goals reducing the vulnerability of the population to climate change and natural disaster risks emerging as a consequence of the change. Catastrophe risk insurance is certainly one of the key factors that can contribute to the sustainable economic, social and environmental development of the country. Therefore, the subject of the paper is presenting the contemporary models of natural disaster risk management. The aim of the paper is to propose a model based on the existing catastrophic risk management models in other countries that could be applied in Bosnia and Herzegovina as well. Special emphasis will be placed, within the explanation of the existing models, on the ways of financing the elimination of adverse consequences of natural disasters.*

Keywords: *catastrophic risks, insurance, models of natural disaster risk management, Bosnia and Herzegovina.*

1. INTRODUCTION

Natural disasters have adverse impact on long-term development, economic and social aspects, affecting especially developing countries.

Although the data show that the damages caused by natural disasters in absolute amounts are more significant in developed countries, their relative amount, compared to GDP, is higher in underdeveloped and developing countries (Kocovic, Koprivica and Krstic, 2017).

According to MunichRe, only in 2017, natural disasters caused the loss amounting to \$ 340 billion, which is the second largest annual loss in the world after 2011 and almost twice as big as the one recorded in 2016. Moreover, some countries are more risk-prone because of their loss scenario, which occurs once in 250 years, exceeding 4% and even 10% of GDP (EIOPA, 2016).

In September 2015, at the Sustainable Development Summit, United Nations member countries adopted the "Sustainable Development Goals by 2030", which comprises 17 goals (United Nations, 2015). One of the major demands is to undertake urgent action to combat climate change and eliminate its consequences.

Due to the global climate change, more natural disasters can be expected in the future. Their devastating effects threaten the development opportunities of entire regions, assuming that developing countries will be most affected by them. The obvious vulnerability requires new,

integrated approaches to creating the preconditions for sustainable economic development and risk management, with the particular emphasis on catastrophe risks (Tescic, Paunovic, 2018).

The aim of the risk management of natural disasters should be to reduce their impact - before, during and after the event. Historically, the efforts in this area used to be made mainly during the disaster itself, immediately after it happened and during the recovery and reconstruction of destroyed property. Such an *ex-post* approach implies mere compensation of the losses, mostly by borrowing funds, government grants, or humanitarian aid.

Having proved to be unsustainable in the long run, the catastrophic risk management paradigm gradually shifted towards the importance of preventive measures presented by an *ex ante* approach. Natural disasters started to be taken more seriously.

Therefore, at the beginning of the last decade of the 20th century United Nations General Assembly (UN) proclaimed it to be the International Decade for Natural Disaster Reduction (IDNDR). Nowadays, a comprehensive approach that presents a combination of *ex-ante* and *ex-post* measures is mainly used.

Within *anex-ante* approach, it is possible to apply the following instruments: risk transfer, which provides the compensation for damages based on insurance premiums (the most common forms are insurance and reinsurance), contingent reserve arrangement - where the capital is accumulated by liquid assets allocation at annual level (during the years without disaster), and potential credit arrangements - where the risk is not transferred, but distributed intertemporally (Freeman et al., 2002).

In the conditions of growing intensity and frequency of catastrophic events, the priority of developing countries, such as Bosnia and Herzegovina, should be to limit the fiscal exposure to the negative effects of these events.

An effective natural disaster risk management system for developing countries involves insurance in the form of public-private partnerships (Kocovic et al., 2017).

The subject of the paper is the presentation of contemporary models of natural disaster risk management.

Based on the experience of applying the existing risk insurance schemes for natural disasters in the countries at similar level of development, as well as in economically developed countries, a model is

suggested that could be applied in Bosnia and Herzegovina. Within the framework of presenting the existing models, special attention will be paid to the ways of financing the elimination of the harmful effects of natural disasters.

2. Models of Natural Disaster Risk Management

In developed countries, unlike developing countries, the governments put in effort to partly transfer disaster recovery funding after the disaster to the insurance market. The analyses indicate that insurance is primarily a phenomenon of a developed market (Cummins & Mahul, 2009). In developing countries, insurance companies face numerous obstacles, such as small markets, political issues and inadequate institutional frameworks (Cavallo & Noy, 2011), which make it difficult to create adequate risk communities.

Therefore, the risk management policies of these countries differ primarily regarding risk transfer. Insurance, as a primary risk transfer mechanism, has several advantages: it allows risk dispersion between its holders, reduces the risk of an individual, stimulates loss reduction activities and provides the means for monitoring and controlling behaviour (Freeman & Kunreuther, 1997).

However, the use of traditional insurance in catastrophic risk management can be up to seven times more expensive than other types of insurance (due to the need to maintain reserves and high costs of liquidated damage) (World Bank, 2010).

Catastrophic risk insurance, including natural disaster risks, can be organized in the form of three modalities (Table 1).

There is a public programme, based on intensive government support, when a state insurance company offers relatively standardized insurance against certain catastrophic risks, depending on the type of risks that the country is mostly exposed to.

The second option is a private insurance programme organised by private insurers. The role of the state is only subsidizing insurance premiums to certain categories of the insured.

The third modality, created as a result of the combination of the previous two, is a public-private partnership (Kocovic, Rakonjac and Jovovic, 2016).

Table 1 The features of possible modalities of organising the catastrophic risks insurance

	Public	Private	Public-private
	programme	programme	partnership
Market penetration	high	low	high
Portfolio diversification	large	small	large
Competition	does not exist	exists	exists
Prevailing business criteria	social	commercial	technical
Service quality	low	high	high
Fiscal costs	high	low	acceptable

Source: Itturioz, R. (2009). Agricultural Insurance. Primer Series on Insurance, 12(2009), Washington, DC: World Bank, p. 20.

The model of a public-private partnership implies the establishment of a separate entity that provides catastrophic risks insurance. This special-purpose entity operates as an insurance company and has the access to the capital market and reinsurance. Private insurance companies are active in the field of marketing, selling of insurance policies, premium collection and damage assessment. The state plays the role of a guarantor. The system can be combined with other insurance arrangements. The insured can purchase some form of non-life insurance (for example, fire insurance) and automatically receive a natural disaster insurance (floods, droughts, etc.), which is in some countries mandatory (Kocovic, Randjelovic and Paunovic, 2015). A specified catastrophic event is a "trigger" for the payment of damage compensation, while catastrophic risk is distributed to policyholders and taxpayers. There are numerous advantages of the model: the state contributes to the development of the domestic insurance market; it reduces moral hazard and fiscal pressures during the recovery after the disaster, facilitates the access to the international reinsurance market and the capital market, and stimulates transaction cost reduction. Furthermore, the risk diversification is larger and an adequate level of liquidity is maintained, giving the state the possibility to provide more material assistance to the poor and the most vulnerable inhabitants affected by the disaster.

The existing catastrophic risk insurance schemes both in the countries of a similar level of development, such as Bosnia and Herzegovina, and in economically developed countries can be used to show an adequate flood risk management mechanism for Bosnia and Herzegovina. Thus, the models of catastrophic risk management in France, Turkey and Romania will be presented.

France is a country known for its public insurance system (Catastrophes Naturelles (CatNat), which provides cover against catastrophic risks (floods, earthquakes, landslides, droughts and volcanic eruptions) to real estate owners on the principle of

national solidarity. Since 1982 private insurers have had the obligation to offer cover for natural disaster risks along with property insurance at the fixed price defined by the French Treasury. Insurers directly provide insurance cover, collect premiums, perform administrative tasks related to insurance policies, assess damages and make payouts. The state is, on the other hand, responsible for the reinsurance, formulation and implementation of a natural disaster prevention programme and its relief. Since the premium rates are not differentiated according to risk levels, there is cross-subsidization by individuals from low-risk areas to individuals in high-risk areas of the country. Reinsurance is conducted by a 100% state-owned company - *Caisse Centrale de Reassurance* (CCR), transferring a part of premiums directly to the French government. According to CCR data (2017), premium rates were 12% for facility insurance, 6% (fire risk or theft), 0.5% (other risks) for vehicle insurance, and 12% for closing of a business. In local communities where there is a natural risk prevention plan, a fixed franchise of 10% is established, while in other communities the franchise amount is higher, depending on the specific circumstances (Nguyen, 2013). Since almost 99% of the enterprises and households own property insurance, the market penetration rate is rather high (OECD, 2013).

Turkey is globally ranked among the countries with the highest level of exposure to the earthquake risk. When a major earthquake hit the Marmara region in 1999, the Turkish government, with the support of the World Bank, formed the Turkish Catastrophe Insurance Pool (TCIP) in 2000. By the amendments to the regulations, the government denied the possibility to grant loans for the reconstruction to the owners of residential buildings affected by the earthquake who do not possess catastrophic risk insurance coverage. The insurance can also cover the risks of possible earthquakes, fires, explosions, landslides and tsunami, happening during an earthquake. The

insurance premium is obtained by multiplying a sum insured and a tariff rate. 15 tariff rates have been differentiated based on 5 risk zones and 3 construction styles. An average annual premium is USD 62, while the franchise of 2% is established by the insurance contract (Gurenko & Mahul, 2011). As a public-private partnership, the TCIP manages the first US\$ 80 million damage, while the rest of the damage is transferred to the international reinsurance market. The Turkish government covers the damages that exceed the capacity of the TCIP, which is sufficient to cope with the effects of an earthquake that takes place once in 350 years (Kuo, Chang, Wan & Sarabandi, 2012, p. 6). Approximately 30 authorized private insurers are engaged in the distribution of insurance policies, premium collection, assessment and liquidation of damages on behalf of the TCIP (with commission rate of 12.5-17.5%) (DASK, 2015, p. 37).

Romania has a mandatory disaster risk insurance scheme (*Programul Roman de Asiguraire la Catastrofe* - PRAC) which was created by the World Bank and Romanian Government. Natural Disaster Insurance Pool (*Pool-ul de Asiguraire Împotriva Dezastrelor Naturale* - PAID) was established in 2009 by 12 insurance companies, as the shareholders of the Pool. Each insurer is obliged to invest a minimum capital amount, whereby the share of an individual insurer cannot be higher than 15% (CCS, 2008, p. 134). According to the law, PAID provides mandatory house insurance against three catastrophic risks typical of the Romanian area: earthquakes, floods and landslides. The facilities are divided into two types according to the construction. The sum assured for the facility of type A amounts to EUR 20,000, with a premium of EUR 20 per year, while a sum of EUR 10,000 is provided for the facility a type B, and a premium of EUR 10 per year (Maccaferri, Cariboni & Campolongo, 2012, p. 119). Legal entities or individuals who do not insure their residential property shall not be entitled to any kind of assistance by the state or a local government if it gets damaged by a natural disaster. At the same time, failure to comply with the obligation to insure against catastrophic risks is punishable by a fine ranging from 100 to 500 RON (approximately 22-110 EUR) (Orheian, 2013, p. 178). Distribution of policies, collecting premiums, assessment and payment of damages are performed by the insurers on behalf of PAID pool (with a commission of 10%) (Antal, 2012, p. 831), but they run the risk only in the amount of their share in the pool capital. If all the funds of the PAID fund are exhausted, the government should provide additional funds to settle the obligations to the insured.

Prior to suggesting a new model for natural disaster risk management for Bosnia and Herzegovina, it is necessary to consider possible ways of catastrophe risk financing within the existing models.

3. Models of disaster recovery funding

Disaster recovery funding is one of the most controversial issues. Catastrophic events are forms of crisis which can significantly determine further course of the country's progress. Globally, there are a number of solutions for disaster recovery, presented in the previously analysed examples. The adequacy of the funding system is conditioned by risk distribution. The instruments for natural disaster recovery should be selected depending on the frequency and intensity of the disaster (Punkdrik, 2010).

Risk distribution is conducted by different risk aggregators at different levels (SwissRe, 2011): subnational aggregators (individuals and corporate entities - low level aggregation); national aggregators (domestic insurance companies and governments - medium-level aggregation); multinational aggregators (international insurance companies - higher-level aggregation) and global aggregators (international reinsurance companies and bond markets - the highest-level aggregation). The bigger the risk community, the higher level of aggregation it turns to be. According to the criterion of the most frequently used instruments, there are several modern, applied models of catastrophe risk financing: catastrophic damage relief (Doś, 2013); a risk transfer model, a market risk model, a supported market risk model, and a public-private partnership model.

In the countries of lower level of development, such as Bosnia and Herzegovina and in some developed countries, there is a tendency to underestimate catastrophic risks. Under such conditions, the risk community is too small; the insurance is not used enough, which leads to higher insurance premiums or the withdrawal of insurance products from catastrophic risks. When a catastrophe occurs, there are damages that cannot be compensated without government intervention. However, when the state is an aid provider, insurance coverage is unnecessary (the insured pay premiums, while the uninsured get insured even though they do not pay premiums). In literature, the phenomenon is called a "disaster syndrome" (Kunreuther, 2000).

In a risk transfer model (Poland, Germany, Italy), the problem is neglected, and *ad hoc* donations by the government are allocated to the uninsured affected by disasters. The bulk of the burden of disaster recovering funding is carried by the state,

that is, taxpayers. This system does not provide sufficient security to the victims, since the size of the *ad-hoc* aid is not regulated and is conditioned by media intervention and political factors (Jha, Bloch, Lamond, 2012).

A market risk model implies the catastrophic risk allocation among insured persons. Primarily on the US market, some insurance companies have begun to apply a range of innovative solutions (e.g. issuing insurance-linked securities (ILS) or establishing sidecars to collect sufficient disaster relief funds) (Cummins, Weiss, 2009). It led to strengthening the market capacity and the insurance. On the other hand, risk-adjustment is far more expensive and less available to the poor (Mendoza, 2011).

In some countries, the authorities put in efforts to increase the availability of insurance products. This is a model in which damages are covered through insurance, while the catastrophic risk insurance market is significantly supported through the regulations and the instruments of public finances. An example of a supported market risk model is the United States, where the state acts as a reinsurer. However, subsidizing an insurance premium creates a substantial social cost, leading to inequality, increasing moral hazard and loss growth (Klein, Wang, 2009).

In the system of catastrophe risks financing, prevention is extremely important. Insurance companies have developed a series of measures that encourage insurers to act preventively to mitigate catastrophic risks.

Parametric insurance (most commonly used in a public-private partnership model) reduces moral hazard and encourages prevention more effectively than traditional insurance. The examples of the implementation of a public-private partnership in catastrophe risk financing are the South East Europe and the Caucasus Regional Risk Insurance Facility Project, the Pacific Catastrophe Risk Assessment and Financing Initiative, and the Caribbean Catastrophe Risk Insurance Facility.

4. Proposal of a model for natural disaster risk management for Bosnia and Herzegovina

The territory of Bosnia and Herzegovina is exposed to various types of natural disasters. Some of the most present are droughts (2000, 2003, 2011 and 2012) and floods (2002, 2004, 2006, 2009, 2010, 2013 and 2014). Nevertheless, in terms of material damage and lost human lives, extreme floods and landslides in 2014 were the most devastating. The heavy rainfall that hit Bosnia and Herzegovina that year caused the worst floods and landslides over the last 120 years. According to UNDP Bosnia

and Herzegovina data (2016), the natural disaster affected millions of people, inflicting enormous material damage to the infrastructure, economy, households and crops worth over 2 billion EUR, out of which over EUR1.02 billion in the Federal Republic of Bosnia and Herzegovina and in the Republic of Srpska it amounted to 965 million EUR. It is estimated that the floods caused the damage of 15% of GDP. According to the Insurance Agency of the Republic of Srpska, in 2014 the insurance companies paid a total of 24.78 million KM in compensation to the victims who had flood insurance (or 1.31% of the total estimated economic losses in the RS).

The abovementioned data clearly indicate that there should be a serious approach to creating a flood insurance scheme, as the most present natural disaster in the area, in the form of a public-private partnership based on the efficient existing models abroad. The paper presents a suggested model of a state programme for flood risk insurance, as a combination of mandatory index and traditional insurance, bearing in mind that the same scheme can be applied to other natural disasters, such as drought, earthquakes, etc.²The following are the key elements of a macro model which can be applied to all river basins in Bosnia and Herzegovina:

The holder of the State Flood Insurance Program would be a special legal entity founded by the state, with 51% stake, and three insurers with the best rating with 49% stake. It is necessary to establish 2 Pool insurances, one in the Republic of Srpska and the other in the Federation of Bosnia and Herzegovina.

The legal entities would be responsible for securing, implementing and managing mandatory index and mandatory or voluntary traditional flood insurance. To enable their foundation, appropriate amendments to the legislation are necessary. In the Pools, the appropriate Guarantee Fund should be established (from the funds that will be taken from the collected premiums, as well as from the implemented contribution for natural disasters). The financial resources from the Guarantee Fund would be used only when the Pool's reserves are not sufficient enough to cover the damages higher than expected, as well as for preventive measures. In the absence of the funds from the Guarantee Fund, damages would be covered from the state budget.

²The model was proposed as a part of the United Nations Development Project (UNDP 2017), where Prof. Jelena Kocovic, Ph. D. participated.

In the Insurance Act it is necessary to separate flood insurance, as an independent type of insurance. In Bosnia and Herzegovina, flood insurance is organized as an insurance of so-called additional risk, which is separately considered when fire insurance and natural disaster policies are taken out. Flood risk also occurs in property insurance, Casco insurance, goods insurance in transport and accident insurance. Separating flood insurance, as a special type of insurance, from other natural disasters is a necessity, since according to the current regulations this insurance cannot be contracted independently.

It is necessary to introduce mandatory index insurance for agricultural protection against flood. The insurer would be the Pool insurance in case of floods, the sum of insurance would be 300 KM, a premium rate 10%, i.e. insurance premium would be 30 KM. Indices would be determined by individual agricultural crops, in accordance with risk maps, based on the ratio of perennial average crop yield (kg/ha) and perennial rainfall average (mm/ha) or level of water, multiplied by the market price of the product (KM/kg). The insurance payout would be determined on the basis of the deviation of the actual amount of rainfall (or water level) during the insurance period from the perennial average (at least for the previous five years) and index values. To establish an index insurance model, it is necessary to make amendments. All subsidies in agriculture would be conditioned by the possession of an index and/or traditional flood insurance. In addition to index insurance, voluntary traditional agricultural insurance for farmers would also be offered, above the insured amount for index insurance, with state subsidies amounting to 40%.

It is also necessary to introduce mandatory or voluntary traditional insurance of households, business facilities, educational facilities, health facilities and cultural facilities from flood risk within a public-private model. For house insurance, the state would subsidize the premium in the amount of 40%, while the subsidies by municipalities would be from 5% to 10%, depending on economic aspects. For education, health and cultural facilities insurance, the state would bear the costs of a flood insurance premium by providing material costs to these entities. The legal entities would pay the premium by themselves. Tariffs for traditional house and agriculture insurance would be determined in accordance with the number and amount of the damage over the previous period (at least 10 years) caused by floods, and differentiated on the basis of risk maps. As for insurance tariffs, the experience

of the insurers from Serbia, Bosnia and Herzegovina and Slovenia would be used, as well as the conditions and databases on the number and damage amount in the risk zones in Bosnia and Herzegovina for agriculture and house insurance. The premium rate should include an additional amount to cover the operating costs of the Pool.

The Pool would take some of the risks in line with the financial capacity, and additional risk would be re-directed abroad directly to renowned reinsurers. The sources of the Pool funds would be: insurance premiums, budget funds allocated for prevention, contributions for catastrophic risks, and donations. The Pool insurance would be under the direct control of the state through the Ministry of Finance of the Republic of Srpska, that is, the Federation of Bosnia and Herzegovina, which would be responsible for implementing subsidization of the premiums and control of the operations of the Pool, as well as for the implementation of an active public campaign promoting flood insurance. Local governments would provide data on facilities, land, damage on their territories, and check the fulfilment of an insurance obligation. According to the Law, the Insurance Agency would be in charge of controlling the legality of operations of the Pool. Direct reinsurance of catastrophic risks abroad should be allowed according to the law. Therefore, Bosnia and Herzegovina should join the Europa Re project.

The realization of the model also implies the introduction of a mandatory fund in the municipalities and at the state level within the mandatory budget reserve for flood prevention, as well as the contributions of 0.5% to net income from which the state would finance the Guarantee Fund. The state would allocate a part of the funds for preventive measures to the municipalities according to the situation and needs.

The combination of *ex-ante* and *ex-post* approaches in this way would lead to a gradual decrease and withdrawal of the state, as the most dominant and the only entity from whom it is expected to manage flood recovery.

CONCLUSION

Under the influence of global climate change, natural disasters are becoming more frequent, and their consequences more destructive. The ability of developing countries to limit fiscal exposure regarding catastrophic risk is vital for their sustainable development. An efficient model of natural disaster risk management for developing countries, such as Bosnia and Herzegovina, implies the insurance in the form of a public-private partnership. An extremely low share of the

insurance sector in flood coverage in the previous period indicates that a serious approach is needed to create a flood insurance scheme, one of the most significant natural disasters in the area.

Based on a comparative analysis of the experiences of other countries, the paper proposes a model for flood and other natural disaster risk management in Bosnia and Herzegovina. The proposed model, in the form of a public-private partnership, is a combination of mandatory agriculture index insurance and traditional mandatory or voluntary flood risk house, corporate and facility insurance. The insurance holders would be the insurance pools in entities, which would be reinsured abroad along with having the Guarantee Fund. The implementation of the model would require the introduction of mandatory contributions for natural disaster risk management, as well as a number of legal amendments. Through the reduction of fiscal exposure regarding floods, budget funds would be directed to vulnerable categories of the population, and an effective approach to the international reinsurance market would be realised. Finally, the proposed model for catastrophic risks management would contribute to the sustainable development of the country.

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SUMMARY

Natural disasters have adverse impact on long-term development, economic and social aspects, affecting developing countries in particular. The focus of natural disaster risk management should be to reduce their impact - before, during and after these events. Due to growing intensity and frequency of catastrophic events, the priority of developing countries, such as Bosnia and Herzegovina, should be to limit the fiscal exposure to the negative effects of these events. An effective natural disaster risk management system for developing countries involves the insurance in the form of a public-private partnership. There are numerous advantages of the model. In the countries of lower levels of development, such as Bosnia and Herzegovina, as well as in some developed countries, there is a tendency of underestimating catastrophic risks. The paper presents the suggested scheme of the state program for flood risk insurance, as a combination of mandatory index and traditional insurance, while the same scheme can be applied to other natural disaster risks, such as drought, earthquakes, etc. The combination of *ex-ante* and *ex-post* approaches would lead to a gradual withdrawal of the state, as the most dominant, and the only entity which is expected to manage flood recovery.