

Problems of landslides in Serbia, their prevention, remediation and insurance

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Abstract: Over the past ten years, particularly during the last two, the occurrences of natural hazards such as landslides, landfalls and rockfalls are frequent. Instability should be caused either by natural geological conditions (natural disaster) or by human activities, when is applied as technogenic or anthropogenic hazards. The main goals of this work are to highlight the causes of enhanced risk and necessity of their recovering and preventive measures, as well as the costs of estimated damages in accordance with the Law on Emergency Situations (“Official Gazette of the Republic of Serbia”, no. 111/2009, 92/2011, 93/2012), Law on planning and construction (Official Gazette of the RoS, no.72/2009, 81/2009, 64/2010) and the Insurance Law (Official Gazette of the RoS, no.55/2004, 61/2005.85/2005.101/2007.63/2009).

Key words: natural disasters, landslides, flooding, preventive measures, recovery, refund of damages, insurance

1. Introduction

The area of Serbia, concerning the risk from natural hazards, is within the vulnerable regions. Approximately 30% of its territory is exposed to landslides. The number of landslides in Belgrade exceeds 750 and in Serbia as many as 36000. The more vulnerable areas in Belgrade are Karaburma, Mirijevo and some parts of Zvezdara. Large and complex landslides are those near Beška, Čortanovci, landslide Duboko at Umka, the area between Belgrade and Smederevo, road along the Djerdap Gorge, etc.

However, landslides are the global problem. The annual costs for damages caused by worldwide landslides are estimated on several billions of dollars. These disasters give thousands of human victims every year. Introducing with these emergencies and avoiding construction on land at risk is necessary for reducing damages (<http://www.geologija.org/articles/geo.php?t>, 2006).

The large flood events in 2014 led to landslides that caused great loss to inhabitants and economy in Serbia though the possibilities and ways of compensation of these damages need to be taken in consideration.

2. Methods and results of researches

In this paper were applied normative-analytical and statistical methodology based on analyses of valid rules that concern natural hazards and emergency situations, the conditions and modalities of construction and insure properties, as well as statistic data obtained by the insurance companies Axa and Delta Generali.

Obtained results led to conclusion that is Serbia seriously endangers by landslides and that measure for elimination of causes and harmful consequences has to be undertaken.

3. Landslides

3.1. The development of landslide

Landslide occurs on terrains built of young and weakly cemented rocks, especially on Tertiary and Quaternary clays, but may occur at flysch products composed of marlstone, sandstone and limestone. The development of landslide depends on geological background and being additionally supported by tectonic movements, which took part during the geological evolution (Čolić, 1987)

Landslides occur on slopes of various angles, from very gentle to steep. The speed of movement of material widely ranges, and the final effects of land sliding depend on the volume and speed of downslope movement.

Landslides are often the consequence of some misbalance (instability) of soil. They represent an "attempt" of soil to reach the balance (stable) state. They become active usually after torrential rain flows or sudden melting of snow. Two elements are required for the development of landslide:

1. Slope
2. Water

Water erosion takes part with any rain drops that falls on the ground. The intensity of erosion depends from speed and intensity of rainfalls. The latter varies from very mild to torrential. The erosion is commonly caused by more intensive rainfalls, with the intensity of about 1 millimeter per minute (Gavrilović, 1987)

However, the existence of slope saturated with water does not lead always to formation of landslide. Numerous factors, such as type of soil, steepness of slope, level of ground water, rate of soil damage caused by tectonic movements or by human activities, earthquakes, volcanoes, weight of artificial objects on slope (roads, buildings, etc.) control landslide formation. In the sense of lithology (type of soil) the clays are particularly significant in landslide generation. Clays are able to absorb water and swell (increasing their volume up to 3-4 times). Although the landslide may occur at gentle slopes, the risk of it increases with the steepness of a slope. As a rule, landslide forms with the rise of level of ground water. Tectonic is also the important factor. If the sedimentary layers deep parallel to the slope, than bedding planes easily can be transformed into sliding surfaces. Tectonic movements can disturb ground causing misbalance that develop landslide afterwards. Instability of ground is often caused by human activity. Construction of building at inappropriate locations can overlade the slope and initiate the landslide development. Additionally, the constructions of certain objects at unsuitable places can embarrassment ground water and accumulation of large amount of water at the slope base. Digging and storing of large amounts of soil at certain places lead also to misbalance of the slope and to landslide development. Earthquakes disturb the stability of slopes and support the occurrence of sliding. Those with magnitude exceeding four are called "initiators of landslides" (Petković, 1978).

3.2. Types of landslides

Landslides may be classified using different criterions: structure of slope, place of origin, way of motion, depth of sliding surface etc. (Marković *et al.*, 2003).

According to the depth of sliding surface can be distinguished:

1. **Surface** (up to 1m deep),
2. **Shallow** (to 5m),
3. **Deep** (to 20m) and
4. **Very deep landslides** (exceeding 20m).

According to the mode of origin could be recognized:

1. **Delapsive landslides** (landslide impulse spreads from the basis of slope upward, towards the top),

2. **Detrusivne landslides** (forms at higher altitudes on slope and shear forces spread downward, towards the basis)

According to the shape of sliding surface, relief and way of motions Bognar (1996) distinguished:

1. **Creep,**
2. **Rotational,**
3. **Stepped landslide,**
4. **Block landslide,** and
5. **Earthflows landslide.**

Heavy rains in our country in May, 2014 and afterwards left a large amounts of water that eroded and destroyed ground, moving a part a huge amounts of eroded material. Torrential streams destroyed fields, roads, railways, houses and other objects. After floods, a broad landslides occurred (Figures 1.2.3, and 4).



Figures 1 and 2. Landslides in the village Bogdanje by Trstenik.
(<http://www.geologija.org/articles/geo.php?t>)



Figures 3 and 4. Landslides (http://www.rtv.rs/sr_lat/drustvo/spiskovi-klizista-za-sanaciju_487209.htm)

3.3. Rehabilitation of unstable occurrences

Restoration of unstable terrain itself includes the determination of the terrain's property within the broader area, as well as in the area of landslide. This process embraces various geological methods (engineering-geological, land mechanics, hydrogeological, etc.). According to obtained data the decision of restoration or utilization of certain measures (reforestation, arrange of park surfaces etc.) takes place.

Large landslides lead to catastrophes. The restoration of unstable regions, particularly landslides, is one of the heaviest geotechnical tasks. Struggle against is very hard, long-lasting and expensive in spite being often unreliable (Čolić, 1987).

The main prevention measure is the elimination of the cause of landslide development. As the water represents one of the main factors, the gathering of water in susceptible terrains requires a particular attention. In urban areas the construction of appropriate sewage system is obligatory. Septic tanks and damaged sewer systems destabilize terrain. Vegetation of high absorption ability for sufficient moisture (e.g., willow) should be plant where it is possible.

Forests help in stabilizing ground by tree roots. However, vegetation does not help significantly at broad landslides as a sliding surface is often at depths greater than that of roots. In such cases the whole forest removes. Landslide in forest is accompanied with bending of trees and such occurrence is referred "crooked forest".

In some cases at already removed landslides is not possible to apply rehabilitation until they stop moving. Such case is in the village Bogdanje, near Trstenik, where nearly all inhabitants had to be displaced due to landslide approximately 2 km long (<http://www.geologija.org/articles/geo.php?t>).

The struggle against landslides commonly includes diggings up, use of piles, building of defense walls and accesses a drainage (carrying off water). Identified rockfalls and landslides in Serbia are presented at the map, which was prepared by the Institute for roads in Belgrade (figure 5).

4. Remediation of damages after natural hazards

4.1. The loss of damages caused by natural hazards in Serbia, excluding the earthquake in Kraljevo, until December, 2013 reached 10.5 billion of dinars. This estimation was presented in the journal „All about insurance“ by

the Government Commission for Emergency Situations on the basis of data proceeded by local self-governments. It has been estimated that the renovation of houses, hospital, schools and other destroyed objects in Kraljevo would cost at least the same. According to the preliminary estimation for floods caused by the River Lim, the additional half of one billion of dinars will be needed. Therefore, the total sum of loss is 21.5 billion of dinars, and the biggest part will be provided over taxpayers (<http://www.sveoosiguranju.rs/?page=227>).

The announce of emergency situations, when a sudden disaster interrupts a common life, brought victims and either a great damages of properties or its loss including damages in infrastructure that exceed the financial ability of an community. In such instances endangers are left only to compassion and the potential budget excess. The latter is commonly missing. For example, the budget for 2013 predicted six time lesser amount for covering costs of injures or damages caused by elementary disasters or some other natural hazards than it has been really after floods, discharge of ground water, hails and landslides.

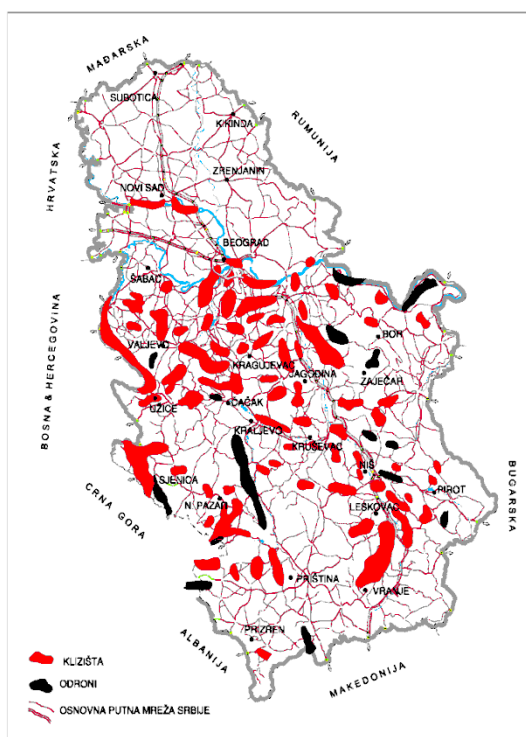


Figure 5. Map of rockfalls and landslides in Serbia (Abolmasov, 2014)

4.2. The whole year is behind the catastrophic flood events, the largest emergency situation in Serbian history. Total costs and financial loss exceeded 1.53 billion of euros, what is 4.5 % of the gross national income in Serbia. The costs for recovery and remediation are mostly paid by national budget resources, donations and foreign credits, whereas the insurance companies covered insignificant part of the total loss (<http://bif.rs/2015/07/osiguranje-u-borbi-protiv-elementarnih-nepogoda-kad-ce-to-meni-da-se-dogodi/>).

4.3. Economy and inhabitants were not assured and such trend excluding the short-lived interest for the insurance just after terrible floods, continued. The citizens did not change their decision concerning insurance although a catastrophic scenes of flooded, almost sunk cities and destroyed houses, and drowned cars including efforts and advices of economic advisers to protect their properties and assure them for emergency situations.

Undoubtedly the conscience of insurance regarding natural hazards should be much higher in the country that has been hit within the last decade several times with destroyable tempests and human victims and significant material losses (earthquakes in Mionica, Kraljeva, floods along the watersheds of the Rivers Danube, Sava and Tamiš, and subsequently landslides).

In spite worst economic situation and low conscience on the insurance significance, the Republic of Serbia has in the future decade to yield and apply measures for increasing the role of insurance companies in solvation of problems after elementary disasters. Thereby, the insurance would be much more important resource for recovery programs than it is now.

4.4. The first step should be the establishing the Strategy of Serbia, which should clearly determine the obligate insurance and those state needed. So, the priorities would be defined. As been exposed to inappropriate influence of climate changes and frequent accidents, Serbia needs to protect its strategic segments. The last year, when disaster flood events in May destroyed expensive equipment of state companies which were not assured, should not be repeated ever again (<http://bif.rs/2015/07/osiguranje-u-borbi-protiv-elementarnih-nepogoda-kad-ce-to-meni-da-se-dogodi/>)

One of the main measures should be to insure the large state corporations from natural hazards. The most endangered sectors by mentioned floods were mining and energy sector. Although their loss was estimated on 180 million of euros, it is much more due to break in coal production. The state was forced to export electricity to supply the economy as well as citizens.

Though the total loss exceeded 300 million of euros, reflecting that the mining and energy sector experienced a deficit of nearly half billion of euros.

Another step should be the implementation of insurance from natural hazards for collaterals. Any credit given by a bank and supported by hypothecation of properties should include insurance from natural hazards not only from a fire as at present.

4.5. Insurance companies suggest to introduce the so-called „French model“ of insurance against loss from natural hazards, which although simple and of acceptable price, allows citizens better financial support in extreme weather instances. This model considers the legislations between insurance policies for fire rescue with risks from floods, earthquakes, hails etc. This will enable to owners of policies for house or apartment protection against the main risk to count on covered risks from the natural hazards, too. This model is also applicable on the economy.

The example of Romania, which introduced the obligatory insurance after the flood events in 2010, although less destructive than that in Serbia, is often mentioning as a proposal in our country.

4.6. Serbian citizens hardly insure their property. According to data of the Central bank, the total rate of premium from insurance from floods and earthquakes makes only 0.8 % of the total rate of premium from general (any that is not life insurance) insurance. According to data provided by the National bank of Serbia for the past nine month the insurance from floods participate with only 1.5 % of the total rate of premium from general insurance; against risk from earthquake about 0.6 %. It should be emphasized that statistical approaches were not practiced until this year.

There are two reasons for such suspicion of Serbian citizens. Although a majority of the insurance companies do not ask license application or legalization document for object, if their workers get opinion that house or office is on rescue land and may be easily drowned every year, the premiums may be very high and out of financial ability. If this insurance is obligatory, than the premium would be lower, due to greater number of houses/objects that are covered with insurance.

The second reason has psychological roots. Actually, citizens do not have in their mind that elementary accidents occur worldwide, i.e. everywhere and that nobody is "spared". However, the interest of citizens for policy insurance that encloses risk from earthquake increased, although not drastically, after the earthquake in Kraljevo.

4.7. Taking into consideration that the elementary accidents became serious threat, the insurance companies underline this type of insurance. In this situations when people do not insure their properties even from the major risks, and expect help from governments if something bad happened, the country is that who is responsible and should involve significant changes and enlarge number of obligatory insurance.

5. Conclusion

According to all cited above, may be concluded that the area of Serbia is seriously exposed to risks from landslide and that in the last two years these occur at large scale. Landslides derived after floods in 2014 caused the enormous loss to citizens and economy. Efforts for the loss reduce include better knowledge and introducing with these occurrences. The elimination of causes needs sustainable strategy of prevention measures and recovery. Their implementation for already undergone damages exceeds the financial capability of the country itself. One of the possibilities in providing financial support and financial safety in emergency situations is that country has to accept measures for increasing role of insurance in such cases. This should be provided either over the obligatory act within the already existed standards defined by law or by introduce the quite new regulative.

References

- Albomasov B. 2014. Predavanja iz inženjerske geodinamike. Zaštićena multimedijalna prezentacija. www.rgf.rs
- Gavrilović Z. 1987. Elementarne nepogode i katastrofe: Prvo jugoslovensko savetovanje u Budvi. Narodna tehnika, SSNO, Beograd, 297-311
- Marković M., Pavlović R., Čupković T. 2003. Geomorfologija, Rudarsko-geološki fakultet. Zavod za udzbenike, Beograd.
- Petković K. 1978. Geologija Srbije. Inženjerska geologija-VIII-2. Zavod za regionalnu geologiju i paleontologiju, Beograd.
- Čolić B. 1987. Elementarne nepogode i katastrofe: Prvo jugoslovensko savetovanje u Budvi. Narodna tehnika, SSNO, Beograd, 282-296
- <http://www.geologija.org/articles/geo.php?t> (2006)
- http://www.rtv.rs/sr_lat/drustvo/spiskovi-klizista-za-sanaciju_487209.htm (2014)
- <http://www.sveoosiguranju.rs/?page=227>
- <http://bif.rs/2015/07/osiguranje-u-borbi-protiv-elementarnih-nepogoda-kad-ce-to-meni-da-se-dogodi/>