FLASH FLOODS RISK PERCEPTION TO SUPPORT SOCIAL RESILIENCE IN THE BEND SUBCARPATHIANS, ROMANIA

Dr. Micu Dana, **Dr. Sima Mihaela, Dr. Dumitraşcu Monica**,

Dr. Grigorescu Ines, Dr. Dragotă Carmen

Institute of Geography, Romanian Academy, **Romania**

ABSTRACT

Assessing and communicating public perception on flood risk became essential for assuming effective and efficient management actions and policies, especially in areas prone to extreme natural events (e.g. floods). The current study explores the community awareness and perception on flash floods and their role in fostering social resilience, in relation to the mitigation measures carried out by local authorities. The study-area is located in the Bend Subcarpathians (Romania), a region known for its high seismicity and dynamics of hydro-geomorphic processes (e.g. floods/flash floods, landslides). The area proved its high exposure to flash floods in small river catchments (below 200 km^2), during some recent major events (e.g. 2005, 2010), which impacted significantly the local rural communities, determining great losses to their assets, as well as psychological effects. The current research relies on a questionnaire-based survey which was conducted in the summer of 2014 and addressed to 50 households form seven rural settlements, significantly affected by flash floods. Therewith, several structured interviews were held with local authorities (e.g. local decision-makers, county Civil Protection Inspectors). The questionnaire survey provides some valuable insight into the local human vulnerability to environmental change and extreme hydro-meteorological events, aiming to outline the previous personal experience, people's awareness and worrying, as well as the post-disaster level of preparedness. The survey underlined some discrepancies between people's perception on the local authority's reaction during and post-event and the local authorities' perception on their response and preparedness measures. Moreover, a high interest of local authorities to access scientific data (e.g. flash flood hazard and risk maps, climate change projections) in order to support the development of adequate mitigation measures, was also noticed. However, the lack of financial support is still limiting factor in their implementation, as well as the development of long-term strategies.

Keywords: flash floods, awareness, worry, preparedness, Bend Subcarpathians.

INTRODUCTION

Romania is recognized by the Romanian Catastrophe Insurance Scheme (PRAC) as highly exposed to natural disasters including earthquakes, floods and landslides. Among all these threats, floods are dominant in terms of frequency (e.g. the severe floods have in some areas, like plain landforms, low return periods of up to 10 years) and economic damage losses, having a great impact on human communities. The country profile of the

EM-DAT natural disaster database ranked the floods of June 2010 as the costliest from all past flood events, through a total economic damage cost of over 1 million US$x1,000 at national scale, followed by the floods of June 2005 (800,000 US$x1,000). According to the Natural Disaster Insurance Pool (PAID)[1], the floods of 2005-2010 produced in Romania a total (direct) loss of more than 3 billion € (1.5 billion € only in 2005), including 62,000 affected and 15,600 destroyed houses.

The Bend Subcarpathian region is prone to slow-onset floods, affecting the medium- and large-size river basins, but also to flash floods, the most common and widespread hydro-meteorological hazard in the areas meeting favorable triggering conditions such as: small catchments, steep slopes, high relief fragmentation, low duration heavy rainfalls (exceeding the concentration time of the river basin) with a prevailing torrential and a high intensity character [1]. The areas affected by flash floods are commonly small rural settlements, in general with a limited adaptive capacity to the adverse effects of such events, due to the regional socio-economic vulnerability context (e.g. aging population, low economic power). A flash flood susceptibility index developed by [2] was used to identify the rural settlements located in areas with a high susceptibility to flash floods with return periods of 50 and 100 years in the Subcarpathian sector of the Teleajen and Buzău River Basins, taking into consideration the great variability of triggering factors (e.g. concentration time, length of water courses, average basin slope, curve number parameter) (Fig. 1). The exceptional flash flood events which significantly impacted the local rural communities of the Bend Subcarpathians were recorded in 1975, 1991, 2005 and 2010, but among them those recorded in 1975 and 2005 were particularly severe, as revealed by the historical cumulated precipitation amounts and maximum discharges recorded in the network of in situ meteorological and hydrological measurements.

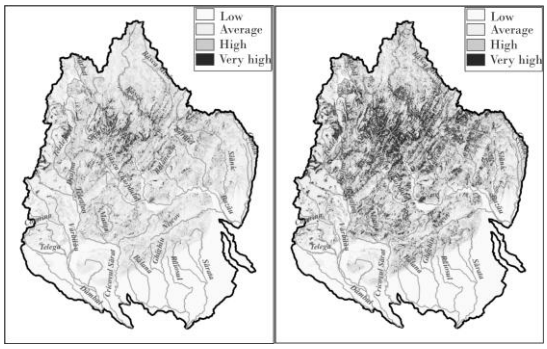

Fig. 1. Flash flood susceptibility index with 50 year (left) and 100 year (right) return periods in the Teleajen-Buzău hydrological area (Bend Subcarpathians) [2].

This study presents the current perception of flash flood risk at the level of villages and communes targeting affected households. The analysis was conducted on the basis of the social and cultural settings of affected population sample. The local rural community perception to flash flood risk is addressed at the level of three components based on the concept proposed by [3] (awareness, worry and existing level of preparedness; the previous individual experience was included as an additional component) which suggest the transition towards a resilient community to flash floods.

[1] www.paidromania.ro

METHODOLOGICAL APPROACH

This study was undertaken in seven rural settlements of the Buzău (Chiojdu, Lera and Bâsca Chiojdului villages and Starchiojd Commune) and Prahova counties (Cerașu, Valea Borului and Slon villages) located in areas highly susceptible to flash flood occurrences of the Bend Subcarpathian region (Fig. 2). This region was selected as representative flash flood case study in the VULMIN project (Vulnerability of the environment and human settlements to floods in the context of Global Environmental Change). The research followed a people-centred approach, using a questionnaire-based survey which collected data from a sample of 50 affected households by the flash floods in the past (1975), but also in the recent years (2005, 2010). These households were identified according to the operational reports of local authorities where total loss exceeded in general the average household income and special recovery support was needed (e.g. food and drinking water supplies, assistance to families with affected houses, provision of repair materials).

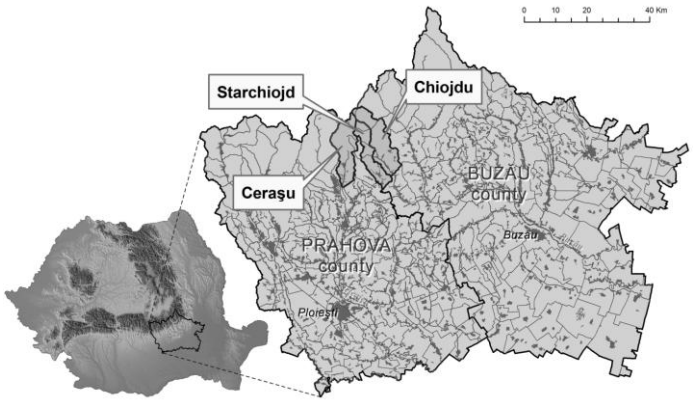

Fig. 2. The location of targeted rural communities.

The questionnaire totaled a number of 57 items and was organized in three main sections: i) local context of rural settlements vulnerability to flash floods, ii) vulnerability to flash floods and iii) elements at risk. The general objective of the survey was to highlight the public perception on flash flood hazard, but also the attributes of societal vulnerability and the environmental issues related to the available local drinking water resources: e.g. the causes and consequences of the recent flash floods in the area, people behavior during the past flash flood events, the proficiency of measures undertaken by the authorities to manage the crisis situation, people's willingness to volunteer, current preparedness to similar hazards. The key topics of the analysis such as previous flash flood experience, awareness and knowledge, worry and preparedness were investigated through key variables (Table 1) derived from the questions formulated in a simple unambiguous language, in order to minimize the risk of misunderstanding. Further investigations to understand the local community perception on flash flood risk were conducted through direct interactions with representatives of local authorities (municipality and county civil protection), through participatory-oriented interviews.

The research sample of the affected people have an overrepresentation of males (60.6%), young respondents (50% share of persons below the age of 40) and middle level of attained education (75.8%).

Table 1. Key variables investigated during the perception survey on flash flood risk

Key topics	Key variables
Previous experience to flash floods	Personal experience (residence flooded, evacuation during flooding) Indirect experience (knowledge about relatives, friends or known people affected by flash floods)
Awareness	Perception of living in an area prone to flash floods Knowledge level of the local flash flood causes Awareness on previous flash flood damage potential
Worry	Degree of worry associated to the main natural hazard types in the area Degree of worry regarding flash flood occurrence in the area Degree of worry related to personal, relatives
Preparedness	Self-assessed level of personal preparedness Measures required for community preparedness Measures undertaken by authorities for community preparedness Proficiency of measures undertaken by authorities for community preparedness Responsibility for implementing preparedness measures

There are also high retirement (21.2%) and unemployment (24.2%) rates in the sample of the affected population (Table 2). Despite these overrepresentations, the targeted group is still characterized by a large range of elderly people with mixed education and income levels, which ensure the robustness of findings and reflects the main social characteristics of the local affected community. By means of elements at risk, most respondents had their households located in flash flood prone areas, as also validated by the values of flash flood susceptibility index.

Table 2. Characterisation of the affected population sample

Age (years)	**%**	**Ethnicity**	**%**	**Income level (€)**	**%**	**Income source**	**%**
<40	50	Romanian	93.9	<150	21.2	Public services	15.2
41-50	11	Rroma	6.1	150-250	45.5	Private services	21.2
51-60	18			250-350	9.1	Retired	21.2
<60	21	**Education (ISCED)***	**%**	350-450	9.1	Other	18.2
		1	3.0	>450	15.2	Unemployed	24.2
Gender	**%**	2	75.8				
Male	39.4	3	6.1	**Geographic position of the household**			**%**
Female	60.6	4	3.0	Floodplain			41.2
		5-6	9.1	Alluvial cone			11.8
		No studies	3.0	Terrace			47.1

* ISCED 2011

RESULTS AND DISCUSSIONS

Previous experience to flash floods

Past experience of population related to flash flooding and the perceived associated risk play a key role in shaping the future individual behavior and response to the upcoming

events [4]. The recent flash floods of summer 2005 appear as a permanent reminder for most respondents under the age of 50, while the events of July 1975 only to those above the age of 60. The perception of residents on flash-flood risk is largely influenced by the recent extreme hydro-meteorological events of 2010, but especially of July 2005. In this month, the prolonged spells of heavy rainfalls contributed to the large positive anomalies of the annual amounts (50-70%) and resulted in peak maximum discharges over 2,000 l/s/km^2 in most local catchments [1]. Four of the surveyed villages were significantly impacted by flash floods (Slon, Ceraşu, Chiojdu, Valea Borului) and this is well reflected by the share of people with previous flash flood experience and knowledge (e.g. causes, seasonal frequency, associated geomorphic processes).

Most residents were witnesses to flash floods in the last 10 years (88%) which could largely explain the high level of awareness of the affected community (90%) (Fig. 3). However, the indirect experience rate is rather high (52%) within the research sample, only up to 2% of local population was evacuated. The perception of these respondents proved to be developed particularly during the recent flash flood events of 2005 by providing help to the affected relatives, neighbors and family friends or based on information received from acquaintances and local authorities. The community also benefits from the previous experience of elderly people (21%) which is expected to have supplemented the share of aware respondents across the research sample.

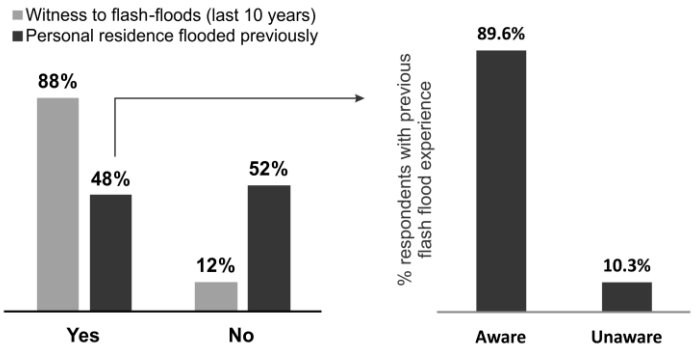

Fig. 3. Experience of past flash flood events and associated awareness level.

Most respondents described their households as being partially damaged (49%) by past flash floods, whilst the share of those having had their property flooded and damaged is about one third of the research sample (27%) (Table 3). In response to the previous experience, about 78% of respondents are willing to leave their houses during the upcoming flash flood events (forced or imposed by the local authorities, but most of them through self-motivation).

Table 3. Damage levels and types of flash flood affected households

Damage level	%	Damage type
Significant damage	27.3	Household flooded; destruction of the house; isolation from the main access road
Partial damage	48.9	House walls partially collapsed into the riverbed; personal assets taken away by the flood; flooded agricultural lands; stowed materials transported by the flash flood (e.g. boulders, tree trunks, alluvia)
No damage	18.2	-

Flash flood awareness and worry

Awareness has a key role in the effective adaptation to the flood risk for a community and is "an integral component to effective flood risk management" [5]. However, with time and under a less appropriate risk communication, the awareness and worry are tending to diminish [6].

The recent flooding of 2005 and 2010 were the main impetus for increasing the worry degree at community level and implicitly, for improving public awareness. The study revealed that the sample population is aware that their community is at risk (76% of respondents), recognizing flash floods, floods (herein associated to slow onset floods) and heavy rainfalls as the main natural hazards affecting their living area. Moreover, the respondents identified correctly the main triggering causes, as well as the associated processes (landslides, river bank erosion) (Fig. 4). There is a very high emotional reaction of respondents (degree 5 of worry) in relation to the previous and upcoming flash flood and heavy rainfall events in the area (mostly in the Slon village), but also to the landslides associated process (e.g. Ceraşu village). About 3.4% of the affected population developed psychological fears in relation to the forthcoming heavy rainfalls and flash floods in the area, given the damages produced by the July 2005 events.

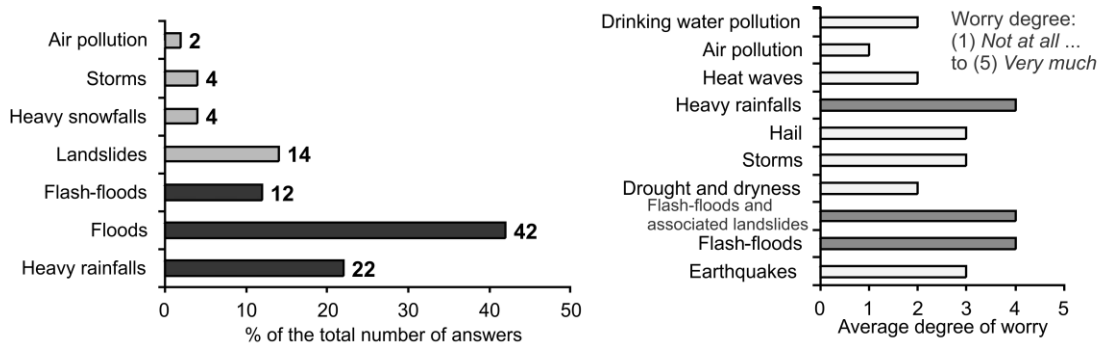

Fig. 4. People's awareness on the main hazards affecting the living area (left) and the existing worry degree to natural and anthropic hazards (right).

The research sample of respondents exhibited a higher worry degree related to the personal and family safety (57%) than to the living household destruction (27%) during the future flash flood events. In response to the recent hydrological events of 2005 and 2010, about 88% of affected residents are currently insured to floods.

The current level of education coupled with the previous flash flood experience are good indicators of the degree of knowledge, thus explaining the general willingness of people to access flash flood-related information. Most of the general public (57%) is interested in weather and hydrological warnings delivered through mass-media (particularly television and radio) in order to follow the heavy rainfall occurrence and the potential flash floods in the area. The respondents identified the weather forecasts provided by the National Meteorological Administration as the most important warning source at the level of their community. The respondents recalled no awareness-raising actions or flash flood risk communications from the local authorities prior to the major events. Most people would welcome more information about flood warnings and flood preparedness to be delivered by the local authorities in due time, prior to the flash flood events.

Existing preparedness

A higher level of worry is more likely to result in a higher level of preparedness [3, 7]. In the case study area, preparedness for flash floods is in general determined by perceived fear associated to flash floods and their potential damage.

The recurring events were expected to have strengthened the planning of effective mitigation strategies and to have empowered the investment activity of local administrations for flash flood and flood structural defense measures. Currently, most villages have local flood defense plans for the 2014-2017 time-horizon advised by the County Council for Emergency Situations, in response to the joint legislative initiative of the Ministry of Environment and Forests and Ministry of Interior Affairs started before 1989 (last republication - Ministry Order no. 1422/May 16, 2012 and 122/August 2, 2012). These plans regulate the structure of the local committee and of the temporary operative centre for emergency situations, the institutional informational flow during flood events and inventory the available materials and equipments for flood defense, elements at risks (households, bridges, social and economic structures), settle the flood defense thresholds and identify the preventive flood measures to be implemented.

The municipality invested in the flood prevention and protection works along the Drajna river, most of them implemented after the hydrological events of 2005 and 2010 (Fig. 5). These measures have not decreased the existing worry level of the previously affected residents or the increased damage potential of future flash floods (e.g. in the Slon village). Local population perceives most of the undertaken measures as insufficient, formal and inadequate (especially in the river sectors prone to flash flooding), claiming for further investments to protect appropriately the community against flood and flash flood risk.

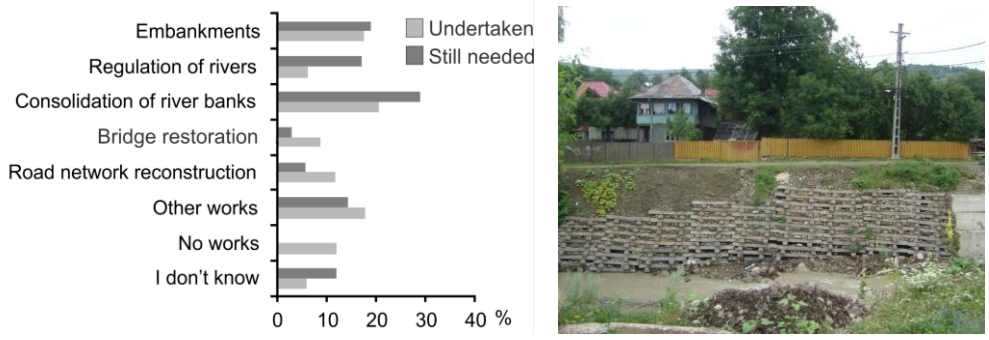

Fig. 5. Community perception on the flash flood preparedness (left) and example of inadequate prevention and protection flood and flash flood measures (right).

Individual preparedness level among the affected residents is rather low, mostly in relation to the existing average income level. Many exponents of the researched population are open to leave the responsibility for flood and flash flood mitigation in the hands of local (70%) and county authorities (15%), contributing to the reduction of the individual and community coping capacity to major hydrological events. The current response capacity of the local authorities is perceived differently within the research sample reflecting a high level of uncertainty associated to the current community preparedness: average (31%), good (24%), very low (18%), low (15%), very good (9%). About 3% of respondents couldn't provide a precise opinion in this matter (by answering ”I don't know” to the question at stake). Most trusted social support systems

at the level of affected communities are the municipality (34%), neighbors and friends (28%) and family (19%).

CONCLUSIONS

The study provides valuable insights into the public perception on flash flood risk in an area affected by severe extreme hydro-meteorological events (1975, 2005, 2010). The current research showed a strong relationship between the "worry" and the "awareness" components of risk perception, even 10 years after the last major flash flood event occurred (2005). This connection appears as vital for the community adaptation to flash flood risks. However, the existing level of community resilience is mainly derived from the high levels of awareness and worry rather than from the current individual or community preparedness. Moreover, awareness and worry are not visibly correlated with the current individual and community preparedness.

The study identified several key issues related to the role of public perception and awareness in the local flood and flash flood risk management, thus being able to improve the social dimension in adaptation and mitigation strategies. The results of this research could also overcome the existing gaps in the effective communication of flash flood risk which could ensure an efficient transition towards more resilient communities in a region prone to frequent and damaging flash flood events.

ACKNOWLEDGEMENTS

The current study was conducted in the framework of the project "Vulnerability of the environment and human settlements to floods in the context of Global Environmental Change (VULMIN)" (PN-II-PT-PCCA-2011-3.1-1587) funded by the Ministry of National Education for the period 2012-2016 (http://www.igar-vulmin.ro).

REFERENCES

[1] Chendeş V., Resursele de apă din Subcarpaţii de la Curbură. Evaluări geospaţiale, Edit. Academiei Române, Bucureşti, 340 p., 2011.

[2] Chendeş V., Bălteanu D., Mătreaţă M., Sima M., Identificarea arealelor cu potenţial de producere a viiturilor rapide, Presentation to the Scientific Conference of the National Institute of Hydrology and Water Management, November 10-11, 2014.

[3] Raaijmakers R., Krywkow J.R., van der Veen A., Flood risk perceptions and spatial multi-criteria analysis: An exploratory research for hazard mitigation, Nat. Hazards, 46, pp 307-322, 2008.

[4] White G.F., Paths to risk analysis, Risk Analysis, 8(2), pp 171-187, 1988.

[5] Bradfort R.A., O'Sullivan J.J., van der Craats I.M., Krywkow J., Rotko P., Aaltonen J., Bonaiuto M., De Dominicis S., Waylen K., Schelfaut K., Risk perception - issues for flood management, Nat. Hazards and Earth System Sciences, 12, pp 2299-2309, 2012.

[6] Shen X., Flood risk perception and communication in different cultural contexts – a comparative case study between Wuhan, China and Cologne, Germany, Ph.D. Dissertation, University of Bonn, 2009.

[7] Miceli, R., Sotgiu, I., and Settanni, M.: Disaster preparedness and perception of flood risk: A study in an Alpine valley in Italy, J. Environ. Psychol., 28, 164–173, 2008.