

## **DEVELOPING SOFT MEASURES FOR FLOOD RISK MITIGATION AND ADAPTATION IN ROMANIA: PUBLIC INFORMING AND AWARENESS**

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**ABSTRACT.** – **Developing soft measures for flood risk mitigation and adaptation in Romania: public informing and awareness.** This paper highlights, firstly, some general aspects concerning flood risk adaptation measures, especially those aiming public informing/education and awareness. Secondly, the paper is focused on Romania and presents: the legislative and action general framework on climate change adaptation and flood risk management; potential measures for flood risk mitigation and adaptation, with special focus on public informing/communication and education actions; institutions and tools for public informing on flood risk in Romania. Finally, some examples of actions aiming flood risk informing/education and awareness at local scale (Tecuci City in Galați County, and the communes of Vulturii and Nănești in Vrancea County) are presented.

**Key words:** flood risk, adaptation, soft measures, public informing, awareness, Romania.

### **1. INTRODUCTION**

Disaster risk prevention and reduction is crucial to enhance the economic, social, health and cultural resilience of persons, communities, countries, as well as of the environment (UNISDR, 2015a). In the context of climate change, where floods are expected to be more frequent and intense (IPCC, 2014a), flood risk mitigation is a major concern of water policies and sustainable development strategies at different spatial scales (from European Union - EU, to national, regional and local scale). Managing the climate change related risks, in general, and flood risk, in particular, requires among, other things, adaptation decisions and strategies with implications for future generations, economies, and environments (IPCC, 2014b).

This paper aims to highlight the importance of the soft (non-structural) flood risk mitigation and adaptation measures in flood risk management. It presents the

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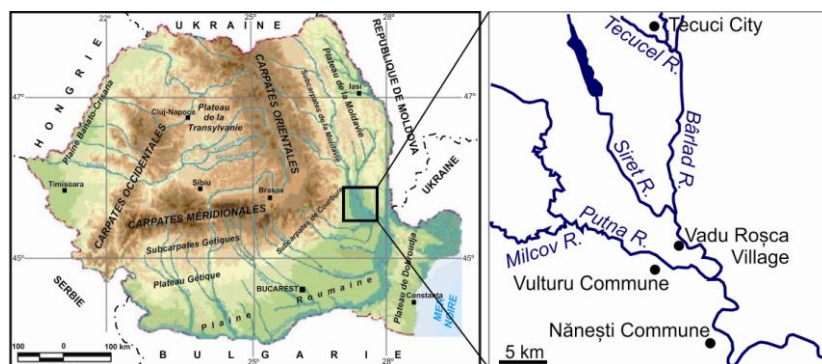
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example of Romania, country having one of the highest flood risks in Europe (Kundzewicz et al. 2014). The damaging floods occurred in the last years in Romania led to the development of new strategies, plans and regulations, in the field of water and flood risk management. The paper focuses on the measures aiming the public informing and awareness. It is a relatively new and original approach, whereas, previous works in the field of flood risk in Romania, focused mainly on flood events analysed for different spatial scales, or on theoretical aspects (e.g., Stănescu & Drobot, 2002; INHGA, 2009; Steiner & Andriciu, 2009, etc.). Some papers presented local case studies with references on structural and non-structural measures for flood risk mitigation (Minea & Zaharia, 2011; Zaharia, 2014; Zaharia et al., 2015). Only a few works focused on flood risk culture and memory (Zaharia, 2010; Florian, 2015a, b). Relevant information on flood risk management on the Danube River (including the Romanian sector) are a part of the project *Danube Floodrisk. Stakeholder oriented flood risk assessment for the Danube floodplains* (2009-2012), which had as main result *Danube Atlas. Hazard and risk maps* (edited in 2012) (South East Europe, 2012).

## 2. DATA, METHODS AND STUDY AREAS

The paper is based mainly on data and information obtained from bibliographical research and from own field investigations in some areas in Romania affected in the last years by catastrophic floods. The case studies were performed in Tecuci City (Galați County) and in the communes of Vultur and Nănești (Vrancea County), located in the eastern part of Romania (Fig.1). The field investigations were performed in many campaigns, between September 2007 and 2015, which included observations and questioning of city residents and local authorities. The main methods were the synthesis of the data from the scientific literature, field observations, surveys and their statistical analysis.



**Fig. 1.** Position of the study area in Romania (left) and detail with the location of the analyzed settlements (right)

### 3. FLOOD RISK ADAPTATION – GENERAL ISSUES

In common sense, according to *Cambridge dictionaries*, the word *adaptation* means the process of changing to suit different conditions (<http://dictionary.cambridge.org>). In a particular context, namely one of the climate variability and changes to which the flood risk is directly related, the adaptation means “the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (UNISDR, 2015b). Adaptation is one of the keys of the existence of natural and human systems. It enables them to survive in changing, even critical conditions. Given the observed and projected climate changes, the increase of the climate-related risks (floods included) is expected (IPCC, 2014a). Therefore, human adaptive responses to these changes should be considered in risk-reduction and development of future strategies.

Many of the flood risk mitigation measures are also flood risk adaptation measures. Consequently, the adaptation involves a mixture of hard (structural) and soft (non-structural) measures and actions. Their implementation should be done in a complementary way across levels, from individuals to regional and national governments (UNECE & INBO, 2015).

Whilst the hard approaches involve actions for designing, building, or modifying physical infrastructure aiming, generally, to protect and defence against floods, the soft approaches are particularly useful for creating the enabling conditions for more effective and resilient flood risk management. Such measures involves: creating information and control systems; operating regimes for new or projected hydrological conditions; regulatory and economic instruments; training, educating and raising awareness measures, etc. (UNECE & INBO, 2015; UNISDR, 2015b).

As the flood risk is directly related to climate variability, flood risk adaptation strategies should be developed according to the changing climate. The adaptation issue to climate changes and water-related risks is extensively approached in the IPCC report on *Climate Change 2014: Impacts, Adaptation, and Vulnerability* (<http://ipcc-wg2.gov/AR5/report/>). In EU, there are a number of adaptation projects/programs/strategies at large spatial scales, like in the Baltic Sea Region (*Climate Change: Impacts, Costs and Adaptation in the Baltic Sea Region project*; [www.baltcica.org](http://www.baltcica.org)) and in the Danube Basin (*Danube study – climate change adaptation; ICPDR Climate Change Adaptation Strategy*; <http://www.icpdr.org/main/activities-projects/climate-change-adaptation>).

Generally, adaptation strategies to climate changes and related risks (including flood risk) were designed in each EU country.

## **4. PUBLIC INFORMING/EDUCATION AND AWARENESS – WAYS FOR IMPROVING THE SOCIETIES’ ADAPTATION AND RESILIENCE TO FLOOD RISK**

### **4.1. Overview on risk information and education**

In the last years, at the EU spatial scale, the hard measures were no longer considered as best solution for flood risk mitigation and the soft measures were brought forward (ANAR, 2015a). Among these, people informing/communication and education concerning the risks they are exposed to (in general), and the flood risk (in particular), are considered two major means of social capacity building and of resilient societies developing. Risk communication addresses the exchange of information, knowledge and attitudes between decision makers, experts, stakeholders, and the affected public. Risk education refers, generally, to the transfer of more generalized knowledge on hazards and risks from professionals in teaching institutions (schools, providers of courses) to persons in schooling and training (Höppner et al., 2010; Komac et al, 2010).

Risk information refers to “comprehensive information on all dimensions of risk including hazards, exposure, vulnerability and capacity related to persons, communities, organizations and countries and their assets” (UNISDR, 2015b).

The informing/communication and educating actions are closely related and they enable the people to have proper knowledge about the risks they are exposed to and to form appropriate behaviours and attitudes before, during, and after the occurrence of flood events. They also play a major role in flood risk awareness raising, which is a key factor in effective disaster risk reduction. Public awareness proves “the extent of common knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards” (UNISDR, 2015b).

Risk education and communication are basic components of the “risk culture” or “culture of disaster resilience” whose development is one of the major challenges for current societies, particularly under the conditions of climate change (CapHaz-Net, 2010).

Actions concerning public informing/education and awareness on risks are planned within documents at different spatial scales. At the global scale, *Sendai Framework for Disaster Risk Reduction* (2015-2030) can be mentioned. One of its seven global targets is „Substantially increase the availability of and access to multi-hazard early warning systems and **disaster risk information** and assessments to people by 2030” (UNISDR, 2015a).

### **4.2. Means and ways for public informing and awareness on flood risk**

Public informing and awareness on flood risk can be achieved by a complex of means and ways. For flood risk memory and awareness enhancing, the flood

marks location is one of the most common and efficient ways. Historical witnesses of the past flood events, the flood marks make the population more sensible and aware to flood risk. They offer information on: the water level, flood frequency, periods when the flood occurred, their spatial extension (Zaharia, 2010). Other means for flood risk memory enhancing are: monuments, commemorations, exhibitions, publications, information centres, etc.

For public informing/communication, education and awareness on flood risk, there are many ways, such as: web-sites/web-platforms (at national, regional/departmental, communal scale), advertising/information materials elaborated by the local authorities and responsible institutions for flood risk management and disseminated under various forms (billboards/panels, flyers, leaflets, brochures dedicated web-sites, etc.), thematic lessons/activities/field trips in schools, thematic programs and spots on TV and radio, documentary movies, etc. An important role is played by exercises simulating flood crisis, which aim to train the population on how to act during and after the flood event in order to mitigate the damages and to return to the normality.

## **5. FLOOD RISK MITIGATION AND ADAPTATION MEASURES IN ROMANIA: DEVELOPING PUBLIC INFORMING AND AWARENESS ACTIONS**

### **5.1. Legislative and action general framework on climate changes adaptation and flood risk management: references on public informing/education and awareness**

**Climate changes adaptation.** In accordance with the actions taken at the international and EU levels, Romania proceeded to the development of strategies and action plans regarding the adaptation to climate changes and flood risk mitigation.

The first *National Strategy for Climate Change* (NSCC) and the related *National Action Plan on Climate Change* (NAPCC) were elaborated in 2005 and plan measures and actions for the period 2005-2007. One of the four main topics of the NAPCC was the *Adaptation to climate change, awareness, education and public participation*. In 2008, the *Guide regarding the adaptation to climate change effects* was adopted; it aims the identification of necessary measures to limit the negative effects anticipated by climatic scenarios, estimated by 2030 (MMAP, 2008). The guide foresees, among others, measures adapted to flood risk management. They comprise hard measures, as well as soft measures including the education of the population in order to have an adequate behaviour before, during and after flood events. Afterwards, the NSCC and NAPCC were revised and actualized. The most recent versions were published in December 2015. The NSCC covers the entire period to 2030-2050, and the NAPCC is applicable by 2020.

Concerning the flood risk mitigation, the new strategy intends to raise awareness among the population exposed to floods (MMAP, 2015).

**Flood risk management.** The legislation and action framework regarding flood risk management in Romania is in accordance with the framework existent at the EU level, more precisely the *EU Water Framework Directive* (WFD) 2000/60/EC and the *EU Directive 2007/60/EC on the assessment and management of flood risks* (*Flood Directive - FD*). The most important national document regulating the flood risk management is the *National Strategy for Flood Risk Management (NSFRM) for medium and long term* (adopted in 2010). The NSFRM defines the technical, institutional and legal frame to diminish the negative consequences of floods on socio-economic activities, life and population health, as well as on the environment, for the period 2010-2035 (MMAP, 2010).

According to the demands of the FD, in December 2015, *Flood Risk Management Plans* were elaborated for all the 11 hydrographic districts (Water Branches) of the country. These plans contribute to the achievement of the NSFRM objectives. They contribute also to raise awareness and knowledge on flood risk, especially in areas with significant potential for floods (ANAR, 2015a).

For the Danube Basin (including Romania), in December 2015, the International Commission for the Protection of the Danube River (ICPDR) published the *Flood Risk Management Plan for the Danube River Basin District*, which mentioned the priorities for 2021 for the sustainable management of flood related risks. The plan highlights the prevention, protection and preparedness measures (ICPDR, 2015a). A special chapter (12) is dedicated to public information and consultation, and the Annex 2 presents an overview of these measures (see §5.2.).

## **5.2. Potential measures for flood risk mitigation and adaptation, with special focus on public informing/education and awareness actions**

The NSFRM of 2010 presents a set of measures and actions at national, basin and local scale, regrouped in 3 major categories: 1) preventive (prevention, protection and preparedness), 2) operative management (management of emergency situations), and 3) post-flooding. Among preventive actions, public informing/communication and education on flood risk have an important place.

The action plan for the implementation of the NSFRM includes 23 categories of measures and 93 associated actions. Among the 23 categories, there are two (F and I), which includes seven, respectively four actions aiming to inform, educate and prepare the population and the specialists with regard to the flood risk and the development of a resilience to floods. Among these actions, the following are the most relevant: organisation of national campaigns of public awareness and dissemination of information on flood risk (action F2); organisation and monitoring of local campaigns of consultancy and public awareness (F3); information,

education and preparedness programs (F4); organisation of defence and evacuation exercises (F5); inventory of floods' consequences and mark of historical floods witnesses (F6); formation of local agents for floods (I2); creation of academic programs and development of research programs on flood risk (I2 and I3).

In the *Catalogue for potential measures at the national level*, according to the Annex 2a of the *Methodological frame for the elaboration of Flood Risk Management Plans at Water Branches levels* (ANAR, 2015 b), 23 measures are anticipated and proposed, which are regrouped in five domains of action corresponding to the phases of the flood risk management cycle: prevention, protection, preparedness, awareness and recovery. For each type of measure, there are given some precise examples, the list being non-exhaustive (about 70 examples of measures). These measures may be applied at the national, regional (Water Branches), and local scale (areas of potentially significant flood risk or administrative-territorial unities). Most part of the measures (22) belong to the soft category.

Within the domain of „Public awareness”, there are foreseen two major types of measures: 1) activities to adequately inform the public and to promote public participation, and 2) education activities/population training. In the first category, there are measures such as: activities to inform the public regarding flood risk awareness; activities to promote public participation to the phases of the FD implementation; elaboration of a guide concerning the people education and behaviour in flood risk areas, etc. In the second category, there are measures such as: publishing brochures and flayers, and communicating with the media (ANAR, 2015 b).

In the *Flood Risk Management Plan for the Danube River Basin District*, as mentioned before, a special chapter (12) is dedicated to public informing and consultation, and the Annex 2 presents an overview of measures necessary to achieve the objectives of flood risk management in the Danube River Basin District. The Chapter 5 of the Annex 2 presents raising awareness measures. For Romania, these measures concern: flood simulation exercises with inter-institutional participation; adequate public information activities and promoting public participation; active education/training of the population (brochures, leaflets, media communication) (ICPDR, 2015 b).

### **5.3. Institutions and tools for public informing/education and awareness on flood risk in Romania**

At national level, four major institutions contribute to public informing and training in the field of the flood risk: Ministry of Environment, Water and Forests; National Administration ”Romanian Waters”; National Institute of Hydrology and Water Management, and General Inspectorate for Emergency Situations.

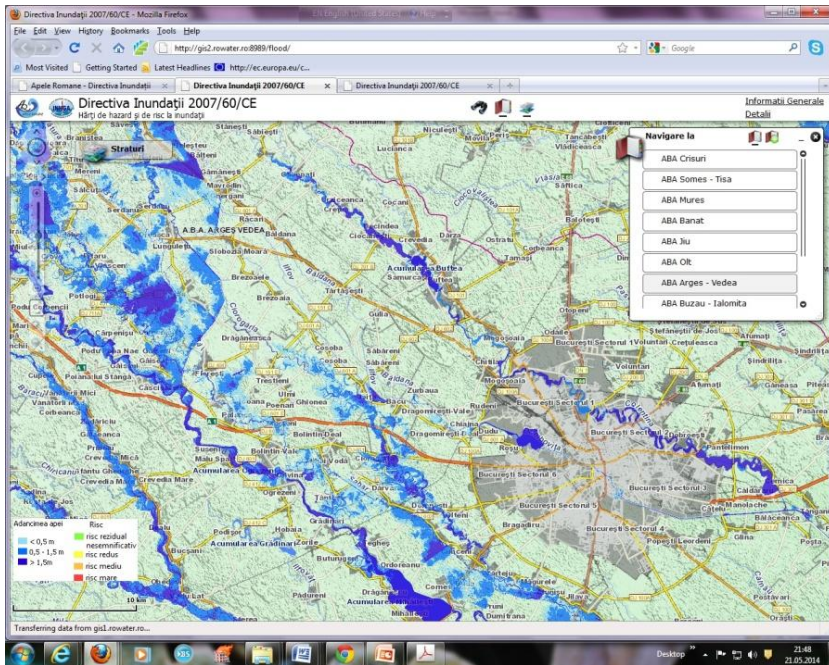
Information on flood risk and its management are presented under many forms (warnings, information reports, studies, maps, brochures, leaflets, legislative documents, etc.) on the web-pages of these institutions.

The **Ministry of Environment, Water and Forests** (MEWF) presents on its web-site (<http://www.mmediu.ro/>) a domain designated to *Water Management*, which includes the sub-domain *Flood Risk Management*. This sub-domain regroups information regarding: floods and flooding, the NSFRM, the FD, legislation on emergency situations management, etc. The web-page of the MEWF includes also a domain regarding *Climate Change* with information on the adaptation to the effects of climate change at the EU and national levels, as well as the NAPCC.

Created in 2002, the **National Administration "Romanian Waters"** (NARW) is the national authority for waters, under the coordination of the central public authority (MEWF). The NARW administrates public waters and applies the national strategy and policy for the quantitative and qualitative management of water resources (ANAR, 2015c). On the web-page of the NARW (<http://www.rowater.ro/>), two domains were designed, containing information on flood risk: *Emergency Situations Management* and *Flood Directive* (FD). In the first domain, there are presented informative documents on: legislation; basin and county-scale plans on flood defence and on other hydrometeorological hazards; spreading information and decisions in case of emergency situations; daily hydrological reports on rivers and lakes in Romania; hydrological warnings. In *Flood Directive* domain, there are documents regarding: FD; legislation for the implementation of the FD in Romania and resulted products (i.e., preliminary flood risk assessment, flood hazard maps, flood risk maps and flood risk management plans). These results are presented under various forms (e.g., texts, tables, maps, diagrams), containing rich information on national scale and for the 11 water branches in Romania (i.e., *Flood Risk Management Plans* elaborated at the end of 2015). Associated to the *Flood Risk Management Plans*, there is also an *Informative flyer for local and county authorities* implicated in the flood risk management ([http://www.rowater.ro/pmri\\_site/4\\_Pliant%20inundatii\\_BT.pdf](http://www.rowater.ro/pmri_site/4_Pliant%20inundatii_BT.pdf)). The *FD* domain contains also the *Flood Risk Management Plan for the Danube River Basin District* (including the annexes) (see also §5.1. and §5.2.).

The flood hazard and risk maps, published in March 2014, may be consulted directly on the web-page of the NARW. So far, the available information refers only to the medium scenario for inundability (maximum discharges with the probability of 1%). Later, according to the FD, the flood hazard and risk maps should be elaborated as well as for low (0.1%) and high (10%) probabilities scenarios. Fig. 2 presents the flood hazard map for Bucharest City area.



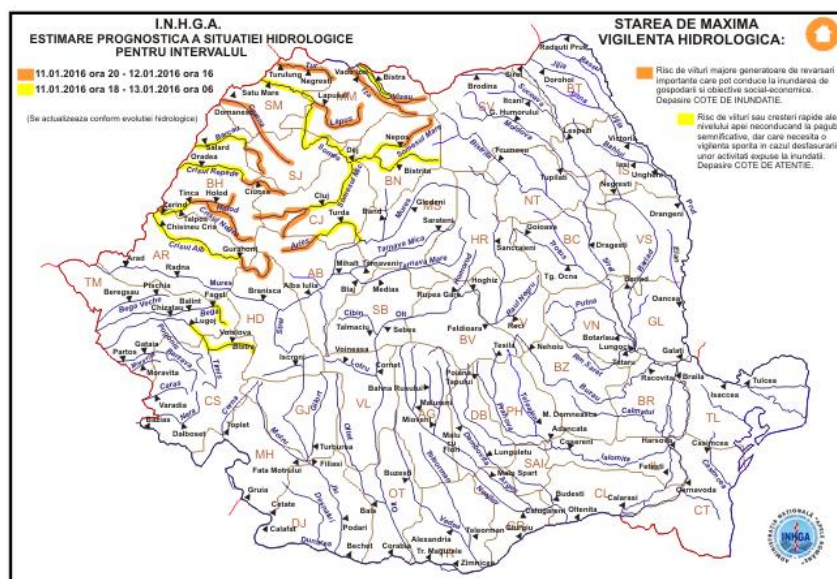


**Fig. 2.** Flood hazard map for Bucharest City area, published on the web-site of the NARW (<http://gis2.rowater.ro:8989/flood/>). The water depth in case of 1% floods is coloured in blue (from light blue <0.5 m to dark blue >1.5 m)

The **National Institute of Hydrology and Water Management (NIHWM)** conducts operational activities and researches in hydrology and water resources management for decisional factors in this domain (MEWF, NARW), as well as for public and private beneficiaries. NIHWM emits and publish on its web-page (<http://www.inhga.ro/>) hydrological warnings as texts and maps (Fig. 3). On NIHWM web-site are presented information regarding the daily hydrological reports and prognosis on short and medium term. The web-page includes also information on *Flood Risk Management Plans*, which may be found on the web-page of the NARW.

Constituted in December 2004, the **General Inspectorate for Emergency Situations (GIES)** aims at organising actions for the prevention and the management of emergency situations, in order to keep under control the risk and preserve a normality state of the human communities (IGSU, 2015 a). The GIES web-site (<http://www.igsu.ro>) includes the domain *Preventive information*, which aims at raising people awareness regarding risks, spread information regarding the measures for defence and the behaviour to adopt in case of emergency situations, educating the public on the warning system and broadcasting permanent

information in case of emergency situations (IGSU, 2015 b). Within *Preventive Information* domain, there are also materials for preventive information, including three flyers presenting: emergency backpack, warning codes, and fundamental rules to respect before, during and after flood events. The materials for preventive information on floods includes also a *Citizen's Guide for Emergency Situations* (38 pages), pages 11-13 being dedicated to floods (IGSU, 2015 c).



**Fig. 3.** Map with hydrological warnings n° 4 of 11th January 2016, emitted by the NIHWM (<http://www.inhga.ro/-/avertizare-hidrologica-nr-4-din-11-01-2016>). Yellow corresponds to the attention stage, and orange to the flooding stage

#### **5.4. Examples on actions aiming flood risk informing/education and awareness at local scale**

The damaging floods occurred after 2000 in Romania led to the development of new strategies and actions aiming to mitigate the flood risk by improving its management. As mentioned before, the most important regulatory documents are the NSFRM and the Flood Risk Management Plans (see §5.1.). This part of the paper investigates how the actions stipulated in these documents were implemented so far. This investigation focused on measures such as people informing/education and awareness regarding flood risk in several settlements affected recently by floods with severe consequences: Tecuci City (in Galați County) and Vulturu and Nănești communes (in Vrancea County).

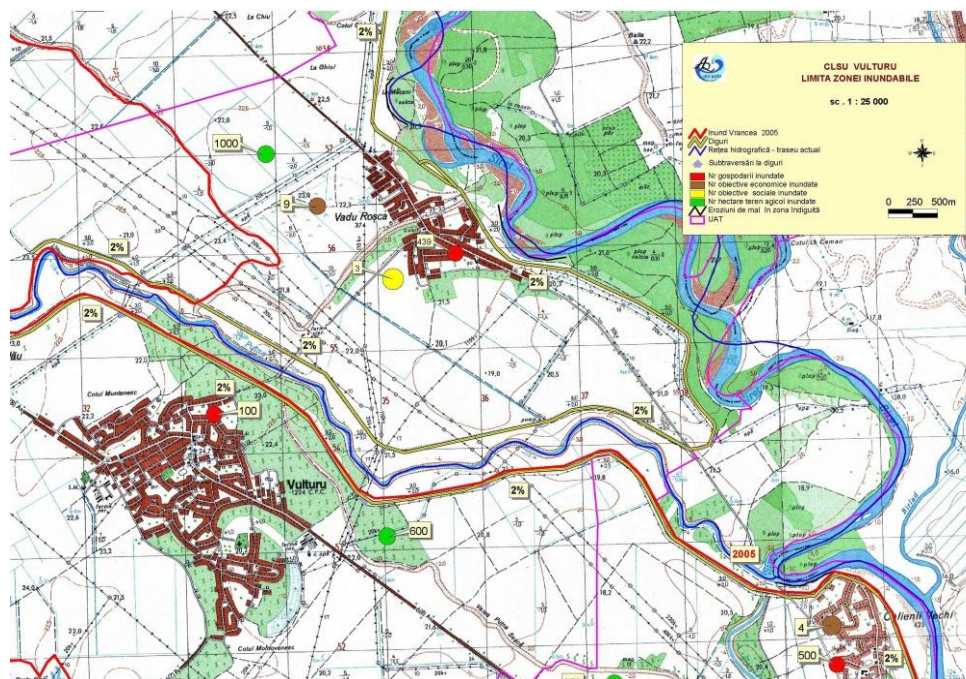
The **City of Tecuci** was affected in September 2007 by a flood covering 70% of the built city area (with water layer thickness exceeding 1 m) with disastrous consequences: 3 fatalities, 2210 houses damaged (of which 392 were completely destroyed, and 425 suffered serious structural damage), and a total cost of the damage estimated to approximately 6 million euro (Zaharia et al., 2008).

The investigation conducted in 2009-2014 regarding people informing and training on flood risk showed an improvement over time. Thus, the survey performed in August 2009, when 163 persons were queried, revealed that 92% of the respondents considered they were insufficiently informed and trained about the flood risk, and expressed their desire to know more in this respect. The survey of May 2014 (when 101 persons were interviewed), showed the decrease at 59% of the rate of respondents considering they were insufficiently informed and trained about the flood risk. Our investigations showed that the improvement of the degree of information of the population may be due to actions taken for this purpose by local authorities. Thus, at the end of May 2013, the Tecuci City Hall completed the *Analysis and Risk Coverage Plan in Tecuci City*, which comprises potential risks identified at the local scale (out of which flooding is representative), as well as measures, actions and resources needed for properly managing these risks (Primăria Tecuci, 2013). On the City Hall's web-site, the *Analysis and Risk Coverage Plan in Tecuci City* may be accessed in the domain *Preventive measures* ([http://www.municipiultecuci.ro/isu\\_prim\\_tecuci.html](http://www.municipiultecuci.ro/isu_prim_tecuci.html)). The interviews with locals showed that, in the last years, several public disaster alarm exercises were scheduled in Tecuci, aiming the public training for risk mitigation.

The communes of Vulturu and Nănești, located on the Lower Siret River (Vrancea County) were severely affected by the flood of July 2005. The most affected was Vulturu Commune (especially Vadu Roșca Village), where 7 fatalities and 330 destroyed houses were counted (of a total number of 393 houses affected by the flood). At Nănești, 422 houses were affected, 175 being destroyed (MMAP, 2009).

The investigations conducted in these communes showed that recently measures of people informing/education and awareness regarding flood risk were initiated. Thus, in **Vulturu Commune**, at the entrance in the Town Hall, billboards with textual information and maps regarding flood risk were identified in May 2015. The information includes measures taken at the local level for flood defence and the significance of warning codes in case of floods. The map (scale of 1:50000) shows the limit of the area flooded in 2005 and information regarding the number of houses, of social and economic stakes, and of flooded hectares. The information from the panel located at the entrance of the Town Hall are also presented on-line, on the official web-page of the commune (<http://www.vulturu.primarievn.ro/>), as *Public documents*, including the *Plan for defence in case of emergencies for the period 2014-2017*. The Plan includes, among others, information concerning: the composition of the Local Committee for

Emergency Situations; the scheme of transmitting information in case of emergency situation at local scale; defence measures against floods at local scale; limits of the flooded area (Fig. 4); other data on operative actions (Primăria Vultur, 2016).



**Fig. 4.** Map showing the limits of the flooded area and the elements affected by the flood of 2005 (houses, social and economic stakes, agricultural fields, bank erosion) posted on the web-page of the Vultur Town Hall (<http://www.vultur.ro/docs/svsu/2014/Limita%20zonei%20inundabile.pdf>) and on the panel located at the entrance in the Town Hall

The discussions with the local authorities responsible for emergency situations management indicated that exercises and simulations of flood crises were organised every year in order to train the population. Moreover, in Vultur School, actions to raise awareness and educate the children in floods' domain were conducted, as well as the competition „With my life I defend my life”.

At **Nănești**, the field investigations of May 2015 allowed to identify a panel in the Town Hall entrance (Fig. 5), with information regarding: the significance of warning codes in case of floods; the scheme of transmitting information in case of emergency situation at local scale; the map with the flooded area. The official web-site of the commune (<http://www.primariananesti.ro/>) includes the folder *Public*

documents and, more precisely, the *Plan of defence against floods, icing and pollution accidents of the Local Committee for Emergency Situations Nănești 2014-2017*, which is similar to Vulturii Commune. It includes documents regarding: defence measures against floods at local scale; other data concerning the operative actions of the Local Committee for Emergency Situations; the stock of materials, tools, devices, equipment and transportation for defence against floods; the scheme of spreading information in case of emergency situation at local scale (Primăria Nănești, 2016).



**Fig. 5.** The Nănești Town Hall and the entrance panel with informations regarding the flood risk (Photo: Zaharia, 2015)

## CONCLUSIONS

Flood risk adaptation is a crucial key of the people existence, enabling them to survive in changing and critical/extreme conditions, such as floods. The adaptation to flood risk can be accomplished by multiple and various structural (hard) and non-structural (soft) measures, all contributing to flood risk mitigation. In the last years, the flood risk integrated management highlights the important role of soft measures, including those aiming people informing/communication, education and awareness concerning the flood risk.

The results of our study showed the noteworthy progres towards the development of soft measures to diminish the flood risk and adapt to this hazard in Romania. These measures include strategies and action plans for flood risk management, some of them being already implemented or under implementation.

Thus, regarding the people informing/education, training and awareness regarding the flood risk, this paper identified and highlighted actions taken at the national level (institutions involved in flood risk management), as well as at the local level (the case studies of Tecuci City and the communes of Vulturii and Nănești). These measures must be extended in other settlements affected by floods and exposed to this hazard in order to mitigate the related damages.

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