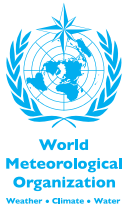
Guidance on Flash Flood Management

Recent Experiences from Central and Eastern Europe



Institute of Meteorology
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Poland

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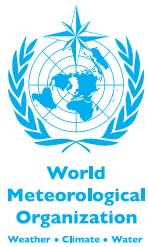
Recent Experiences from Central and Eastern Europe

Associated Programme on Flood Management

December 2007

The Associated Programme on Flood Management (APFM) is a joint initiative of the World Meteorological Organization and the Global Water Partnership. It promotes the concept of Integrated Flood Management (IFM) as a new approach to flood management. The programme is financially supported by the Governments of Japan.



The World Meteorological Organization (WMO) is a specialized agency of the United Nations. It coordinates the activities of the meteorological and hydrological services of 188 countries and territories and as such is the centre of knowledge about weather, climate and water.

The Global Water Partnership (GWP) is an international network open to all organizations involved in water resources management. It was created in 1996 to foster Integrated Water Resources Management (IWRM).

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Institute of Meteorology and Water Management (IMGW) is a research and development unit responsible for National Meteorological and Hydrological Service in Poland. IMGW offers various services and expertises in the field of meteorology, hydrology, oceanology and water management.

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EXECUTIVE SUMMARY

The increasingly variable climate in Europe has seen rising numbers of extreme flood events in the last decades, in the Danube, Odra and Elbe river basins just to name a few. This has been accompanied in parts of the region with interludes of intense dry spells. The floods most perceived by the public are the large-scale riverine floods; however, there is evidence that the most deadly floods are those with short lead times – flash floods - which in Central and Eastern Europe have mostly a spatially limited character and can occur far away from major rivers. Those floods pose great challenges to the National Meteorological and Hydrological Services (NMHSs), the Emergency Services and local communities, in the area of flood forecasting, warning, emergency preparedness and response. The recently published result of the Fourth Assessment Report under the Intergovernmental Panel on Climate Change (IPCC) indicates that Europe is likely to see more flash floods in future.

Under those circumstances adaptation efforts cannot be undertaken by only one sector, but must be based on the expertise and capacity of various competent actors and their interaction with those directly affected. For flash floods in particular this calls for a close interaction between the hydrological and meteorological services, however, beyond that the information products and services provided through the National Hydrometeorological Services need to be based on user needs and that is where crisis services, local and district administrations and various other users need to be actively involved.

The World Meteorological Organization (WMO) and the Global Water Partnership (GWP) have responded to this challenge by formulating and advocating an integrated approach to flood management embedded in the context of Integrated Water Resources Management. For the European region a special emphasis has been placed on conducting a pilot project with a particular view to flash floods[1] . This project has aimed at increasing the preparedness and response capacity of the local authorities and population in flash flood prone pilot communities to forecasts and warnings issued by respective authorities in order to reduce the vulnerability of the affected population. As such, the focus of the project has been placed on optimizing or complementing available technological means in flash flood forecasting in the given socio-economic context of the participating communities. Three pilot communities participated in the project, namely Gorzanow in the Klodzko District in South-Western Poland, Cheia in the Southern part of the Eastern Carpathians in Romania, and Vrbovce in North-Western Slovakia.

The project has offered an opportunity for the involved institutions (NMHSs, GWP regional and country water partnerships, civil defence authorities, regional authorities, municipalities) to draw closer to the communities potentially affected by flash flooding, i.e. the users of their products. This has led, on pilot scales, to an insight into the information and preparedness requirements of local communities and the development of solutions adapted to the social realities. In some of the pilot areas this was required not least because trust in public authorities in particular about flood warnings had decreased after flood events of the past years.

Secondly, it has led to a closer cooperation and coordination for flood forecasting and warning services of institutions based on user needs. One example has been that under the umbrella of the pilot project new institutional arrangements could be agreed between different levels of government to increase the effectiveness of the current warning system.

Thirdly, based on the flood event studies, and including consultations with affected communities and other recipients of flood warnings, improved technical means of detecting the areas at imminent risk and warn more effectively, have been developed. The effectiveness of those can finally only be judged once the next flash flood hits that area, yet efforts have been undertaken to urge participating communities to run regular emergency drills to keep up the preparedness levels of the respective authorities and the risk awareness of the population. In particular the latter is a key determinant of success when it comes to flash flooding, as authorities will also in future be faced with significant uncertainties in the forecasting process when it comes to flash flooding. This has in some instances led to a move towards combining the strengths of centralized parts of the forecasting process (such as Nowcasting and Numerical Weather Prediction products) with decentralized systems like local flood

[1] The official title of the project has been "Forward integration of flood warning in areas prone to flash floods"

warning systems (based on local observing systems). Close collaboration between local communities (emergency services) obtaining such systems and the respective National Hydrological and Meteorological Services to enable the best possible interoperability and observance of agreed standards is of essence and requires political commitments on both sides. It has shown that questions of institutional mandates and resulting liabilities in the warning process are key questions to be explicitly addressed.

A general lesson about the development of integrated flood management practices relates to the fact that flood management responsibilities are scattered under a multitude of institutions. Each of these institutions has a mandate to fulfil and is supposed to spend its budget on it. If gaps are to be addressed or an institution wants to move closer to the community needs, this requires initially extra budgetary funds. Once success stories can be developed on pilot scales, required institutional changes (laws, policies and administrative arrangements) can be implemented. One such step identified is to develop flash floods as a explicit item in the national strategy on flood management to account for their special characteristics. Another essential aspect is the preparation and implementation of municipal flood preparedness and response plans to facilitate and coordinate the work of all required local actors.

Based on the pilot projects and available literature, the report seeks to synthesize and, as far as possible, conceptualize the approach that can be taken to address the issue of flash floods both on the national and (for flash floods most importantly) on the lower administrative scales of districts and communities. As such, the report may serve as a tool to reach out to local communities, mayors, emergency services on various administrative scales and the National Hydrological and Meteorological Services on broader scales to maximize the impact of this initiative towards a significant reduction of the vulnerability of flash flood affected communities and the associated deaths and misery.

ACKNOWLEDGEMENTS

This activities described in this publication have been made possible through a joint commitment of the World Meteorological Organization and the Global Water Partnership within the framework of the Associated Programme on Flood Management. The project could profit from the vast experience and professionalism of the involved partners namely of the Polish Institute of Meteorology and Water Management (IMGW), the Slovak Hydrometeorological Institute (SHMI) and the Romanian National Institute of Hydrology and Water Management (INHGA), as well as the Global Water Partnership's regional chapter in Central and Eastern Europe (GWPCEE) and the GWP national chapters in Poland and Romania.

Particular thanks are due to Roman Konieczny, Pawel Madej, Malgorzata Siudak and Malgorzata Barszczynska from the Office for Local Government Collaboration of the Institute of Meteorology and Water Management (IMGW) for their crucial role in implementing the pilot project in Poland and in drafting the herewith presented report.

Special gratitude's are also due to the following:

- All local officials and volunteers that where involved in the pilot activities in the communities of Gorzanow/ Klodzko, Vrbovce, and Cheia, for their commitment in pro-actively addressing the flash flood risk they are confronted with;
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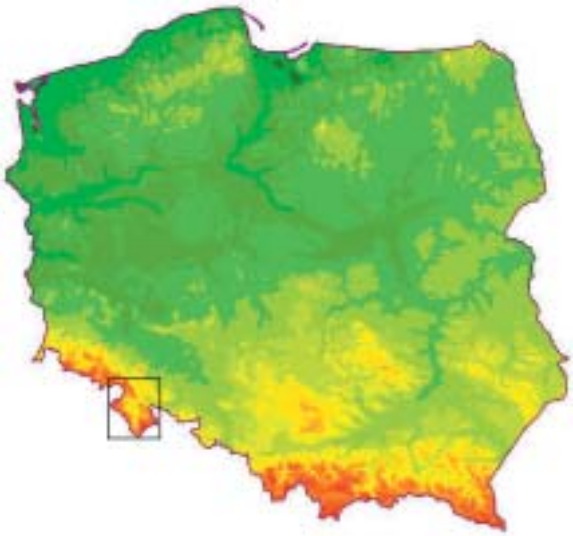
1. INTRODUCTION

The objective in presenting this report is to provide easily accessible guidance on flash flood management to mayors, provincial administrators and the National Meteorological and Hydrological Services, enabling and motivating them to launch joint programmes for reducing the vulnerability of local communities to the impact of flash floods, within the overall flood management policy of the country. As such the material has been conceived to be understood also by non-technical audiences such as may be mayors of flash flood-prone communities.

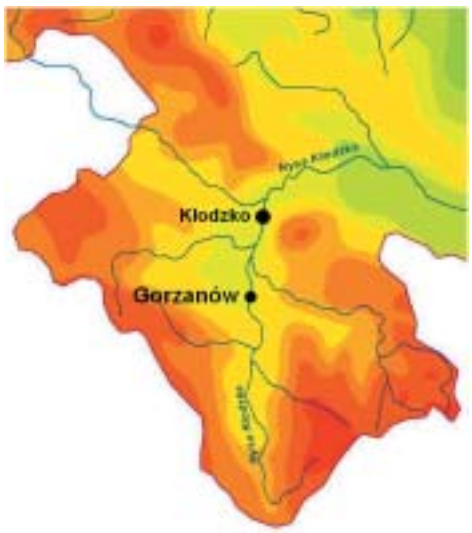
The material is based on an effort undertaken in Central and Eastern Europe within the framework of the Associated Programme on Flood Management, a joint initiative of the World Meteorological Organization (WMO) and the Global Water Partnership (GWP). The initiative has been financially supported by the Government of Japan.

The effort is based on reports of seven countries on flash floods they experienced in the recent past, namely from Bulgaria, Czech Republic, Lithuania, Poland, Romania, Slovak Republic, and Slovenia. Three of those countries (Poland, Romania and Slovakia) have conducted pilot projects in flash flood prone communities to develop and refine their approaches with a particular view to flash flood warning and community preparedness[1] . All pilot projects were conducted in project consortia consisting of the National Hydrometeorological Services (NMHSs), mayors and civil defence authorities of affected municipalities, and representatives of the Global Water Partnership in the Region (GWP-CEE) and individual countries. The short characteristic of the pilot sites is provided below.

The village of Gorzanow in Poland is a large village situated in the Klodzko Valley, upper part of the Nysa Klodzka river basin encompassed area of approx. 1500 km^2 in the south western part of the country (see figure below). For many reasons, it has been and still is considered to be interesting place in the Klodzko area. Besides its historic buildings (castle ruins, Baroque church), another factor contributing to its popularity was the discovery of its mineral springs in the second half of the 19th century.



Location of Klodzko Valley



Location of Gorzanów village

Within the village are located 214 residential buildings, inhabited by nearly 1000 persons (as of 2006). Among those who are professionally active, approx. 10–15% are farmers; 20–30 % work in small and medium-size enterprises in Gorzanow or the vicinity. A sizeable portion of the community does not work – is unemployed – approx. 14%.

[1] The official project title: "Forward integration of flood warnings in areas prone to flash floods"

The Klodzko Valley, located at 350 – 450 meters above sea level, is surrounded by the mountains, up to 1200 m a.s.l., with steep slopes. Those topographic conditions and thick river network result in fast runoff concentration and in consequences high flash flood hazard. Among the nearly seventy documented floods, mentioned by Polish, German and Czech chroniclers already since the 10th Century, the largest are those from 1310, 1598, 1783, 1854, 1883, 1903, 1938, 1997 and 1998. The flood in 1997 was the largest one still remembered by people here, and the largest in the preceding hundred years.

One of Gorzanow village inhabitant shows water level in 1997

Combined losses caused by the 1997 flood in Gorzanow amounted to approx. 13.2 million zloty (~3.6 mln Euro)[2]. This includes inundation of 81 residential houses (including one completely destroyed), 100 farm buildings (including 3 completely destroyed), agricultural land belonging to over 70 farmers and damages in transport infrastructure i.e. several kilometers of roads, 4 bridges (2 washed out and 2 damaged).

The village of Vrbovce in Slovakia is located in the Senica district neighboring with the Czech Republic in the western part of Slovakia (see figure below). Village Vrbovce is situated in the basin of Myjava river, left side tributary of river Morava (Danube river basin). The Myiava river runoffs the water from the area delineated by the Biele Karpaty mountains (White Carpathians, spring area) and Malé Karpaty mountains (Little Carpathians), southwest bound from their connection line. The described river basin is situated at the boundary of 2 main orographic provinces: Western Carpathians and Westpannonian basin.

At present less than 1600 persons live in the Vrbovce. Age structure indicates that population is older as compaered to urban areas. Young families are mostly moving to the cities. Many of the houses are now used by urban people for recreation. The potential for tourism is large both in summer and in winter.

Location of Myjava river basin

Location of Vrbovce village

[2] According to information from the City and Municipal Government Office in Bystrzyca Klodzka published in Master's thesis written by Adam Olczyk

Most of working people are employed in Senica district town and in the area of Bratislava. Only less than one third is working in the village. The unemployment rate is 12%. There are 20 self entrepreneurs in the village and no large companies.

For the flood protection system, there is an important fire brigade and a flood protection unit.

Between 1996 and 2002, Slovakia has suffered from 80 major damaging floods, including the catastrophic flash floods in the middle and north part of the country. The majority of them have caused victims, the dislocation of hundreds of people and enormous economic losses.

In the summer of 1997, extensive and long-lasting floods originating from heavy rain, hit the majority of the rivers in Slovakia. The most hazardous situation was on the Morava river, where the highest degree of flood activity – emergency –continued during 21 days. The relief costs, preventive work and flood damages amounted to nearly 50 million USD. Floods affected 366 cities and municipalities, 8255 houses were inundated, from which 70 were completely destroyed.

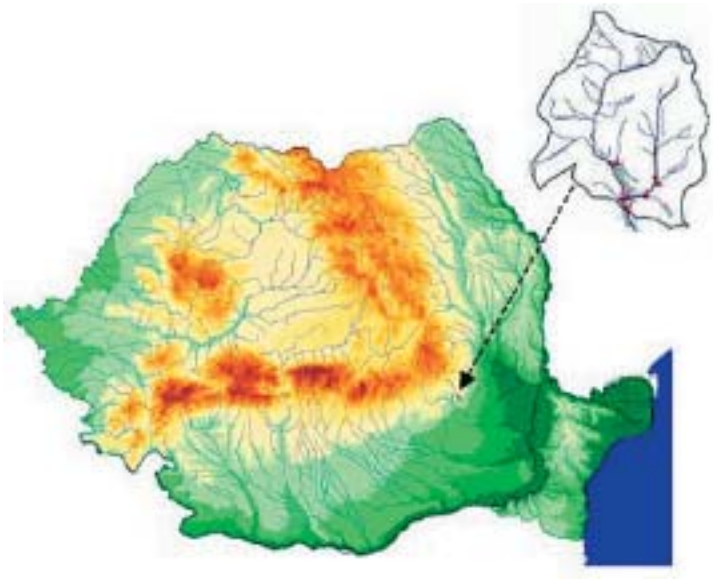
The village of Cheia in Romania is situated within the Măneciu commune, in Prahova County, on the banks of the Teleajen River and within the depression bearing the same name. It lies at the feet of the Ciucaş Mt, 61 km north of Ploieşti.

The Upper Teleajen Representative Basin (Cheia) is located in the Southern part of The Eastern Carpathians (the Curve group), close to the spring of the Teleajen river, the main affluent of Prahova. The basin, with a surface of 41.3 sq km, lies on the Southern side of the Ciucaæ Mountains and its border is situated at approximately 250 m downstream from the confluence of the Cheita and Tâmpa streams, whose joining forms the Teleajen river itself.

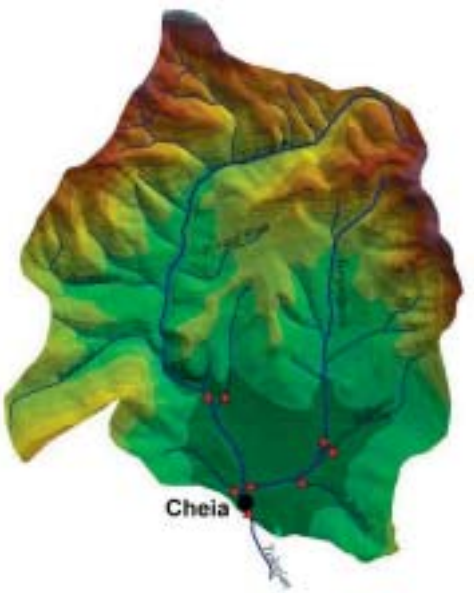
Cheia has been acknowledged as a 'local interest tourist resort'. It is a very picturesque spa, where people can come for a rest at any time of year. Next to the houses of the 350 inhabitants, the resort boasts of several guesthouses, inns, hotels and restaurants. The locality's economic potential mostly relies on its touristic offer. According to last evidences of local administration annually the Cheia resort is visited by 23000 tourists among witch 2.5% are foreigners. The landmarks in Cheia village are: Cheia Monastery (1770) and Upper Valley Teleajen Museum, subsidiary of Ploiesti Museum.

In Romania numerous severe flash floods developed in small basins encompassed either in large areas affected by regional floods or produced by local heavy rainstorms that brought about immense damages and loss of human lives. For example, in 2005 floods in Romania affected no less than 1734 localities, amounting to approximately EURO 1.4 bn worth of damages as well as 76 human casualties.

This report provides in a clearly structured and easily accessible manner basic knowledge about flash floods, the elements of a strategy for addressing the issue as well as suggestions on who can take what kinds of actions and how a collaborative effort to address the issue could be initiated.



Location of the Upper Teleajen Representative Basin (Cheia)



Location of Cheia village

Chapter 2 includes basic information on the aspects and origins of flash floods, the reasons why this phenomenon is so dangerous, and possible activities to limit its consequences.

The 3rd chapter shows activities geared towards flash floods as an element of a whole flood management programme.

Chapter 4, the main part of the publication, will be an attempt to describe the key activities in effective flash flood management. The issues raised here include hazards identification, the basics of forecasting and warning, suggestions regarding the implementation of warning and response systems based on the idea of local community participation in the planning process, and the issue of raising the awareness and flood preparedness of residents and users of high-risk areas. Moreover, reference is made to legal and institutional issues, to problems involved in spatial planning, structural measures implementation and flood insurance.

Chapter 5 includes assignments of the earlier-detailed components of flash-flood management strategy components to the institutions, organisations, and groups on a national, provincial and local level.

Chapter 6 provides tips for starting activities at the local level, and conditions for the success of these activities.

The 7th and final chapter includes recommendations for activities aimed at limiting the destructive effects of flash floods, which were formulated during the "Community preparedness and public participation in flash flood management in Europe" workshops that took place from 29-30 October 2007 in Kraków (Poland).

2. WHAT ARE FLASH FLOODS?

A. HOW ARE FLASH FLOODS GENERATED?

A flash flood is, in short, a sudden local flood of great volume and short duration which follows within a few (usually less than six) hours of heavy or excessive rainfall, or due to dam or levee failure, or the sudden release of water impounded by an ice log jam.

A flash flood can be caused by intense rain, particularly when it takes place in a saturated area where rain has previously fallen or the ground is frozen. In these conditions the additional rain runs off over the surface and accumulates in streams and rivers at a much accelerated pace. Heavy rains, most frequently connected with convection clouds, cover small regions and are short-lived (from a few minutes to a few hours), but very intense such as 100 mm (or 100 Litres per square meter) in the span of an hour or more. Violent rainfall causing flash floods can be accompanied by strong winds and heavy hail formation. They can also appear locally in a large area covered by rainfall.

Štrbský Creek - the water level immediately after culmination (Slovakia)

Štrbský Creek - the water level two weeks after flood (Slovakia)

Another cause of flash floods - particularly in highland areas - can be melting of snow in conjunction with rainfall. After heavy snowfall in winter, a sudden rise in temperature and rainfall in the winter/spring period causes a hastening of confluence of the rain and melting snow, and consequently a flood.

A flash flood can also result from a failure of dams, embankments, or other hydraulic infrastructure. Other causes might be glacier lake outbursts or outbursts of natural dams created by landslides. Occasionally, floating debris or ice can accumulate at a natural or man-made obstruction such as a bridge and restrict the flow of water (also referred to as ice jams or log jams). Water held back by the ice jam or debris dam can cause flooding upstream. Subsequent flash flooding can occur downstream if the obstruction should suddenly give away. On very steep terrains, or where the geological layers are disadvantageously arranged, sometimes flash floods can be rendered to be debris flow or hyper sediment-concentrated flow.

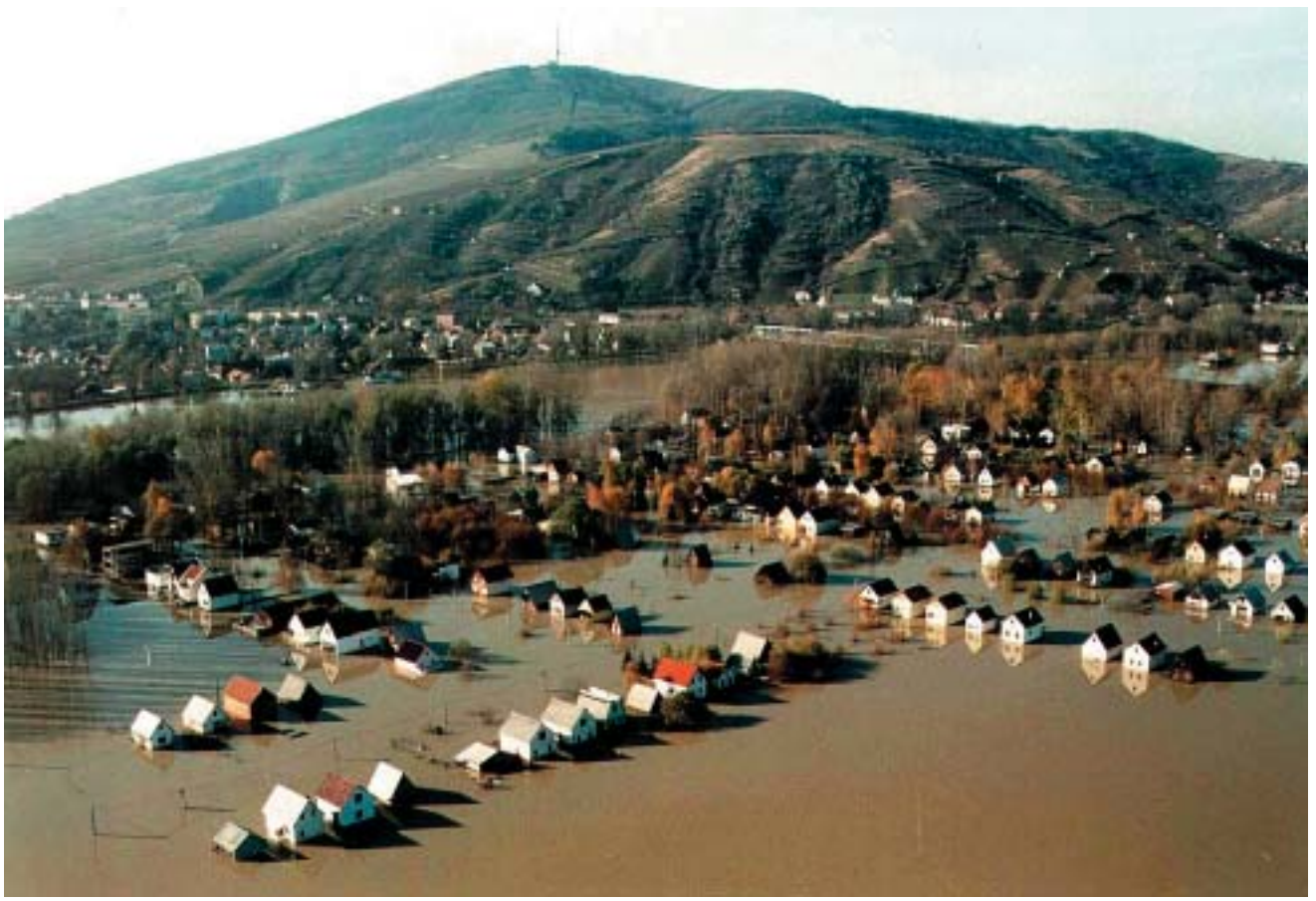
Trotus river (Romania)

Landslides on the Malá Svinka valley (Slovakia)

A flash flood does not necessarily result from a river bursting its banks, and can occur practically anywhere. This does, however, not mean it is impossible to indicate areas that are more susceptible to flash floods than others, or the hydro-meteorological conditions that lead to their occurrence.

Rolling thunderstorm
(photo by John Kerstholt, from Wikipedia)

Single Cell Thunderstorm
(photo by Bidgee, from Wikipedia)



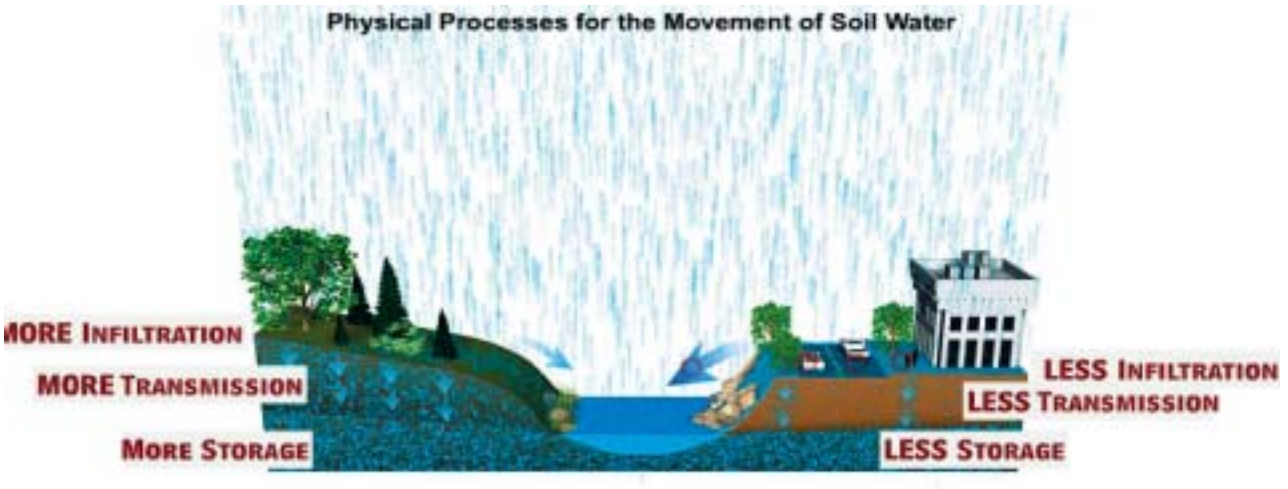
Highland terrains, narrow valleys hasten the runoff and increase the likelihood of flash flood occurrence

Topographical factors are key for the genesis and evolution of the quasi-stationary convective systems (or in simplified terms "slow moving rainfall cells that release large amounts of water over a relatively small area") that are often the cause of flash floods.

From the hydrological point of view, on the other hand, factors that have a decisive influence on the occurrence of flash floods - apart from the intensity and duration of the rainfall - are the topography, soil conditions, and coverage of the terrain. Disadvantageous topographical conditions such as high-exposure (steeply sloping) highland terrains, narrow valleys or ravines hasten the runoff and increase the likelihood of flash flood occurrence. Saturated soil or shallow watertight geological layers increase surface runoff.

Terrain coverage can have a similar effect. Urbanization processes and affiliated construction with watertight materials are thought to make runoff 2 to 6 times greater in comparison to terrains with natural coverage (fields, meadows, forests).

In summary there are various factors contributing to flash flood risk, some being influenced by human intervention and others entirely rather independent from human action.



Natural groundcover slows the speed of surface runoff keeping water in contact with the ground surface for a longer time. This increases infiltration, transmission and storage. (Source: The COMET Program)

The phenomenon of the flash flood is one of the most difficult natural hazards to predict in terms of time and place of occurrence. As a result, it is challenging for the concerned authorities and communities to respond appropriately and response plans are indispensable tools.

B. WHY ARE FLASH FLOODS DANGEROUS?

A flash flood can take place in a time duration that is span counted in minutes, or only a few hours from the event that causes it to happen (excessive rainfall, failure of hydraulic infrastructure etc.). During a flash flood there is a sudden rise in the water level in rivers and streams, and flow velocity can be very high. The force of the water can be so great as to tear away boulders, uproot trees, and destroy bridges and buildings that stand in its path.

Stream in Zarvraggia, July 18 1987

Stream in Zarvraggia 15 minutes later

A strong current of water only 60 cm deep can carry off most passenger automobiles. Therefore, all road depressions, viaduct passes, bridges, and roads leading past riverbanks are unsafe during a flash flood. Many fatal flash-flood related accidents have taken place due to the reckless and improper behavior of drivers. (NOAA/NWS)

In Poland in 2003, 6 people died in their automobiles during a violent downpour by the Wisloka River and its small tributary, the Wilsznia, in the south-east of the country. One fatal accident transpired when a car was parked by a river in which the water had quite suddenly begun to rise, and in the other case a father and his four children perished because they didn't turn off a road which had turned into a river. Such incidents happen all around the world - in the USA, for example, it is estimated that these sorts of accidents are the causes of half the fatal incidences in times of floods. All sorts of underground passageways, tunnels and other depressions can become deathtraps in city areas, as water can gather quickly and cut off all escape routes. Rushing water often changes the river bed, and it can therefore appear in places where it usually does not. That's just how it was during the flood in Gorzanow (Southwest Poland) in 1997 – the Nysa Klodzka River flowed in two beds – the usual one, and another through the center of village. Water at a depth of 1 m and a speed of 1 m/s can pose a deadly danger for an adult person, while flash floods often flow at significantly higher speeds, making a water level of just a dozen cm very dangerous.

Timely warnings could be the key element in reducing the risk to lives and property. Unfortunately, forecasting flash floods is very difficult. Hydrologists and meteorologists claim that with the present progress in meas-

urement, forecasting and nowcasting technologies, the exact place and time of the flood occurrence is known only an hour before it transpires. For instance, NOAA can issue warnings 43 minutes ahead in average ([Slovak Hydro-Meteorological Institute, 2006]). This significantly reduces the possibilities for the early warning of crisis services and residents, particularly considering the fact that in many countries meteorological-hydrological services have a limited range of measurement and forecasting tools at their disposal. The response time remaining is very limited. Often the warnings come too late, or are not supplied at all, either because of the lack of forecasts or because of the difficulties in spreading warnings, e.g. during the night. That's how it was in July 1998, when two people drowned in their own beds because of a sudden rise of water in the Bystrzyca Dusznicka river in south-western Poland.

The damage caused by flash floods is often severe, and distinguishably they present a serious threat to human lives. Statistics published by US NOAA agency state that flash floods are the cause of the majority of flood-related fatalities.

C. CAN FLASH FLOODS HAPPEN IN MY REGION?

Public technical agencies are not always able to ascertain which areas are susceptible to flash floods. The information that flash floods can take place almost anywhere, as intense rainfall can occur almost anywhere, is a message that may just sensitize residents to this problem, but it is not, however, a basis for concrete action. This is why it is essential to recognize the factors which may have an effect on the possibility of a flash flood on a given terrain. The above-mentioned topographical characteristics (steeply sloping terrains, mountain valleys, ravines and blind drainage[3]) can indicate terrains that are quite susceptible to this phenomenon. Whether or not a given area is at risk of flash floods, and in what time periods, can be estimated by taking into consideration the climate, topography, drainage network and the scale and frequency of their past occurrence. For the estimation of hazard it is also essential to have access to meteorological and hydrological data, as well as geological data and information (from the residents in particular) concerning the floods that have taken place in the past. IPCC report [Intergovernmental Panel On Climate Change, 2007] stressed the increase of climate-related hazards (drought, floods) across Europe and high relationship with geographical localization.

Flash flood on July 20, 1998 in Slovak Republic

Analyses made in the countries of CEE indicate that the summertime is the period in which the likelihood of flash floods occurences is the greatest. This stems from the fact that the summer period brings more storms and a greater frequency of heavy rainfall. The flash floods which occurred on July 20, 1998 as a consequence of extreme storms, struck about 30 villages in the eastern part of Slovakia in the Hornád river catchment. The losses were catastrophic. Flood damages were estimated at 25 million USD, human losses were unprecedented in recent history – fifty people died.

Source: [Slovak Hydro-Meteorological Institute, 2006]

It is often man himself who increases the danger. When a flash flood destroys a city, the flood is largely seen as the cause of the tragedy. It is not asked if in our use of the area and changing the hydrological circumstances we do not cause the damage ourselves in areas where topographical and climate conditions had not previously created susceptibility to flash floods. Technological means of flood protection and water-storage constructions can and do help in many circumstances but cannot provide absolute safety from flooding. This needs to be actively communicated to avoid a false sense of security.

The worst flood in United States history occurred on May 31, 1889 in Pennsylvania. An upstream dam was old and broke. Most of the city of Johnstown was smashed by the water and mud. More than two thousand people died in the flood.

[3] Blind drainage - areas in which surface flow collects in sinks or lakes not connected by surface channels to other streams in the basin (according to the International Glossary Of Hydrology, www.iahs.info)

A flash flood can be an unforeseen event in an area that is perceived as mainly susceptible to other sorts of floods. This was the case with Gdańsk, a city in Poland with 460 thousand inhabitants, situated on the southern coast of the Baltic Sea.

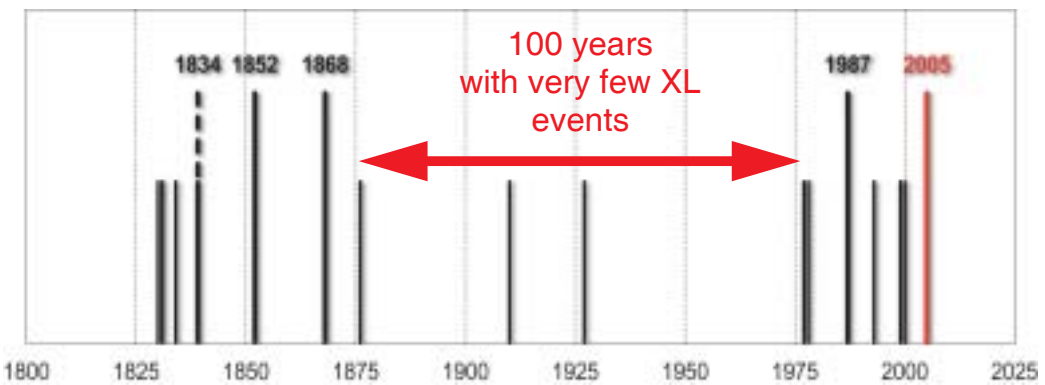
Urban flash flood, Gdansk, Poland, July, 2001
Flood threat in the Gdańsk region may come from three directions: from the old branch of the Vistula (Dead Vistula), which has a direct connection with the Gulf of Gdańsk, from the main Vistula River in the case of high discharges, and especially during ice cover in the mouth region, and from the moraine hills in the case of high precipitation. In July 2001, a severe flash flood resulting from extremely hard rain struck Gdańsk, causing considerable losses. A storm lasting less than four hours produced a rainfall in excess of the average monthly rainfall and caused the Radunia River to burst its banks, as well as water damage and flooding in areas of the town center, even in places where there is no watercourses.

Source: [Institute of Meteorology and Water Management, 2005]

Specialists are generally of the opinion that in comparison to river floods, whose likelihood and place of incidence are relatively well known, reliable risk analyses that include the likelihood of flash floods are necessary, together with indicators as to who and what are most susceptible to them. These analyses should take into account that climate variability and change has the potential to lead to more, intense rainfall events and therefore contribute to an increased flash flood hazard across Europe [Intergovernmental Panel On Climate Change, 2007].

Flood in the Prut river basin area – Romania

About floods it is interesting to note the randomness of their occurrence. In Switzerland, where flash floods are the rule rather than the exception, for a period of almost a hundred years only very few major flood events could be observed. This was followed by a series of serious flood events around the turn of the millennium, the most costly flood on record occurring in 2005.



Large supra-regional flood events since 1800 in Switzerland
Source: Dr. Lukas Hunzinger, WMO Regional Workshop 29-30 October 2007, Krakow, Poland

D. WHAT CAN BE DONE TO MITIGATE THE NEGATIVE EFFECTS OF FLASH FLOODS?

The key characteristics of flash floods that should be taken into consideration when developing a management strategy are: the unforeseeability of the place, local scale of the event, and particularly the violence of the phenomenon, as well as the very short response time and the great threat to human lives. The solutions developed for the management of river floods do not prove effective in dealing with flash floods, which require separate means.

Means of flood protection can be divided, between in structural and non- structural measures, the latter would seem to be the key deserving particular attention in effectively limiting the damage caused by flash floods. This does not mean that structural measures are of no assistance, but the typical procedures, like the building of reservoirs and embankments, can not always be adopted in areas susceptible to flash floods. Small scale structural measures can, on the other hand, play an essential role in delaying the flow of water, allowing it to be locally retained, or diverting it from places where it could pose a threat to people or properties. Operations to limit the shifting of debris, or to stabilize hillsides in areas at risk of landslides are important. The flood-resistance of buildings potentially at risk (floodproofing) should also be secured. It should, however, be noted that flood proofing may not be considered an option where high flow velocities and associated debris loads of flood water can be expected. The dynamic forces of such conditions on structures in general and on residential buildings in particular are very uncertain and difficult to assess.

What is considered key in managing flash floods is the activity of local authorities in warning and responding to floods, with their main goal being to limit the danger to human lives. The activity of local authorities in warning and responding to floods is essential to limit the danger to human lives and property. Flash flood warnings are generated on both a national (and international) level, generally assigned to meteorological and hydrological services, and on a local level. Local warning systems allow us to, on the one hand, to adapt solutions to the locally existing risk, and, to the capabilities of the local communities. Examples of the above-named solutions might be local monitoring networks, systems to warn and inform residents through land-lines or cellular phones, Internet facilities, automatic systems signalizing danger and closing off the roads backed by stream gauges, or use of volunteers. For the warnings to be effective, the organization (in particular in form of response plans) needs to be good, and there needs to be a high degree of community awareness in the areas in danger. This requires ongoing education and information, and the training of crisis services.

In Central and Eastern Europe, flash floods are a phenomenon that takes place in small regions, characterized by limited spatial extent, and this is why the damage they cause can best be limited on the local level. The main tool in this effort are flood preparedness and response plans on the local level. These plans should come about in co-operation with various actors: local self-governments, river administrators, crisis services, residents of the areas at risk, owners of companies located on these terrains, local NGO's, private companies involved in emergency response and recovery[4] as well as meteorological and hydrological services, and geological ones, if necessary.

It is essential that the state creates a coherent legal framework and support for local activities, particularly in terms of division of competencies between particular administrative levels and sectors. The relevant legal solutions concerning spatial planning will also provide support, including the mapping of high-risk areas and restrictions in their use. An additional factor supporting local communities if damage is caused should be a financial system, including an insurance system to provide the possibility of speedy recovery after a flood and sharing of risk.

[4] Such as transport companies, specialized companies to provide flood fighting equipment (sandbags, mobile flood barriers), local media, food outlets, hotels, providers of specialized heavy equipment for debris clearance etc.

3. FLASH FLOODS AS PART OF OVERALL FLOOD MANAGEMENT POLICY

Governmental policy on natural hazards has been aiming at keeping the human loss of life to a minimum, based on constitutional obligations of the state to protect its citizens. The minimization of human loss of life also represents one of the core aims of an integrated approach to flood management. Loss statistics indicate that flash floods are in fact the most lethal flood type.

Therefore, for regions prone to flash floods, governmental flood management policy should explicitly specify the Government's approach and applicable measures to work towards this aim as part of its overall flood management policy and strategy. Government should on the appropriate institutional levels comprehensively address all flood issues. In this it needs to be recognized that the traditional flood management approach employed for low-land riverine floods proves ineffective for flash floods, mainly due to difficulties with accurate forecasting for flash floods, the short warning lead-times, and consequently the requirement to involve much more closely local knowledge, and foster the local preparedness and response capacities. The main differences between flash floods and slow rising floods are illustrated in the table below.

Large River Flooding vs. Flash Flooding[5]

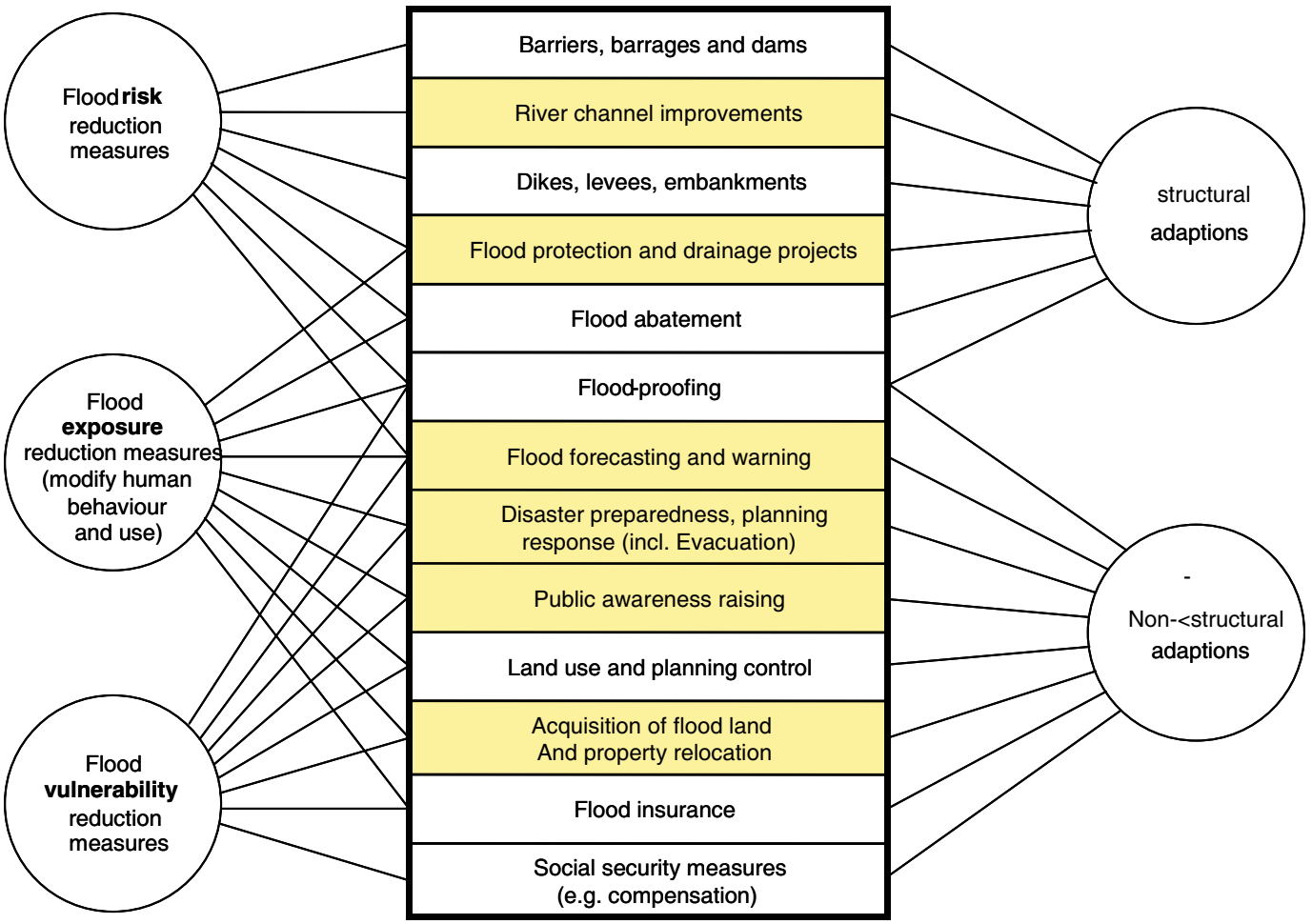
Large River Flooding	*Flash Flooding*
Catchment response affords long lead times	Catchment response is very fast and allows very short lead times (< 12hrs)
Entire hydrographs can be produced with low uncertainty with good quality data	Prediction of occurrence is of interest
Local information less valuable	Local information is very valuable
A hydrologic forecasting problem primarily	A truly hydro-meteorological forecasting problem
Affords time for coordination of flood response and damage mitigation	Coordination of forecasting and response is challenging over short times.

The Figure below presents a categorization of the measures that can be taken for flood management in general and the coloured fields represent the measures that are particularly relevant in dealing with flash floods. In Chapter 3 the relevance and application of these measures as an integral part of a flash flood management strategy is discussed at length.

Another aim of flood management policy that emerged later and is still evolving in various countries points at maximizing the net-benefits from flood plains, rather than aiming solely at minimizing flood damage. This results from the recognition that land resources in many countries are scarce and the development pressure on those land resources keeps on growing. In the mountainous regions where flash floods are most common, floodplains usually represent valuable development assets for settlements, infrastructure, industry and agriculture. In other terms, the comparably low costs of developing and exploiting the floodplains, has attracted humankind for centuries, and will do so in the future.

With floods in general, but even more so with flash floods, the ability of Government to manage risks to life and property solely through its own governmental institutions and resources is inherently limited. As an example, local flash flood warning systems can only operate effectively if the population at risk is (a) aware of a risk, (b) knows how to interpret warnings and how to react upon them, and ideally, however, most unlikely in practice,

[5] Source: Georgakakos, K.P. (2007), communication with WMO



Flood management measures
(adapted from [Parker, D.J., 2000])

knows their own responsibilities vis-a-vis those of the Government. This calls for an approach that interacts closely with those at risk in developing coping mechanisms. Flood risk awareness and the active involvement of the population into planning and implementation of flash flood management strategies are indispensable.

The short warning lead-times, as well as the uncertainties inherent to flash flood forecasting necessitate extensive preparedness planning and efficiently organized flood emergency response, with regular training and exercises. Close collaboration is especially required, between

- various disciplines and professional groups such as hydrologists, meteorologists, civil engineers, civil defence units, public administrators,
- scientists and flood practitioners, and
- various layers of the administration and the affected population.

While the benefits of such broad involvement of stakeholders and experts are recognized, it should, however, not be assumed that involvement of more stakeholders will automatically translate into a more efficient system or a better result. Such approach also involves a number of challenges that if recognized from the outset can be minimized. Those include for instance the risk that the sense of responsibility to deal with the issue of flash floods is diluted between various actors and institutions. Therefore, due care needs to be given to allow leadership to unfold on the appropriate institutional levels, not least by assigning clear responsibilities by law to respective institutions, and to continuously fine-tune those institutional arrangements. In particular, local communities that are located in flash-flood prone communities should be placed in a position where they can invoke support of higher governmental institutions, such as the National Hydrometeorological Services or Crisis Intervention Forces, in raising their flash flood preparedness levels. Local communities, with their socio-economic and institutional fabric, represent the key stakeholders for flash flood preparedness, as they are not only potential victims of a flash flood but need to take preparatory action in the first place. As such, understanding the needs and constraints on this level will be required by any other institution trying to address the issue.

One also needs to recognize that local concerns are many times not the concerns of those in charge of specialized services, charged with flood hazard identification or flood forecasting and warning. It is likely that most local officials are primarily concerned with economic development and job creation rather than dealing with natural hazards (depending on how frequently a community is affected by flash floods). Rather than seeking one-time short term interventions on the community level, the vision should be to develop a long-term partnership between the stakeholders.

In the past decades, due to scientific and technical advances related to forecasting and warning dissemination, but equally important through the recognition on a policy level to involve stakeholders more closely into decision making processes, a huge potential and opportunity to address the issues of flash floods more effectively has been created. Given the political will to address the issue, this potential can be tapped for minimizing the human losses and suffering induced by flash floods.

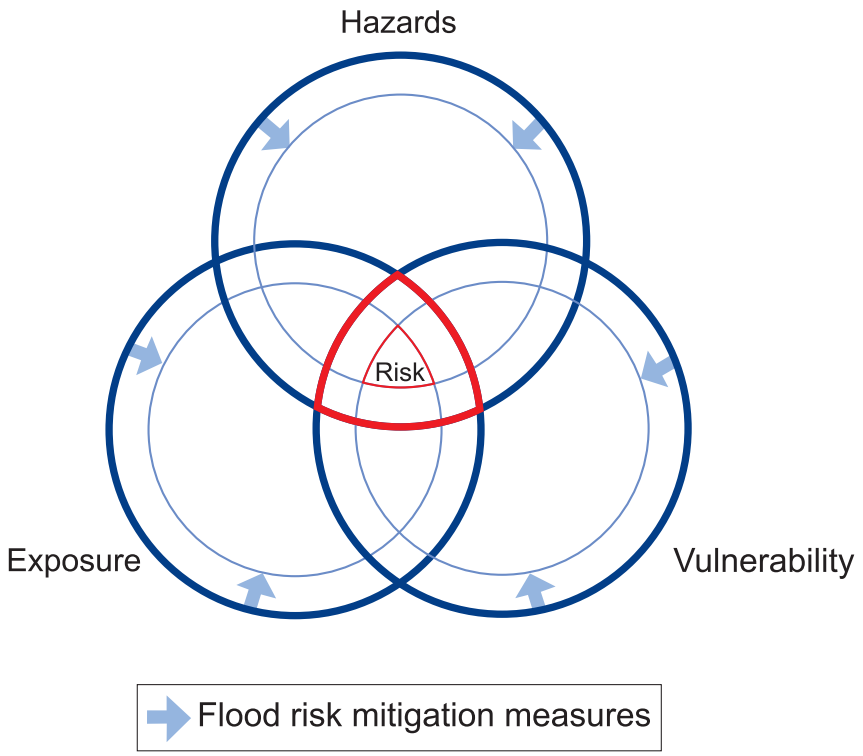
While employing all available means and recent scientific and technical advances, Governmental institutions should also strive to carefully educate the public that while government is doing everything feasible to support communities in increasing their preparedness levels and response capacity, there is no absolute safety from flooding and in particularly not from flash flooding. Analysing and addressing to the extent possible residual risks from flash floods and making clear that individuals and local communities also have choices to make in what way they are ready to accept or address those risks is therefore indispensable.

4. WHAT ARE THE ELEMENTS OF A FLASH FLOOD MANAGEMENT STRATEGY?

A. FINDING OUT WHO AND WHAT IS AT RISK

Factors affecting overall risk

Planning for the limitation of flood damage and choosing the proper methods to reduce losses incurred by flash floods requires that an evaluation of the level of the flood risk in a given area be carried out. The risk level is contained in information on the impact of a flood of defined probability on people, the environment and property, i.e. it describes the potential losses that the flood may cause. Flood risk can be characterized in many ways, but three elements are crucial: hazard, exposure and vulnerability (see figure below).



Construct of flood risk and its reduction (source: [APFM, 2006])

By 'hazard' we generally understand a flood magnitude of a defined probability of occurrence. This information can be translated into maps showing the borders of the terrain at risk as well as depths of inundation and related velocities. The 'exposure' describes human activity and environment on the hazard zone (who and what are endangered by flood). The third parameter that characterizes the general notion of risk is the 'vulnerability' of a given region to flood damage. Presently, various definitions of this parameter are applied depending on the needs. One of these concerns the susceptibility of a region to flood losses, which is defined via the geophysical, economic and societal attributes of a region.

A clear distinction between exposure to hazard and vulnerability is considered essential to analyse the flood problem, clearly distinguishing between strategies that can be adopted from an engineering perspective from those that require consideration of social issues. A thorough risk analysis, which includes an assessment of hazards, community vulnerability and development requirements for building societal resilience, must be carried out.

Flood vulnerability analysis in Slovak Republic

The Slovak Hydrometeorological Institute (SHMU) has conducted analyses to evaluate vulnerability and sensitivity in order to understand flood processes and to develop proper strategies for floods. Territorial vulnerability to flooding was worked out in 2116 selected Slovak municipalities based on four criteria:

- *Urban (settlement significance, size, population, inundation area type, the occurrence of major structures, road and rail network, tourism, etc.)*
- *Hydrological (catchment area shape and size, river basin retention capacity, mean annual flowrate, hydrological data reliability, the rate of forestation, geology, orography, morphology, land management method, etc)*
- *Water management (water management priorities, flood measures, stream modifications, etc)*
- *Environmental (occurrence of locations of relevance to environment conservation)*

The additional development of a flood index K described the hazard of the occurrence of extreme floods on the Slovak territory. The basis for establishing the flood index K was the quotient of maximum inflow observed in particular years at water-level measurement stations in rivers (river gauges) to the average yearly inflow in the same profile. The K indicator was the basis for developing a map of the susceptibility of the various regions of Slovakia to flooding.

Source: [Slovak Hydro-Meteorological Institute, 2006]

The expanded and increasingly applied interpretation of the concept of vulnerability concerns the potential ability of a community to cope with and recover from the crisis that a flood would cause. Social (education, gender, duration of local residence etc.) and political-economic (property structures, level of development, autonomy level) characteristics are often indicators. Both the preparation of single inhabitants and the community as a whole are taken into consideration.

The importance of looking into vulnerability could be illustrated on following example. A person with savings, strong social network, flood adapted house and flood insurance coverage will recover from a flood much faster than other people such as recent migrants to the area or the elderly without much financial means. It should be taken into account during flood risk assessment.

The parameters described, which combine to make up the concept of vulnerability, are evaluated on quantitative or qualitative scales, and then later are integrated to provide, in effect, an indicator of flood vulnerability. Depending on the needs that serve the decision-makers as selection criteria, the best methods for the region may be flood mitigation or preparing maps describing the vulnerability of particular catchment areas (regions) to a flooding catastrophe.

Assessing the hazard

By flood hazard we generally understand the likelihood of a flood happening in a certain place at a certain time. Information about hazard is presented on maps. As a minimum, they include the borders of the area at risk of a "reference flood" - generally a flood of a defined probability of occurrence. These may also be areas at risk of several types of floods (this is established by the Flood Directives Proposal, [Flood Directive, 2007], among others). Apart from the lines marking out the range of floods, risk maps often include information on the depth and velocity of the water, information on possible riverbank erosion, and on landslide terrains. Flood risk maps for terrains situated on riversides are developed in many countries, based on model analyses or historical floods. In establishing areas at risk of flash floods, we must take into account sources of danger other than river overflow.

In establishing places at risk we may use the following information:

Historical information (human memory, chronicles etc.) - These are extremely important sources of information about where these phenomena have occured in the past, and what their extent was. With today's increased mobility, however, people are not always sources of information that can allow us to identify catastrophes from long ago.

Meteorological and hydrological data – This information allows us to evaluate with a fairly high degree of accuracy where floods have taken place and what their extent was. For regions situated far from rivers, they only allow us to estimate what sort of rainfall caused the phenomenon to take place (duration, intensity).

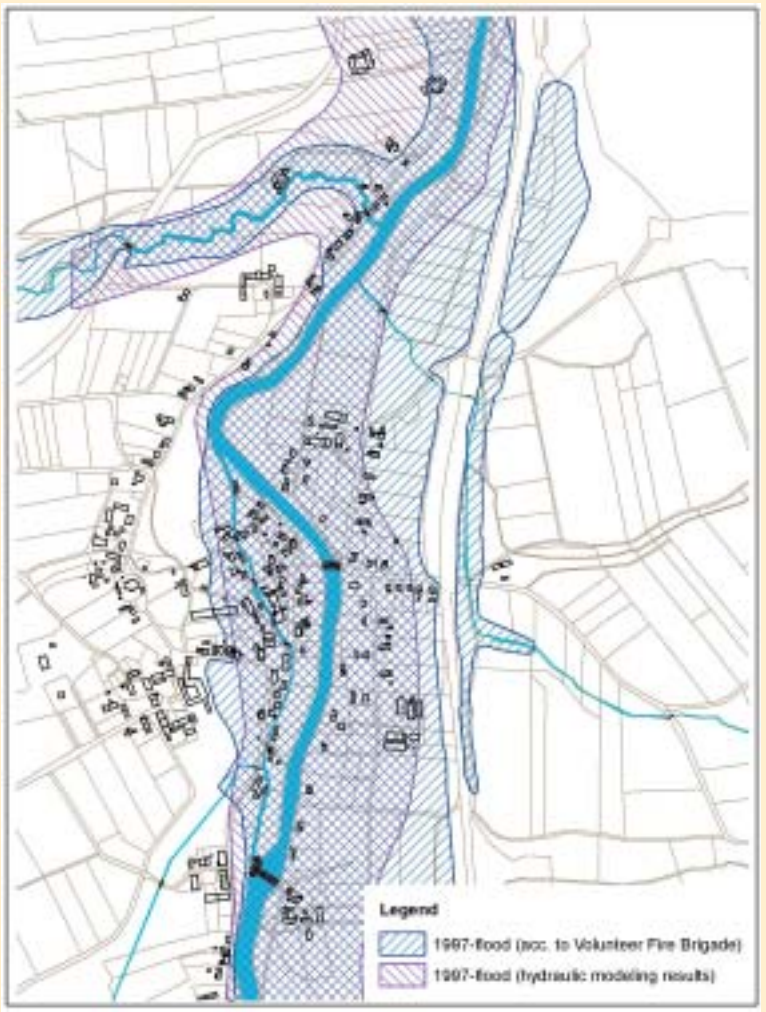
Analysis of potential breakdowns of hydro-technological sites – For the majority of hydro-technological sites, such as dams, reports are prepared during the design phase of the possible consequences of their breakdown. They include data concerning the speed of the phenomenon's course, the extent of potential flood areas, and describe warning system for inhabitants and owners of property at risk.

This data may help in identifying areas at risk of flash floods. The standard procedure for marking out such areas is a combination of hydrological and hydraulic modelling with GIS spatial analyses. Digital maps (spatial

databases), if available, facilitate not only the marking out of areas at risk, but also analyses of who and what is in danger. These analyses are worth verifying and adding to. Local experiences can be used to this end, if possible, to inscribe on the map the extent of historical floods. This can be enhanced together with local services, and even with residents of a chosen location.

Reasonable solution in this field introduces Flood Directive ([Flood Directive, 2007]). Two steps approach is required to identify flood hazard and flood risk. First step include assessment of preliminary flood risk based on the historical floods which have significant adverse impacts on human health, the environment, cultural heritage and economic activity and for which the likelihood of similar future events is still relevant. On the basis of a preliminary flood risk assessment each country will identify those areas for which they conclude that potential significant flood risks exist or might be considered likely to occur. And for these areas flood hazard maps and flood risk maps should be prepared.

Flood hazard map for Gorzanow, Poland



In Gorzanów (Poland), a map of the extent of the water during the flood of 1997 was prepared. Information from firefighters at the Volunteer Fire Department was used in developing it. Apart from the maximum reach of the flood, the map included lines marking out a zone where the depth and velocity of the water did not permit any rescue operations to take place. This zone will be used to develop the warning priority system for the residents of Gorzanów.

During the planning process the map became a great source of information exchange, and an aid to discussions and reconciliations in the team carrying out the project. It also served to present information developed in the framework of a response plan – the evacuation paths and sites. This information was passed on to the local communities in the form of fliers concerning the evacuation plans and a wall map for schools and cultural centers.

The map shows differences between hydraulic modelling results and fire fighters assessment.

Assessing vulnerabilities of the local population

It is impossible to work out a standard list of indicators that should be taken into consideration in evaluating the vulnerability of a community (or region) to flooding. This depends, after all, on the goal, for whose realization a vulnerability analysis is necessary. We might imagine many decision-making tasks that such an analysis might serve, as illustrated by the following questions:

- Where should a new construction or elements of an infrastructure be situated so as to minimize the vulnerability of a region to flooding?
- What activities should be initiated to help social groups who are most vulnerable to flooding?
- What areas in the region require particular attention in designing warning systems and responding to floods?

The methods of making these evaluations will differ if we are analyzing the vulnerability of many communities living in a large area, or if the analysis is to concern only a small community. In addition, some indicators will be identical for many communities, and entirely different for others. For the case of flash floods, apart from the attributes described in chapter 3 (attributes of the physical area, attributes of floods affecting the area, attributes of the management of the area), an essential element that has a great impact on the flood vulnerability of a given community is the effectiveness of the activities to limit flood losses performed by the community. The tactics described below are essential for limiting the risk to life and properties in communities threatened by flash floods, here coupled with elements proposed for the evaluation of these tactics.

Tactics	Indications for evaluation
Preparing sites for flooding	The number of sites equipped with various sorts of floodproofing, such as: security from water seepage inside of the house, equipping the home with temporary sealment walls, situating the home above the level of a sizeable flood, securing the plumbing from backing up sewage, sandbags, and so on
System of warning in habitants	– Number of inhabitants that are reached by flood warnings, – Organizing warnings for those staying temporarily on the terrains at risk (e.g. tourists), – Accessibility of a secondary warning source, – Identification of warning responses
Aid in warning response	Accessibility of evacuation paths and sites to people, animals, vehicles and machines; availability of flood fighting equipment; availability of transportation means for evacuation and equipment transport.
Help after the flood	– Accessibility of flood insurance, – Accessibility of community or district funds for flood aid, – Preparation of a communal flood assistance plan
System of education and awareness raising	– School education program on floods and warning systems and responses; – Information on the warning system and ways of responding on local Internet pages, – Accessibility of information about areas at risk, – Counselling system for inhabitants.

As already mentioned, the methods of estimating vulnerability depend on the size of the area in which the evaluation is to be conducted. In evaluations concerning the area of a country, we will generally base our work on available land data (geographical and economical), climate data and census data. When analyzing smaller areas the basis may be ground surveys and interviews with household residents.

In Gorzanow (Poland) a survey was passed around the inhabitants on the effectiveness of the resident-warning system, their knowledge about the possible methods of preparing for a flood, and the effectiveness of the aid following a flood. It allowed for an initial evaluation of those elements which had been taken into consideration in work affiliated with the organization of a warning system, informing the inhabitants of existing flood hazards, and organizing educational and counselling activities.

Dealing with uncertainty

When we speak of the uncertainties associated with floods, we often have in mind problems with forecasting them, and quantifying the uncertainty of these forecasts. This problem is solved based on ensemble forecasts, giving us a range of forecasts (e.g. for various assumptions pertaining to starting conditions). On their basis, as a result of ensemble forecasts post-processing we can make probabilistic forecasts (e.g. forecasted values with an exceeding probability). This method is however not applicable in case of the flash floods where radar based nowcasting procedures are considered the most reliable. In the operating practices of the National Meteorological and Hydrological Services, deterministic forecasts are prepared without evaluations of their uncertainty.

Evaluating the uncertainty of forecasts is not a challenge for NMHS's alone. The users of forecasts are also accustomed to categorically-formulated forecasts, and a new product like probabilistic forecasts will require training, at least for crisis services.

For the time being, however, we have deterministic forecasts, which leave users, e.g. crisis services, with the problem of how to deal with their implicit uncertainty. Consequently, the forecast user is left on his/her own, not only to deliberate the possibility of a flood occurring, but also its potential harm to people and properties, and then further the effects of a bad decision resulting from an error in forecasting. This is a dilemma of how, on the one hand, to avoid false alarms, and on the other to encourage the warning of residents about a flood that is about to happen. This is why, in addition to preparing forecasts, NMHS's interpret meteorological-hydrological situations and qualify the danger level of a weather phenomenon. For the case of flood hazards, an example of such an evaluation is the four-point scale presented below, which relates to both the size of the threat and the likelihood of its occurrence:

- Flood watch—warning concerning atmospheric and hydrological conditions which could lead to the occurrence of a flood.
- Flood warning—warning concerning an inevitable flood which is to occur.
- Severe flood warning—warning of inevitable catastrophic flooding, requiring immediate evacuation of flood plain inhabitants and users.
- All clear—revocation of warnings when the danger passes, or when meteorological and hydrological conditions improve.

This is an evaluation such as those applied by, for example, the US National Weather Service or the Environment Agency in England and Wales. Not all NMHS's, however, provide such a diversified evaluation of the situation, for flash floods in particular, and moreover the spatial resolution of warnings worked out on a national level may be insufficient for local needs. For this reason, there is need to evaluate flood risk and develop warning and response systems and plans on a local level. Those plans have the core function to clarify roles and responsibilities as well as procedures to be followed, in order to allow the most efficient and effective response, with the available means, in saving life and property.

Flood warning procedure for the Polish pilot site

In Gorzanow, a procedure for warning inhabitants at risk was developed in the framework of building a local warning and response system, in which the competencies of the county and community self-governments were defined in the above-mentioned field, and education and training courses. The warnings took place in many stages, and so the residents would be warned about the danger as the flood situation progressed. The four above-described types of warning bulletins were taken as a model (Flood watch, Flood warning etc.).

Uncertainty with regards to the situation in a catchment area concerns not just the future, but also the current flood situation. Forecast specialists, crisis services and all those at risk have limited, though varied knowledge concerning the situation at hand. This is not just in terms of the hydrological-meteorological situation, but also information such as the scale and type of destruction, the safe evacuation routes etc. One of the methods of dealing with this kind of uncertainty is effective exchange of information between these groups. Open access to measurement data in real time is helpful. Two-way communication yields even better results. This is shown by recent examples in which instant messaging was used to exchange information between meteorological-hydrological services, crisis services and the media (e.g. the tornado in Alabama, 21.04.2004; Hurricane Katrina 23.-31.08, 2005).

B. PROVIDING A TECHNICAL UMBRELLA FOR FLASH FLOOD FORECASTING AND WARNING

Problems Faced by Local and National Services

Flash floods tend to be phenomena of local range which are difficult to predict both in terms of location and magnitude of the hazard. Whether or not rainfall will result in the flooding of a given region is the outcome of many factors. This depends not only on the quantity of the rainfall and degree of moisture in the catchment area (i.e. past rainfall), but also on how the terrain is covered, the topography or the lay-out of the terrain in the zone being considered and the intended functioning of hydraulic infrastructure. Modelling the phenomenon therefore requires meteorological, hydrological and a whole range of other data. Even if geographical features are considered to change little over time, it should be remembered that changes in catchment-area management (e.g. deforestation, sealed constructions, agrotechnical operations) can have a vital impact on the rainfall-runoff transformation, or on the stability of slopes.

National Meteorological and Hydrological Services (NMHS) try to provide warning before flash floods, but their capabilities are limited. It is particularly difficult to work out quantitative precipitation forecasts (QPF) for smaller regions, which is a condition for increasing the warning lead time. Furthermore, one must also bear in mind that NMHS's often do not have the relevant exact and current geographic data at their disposal, and their calibration and verification capabilities of the relationship between rainfall and runoff are limited with respect to the density of the measurement network and their employment capabilities. Thus forecasting flash floods carries with it a great deal of uncertainties.

A local decision-maker responsible for flood security has to figure out how to make the best use of measurement and forecasting information from the national system. On the other hand, he/she is faced with the question: is this information sufficient for the local needs? The response to this question is decisive in shaping the local flood-warning system (LFWS), in particular the components which supplement the national monitoring and forecast systems. The solution has to take into consideration not just the level of flood risk in a given terrain, but also the capabilities of the local community.

Flash Flood Forecasting Possibilities

The work of contemporary NMHS's is based on a measurement system that includes a network of ground measurement stations, a network of meteorological radars, and lightning detection systems. These systems are used by the services of individual countries, and the data they gather is supplemented by information from meteorological satellites, data from measurement sensors mounted on ships and airplanes, and measurement data from neighbouring countries[6]. Meteorological forecasts are based on Numerical Weather Prediction Models (NWPM), and the key NWPM product for our case is the quantitative precipitation forecasts.

Flash floods are caused mainly by convective[7] precipitation (local convection or larger scale organized convection). Current NWPM's are not designed to predict such phenomena. To capture this kind of flood, real-time analysis of actual precipitation intensities and accumulated amounts is needed, using a combination of *in situ*

[6] The international exchange of data is carried out in the framework of the WMO.

[7] The term "convection" depicts a process generally associated with warm rising air and the formation of cloud. Local breezes, wind and thunderstorms are a result of convection in the atmosphere.

and teledetection systems measurements. Predictability of local convective events is very short. Practical predictability is currently less than one hour with modern nowcasting systems. Nowcasting products would be used as an input to an associated hydrological models chain.

Some NMHS's work out forecasting products with an evaluation of flash flood risk. These products are generally worked out over grid spanning from a few to over a dozen kilometers, and are based on rainfall threshold values. An example of such a threshold value is the Flash Flood Guidance (FFG), an internal US National Weather Service product, which indicates the amount of rainfall in a given amount of time (usually less than 6 hours) which most likely will produce flash flooding in a given area. Flash Flood Guidance values are determined statistically or based on geomorphological principles[8]. This solution introduced by the US NWS is also applied in other countries.

In wealthier countries, apart from the most modern measurement systems used by the NMHS, local solutions have appeared to supplement the national measurement and forecasting systems. We might take for example the local flood-warning systems in the USA. Here we find simple solutions based on a local measurement network estimating the flood risk on a similar principle to the FFG, but also examples of co-operation with private meteorological bureaus (Denver, Colorado), or systems facilitating real-time modeling of the extent of flood plains, coupled with automatic alerting of residents in areas at risk (see the box below).

Fort Collins, Colorado Real Time Flood Inundation Mapping & Notification System

This system is integrating hydrological and hydraulic runoff modeling with emergency operations in a system that is user friendly and graphically oriented. It's based on local telemetric flood monitoring network operates in the National Weather Service ALERT format. Data is collected at 54 gage sites from 38 rain gauges, 35 water level gauges and five weather stations.

Hydrological software models allow to develop the real time runoff estimates based on the data received from the gages and from radar. Hydraulic models will develop inundation areas based on the topographic mapping available form the system database and the runoff estimates from the hydrological modeling. All output information will be displayed in graphical format using a Geographic Information System (GIS). In addition to the real time modeling, "what if" scenarios can be run to determine implications of various rainfall amounts based in part on the real time gage data received, and on information entered assuming continued real time rainfall or projected rainfall patterns (weather forecast is available from the National Weather Service). This short-term flood forecasting will allow more lead time for responding to an event. The system will recommend action steps and notification areas for the affected areas of the community based on the results of the real time and prediction modeling. The residents of the area potentially affected could be alerted to the pending or occurring event through various notification media (Emergency Auto-Dialing, AM Radio Station broadcasts, Cable TV overrides that include text and maps of impacted areas, Weather Radio, and a Web page)

Source: http://fcgov.com/oem/rtfim.php http://www.ci.fort-collins.co.us/stormwater/fwsindex.php

The above examples show the opportunities for supplementing the measurement and forecasting information from the NMHS, and developing on this basis equipment to assist decision-makers responsible for the safety of their citizens. This equipment requires relatively detailed measurement information, i.e. the contributions of additional measurement stations maintained by local communities. But if we hope to extend the lead time for our warnings, quantitative precipitation forecasts are essential. In practice, crisis services in many countries work based on general rainfall forecasts formulated by weather forecasters from the National Meteorological Services for larger regions, and they are often missing information on recent rainfall (a sparse and non-automated measurement network, no radars), which greatly complicates the diagnoses of flash flood risk and delivering warnings. An example of a solution allowing the forecast of flash flood danger in such conditions is the system that has been functioning for a few years in Central America (see box).

[8] information concerning FFG, in an accessible way, could be found in the COMET educational materials, see http://www.meted.ucar.edu/hydro/basic/FlashFlood/.

Central American Flash Flood Guidance (CAFFG)

The system was designed by Hydrologic Research Center, a non-profit research corporation from USA, to produce in real time flash flood relevant information for seven countries of Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama) with a 100-300 km^2 spatial resolution. The CAFFG system uses satellite rainfall estimates and telemetered on-site rain gauge observations, both in real time, to produce for each subcatchment 1-, 3- and 6-hour estimates of mean areal precipitation, 6-hourly estimates of depth-integrated soil moisture, and 1-, 3- and 6-hour geomorphologically-based flash flood guidance. The information is transmitted to the national forecast agencies to assist with the short term forecast of flash floods. CAFFG products, generalized to a 15km grid from the original basin-computed values, are also accessible to the public via the Internet (c.f. http://www.hrc-web.org). The system has been operative since 2004, and is the world's first system of this sort with regional coverage.

Source: . http://www.hrc-web.org

The example mentioned in the box shows a regional-level solution applied in circumstances where the measurement information is accessible only to a limited degree. This solution allows for flash flood warnings without additional hydrological-meteorological analyses on a local level.

Experiences of Central-Eastern European Countries Participating in the APFM Project

Background

All 3 countries participating in the second phase of the APFM project have recently taken up the modernization of their national measurement and forecasting systems (POVAPSYS [Hajtášová K., Kyselová D., 2005], DESWAT [Global Water Partnership Romania, 2006], SMOK [Institute of Meteorology and Water Management, 1999]). The impetus for these projects were the floods that transpired at the turn of the 21st century. These modernizations share many similarities. They included automated networks of ground measurement stations, the construction (expansion) of radar networks, the construction of storm detection systems (Poland, Romania), and the construction of meteorological and hydrological forecasting systems facilitating a greater automatization of the forecast preparation process.

In effect, the work of the national services of the above-named countries are capable of supplying receivers with more measurement and forecast information with greater frequency than before. This does not mean that the needs of local decision-makers have been fulfilled in this way. Improvement of local flood warning systems has been carried out both by the NMHS's and by local communities. Examples of such activities described below in this subchapter demonstrate monitoring and forecasting solutions, as well as those to assist the making of a decision to warn inhabitants.

Monitoring

Information from national monitoring networks is often insufficient for local specialists to evaluate flood risk. Often the network density is insufficient, and moreover the national network stations are situated according to hydrological and meteorological criteria, while for the needs of flood warnings based on land development criteria, stations situated locally might be necessary. For these reasons, many countries have local monitoring networks in addition to their national networks.

Local flood monitoring network in Poland and Slovak Republic

Poland is an example of a country that started creating local monitoring networks after the floods of 1997, both as an effect of central initiatives[9] and the activities of local self-governments. These networks are independent from national networks and there is no uniform standard for their construction or delivery of data, though there is also an example of a local monitoring network under construction, integrated with the national network (the Staszowski County). The local networks are commonly based on automatic measurement stations which conduct ongoing measurements, while the transmission of data is based on

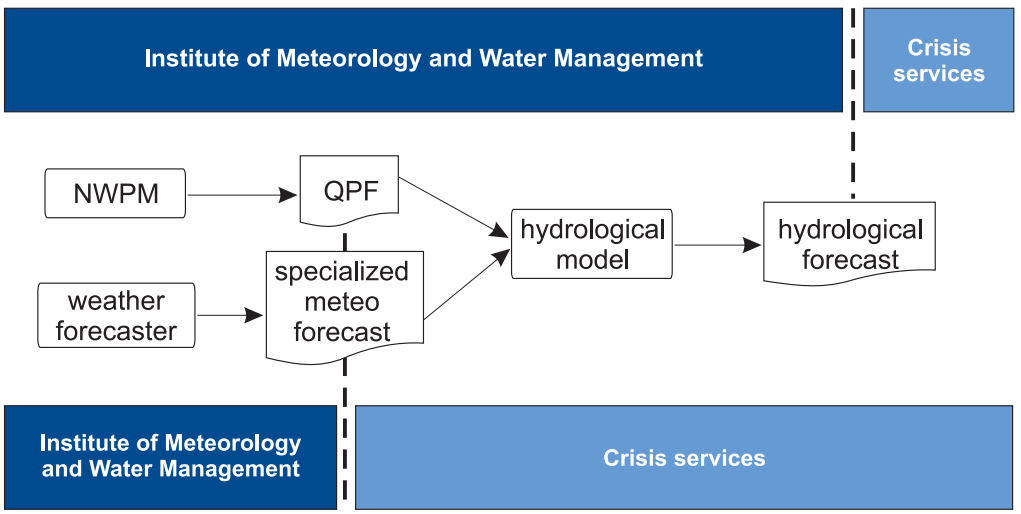
[9] After the floods of 1997, Poland carried out the government-funded Flood Recovery Project, in the framework of which over a dozen local flood-damage limitation and flood prevention plans were worked out. Part of these plans was the construction of a local flood-monitoring network.

an infrastructure of GSM telephone providers or private radio networks. For example, the local flood monitoring system for Klodzko County (area ~1500 km^2 south-west of Poland) is a completely automatic system comprised of 19 river gauge points and 20 precipitation measurement points. Measurement stations are powered by electricity, with backup from battery-powered generators. Transmission of data takes place via radio.
In Slovakia, the national hydro-meteorological service (SHMU) has made an attempt to introduce local measurement networks based on the alert systems operating in the USA. Two local systems for modest-sized areas (a few dozen km^2) have been built by SHMU, and are run by the local communities.

Forecasting

Traditional meteorological forecasts prepared by an NMHS include a description of the current and forecasted meteorological situation, supplemented by information on the anticipated rainfall, temperature, wind velocity etc. They are prepared by weather forecasters for larger regions. Apart from the traditional forecasts, there are also Numerical Weather Prediction Model forecasts available. Poland has recently installed a nowcasting system (ultra-short-term forecasts)[10] but until now it serves only as supporting tool for weather forecasters and is not wider used in operational practice.

Hydrological forecasts are worked out for a relatively small number of profiles, often covering larger-scale catchment areas, and they are rather ineffective for flash flood warnings. Poland's NMHS is in the course of developing/calibrating hydrological models for their hydrological response units (the small catchment areas that the country is divided into), but the use of these models is still in the experimental phase. The solution being tested at the Polish pilot site is a local hydrological model based on meteorological forecasts from the NMHS. It can take advantage of the QPF from the meteorological model, or a specialized weather forecast devoted solely to this region. Two variants of division of competences between NMHS and crisis services are showed in the figure below.



Flood forecasting - division of competences between NMHS and crisis services

Interpretation of the Meteorological and Hydrological Situation

NMHS's perform analyses of the current and forecasted meteorological and hydrological situation. If the situation qualifies as potentially unsafe for people and properties, warnings are issued. These warnings can be the basis for introducing a state of increased readiness for crisis services, but they can not be a basis for securing

[10] NIMROD, license and support from UK Meteorological Office

concrete sites, for example, or evacuating residents. Local crisis services must therefore interpret measurement and forecasting information in an ongoing fashion. This interpretation is generally based on rainfall threshold values, or water level threshold values in rivers. These values might be compared with measured or forecasted quantities, though in the case of forecasted quantities an uncertainty of future rainfall is inevitable.

Application of Flash Flood Guidance in Romania and Slovak Republic

The connection between the precipitation thresholds, leading to the reaching of dangerous levels in the sections controlling small basins with torrential regime, can be established by correlating the characteristics of high flood with its triggering factors. On the basis of these correlations, there can be pre-established thresholds of the precipitation characteristics (amount, duration, etc.), which can cause flash floods. Such a solution was adopted at the Romanian pilot area. Similar solutions can be applied at the national level. The NMHS's in Romania and Slovakia are currently working on equipment to facilitate the evaluation of flood risk, based on the above-described FFG concept. In Slovakia, FFG estimates are made on a local level (the national service would supply the QPF and Antecedent Precipitation Index,), while in Romania they would be estimated on a national level for small watersheds of areas of 100-300 km^2 (based on the Sacramento Soil Moisture Accounting Model).

Source: [Slovak Hydro-Meteorological Institute, 2006], [Global Water Partnership Romania, 2006]

Local crisis services often make decisions based on very limited information. On the other hand, there are high-risk regions for which we have more thorough forecasting and measurement information available, coming from various sources. In this case the decision-makers need equipment to help them integrate the data (e.g. from the national and local networks) for their visualizations and interpretations. This would help them to make the decision to warn inhabitants and users of terrains at risk.

Warnings

As previously mentioned, the NMHS issues warnings on dangerous weather phenomena in addition to meteorological and hydrological forecasts. In Poland, for example, there are two levels of warning on established rainfall threshold values, or wind velocities for coastal floods. The smallest region for which warnings are issued is province-wide (i.e. 10,000-30,000 km^2). These warnings are addressed to both crisis services and the general population.

The warnings formulated by NMHS's are meant to increase alertness. The encouragement to take action is generally given by warnings spread by crisis services at a local level. The warning methods in terms of individual locations depends on the technological capabilities and local circumstances, e.g. the sort of buildings (high or low-density housing).

Examples of flash flood warning techniques from Romania and Poland

The Cheia basin warning system consists of an electro-acoustical system located in the school building, a toll exchange and a team of fire fighters in place, which may act in case of flash flood ([Global Water Partnership Romania, 2006]).

In Gorzanow, a telephone system specially built by the county administration can warn around 800 inhabitants in the course of one hour. This system is backed up by a group of volunteers, "flood guards" who ensure a second route to spread warnings ([Global Water Partnership Poland, 2006]).

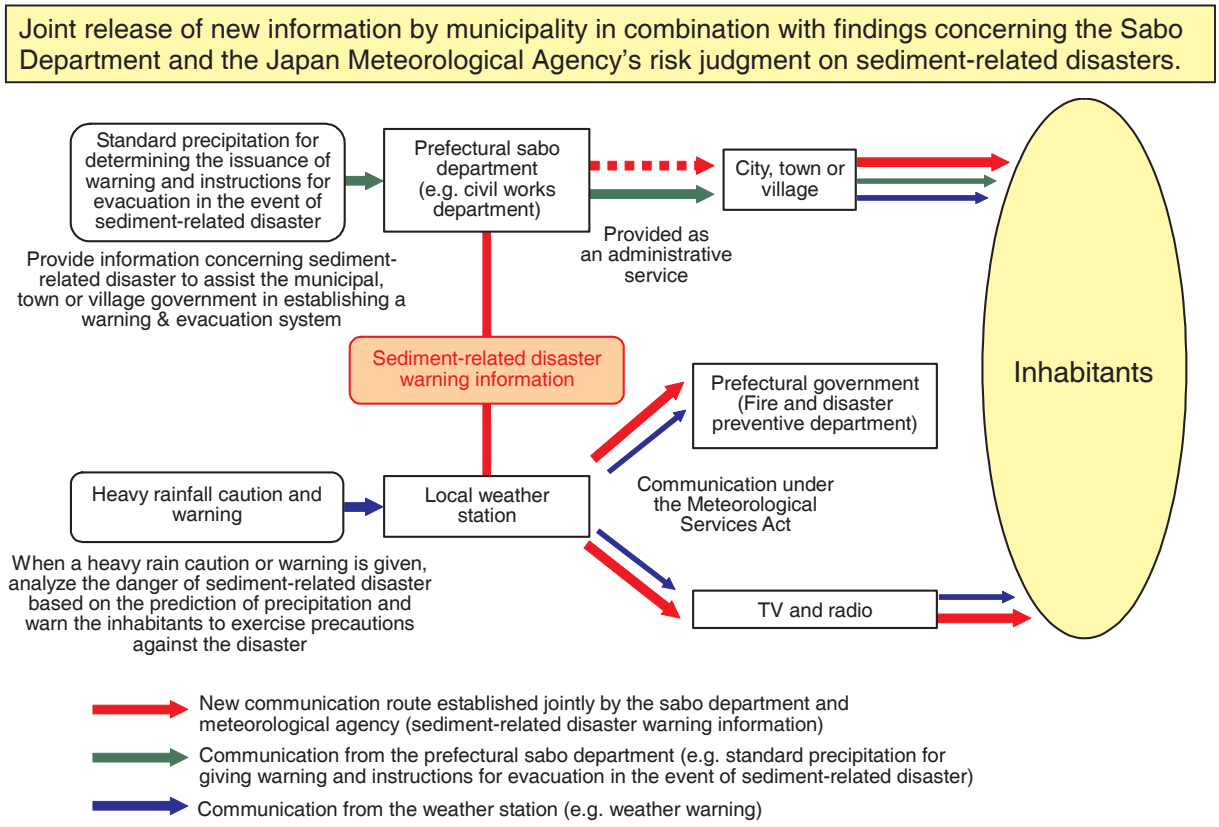
The aim of warning systems is to generate a correct response of those at risk, which is the key to the system's effectiveness. The inhabitants' proper reaction depends not only on a warning that is as timely and precise as possible, but also on the level of their awareness. This problem is dealt with in the following chapters dealing with the issues of public participation, education and awareness-raising.

Role of the National Meteorological and Hydrological Services

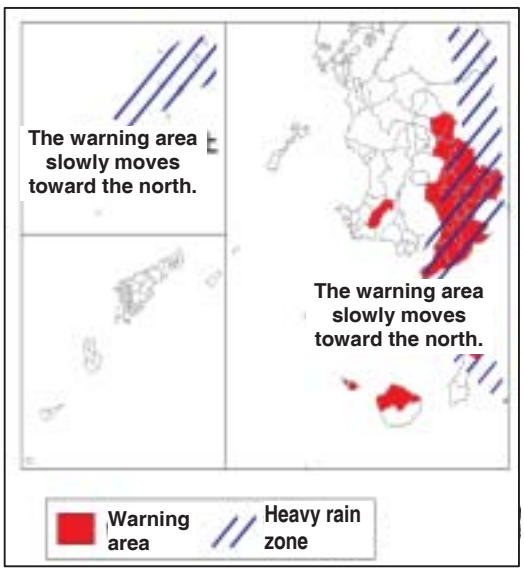
NMHS's are the basic link in the flood-warning system, but effective warning and response to potential danger requires the co-operation of many individuals. Local specialists responsible for the safety of their citizens are sometimes no more than receivers of measurement and forecast information on a national level, but sometimes they can use their own systems. Co-operation between local and national levels requires content-related

and technical aspects coming to terms. In other words, NMHS's need to consult its products with users and local flood warning system operators should also consult on their developments with national services.

A good example is Japan, where flash floods belong to the group of "sediment-related disasters". In Japan, it is quite difficult for mayors to announce an evacuation to residents before sediment-related disasters occur while mayors have a responsibility to announce it to people. Therefore, it is promoted to develop information transfer systems which alert the danger of sediment-related disasters to municipalities based on the rainfall monitoring. Sabo (Erosion and Sediment Control) Department of the Ministry of Land, Infrastructure and Transport (MLIT) and meteorological observatory has begun a joint-work to announce "sediment-related disaster warning information".



Example: sediment-related disaster warning information



Dissemination of Sediment-related disaster warning information in Japan
Source: Sabo Department, MLIT, WMO Regional Workshop 29-30 October 2007, Krakow, Poland

Apart from continually improving their forecasting tools, NMHS's should actively participate in the process of shaping model solutions for local systems (an example of good practice in this respect is the idea of alert systems worked out by the US National Weather Service). In Poland, LFWS's have started working independently of the NMHS. The NMHS tries to support local initiatives through participation in the design process of systems, agreement in terms of data exchange, and testing products developed with an eye for their necessity. For the past few years, the framework of the NMHS has included a team for self-government co-operation affairs, whose tasks includes the organization of training for the construction of LFWS's and methods of limiting flood damage.

Idea of local flood warning system building in Slovak Republic
The Slovak hydro-meteorological service has taken the initiative to build LFWS's on regions of high flash-flood risk levels, according to the following formula. An LFWS is loaned to a municipality for 5 years (maintenance and operation is financed by the NMHS). After 5 years, the system becomes the property of the municipality; further operations are to be financed by the municipality ([Slovak Hydro-Meteorological Institute, 2006]).

C. PARTICIPATORY PLANNING AND IMPLEMENTATION OF A WARNING AND RESPONSE SYSTEM

The Need for Participatory Planning

The various characteristics of flash floods mean that if activities to limit the damage they cause are to be effective, they must be planed out precisely. This is particularly true for those areas where such events occur periodically, or where hydrological-meteorological characteristics or the lay of the land abet such an event. It is worth emphasizing this requirement, as one often comes across the argument in dealing with local authorities or crisis services that nothing can be planned in such an area, because the course of the flood is too rapid and the effects are difficult to predict. This is hard to agree with for a few reasons:

- The possibility of limiting danger to people's lives and protecting their properties falls into the category of preventive activities, which should be taken up by residents, owners of buildings on terrains at risk, and local authorities. This requires planning and co-ordination of activities.
- The ability to respond correctly to a quickly transpiring phenomenon depends on the knowledge and consciousness of the residents at risk, the users of the terrain and the crisis services. This requires planning of simple advisory and educational activities, carried out systematically and over the course of years.
- The effectiveness of the activities hinges on local groups devoting their time and/or money. The identification of the realistic capacities of the residents, owners of sites and the local self-government requires careful analysis and mutual understanding.

Individual activity – flood wall, Gorzanow (Poland)

Plans at the local level should be initiated by the self-government, but the planning process itself should be conducted with the participation of all those interested: those at risk, those who are competent in assisting damage-limitation activities (e.g. crisis services, institutions overseeing the maintenance of rivers and streams, construction of dams, drainage, and forecasting services), as well as those who to some degree can help in limiting flood damage (e.g. local NGO's, mass media). Co-operation, discussion and contact between the groups at risk and professionals in drawing up plans bring many measurable advantages:

- They facilitate precise identification of areas at risk and reasons for this risk.
- They facilitate the finding of acceptable solutions that can be applied by various groups in preparedness, warning, response and damage clearance.

- They increase the knowledge and awareness of residents in the sphere of evaluating the scale of the danger, the various methods of counteracting damage, and behavior during a flood.
- They strengthen the credibility of the various groups taking part in the planning, and encourage the acceptance of the proposed solutions by the local population.

Preparing the Basics of Planning

Before proceeding to work out a plan, the planning framework should be clarified. In its most basic summary, this includes:

Initial identification of the sites at risk – This allows for the identification of people who should be taking part in the plan preparation or at least kept informed on it. This group includes the residents at risk, people running businesses in the danger areas, owners of buildings, public agencies (libraries, museums etc.), communal sites (sewage treatment plants, waste collection areas etc.)

Establishment of local and greater institutions interested in the plan – The task at this stage is to establish all those who ought to be included in the planning, or whose interest ought to be secured. Among these local institutions and organizations we should make mention of crisis response services, police, firefighters, but also greater institutions responsible for maintaining the river and streambeds, water-conservation planning, forecasting, warning about dangerous phenomena etc.

Establishing the structures and principles of teamwork – This concerns the question of who will lead the team, what the group structure will be (will it be one team, or will the group be divided into task-related teams), and what the work principles will be. Depending on the situation, it might be decided that the group will be led by the professionals, while the residents and local representatives will play consultational roles, or it might just as well be decided that everyone should participate on an equal-rights basis, or even that the planning process is led by local representatives.

Establishing methods of supplying information on the work results - The building of a local plan requires the consideration of how the local community will be informed on the results of the work. This is a very important component, as some of the decisions should be put before the whole of the community in danger. There are many methods available, starting with local meetings, co-operation with the local media, using local events (holidays) for this purpose, or sending out surveys and informative materials.

Local flood mitigation plan for small commune (Poland)

In Poland, due to the initiative of 4 institutions (the state hydro-meteorological service, the water management administrator, and the self-administrations that the town and district belong to), activities were taken up to make a plan to limit damage caused by (flash) floods for the small town of Gorzanów (around 1000 inhabitants). The Planning Team thus came about, directed by the town administrator (together with IMGW representatives), whose members included representatives of the local volunteer fire department, a representative of the friends' association of the town, a priest, representatives of crisis services from the commune self-administration and from the district. There also came about a steering committee, composed ot representatives of the institutions initiating the project. The task of the team is to think about generalizing the results of the work carried out in Gorzanow, and spreading them across Poland.

Meeting of the planning team in Gorzanów (Poland)

Stages of the Planning Process

The plan came about according to a standard structure, which includes elements of identifying pivotal problems by establishing goals to be reached, identifying possible solutions, and preparing a plan for implementation. An important aspect in the planning and implementation process of this plan is the consideration of a wide range of flood damage limitation methods. Such an approach is visible in the expectations of local commu-

nities, and in effect guarantees the optimal functioning of the whole flood damage limitation system. The planning process should include the following stages:

Identification of danger, i.e. establishing which areas are at risk, what kind of dangers are taking place there (e.g. violent rise of water in a river, debris and mud flow), and what is at risk. This work, a large part of which should be carried out by members of the local community, will allow for the selection and application of possible solutions to real needs and expectations in the subsequent stages.

Establishment of what has already been done, i.e. collection of information on past and present activities of various institutions (water administrators, hydrological-meteorological services, district and community self-governments) in limiting flood damage in the area.

Establishing the goals, i.e. describing what the plan hopes to achieve. This task leads to the establishment of main goals in limiting flood damage, and what dangers floods introduce for various spheres of a town's life, formulated by working-groups, such as protection of health and lives, property protection, town development, and so on.

Defining the possible solutions (methods of achieving goals). This element would be included in the establishment of what paths could be taken to reach the set goal, what work should be carried out by the residents, the owners of buildings, and the partners, with the understanding of limiting future flood damage. A range of methods for limiting flood damage should be taken into account:

- Non-structural - a monitoring and flood-warning system, education, awareness-raising and training, marking out evacuation routes and sites, securing private and public buildings from being flooded etc.
- Structural - methods of limiting flood damage (addressed to individual users of flood plains, and to the whole local community) such as: improvement of water installations, dams, dyke networks, road culverts and so forth. The tips, suggestions and solutions proposed by residents and local authorities are extremely valuable here.

Developing an implementation plan, including the proposed order of activities, institutions responsible, possible sources of financing or sources to aid the realization of the plans. This is one of the more important phases of the plan's development, overlapping with the previous one, during which time the duties of all the various groups are established.

Local flood issue as a base of local plan (Poland)

At the first meeting with the inhabitants of Gorzanow (Poland) devoted to the implementation of the system, unambiguous suggestions were made to the effect that for the inhabitants a solution of only one of the components limiting flood damage was insufficient. The inhabitants emphasized, for example, the poor state of the riverbeds, the poorly functioning network of drainage system, the disrepair of the levees and many other issues. Consequently, the local flood mitigation plan included all these components. So far the diagnosis of flood risk has been worked out and analysis of the activity of various institutions from the region related to the flood hazard limitation has been done. Consequently an initial list of needs has been drawn up, as well as an initial list of proposed solutions. In the framework of the APFM project, a resident warning system was built and implemented (see Chapter 3). Moreover, from the framework of the Gorzanow plan there came about an evacuation plan (evacuation routes and sites), as well as a plan for education and making information accessible. A water gauge was also set up, and a map of risk areas was hung in a local club. Technological needs are currently under analysis, which could improve the safety of the town (improvement of the drainage network, replacement of road culverts, repair of the destroyed dam and so on).

Water gauge, Gorzanow (Poland)

Map of risk areas, Gorzanow (Poland)

Challenges in Community Participation

Planning with the participation of local communities can bring many difficulties. The main cause of these difficulties is the passivity of local communities in solving their own problems. This not only results from the conviction that only structural solutions can limit flood damage, but also from a lack of faith in having some effect on the surrounding reality. According to studies (CBOS, 2000) only 16% of Polish citizens believed that they had any impact on the country's affairs, while 31% thought that they had an impact on the decisions made in their area.

Another problem which could create difficulties in participatory planning is the fact that non-governmental organizations occupy a fairly weak position in this part of the world – and this is particularly important when the plans concern large areas, where the direct participation of the inhabitants in their construction is impossible. In Central and Eastern Europe NGO's are relatively weak: not many of them represent the interests of professional groups or work for the environment (not much more than 2% in Poland). Furthermore, the participation of these countries' citizens in NGO's is very low in comparison to countries with more advanced democracies (5,4% in Poland, 9,2% in Hungary, 19,3% in France, 38,5% in Norway) [Herbst J., Gumkowska M., 2007].

Additional problems arise in areas whose development has been blocked, or in poor regions. In such places people's consciousness is such that the priority is the fight against poverty, unemployment and many other problems, and only to a lesser extent securing themselves against floods. On the other hand, a great deal of unemployment means that these areas are systematically abandoned by young people, which makes these communities less dynamic.

Social activity issues in Gorzanow

In Gorzanow, the above-described factors were the source of many problems. Firstly, the inhabitants' participation in the planning groups was sporadic, they appeared for meetings here and there but did not systematically take part in the work. These were most often elderly people, as the young people were rather uninterested in these matters. For a few meetings the majority of the participants were passive. It took a great deal of effort to activate them - it was only after a few meetings that participants started getting engaged in group work, which then yielded some interesting solutions from the point of view of warnings, and warning response.

On the other hand it was possible, thanks to the work of the volunteer fire department, to gather detailed information concerning the flood that took place in this area in 1997 (the extent and depth of the flood and the reasons for the flooding).

A group of volunteers was also formed ("flood wardens") to help in warning the residents and disseminating information on flood risk, and if this turns out to be a lasting initiative it will show that participatory planning can indeed stimulate residents to act.

D. RAISING AWARENESS AND PREPAREDNESS LEVELS OF LOCAL INSTITUTIONS AND INHABITANTS

The role of flood education and information

In light of the current trends of flood management mitigation of flood damage requires the participation of all those who are capable of contributing to this cause, not only those engaged in the process of flood risk management (i.e. government and self-government administrations and crisis services in the broadest definition of this term), but also those using the flood plain areas (i.e. commercial companies, public institutions and residents).

The effectiveness of the implementation of this changed approach is contingent upon its wide promotion. The problem is that spreading this information to many groups is difficult and requires special strategies. All the more so given that it is not only the transmission of information that is necessary, but also a change in ways of thinking about flood protection. The matter is further complicated by the fact that people are reluctant to invest in security to protect them from seldom-occurring phenomenon. It is true that a great deal of activity is visible in local authorities and inhabitants at risk *after* a flood occurs, but as time goes by that interest begins to slacken off.

The question therefore arises: what forms and tools of informing and educating (awareness-raising) should be used to be as effective as possible? What elements are important? Who can and should this flood education involve?

The APFM project has made an attempt to answer some of these questions. Partners from Slovakia, Romania and Poland have considered these issues in their activities, and resolved them to varying degrees.

Components of the Flood Education Plan

The planning of informational and awareness-raising activities should first precisely define the target group for the knowledge, and next establish a specific topic field for each of them, and the most suitable way of working with this group.

Activity Target Groups

From the point of view of the topic fields and ways of making the information and knowledge accessible, three main target groups should be singled out: administrative and self-governmental authorities, crisis services, and users of flood plain areas; this last group should be further divided into adults and children, as well as into various occupational groups. It would also be worth isolating one more group: all those who can help out in carrying out the educational and awareness-raising activities, such as teachers, social organizations, journalists, local leaders etc.

Target groups engaged in informational and educational activities in Poland, Slovakia and Romania

The educational plans proposed by the partners were mainly addressed to adults and children in general. All the partners also confirmed the importance of close co-operation with teachers. In Romania, tourists were isolated as a special group. In Slovakia, various people were invited to help plan their undertakings, including representatives of agriculture companies, farmers, sport clubs, hunting units, state forestry units, and folklore groups, while in Poland participants in flood groups included representatives of volunteer fire brigades, representatives of community councils, priests, representatives of NGO's and residents. It is true that these were not outright target groups of the education activities, but their participation in the creation of the plan, which in this case was a flood mitigation plan is one of the most effective ways of educating adults. Similarly, the partners also engaged in activities to increase the knowledge and the abilities of decision-makers and crisis services, and propagate among them their gained experience through enlisting their co-operation in carrying out tasks and/or organizing meetings to encapsulate the project.

Topic Range

IMGW's (Poland) research shows that educational activities aimed at residents and flood land users should concentrate on three main topics:

- "Floods are inevitable"
- "Everyone has an impact on the extent of damage that a flood can cause to their home or property"
- "There exists a structure of services and institutions to support residents and land-users in flood-risk areas."

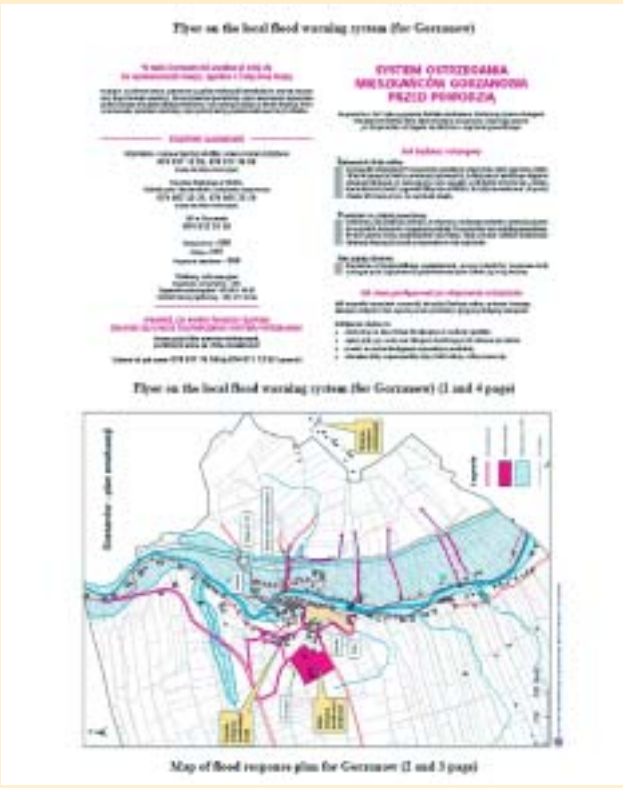
Universal understanding and acceptance of these messages is the key to inspiring individual initiative in flood damage mitigation.

Providing basic information for all those at risk should be the primary goal of all activities. This includes: the level of flood risk (flood maps), methods of limiting flood losses (e.g. methods of securing one's home from flooding), operations of flood warning systems and response systems, as well as the competencies of crisis services.

It is thus worth taking into consideration the state of awareness of flood plain areas users. We might take for example the research survey conducted in Poland, which shows that residents at risk see structural measures (river embankments and regulation) as the most highly effective, and they demand this kind of security. They underestimate the role of early-warning systems and their own activities in limiting flood damage and overestimate the role of local and state authorities. This is why they do not engage in preventative activities.

Crisis services require regular professional training, but as practice shows us (in Poland, for example), non-structural methods of flood damage limitation have till now either entirely been disregarded in this training, or considered to a very minor extent. Self-government authorities should also undergo a certain form of training, as they make key decisions in terms of the direction and scopes of activities, and should thus be made familiar with which forms of flood damage limitation are the most appropriate for their local conditions.

Examples of informational and educational materials for residents (Polish pilot site)
Within the framework of this project, materials have been developed to inform residents of how to behave right before a flood, during a flood and after a flood, as well as information concerning local flood risk and the operation of flood-warning systems. After an analysis of problems in Poland, it was decided that the main emphasis in education should be placed on methods of protecting one's home from flooding, as well as the operation of the warning and response systems (including evacuation paths and sites), while in Romania the information materials additionally emphasized the possibilities of epidemiological and ecological danger after a flood.



Leaflet about local flood warning system (Poland)

Leaflet containing some advices about floodproofing (Poland)

Ways of Educating and Informing

The selection of the appropriate forms of information and education is an important component of the plan to increase knowledge and the consciousness level of flood land users. We present a few examples of such forms for particular user groups below.

Children and students. For this group we might suggest lectures and presentations (communicating the basic knowledge), competitions between schools (e.g. for the best exhibit on the flood history of the region), and workshop classes (e.g. devoted to plans to limit flood damage in the area). A condition for success is the prior education of teachers, and providing the required educational and didactic materials. Children and schools can also be of great use in educating adults.

Children's education – Polish and Romanian examples

In Gorzanów (Poland) classes on floods and flood dangers were introduced into the school programs (thematic lessons, knowledge tests, visual workshops and interviews with the town's inhabitants concerning the flood of 1997). A photography exhibition was also organized (from the most recent flood) and a competition was announced for students and their families to prepare a Family Evacuation Plan. The competition was preceded by special lessons prepared for the students, and meetings with the IMGW crisis services were organized in the school for the parents. The teachers also received didactic materials with ready-made lesson plans and organizational support from a local NGO (The Society of Friends of Gorzanow).

On the left side – Family Evacuation Plan pepared in the school in Gorzanow (Poland)

In Romania, a special information brochure was developed for children, which drew the interest of representatives of education departments in city offices, and in Slovakia (Lokca) a wide-ranging discussion was organized with local authorities and teachers, concerning the possibilities of introducing flood-related subject matter into the curriculum.

Workers in companies, factories and institutions at risk. This is a group for whom you can organize various types of training affiliated with security and protection (the company's possessions), but also concerning proper conduct during a flood (assistance in developing flood instructions for a factory). The training session should be supplemented by printed informational materials.

The framework of the project did not include educational and informational activities for this target group.

Adult residents at risk. Access to this group is difficult, as its members do not undergo any organized form of education that can be used for flood-education purposes. They must therefore be reached by taking advantage of various opportunities and occasions. A typical way of proceeding is disseminating information on flood risk and ways of combatting it during local celebrations and festivities that draw the interest of the inhabitants. Another effective method is educating occupational groups who through their profession are in constant contact with the local residents (doctors, mailmen, veterinarians and others). Co-operation with local media also brings results, as their influence and credibility are of great help in getting the message across.

The commonly-used brochures, fliers and posters should be seen as mainly supporting the above-mentioned activities, rather than as a separate form of communicating information.

Raising peoples awareness – pilot sites activities

In the project's framework, all the partners have prepared special informative and educational materials for residents of flood lands in the form of brochures (Poland, Romania), posters (Slovakia), boards with maps showing flood terrains, and special local web pages (Poland).

In Gorzanów (Poland), a local festival was used to increase the effectiveness of getting information to residents - in the course of the festival information meetings were held, pre-prepared materials (flyers) were distributed, and a competition for the best family evacuation plan was organized. Moreover, elementary-school teachers were enlisted to educate adults through their children (see the section on children's education). Maps of the flood regions were placed in central areas. Another idea was to make use of flood wardens in educating residents (Gorzanow), as they are able to promote informational materials and, after training, assistance and council in ways of limiting flood damage.

Local festival, Gorzanow (Poland)

Local festival, Gorzanow (Poland)

Exercises in Vrbovce (Slovakia)

In Vrbovce (Slovakia) exercises were organized within whose framework they simulated being under the threat of a flood and the proper response to a flood warning. These exercises had a very high educational value (learning through experience), which was added to by the fact that the media (TV, Internet) broadcast reports of the exercises.

Representatives of the local society were recruited to develop the plan to limit flood damage in both Poland and Slovakia, assuming that one of the goals of this planning would be the education of the participants. This group was given knowledge on the limitation of flood damage, and they then became a reliable source of future information for the other local residents.

The project did not set about to train decision-makers and crisis services, but these people are doubtless already experienced in this field. In Poland, the IMGW has been organizing yearly workshops for local crisis services on non structural measures of limiting flood damage for several years now, and in Romania special materials for self-governmental authorities has been prepared by one of their ministries (Prefect Manual for Flooding Situation Management, Mayor Manual for Flooding Situation Management).

E. PROVIDING A LEGAL AND INSTITUTIONAL FRAMEWORK

Management of flash floods touches upon several sector-specific areas of public law, in particular in the realm of disaster preparedness and mitigation, as well as natural resources management. Laws and regulations perform a number of crucial functions in implementing governmental policies in those realms. In particular they

- define institutional roles and responsibilities
- determine and protect rights and obligations, both of institutions and individuals
- provide mechanisms for dispute management

With reference to flash floods the following questions would for example need to be addressed in a legal and institutional framework:

- Who provides for flood preparedness planning, flood monitoring and forecasting, public awareness raising, public warnings, evacuation, compensation, etc.? And importantly on which levels of administration
- What are the rights and obligations of individuals in protecting life and property against the effects of flash floods and in taking part in the decisions affecting their flood risk?
- What are the powers required by various parts of the administration to properly execute their functions (especially: enforcement of spatial planning decisions on the local level for flood risk reduction, access to private property for maintenance of the drainage system and flood fighting, enforcement of evacuation orders etc.)
- To which extent can information providers be held liable if forecasts provided are inaccurate or warnings are inappropriate? To whom should forecasts and warnings be addressed - only to country and regional government and crisis management units? Direct to individuals? If yes, the proper communication channels should be establish – public tv, radio, special radio and tv channels, others.
- What is local government legal responsibility of missing warnings and/or false appraisal of flood situation?
- Is it reasonable to put into practice legal responsibility for NHMS and local government, if there exist uncertainties in forecasting the magnitude, timing and potential consequences of flash floods?

A legal framework in this sphere does not consist of one law but generally entails laws and regulations on disasters (natural and technological), life-saving (medical, chemical etc.), organization of specific services such as the NMHSs or Civil Defence, land use regulation as well as regulations on the activities of government and local councils of various ranks.

Tendencies have recently been observed in the countries of Eastern and Central Europe to replace occasionally-functioning crisis structures (when dangerous situations come about) with permanently-functioning ones (see: the nationwide report from Romania). According to the report prepared by the UN Secretary General's request on the global early-warning system for weather phenomena, early warning of danger is among the duties of the National Meteorological and Hydrological Services The prognoses and warnings they work out are the basis for putting crisis structures in a state of readiness. These services are normally not held liable for conveying inaccurate forecasts, but they do have an "administrative" responsibility if they do not give warning. This may in practice lead to pathological situations, wherein the national service is conscious of the uncertainty that comes with prognoses, and thus sends warning regardless of the size of the storm, in fear of the consequences of not informing those at risk.

The uncertainty of forecasts is also caused by the fact that national services prepare forecasts and warnings for fairly large regions. This creates major decision problems for local self-governments, as they are obliged to make independent evaluations of whether the forecast rain will fall in their region or not. Thus the attempts to find methodological solutions aim at more frequent and more accurate prognoses.

In Poland the national services, in keeping to the letter of the law, are obliged to send warnings to central and regional administrations. The latter are then obliged to send those warnings to the communities at risk. In the case of flash floods, the information chain from the central or regional level to the community level is too long, the warnings arrive too late, sometimes even after the flood. Lately there have been observed attempts to solve this problem via signing of agreements between the national service and local governments on the administrative district level (see: the Polish national report).

The most important role of the early-warning system is to put the crisis services in a state of readiness, and set in motion response forces and measures via these services. In general, legal responsibility for the safety of inhabitants lies in the competencies of the local authorities, in it also putting individuals into a state of readiness

and warn them. If a phenomenon spans a larger terrain, or the local authorities do not have enough forces and means at their disposal to counteract the effects, the co-ordination of activities is turned over to higher authorities.

One of the dilemmas faced by crisis services concerning the moment of the decision to warn and inform other services (e.g. fire fighters, police, military) is that too-frequent warning weakens the vigilance of crisis services, and inaccurate warnings can lead to a lack of trust and result in undue costs. On the other hand, an even greater threat may come about if the warnings to inhabitants at risk are ignored, or acknowledged too late. This is one of the most essential reasons why locations particularly vulnerable to flash flooding should receive local-warning systems. Most often, however, their construction and monitoring exceeds the organizational and financial capabilities of the lowest-rank authorities. This is why such systems are built for groups of many communities (local self-governments), in Poland over about the size of one administrative district, containing sometimes over a dozen communities. There is also a lack of adequate legal solutions to regulate the responsibility of particular levels of administration for the functioning of the various elements of the warning system.

A problem then emerges in defining competence in warning residents in various phases of danger (e.g. using direct telephone warning for residents), ensuring schooling and educational support, and other activities. In such a legal situation, this should be established during agreements between local authorities of various ranks. An example of this kind of coming to terms can be found in the national report concerning the local system in the village of Gorzanów in Poland.

F. SPATIAL PLANNING

Spatial planning can be an effective means of limiting the increase of flood risk. Its main tasks in this field are:

- Limiting the flood damage potential, in particular to high value developments and uses
- Protecting natural retention in the catchment area, including protecting terrains put at flood risk by unmonitored increase in development upstream.
- Limiting the potential of negative environmental fallout from flooding through secondary hazards (chemical or bacteriological spills).

A condition for the efficacy of activities is the introduction of mechanisms to ensure cohesion between spatial management plans prepared on the basis of administrative districts and flood risk management plans, prepared on the basis of catchments. The key is to take into account information about flood hazard areas in spatial planning. According to the proposals of European Flood Directive [Flood Directive, 2007], and also in terms of practice in a great number of countries, these are the basis for flood risk management plans [11].

Generally, marking out flood hazard areas represents the basis for assessing flood risks of existing or planned developments and consequently for regulating new development on the flood plain, Flood hazard maps should importantly be introduced to spatial management plans. This delineation is, however, not an easy and straightforward process, in particular when it comes to flash flood hazard areas.

Regulation could generally involve prohibiting new constructions in regions of high flood risk, and introducing necessary restrictions in regions of medium and low risk. These restrictions are on the one hand technical conditions for investments located in risk zones, ensuring them lower susceptibility to flooding, and on the other prohibitions on important sites - such as schools or hospitals - being located in flood risk areas, or those which could cause secondary hazards (e.g. chemical spills from factories, and mines, or domestic oil storages, bacteriological spills from wastewater treatment plants or blackouts of flooded installations of the electricity grid etc). Some of the world's richest countries (the USA, France, Holland) have introduced financial incentives to move or liquidate sites located on high-risk areas.

The legal regime behind spatial planning processes is of crucial importance as it sets out who is to prepare flood hazard maps, and what specific regulations apply to the different hazard areas.[12] It also provides the mechanism by which to enforce regulations. In practice, in case there is a rather wide gap between local

[11] The proposal of the above-mentioned directive makes reference to flood risk maps, in which floods of high, medium and low probability are taken into consideration.

[12] See also : Legal and Institutional Aspects of Integrated Flood Management, Flood Management Policy Series, WMO, 2006, available at http://www.apfm.info/pdf/ifm_legal_aspects.pdf

politicians, deciding on individual developments, planners, and legislators developing the applicable regulation. As flash floods, in comparison with riverine floods are occurring on relatively small spatial scales, the sense of joint responsibility to address the issue on all necessary levels needs to be fostered. That means that good cooperation is required to build capacities on the local level to integrate the development and flood risk perspectives in their spatial development plans and to provide adequate legal enforcement mechanisms for those from the side of the legislator.

Cohesion between spatial planning and flood risk management plans ensures proper regulation, as it requires the consideration of flood risk zones in spatial management plans, and the establishment of technical conditions for investments to be situated in high-risk areas. In this way it reduces the pressure investors put on local authorities responsible for spatial planning on the level of individual towns. On the other hand, we must bear in mind that flood-risk areas are also often attractive ones, or those which are among few available to investments that might profit the local communities. Thus we need to find a reasonable compromise between limitation of flood risk and limitation of development opportunities. This is why a certain flexibility in building restrictions is advisable. The American National Flood Insurance Program provides an interesting solution here, as instead of inflexible restrictions they have introduced financial mechanisms which encourage local societies to introduce construction limitations in high-risk areas (cf. chapter 3h). Other solutions involve separate treatment for areas that have already been urbanized (France), or allowing for the possibility of negotiating building restrictions between the local administration and the catchment management board (water administration).

Spatial planning should also aid the protection and - if possible - enhancement of the catchment area's natural retention. This concerns not only the communities alongside bodies of water and forested regions, but also micro-retention areas (parks, local depressions in the terrain etc.) and activities resulting in the increase of surface runoff. This task goes hand in hand with the promotion of sensible practices in activities affiliated with land development and exploitation. Here we are speaking of working against hermetic constructions over large spaces (parking lots), by for example using them for responsible farming, limiting erosion and not reducing the permeability of the soil.

To conclude, it is also worth stressing that spatial management plans are also a tool of defence against development of terrains on which structural flood protection measures are planned to be built, as well as to keep the river corridor unobstructed to the extent necessary to convey design flood discharges.

G. STRUCTURAL FLOOD MANAGEMENT MEASURES AND THEIR APPLICABILITY FOR FLASH FLOODS

The components of flood-management strategies described in the preceding chapters concentrated on non-structural measures, which are key to the success of a flood-damage limiting strategy in the case of flash floods. One must bear in mind that flash flooding occurs mainly in mountainous areas or in their foothills, where large retention reservoirs are not available upstream, and the narrow valleys do not permit levees. Nonetheless, there are many structural measures that can and should be applied in tandem with non-structural measures.

The aim of traditional structural measures was mainly to control the spread of the floods (embankments) or limit the size of culmination (dams which allow for the collecting of the water in retention reservoirs). Currently, the aim of structural activities is also to delay the surface run-off onto the catchment area terrain, to prevent the erosion of the soil, to quickly redirect the water from built-up areas, to assist the soil in absorbing the water, and so forth. The activities that can be seen as crucial in areas where flash floods occur can be divided into 4 groups:

Activities in the whole of the catchment area. Their goal is to delay the speed of surface run-off and limit the erosion, which in consequence leads to a reduction in flood culmination. Engineering work in this group includes: interference in the lay of the land (e.g. terraced farm crops, construction of stone walls on the baulk, promotion of correct farming strategies and practices (e.g. development of forested lands and pastures), and minor engineering procedures (stabilization of the beds of small streams via wooden or stone thresholds, reinforcing steep slopes, and stabilizing the bottoms and sides of drainage ditches).

Regulating rivers and streams. Their aim is to control the water regime through limiting the slope of river and streambeds, while reinforcing the banks to limit erosion. The basic forms include: barriers made of wood, stone or gabions, wooden or stone thresholds, various types of anti-debris dams, as well as dikes and embankments to protect buildings. Many of these engineering projects are presently made with natural materials, so as to interfere with the environment and the landscape to a minimal extent.

Shaping retention. The aim in shaping retention is to reduce flood wave. In practice, many hydro-technological operations are used to increase a catchment-area's retention. The most popular of these include, of course, various sorts of small reservoirs that collect water in a permanent or temporary fashion: retentive reservoirs, dry reservoirs and polders. But we can also add small dikes and dams raised from local materials, and such structural measures as culverts under roads.

River conservation. For a river valley to be prepared to redirect flood water, a river corridor must be shaped in the correct fashion. According to traditional understanding, maintaining a river corridor mainly concerned the river bed: control of its depth and slope, and care for the capacity of the valley (cutting down trees). Current work in this field is significantly broader in character, resulting from changes in ways of thinking about the water environment and its function. These treat the water environment as a whole (including not just the lay of the land, but also its flora and fauna), they protect these elements and make use of those which abet activities to limit damage caused by floods.

To conclude, it is worth emphasizing that the structural methods described should be carried out not just by institutions and companies, but also by individuals, such as road services, farmers, or owners of sites on the whole of the catchment area. A typical example might be activities to decrease surface run-off, activities to shape a small retention, or work to assist water infiltration.

H. SPREADING FINANCIAL RISKS

Flood insurance is one of the most important ways of sharing and spreading the cost of taking risk over space and time in order to cope with the aftermath of flooding events. It provides, on the one hand, financial security against the potential risks of extreme events and on the other it allows reduction of the financial burden on the state's exchequer in dealing with the rehabilitation after the flooding events. Flood insurance (or the applicability of the specific conditions of insurance policies) can serve as a means of encouraging behaviour to reduce exposure to flood losses.

Unfortunately, both experience and research indicate that people do not want to voluntarily insure themselves against flooding - generally speaking they have little interest in insuring themselves against catastrophes which have a very small likelihood of occurring [Kunreuther, 1979]. In addition, the insurance premiums are relatively high. This is, no doubt, the reason why almost nowhere in Europe do insurance companies offer separate insurance for floods or other natural disasters [Van Schoubroeck C., 1999]. According to the OECD report [Paklina, 2003], their effectiveness is very low, and carries 5–10% of the market shares worldwide. One might take the example of Germany and Austria, where only 10% of building owners bought additional flood policies, while practically all of them bought fire policies. As a result, insurance companies offer flood insurance in packages, most commonly in combination with home fire insurance. The market penetration in this case is substantially higher, but even so it does not cover all those at risk.

An additional important reason why owners of sites at risk show a lack of interest in insurance is their lack of knowledge about the risk itself. Research conducted by the IMGW in several Polish locations suggests that in some of them only 20% of inhabitants knew prior to the floods of 1997 that their buildings were situated on terrains at risk. In the case of flash floods, the situation is even more difficult, as some of the areas at risk are found outside of the river flood plains. Insurance companies do not recognize these as flood risk areas.

This situation has spurred the governments of many countries to attempt to correct the situation. In practice, various forms of interference are applied: introducing mandatory insurance, and subsidies (or guaranteed) insurance from the government.

One of the more interesting examples of this system in Europe is the French NAt – Cat insurance system, which has introduced mandatory insurance for all citizens against several catastrophes, such as floods, avalanches, landslides and earthquakes. The insurance premium is taken by commercial agencies as a percentage (presently 12%) from the insurance of the home, apartment or car. Pay-outs take place upon the Prefect of the province announcing a state of natural catastrophe. The state, through its reinsurance agency, gives an unlimited guarantee for commercial insurance companies in the case of particularly large-scale catastrophes. This system is complemented by preventative activities: in 1967 a ban on construction in particularly flood-sensitive areas was introduced, in 1982 the obligation to prepare Natural Danger Plans was introduced, whose basis was flood zones, in 1987 the obligation to prepare Prevention Plans came about, and in 1997 2.5% of the proceeds collected from insurance funds was assigned to the above-described plans, and to the purchasing of buildings

on flood lands. In the future there are plans to vary the insurance premiums depending on the preventative steps taken.

In United States of America the National Flood Insurance Program (NFIP) is highly subsidised by the state. Insurance in the NFIP is targeted at owners of high-risk buildings, but an equally important, or perhaps more important function of the program is to activate local communities to initiate flood loss prevention. Property owners can purchase subsidized and government-guaranteed insurance on buildings (offices and companies as well) and their furnishings (to a limited extent), but only under the condition that the site is located on the terrain of a community that has joined the National Flood Insurance Program. So as to therefore purchase a policy, the owners of the real estate at risk must convince their local representatives to join the program. All the more so given that membership in the NFIP involves the community taking on certain responsibilities, such as: researching and evaluating the risk of flooding to the community, and introducing building development restrictions in flood areas. A basic advantage for the community is the option of using NFIP funds to finance activities which aim at reducing future flood losses and which meet the demands of the program.

In spite of this system's many shortcomings, it stands as an interesting example of state administration investment in preparing for future floods. The mechanism applied also plays a role in increasing people's knowledge of potential risk, and methods of insuring themselves against loss. As such it has a strong stimulating and educational impact on those provided with insurance.

In recent years other financial apparatus such as catastrophical bonds have emerged in the market, which allow for the creation of funding in the event of a flood, on the lines of the stock market. Local and regional funds set aside for the clearing of damage caused by floods or other catastrophes also play an important role. In many countries they are counted into the yearly budget at all levels of administration (central, regional and local), and are accessible to local self-governments according to established principles. This allows for those most seriously affected to gain assistance, and above all it facilitates the rebuilding of communal infrastructures and public sites.

5. WHO CAN TAKE WHAT KIND OF ACTION?

In the previous chapter we have briefly outlined the components of flash flood management strategy. Below is an attempt to ascribe activities resulting from this strategy to various entities at particular levels of management. The suggestions regarding the activities of various units are based on the following premises:

- flash floods can effect everyone,
- participatory approaches are crucial for the effectiveness of flash flood management

Owing to the fact that minimizing the risk to lives is the foremost goal in managing flash floods, problems related to flood preparedness, warning and response of peoples at risk will occupy most of our attention in this chapter.

A. NATIONAL LEVEL

Central Administration

The main task of the central administration in managing flash floods is developing a national strategy and creating a legal and organizational framework for it, as well as the financial mechanisms for it to be carried out. Its role is also to stimulate educational and research activities, as well as international arrangements.

Country Flood Mitigation Strategy

A strategy for managing flash floods requires goal definition, as well as the development of a long-term plan of activities to allow these goals to be carried out. It should include both an evaluation of flood risk and the means to ensure its limitation, as well as a flood response system and reconstruction assistance. To demonstrate the range of tasks which are indispensable in developing a strategy, the box below provides questions which should be taken into consideration on the strategic level.

Questions need to be addressed to develop an affordable and efficient hazard risk management strategy:

Risk identification and assessment: What is the country's hazard exposure? What are the economic and social losses? What is the probability of loss exceedance? Where is the risk concentrated?

Risk mitigation: What structural and nonstructural measures are suitable and affordable to mitigate physical damage? What are the priorities for intervention, considering risk to lives, livelihoods, and the need for emergency facilities? How best can these measures be financed and sustained?

Emergency preparedness: Is the country prepared to respond to emergency situations organizationally as well as technically? Does the existing coordination and response mechanism function under stress? How efficiently are public, nongovernmental, and bilateral and international aid institutions integrated in the emergency response system?

Catastrophe risk financing or transfer: What is the country's financial capacity to absorb catastrophic events? Is there a funding gap? What are the most suitable financial instruments with which to address the funding gap?

Institutional capacity building: What is the country's capacity to manage emergencies at different levels of government? Is an institutional framework and coordination mechanism in place that allows strategic planning and decision making at the central, regional, and local levels? Are technical, social, and economic considerations integrated adequately in the investment decision process?

Source: [Pusch Ch., 2004]

For a national strategy to be effective and employable it should be developed with the participation of all potential stakeholders. This requires analysis, co-operation and agreement between many entities at various levels. The role of the central administration is to guide just such a strategy-development process, to ensure the

real participation of those interested in its development. Another crucial role of central government is usually to set guidelines or standards that ensure required levels of coherence in different parts of the country. This need is especially pronounced in federally organized countries.

Legal Framework

Flash flood management involves the competencies of several government departments, such as the Ministry of the Environment, The Ministry of Internal Affairs, and the Ministry of Construction or Transport. Thus the clear definition of the roles of various institutions participating in this process at various levels of management is a task which can not be overestimated. This concerns both legal instruments describing the range of their responsibility, and those defining their mission, thus facilitating the co-operation of these institutions. The main fields that need settling in defining the competence of particular institutions are:

- the framework of the planning process, including the above-mentioned relationships between flood mitigation planning and spatial planning,
- flood response as a component of a general framework for responding to natural and technological disasters,
- economic instruments (taxes, flood insurance, interventional funds, funds in support of preventive activities).

Owing to the violent nature of the phenomenon, clear guidelines concerning competencies and responsibilities are particularly important for flood warning and response.

Other Areas of Interest

Flash floods occur in seemingly unexpected places. The effective response of those at risk depends on the level of their awareness of flood risk, as well as their knowledge of the principles of the flood warning and response system. This is why the central administration units should assist educational activities and information targeted at building awareness and risk culture in the whole society. The national level also shows a predisposition to stimulate research and implementation activities targeted at solving flash flood management problems.

National Meteorological and Hydrological Services

The main role of NMHS's in managing flash floods is their operative activities consist of hydrological and meteorological observation (both in situ and telemetry) and severe weather and flood forecasting and warning. This is a very essential component of the warning system. The precision of threat forecasting and amount of lead time we have depends on the technical equipment of these services, the prognostic tools applied and the competence of the personnel. Weather conditions know no national boundaries, and so for effective warning of weather-induced hazards international information exchange is necessary. The content-related and technical aspects of global exchanges of meteorological information are also the domain of NMHS's concentrated in the World Meteorological Organization.

At the global level, the WMO World Weather Watch Programme is the international cooperative programme which arranges for the gathering and distribution, in real time on a worldwide scale, of meteorological information including marine weather and oceanographic observations, forecasts and other bulletins. The World Weather Watch is composed of coordinated national systems operated by national Meteorological Services. Its three components are the Global Observing System which provides the observed data, the Global Data-processing and Forecasting System which produces analyses and forecasts and the Global Telecommunication System which relays information around the globe.

Source: World Meteorological Organization

The goal of the warning system is to get those in danger to respond, and in realizing this goal NMHS's need to co-operate with various institutions. The place and role of the NMHS in flash-flood warning systems was presented in more detail in the previous chapter, emphasizing the potential input of these services not only in operational activities, but also in shaping warning politics and practices (e.g. by developing model solutions for local flood warning systems).

In addition to its operational activities, the NMHS's also carry out research. These services can make a vital input into planning work, providing flood hazard analyses affiliated with climate changes, classification of regions of the country according to flood hazard etc. NHMS's could also provide specific advisory services, e.g. for local communities establishing local flood warning systems.

Challenges

A clear structure of responsibility (rights, powers and obligations) defining which institution is to fill the leadership role for the budget particular flash flood management activities is very important for the activities to be effective. This involves the roles of residents and users of the terrains at risk, whose range of responsibilities should also be described. It may prove to be a challenge to define their roles as active actors and gain acceptance for this fact among those interested. A clear mandate to undertake parts of a flash flood management strategy is the basis for budget allocation and accountability.

A challenge in the NMHS's competencies, on the other hand, would seem to be the uncertainty of forecasts and introduction of probabilistic forecasts into operational practice. This concerns not only preparation of these sorts of forecasts by NMHS's, but also their relevant use by crisis services and residents, which requires training, forecast interpretation procedures, the development of appropriate formulations for warning bulletins etc.

B. PROVINCIAL/BASIN LEVEL

River Basin Organisations

Many countries in the world have introduced catchment-area water management carried out by River Basin Organisations (water agencies, river-basin boards, environmental agencies etc.). This level of flood management would appear to be key for planning and prevention activities. RBO's should work out long-term policy premises for flood management, taking into consideration development scenarios and climate change hypotheses. On the other hand, the RBO's task is to make short-term plans focused on developing concrete solutions adapted to the conditions in the river basin or catchment. The basis for planning activities should be flood hazard maps and flood risk maps, whose creation is one of the tasks of the RBO's ascribed[13].

Flood management activities should be negotiated with activities planned in the framework of other water economy tasks. They should also take into consideration the requirements of natural environment protection. These postulates were formalized for the European Union, inscribing in the Flood Directive demands for the harmonizing of flood management activities and planning activities affiliated with the realization of the Water Framework Directive. Conforming activity in these fields is also the task of RBO's. Another important stream of RBO's activity is increasing the knowledge and awareness of all stakeholders in terms of the nature of flash flood hazard and methods of limiting flood damage. Of particular importance here are activities targeted directly at residents at risk.

Apart from the above described planning and prevention tasks, RBO's are often, though to varying degrees involved in operational activities. They can carry out tasks like: forecasting of the water levels in the rivers, controlling hydro-technical structures (reservoirs, polders, weirs), and warning residents. The role of RBO's in the flood warning and response system depends on the legal and organizational model adopted in a given country.

Flood warning in Great Britain

An example of a solution in which an RBO has a significant role in flood warning and response system is the British model, where the responsibilities for flood warning were moved in 1996 from the local police and local authorities to the Environment Agency. Warnings may be issued directly (Automatic Voice Messaging, Flood Warden, siren or loudhailer) or indirectly (TV/radio, Floodline, www). Individuals can register for Floodline Warnings Direct; a free service that provides flood warnings direct by telephone, mobile, fax or pager.

[13] Complementary solution is to prepare such maps at a local level.

Provincial Administration

Depending on the level of decentralization in a country, provincial administration can hold a lot of power and responsibility, also in the area of flood management. Much as with RBO's, the basic streams of provincial administration activities affiliated with flood management are planning and mitigation. The link between catchment area planning of flood management and regional spatial planning is not limited to negotiating the location of large anti-flood structural measures and limiting investments in high-risk areas. Much as plans for management of flood risk should take into account regional development requirements, so too regional development plans should be based on the identification of limitations (challenges) resulting from the present and forecasted flood hazard.

Provincial administration may also have ascribed tasks affiliated with the construction and maintenance of engineering structures. This is the case in Poland, for example, where provincial Drainage and Water Equipment Boards functioning within administrative borders respond to activities connected to the construction and conservation of embankments and pondage, as well as those dealing with drainage and partially streams maintenance.

Crisis response groups also function in the framework of provincial administration, generally as a component of a hierarchically organized national structure. In the case of flash floods the role of these structures in operational activities is not key, owing to the speed and usually local character of the phenomenon. They can, however, play a vital role as training centers for low-level crisis services. Their role is also to provide guidance to local crisis teams in preparing operational activities such as flood preparedness and response plans, and in activities aiming to raise the level of residents' awareness.

Challenges

Developing a flood management plan is a difficult task. Its main aim is to minimize the threat to human life, and to keep the risks to the economy from flooding at manageable levels. This less concerns the minimization of flood damage than it does the maximization of net benefit arising from the exploitation of the catchment area. The identification of needs, the defining of particular goals and negotiation of the means for their realization require the participation of specialists from various fields and representatives of local communities. Specialists dealing with flood management must take into account the needs of these groups. On the other hand, they should make all those interested aware of the dynamic nature of flood hazard, i.e. its dependency on climate change and changes in the management of the catchment area. This all means that the development of an effective scheme for developing and implementing a flood management plan for the river basin is a true challenge.

C. LOCAL LEVEL

Local Administration

We might say without much fear of exaggeration that local activities to limit flood damage are the most important elements in determining success when it comes to flash floods. It is on this level that the real threat can be analyzed, i.e. who and what are at risk, and determine what remedial measures could be both effective and implementable by the local community.

The significance of the activities of local communities in limiting flood risk places a heavy obligation on the district administrative authorities. They bear the burden of preparing the community for a flood, particularly in regions where flash floods occur. The specific attributes of these mean that planning activities that include all the links of the chain of flood-risk management, and the integration of all the units taking part in the process take on greater significance. Consequently, the tasks which stand before the local administration are:

- rational spatial planning, maintaining a balance between the advantages to be gained from the exploitation of attractive sites alongside rivers, and the dangers they introduce,
- assisting the preparation of buildings for floods,
- the building of integrated warning systems for residents and users of terrains at risk,
- organizing an evacuation base for people, equipment, and farm animals,
- the clearance of damages, and assistance after the flood.

These tasks should be carried out in the framework of a flood preparedness and response plan. The efficacy of work on the plan and success in its implementation will to a large extent depend on the inhabitants' knowl-

edge level of the flood risk on the given terrain, of methods to limit damages, and finally of the available solutions for the community as a whole. The activities employed are generally rather ineffective, as they generally involve single actions that are of dubious value in keeping residents alert to the possibility of danger over longer periods of time. In practice, the most effective solution is to create conditions whereby all those organizations and institutions (e.g. local NGO and mass media, schools) whose competencies involve education and the transfer of information include this issue into their plans. The role of the administration would then be to program the main streams of operation and animate the activity of the various institutions and organizations in this field.

Educational Flood Forum in Klodzko District
The first steps in this direction were taken in Kotlina Klodzka in Poland, where an attempt was made to organize an educational forum, whose goal was the inclusion of both individuals responsible for the safety of the inhabitants and institutions like libraries, schools, NGO's and the mass media into the process of education and awareness raising. The first meetings organized showed that some of these individuals were eager to declare their commitment to ongoing activities, such as a library to collect specialist literature and promote it, a periodical that would be prepared to dedicate a regular space to texts on flood issues etc.

Spatial planning is exceptionally important for the effectiveness of activities limiting flood risk. Similarly, building an effective warning and response system is key to the safety of inhabitants. Owing to the gravity of these matters, they will both be explained in more detail below.

Spatial Planners

The essential instruments for limiting the risk to human life and property include legal regulations that make the manner of flood land exploitation dependant on the level of risk involved. These regulations mainly apply to spatial planning. In many countries, spatial planning falls within local self-governments' jurisdictions, and in others the self-government plays an essential role in the process. The local self-government's obligation includes identifying landslide and flood-risk areas and presenting them on maps (caused by rivers and streams, and flash floods resulting from the topography, or potential catastrophes in hydrotechnical sites). We must bear in mind, however, that introducing limitations into the management of these areas can cause a great many difficulties in practice. These arise from two causes:

- the attractiveness of the flood land from the perspective of running economic activities of all descriptions, tourist ones in particular
- the necessity of paying landowners recompensation if construction limitations should cause their land's market value to plunge.

A local administration's tasks therefore include finding solutions which, on the one hand, will not hamper the long term economic development of the area, and on the other will reduce the threat to the lives of the residents and users of these lands.

Crisis Services

Warning systems on lands at risk of flash flooding are one of the most important forms of limiting risk to people's lives and property. Regardless of who administrates such a system, the local administration and the crisis services usually subordinate to it will be one of the important links in this chain. The solutions applied in practice have varied greatly: from simple and inexpensive systems based on the participation of local residents, to complex, multi-component and expensive systems. There are a number of elements which have an impact on the guaranteed effectiveness of the working of such a system, but the most important among them are:

- the co-operation of local authorities with hydrological services, the outcome of which should be the regular receiving of forecasts as well informed as possible on the selected region, and assurance of receiving warnings on the approach of undesirable hydro-meteorological situations.
- the planning and implementation of methods of warning people to guarantee that warnings reach people whether it is day or night, and regardless of whether they are at home or out.

The warning system should be supported by a response plan. The response plan is, put simply, a list of essential activities to be performed by certain groups at risk of flood, as well as individuals supporting these activities and taking care of their safety. The plan should also cover organizational solutions to improve the guaranteed performance of particular activities by those at risk.

One of the standard elements of a response plan for areas where flash floods occur should be a response to the question of which endangered groups can and should undertake independent activities, and what assistance from crisis systems they require. The very short period of time between the warning and the onset of the flood wave means that the optimal activity is the independent response of those at risk, both in terms of preparing for evacuation, and in the evacuation itself. Assistance from crisis services is based on organizing evacuation sites for people, equipment and animals, as well as safe evacuation paths. These places should be well known to all the local residents – this requires educational support. In case of factories, utility companies etc., each of institution should prepared his own flood preparedness and response plan and flood instructions for employee.

Challenges

The most important problem at this level is the integration of activities, understood as the co-operation of many individuals, both those responsible for the inhabitants' safety (firefighters, police, road services, sanitation services) and those who make every community run smoothly (e.g. planning services, energy distribution services, transportation etc.), but also higher-level structures (hydrological and meteorological services, upper-rung crisis services). Both local plans and operational activities depend on this co-operation. Integrated activities adopted by a local administration should concentrate on a goal - which is not just the safety of the inhabitants, but also the creation of conditions of development for a given community. This is a fairly difficult undertaking if we consider that there are no administrative relations between many of these institutions, and so the co-ordination of their work can only be based on carrying out a common goal, which can be achieved with the participation of all the individuals. The main role of the self-government is ensuring conditions for the co-operation of institutions, and facilitating the inhabitants' inclusion in various forms in the process of managing flood risk at the local level.

D. COMPANY AND INDIVIDUAL LEVEL

Households

Owners of buildings and homes on areas at risk of flooding should take up various activities in order to significantly reduce flood damage. There are a great number of possibilities here, and they cover activities which fall into four categories: securing a house against flooding damage, organizing life in the household in a way that reduces its susceptibility to damage, and preparing the family for a flood, and buying insurance.

Securing the Household from Flooding.

Among the basic technical measures that can cause the reduction of flood damage in a decisive manner are: the correct drainage of rainwater from the house's environment, care in assuring the correct functioning of drainage ditches. Other activity options include:

- safeguarding the home through constructing concrete or stone walls to keep the water from seeping into the environs of the home,
- applying waterproof construction and finishing materials, such as: floors made of ceramic tiles (instead of parquet or wood panels), and walls made of concrete components (and not plaster, for example),
- situating some appliances, such as central heating furnaces or electrical switchboards on the first floor or in the attic
- securing the sewers system from backflow valve – in many cases the source of damage at home is plumbing system
- securing oil tanks.

A house can also be prepared for flooding through installation of safety closures on the windows of cellars and entry doors to the building (or preparing sand bags, mobile barriers etc.). Very important is also to secure sources of indirect damages (chemicals).

Organizing Life at Home

The aim of this activity is to organize the home in such a way so that valuable objects and appliances are not located down below, where the flood risk is at its highest, but rather on the upper floors. This includes all sorts of electronic equipment, computers etc. It is also vital that important documents, such as passport property

deeds, insurance policies, work certificates, birth certificates, wedding papers, money and valuables and (family) memorabilia are stored on the higher floors.

Preparing the Family for Evacuation

Flash floods mean that advance preparation is necessary for evacuation. This is why family members - children inclusive - should be prepared for such danger, and should know how to respond and what to take with them in the event of an evacuation. It is also important to know about the source, nature and level of the flood threat in the place of inhabitance, as well as how the local flood warning and response system works, i.e. what information and what form of assistance a citizen can expect from the local authorities.

Family evacuation plans are promoted in many countries, containing information on:

- evacuation paths and sites for farm animals, automobiles, machines and mechanical appliances,
- sources of gaining information on the impending danger,
- gathering spots for families if the flood surprises them away from the home (at work, school etc.),
- objects that should be taken along when evacuating, such as: important documents, medicine, family keepsakes, pets,
- electricity, gas and water shut-off valves.

Preparation for such a plan of operation facilitates action in a danger situation and allows people to avoid mistakes caused by stress and time limits.

Companies, Farms, Hotels etc.

All companies and services on flood lands should have a ready-made action plan for damage minimization which includes preventive action and evacuation, as well as a plan for clearage of flood damage.

Preventive action for companies has a very similar scope to the actions of individual property owners (described above) and includes securing the building, securing the machines and appliances, and organizing the workplace. The difference is in the scale of the procedures and loss potential.

The general structure of the response and evacuation plan for companies includes: identification of danger, identification of the effects of various situations caused by the danger (such as: lack of power, lack of gas, lack of communication, roads being cut off and consequent disconnection of market places, damage or flooding to the building etc.), proposed counteractive measures, such as a method of securing equipment, machines and storehouses, as well as the evacuation of people, equipment and gathered possessions. And yet, depending on the site, the particular solutions can be quite different. They will differ for large production companies or service factories, and differ again in the case of farmlands or hospitals. Such plans are of particular importance wherever valuable possessions are gathered together, and wherever the service receivers are people. An example of the latter is tourist sites, such as bed and breakfasts, hotels, or vacation homes. It is vital that the plan's framework include instructions for the guests on how to proceed in the event of a flood or a flood warning. These instructions should include information on: who in the hotel is responsible for the guests' safety, who will warn, what services the staff provides, and what actions they should take themselves and what they should not do.

The response and evacuation plan should be known to the personnel. The best way to make it known is through practice exercises simulating actions in a danger situation.

Challenges

The actions of the individual residential landlords or homes, as well as the owners of production and plants or administrators of public property sites should be supported by the local administration. Experience shows that without reminding, education and informational activities, the engagement of the above-listed parties will slacken or disappear over time.

E. SUPPORTING GROUPS

In addition to the individuals on whom flood damage limitation directly depends, there are also those who can support their activities in a vital way. If at all possible, it is essential to make contact with them and to make use of their potential – mainly in terms of information, knowledge and advisory and educational opportunities. Among the many possible groups, the most important are: professional and scientific circles, teachers, mass media and NGO's.

Professionals and Scientists

Scientific communities and specialists can be essential partners in creating a stock of universal knowledge and information required to raise the awareness of all the groups interested, and making them acquainted with damage-limitation methods. Potential spheres of activity of these communities are:

- participation in the work of planning groups,
- working out guidelines and practical solutions for construction on flood lands,
- preparing informative materials (handbooks, textbooks, school materials etc.) aimed at various target readers, and summing up the existing knowledge of these communities in a form that is accessible to non-professional readers,
- consultation in solving content-related problems for self-government units and educational communities,
- participation in or organization of training and workshops for individuals associated with information or educational policy and training.

The knowledge and experience of these communities might serve to support the activities of self-governments, administrations, teachers and residents.

Teachers

The experience of the authors of this report indicates that teachers in schools of various rungs are interested in introducing subject-matter involving natural disasters, floods inclusive, into the school curriculum. This is true in particular as far as local danger is concerned, and self-governmental authorities are interested in supporting such undertakings. The condition of these groups' activity is access to educational materials and training (which allow the teacher to prepare for his/her lesson), as well as access to didactic aids. The lessons' subject-matter should not be limited to general knowledge about floods, and should also deal with:

- the flood threat to the land on which the school is situated,
- how the local flood-damage limitation system operates,
- individual methods of limiting flood damage.

Materials for schoolteachers might be prepared by professional or scientific communities, and their training might include enlisting teachers whose role will in part be to improve the knowledge of the teachers' community.

Mass Media

The mass media is an extremely important partner of the governmental and self-governmental administrations in aiding education and promoting model behavior. Owing to its high credibility in the community, its power and the scope of its effect, it can play an essential role in promoting thinking habits in accordance with local strategy. Practice shows that the mass media can fulfill the function of an effective means of spreading information on flood danger, and it is generally employed as one of the paths of transmitting warnings. This particularly applies to television stations and radio broadcasts. The latter is an ideal means of communicating with inhabitants at risk, thanks to the shrinking of the radios themselves. In Poland there were examples during the most recent flood in which the local media (e.g. radio broadcasts) played a very essential role in the dissemination and exchange of information, even after the flood, when the normal means of communication didn't work. Another task of the media during the flood and afterwards is to help in transmitting practical information and advice to residents on how to deal with problems like bacteriological contamination, drainage, cleaning the mould from the walls of a building and making contacts with aid institutions etc.

Partners might be national or regional (provincial) media, or local media affiliated with local communities, and which are therefore eager to co-operate with education and promotion of preventive, warning and advisory activities.

Co-operation with the mass media should include planning, such as: identification of which media have the greatest influence on the area at risk of flooding, defining the aims of co-operation with each of these, finding the best forms of communication and co-operation and giving them an organizational framework (e.g. formal contracts).

Non-Governmental Organizations (NGO's)

NGO's make natural partners in the planning process, owing to their organizational experience and contact with local communities. They can simultaneously carry out certain tasks which might be difficult for a local administration, such as those involving the transfer of information and knowledge. They can also organize effective information campaigns, not just on the local level, but sometimes even nation-wide. NGO's distribute materials, organize meetings (seminars), exhibits etc.

One of the most important tasks that non-governmental organizations can fulfill is help after a flood, which requires a large quantity of volunteers, and professionalism in the manner of giving help and generosity. An example of such organizations that bring help in times of flood are the volunteer fire departments active in many countries, and in the field of humanitarian aid there is the Red Cross, as well as other local organizations functioning in the areas of various countries.

Challenges

Supporting organizations can be partners worth taking into consideration in the flood-damage limitation process. Because these are independent units, after all, and are not directly involved with the problem of limiting flood damage, their activity must be stimulated by the organizers of the flood-damage limitation plan, for example through local or regional administrations.

6. HOW TO GET STARTED AT THE LOCAL LEVEL?

Developing a local flood risk management plan is most often initiated by the local administration. The stimulus to take up such activities might be a flood that has demonstrated the inadequacy of a protection system, or the growing consciousness of local authorities that flood risk may stand in the way of economic development or legal regulations.

In chapter titled "Participatory planning…".the aim was described, as well as a method for developing a plan and its components, whereas here we will outline the first steps that are decisive in the success of the whole planning process and the realization of the plan in practice, and which deal with ensuring community support for the planned activities.

Ensuring community support is no easy matter, and it is time-consuming in even the most favorable circumstances. It always requires preparation, a knowledge of methods of co-operation with people, and caution in dealing with them (to minimize conflicts as much as possible). It is often essential to remove any barriers resulting from the insufficient knowledge of some of the decision-makers and residents.

The first step in constructing a plan should therefore be the establishment of what support can be anticipated from both the decision-makers and the local community. This step must include an estimate of the readiness level of these groups to participate in the planning process, and their determination to increase the local flood security.

The next step should be to put together a team to develop a plan. Here it is vital to determine the make-up of the team, i.e. to appoint individuals and representatives of companies and institutions who should participate in the planning process, and to ensure the participation of the representatives of each of these groups.

The following step should be to ensure and organize as wide a spectrum of local community participation as possible in the creation and shaping of the plan, which significantly increases the chances of its acceptance, as well as the favorable realization of the planned activities in the future.

A. STEP 1 – EVALUATION OF COMMUNITY READINESS TO TAKE UP ACTIVITIES

Before any actions are taken to develop a plan, one should ask oneself if the local community the plan concerns is prepared to take up such activities. A good method of acquiring this information is to organize meetings devoted to flood matters, or to distribute surveys amongst the residents and users of the flood lands. Their goal should be to determine how the residents feel threatened, what their potential involvement might be, and what their level of confidence is in the institution initiating the plan.

If it should turn out that the residents are insufficiently aware of the level of danger, and feel no need to take action to reduce or limit the risk, we shall not receive the required support for our activities. In such a situation it is also difficult to gain information from this community, or the assistance required to work out a good plan. Should such a situation exist, work on plan preparation should start with flood education in the circles whose lack of knowledge obstructs the development of a plan.

The best moment for starting the planning process is the period directly after the flood, when the residents themselves are interested in taking up preventive measures.

> In Poland, after the flood of 1997, many local initiatives cropped up to improve the state of the flood security. The majority of these were not complex, but there did come about many interesting solutions in the field of local monitoring and warning systems, for example, or informative materials for residents (flood instructions).The work on the local flood-damage limitation plan for the Gorzanow locality was introduced based on experience from the most recent flood.

In the event of it being necessary to work earlier to convince a community of the usefulness of working out a plan through awareness-raising, it is best to make use of positive examples – the results of similar activities that have been achieved in other locations make for good educational materials. It is also worth figuring out if developing a flood-risk limitation plan might not help the local community in solving some other problems, which would be an additional argument to its advantage (e.g. recreational or sport use of the flood lands instead of introducing restrictions on their economic exploitation).

B. STEP 2 – CREATING A PLANNING TEAM

The task of the planning team has been described in depth in chapter focused on participatory planning. Generally speaking, the criteria for choosing participants for the planning team should take the flood-protection needs of all the land users into consideration.

A team like this, depending on what is initially established and the local capabilities, may vary in their decision-making competencies, and its work method may also be organized in various ways.

Team Competencies

The planning team might be a decision-making body (if such a function is officially accepted and confirmed by the local authorities) – and then the aim of the team is to develop a plan proposal, or it may only fulfill an advisory function – and then its suggestions will be passed on to specialists, who will work out a plan on their own. From the planning team might emerge a "steering committee" and a planning group. The task of the steering committee is to supervise the proper running of the planning process, and take care that the plan is implemented in reality (including attempts to raise funds). The task of the planning group is to work out a plan. Both the competencies and the manner of making use of the planning group will always depend on the local conditions and capabilities.

> The group responsible for developing a plan in Gorzanow served as advisors and consultants, though the majority of this group's suggestions were taken into consideration in the work thus far carried out by the IMGW representatives and the district administration, as well as the local administration.

The Make-Up of the Team

The make-up of the team should include - apart from specialists - local leaders, residents, and representatives of various users of the flood prone area (owners of private companies, managers of companies and state institutions, farmers etc.); i.e. everyone who might be affected by flood damage, as well as representatives of social organizations (NGO's), and all those who are interested in limiting flood damage. It is in the interests of the initiators of the undertaking to ensure the participation of decision-makers and influential figures in the plan's development (representatives of the government administration at the national and regional level, members of parliament, representatives of financial and business organizations etc.), who could promote the plan in the higher structures and seek out sources for funding. A condition for ongoing participation in the planning team's work should be a declaration of regular attendance in organized meetings. And yet even after receiving such a declaration, one should count on seeing a fairly high turnover in the members of the group.

Work Principles and Organization

Organizing the work of a team made up of people from various interest groups, levels of education and knowledge, mentalities, life experience and personalities is very difficult. If it is poorly conducted there is the danger of causing disputes or aggravating old ones, thus discouraging participants from co-operating.

As a result, certain principles should be observed which help to smooth over conflicts and facilitate the finding of common solutions: a) a leader candidate should be carefully selected, a person who enjoys some authority and possesses the qualities of a mediator, b) work should be established wherein everyone can express their own position and freely criticize ideas and solutions, c) every meeting should yield a report, which each member of the group ought to receive. These are only a few principles by way of example, many more could be enumerated, which is why the best solution is to ask for help in leading, or at least in organizing group work from a specialist in social communication.

C. STEP 3 - PUBLIC CONSULTATION

Regardless of the involvement of the representatives of the local community in the planning process (in the framework of the planning team), it is important to give the local community access to information on problems which directly involve them, and to work out evaluation procedures for the prepared estimates and plans. As mentioned earlier, co-operation between professionals and the groups that stand to be at risk brings measurable advantages: above all, it is a source of information on the regions and causes for danger, and helps in choosing acceptable solutions, thus fulfilling an educational role as well. For it to be effective, however, there must exist a mechanism that facilitates mutual communication. This can not be merely a one-way flow of information through the publication and distribution of bulletins or reports, it is also essential to create the opportunity to make applications and express opinions on the issues (evaluations, decisions) contained in the documents submitted for consultation.

The most important steps of the planning process to be submitted for community consultation include:

- a diagnosis of the local flood risk,
- the proposed aims of the activities (included in the plan) and priorities,
- an analysis of the proposed solutions (an initial plan).

So as to achieve the desired effect, i.e. to draw attention to the particular elements of a plan and gain as wide an acceptance as possible for it, we must create favorable conditions for consultation.

One way of striving toward this is to ensure the participants' influence on the decisions made in the above-mentioned planning phases. This means that disseminating information about the planned activities beforehand is a necessity, as is a schedule, and the establishment of possible forms and principles of consultation (e.g. at specially organized meetings, and via surveys, correspondence, e-mail, web pages and so forth).

Documents and materials put forward for consultation should be prepared in a form that is comprehensible to all and easily accessible. The consultation participants should also be familiar with how to make use of the remarks contained therein – and therefore it is essential to employ special procedures to consider and publicize the outcome of the consultation.

D. CONDITIONS FOR SUCCESS

The above-described activities concentrate on a diagnosis of the state of awareness of a local community, and ensuring its acceptance and participation in the planning process. This is an important condition for the work's success, but it is worth recalling that its fulfillment does not guarantee success. Preparing and carrying out a local flood-risk management plan also requires that local self-government structures have experience in creating plans, organizational ability (including teamwork organization), human resources (planners and specialists), and practice co-operating with institutions, social organizations, media etc.

7. CONCLUSIONS AND RECOMMENDATIONS

The initiative taken in the domain of flash flood management as provided in this report has been the central element of discussion at a regional workshop on "Community Preparedness and Public Participation for Flash Flood Management in Europe", held 29 and 30 October 2007 in Krakow, Poland. Participants of this workshop agreed to the following conclusions and recommendations that should emanate from this initiative in order to continue and strengthen efforts in the region to minimize losses of life from flooding and reduce the vulnerability of communities to the adverse impacts of flash floods.

Taking note of the high losses of human life from flash floods across Europe, the likeliness of climate change to result in an increase in intense short-duration precipitation in most of Europe and human alterations of the landscape to further increase flash flood risk,

Being aware of the experiences gained during pilot projects undertaken in the Central and Eastern European region with the aim of reducing the vulnerability of flash flood prone areas within the Framework of the Associated Programme on Flood Management (APFM),

The participants of the workshop "Community Preparedness and Public Participation in Flash Flood Management in Europe" are presenting the following conclusions and recommendations to decision makers in the national administrations, researchers and operational managers in the National Meteorological and Hydrological Services, mayors and local decision makers in order to reduce the devastating impacts of flash floods:

1. Flash floods due to their special characteristics, causes of occurrence, and need for improved understanding require a multi-disciplinary and multi-sectoral approach in managing and mitigating their adverse impacts.

2. Due to their local characteristics and sudden nature of occurrence, flash floods are best managed by the local authorities with active and effective involvement of the people at risk. However, there is need for a National strategy to deal with the flash floods within the overall Integrated Flood Management policies duly recognising the subsidiarity principle.

3. Flash floods should be especially and specifically addressed while implementing the national or regional (e.g., EU Flood Directive) flood management policies, IWRM and basin flood management plans or disaster/crisis management plans.

4. The National Strategy to manage flash floods should be focussed on providing the necessary technical, financial and legal framework for the competent authorities to play their legitimate role. The extent of responsibilities that have to be shared by the National agencies with the local authorities would follow the proportionality principle and depend on the physical and economic capacities of the local authorities. Some of these areas are listed below:

i. The meteorological backup for providing global/regional meteorological data and required flash flood guidance products, watch and monitoring of flash floods, particularly based on Numerical Weather Prediction (NWP) and nowcasting procedures;

ii. Support the establishment and maintenance of local flash flood monitoring, warning and alert systems;

iii. Preparation of national flash flood inventories, based on historical information and post flood analysis, as required, as part of wider inventories on severe hydro-meteorological events;

iv. Identifying areas prone to significant risk of flash floods requiring the local authorities to conduct flood hazard assessment through hydrological and other technical backup provided by relevant technical agencies;

v. Building national enabling environment for public participation in flash flood management with particular reference to educational and public awareness plans for flash flood risks;

vi. Help and support the preparation of crisis preparedness and response plans on the local level (especially the municipal and district levels) including training of crisis management personnel;

5. There is a need to build an appropriate national time table for actions and provide necessary financial support, wherever applicable;

6. The flash flood hazard assessment shall be carried out for all possible sources of flash floods (cloudbursts, lake outbursts, etc) within the overall flood risk assessment of the river basin, duly involving the multi-hazard approach, including those for landslides, mudflows and debris flows, avalanches etc., wherever appropriate.

7. Appropriate legal provisions should be made to clearly define the roles and responsibilities of various institutions at different administrative levels (national, river basin, state, district or local) involved in flash flood management including the mechanism for flow of data, information, forecasts and warnings.

8. Local authorities should be enabled through legal and technical means to undertake spatial planning that duly considers the flash floods hazards.

9. Financial mechanisms to undertake mitigation measures against flash floods should be clearly defined. Appropriate instruments need to be established at various levels within the existing financial framework (insurance, calamity funds at various levels of the governmental hierarchy, etc.).

10. There is need for a platform for sharing data and information among the National Meteorological and Hydrological Services (NMHSs), Local Authorities, civil protection authorities and educational and public awareness institutions on flash floods. There should be a mechanism to share the experiences in flash flood management within the countries and an ongoing international exchange on the topic.

11. There is need for greater emphasis on research in atmospheric processes leading to flash floods, and in building capacities to monitor and provide better warnings on flash floods.

12. There is a need for in depth studies in the causes of flash floods, especially with a view to the role of climatic changes and human alterations of the catchment.

13. Safety regulations for hydro-technical works should include provisions to minimize the risk of generating flash floods through operational, maintenance and design aspects.

14. There is need for developing risk-sharing mechanisms among various levels of government and individuals to strengthen the resilience of flood affected communities.

15. Policy makers should be aware that a reduction in the density of in-situ hydro-meteorological monitoring networks would also reduce the capacity to adequately monitor and forecast short-duration localized hydro-meteorological events such as flash floods.

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Institute of Meteorology and Water Management

Global Water Partnership Central and Eastern Europe

WMO/GWP ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

World Meteorological Organization
Weather • Climate • Water