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RAINMAN

Integrating pluvial flood risk management into flood risk management plans according to the EU Floods Directive and beyond

Findings and recommendations from the INTERREG Central Europe project RAINMAN

Key message:

The management of pluvial flood risk is a cross-sectional issue. It needs to be considered both, inside AND outside of flood risk management planning processes according to the EU Floods Directive.

The risks of heavy rain events are increasing all over Central Europe. The main objective of the Interreg Central Europe project RAINMAN was to improve integrated management capacities of public authorities to mitigate heavy rain risks.

Partners from six countries have joined the project to develop and test innovative methods and tools for the integrated management of heavy rain risks by local, regional & national public authorities (07/2017-06/2020). Project findings have been published as a webpage with a comprehensive set of transferable tools and methods for stakeholders on local and regional level - the RAINMAN-Toolbox.

This policy brief aims at providing RAINMAN findings, conclusions and messages regarding an integrated pluvial flood risk management into the daily practice of policy and decision makers on EU and national level. The paper focusses on:

- Integration of pluvial flood risk management into management plans according to the EU Floods Directive by regional and local water authorities;
- Integration of pluvial flood risk management into relevant action by other regional and local authorities.

A draft version of this paper was presented to the EU-working group on "floods" (WGF) and discussed with the working group members in October 2019.

→ Access the RAINMAN-Toolbox:

http://rainman-toolbox.eu

→ Learn more about the RAINMAN project:

https://www.interreg-central.eu

Definition of flash flood and pluvial flooding

Monacelli and Bussettini 2011

The WGF has defined the different types of floods. Among others, also definitions for the flood types flash flood and pluvial flood are provided:

FLASH FLOOD: a flood that rises and falls quite rapidly with little or no advance warning, usually as the result of intense rainfall over a relatively small area (Glossary of the American Meteorological Society, 2000). *Key aspect of the definition is the time scale: sudden hydrological response to the causative event.*

PLUVIAL FLOODING: direct runoff over land causing local flooding in areas not previously associated with natural or manmade water courses. *Key aspect of the definition is the lack of proper drainage network in the area impacted by the flood.*

The RAINMAN project reflected these definitions, explicitly in the pilot action in different Central European countries according to their practicability for a wide range of project characteristics and according to their transferability with the following two main conclusions:

Communicate more simplified definitions

1) For practical and legal aspects more simplified definitions should be considered according the target groups, e.g.:

- Fluvial flooding: surface water COMING FROM water bodies
- Pluvial flooding: surface water GOING TO water bodies.

Different RAINMAN pilot implementations of heavy rain risk management approaches focus on pluvial flooding as well as on flash floods and show that differentiation.

Consider retention & infiltration in addition to drainage

2) Key aspect of pluvial flooding is not only a lack of proper drainage network. In practise, pluvial flooding is very much influenced by a lack of retention of surface water before it enters (urban) areas. The impact of missing natural retention has to be highlighted because of its important impact on the occurrence of pluvial floods. Furthermore, “proper” needs to be defined clearly.

RAINMAN recommends to use the WGF definition of flash floods but to adjust the WGF definition of pluvial flooding according the abovementioned addition of retention and infiltration aspects related with impacts of land use.

Pluvial flooding in flood risk management planning

Preliminary Flood Risk Assessment (PFRA) and determination of areas of potentially significant pluvial flood risk (APSFR)

According to the WGF guidance documents, all types of flooding have to be considered in the whole flood risk management process, if defined as significant by the member states. Areas of potentially significant flood risk (APSFR) are to be determined. According to the EU-FD 2007/60/EC, article 4(2)b, past events are the basis for determination where the relevance is the decisive factor. However, for determination of APSFR for pluvial flooding there are still numerous methodological questions open. In general, there are two basic expert positions:

Heiland et al., 2016

A) Determination of APSFR for pluvial flooding is impossible.
Heavy rain events can occur everywhere. To determine reliable APSFR is not possible based on existing data on the scale of PFRA. Thus, APSFR are not defined for pluvial flooding in the PFRA but pluvial flooding-related flood risk management should cover all vulnerable areas.

B) Determination of APSFR for pluvial flooding is possible.
APSFR can be determined on the scale of PFRA based on the evaluation of high-probability areas for heavy rain events (topographic analysis, rain statistics etc.) in combination with GIS-analysis of the surface and significant vulnerability of land use.

The RAINMAN pilot actions deliver experiences but no uniform positions:

Determination of APSFR remains controversial

1) The method of using historic pluvial flood events remains controversial: the analysis of past events allows identification of areas with damages due to pluvial flood-events in the past. But statistical analysis cannot proof that the risk for future events is higher if damages occurred in the past in an area or not.

Make use from a variety of existing methodological approaches

2) Other appropriate methods to assess pluvial flooding risk were tested and might also be used for the determination of APSFR, e.g. empiric knowledge methods, flow pathways/runoff accumulation methods (based GIS-analysis) or hydrodynamic simulation methods. The decision on the most appropriate method depends on many local conditions (see also the RAINMAN Toolbox). The development of methodological standards could be of help for practitioners.

Visit the RAINMAN-Toolbox for an overview on potential approaches

3) Experiences on modelling pluvial flood hazards and risks on different scales and in different areas gained in the RAINMAN pilot actions are documented in the RAINMAN-Toolbox. Those approaches might be used for the identification of APSFR for pluvial flooding in the 3rd flood risk management cycle (if not already applied in the 2nd).

Determine pluvial and fluvial APSFR separately

4) If APSFR for pluvial flooding are determined, they should be documented apart of APSFR for fluvial flooding or separately named, because of the different characteristics and the consequences of both types of flooding.

Pluvial flood hazard and risk mapping

Among experts, there are also two basic positions on the issue on how to visualise pluvial flooding on flood hazard and risk maps:

A) Fluvial and pluvial flood hazards and risks should be shown in one integrated map.

B) Fluvial and pluvial flood hazards and risks should be shown in separate maps.

In this context, the mapping activities in RAINMAN pilot action areas deliver experiences that show the importance of the perspective of the different types of map users (non-experts / specialists):

Address the different types of map users; communicate uncertainties and different rainfall / flood scenarios

Non-expert users usually call for one simple map. Indeed, fluvial and pluvial flooding hazards and risks can be documented in one integrated map if appropriate scenarios are chosen. The RAINMAN pilot implementations have shown that one integrated map would create a better, clearer message towards the users of the maps, because hazard areas and risks are visible.

However, specialists point out the problem that the characteristic and occurrence of hazards from fluvial and pluvial flooding can differ a lot in terms of uncertainties, scenarios, forecast time, velocity etc. Thus, they call for separate maps as they take the characteristics better into account and allow drawing proper conclusions for action.

While fluvial flooding can be some meters high, pluvial flooding causes mostly much lower water level. Thus, if water levels of fluvial and pluvial flood differ too much, they should be visualised in different maps.

Use the mapping process for making non-expert map users familiar with the characteristics of pluvial flooding

Not only the design & layout of maps but also the working process of pluvial flooding hazard and risk mapping should consider the necessity of approaching stakeholders with a varying depth of knowledge about the peculiarities of pluvial flooding and the question of how to properly assess such events. The project states the following:

1) It is advantageous if potential users are involved in the scenario selection and definition process from the beginning on.

2) Visualisation of the hazard (flooding process, time, filling of areas, blocking of culverts, flow velocity etc.) is decisive to raise risk awareness and to demonstrate risks.

3) Communication of uncertainties and further risks is very important.

4) Visualisation of potential measures and their impact helps to illustrate debates and to foster decision making and planning.

Flood risk management planning and proposing of risk reduction measures

According to the EU Floods Directive, flood risk management plans shall propose measures to manage identified risk of (pluvial) flooding.

Since the management of pluvial flood risk requires individual solutions appropriate to an area, potential measures can be best organised by local actors and range on a quite detailed and local level. Nevertheless, pluvial flood risk management contributes to reach the objectives of the Floods Directive (also according annex B) and should be integrated in the periodical monitoring concepts.

Consider measures reducing the risk of pluvial flooding in periodical monitoring concepts

Experiences with national and regional funding of local pluvial flood risk management provide examples for the effectiveness of the local approach, when there is support by national or regional funding programs available. Such programmes can be beneficial also in the harmonisation and standard setting processes. They also show that many fields of action need to be tackled and the local actors need to get orientation on the strategies to be followed.

Without making a comprehensive claim, the RAINMAN-Toolbox presents five essential strategies for effective implementation of risk reduction measures:

Support local action through advice on strategies

- "Prevent damages!" invites regional authorities, municipalities and private persons to explore what they can do to prevent damages.
- "Retain rainwater!" introduces different retention concepts and addresses municipalities as well as private persons and farmers.
- "Adapt spatial planning!" invites municipalities to use the risk reduction possibilities of different planning instruments.
- "Improve early warning!" teaches the user on how to interpret, assess and forward warnings
- "Organise emergency response!" Provides step-by-step-guidance on how to adapt emergency response to heavy rain risks.

Furthermore, the RAINMAN-Toolbox offers a catalogue of 100 risk reduction measures whose entries mainly belong to the WGF "prevention" type of measures. The catalogue entries have been compiled through a comprehensive review of exiting catalogues and literature on approaches that have been implemented in Central European countries by many projects and actors. A wide range of very different measures have been identified as being beneficial for the reduction of heavy rain risk and as being applicable under consideration of conditions in an area. A large number of entries are "illustrated" with implementation examples from the RAINMAN pilot action areas and guide the user to further information sources. Furthermore, the measures are related to different "fields of action" and the five relevant strategies to reduce heavy rain risks effectively by precautionary measures.

Spread the knowledge about developed solutions; consider local situation when taking over solutions

Further essentials

Balvin et al 2018, Broer and Spira 2018

The RAINMAN project delivered an overview about available methods and implementation solutions as well as about implementation requirements and the state of practice on heavy rain risk management in six Central European countries. In the RAINMAN-Toolbox this knowledge has been made available to experts and to the public, organised in tools as website content, as downloadable studies and as user stories of about 80 downloadable factsheets.

Any information is assigned to one out of three main tasks of each flood risk management planning process:

Foster systematic action

1) Get to know the risks – risk assessment and mapping;
2) Communicate the risks – risk awareness and risk communication;
3) Take precautions - determination of risk reduction measures.

However, since the best technical solution always depends on the individual risk situation, no unique recommendation and one-size-fits-all solution was possible – for none of these tasks. Instead, the RAINMAN-Toolbox stresses the need to always consider the specific situation of the location and to approach and integrate the relevant stakeholders into the entire management process.

Stimulate risk communication, integration of relevant stakeholders and thinking outside the box

RAINMAN considers risk communication as a central element for truly integrated risk management approach for pluvial flooding. This requires appropriate skills and priorities of the experts involved as well as their readiness to manage the risk not only through flood risk management planning according to the EU Floods Directive but also through approaching other planning processes.

Risk communication with stakeholders and citizens

Support local authorities in their risk communication activities

Comprehensive survey campaigns in the pilot areas of the RAINMAN project have shown that the general awareness for pluvial flood risk and for rising risks due to impacts of climate change exists in all participating countries. However, regular information and updating of public information regarding risks and risk reduction measures is very important. To encourage and to qualify communities and local authorities to start pluvial flood risk analysis, risk mapping and risk mitigation planning, much more support and assistance is necessary. The RAINMAN toolbox provides support, like

- National / regional guidance, approaches and data (see country-specific information on the tools in the RAINMAN-Toolbox: e.g. the prevention tool informs stepwise from „Know your risks“ to „Prevent damages“).
- Models and tools for risk assessment and risk reduction (see toolbox).
- National or regional funding instruments to support local actors (e.g. the example of Wroclaw: the subsidy program "Catch the Rain”)
- Consulting capacities (decentralised, e.g. by environmental agencies).

Especially smaller communities need support for their risk communication towards stakeholders and potentially affected persons in all phases of flood risk management. According to measures' types "prevention" and (individual) "protection" this should always include both fluvial and pluvial flood risk. A differentiation in the communication is not understandable for the public and many individual precautionary measures are similar.

However, complexity of hydrological processes, cause-effect mechanisms and approaches for risk reduction require explanation, e.g. in order to enhance transparency and comprehensibility of administrative decisions.

Coping with pluvial flooding outside the EU Floods Directive

Many different stakeholders can contribute to retention of water from heavy rain events at the origin, proper drainage, protection of hazard areas from raising risk by human impacts and reduction of risk by proper land use and constructions. Hence, effective risk reduction by precautionary measures can't be tackled only through processes in the framework of EU Floods Directive but calls additionally for adequate use of many different (planning) instruments in different sectors. This requires proper coordination of instruments and applications. Increasing risk due to changing conditions as result of climate change shall be considered.

Use synergies with other planning processes like climate change adaptation, spatial planning, and rural development

Not all measures that are risk reducing have their origin solely in flood risk management. The use of synergies is very important and effective. Pluvial flood risk management is also part of comprehensive local climate change adaptation strategies. For politicians, decision makers and the public a sound integrated picture of climate change adaptation (CCA) is very important. Reduction of the risk of potentially increasing heavy rain events should be integrated in local adaptation strategies and can be an important link between climate change adaption and flood risk management.

Spatial regional and urban planning has to protect retention areas and prevent new constructions in hazard areas. Urban zoning plans should consider pluvial flood risk management and have to control the urban development in the light of risk reduction.

Furthermore, rural development planning and agricultural sector plans should consider the importance of decentral water retention in the soil and in natural drainage systems (e.g. small, dry management integrated detention ponds on arable land) and the influence of tillage intensity on the pluvial flood risk.

In the same sense the integration of flood risk management (including pluvial flooding) river ecology and climate change should be enforced to:

1) Raise the acceptance in the public and for decision makers;
2) Increase the cost-effectiveness by using synergies; and
3) Improve the integrated thinking about one water and river system, which includes quality and quantity.

Let the environment benefit from pluvial flood risk management

Last but not least, pluvial flood risk management should contribute to reach a sustainable development.

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