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TRANS-ADAPT

Societal transformation and adaptation necessary to manage dynamics in flood hazard and risk mitigation

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Contributors

Sven Fuchs	University of Natural Resources and Life Sciences Vienna, Austria
Mathieu Bonnefond	National Conservatory of Arts and Crafts, Geomatics and Land Tenure Laboratory, Le Mans, France
Darren Clarke	Maynooth University, Co. Kildare, Ireland
Peter Driessen	Utrecht University, The Netherlands
Marie Fournier	National Conservatory of Arts and Crafts, Geomatics and Land Tenure Laboratory, Le Mans, France
Amandine Gatien-Tournat	François Rabelais University, Tours, France
Mathilde Gralepois	François Rabelais University, Tours, France
Dries Hegger	Utrecht University, The Netherlands
Heleen Mees	Utrecht University, The Netherlands
Conor Murphy	Maynooth University, Co. Kildare, Ireland
Sylvie Servain	INSA Centre Val de Loire, Blois, France
Thomas Thaler	University of Natural Resources and Life Sciences Vienna, Austria
Caroline Uittenbroek	Utrecht University, The Netherlands
Martin Wenk	University of Natural Resources and Life Sciences Vienna, Austria

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SYNTHESIS

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Foreword

Foreword JPI CLIMATE

The historic Paris Agreement establishes an ambitious transformation which is required if we are to avoid dangerous and irreversible impacts of climate change. The Paris Agreement sets out a pathway and a process by which this transformation can occur through collective global actions.

The Joint Programming Initiative "Connecting Climate Knowledge for Europe" (JPI Climate) is designed to provide knowledge to inform actions to address climate change. It is a pan-European intergovernmental initiative under which European countries act to jointly coordinate national climate research and fund new transnational research initiatives that increase and enhance the provision of climate knowledge and services. It is focused on high-quality research with high societal relevance in Europe and globally and has an overall objective to strengthen the European, science-based efforts in tackling the societal challenge of climate change.

TRANS-ADAPT is one of the six projects funded by JPI Climate by the joint call on „Societal Transformation in the Face of Climate Change" aimed to connect scientific disciplines and enable cross-border research with the view to increase the science-practice interaction and supported by 13 European countries. TRANS-ADAPT analysed local community-based initiatives in the policy field of local adaptation strategies to flood risk in four countries. It aimed to describe the processes through which these initiatives are initiated, implemented and maintained, as well as to evaluate their success. The results produced by this project, are presented here. They identify lessons that can assist those planning or working on the implementation of climate change adaptation strategies arising from flood risk in Europe and globally.

The uptake of the knowledge produced by projects like TRANS-ADAPT is key to advancing climate action to implement the Paris Agreement. This is a priority for JPI Climate, which aims to innovate with the (end-) users on societal transformation for low carbon climate resilience and broader sustainability. JPI Climate has recently established an Action Group on Social Sciences and Humanities, which deals with valorisation aspects of research results and we count on successful projects like TRANS-ADAPT and their partners to further engage with JPI Climate in achievement of its aims and objectives.

With best regards and trust in the virtue of European collaboration,

Frank McGovern
Chairman of the JPI Climate Governing Board

Foreword INTERPRAEVENT

Facing the challenges of climate change, the JPI CLIMATE project TRANS-ADAPT analyzed and evaluated the multiple use of natural hazard mitigation schemes with a particular focus on underlying social transformation in communities exposed. Based on case studies in four European countries the project assessed changing responsibilities between public and private actors necessary to arrive at multiple use of mitigation, which repeatedly leads to more resilient societies. Yet each risk mitigation measure is built on a narrative of exchanges and relations between people and therefore may condition governance. As such, governance is done by people interacting and defining risk mitigation measures as well as climate change adaptation; and is therefore simultaneously both outcome of, and productive to, public and private responsibilities.

The aim of the INTERPRAEVENT Research Society is to support prevention against natural disasters and to facilitate interdisciplinary in the field of hazard and risk management. As such, INTERPRAEVENT supports the exchange of knowledge and experience between science, practitioners and decision makers in hazard and risk management. The synthesis of the JPI CLIMATE project TRANS-ADAPT will be a valuable continuation for all stakeholders involved in mitigation planning to prevent losses from natural hazards. The TRANS-ADAPT partners synthesized the outcomes of the project in order to provide a guiding document for a future application of such multiple use protection schemes in settings different from the case studies. Thus, this report contributes to the main aims of INTERPRAEVENT such as providing information for stakeholders in natural hazard and risk management, promoting scientific debates and presenting conclusions to practitioners, and supporting decision-making for all questions of technical and non-technical preparedness.

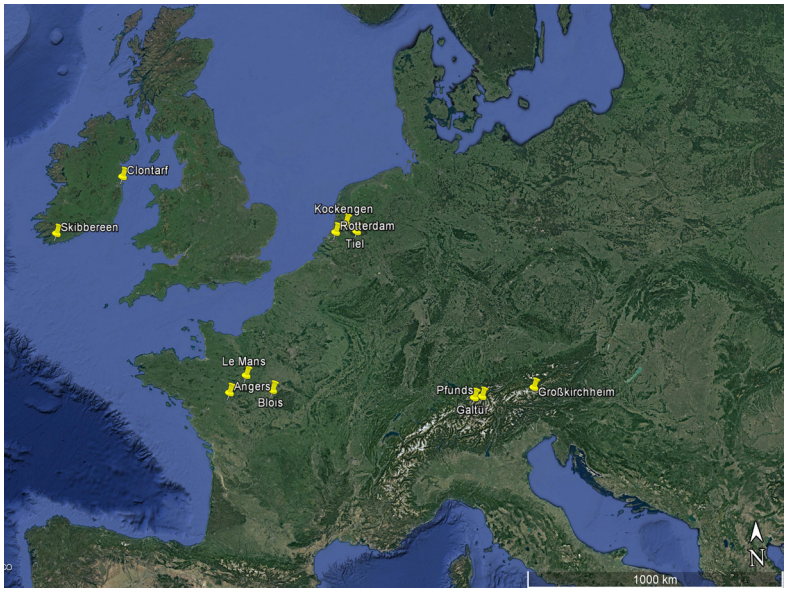
Kurt Rohner, President
Gernot Koboltschnig, General Manager

Contents

Introduction

In a context of climate change, extreme hydrological events experienced in Europe have focused the attention of policy-makers on flood hazards. Decades of top-down flood management policies, however, have given little consideration to social representation and local solutions, especially non-structural approaches. Only recently, there is increasing attention on dynamics beyond vulnerability and flood risk, such as climate change and dynamic forces of exposed societies. With the objective of giving rivers more space (EU Floods Directive 2007), flood management should consider the maintenance and/or restoration of floodplains where possible. The definition of multi-use in the scope of flood risk prevention goes beyond this concept and is the combination of several functions or activities through space (on different plots of the same location), or through time on a same location, associating at least one use of land that serves the interest of managing floods, regardless of the type of flood risk management involved. As exposed societies contain a concentration of people, economic resources, transportation, interdependent networks, social and informational activities, agglomerations throughout Europe are especially vulnerable to flood risk. In this context, the TRANS-ADAPT project focused on the question of how bottom-up initiatives lead to multi-functional use of flood hazard mitigation strategies.

The context of a changing role of the state in responsibility sharing and individual responsibilities for risk management and precaution lead to the question of innovative flood risk mitigation strategies. Indeed, the implementation of the European Floods Directive (EU, 2007) puts responsibility on local organisations to determine local strategies to manage local risks, which in turn demand societal transformation in vulnerability reduction.



Case study locations. Credits: Google Earth

Therefore, TRANS-ADAPT centred on how emerging natural hazard strategies place the lead responsibility on local organisations to determine local strategies to manage local risks, which demands societal transformation in vulnerability reduction.

TRANS-ADAPT focused on the understanding of how bottom-up initiatives may create innovative spatial flood alleviation schemes and what they teach us about flood risk management. TRANS-ADAPT dealt with cases where a significant amount of responsibility is given to local authorities and/or residents. Bottom-up initiatives are concerned with the decision-making process and policy implementation in which local stakeholders address problems of local concern, first, to share flood management between the state and the local stakeholders, and second, to find more creative and innovative solutions to face adaptation to climate change in flood risk management.

The main reason for this shift from centralised to decentralised organisation is that local scale can be more innovative in dealing with those tasks relating to risk and emergency management. TRANS-ADAPT understood and conceptualised societal transformation as specific local governance initiatives instigated by local governments, residents, NGOs or private parties with the aim of complementing conventional flood policies from the perspective of changing responsibility division between public and private actors necessary to arrive at more resilient societies. As such, current and future governance structures define the outcomes of, and are productive to public and private responsibilities. The transformative potential of these initiatives may come from replication or transfer of these initiatives to other contexts or they may induce wider institutional changes facilitating uptake of novel initiatives.

TRANS-ADAPT paid special attention to the role of communities in the emergence of bottom-up initiatives. The project focused on community-based initiatives for natural hazard management strategies that are clearly different or a niche relative to mainstream solutions of flood risk management. Yet each risk mitigation measure is built on a narrative of exchanges and relations between people and therefore may condition the outputs. Of particular interest given the involvement of diverse actors are multi-functional use of the same place or several (spatial and/or social and/or economic) functions and interests. The initiatives are often pursued by local actors and stakeholders, not with the aim of contributing to broader societal transformation but to address local problems or to seize local opportunities. TRANS-ADAPT had shown that motives of community-based initiatives with multiple functionality and use of flood risk mitigation measures include: (1) lack of funding, (2) lack of legal protection to include local interests or (3) lack of space, where classical flood risk management measures, which are dominated by one type of use (protection), cannot respond to the new circumstances. Acknowledging these constraints, a major challenge of multi-functional use of natural hazard management strate gies is to represent the complexity of coupled human-environmental systems and particularly the feedback loops between

environmental dynamics and human decision-making processes to better understand the current social developments. TRANS-ADAPT explored and analysed what and who is behind these initiatives (legal, economic and socio-ecological pressures) and showed the (often complex) motivation for and key aspects of multi-functional initiatives. TRANS-ADAPT was based on eleven case studies from Austria, France, Ireland and the Netherlands. In these countries natural hazard management has been institutionalised for decades, but with different institutional settings as a result of multiple dimensions of vulnerability. This will help to identify wider lessons for other European regions currently working on the implementation of climate change adaptation strategies arising from flood risk.

The TRANS-ADAPT consortium kindly acknowledges funding received from the Austrian Federal Ministry of Science, Research and Economy (BMWFW), the French National Research Agency (ANR), the Ireland Environmental Protection Agency (EPA) and the Netherlands Organisation for Scientific Research (NWO).

Davos Frauenkirch - traditional local structural protection. Credits: S. Fuchs

TRANS-ADAPT kick-off meeting in Vienna. Credits: TRANS-ADAPT Consortium

Le Mans, France: Île aux Planches as an example for flood mitigation with multiple use. Credits: S. Fuchs

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Societal adaptation

Climate change – fostered by natural climate activity but also human activities – is triggering changes in the extremes of meteorological events, including the magnitude and frequency of flooding. As a consequence, processes such as heavy rainfall, increased activity of wind storms combined together with changes in the natural environment such as increased deforestation repeatedly lead to severe river flooding throughout Europe. European cities and villages are increasingly prone to these processes, which leads to more vulnerable societies. The effects of hazard processes on these vulnerable societies are high, and specific challenges result for adaptation and mitigation.

In this context, societies are engaging at different levels in adaptation processes. Adaptation is defined as the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. Therefore, adaptation includes initiatives and measures to reduce the vulnerability of natural and human systems against natural hazard impacts. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Hence, adaptation is manifested by adjustment in ecological, social or economic systems in response to observed or expected changes in hazard stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities. Adaptation can involve both building adaptive capacity thereby increasing the ability of individuals, groups, or organisations to adapt to changes; and implementing adaptation decisions, i.e. transforming that capacity into action. Both dimensions of adaptation can be implemented in preparation for or in response to impacts generated by a changing climate. Hence, adaptation is a continuous stream of activities, actions, decisions and attitudes that informs decisions about all aspects of life, and that reflects existing social norms and processes.

According to the general definitions, adaptation challenges the prevention of risks in the context of extreme events, and consists of adjustments in responses, and integration of prevention against extreme events in local development. Societies face the challenge of continuing development and at the same time, building acceptable infrastructure and making planning choices based on projected events. In this context, especially when it deals with national security and protection, several strategies are taken by national authorities, but also by regional and local authorities – concerning urban development for example –, sometimes with the collaboration of civil society. Initiatives intend to make organisations more efficient and socially beneficial, trying to make more advantage of land.

Collaboration with civil society in managing natural hazards and their impact is challenging, in particular because for decades risk management has been institutionalised and assigned to public bodies and governmental agencies throughout European countries.

Concerning these aspects, TRANS-ADAPT had shown a range of risk management strategies from the different case studies in four European countries. For example, French case studies deal with risk prevention, flood defence and flood mitigation. Dutch case studies include one case with flood preparation, one with flood defence and mitigation, and one with flood mitigation. As case studies represent various combinations of flood management strategies, it will be important to specify exactly which strategies have been chosen by stakeholders, and if those strategies are part of a larger flood management scheme. The interest for TRANS-ADAPT was to address a similar question as the central pillar: how do bottom-up initiatives lead (or not) to multi-functional use of land, in urban and rural contexts, in the field of flood management? The TRANS-ADAPT case studies were similar in the way that there are successful or unsuccessful initiatives to implement multi-functional alleviations for flood management. The differences amongst the case studies helped to evaluate the criteria and to analyse the drivers and barriers, especially in non-conventional flood risk management.

The two guiding questions were:

1. How are multi-functional bottom-up climate change adaptation strategies with respect to flood hazards institutionalised in different societal environments, and are there specific actions undertaken to reduce climate change vulnerability, such as permanent technical mitigation measures, temporal organisational measures, or a combination of them? Are incentives set to support citizens in their own adaptation efforts?
2. What mechanisms and actions have been used to adapt institutions for multi-functional climate change adaptation strategies? What are the conditions that enable effective collaborations within flood risk management?

Conventional mitigation of natural hazards institutionally originates from the 1890s when the French system of forest-technical torrent and avalanche control was adopted. Watershed management measures, forest-biological and soil bio-engineering measures as well as technical measures (construction material: timber and stone masonry) had been implemented. Thus, conventional mitigation concepts only consider technical structures within the catchment, along the channel system or track and in the deposition area. According to the approach of disposition management (reducing the probability of occurrence of natural hazards) and event management (interfering with the transport process of the hazard itself), a wide range of technical measures are applicable.

Conventional technical measures against flood hazards, such as deflection and retention walls as well as barriers or flood protection dams, are not only very cost-intensive in construction, moreover, because of a limited lifetime and therefore an increasing complexity of maintenance, the feasibility of technical structures is restricted due to a scarceness of financial resources provided by responsible authorities. If maintenance is neglected mitigation measures will become ineffective and can even increase the catastrophic

potential of natural hazards. Since conventional technical measures neither guarantee reliability nor complete safety a residual risk of damage to buildings, infrastructure and harm to people remains.

Experience from previous research suggests that values at risk and spatial planning should be increasingly considered within the framework of natural hazard risk reduction. To meet this goal, integral risk management strategies seem to be a valuable instrument to reduce the vulnerability of buildings and infrastructure to natural hazards and to develop strategies for a strengthened resistance, above all by means of local protection measures.

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Important aspects of TRANS-ADAPT. Credits: S. Fuchs based on wordart.com

Stakeholder consultation as one important step of societal transformation in natural hazard management Credits: S. Fuchs

Adaptation challenges the prevention of risks in the context of extreme events, and consists of adjustments in responses, and integration of prevention against extreme events in local development. August 2005 floods in Austria. Credits: Austrian Armed Forces

Bottom-up initiatives

Since the late 1980s the context of globalisation of exchanges radically changed management and policies. The multiplication of actors, rules or sources of information highlights the importance of collaborative process characteristics in reaching agreements. To solve emerging problems, uncertainties and risks, especially linked with environmental issues, some experts and scholars have defined an ascending process of problem solving, based on collaboration to find a consensual solution. This collaboration is associated to bottom-up decision making.

Bottom-up initiatives represent a way to make decisions and implement changes from and with local users. In the field of flood risk management, it is an alternative to the traditional and often governmental expert-based decision and a decision-making process for more innovative measures. Bottom-up processes can be contrasted with top-down processes and necessarily imply a sound participation from local actors. There is a strong need for a new division of responsibility between the government and its citizens, leading to a new balance between structural and non-structural risk management options, towards more tailor-made choices, depending the spatial, social, economic or cultural characteristics of the nature of the place and the risk.

Often, bottom-up initiatives are based on efficiency; therefore, some goals should be decided and implemented by policy-makers. However, it may turn out to be more efficient to let users define goals and implement such goals themselves. Bottom-up initiatives are not equal to public participation or any new way of local democracy. Nevertheless, bottom-up initiatives propose an alternative to hierarchical top-down decision processes even if on the top of the pyramid there may be a leadership institution (economic, political, and religious) depending on the policies and the context. Moreover it is argued that in order for this shift to occur, it is necessary to integrate disaster management and community planning. Current practice seldom reflects such a synthesis, and this is one of the reasons why hazard awareness is usually absent from local decision-making processes. It is asserted that if mitigation strategies are to be successfully implemented, then the disaster management process must incorporate public participation at the local decision-making level.

Bottom-up initiatives are important drivers in flood risk management. Credits: S. Fuchs

TRANS-ADAPT provides a way to understand how bottom-up initiatives create innovative spatial flood risk measures and what they teach us about flood risk management. TRANS-ADAPT dealt with cases where a significant amount of responsibility had been given to local authorities and/or residents. TRANS-ADAPT defined bottom-up initiatives as the decision-making process and policy implementation in which local stakeholders in a local area address problems of local interest, as a double trend, first, to share flood risk management between the State and the local stakeholders, and, second, to find more creative and innovative solutions to face climate changes in terms of extreme events in urban areas.

The evolution of flood risk management governance shows that the process is linked to the concept of shared responsibilities with European institutions, local authorities, private stakeholders, lobby interest groups, advocacy actors and citizens. In particular citizens are being increasingly required to take responsibility for the management of their own flood risk at a local community, business and individual household level. Stakeholders are understood as persons interested and actively engaged (in terms of support) in the policy system. This differs from individuals, which are those who are not actively involved or interested in the policy system. An individual, group or firm who will be affected by the consequences of a decision and hence is regarded as having an interest that needs to be taken into account in the decision. This may vary from being heard through to being involved in determining what the decision should be.

TRANS-ADAPT paid special attention to the role of community in the emergence of bottom-up initiatives. Besides stakeholders involved in the flood risk management policy, there are three characteristics that compose the definition of community, (1) a system of interrelations around a common interest, (2) the improvement of their own representation of spatial quality of life, and (3) a notion of spatialisation in the community.

In the TRANS-ADAPT case studies, groups of people locally based, on land that bears specific features geographically defined, with a definite flood exposure, were studied. Such groups included those in close proximity to rivers, flooded districts, local authorities, political authorities, fisheries interest groups, environmental associations, etc. Each community carried the objective of protecting their environment, their quality of life and their future in using potentially flooded areas for any purpose.

TRANS-ADAPT was based on two assumptions.

The first assumption was that community initiatives create original ways of managing floods in terms of how community-led initiatives are creating some new, original ways of managing flood prevention infrastructures, specifically mul-

tiple use strategies. The first hypothesis is that the bottom-up process of local actors is more innovative than traditional institutional arrangements. The main reasons for this shift from centralised to decentralised organisation is that local scale seems to be more efficient in dealing with those tasks relating to risk management.

The second assumption was that multiple use is a resilient outcome that can be replicated. Do community processes lead to a more successful outcome, in terms of vulnerability reduction and resilience, in which multiple-use is the observed outcome? By multiplying the functions of land (leisure, sport, commercial activities, fishing places) and by thinking about the vulnerability of those activities, TRANS-ADAPT determined if multi-functionality increases resilience, when it is defined as the capacity of a system to respond to a disturbance by resisting damage and rebuilding itself without collapsing into a qualitatively different state that is controlled by a different set of processes. Classical flood risk management measures, which are dominated by one type of use (flood protection), cannot respond to the new circumstances. TRANS-ADAPT argued that such approaches hold much, as yet unexploited, potential for realising unexpected solutions for dealing with flood risks.

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Information and communication are essential for creating incentives for bottom-up initiatives. Credits: S. Fuchs

Bottom-up initiatives as a way to make decisions and implement changes from and with local users. Credits: S. Fuchs

Meeting of stakeholders and decision makers. Credits: S. Fuchs

Discussion among stakeholders and hazard experts. Credits: S. Fuchs

Galtür avalanche dam

Even though beyond the narrow scope of flood hazard mitigation, the Galtür avalanche dam is an excellent example of multi-use in risk management. The municipality of Galtür is located 35 km southwest of Landeck in the western part of Austria near the Swiss boarder at an altitude of 1580 m a.s.l. The municipality covers an area of 121 km2 and 771 inhabitants lived there in the year 2016. During wintertime, up to 4000 additional persons are present in the hotels and guesthouses of the village. More than 26 avalanche paths, nine of which are equipped with defence structures in the starting zone, endanger the community. During the so-called avalanche winter in 1998/99, major avalanches occurred throughout the Europpean Alps. A 50 m (160 ft) high powder avalanche traveling at 290 km/h (180 mph) hit the village on 23 February 1999. As a result, 57 people were buried and 31 of them died.

The Galtür avalanche dam was constructed as a multi-functional protection scheme as a response to the 1999 avalanche events. The national, regional and local authorities developed an innovative management concept for the community which included snow fences made of steel in the avalanche starting zones on top of the slopes, and a 300m avalanche dam to protect the mountain village in the run-out area. The Austrian Torrent and Avalanche Control Service initiated the project, where the local citizens were the main driver for the development of a multi-functional use of the dam. Multi-functional use included an exhibitions room, a panorama café, a climbing wall, a conference location and the centre of the civil protection integrated in the protective structure. The avalanche dam has multiple functionality as a response to the lack of space in the village; and therefore a strong community engagement was observed to use the dam with secondary purposes. As such, the Galtür example is a frontrunner of multi-functional natural hazards protection schemes, especially to overcome the problem of lack of land. Consequently such multi-functional natural hazard constructions are gaining momentum in Austria.

Galtür avalanche dam. Credits: Google Earth

Planning

The limited living space, proximity of safe and hazard-prone areas, and continuous land use pressure – but also increasing financial limitations – sparked strong community engagement to use the dam for additional purposes. The project was planned immediately after the avalanche event and implementation started even before the winter of 1999 for reasons of timely avalanche protection of the village. The dam was constructed as a multi-storey building following the adjacent federal road on a length of 135 m. The 345 m long and up to 19 m high avalanche wall not only integrates art and culture, but impresses with modern interior design and the exterior architecture adapted to the townscape and nature. Whereas the avalanche protection was planned by the responsible section of the Austrian Service for Torrent and Avalanche Control, the adjacent building was planned by a local architecture firm and is now operated by the Alpinarium Galtür society, a registered Austrian association targeted at a further promotion of topics related to the natural heritage and cultural activities of the region. The basement is used as an underground car park, and also includes the building equipment and appliances facilities. The ground floor includes the museum of Galtür including the necessary facilities, an indoor climbing wall and the fire station as well as the local mountain rescue service. In the first floor, a coffee bar, lecture rooms, the administration and the archives of the museum are located. The combination of protective walls and exhibition rooms makes the Galtür Alpinarium and its architecture unique in Europe. The multifunctional construction was a highly complex and innovative project with strong citizen participation in the decision-making process. Many efforts were invested in developing new administrative arrangements to settle responsibilities and liabilities between the municipality, citizens and the Austrian Service for Torrent and Avalanche Control – as well as in securing new financial resources to develop and maintain structural protection schemes.

Implementation

The key players in implementing the Alpinarium were the Austrian Service for Torrent and Avalanche Control and the Federal State of Tyrol, which both led the discussions in Galtür. Tyrol was powerful because of its importance regarding funding sources, while the Austrian Service for Torrent and Avalanche Control was responsible for designing and constructing the dam. The national, regional and local government provided € 9.5 million towards the project, receiving additional funds by international donors who supported reconstruction following the 1999 disaster, such as the Autonomous Province of Bolzano, Italy.

Challenges

The leadership at the local and regional level was key in driving the strong community engagement. It was also pow-

erful enough to influence the current policy discourse, due to its technical knowledge and expertise. The main challenges identified were the gap between policy guidelines, regulations and the implementation process at local level. Inhabitants showing higher risk awareness were more likely to participate in the process. Another challenge was the shift of legal responsibilities between the different public authorities involved and their regulatory power, such as planning regulation (municipality) or permission to carry out the construction (Austrian Service for Torrent and Avalanche Control). Moreover, a central aspect was the question of responsibility for potential damage from future natural hazard events, which was finally transferred to the municipality. Thus, the avalanche dam contributed to improving social capacity-building of the community of Galtür – increasing risk perception, risk communication and risk education, with respect to a sustainable mountain development.

Recommendations

The Galtür case study demonstrated a strong driver towards encouraging local actors and stakeholders to support 'their' community scheme. Local actors and stakeholders have used their social capacity to adapt the protection scheme to their needs and interests in order to drive socio-economic development as well as gaining the avalanche protection. The processes included besides the representatives from the government also the residents. The Austrian Service for Torrent and Avalanche Control recognised the realisation of the multi-functional dam as a legitimate solution for avalanche protection. In terms of representation and transparency, all stakeholders were quite satisfied with the entire negotiation process. Therefore, the outcome represented adequately the interests of the local population as well as of the Austrian Service for Torrent and Avalanche Control. The project has also received positive attractions in and outside the country, which made it one of the first pilots of multifunctional use in hazard protection schemes.

Summary

The community-based initiative encouraged citizens to actively engage in risk management. The initiative ensured that local interests and well-being were met.

Multifunctional protection schemes provide multiple benefits. Such schemes reduce pressure on limited land and thus mitigate land use conflicts. They can attract investors, providing new financial resources to complement scarce public finances. And they can be used for risk communication and education in promoting local resilience.

Major investments in disaster risk reduction often require collaboration between local, regional and national authorities – and both vision and a new division of responsibility.

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Galtür avalanche dam. Credits: S. Fuchs

Alpinarium Galtür. Credits: M. Keiler

Galtür avalanche dam. Credits: J. Hübl

Pfunds flood protection

The local authority Pfunds is located in the western part of Austria close to the Swiss border, with a population of approximately 2,570 people. The town is situated on the River Inn and the Stubenbach torrent. The river basin is part of the Samnaun mountain range. Geologically, the basin is located within the Engadin window, a Mesozocic ocean basin, which was lifted and then over-thrusted by older layers (Silvretta and Ötztal layer). The dominant lithology of the basin comprises several local types of shale with interbedded strata of quartzites. The Stubenbach torrent is characterised by fluvial sediment transport processes and debris floods and is a tributary of the Inn river. Directly on the fan the municipality of Pfunds is located, where several damaging torrent events were recorded since the 1830s. In 2005, Pfunds suffered heavy damage due to another event, with a magnitude up to 6 m and more than 60 damaged buildings. After the event the local authority had been actively and intensively involved in the development of a local risk management plan. In overall, the risk management plan included two main components:

1. Natural hazard management: a retention basin was planned in the village; the retention basin acts as a primary torrent protection measure. Therefore, it legally falls under the authority of the Austrian Torrent and Avalanche Control Service and the local authority of Pfunds. The municipality has taken up the responsibility of evacuation and maintenance of the basin, whereas the Austrian Torrent and Avalanche Control Service was responsible for planning and implementing the measure.
2. Multi-use design: the retention basin can be used for leisure activities; fountains and artwork were included in the design of the retention basin and acts as archiving memories and informal flood risk communication.

Pfunds flood protection. Credits: Google Earth

Planning

Following torrential flooding in 2005, the Austrian Torrent and Avalanche Control Service developed a local flood risk management strategy to determine areas of the community exposed to torrential flooding. The Austrian Torrent and Avalanche Control Service proposed to develop flood defences outside and insight the community of Pfunds to protect the residential and non-residential buildings along the Stubenbach torrent. This included two retention basins, one in the centre of the community and several flood walls along the course of the torrent. However, the main challenge was to implement the retention basins on private land. The local authorities initiated in close collaboration with local citizens a new planning concept for Pfunds. Consequently, the stakeholder engagement presented the concept of a multi-functional use of the retention basin in the town centre with the purpose of risk communication.

The dam was funded by the national, regional and local government as well as internationally funding schemes, such as European Union. The share for the realization of the retention basin was Austrian Torrent and Avalanche Control Service (62 %), the Federal State of Tyrol (21 %), the regional road authority (2 %) and the local municipality (15 %). The local authority and the EU-Interreg program mainly funded the cultural installation.

Implementation

The focus of the local management scheme was the development of a classical protection measure initiated by the Austrian Torrent and Avalanche Control Service. Moreover, not to develop a multifunctional system in the area. The engagement from the local authority (whereabouts the mayor was the central actor in the overall process) enforced a partly re-design of the local risk management plan. The study sites show a central relationship between national and local level (between the local mayor and the Austrian Torrent and Avalanche Control Service). However, the lead of the risk management plan was still on the side of the Austrian Torrent and Avalanche Control Service.

The interaction by Austrian Torrent and Avalanche Control Service with the community was mainly organised informally and only in the planning phase based on different interests between local authority and residents. In particular, the local mayor (an architect) showed high interest in the development and realisation of the new multifunctional flood alleviation scheme. He played a central role in the planning process, especially for the realisation of the cultural installation in the retention basin. Besides, he was able to mobilise additional financial resources and approval from national and regional authorities to implement the multi-functional retention basin. However, there were some delays in the planning process, because of problems in the purchase of the necessary land for the retention basin. Nevertheless, the integration of the multi-functional purpose was not a key issue for the Austrian Torrent and Avalanche Control Service.

Challenges

An important driver in the process was the engagement of one person (policy entrepreneur) in the overall process. The mayor stimulated the residents of the neighbourhood in Pfunds to start the engagement process. The outcome was that the local level was actively involved in the development of a strategy for flood management. A key challenge in the realisation of the project included the question of responsibility (liability) if something would happen during a future torrent event. So far, the Austrian legal system foresees that the Austrian Torrent and Avalanche Control Service is responsible if someone in the retention area would be injured or would decease by an event. Consequently, the national authority was quite critical in the beginning of the project. Here, in order to overcome this liability, the Austrian Torrent and Avalanche Control Service had to transfer the responsibility to local level. Besides, a key driver for the Austrian Torrent and Avalanche Control Service was the realisation of a multi-functional dam as a legitimate solution to the issue of future torrential floods.

Recommendations

The processes included besides the representatives from the national government also the local level. The Austrian Torrent and Avalanche Control Service recognised the realisation of the multi-functional dam as a legitimate solution to the problem. In overall, all stakeholders were quite satisfied with the entire negotiation process, in terms of representation and transparency. Therefore, the outcome was that the interests of the residents were adequately represented and recognised by the Austrian Torrent and Avalanche Control Service. The communication process was organised through various meetings among all different stakeholders. The mayor had also a strong influence on the design of the cultural activities in the retention basin.

The responsibility was rather clearly defined between the different stakeholders in the planning and implementation phase. The authorities involved used their responsibility for their primary goals, mainly to provide a flood protection scheme. Local stakeholders were mainly responsibility for the tasks outside the hazard management. However, the municipality and residents were mainly involved during the planning/initiation phase of the project. In this phase, especially the residents were strongly involved in the decision-making process. In terms of the legal responsibility, the authorities were quite sceptical at the beginning, but the solution was a responsibility-transfer to the local authorities.

Summary

The case study demonstrates a strong driver towards encouraging local actors and stakeholders to support their community scheme.

The cultural activities are well used by the residents and foreigners; the construction plays an active role in risk communication and increasing of risk awareness. The project has also received positive attentions outside of Austria and is favourable for the municipality.

The outcomes of the project were accepted by the local residents. In particular, the policy entrepreneur (mayor) played a central role in the successful implementation.

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Fountains in the flood retention basin. Credits: S. Fuchs

Pfunds flood retention basin. Credits: S. Fuchs

Pfunds after the 2005 flood event. Credits: M. Rinderer

Großkirchheim flood protection

The municipality of Großkirchheim in south-western Austria with a population of approximately 1,300 people is situated on the Möll river and therefore prone to flooding. The flood history during the 20th century shows various events, in particular during the 1960s but also in recent decades. The main economic activities are dominated by agricultural land use, energy production (hydropower), small to medium handicraft businesses and the tourism sector – mainly in the upper part of the catchment. Apart from flooding, the catchment includes multiple hazard sources for landslides and snow avalanches. Großkirchheim is protected from flooding by a dam along the Möll river; beyond flood protection this dam facilitates another use since it includes an indoor shooting range. The indoor shooting range is an integral part of the flood alleviation scheme protecting in particular the commercial and leisure centres. The Federal Water Engineering Administration initiated the project with the aim to reduce the physical vulnerability of the community. However, the focus was on the development of the protection scheme and not to develop a multi-functional system. The idea to integrate cultural activities in terms of a shooting range was developed by the local authority of Großkirchheim. The concept for the indoor shooting range in the dam started right after the planning process of the flood protection scheme. Nevertheless, it has been a highly complex project with multiple different professional stakeholders from the public and private sectors. The development of this project was very innovative and resulted in many efforts put into legal arrangements to settle responsibilities and liabilities between the municipality and the Federal Water Engineering Administration.

Planning

Following flood risk analysis, the Federal Water Engineering Administration developed a local flood risk management strategy for the community of Großkirchheim. The local authority proposed to develop a multi-functional flood defence along the Möll river. The project included a dam with an integrated indoor shooting range with the aim to protect residential and commercial premises from future flood events. The multi-functional flood alleviation scheme was developed in close collaboration by the water authority and the community. It was proposed as a common project in terms of design, planning, implementation and maintenance. Nevertheless, it has been a highly complex project with multiple different professional stakeholders from the public and private sectors. The development of this project was innovative and resulted in many efforts put into legal arrangements to settle responsibilities and liabilities between the municipality and the Federal Water Engineering Administration.

Großkirchheim flood protection. Credits: Google Earth

Implementation

An important driver to initiate and to implement this multi-functional project was the political will and leadership at local level. In overall, key players in the Großkirchheim were the Federal Water Engineering Administration of Carinthia and the local authority. The mayor played a central role in the planning process especially for realising the indoor shooting range. Both organisations (Federal Water Engineering Administration and community) were leading the discussion during the planning process of the flood risk management strategy. The Federal State of Carinthia has been powerful in terms of funding sources – without the financial support of the Federal State the project would never have been realised. The Federal Water Engineering Administration was the most important actor in the entire process. In particular, this government department dominated the planning process, making them the gatekeeper for the project also according to institutional and organisational norms.
The national, regional and local government as well as international bodies such as the European Union funded the dam or provided subsidies. The share for the realization of the project was 50 % for the Federal Water Engineering Administration, 40 % for the Federal State of Carinthia and the remaining 10 % for the local authority, amounting to a total cost of € 1.5 million.

Challenges

The case study had shown various mechanisms and actions encouraging a change of current natural hazards strategies. The involvement of local stakeholders in the planning process was an important step in the successful creation of a partnership approach between the different local and national actors and stakeholders. Analysing the case study resulted in five general drivers which encourage the implementation of such multi-functional protection schemes. First, an important driver was the mayor. The mayor recognised the window of opportunity to realise a multi-functional dam as a legitimate solution to the issue of flood hazards. Further, the direct engagement of residents was very limited because the mayor acted as a catalyst introdu-

cing a new flood risk management policy. A second main driver reflects the recognition of need for protection scheme in the community. This need was the most important driver and at the same time the starting point in the overall discussion of combing the indoor shooting range with the protection scheme. A third important development reflects the positive net present value of the project as well as that the additional costs were not paid by the Federal Water Engineering Administration. The fourth driver reflects mainly the political interests and capacity at the local level; especially the engagement of the mayor and few residents (from the local hunting organisation). Finally, the project was a win-win solution between the different players. The water authority was able to get additional room for the river and the local authority was able to get a shooting range in an area with a high pressure on current land use. Throughout, with current pressures on local authorities to reduce the spending and in parallel, a reduction in governmental resources, multi-functional use of natural hazards management has been seen as a possibility to both increase the value of budgets available and to increase efficiency in using current public funds and resources.

Recommendations

Local engagement plays a central role in the development of multi-functional flood alleviation schemes. However, the engagement and influence of citizens at risk depends on the individual awareness (risk and environment). If citizens show a high risk awareness they are more likely to participate in the process. This is strongly connected with an incentive for the expectation of safety. An important driver was the use of legal instruments. Above all, the gatekeeper (in the case of Großkirchheim the Federal Water Engineering Administration) wants to transfer the responsibility towards local level. Consequently, the local level has to take over this responsibility for economic loss and the harm of people affected. Besides, the project needs a win-win situation for all participants.

Summary

In overall, the protection scheme has been achieved at low costs, especially with regards to time and resources (effective use of scare land resources). However, the project lead to relatively high construction costs for the indoor shooting range. In addition, there were no further costs for the Federal Water Engineering Administration.

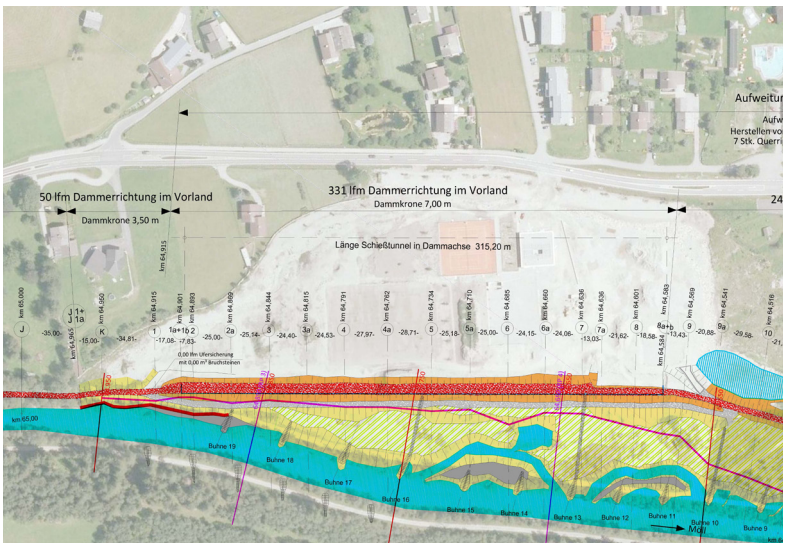
The key goals of the municipality as well as of the community have been achieved in the realisation of the project idea. The shooting range is well used by the residents and also tourists.

The case study demonstrated a strong driver towards encouraging local actors and stakeholders to support their community scheme.

Entrance shooting range Großkirchheim. Credits: A. Rieger

Shooting range Großkirchheim. Credits: A. Rieger

Großkirchheim flood protection. Credits: A. Rieger



Implementation plan Großkirchheim flood protection. Credits: Land Kärnten

Angers flood protectionj

Angers is a city in western France, about 300 km southwest of Paris. The city with approximately 149,000 inhabitants developed at the confluence of three rivers, the Mayenne, the Sarthe, and the Loir, all coming from the north and flowing south to the Loire. The Île Saint Aubin, located around 2 kms from the city centre, is known for its important role in river management. With an area of 600 ha, the island is a wetland area. Until 1950, it was the largest wetland in Western France and as such an important flood retention protecting the city. At the same time, due to a high biodiversity the island is part of the NATURA 2000 conservation network which catalogues areas within Europe that have a scarcity or fragility of flora or wildlife. The last major floods affecting Angers date back to January 1995.

Planning

Apart from the importance of the area for flood water storage, the Île Saint Aubin is a multi-functional place, combining environmental conservation, agricultural and – restricted – leisure and tourism activities. As such, land uses change in annual cycles. While in winter, the island is flooded and migrating birds rest there, in spring, the area is favourable to pikes reproduction and later birds nesting. From late June until August, farmers mow grass on their parcels, and from September until November, most of the land becomes common pasture land for cattle grazing.

Implementation

The status of the Île Saint Aubin is mainly given by French and European legislations. The island has been preserved as a wetland and therefore an area with high flood frequency and magnitude. The success is due to the achievement of two goals with first, it has been recognized as a Zone Naturelle d'Intérêt Ecologique Faunistique et Floristique (French inventories which recognize zones of floristic, faunal and ecological value) with no specifically binding rules, but also as an Important Bird Area (IBA/European legislation) and a Special Protection Area (as part of the Natura 2000 network). Natura 2000 is not a system of strict nature reserves from which all human activities would be excluded. While it may include strictly protected nature reserves, most of the land remains privately owned. The approach to conservation and sustainable use of the Natura 2000 areas is much wider, largely centered on people working with nature rather than against it. Additionally, the Île Saint Aubin has been identified in the flood risk management plan (Plan de Prévention du Risque d'Inondation) as an area with a high or very high flood-risk, which should be prevented from urbanisation.

Angers flood protection: the Île Saint Aubin. Credits: Google Earth

Challenges

Even though farming is declining, it remains crucial (via extensive grazing and mowing) on the island for all environmental objectives to be met (open land for water retention, wet meadows for birds, etc.). Therefore, the main challenge is to keep farming active on the island. Since the 1970s, local institutional stakeholders understood it was important to buy land in the Île Saint Aubin in order to reach their environmental objectives: preservation of a flood retention zone, preservation of resting areas for migrating birds, nesting areas for corncrakes, spawning grounds for pikes. Local authorities still regularly have to convince farmers to keep using their lands. The various local uses, even though they tend to diversify during the last few years, do not constrain the capacity for flood protection: Locally, there has never been any ambition to protect the Île Saint Aubin from flooding, and to allow for other land uses.
Nevertheless, there are new signals of change due to the fact that grazing and mowing are not economically viable in recent years. In parallel, a new decline of agriculture on the island because of the retirement of farmers, cattle grazing which is getting less and less cost-effective, private landowners who keep selling their land to the institutional stakeholders, etc. are increasingly relevant.

Recommendations

A strong and personal exchange between the various land users is important and has to be further encouraged. In particular farming activities have to be maintained. Even though farmers work on this land for generations, it is at risk of agricultural decline.
A specific institution (here a Syndical Association composed of all landowners) may be helpful to regulate the various expectations of all stakeholders on the island and to constitute an important local arena for discussion.
The example of the Île Saint Aubin shows that there can be synergies between environmental rules and flood management rules. Stakeholders can work to align different legislations and reach their goals.
Moreover, the case study also shows that multi-use has to be considered not only within a specific time frame. Therefore, planning rules have to be settled in order to coordi-

nate various and temporary variable uses.

Summary

The Île Saint Aubin is a large wetland, mainly dedicated to extensive cattle breeding. It is the main water retention area upstream the city of Angers.

Since the 1970s, the Île Saint Aubin has faced agricultural decline and a risk of reforestation. Those processes appeared as potential threats for several institutional stakeholders with environmental objectives locally. In order to prevent such an evolution, local institutional stakeholders started to buy land and keep trying to maintain farming on the island.

Local owners and stakeholders of the Île Saint Aubin are successfully involved in the planning of the site. Today, even though there is a debate about the future of the island, the Syndical Association has settled rules to control uses and it remains the most important place for discussion locally. Flood management is one environmental issue among various other concerns (biodiversity, landscapes, sustainable farming). As such, land management on the Île Saint Aubin is not only focusing on one single objective and local stakeholders look for synergies between local issues.

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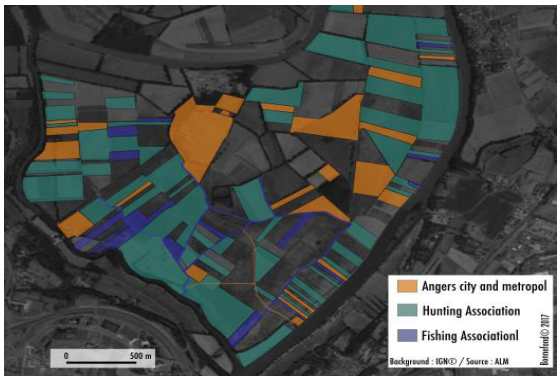
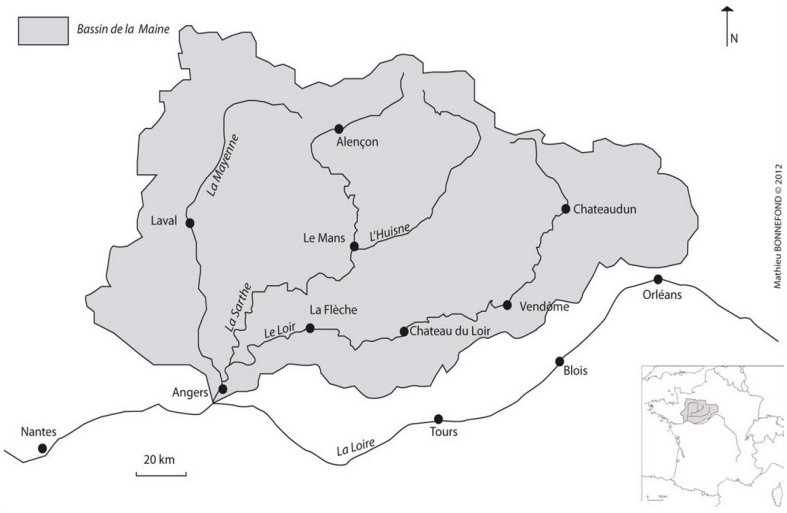
Agriculture at the Île Saint Aubin. Credits: S. Servain

Multi-use occupation of a flood-prone area. Credits: M. Bonnefond



Distribution of land ownership. Credits: M. Bonnefond



Location of the case study. Credits: M. Bonnefond

Le Mans flood protection

The Île aux Planches – historically an industrial area located on the Sarthe river – is an urban park located on an island in 500 meters distance from the city centre of Le Mans (about 205,000 inhabitants in the agglomeration). Today, it is a multi-functional place, combining a recreational area, a flood risk mitigation area and a residential area.

Planning

The whole green area of the island and the adjacent children playground are adapted to flooding. First, the area is a spillway subject to occasional flooding between the channel and the main river (with a small discharge channel); and second, other uses (for leisure) have been adapted to the specific hydraulic needs of the area. The downstream part of the island includes a small social housing scheme with one building containing approximately 20 apartments. Because this building is above the regular flood level there is a relatively low flood risk for the inhabitants.

Implementation

The narrative starts with the story of a contested residential project planned during the 1990s in this former industrial zone, which created strong protests among local communities and inhabitants in the neighborhoods. The created pressure was very active and local residents asked for green areas instead of new housing. Two elements can explain that the residential project has been finally abandoned. First, there has been little private interest (and few investors) for this housing estate. Second, a major flood hit the city in 1995 and reminded local authorities that the flood issue is strong in Le Mans. Central government and local authorities (municipality) reached a consensus on the fact that there was a need for new protection or mitigation works. In this context, a new project idea came up taking into account two objectives: to improve flood risk management and to provide the area with a large green zone. The implementation of this idea took four years from 2004 (start of the architectural competition) to 2008 (opening of the parc to the public), followed by a management phase (from 2009) in order to organise multiple public events and necessary maintenance works.

Le Mans flood protection: the Île aux Planches. Credits: Google Earth

Challenges

The municipality is the main actor and initiator of the project. The implementation of the Île aux Planches as both a flood protection and leisure area was a long process, a continuous source of conflict and time-consuming in the planning phases (consultation, negotiation). However, stakeholders never gave up and made the project possible and achievable.

Regional synergies of the urban multi-use of the site are high. The combination of functions is working well. If floods occur, flood risk management impedes any other use of the park. The project even created positive loops, especially on urban riverbanks integration in Le Mans. It is also interesting that the association of inhabitants and local opponents which had been created to fight against the first residential projects on the island drastically changed its objectives after the implementation of the project. Nowadays, it contributes to the attractiveness of the island and participates in the organization of special events there.

Recommendations

A multi-use of flood prone areas can provide high-quality public space especially for river banks, in particular along city centres and when former industrial areas (brown fields) are revitalised.

Conflicts can lead to novelty. In case of Le Mans, the Municipality succeeded in integrating various demands and solved protests to transform demands into an innovative multi-use project on a flood prone area.

Summary

A first conflict emerged between local communities who wanted a green urban space in the late 1990s on the island, and on the other hand, the land owner, EDF (French Electricity Company) who wanted to develop a housing project. Eventually, the municipality bought the land.

Major floods hit Le Mans in 1995 (25-year floods with long remaining time, approximately 685 damaged buildings and severe economic loss), which made the City to launch a study about flood risk prevention, and to consider developing a new housing site on the Île aux Planches.

Under pressure by two citizen groups (Flooded Inhabitants association and Île aux Planches association), the Municipality eventually accepted the idea of a park on the island, coupled with a flood risk mitigation measure.

In 2005, a project designed by HYL consultancy was chosen and the park opened to the public in June 2008. It is a recreational area, with a green outdoor circle theater, a playground and banks opened to fishermen; it is also a spillway that is covered with water when the river level rises, which

lowers the level of water for Le Mans downstream districts.

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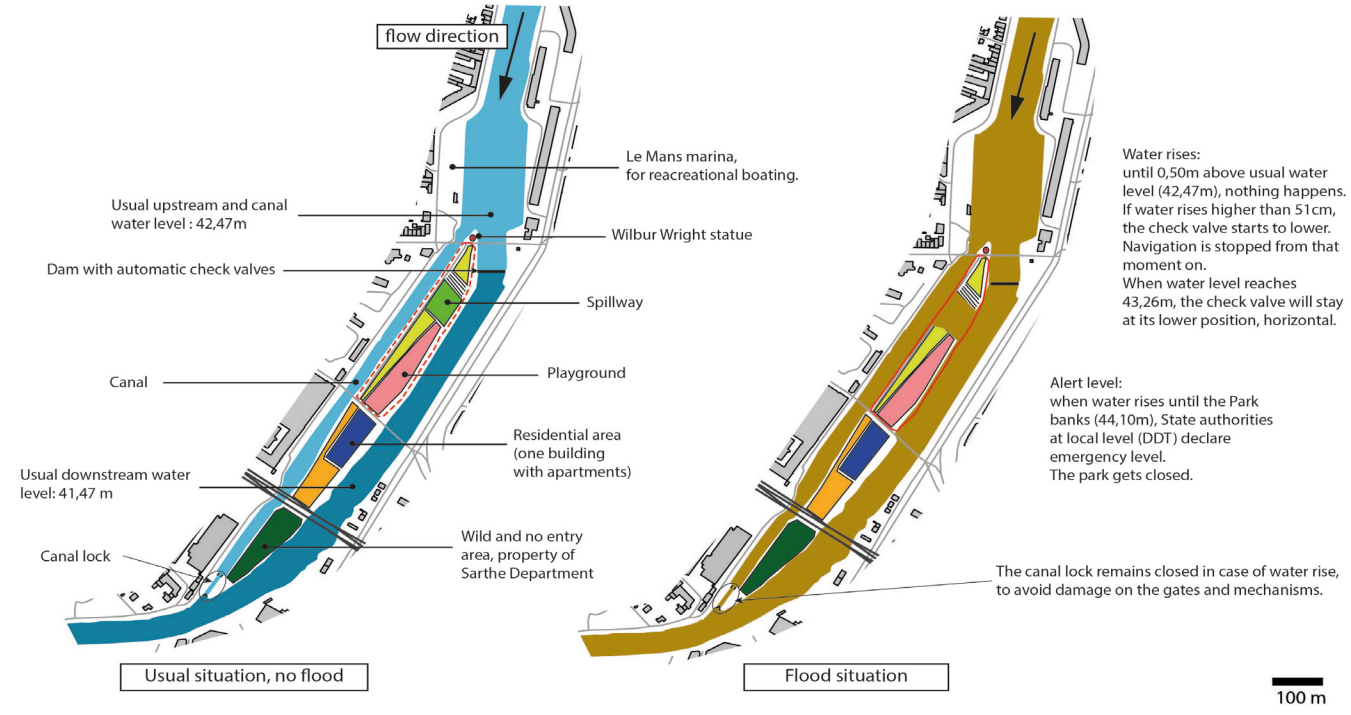
Amphitheatre of the Île aux Planches. Credits: A. Gatien-Tournat

Overview Île aux Planches. Credits: M. Fournier



Schematic plan of Île aux Planches. Credits: A. Gatien-Tournat

Blois flood protection: La Bouillie spillway

Blois is a touristic city along the Loire River with approximately 46,000 inhabitants. The most recent flood in Blois occurred in May 2016, with major damage to the economic sector (mainly businesses and infrastructure). The villages and settlements in the Loire valley are protected from flooding by a system of dikes which have been progressively built since the 15th century to develop agriculture, economy, transportation and urban activities across the floodplain. To avoid damages resulting from floods to the city of Blois, the Bouillie spillway (570 meters long) and a corresponding discharge channel are located upstream the city with the aim to limit the water flow in the riverbed. The spillway is equipped with a fuse wire, which is destroyed by water during a flood to divert the water flow into the discharge channel.

Planning

From the end of the 19th century, residential and commercial buildings have progressively been constructed along the discharge channel. As the spillway was raised higher after the 19th century flooding, the population started progressively to build informal housing. At the beginning of the 2000s, the discharge channel was occupied by more than 135 individual houses and 14 commercial plots employing 1,800 people, but also sport grounds and family gardens. In the 2000s, the city of Blois took the situation very seriously and decided to implement a program to relocate people living in the flood-prone area. The objective was to re-establish the flood retention zone by removing all constructions and population. Relocation of houses and activities was estimated up to € 13 million. It is a very rare case in France, regarding flood-prone areas, in which local authorities were very active.

Blois flood protection: the Bouillie spillway. Credits: Google Earth

Implementation

The relocation was a challenging issue for local authorities. In October 2003, the City of Blois accepted to launch a specific legal procedure (Deferred Planning Zone – Zone d'Aménagement Différé) to progressively purchase land in the discharge channel in cooperation with two other municipalities, and under the coordination of the inter-municipal agglomeration (Agglopolys Communauté d'Agglomération). Relocation would not have been possible without local cooperation and political support of local representatives.

Challenges

The Bouillie spillway is located near the historical city center of Blois: a major issue is to develop a truely dynamic multiple-use occupation of the place, in respect to the performance of the discharge channel as an hydraulic infrastructure. Rules concerning flood risk management are very strict. Therefore, the difficulty is to design a spatial and social project for this area in the future. Today, stakeholders are imagining an agricultural park.
Another challenge is public involvement. At the beginning of the process, participation was not anticipated enough, so local residents' protests have been intense.

Recommendations

Planning project with multiple use needs to be very clear from the beginning. This case shows that multi-functionality should be a goal defined in itself more than a result of successive choices and solutions to problems.
Governance has to be bottom-up, in cooperation with local stakeholders and inhabitants.
The balance of responsibilities between central government and local authorities has to be very clear in order to clarify cooperation, participation and decision-making process.

Summary

Blois is a touristic city along the Loire River. Even if there is a defense system of dikes, spillway and discharge channel, every stakeholder has to remember that floods are still possible.
Urban development was progressively set in the discharge channel of La Bouillie. The relocation process is a unique case for France: 135 houses and 14 shops were moved away.
Even if flood management rules are very strict, local authorities were active and solution-drivers, especially thanks to the intermunicipal cooperation council.
Inhabitant's protests were under-estimated. The duration of the whole process (more than 15 years) helped to progressively solve the situation. In any case, public participation should be anticipated.

Further reading

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Fuse wire of the Bouillie spillway. Credits: M. Gralepois

Local protest of homeowners. Credits: M. Gralepois

Protest against relocation in La Bouillie. Credits: M. Gralepois

Skibbereen flood protection

Skibbereen, Co. Cork is Ireland's most southerly town, with a population of approximately 2,000 people. The town is situated on the River Ilen and acts as a gateway to the south-west of the country, one of Ireland's largest tourist regions. Skibbereen has a long history of flooding, particularly in recent years with severe flooding occurring in 2009, 2010, 2012 and 2013. Following extensive flooding in 2009 a local environmental group proposed to develop an environmental park in a marsh area on the town's periphery. The environmental park was to serve as a multi-functional facility and incorporate woodlands, waterbodies, valleys, hills and numerous habitats. These were envisaged to provide opportunities for walking and recreational and cultural activities, as well as serving as a wetland storage system to protect the town from fluvial flooding. The amenities proposed within the park in terms of natural and constructed features were to provide a potential communal recreational resource and tourist attraction for the town. The park was to be the first of its kind in Ireland in terms of its multi-functionality in integrating both flood relief and recreational uses.

Planning

The environmental park was developed to a conceptual stage only by the local environmental group. It was proposed as a community-led project in terms of design, planning, implementation and maintenance (post-completion). The local environmental group presented the concept to the Office of Public Works (OPW) (national flood authority), various community organisations, the town council and local politicians.

Implementation

Prior to and in conjunction with the timing of the environmental park proposal a flood committee within the community were advocating for flood relief works to alleviate the historic problem of flooding in the town. This group believed that implementation of the environmental park would complicate and delay necessary flood relief works on the river and opposed it on these grounds. The local flood committee represented the flooded community of 230 residents and businesses and were keen to ensure that flood relief works would be sufficient to protect the community.

Skibbereen flood protection. Credits: Google Earth

Challenges

Several interrelated barriers arose at local and national levels in relation to the merits of the environmental park being considered. First, the marsh area was owned by the county council who were considering building a car park for the town. The development of an environmental park was complicated by the prior building of a pedestrian bridge across the river by a local developer which connected the town centre to the marsh, and which was to serve as a gateway between the proposed car park and the town centre. Consequently, the executive committee of the county council refused to support it.

Second, despite the recommendations contained within a national Flood Policy Review in 2004 that a move away from structural flood defences towards non-structural approaches was necessary, Irish national discourse promotes structural solutions to manage flood risks. This issue is particularly prevalent in the context of budgetary resources allocated for both structural and non-structural flood relief measures following the Flood Policy Review in 2004, with € 26 million committed to non-structural measures over a 6-year period compared to € 440 millon for structural flood relief projects over a 10-15-year period. Moreover, current practices continue to promote structural flood defences, with the national government assigning a further € 430 million for structural flood relief measures over the period 2016-2021.

Finally, the OPW believed that the proposed park would not provide sufficient protection against fluvial flood risks as per national flood design standards. In addition, following the 2009 floods the local flood committee were involved in lobbying the necessary flood authorities for structural flood relief works. Consequently, the proposal did not gain the necessary support or traction at local levels (community), or at council or national (institutional) levels. This preference for structural solutions to managing flood risks was directly linked to concerns relating to non-availability of flood insurance. Nationally, structural flood defences are deemed a pre-requisite by the insurance industry in providing flood insurance, which subsequently limited the community's support for proposed non-structural flood defences. This, compounded with the lack of the national flood authority's experience in integrating structural and non-structural flood defences, played a significant role in contributing to the non-implementation of the park.

Recommendations

Institutional flood risk management practices in Ireland are deeply embedded in structural flood relief measures. This is further compounded by a distinct lack of financial

resources allocated to non-structural flood relief measures and demands of the insurance industry. Those institutional practices which prioritize structural flood relief measures create a positive feedback mechanism whereby technical skills and expertise are the primary means of managing flood risks nationally. Moreover, the significance of flooding in Skibbereen in 2009 served only to reinforce these institutional preferences at a community level.

Moving to non-structural approaches — as recommended in the national Flood Policy Review over a decade ago — will prove challenging however. Owing to demands for continued economic growth within national policy and an emphasis on structural flood defences in the provision of flood insurance, any alterations to flood risk management strategies are unlikely to significantly deviate from the status quo. Integrating non-structural strategies into adaptation planning may be best initiated where decisions taken are classified as 'no-regrets', that is, having no residual impact on flood risks e.g. on flood insurance provision or on the continued implementation of structural measures.

Top: Existing view entering Skibbereen. Bottom: view entering Skibbereen on completion of current structural flood relief works. Credits: Office of Public Works

Top and bottom. Concept of multi-functional environmental park. Credits: Partnership for Change

Summary

In Ireland, structural flood relief measures remain the dominant approach to managing flood risks.

Integrated flood risk management (combined structural and non-structural measures) is constrained by institutional expertise and resource-based barriers.

Demands for continued economic growth and the role of the private insurance industry highlight the challenges for authorities/policymakers/communities/ in supporting non-structural approaches.

Non-structural solutions classified as 'no regrets' offer a sustainable approach to managing flood risks.

Further reading

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- Office of Public Works (2013) *Skibbereen Public Exhibition Stage Document*. Dublin: Office of Public Works
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Clontarf flood protection

Clontarf, Co. Dublin is a coastal suburban town located approximately 6 km to the north of Dublin city centre, with a population of approximately 31,000 people. The town is bordered to the east by the Irish Sea and to the south by the River Tolka, one of Dublin's three main rivers. The area is noted for its scenic qualities and recreational opportunities given its location overlooking Dublin Bay to the east and the Wicklow mountains to the south. A 3 km coastal promenade is highly utilised as a recreational area for walkers, joggers, exercise enthusiasts and bird watchers. The promenade is unique in terms of the presence of green space in proximity to the sea and the city centre, with large sections of the 3 km stretch consisting of wide green space. Consequently, the facility attracts a large number of visitors on a daily basis, both from Clontarf and from surrounding areas. The area is also connected to Bull Island, classified as a Special Protection Area and a candidate Special Area of Conversation under the EU Habitats and Birds Directive, a proposed Natural Heritage Area, and a UNESCO Biosphere Reserve, accredited as the sole Biosphere Reserve worldwide to include within its extent a national capital city.

Planning

The environmental park was developed to a conceptual staFollowing coastal flooding in 2002 and 2004, flood risk analysis was undertaken to determine areas of the city exposed to tidal flood risks, in which Clontarf was identified as particularly vulnerable. Dublin City Council (DCC), the local authority, proposed to develop flood defences along the promenade to protect residential and commercial premises from future coastal flooding. This involved the construction of an earthen mound through the centre of the promenade and erecting flood walls at several locations along its course. The proposed height of the defences ranged from 0.85 m to 2.75 m. Planning permission for the defences was granted in 2008. However, initiation of works was delayed for a number of years.

Clontarf flood protection. Credits: Google Earth

Implementation

In 2011, community groups became aware of the scheme and raised significant objections. The groups were subsequently influential in compelling DCC to revisit proposals, organizing a public protest to illustrate opposition, which was attended by approximately 5,000 people. Discussions over an alternative flood relief scheme are ongoing.

Challenges

The implementation of proposed flood defences in Clontarf were constrained by a number of issues. First, the proposed flood defences were deemed incompatible with the landscape and the social values ascribed to the promenade from a community perspective. Illustrating these social values, community members displayed a strong attachment to the promenade in terms of their functional dependence on it and how it represented a part of their social identity. The promenade was seen as an integral link between the coast and the community. As such, they vehemently opposed any alterations to the landscape which would sever this connection.

Second, the dominant role of technical institutional knowledge and practices, which promote structural flood defences nationally, were also deemed incongruous with the local environment by residents. Whilst individuals acknowledged the effectiveness of such practices in preventing flood risks, they nonetheless believed that flood defence planning should extend beyond technical expertise to incorporate local knowledge and societal concerns, particularly where environmentally sensitive landscapes are considered. Finally, findings from Clontarf demonstrate that statutory policies related to the notification of flood relief projects are not conducive to facilitating effective governance practices. Barriers that emerged during the governance process in Clontarf are indicative of procedural justice concerns and broader institutional practices and regulations defined under national and EU legislation regarding how flood relief schemes are designed, communicated and subsequently consulted upon.

Recommendations

Overcoming challenges pertaining to place attachment might only occur when extreme weather events occur. Communities may continue to favour changes which do not interfere with social values until sense of place is threatened from natural as opposed to anthropogenic forces i.e., threats from extreme events rather than anticipatory changes initiated by institutional authorities. Understanding residents' environmental perceptions toward change early in the adaptation process is therefore crucial because it potentially impacts on attachment to place, which might serve to identify latent social values early in the adaptation process. For challenges related to continued reliance on technical expertise and investment at the expense of other knowledge

forms, barriers may be overcome by altering governance and institutional systems to embrace inter-disciplinary knowledge. This may facilitate a move from rigid path dependencies that lock-in the range of available options for future generations to more transformative agendas.
Finally, where institutional policies are an impediment to deliberative governance processes, improving perceptions of public participation may require looking beyond statutory practices to embrace more innovative means of dissemination and consultation e.g. through utilisation of modern technological means.

Summary

Societal support for adaptation measures should not be assumed in areas exposed to extreme weather events, and place attachment can act as a significant barrier to adaptation

Identifying and understanding latent social values and concerns early in the adaptation process is crucial if adaptation is to progress effectively and efficiently

Flood risk management practices nationally favour technical expertise and solutions at the expense of local forms of knowledge

Current approaches to public participation are not perceived as fair or transparent. Overcoming this challenge requires moving beyond statutory means of communicating by utilising a range of technological resources to enable deliberative consultation.

Further reading

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View 1. Top: existing view of Clontarf promenade along Oulton Road. Bottom: proposed flood defences and view of Clontarf promenade along Oulton Road. Credits: Dublin City Council

View 2. Top: existing view of Clontarf promenade along Fortview Avenue. Bottom: proposed flood defences and view of Clontarf promenade along Fortview Avenue. Credits: Dublin City Council

Rotterdam flood protection

Dakpark (rooftop park) Rotterdam is a multi-functional dike in the middle of the harbour area of Rotterdam, which lies in front of one of the most densely populated neighbourhoods of Rotterdam. The dike is a primary flood defence structure along the river Meuse. The dike has been integrated with a shopping mall and a park for the residents of the neighbourhood behind the dike. The Dakpark is 1,200 m long, 90 m wide, and consists of eight hectares of traditional park (grass, trees, playground, water steps, BBQ places, etc.) on top of the dike and shopping mall. High pressure from the surrounding residents to create new green space was key to the emergence of the stapling of land-use functions in the project: the neighbourhood is densely populated, rather deprived (crime, drugs, prostitution) and lacks green space. This led to the idea to create a park on top of the shopping mall, and to integrate the park and the building with the existing dike and infrastructure for district heating. Dakpark is a frontrunner of multifunctional land-use, and one of the first multifunctional dikes in the Netherlands. Plan development started in 2000, and the park was officially opened in December 2013. It has been a highly complex project with multiple different professional stakeholders from the public and private sectors. Also the residents from the surrounding neighbourhoods have been actively and intensively involved in various stages of the project. Project duration has been very long (≈ 15 years) due to various hick-ups between stakeholders with conflicting interests, but also due to the financial crisis.

Planning

Planning of the project commenced by the municipality of Rotterdam at the end of the 1990s. Residents were involved from 2000 onwards; the project developer of the shopping mall from 2001 onwards. A project team was created consisting of municipal officers, a group of residents and the project developer. In particular, residents influenced the design of the park, for which they developed eight so-called commandments that acted as check mechanisms for the design of the park. In the first two years, a group of 4-6 highly active citizens were part of the project team. Later on, the citizens were professionally represented by a social NGO, consisting of a few former community workers, who acted and decided on their behalf in the team. It was agreed in the project team that a neutral professional would be better able to represent the views of all citizen groups, as this person was very active in contacting and engaging a variety of citizen groups in the surrounding neighbourhoods including ethnic minorities. In addition, direct interactions between the municipality, the project developer and the residents took the form of ateliers, workshops, "Dakpark cafés" (information sharing events), joint group excursions to other parks, and other events. The water authority was also involved in the planning phase. It did not want the building and park to interfere with the dike because this might put the water safety of the area at risk. Therefore, the water authority was reluctant to move or integrate the dike, and was not open to the idea of designing and using the building as part of the dike system for retaining water. Ultimately, the water board utilized its legal authority to keep the dike as is. Therefore, the building and park were built across the dike, and interfered with the protection zone of the dike as little as possible.

Rotterdam flood protection: The Dakpark. Credits: Google Earth

Implementation

The planning and implementation of the project took a long time. The shopping mall was completed in 2012, and the park on top of the mall at the end of 2013. Residents were less involved in the implementation of the project. In this phase the municipality and the project developer were the main actors, and they had long negotiations; the development of a public park on a private building is very new and resulted in many efforts put into legal arrangements to settle responsibilities and liabilities between the municipality and the project developer. After completion of the park, residents united themselves in a foundation ("Stichting Vrienden Dakpark") to organise their participation in the maintenance and oversight of the park in the managing phase. In the managing phase there is regular interaction between the residents' foundation, the gardening company and the municipality (city management department) to discuss which tasks the residents take on themselves in the maintenance of the park.

Challenges

Several interrelated barriers arose to different aspects of the project and in different phases of the project.

Overall, there were quite a number of barriers to the continuation of the project (there were several stand stills). Some were social-cultural in nature: (1) different interests of stakeholders that were difficult to reconcile for a multifunctional project, resulting in several clashes (between the water authority and the municipality regarding the interfe-

rence between the dike and the park; between the municipality and the project developer regarding the interference between the shopping mall and the park); and (2) the need for continuous cooperation among stakeholders, resulting in high transaction costs and the blurring of responsibilities. Some were technical in nature: issues with land erosion, damage to the district heating pipes during construction of the park, design failures of the park (limited accessibility of the park and green house). Some were resource related: the construction of a park on a building requires additional investments (heavy constructions, provisions against leaking etc.), and financial resources are limited.

There were several predominantly social-cultural barriers to the involvement and participation of residents in the project. The fragmentation of the municipality into several sectoral departments and lack of an integrated vision made it difficult for residents to know and understand who to approach for what and how things work within the municipality. Furthermore, there were many changes in personnel in the municipality: over the course of 15 years there were four different project managers. Each project manager has his/her own style and values when it comes to involving residents. Some are less participatory than others, and this leads to different styles of interactions with residents, which led to frustrations among residents on a number of occasions.

Recommendations

Based on the learnings and findings of this project, the following recommendations are formulated:

Development of a business case: involvement of the private sector, sponsoring, monetizing the effects of the enhancement of social cohesion in the community, and of the personal growth of residents. Subsidies for such initiatives are good to start the project, but a business case is needed for the long term. It should be possible to move budgets from one municipal department to the other (social care gives money to green care because of the enhancement of the social cohesion).

Professional base to support residents groups: use a professional to facilitate interaction with all different residents groups. Hire a few residents as professionals to manage the group/foundation of residents. Have one contact point within the municipality for residents to provide some basic support and exchange of information and ideas.

Give the residents ownership and responsibility in the form of mandates and budget to do their thing. The municipality can provide the overall guidelines and monitors whether these guidelines are respected. Nail responsibilities and budgets down in a contract.

Summary

The project is a show case for relatively well organized residents' participation, and hence a relatively high influence of residents on the project (design of the park).

The key drivers of the project are (1) The availability of financial resources; (2) persistent policy entrepreneurs, and (3) residents' pressure (instrumental to the initiation of the multi-functionality of the project).

The key barriers are (1) The fragmentation and silo-thinking within the municipality, and (2) The clashing of multiple interests from multiple stakeholders.

Dakpark Rotterdam is a relatively successful project. It has achieved its main goals; the outcomes of the project are quite well accepted; responsibilities are clear and the decision-making process has been quite participatory and transparent; the residents have had considerable influence on the design of the park, and the social capacity of the residents has been raised.

The major failure of the project is that it has not been efficient, mainly due to high transaction costs and lack of synergy effects from the combinations of functions.

Further reading

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Rooftop park after completion. Credits: S. Brakkee

Rooftop park Rotterdam. Credits: S. Fuchs

Tiel pluvial flood protection

Water Square Tiel is a public square which also functions as water storage in times of (heavy) rainfall. The water square is situated in a working class neighbourhood in the town of Tiel. The neighbourhood deteriorated over the past years and was in need of urban renewal. In this process of urban renewal, several issues needed to be solved such as the water nuisance issue. The idea of a water square in this area was already incorporated in a planning document written by the water board and the municipality. The water square together with other solutions, such as less paved (public) space, drainage systems in the streets, lifting the new housing constructions, would solve the water nuisance issues by improving the water storage capacity of the neighbourhood. The square includes four water basins: one big basin that also functions as sport court and the smaller basins are used for transportation, additional storage and infiltration of water. 'De Urbanisten' designed the water square and have incorporated only natural processes in the design to collect and transport the water (e.g. high and low topography to stimulate free fall of water, so no electric pumps or devices). In total, the water square is to store 550 cubic meters of rainwater.

Planning

Between 2007 and 2016, the municipality has invested time and money to improve the neighbourhood and with that the implementation of the water square. The province supplied a slush fund to invest in solutions for the water issues after several development plans were blocked. The municipality worked together with the local community (residents and primary school), housing corporations, water board and urban designers. Remarkable is the intensive communication with the residents via survey, 'at home' interviews, public hearings and newsletters; and the involvement of schoolkids in the design of the plan. 'De Urbanisten' wanted input from residents on how to design the water square. For this the input of schoolkids was asked as the water square is situated next to a primary school. In a fun design assignment, kids were able to explain what kinds of play and colours needed to be incorporated in the design. This led to a final design that was implemented in 2016.

Tiel flood protection: The Water Square. Credits: Google Earth

Implementation

The water square has dealt with delays and multiple changes in the design, but in the end, the plaza got implemented and solves (together with other measures: additional drainage and permeable streets) the water issues in the neighbourhood. The outcome of the project is largely accepted. Responsibilities were mostly clear throughout the process and the decision-making was participatory and transparent. The residents could influence the urban renewal process, but were shy in doing so. The schoolkids was therefore a relevant input for the designers of the square. Overall, the goals are met and the outcome is considered legitimate by the residents.

Challenges

During the initiation phase there were no big barriers blocking the water square. In the planning phase, the main barrier was that the size of the water square was altered because the primary school had decided first decided to go, but then decided to stay on its location. This translated in new barriers such as delay and problems with meeting up the expected water storage standards. The implementation phase dealt also with delay because it took some time to relocate the current users of the building that was on the square before the water square. After this was arranged by the municipality, it was possible to demolish the building and start construction of the water square.

Some specific barriers can be identified in relation to residents participation. While the municipality had spent much time to connect with the residents over the problems and solutions for the urban renewal, but the residents were not all willing to spend time on giving input. Due to this, the municipality did not want to push for more public participation specifically for the design of the water square. 'De Urbanisten' then decided to involve the schoolkids for input. Nevertheless, the municipality and 'De Urbanisten' organized two more public meetings to communicate the design of the water square to the residents, but these sessions had low attendance. This could possibly be explained by the social capabilities of the residents, but also the planning of these public meetings is of importance as planning during an important national soccer match might influence the number of attendance.

Recommendations

Based on the learnings and findings of this project, the foll-

Because the water square was part of a larger urban renewal program, it had to deal with changes in the larger plan which resulted in delays. However, being part of a larger plan, made it possible to find synergies in use and to secu-

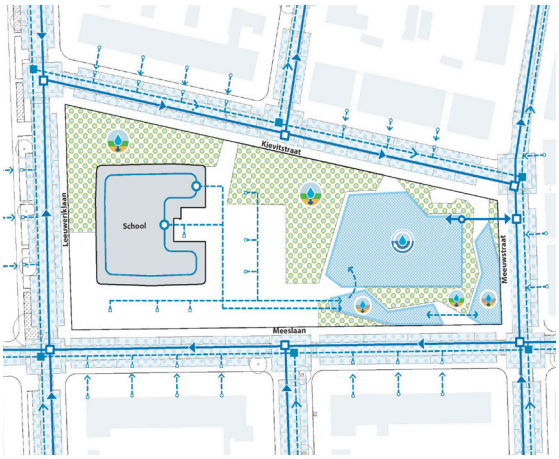
re implementation. Hence, mainstreaming the measure in planned spatial programmes can be beneficial.
Besides it is important to acknowledge that the strength of the water square is that is combines multiple spatial functions: public space for play, encounter and green, with water storage capacity. This way it is easier to sell a measure to residents and politicians as it not addresses one purposes, but multiple.
The project does and does not stand out in terms of resident's participation. Asking input from schoolkids for the design of the water square was fun and innovative, but the project also indicates how difficult it can be to involve residents in planning processes. Some lessons for public participation that can be extracted from the case are that (1) it is important to invite residents on time and through various channels otherwise only a limited group of residents shows up, and; (2) in case that residents are not eager to participate, a contact person should still be available and recognizable for the residents.

Summary

The water square was part of a larger urban renewal project. Solving the water issues in the neighbourhood would assist further urban development and increase liveability.
The municipality spend much time in public participation at the beginning of the urban renewal project, but they also realized that no more input would come from the residents and that it was time to focus on implementation.
Residents were not necessarily eager to participate in public participation processes. The actual planning of public hearings and the social capacities of residents can be explanatory factors for limited willingness to participate.
The water square is an innovative measure as it combines multiple uses (encounter, green, play, water storage) and could be transferred to other European cities.
The water square is designed in such a way that it is low in maintenance as there are no electric pumps needed.

Aerial view of Tiel Water Square. Credits: J. Bouwhuis

Ground view of Tiel Water Square. Credits: J. Bouwhuis



Plan of Tiel Water Square. Credits: De Urbanisten

Ground view (detail) of Tiel Water Square. Credits: J. Bouwhuis

Kockengen waterproofing

Kockengen Waterproof is a project to make the village of Kockengen more resilient to flooding in 50 years' time. The village of Kockengen (3,000 citizens) has a history of surface water flooding from land subsidence (the rate of land subsidence is 2-4 cm/year) and heavy rainfall. In the recent past streets in Kockengen have regularly flooded, sometimes for several days in a row, disrupting social life in the village and causing material damage to houses and to agricultural land. The damage to houses from the most recent and serious flooding event (July 28th, 2014) ranges from € 10,000 to 100,000 per house, most of which has been covered by insurance (in the Netherlands damage from pluvial flooding is covered by home insurances, as opposed to damage from fluvial flooding which cannot be insured in the Netherlands). The damage to agricultural land is not exactly known, but several farmers have filed a claim of € 200,000 with the water authority. The project has its origin in 2012, when the municipality decided that a more profound solution was direly needed, instead of the incidental elevation of several roads in the village which was the practice until then. Together with the water authority and the Province, the municipality developed a program to elevate the ground level of the public space (streets and green space) by approximately 60-80 cm with lightweight material for a large part of the village, a project carried out in 10 stages between 2014 and 2024. In order to make multiple use of the street renovations, the public space and infrastructure were renewed and enhanced following the specific demands from residents.

Planning

In 2013 the three public authorities (the municipality, water board and province) signed a contract in which they agreed on a common goal, the terms of their cooperation, and the division of responsibilities and costs. The municipality instigated a sounding board group Kockengen Waterproof in 2012, consisting of several representatives of the private interests in Kockengen. The sounding board group gives solicited and unsolicited advice to the three public authorities regarding the program. In terms of involvement of residents, several different participation forms have been used, depending on the nature of the occasion. In the planning phase of the program three Climate Ateliers were organised, in which residents participated alongside experts to brainstorm about potential solutions to the recurring surface water flooding issue.

Kockengen, the Netherlands. Credits: Google Earth

Implementation

In October 2013 and July 2014 two major flood events occurred from heavy rainfall. In particular the July 2014 event caused calamities and considerable damage. These events have accelerated the start of the implementation of the elevation (by mid-2017, two neighbourhoods have been elevated). In the implementation phase the municipality issued several newsletters to keep the residents informed. They also created a project office, open to the public one day per week, where residents could go to ask questions or get information. The municipality has also organised several traditional information sharing events for the residents whose neighbourhood is being elevated. A big information meeting was organised by the municipality and the water board in September 2014 after the shock event of July 2014 to deal with the public unrest among the residents of Kockengen. It turned out to be an event in which the residents blew off steam, because they felt neglected by the public authorities. Both the municipality and the water board have put considerable effort into communication and information sharing with the residents, particularly after the July 2014 shock event.

Challenges

Several, mainly political barriers arose to different aspects of the project and in different phases of the project. One important barrier to the initiation of the project has been the lack of political commitment. It took a long time (2006-2014) before there was sufficient political commitment for spending a considerable budget for elevation. The considerable investment was mainly a barrier before the shock event of July 2014.

Another important barrier to the implementation of the project has been the conflicts of interest among different stakeholders in Kockengen arising from multiple differential claims on water. Several residents need high water levels (to preserve the wooden foundations of their houses). Other residents want lower levels to avoid street flooding. The farmers in the area surrounding the village need low water levels for their agricultural business. The nature conservation NGO would like high water levels for the same agricultural land.

Another important barrier is the tenability of the water level management system in the near future. The tendency is to focus on the visible issue of wet feet, and to solve this

issue with short term technical measures, rather than looking at the long-term perspective of the region (e.g. transition towards new functions), and questioning the long-term viability of the village. This short-term myopia is aggravated by the recent shock events.

Recommendations

Based on the learning and findings of this project, the following recommendations are related to residents participation, as one of the main issues of this case study:

As municipality, be open and transparent about how decisions have been made, and how/to what extent the input of residents (represented by the sounding board group) have been taken into account;

Let residents have actual influence on several key decisions that directly affect them; and be clear about which key decisions are the territory of the public authorities/experts;

As public authorities, communicate with one voice to the residents.

Summary

The key drivers of the initiation of the project were the urgency of the problem, accelerated by climate change, while the occurrence of 2 major shock events were the key drivers for the acceleration and continuation of the program. The key barriers are the clashing of interests, and troublesome communication from the side of the public authorities with the residents which are hampering the participation of residents in the program, and hence their influence on the key decisions that affect them.

Kockengen Waterproof has been encountering several legitimacy, social justice and social capacity issues stemming from a lack of trust and troublesome relationship between the residents on the one hand, and the municipality and the water board on the other hand.

Further reading

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Flooded streets in Kockengen after the heavy rainfall of July 2014. Credits: G. Kleinveld

Elevated street after reconstruction. Credits: G. Kleinveld

The planning of the elevation of the public ground in the village. Credits: www.kockengenwaterproof.nl

Construction of street elevation. Credits: G. Kleinveld

Lessons learnt

Transformation is often characterized by non-linear changes or departure from the status quo. Climate change is expected to increase flood risk across much of Europe, indeed changes in the timing of floods as a consequence of human caused climate change has already been detected. TRANS-ADAPT has resulted in a substantial empirical assessment of how transformation is happening in flood risk management in four European countries (Austria, France, Ireland and the Netherlands). Our case studies highlight innovations in flood risk management that are serving to increase the resilience of vulnerable communities. A key challenge then, is to distil our key learnings and recommendations from across case studies, so that such innovations can inform other locations and jurisdictions.

Our analysis finds that what constitutes transformation is context specific. Whilst the Netherlands has a long history of managing flood risk through multiple land-uses, such approaches are only emerging in other jurisdictions. Who and what is transformed is also case specific. Multi-use flood protection, for example, can be transformative for flood risk management governance structures, but it can also be transformative for communities involved. We find that demands for novelty arise from issues including (1) lack of funding, legal protection and space, (2) communities demanding increased input into planning/implementation, and (3) blurred boundaries between public and private spaces and responsibilities.

Across our case studies it is worthwhile pointing out that it is the combination of changing flood risk with other societal pressures that is driving transformation in flood risk management. For instance, in Le Mans (France) and Rotterdam (The Netherlands), changing flood risk, in tandem with a desire for better urban environments, that enhance community wellbeing, were key motivating factors. In these cases, urban communities with high levels of social problems and historically deprived of greenspaces for sport, recreation and leisure, were successful in disrupting the traditional approaches to flood risk management, resulting in two case studies that are leading the way in community led, multiuse flood defences. On the other hand where attempts at multi-use approaches failed, such as in the case of Skibbereen (Ireland), the dominant voice of the business community was for a simple, traditional, single function, engineered flood defence, rather than a multiuse flood park. Interestingly, this was a more rural setting where access to land is not problematic and the single objective of the community was flood risk reduction. Where successful, we find that multifunctional protection schemes provide multiple benefits through reducing pressure on limited land and thus mitigation of land use conflicts. They can also attract investors, providing new financial resources to com¬plement scarce public finances.

Across all of our case studies attempts at transformation were undertaken during 'windows of opportunity', typically after the occurrence of a major hazard event. For example at Pfunds (Austria) deliberations commenced following the floods of 2005, similarly in Le Mans (France) attempts at change commenced following flooding in 1995. Where a window of opportunity did not exist, i.e. a recent flood had not happened (e.g. Clontarf (Ireland)), attempts at transformation were stifled by conflict between the local government and communities.

When a window of opportunity appears successful transformation still depends on a key individual or group that act as an agent of change or a policy entrepreneur. For instance, in the case of Pfunds (Austria) this was the local major, in Le

TRANS-ADAPT has resulted in a substantial empirical assessment of how transformation is happening in flood risk management in four European countries (Austria, France, Ireland and the Netherlands). Flooding in August 2002 in Emmersdorf/Danube, Austria. Credits: Austrian Armed Forces

Innovation in natural hazard risk management that are serving to increase the resilience of vulnerable communities are needed. A key challenge is to distil our key learnings and recommendations from across case studies, so that such innovations can inform other locations and jurisdictions. Rescue operation after the Galtür 1999 avalanche events. Credits: Austrian Armed Forces

Mans (France) it was the local community. In each successful case the policy entrepreneur maintains pressure on government agencies for change and takes a leadership role in communicating between communities and government agencies. In all cases, success at innovation and transformation is predicated on institutions involving and activating the public in planning and implementing flood risk policies in both public and private space. This requires a transformation of governments' (facilitation) and the public (taking and keeping charge). However, even where flood management is heavily top down, opportunities exist for local stakeholders. Identifying and understanding latent social values and concerns early in the adaptation process is crucial if innovation is to progress effectively and efficiently.

'Community-based' initiatives are still dominated by local governments (municipalities) as the key actors, initiators and decision-makers. Institutionalization enables a clear allocation of responsibilities to local governments and causes a legal obligation to involve residents in these kinds of initiatives, but this is a quite basic form of participation (information sharing and consultation). The cases show differences in willingness to participate by the residents. This can be explained by differences in social capacities, and by differences in facilitation from the side of the local governments. The influence of residents, resulting from participation, is often limited to the design of the adaptation measures. In the analysed cases residents did not have any influence on the selection of the measures themselves.

Increasing the participation of communities is key to realising the benefits of multiuse flood defences and other innovations in flood management. Priority should be given to identifying ways to increase residents' participation beyond consultation and information sharing, towards co-creation of flood solutions. This could be through hiring of people with specific skills or use existing community managers who are already familiar with the neighbourhood patterns and social structures.

Where efforts at novelty have failed, barriers include: (1) social and cultural values (communities and institutions); (2) institutional reliance on technocratic approaches above valuing local knowledge; (3) institutional regulatory practices and (4) failure of public participation. Taken together, these cases offer valuable empirical insights into the process of transformation and an opportunity to learn from empirical examples of what works and doesn't when it comes to transformative approaches to flood management.

Mitigation beyond technical approaches is needed to foster societal transformation in hazard risk management. Credits: S. Fuchs

Contributors

- **Mathieu Bonnefond** is Assistant Professor in Land Planning and Environmental studies at the National Conservatory of Arts and Crafts, Graduate School of Land Surveyors and Topographers, Le Mans, France. E-mail: mathieu.bonnefond@lecnam.net. He is the coordinator of the 'Land Tenure' group in the Geomatic and Land Tenure Laboratory – G&F and Co-Director of the team "Zone Atelier Loire", a French interdisciplinary network for long-term environmental research on human-dominated landscapes. He carries out studies on the link between river management, environmental policies and regulations.
- **Darren Clarke** is a PhD candidate and an environmental social scientist in the Department of Geography at Maynooth University. E-mail: darren.clarke@mu.ie. Darren's research interests span disciplines such as climate change adaptation, environmental governance, flood risk management and environmental psychology. His work extends on existing understanding of the challenges societies and governments face in adapting to climate change.
- **Peter Driessen** is Full Professor of Environmental Governance with the Copernicus Institute of Sustainable Development, Faculty of Geosciences, Utrecht University. E-mail: p.driessen@uu.nl. His research contributes to the scholarly and political debate on sustainability governance, by analysing interventions that have the potential to make governance outcomes more congruent with sustainability goals.
- **Marie Fournier** is Assistant Professor in Planning and Land Management at the Ecole Supérieure des Géomètres et Topographes (ESGT/CNAM), Le Mans, France. E-mail: marie.fournier@lecnam.net. Her research focus is on various environmental public policies both at French and European levels.
- **Sven Fuchs** is Senior Scientist at the Institute of Mountain Risk Engineering at the University of Natural Resources and Life Sciences, Vienna, Austria. E-mail: sven.fuchs@boku.ac.at. His research interests include mountain hazard risk management, the study of coupled human-environment systems and vulnerability assessment for natural hazards.
- **Amandine Gatien-Tournat** was contributing as a member of the François Rabelais University, Tours, France, to TRANS-ADAPT. She is currently a Senior Consultant at Auxilia. E-mail: amandine.gatien@auxilia-conseil.com. Her fields of research are rural geography, agronomy, farming systems economics and rural policies.
- **Mathilde Gralepois** is Assistant Professor in Planning and Local Governance at the Planning and Environment Department of the François Rabelais University, Tours, France, and in the laboratory center UMR 7324 CITERES (Cité Territoire Environnement Société). E-mail: mathilde.gralepois@univ-tours.fr. She is an expert on local governance in risk prevention and mitigation strategies and civil security transformation.
- **Dries Hegger** is an Assistant Professor at the Environmental Governance Section, Copernicus Institute of Sustainable Development, Utrecht University. E-mail: D.L.T.Hegger@uu.nl. His research contributes to the study of modes of environmental governance and their relationship with sustainable development.
- **Heleen Mees** is an Assistant Professor in Local Sustainability Governance at the Copernicus Institute of Sustainable Development of Utrecht University, the Netherlands. E-mail: h.l.p.mees@uu.nl. She is an expert in urban climate change governance. Heleen's research interests are in urban governance issues, including topics such as: (shifts in) governance modes, divisions of responsibilities, democratic governance (legitimacy and accountability) and participation and coproduction of citizens.
- **Conor Murphy** is a Senior Lecturer in the Department of Geography at Maynooth University. E-mail: conor.murphy@mu.ie. His research interests includemodelling climate change impacts, quantifying uncertainty and exploring how uncertainty in future impacts can be integrated into decision making, detection and attribution of climate change signals from observations and the reconstruction and analysis of long term records of key climate variables, and understanding the social dynamics of adaptation to climate change.
- **Sylvie Servain** is Full Professor of Geography in the Graduate School of Landscape Architecture (INSA Centre Val de Loire), Blois, France, and in the laboratory center UMR 7324 CITERES (Cité Territoire Environnement Société). E-mail: sylvie.servain@insa-cvl.fr. Her research interests are strongly related to landscape, vulnerability and flood risk management.
- **Thomas Thaler** is a Research Fellow at the Institute of Mountain Risk Engineering at the University of Natural Resources and Life Sciences, Vienna, Austria. E-mail: thomas.thaler@boku.ac.at. His research interests include to policy issues in mountain hazards, focusing on national risk management and related policies strategies in different European countries.
- **Caroline Uittenbroek** is a Research Fellow at Copernicus Institute for Sustainable Development at Utrecht University, The Netherlands. E-mail: C.J.Uittenbroek@uu.nl. Her research interests include environmental policy integration, urban governance and water management in the changing context of climate change.
- **Martin Wenk** is a Research Fellow at the Institute of Mountain Risk Engineering at the University of Natural Resources and Life Sciences, Vienna, Austria. E-mail: martin.wenk@boku.ac.at. His research interests include the cartographic representation of risk and spatio-temporal statistics.

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