

INTEGRATING CLIMATE CHANGE ADAPTATION AND URBAN PLANNING IN KARLSTAD, SWEDEN

Nebojša Čamprag¹

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***Summary:** Building urban resilience is an extremely complex task, highly depending on given circumstances. Each specific constellation of risks requires corresponding solutions, which illustrates at its best the complexity of the tasks that local urban planners and policy makers are facing today. Understanding and learning from different successful cases could be a way for the planners to learn how to deal more effectively with specific situations. In addition to understanding its complexities, this article sets its focus on challenges for building urban resilience in Europe through the example of the Swedish most vulnerable city, where the most topical issue of climate change adaptation is successfully being implemented through its integration with planning policy.*

Keywords: Urban resilience, climate change adaptation, urban planning, Karlstad

1. INTRODUCTION

Some of the greatest global challenges of the 21st century on the one hand involve rapid urbanisation occurring with unprecedented scale, while on the other hand refer to the multiple effects of unpredictably changing climate. Complex links between the two are getting clearer when acknowledging that directions for future development of cities could directly reflect their capacities to absorb and recover from disastrous events. Carefully planned resilience building not surprisingly already became an important matter for many communities all over the globe. However, despite the high awareness about its significance, building resilience surely is not an easy task for many reasons – on the one hand, cities are extremely complex systems, while on the other hand, any intervention affecting adaptability of such systems inevitably must take into consideration a variety of local factors and their interconnections. Therefore, understanding the extremely complex nature of urban resilience, along with learning from experiences in this field by many affected communities all over the world seems to be a way towards more effective implementation of this concept in the future.

Building urban resilience is usually a long-term process extremely depending on the variety of temporal, spatial, natural, social or economical factors and their interconnections – all of them, as previously mentioned, strongly influenced and shaped by specific local circumstances. In the contemporary processes of resilience building,

¹ Dr.-Ing. Nebojša Čamprag, Technical University of Darmstadt, Faculty of Architecture, Department of Urban Design and Development, El-Lissitzky-Str. 1, Darmstadt, Germany, tel: +49 (0) 6151 16 22162, e – mail: camprag@stadt.tu-darmstadt.de

city officials and associated institutions are considered to be the key players. Current trends are generally in favour of locally based approaches that proved to be more effective, with high efforts in many countries to decentralise decision making and shift authority from national to local governments. Aside many benefits of such an approach, there are still quite a lot of challenges to be properly addressed. Some of the most topical are surely related to local land use regulations – especially in developing countries – which are often manipulated by real-estate investors, resulting therefore in the creation of economic benefits for some of the population, rather than social, cultural or environmental benefits for all [1]. Equally important challenge concerns establishment of appropriate and relevant hazard database. Highly complex issues of climate change adaptation require relevant data to create useful risk maps and base legitimate decisions on them, but also involve the challenges of dynamic and mutual collaboration between great varieties of stakeholders involved. Even after optimal development plans are once finally established, there are often difficulties regarding their implementation and financing. This paper therefore deals with the mentioned issues through the specific focus on a case study in European Union (EU), in order to find out by which means one of the most powerful politico-economic union finds ways to deal with multiple challenges of making cities resilient.

2. URBAN PLANNING AS A TOOL FOR MAKING THE EU CITIES RESILIENT

According to the European Environment Agency [2], between 1998 and 2009, Europe suffered over 213 major damaging floods, causing some 1126 deaths, displacement of about half a million people, and at least 52 billion euro in insured economic losses. Unfortunately, Europe is in the coming decades likely to face even higher flood risk, and consequently greater economic damage. Therefore, the challenges associated with climate change and response through water management and planning are already recognized as highly important issues in the EU zone, although not without difficulties in their implementation.

European Commission set frameworks for dynamic transnational and interregional cooperation in this field by the Floods Directive 2007/60/EC, proposed on January 2006 and finally adopted in November 2007 [3]. The main aim of this directive, which applies both to inland waters and to all coastal waters across the whole territory of the EU, was to reduce and manage all the risks that flooding represents to human health, environment, cultural heritage and economic activities. The first step in achieving these goals was to identify the river basins and associated coastal areas at risk of flooding by 2011, which was required from all the member states. The next step involved drawing up of flood risk maps for such zones by 2013, followed by establishment of flood risk management plans focused on prevention, protection and preparedness by 2015. Although the steps and actions to be taken in order to shift from mere flood control towards flood risk management were clearly defined, the implementation of the Flood Directive faced a number of challenges. Most of them were related to the scarce information on which methods and tools should be applied in order to fulfill the requirements. In addition, there was also the necessity to coordinate implementation of

the Flood Directive with other plans and documents, such as the most significant Water Framework Directive WFD- 2000/60/EC. Therefore, in order to support efficient and effective implementation of the two directives, as well as to enable involvement of all relevant stakeholders, of great importance were the so-called integrated strategies, mostly based on interregional cooperation, such as the EU-funded SAWA project, launched in 2008 [4].



Figure 1: SAWA partner countries with affected areas (l), and pilot-cities in Sweden (r)

Source: <http://www.sawa-project.eu>, 2016-02-28

SAWA stands for Strategic Alliance for Integrated Water Management Actions that gathers five member states of the North Sea region: Norway, Sweden, UK, the Netherlands and Germany (Fig. 1). The common task of the partner countries was to adapt existing water management systems to the effects of extreme flood events due to climate change, focusing on sustainable development of society and regional economies [5]. In the initial phase, flooding and risk maps for the involved pilot-cities were developed, followed by evaluation of the conditions and tools available to county administration and local authorities. However, when it came to implementation, even the strategy of integrated approach faced challenges of its own. First of all, the risk maps that according to the Floods Directive aimed to describe the social, economic and environmental consequences of flooding were criticized by the SAWA report as they failed to address the effects on important community infrastructure and services, such as electricity, water and sewage, healthcare and welfare, or impact on important transport routes [6]. Other major difficulties that this model of interregional cooperation faced were mostly caused by the intensive attempts to find *one* common strategy that would be applicable to all the pilot regions. This was highly questionable, due to considerable variations in the flood conditions of the region, ranging from riverine floods in small urban catchment in Hamburg, Germany, to lake floods affecting great parts of urban environment, such as in Karlstad and Lidköping in Sweden. As a final solution for the number of challenges, the SAWA report finally evaluated common approach for

development of flood risk management plans across Europe as inappropriate, due to high variety of flood typologies and national contexts. Based on these newly defined standpoints, six different flood risk management plans (FRMP) and one river basin management plan (RBMP) have been developed since for different pilot regions of the SAWA project. In addition, coordinated activities and contributions of responsible authority, research and consultancy were named crucial for successful design and conduction of the planning process. Due to the initial difficulties with implementation of the SAWA project, flood risk management planning was newly approached as a process that requires both enough time and involvement of all key stakeholders [4].

3. THE CASE OF KARLSTAD, SWEDEN

Besides many differences in the current flood management strategies of the north European countries, among the SAWA-pilots only Norway and Sweden took climate change into consideration when producing flood and risk maps [4]. Karlstad, as one of the three pilot-cities in Sweden, generally proved to be an example of advanced integration of both flood management and climate change adaptation into urban planning policy, and for this reason its example will be further analysed.

Karlstad Municipality is the most important and the most populated area situated around the lake Vänern, which stands for Sweden's largest lake and the third largest lake of Europe. City of Karlstad is both the seat of the homonymous municipality and the capital of the Värmland County, at the same time being its largest city with nearly 87,000 inhabitants as of 2012. Besides northern shore of the lake Vänern, its territory also occupies a delta area prone to erosion and sedimentation by the Sweden's longest river, Klarälven, running into the lake. Klarälven River is the lake's most important supplier, while the significantly smaller River Göta represents its rather limited outlet, which results in an unfavourable situation of the inflow to the lake being far greater than its outflow. Therefore, the major flood risks for Karlstad and for the settlements nearby involve both the lake Vänern and the river system discharging into the lake, associated with fluctuations of ground and surface water. The highest potential risk is associated with the spring snowmelt flooding in April/May, although the most serious flooding so far actually occurred in autumn/winter 2000/2001 and was caused by intensive and prolonged precipitations. Although the prime risks factor at present is the river itself, risk of flooding by the lake is increasing in the long-term period. Equally important risk involves the surrounding flat relief, due to which even the slightest increase in the water level could claim considerable land. Under such conditions, the city of Karlstad is the Sweden's most affected city by the flooding hazard (Fig. 2).

Dealing with the flooding risk in Karlstad is generally a highly complex task, facing serious problems and challenges from its very initial phases. Some of them involved conflicts with the company that produces hydroelectric power at the outlet of the lake, as well as some environmental and ecological issues – all of them, however, caused by the idea of lowering the level of the lake in order to avoid dangerously high levels in a flood risk situation. There were also other significant issues, such as the riverbed of the Göta River being highly sensitive for landslides. This implies that the outflow of the lake couldn't be simply increased in order to minimise flooding risk, without simultaneous increase of the risk of landslides. Such a delicate situation forced decision-making

authorities to temporarily accept the extensive damage occurring along the shores of the lake, rather than to take the more serious risks for human lives that increasing the flow of the Göta River could bring. Similarly, the ideas to store excessive water in reservoirs also showed up not to be the proper solution [4]. Other local adaptive flood mitigation measures involved possible dredging of the Klarälven River, for which an extensive study was made. As a part of the SAWA-project, Sweco consultancy office and the city of Karlstad made the Environmental Impact Assessment (EIA) in order to assess the impact of such extensive interventions in the western part of the river delta. The results showed that groynes wouldn't have desired effect, while dredging indeed showed up more potential for lowering the flood risk. However, the study also showed some possible environmental consequences on ecosystem of the river and ongoing delta formation, in case of implementation of the proposed measure [7].



Figure 2. Karlstad, aerial view

Source: Översvämningsprogram Karlstads kommun, 2010, p. 1

A look back to the chronology of addressing the growing flood risk problems in the Municipality of Karlstad reveals the early strategy of 2007, which initially involved appointment of the flood risk management coordinator, followed by the decision for a complete, custom-made flood protection programme. Thereby, priority of the city officials became disaster risk reduction on the level of the whole municipality, both in short- and long-term periods, involving a comprehensive overview of the complete flooding challenge, evaluation of the probabilities and consequences of flooding, and making clear what measures need to be taken. The initiative also involved preparation of the flood maps, with effects of climate change taken in consideration (Fig. 3). Being a comprehensive task, creation of the flood protection programme needed to be based on extensive and relevant investigations, data collections, and risk and vulnerability assessments. In addition, cooperation between municipalities, as well as sharing experiences and knowledge on the national level was also an important issue. For these purposes, workgroups with representatives from different departments within the municipal organization were created. Stakeholders were the County Administrative

Board, some private construction and civil engineering companies, representatives of an insurance company, and researchers from Karlstad University. In some cases the road authority was also invited, as well as the responsible authority for the central hospital, due to its vulnerable position. There were also few representatives of the local interest groups and some political parties [8]. Guiding principle of high importance for the whole region was that the county's vulnerable capital city maintains its functions even during flood events. The workgroups therefore set their focus primarily on the results of investigations that revealed the "100 year" flows in the Klarälven representing a higher risk than the equivalent event in the Vänern. Considering the perspective of spatial planning, it was decided that a 200-year return event in the Klarälven should be a relevant hydrological starting scenario. Based on the results and requirements of both the workshops and scientific investigations, the mission to develop the flood protection programme was finally given to the department of Technical Management and Housing. The department was supported by several other municipal departments and bodies, such as departments for city building, environment protection, rescue services, municipal energy company and the municipal power line company. After approximately one year's work, a draft program was ready, which was then referred back to all participants and other institutions and authorities of both regional and national importance for further consideration. The final result was the Flood Risk Management Plan, completed and finally embraced by the City Council in 2010 [8].



Figure 3: Map of Karlstad based on performed laser scanning, showing a 100-year flooding with the effects of climate change and extreme winds taken in consideration

Source: Översvämningsprogram Karlstads kommun, 2010, p. 26

The Flood Risk Management Plan contains a collection of different information regarding climate change and their possible effects on the city of Karlstad. It also defines responsibilities on the local, regional and national level, and establishes guidelines for urban planning process, as well as climate change adaptation measures to be done, which are at the same time its most interesting aspects. The plan defines four different types of such adaptation measures. Firstly, *contingency measures* encompass elaboration of contingency and evacuation plans, which involve many different stakeholders from both the municipality and from civil society. In addition, these measures also involve

emergency operations procedures during response to a flood event, flooding exercises to increase preparedness, as well as buying, storing and replacement of pumps and temporary barriers. Secondly, *physical planning measures* involve risk and vulnerability analyses based on data collection, surveying and GIS, but it's certainly more interesting aspects are the new guidelines for planning and building. They range from resilient to protective measures, such as adaptation of new construction to address changing climate, elevated ground floors, building permits and some functional requirements, collaboration with stakeholders, etc. Behind all of them are the basic guiding principles, which at first suggest that residents should be able to stay in their homes during a flooding event, while water, electricity, sewage and heating should remain in function; secondly, residents should be able to move to and from their homes during such events. Furthermore, *technical group of measures* should insure that vulnerable roads are fixed, bridges elevated, new channels excavated. They also involve forecasting and warning systems, as well as GIS inventory of important roads that provides information on which alternative roads could be used in case of emergency. However, the most important aspect of technical measures is prioritization and securing of critical infrastructure, involving electricity supply, drinking water quality, heating, sewage system and treatment plants, access, sewage system, open storm water systems with infiltration dams, as well as flood protection in exposed locations such as hospitals, vulnerable communities, and inner harbour. These measures also involve establishment of natural buffer areas, as a simple measure of protection in case of flooding events. Finally, *communication measures* are to insure relevant information for inhabitants and other stakeholders.

In contrast to high aspirations and thorough elaboration, some negative aspects that accompanied the creation process of the Flood Risk Management Plan for Karlstad involved missing feedback from the national agencies concerning guidelines for planning, as well as lack of possibility for the general public to participate in the process [4]. In order to fix the shortage of public participation, in August 2011 the municipality of Karlstad finally organised two 'vulnerability walks' along the flood prone areas in the city, with the aim to inform about the municipality's work with flooding and to invite the public to comment on it.

4. RESULTS OF PLANNING RESILIENCE IN KARLSTAD

Although during the past decade many efforts were invested to make Karlstad a more resilient city, surely there were some difficulties in implementation of all the knowledge collected and plans produced. According to the flood risk management coordinator [9], the most important implementation challenges for the Flood Risk Management Plan were regarding the lack of guidelines in terms of defining acceptable risks, as well as regarding missing predictions of consequences. In addition, hazard maps were described as still being too general and comprehensive, with a lack of knowledge how to properly use them, especially concerning range of stakeholders involved. Finally, there were also financial difficulties concerning implementation of the plan, as well as some challenges associated with collaboration between numerous stakeholders, which was finally described as the most important issue.

In despite of the mentioned implementation challenges, city authorities remained strongly determined to turn their city into a more resilient urban environment, which also brought some significant results. Since the Flood Risk Management Plan came into force, it got reflected in all the later municipal strategic documents. In addition, Karlstad became a pioneer city to promote exchange of knowledge between cities and governments on different levels, as an important aspect of the work on disaster risk reduction. Concerning the regional level, initially national network for the campaign to share experiences and knowledge gradually evolved to the Scandinavian network. In terms of international level, Karlstad also became the first Swedish city to join UNISDR's international campaign "Make Cities Resilient: My City is Getting Ready" in 2012. This international platform for learning and exchange established ten essentials,² developed by the participating cities and local governments of the UNISDR campaign in order to support local government leaders and policy makers in their strives to make their own cities resilient [10]. The City of Karlstad also developed vivid cooperation with the Swedish Civil and Contingencies Agency (MSB). They work together in different areas, such as in the frameworks of the EU Directive on the Assessment and Management of Flood Risks, or on the implementation of the Hyogo Framework for Action 2005-2015, aiming to build resilience of nations and communities to disasters. For innovative use of social media to raise disaster awareness, Karstadt Municipality got rewarded by the International Sasakawa Award for Disaster Risk Reduction in 2013.

5. DISCUSSION AND CONCLUSIONS

As shown by the case study, integrating climate change adaptation in urban planning for the city of Karlstad is a complex and long-lasting process. According to the report that delivered the results and experience of the three-year work on the development of flood risk management planning in the SAWA pilot regions [4], it seems that Municipality of Karlstadt will have to keep finding ways to deal with many challenges and difficulties on all the levels, starting from planning itself, over integration of climate change adaptation, finally to its implementation. First of all, concerning the fact that planning and decision-making process in Sweden is generally characterised by a top-down approach, controlled by professional and political elites, necessary will be to address the current issues of lacking involvement of citizens and users. Recent attempts for participation in the work of Karlstad municipality unfortunately didn't provide satisfactory results. Furthermore, creating development plans in Karlstad usually means dealing with areas that are both attractive and risky. This means that most of the affected zones unfortunately also have the potential to become attractive residential neighbourhoods, such as the ones along the lake itself. On the one hand, although planning and building act allows authorities to stop development of extremely risky areas, in most of the cases they remain in the focus

² The ten essentials involve putting in place organization and coordination to understand and reduce disaster risk, assigning a budget for disaster risk reduction, preparation of risk assessments, invest in and maintain critical infrastructure that reduces risk, assessing safety of schools and health facilities, applying and enforcing realistic, risk-compliant building regulations and land use planning principles, ensuring education programmes and training, protecting ecosystems and natural buffers, installing early warning systems and emergency management, as well as ensuring that the needs of affected population are placed at the centre of reconstruction after any disaster.

of politicians and decision-makers, who prioritize interests for potentially profitable projects. Such circumstances often lead to creation of complex situations, as development of risk-prone areas could force the municipality to take expensive protective measures in the long run. On the other hand, even when flood prone areas are properly planned for development, they could involve different public reactions, due to a general difficulty for common residents to use the knowledge from the vulnerability studies regarding floods in the spatial planning processes. But even greater challenge that the planers in Karlstad will have to deal with in the future involves already existing parts of the city, situated in the areas that from current perspective probably wouldn't be approved for construction. Final difficulty is general integration and harmonisation at different levels. Besides the guidelines at the regional level on how to consider flood risks in spatial planning of the city, a lot of work still remains to be done, especially at the national level. Aside all the above mentioned implementation challenges, not to be forgotten are numerous advantages of the perspective adopted by Karlstad municipality, above all involving risk assessments made in each case, as well as consideration of different solutions to deal with different individual cases. However, although the approach to make Karlstad resilient could be considered as innovative and advanced, analysis of this case study shows that a way towards achievement of defined goals is a long-lasting process, far from being either definite or complete.

In spite of all of the listed challenges and difficulties coming as a result of the specific focus on the Municipality of Karlstad, to a certain degree they could also be understood as general issues, illustrating the complexity of challenges that planers, policy makers and other stakeholders face today in their attempts to create resilient cities. When about finding a proper way to integrate climate change adaptation in urban planning, the ideas set by the UNISDR should certainly be kept on mind: in order sustainable urban development and growth to be ensured in any city, disaster risk reduction cannot be limited to preparedness and response only, but should rather be grasped as its key determinant [11].

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АДАПТАЦИЈА НА КЛИМАТСКЕ ПРОМЕНЕ КРОЗ ПЛАНИРАЊЕ У КАРЛСТАДУ, ШВЕДСКА

Резиме: Креирање резилентности урбане средине је изузетно сложен процес, који директно зависи од датих околности. Ова чињеница подразумева изнајлажење одговарајућих решења за сваку конкретну констелацију ризика, што најбоље илуструје обимност задатка за локалну самоуправу и планере. Разумевање и учење на успешним примерима из праксе је стога један од начина да се ефикасније приступи решавању конкретних проблема. Поред потребе за разумевањем комплексности урбане резилентности, овај чланак има за циљ и упознавање са изазовима креирања исте на примеру најугроженијег града Шведске, где се актуелно питање адаптације на климатске промене успешно спроводи кроз интеграцију са политиком планирања.

Кључне речи: Урбана резилентност, адаптација на климатске промене, урбанистичко планирање, Карлстад