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Article *in* Climate and Development · April 2013

DOI: 10.1080/17565529.2013.789789

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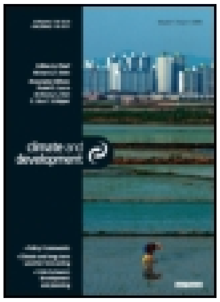

Climate and Development
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tcld20

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Published online: 31 May 2013.

Climate and Development, 2013
http://dx.doi.org/10.1080/17565529.2013.789789

climate and development

RESEARCH ARTICLE

Climate change impact on small coastal river basins: from problem identification to adaptation in Klaipėda City

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Climate change is a process which is global in nature, but which has direct consequences at regional and local levels. Coastal areas as a whole, and small coastal river basins across the Baltic Sea in particular, are especially vulnerable since they directly suffer the influences of phenomena such as heavy precipitation and flash floods, the frequency of which has been increasing over the last few years, as well as rising sea levels. This paper describes the framework of the process of adaptation to climate change in small coastal river basins, based on a case study from the city of Klaipėda in Lithuania. In particular, the paper outlines the degree of vulnerability of coastal areas and describes some of the work undertaken and experiences gathered by the EU's BaltCICA project (Climate Change: Impacts, Costs and Adaptation in the Baltic Sea Region), which has been undertaken with a view to identify the problems and developing adaptation options in the region.

Keywords: climate change; adaptation; BaltCICA; river basin; coastal management; stakeholder interaction

1. Introduction

It is widely known that climate change affects many human activities and every part of natural world, especially water resources and ecosystems (Aloj, De Castro, Totàro, & Zollo, 2012; BACC Author Team, 2008; ETC/ACC, 2010). As outlined in the 4th Assessment Report produced by the Intergovernmental Panel on Climate Change, climate change influences key natural and human living conditions and thereby also the basis for social and economic development. At the same time, society's priorities with regard to sustainable development influence both the GHG emissions that are causing climate change and our vulnerability to it (Metz, Davidson, Bosch, Dave, & Meyer, 2007).

Coastal and urban areas are among the most vulnerable systems, and the severity of the impacts of climate change varies by region (European Commission, 2009; IPCC, 2007). It is estimated that 23% of the world's population lives within 100 km of the coast and at less than 100 m above sea level (Feiden, 2011). Rapid urbanization is exacerbating climate risks, creating new ones and heightening human vulnerabilities to these risks (Tanner, Mitchell, Polack, & Guenther, 2009). Another important issue concerning the impacts of climate change is resilience, which depends on the size and adaptability of ecosystems. For small coastal river basins situated in urbanized territories, resilience is weak and the implementation of adaptation options is very complicated. An integrated approach to adaptation in urban areas is needed (Kirshen, Ruth, & Anderson, 2008; Rosenzweig & Solecki, 2003). However, developing adaptation strategies in urban systems is an extremely complex and a challenging process (Matthews, 2011).

Coastal areas and cities are affected by high sea-water levels and storm surge risks (Apel, Aronica, Kreibich, & Thieken, 2009; Hallegatte et al., 2011), which will continue to rise in the future (Meier, Broman, & Kjellström, 2004). The Baltic Sea Region (BSR) is very sensitive to climate change because of its heavily populated areas and concentration of the large cities (Schernewski, Hofstede, & Neumann, 2011). Heavy precipitation and flash flooding have become more frequent in the region (BACC Author Team, 2008). Along with a rise in sea levels and an increase in storm surges, this could cause a loss of urban infrastucture and a shortage of drinking water due to saltwater intrusions (ETC/ACC, 2010). Therefore, flood damage and storm-surge risk assessments have become very important (Boettle et al., 2011; Hallegatte, Hourcade, & Dumas, 2007; Schmidt-Thomé & Peltonen, 2006).

The BaltCICA (Climate Change: Impacts, Costs and Adaptation in the Baltic Sea Region) project focuses on climate change vulnerability and the assessment of sensitivity to it in the BSR. A foresight approach to climate change adaptation was implemented to support the project's conceptual framework. Thirteen case studies were chosen across the Baltic Sea (BaltCICA, 2010, 2012).

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Klaipėda city was chosen as one of the case study areas for Lithuania. The main findings of the BaltCICA project are presented by Rimkus, Stonevicius, and Ramanauskaite (2011), Kažys (2012) and Rimkus, Kažys, Stonevičius, and Valiuškevičius (2013). This paper focuses more on the development of the process of adaptation and interactions between different stakeholder groups. The aim of the paper is to outline the process of climate change adaptation in the Klaipėda city case study. The adaptation framework highlights the main stages of the adaptation process. It also presents an evaluation of various adaptation options according to certain criteria. Some findings could be applied to other small coastal river basins around the world. Though it highlights good practices and uncertainties, it also reveals mistakes that were made and challenges that were faced in coastal areas. It shows new methods of communication between scientists, local authorities and stakeholders.

Figure 1. Case study area in the lower reaches of the Smeltalė river.

2. Identification of the problem and outlining the process

Klaipėda is a coastal city. Almost all of its territory is located on coastal lowland, which is why there is frequent flooding in areas of Klaipėda city. The Smeltalė river is situated in the Southern part of Klaipėda city, and has a catchment area of 124.1 km^2 (Gailiušis, Jablonskis, & Kovalenkovienė, 2001). The Smeltalė flows into the Klaipėda Strait, which connects the Baltic Sea and the Curonian Lagoon (Figure 1). The shores of the Smeltalė river are not reinforced, so the area near the river is not protected from flooding. The lower reaches of the Smeltalė river are situated in the lowland where the land surface is almost flat. Consequently, the floodplain of the Smeltalė river is wide.

The catchment is small, but consists of two very different parts. The lower reaches of the Smeltalė river, situated in Klaipėda city, are highly urbanized, while the other part of the catchment area is mostly agricultural. Impervious surfaces cover a considerable area in the lower reaches of the Smeltalė river. The natural flow paths are replaced by the rain drainage system. Consequently, the flash flood peak discharge is much larger than that in natural conditions.

The flooding of surrounding areas (water can reach the built-up areas) is one of the most important problems associated with high water levels and flash floods by the Smeltalė river (Figure 2). Another problem associated with floods is the additional sediment and pollution from the rain drainage system.

The water level rise in the Baltic Sea will affect the water level regime in the Smeltalė river's lower reaches. It is likely that the extreme water levels will also be affected by the sea level rise. Extreme water levels in the Baltic Sea near Klaipėda are related to storm surges. The change in the

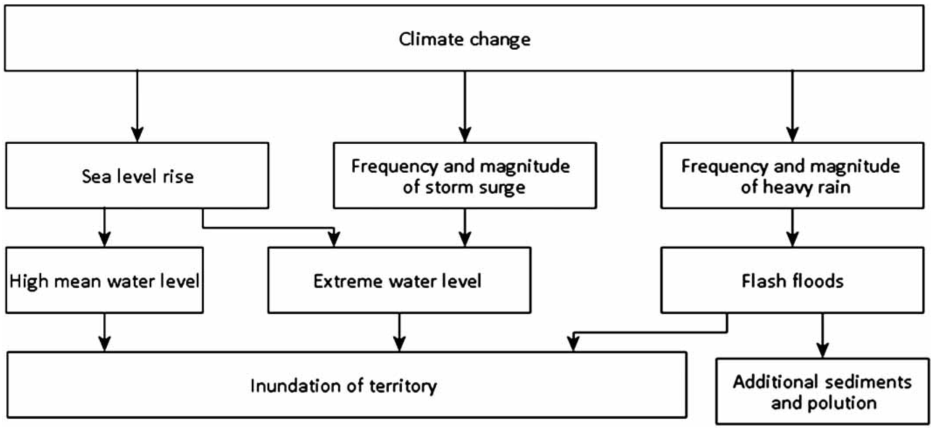

Figure 2. The effect of climate change on the problems in the lower reaches of the Smeltalė river.

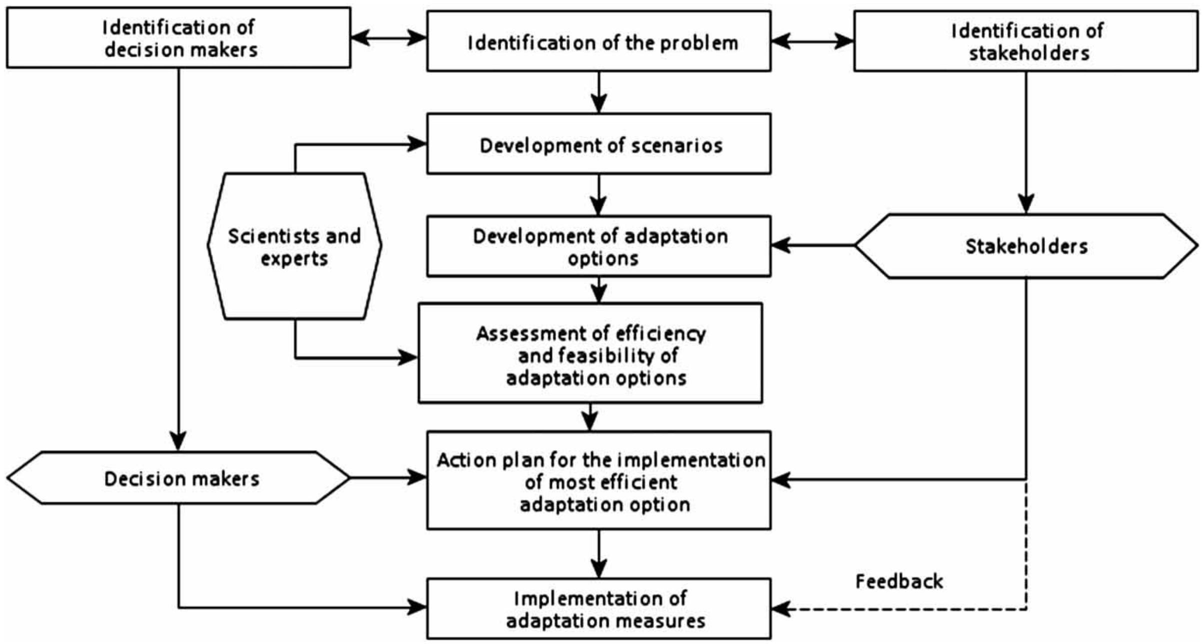

Figure 3. The framework for adaptation to climate change used in Klaipeda City.

intensity and frequency of heavy rain and flash floods can also affect the area of flooded territory and the frequency of flooding. The change in the flash-flood regime may also change the sediment regime of the Smeltalė river and the pollution from the rain drainage system (Figure 2).

During the initial stage of the adaptation process, analysis of climatic parameters and sea-level change during the observation period was carried out and projections for the twenty-first century were prepared. Climate projections were used as the background for hydrological modelling which has been carried out, and possible future changes in the hydrological regime were determined. The whole process is fully described in another BaltCICA project publication. The most important results necessary to initiate the adaptation process and for quantitative assessment are the following (Rimkus et al., 2013):

(1) The water level in the Baltic Sea near Klaipėda city and the lower reaches of the Smeltalė river have increased significantly. The recorded sea-level rise over the twentieth century was approximately 15 cm. All modelling results indicate a sea-level rise of between 25 and 86 cm (mean value of the whole forecast: 52 cm) in Klaipėda in the twenty-first century.
(2) High water levels during flash floods were usually caused by heavy rainfall that lasted for one to three days. Study results showed that during the investigation period 1961–2008, the reoccurrence of heavy-precipitation events increased greatly. Modelling results show that recurrence of heavy precipitation in Klaipėda will also increase in the twenty-first century (by up to 30%).
(3) Hydrological modelling results of potential changes in the Smeltalė river flow regime in the twenty-first century show that the risk of flooding for nearby residents will increase in the future due to the sea-level rise and heavy rain. A rise in flooding magnitude and frequency is very likely. The area of flooding will increase.

The identification of these problems is only the first step of the adaptation process. Adaptation is a very complex process, especially if the goal is to adapt to projected changes. Adaptation involves many actors with different knowledge and responsibilities. Despite its complexity, the adaptation process should lead to common decisions and solutions. During the initial stages of the BaltCICA project the conceptual methodological approach was proposed (BaltCICA, 2010). This approach was used as the framework for the development of case study-specific adaptation processes. The same methodological approach was used to develop the framework for the process of climate change adaptation in the southern part of Klaipėda (Figure 3).

At the beginning of the adaptation process it is crucial to identify the problems and main actors in the area. It is very important to understand the current problems, as they can also be integrated into the process of adaptation to climate change. The problems can best be identified by those directly involved. Thus it is very important to identify the local stakeholders and decision makers. The identification of stake holders and decision makers is related to a better and broader understanding of the problems. The stakeholders may describe very specific aspects of the problems which are not known by external experts. The identification of problems and the identification of actors is a two-way process, as the successively more detailed description of the spatial and structural boundaries of the problem helps in turn to complete the list of actors involved in the adaptation process (Figure 3).

The stakeholders and decision-makers usually have a good knowledge of the area and the problems, but they may need assistance in the development of climate change scenarios (Figure 3). The scenarios allow the stakeholders to understand how the problems will develop further and what new issues may be expected. The development of possible adaptation measures can be performed by the stakeholders with the assistance of scientists and experts (Figure 3). Stakeholders usually base their proposals of options for adaptation on subjective and qualitative criteria. The possible options for adaptation suggested by the stakeholders may therefore be biased and not effective or feasible. It is the external experts who assess how feasible and efficient potential options for adaptation would be. These external experts have the knowledge and experience in the use of more objective quantitative methods and are familiar with the finer points of the adaptation process (Figure 3). Climate change is a dynamic process, and adaptation to climate change should be dynamic too. Robust and flexible adaptation measures are usually the best solution (Nelson, Adger, & Brown, 2007) because they can be more easily incorporated into future adaptation processes. The flexibility of measures should also be communicated to stakeholders and decision-makers by experts.

Once feasibility and efficiency have been assessed, the stakeholders and decision-makers can develop a plan to implement the most suitable adaptation measures. The last step of the adaptation process is the implementation of adaptation options (Figure 3). The decision-makers are responsible for the implementation of the adaptation process, while including feedback from local stakeholders.

3. Development of the adaptation options

The framework for the adaptation process (Figure 3) only describes the basic principles of the adaptation process, although there was extensive information and knowledge exchange between all those involved in the project. Beforehand, predictions are made of the activity levels of local stakeholders at different stages of the process. However, it was very difficult to foresee these levels during the project, as a wide range of activities was involved. The problems

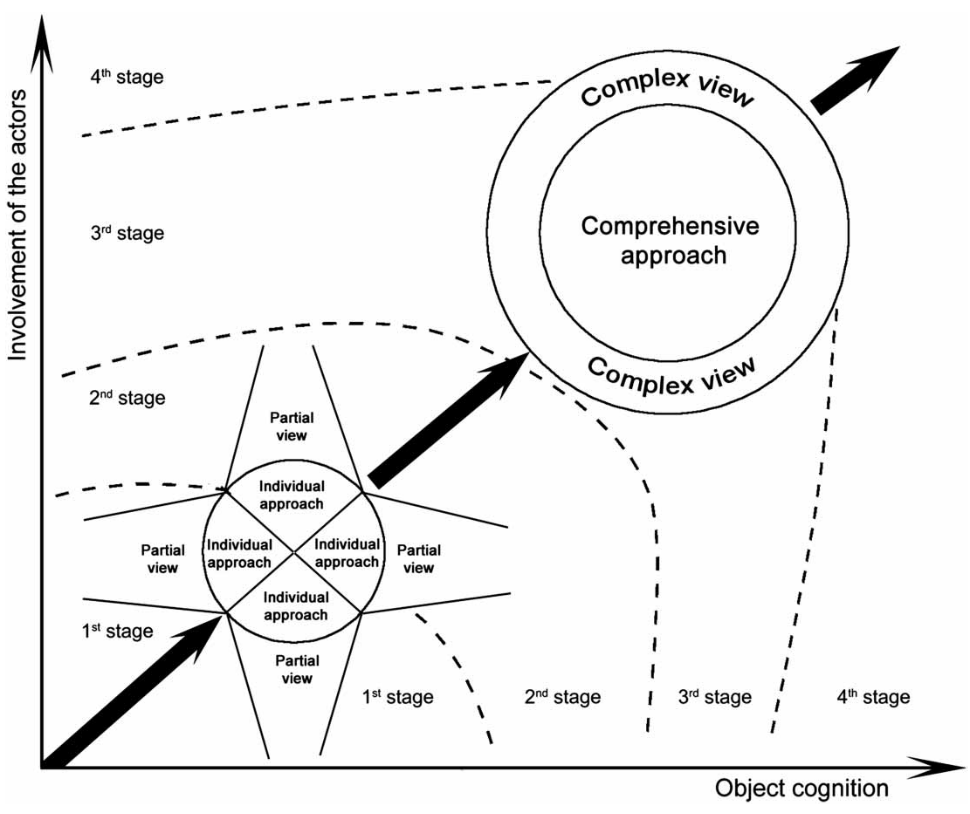

Figure 4. Changes in the behaviour of the actors and object cognition with regard to solving problems at different stages of the process. Dotted lines frame the degree of concern at individual stages.

Table 1. Main actors and the duration of stages in the development of adaptation options in the Klaipėda case study.

Stages	Substages	Main actors	Duration
1. Identification of problems and preparation for evaluation	Data collection	Decision-makers, scientists	2 months
	Building of scenarios and identification of local stakeholders	Scientists, stakeholders	3 months
2. Initial evaluation of adaptation options	Research of hydrological characteristics in the lower reaches of the Smeltalė river	Scientists, stakeholders	3 weeks
	Modelling of flooded area and possible consequences	Scientists, stakeholders	4 months
	Planning of options for adaptation to flooding	Stakeholders, scientists	5 months
3. Evaluation of feasibility of adaptation options	Presentation of possible adaptation options	Stakeholders, decision-makers, scientists	2 weeks
	Quantitative assessment of adaptation options	Stakeholders, decision-makers, scientists	2 weeks
	Preparation of feasibility study of possible adaptation options	Decision-makers, scientists, stakeholders	8 months
4. Final evaluation of adaptation options	Feasibility study – evaluation and selection of best adaptation options	Stakeholders, decision-makers	2 weeks

identitfied by local stakeholders were well known, but only separate 'segments' were interesting for different groups (local inhabitants were concerned about flash floods; small shipping associations were interested in the development of the harbour; the water utility company wanted the construction of new sewage collectors etc.). The main purpose of the project was therefore to merge the interests of different groups to reflect the complexity and to select the best adaptation option. It turned out that the frameworks for adaptation (Figures 3 and 4) we developed is relevant and very effective.

The diversity of project actors' input is clearly shown at different stages of the development process of the adaptation options. We distinguish between four main stages of the adaptation process (Table 1 and Figure 4) based on the number of actors, activity levels, project progression and decision-makers' evaluation criteria. Duration of main stages and substages and the actors involved in each stage (Table 1) could be seen as an initial reference structure for environmental and cultural protection projects in urban environments. The structure of the process reveals main elements and actors that are essential for the future development of similar projects. They are very important in dealing with the impact of climate change on urban (spatial) planning projects. There are currently huge gaps in the understanding of adaptation processes, and this reference structure might help emphasize the impact of the combination of all factors on the development of adaptation options.

The first stage covers the identification of causes for the Smeltalė river overflowing its natural bed. The main goal of this phase was the collection and specification of information about flood-generated problems in the southern part of Klaipėda city. The main actors at this substage were decision-makers (the Klaipėda city municipality) and scientists (Vilnius University). At the end of the data-collection substage, the requirements for the development of adaptation options were presented to local stakeholders. Visits to the potential flood areas and affected properties were organized, identifying the main impacts of future climate change on the lower reaches of the Smeltalė river.

Once sufficient data had been collected, the first stage led to an assessment of the consequences of climate change and an identification of local stakeholder groups. The majority of stakeholders had already been identified because of their previous reactions to problems with the Smeltalė river. Stakeholders involved in maintenance and administration groups made particularly significant contributions to the scenario development process: the Klaipėda city municipality, the 'Klaipėdos vanduo' stock company and the administration of the small harbour. This triggered a chain reaction and helped bring the message to associates, neighbours, specialists, etc. Experience gained in earlier research projects was also useful, especially involvement in the ASTRA project (Hilpert, Mannke, & Schmidt-Thomé, 2007), analysing similar issues with adaptation to climate change.

The second stage was designed for the evaluation and modelling of the Smeltalė river floods. The lower reaches' discharge characteristics were analysed, as regular measurements taken from the river were not available. Data collected enabled comparison of the results with those from rivers in adjacent regions and the assessment of water balance elements at different water levels. In the second substage, modelling of areas prone to flooding and possible consequences was carried out according to climate change predictions. The leading role in the second stage (especially in the first two substages) was reserved for scientists, as the initial evaluation was based on a scientific background. Only in the third substage did local stakeholders become involved to assess possible options for adaptation to the impacts of flooding. The initial evaluation of the adaptation options stage lasted eight months. The substages varied in time because of variations in the intensity of the process.

The first two stages mainly concentrate on object cognition. This was because of the lack of sufficient scientific information about the area and related processes. Some time and energy were lost due to difficulty in integrating some of the involved parties. The scientists were not familiar with the peculiarities of the area and did not recognize all local stakeholders. However, towards the end of the second stage when the comprehensive report was completed (Stonevičius, Valiuškevičius, Rimkus, & Kažys, 2010), the majority of stakeholders was still focused on their own interests and did not recognize the importance of contributing to the general context. The turning point in the object cognition (affected by the Smeltalė river floods) and the involvement of the actors (local stakeholders, decision makers, scientists) in the adaptation process were achieved at the beginning of the third stage. This is shown in the diagram (Figure 4) showing the actors' behavioural changes at the different stages of the adaptation process. Figure 4 shows some details relevant to the future development of adaptation options, which could not be seen in the analysis of the stages shown in Table 1. Also, the diagram could be treated as an example showing relations between object cognition and different actors' involvement in implementing the process of adaptation to climate change in an urban environment.

At the beginning of the third stage, the results of the comprehensive report were presented to local stakeholders in the first scenario workshop. Two main groups of possible adaptation options were identified (Stonevičius et al., 2010):

- (Technical) direct water balance measures (partly channelling precipitation to other places, allowing water to run more freely in overflows, etc.);
- Indirect water balance measures (controlling the urbanization of rural areas, regulating the relative size of the urbanized basin, etc.).

Prior to the scenario workshop, the problems were introduced to the local media (Kažys & Valiuškevičius, 2010); this increased local stakeholders' involvement in the process. The fruitful discussions between local stakeholders, inhabitants and the Klaipėda city municipality resulted in a proposal for the preparation of a feasibility study. It was supposed to comprise a cost overview of the various adaptation options and an overall efficiency evaluation. After the workshop there were also reactions on local online news portals (Matutis, 2010a, 2010b). Moreover, a quantitative assessment of the various adaptation options was carried out (the assessment results are illustrated below).

The feasibility study was prepared by JSC 'Vilniaus hidroprojektas'. The company evaluated preliminary costs and efficiency of the various adaptation options. Also, two additional adaptation options were developed for the mitigation of the impacts of flooding on the lower reaches of the Smeltalė river. In the fourth stage, the final evaluation of the various adaptation options was carried out (Table 1). One of the additional options consists of complex embankments and dyke systems on both sides of the Smeltalė river. Though this option is one of the most expensive ones, local stakeholders and municipality representatives considered choosing it during the second scenario workshop. The main reasons for choosing this option were the results of the feasibility study. This option produced the highest efficiency and durability (including climate change impact). Moreover, the embankments are supposed to be incorporated into a recreational zone, which will be established in the area.

The crucial moments of the adaptation process were well-organized scenario workshops and opportune information appearing in the media. The results of the project were published at a local (Kažys & Valiuškevičius, 2010; Matutis, 2010a, 2010b), national (Spraunius, 2010; Rimkus & Satkūnas, 2011) and international (Rimkus et al., 2011) level. This enabled the spread of news to a wider spectrum of society, involving stakeholders in active contribution and achieving the result of solving the problem.

The case study shows that due consideration should be given to technical elements which may significantly impact the landscape. Also, to simplify the adaptation process while involving different actors, the following statements should be noted:

- The most acceptable and comprehensible adaptation options for society were associated with the present situation and solutions to concrete problems, not only determined by future threats.
- It is easer to incorporate adaptation options into existing regulation schemes than to start the implementation process from the very beginning.

Owing to the fact that climate change entails multifaceted and multidimensional concepts, there is also a need to have multifaceted approaches (Figure 4) and solutions to the problems related to it. Acceptable and comprehensible adaptation options may be identified to handle current problems and, at the same time, to take into account possible future trends.

Table 2. The distribution of 14 damage criteria according to the importance and feasibility in PIK partners and the Klaipėda case study schemes.

Importance	PIK	Klaipėda	Feasibility	PIK	Klaipėda
Important/feasible	3	3	Feasible/important	3	3
Important/unfeasible	1	4	Feasible/unimportant	5	4
Unimportant/feasible	5	4	Unfeasible/important	1	4
Unimportant/unfeasible	5	3	Unfeasible/unimportant	5	3

4. Evaluation of criteria for adaptation options

The Potsdam Institute for Climate Impact Research (PIK) developed instruments to assess adaptation measures for the BaltCICA project (Boettle, Rybski, & Kropp, 2012). The results of the application of *Cost–Benefit Analysis* (CBA) and *Multiple-Criteria Decision Analysis* (MCDA) in the Klaipėda city case study are presented in a comprehensive report (Kažys, 2012). However, this paper does not focus on the outcomes of CBA and MCDA, but on the difference between personal (group) priorities and interests in the evaluation of criteria. The outcome of the quantitative assessment is determined by primary people choices which, in turn, are determined by different socio-economic attitudes, priorities, interests, expectations, political views, educational background, etc.

In the first Cost Assessment Workshop at PIK (October 2009), the project partners developed general criteria for determining flood-prone areas and created a damage cost assessment scheme. Fourteen criteria were used: *building damage, building content, car replacement,changes in ecosystems, nourishment of coastline, crop replacement, evacuation, food and drinking water supply fresh water treatment, infrastructure, opportunity, public/social sector disruption, treatment* and *tourism*. The damage costs were determined by importance (1 – not important, 5 – very important) and by feasibility (1 – very feasible, 5 – not feasible). The medium value for the criteria is 3.

In addition, the same analysis was performed for the flood-risk area of the Smeltalė river. The Klaipėda case study partners and stakeholders (16 people) were asked to fill in a questionnaire in which they were able to assess adaptation options using quantitative methods and to identify the main indicators of the feasibility of adaptation measures in the lower reaches of the Smeltalė river (Kažys, 2012). The importance and feasibility of the criteria depend on local factors. In very complex and vulnerable environments, many criteria may come out at the same high-importance level. The most important and most feasible criteria are related to infrastructure and building assessment (Table 2). However, respondents in Klaipėda overestimate more important criteria and underestimate less important ones. Though the importance of building damage criteria was considerably less in Klaipėda city, this illustrates lack of experience in the prioritizing and weighting process. It does not mean that the evaluation of criteria in the Klaipėda case study is 'less right', it only reveals significant differences between the two groups. The PIK partners' results for the evaluation of damage criteria were chosen as a reference point due to the partners' plural opinions, wide representation of institutions, experience in climate change adaptation processes, knowledge of spatial planning, etc. In addition, an overestimation of the less-feasible criteria in Klaipėda city could by explained by a lack of knowledge with regard to the economic assessment of tangibility. Another possible reason for mismatching in criteria evaluation for both groups is that the majority of respondents in Klaipėda were local authorities (narrow view), while PIK partners represent various institutions. Also in the Klaipėda case study, the criteria values are lower; this shows some incomprehension of and a careless attitude towards the importance and feasibility features. Meanwhile, ecological and social criteria are quite difficult to assess in both schemes (Table 2).

Variations in the type of people involved could have different effects on the results of the study. The answers in the questionnaire were divided into different groups (Figure 5) according to the following respondent categories:

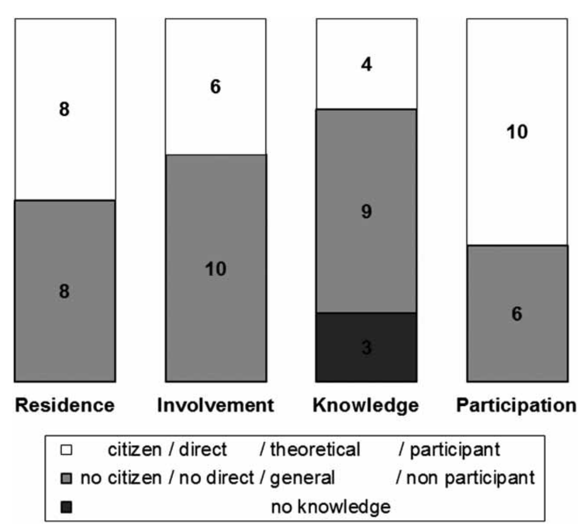

Figure 5. The distribution of the respondents between residence, involvement, knowledge, and participation groups in the Klaipėda case study questionnaire. Number indicates the number of respondents in the groups.

Table 3. The distribution of respondents' answers to the questionnaire themes divided into residence, involvement, knowledge and participation groups: ⇑ – more confident answers; ⇓ – less confident answers; ⇔ – no difference in answers. The number of respondents is shown in brackets.

	Groups							
	Residence		Involvement		Knowledge		Participation	
Themes	Citizen (8)	Not citizen (8)	Direct (6)	Indirect (10)	Theoretical (4)	Nothing (3)	Yes (10)	No (6)
Elaboration of cost–benefit criteria	⇓	⇑	⇔	⇔	⇑	⇓	⇔	⇔
Importance of cost–assessment criteria	⇓	⇑	⇔	⇔	⇑	⇓	⇔	⇔
Feasibility of cost-assessment criteria	⇓	⇑	⇑	⇓	⇑	⇓	⇔	⇔
Importance of adaptation options	⇔	⇔	⇔	⇔	⇔	⇔	⇓	⇑
Weighting of adaptation options criteria	⇓	⇑	⇑	⇓	⇔	⇔	⇓	⇑

- Residence – citizens of Klaipėda city/non-citizens.
- Involvement – direct involvement in the project/no direct involvement.
- Knowledge – theoretical CBA and MCDA background/only general knowledge or no knowledge.
- Participation – participants in local scenario workshops in Klaipėda/no participation.

Only if a difference in group answers amounts to more than standard deviation values isit considered a difference. Further attention is paid to extreme mean values and amplitudes of answers distribution among different groups. Respondents were requested to contribute their opinions on these themes to the Klaipėda case study (Kažys, 2012):

- Elaboration of cost–benefit criteria.
- Importance of damage-cost assessment criteria.
- Feasibility of damage-cost assessment criteria.
- Ranking of adaptation options according to their importance.
- Weighting of criteria for adaptation options.

The residence (citizen vs. non citizen) group answers show that local respondents overestimate the overall adaptation assessment process (Table 3). They believe that the estimated adaptation measures should be more detailed, that cost-assessment criteria are more important and also very feasible. Also, the sequence of adaptation measures is framed in advance, while the differences between the highest outcomes are not clearly marked. This is a typical behaviour for local communities when general perspective is lost. CBA and MCDA methods could not be implemented, even though they may have appealed to local respondents because of difficulties with data availability, time constraints etc.

The margins between the answers from respondents from the project and from participants who are not directly involved (the involvement group) are lower. A greater variation in the weighting of cost-assessment criteria feasibility and adaptation measures criteria is observed in the answers of persons directly involved (Table 3). This shows a deeper knowledge of the assessment of criteria for CBA and MCDA.

It is difficult to identify trends in the answers from respondents with theoretical, only general or no knowledge (the knowledge group), as the sample size is quite small (Figure 5). It is clear that theoretical knowledge of CBA and MCDA prevents respondents from overestimating the importance of cost-assessment criteria and adaptation costs as well as the benefits elaboration process (Table 3).

The impact of whether or not respondents were participating in the Klaipėda case study scenario workshops on the questionnaire answers is virtually irrelevant (the participation group). The majority of workshop participants are local stakeholders who are not familiar with CBA and MCDA methods and not directly involved in the project. Moreover, various conflicts of interest and ideas are possible in answers which are directly related to the process of implementing adaptation options (Table 3).

In the Klaipėda case study, results using the CBA and MCDA methods are very much dependent on respondents' answers. The variability of majority criteria values is biased. Moreover, there is conceivable underestimation of important and overestimation of insignificant criteria. This shows a lack of general knowledge about quantitative methods and an exaltation of local area priorities. The knowledge (even theoretical) of methods and direct involvement in the process are beneficial in the quantitative assessment of the implementation of an analysis of options for adaptation. The variety of opinions and local stakeholders' involvement are welcome and crucial for the success of the assessment.

5. Conclusions

The first conclusion which can be drawn from this paper is that the adaptation framework here provided could and perhaps should more widely be implemented in climate change vulnerability assessment projects in small coastal rivers basins. This reasoning applies to the Baltic Sea Region –since the framework emphasizes the importance of urban (spatial) planning in the process of implementing adaptation options in the Baltic Sea Region – but also to other parts of the world, where regional attempts to adapt to climate change are taking place.

In addition, the research presented in this paper produced an initial reference structure of an environmental and cultural protection project in an urban environment, where the main stages and substages were established, the duration of the stages was calculated and, most importantly, the main actors in the adaptation process were highlighted. Even though the local (Klaipėda city stakeholders) respondents were less confident in answers on the topic of the development of adaptation options (probably because of a lack of knowledge of quantitative assessment methods), they did acknowledge the importance of inputs from outside the area as being crucial to the decision-making process and evaluation of adaptation options.

Furthermore, it can be concluded that the importance and feasibility of damage criteria are very much dependent on local factors in flood-prone areas, which indicates that knowledge in spatial planning and experience in climate change adaptation processes are very important, in prioritizing and weighting the criteria.

Acknowledgments

The authors are grateful to the BaltCICA project for supporting this research and to Klaipėda city municipality for active participation in the process. Specials thanks to the Potsdam Institute for Climate Impact Research (PIK) for the workshops and valuable recommendations.

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