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# Flood risk management in Spatial Planning of Estonian Coastal regions

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## Abstract

Adapting to climate change in spatial planning of coastal municipalities needs further development of the resilience approach as well as identifying how it can be practically used in local actions. It is necessary develop coastal management strategies including spatial planning that can be adapted to potential climate change impacts over time.

The importance of including flood risk policies in the spatial planning cannot be overstated. While development strategies will be informed by national planning policy such as these guidelines and regional planning guidelines addressed above, they must take all practicable steps to ensure the prior identification of any areas at risk of flooding and flood zones in order to effectively shape the drafting process.

The paper is focused on Spatial Planning of Estonian Coastal regions (coastal spatial planning) aimed to decrease risk by decreasing potential damage. Coastal flood risk is defined as a product of probability of event and its effect, measured in terms of damage. Flood risk management requires that consideration be given to coordination with different types of usage from the point of view of spatial planning. In certain situations, new types of usage are required in order to achieve an effective balance between existing interests and new possibilities.

The study was guided by two research objectives:

- To examine the potential and actual role and impact of the climate change of spatial plans to flood risk management in Estonia, contribution to flood risk management in practice of spatial planning.
- To develop recommendations to improve the effectiveness of the contribution of spatial plans to flood risk management.

These research questions are answered through studying national, regional and local spatial planning projects in which spatial measures for the reduction of flood risks were developed. These projects are discussed from a spatial planning perspective. The study analyzes in the first the perspectives of spatial planning. The objective is used to analyze the spatial planning by case studies and to increase understanding of practices and conflicts related to the development and implementation of spatial measures. In addition, the spatial planning perspective is used to provide suggestions on how things might be done differently.

*Keywords* - climate change, coastal zone management, spatial planning, flood risk management.

## **Data and Methods**

Data to answer the research questions were collected in Pärnu and Lääne Counties as well as the coastal areas of the South-West part of Estonia. The study area (Fig 1) covers the coastal municipalities of Pärnu County (Pärnu, Tahkuranna, Häädemeeste, Audru, Tõstamaa, Varbla, Kihnu) and Lääne County (Haapsalu, Nõva, Noarootsi, Vormsi, Ridala, Martna, Lihula, Hanila, Oru).

The study area can be regarded as significant risk of flooding include those around the Bays of Pärnu and Haapsalu.

Nevertheless, the historical settlements and some new house construction projects were located and proposed in these areas.

The key underlying aim of this paper is to help to address the policy implementation gap that exists concerning the translation of flood risk management policy into spatial planning practice. This paper looks how spatial planning process can help to reduce flood risk. The paper provides a context for the discussion of the flood risk management of spatial plans. With the theoretical linkages between spatial planning and flood risk management established, the discussion addresses the practical contribution of spatial planning in Coastal Regions South-West part of Estonia. This is considered in the context of the climate change of National and Regional Spatial Strategies. Drawing on the key findings of the research, the report concludes with a series of recommendations.

The study was guided by two research objectives:

- To examine the potential and actual role and impact of the climate change of spatial plans to flood risk management in Estonia. Exploring the contribution to flood risk management in practice of spatial planning.
- To develop recommendations to improve the effectiveness of the contribution of spatial plans to flood risk management.

These research questions are answered through studying national, regional and local spatial planning projects in which spatial measures for the reduction of flood risks were developed. The study analyzes in the first the perspectives of spatial planning. The objective is used to analyse the spatial planning by case studies and to increase understanding of practices and conflicts related to the development and implementation of spatial measures. In addition, the spatial planning perspective is used to provide suggestions on how things might be done differently.

### **The Estonian coast**

Estonia has a long (3,800 km) coastline due to numerous peninsulas, bays and islands, over 1,500 [1].

Due to a long coastline and extensive low-lying coastal areas, global climate change through sea-level rise will strongly affect the territory of Estonia. A number of valuable natural ecosystems will be in danger. These include both marine and terrestrial systems containing rare plant communities and suitable breeding places for birds. Most sandy beaches high in recreational value will disappear. However, isostatic land uplift and the location of coastal settlements at a distance from the present coastline reduce the rate of risk [2].

In Estonia, the most vulnerable areas to storm surges are the shallow and narrow bays of Pärnu, Matsalu and Haapsalu, which are exposed to the strongest storm winds in the Baltic Sea region [2].

The particular focus on this paper is South-West part of Estonia (Fig 1), in the coastal municipalities of Pärnu and Lääne Counties, as shown in Table 1 the length of coastline of study area is 642 km.



Figure 1. The Coastal Municipalities of Pärnu and Lääne Counties

The area is located in on the western coast of Baltic Sea. Forested by precious coniferous pine forests, this region has high environmental value, mild maritime climate conditions, favorable for health, as well as esthetic views of coastal landscapes and a high proportion of Natura 2000 sites (Tab 1). Therefore, this area is traditionally highly attractive for a large number of tourists in summer months, and very popular as a place for permanent residence among local Estonian people. In the past decades, the region is becoming increasingly popular for housing and cottage building, also intended for flood risk assessment.

Table 1. Coastal areas of Pärnu and Lääne Counties

County	Length of coastline km	Coastal area km <sup>2</sup>	Population	Population density	Percentage of Natura 2000 sites %
Lääne	400	2383	27187	11,4	32
Pärnu	242	4806	88137	18,3	24

Sea level measurements in the Estonian coastal waters have been carried out with small gaps since 1842 (in Tallinn). According to the statistics of historical data, the possibility of both high and low sea levels is highest in the meteorologically variable winter months. [3].

The top five storm surges of Pärnu include: 2.53 m (October, 1967), 1.84 m (February, 1990), 1.81 m (September, 1978), 1.80 m (November, 1923) and 1.79 m (April, 1932) for the period of 1923–2001 [3].



Figure 2. Flooding in 1923 and 2005 at Pärnu Supeluse avenue

A hurricane was known Gudrun in the Nordic Countries and Erwin in the British Isles and central Europe travelled over central Europe and Scandinavia. The storm was one of the worst in Denmark, Scandinavia, and Estonia, causing massive forest damage, and disruption of power and phone lines. The main property damage was a result of strong winds and flooding of the coastal areas, as shown figure 2 [4].

In Estonia rising frequency of floods have been forecasted and that is related also to the increasing number of occurring storms as a factor. It is getting warmer in Estonia mostly on account of higher winter temperatures; in addition, climate is changing to wetter and more windy. The average level of sea water on the Estonian West coast is lifted by 10 cm by increasing proportion of winds from the West. More frequent storms cause more and more often the level of sea water to rise above the registered official records; damages caused by storms are more frequent and considerable in forests, on sea coast and on buildings [5].

### **Flood risk management in Estonia**

The first polder in Estonia lies south from the alley - the Audru polder, 2000 hectares of polder area was set up in 1938 to avoid flooding. This is a nesting site and transmigration area for many bird species. Polder of Audru is the bird area of Natura 2000 network. In Häädemeeste Municipality, Rannametsa village flood protection dike built in the 1970's. The dike was built to protect the settlement. Rannametsa village located in the Luitemaa Nature Protection Area, as well as being a part of the Natura 2000 network.

Subsequently, in order to gain an insight into flood risk management practice at the spatial planning, a review was undertaken of spatial planning projects in national, regional and local level produced during recent revisions. Collectively, these research methods facilitated a study of the role, impact and effectiveness of the spatial plans in the context of contributing towards flood risk management goals.

National planning policy supports the consideration of flood risk management as an important part of achieving proper planning and sustainable development. The National Spatial Strategy (NSS) sets out a framework within which a more balanced and sustainable pattern of development can be achieved [6]. Spatial planning at regional and local levels is an essential part of the overall implementation mechanisms for the National planning policy and planning at these levels should address the suitability of locations for development including considerations relating to flood risk.

The Estonia legislation notes that flood risk management should be included as an element of spatial planning policies in municipal level.

### **Implementation of the EU Flood directive in Estonia**

The aim of the Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding (table 2). For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015[7].

Table 2. Implementation of the EU Flood directive in Estonia

Floods Directive transposition of Estonia legislation	26.11.2009
Preliminary flood risk assessment	22.12.2011
Flood hazard maps and flood risk maps	22.12.2013
Flood risk management plans	22.12.2015

To draw preliminary flood risk assessment the Estonian Ministry of Environment gathered flood data from origin sources source such as data from municipalities; data of the storm of January 9, 2005; spring flood data, 2010; data from media; data from Ministry of the Environment; data from Estonian Environment Information Center.

Preliminary assessment on the risks associated with flood risk was completed by the Ministry of the Environment, providing an overview of past floods and establishing the areas at significant risk[8]..

The assessment highlights 20 risk areas, including Tallinn, Tartu and Pärnu and several smaller areas, such as the rural municipalities of Häädemeeste, Audru and Hanila. Half of these areas are at risk due to rising coastal sea levels; another cause for floods is rainfall and

snowmelt[8]. At the South-West part of Estonia, in the study area, located 8 areas at significant flood risk.

Risk assessment is the first step for reducing the damage caused by floods in the future. Estonia will start comprehensive mapping of risk areas and the risk management plans - specific plans on how to prevent or at least mitigate damages caused by floods[8].

### **Flood risk management in practice of spatial planning.**

One of the most important ground principles of the Estonian Planning Act is - a local government that organises the planning is fully responsible for the content of the plan, the proceedings and planning decisions. The institution adopting a plan has to make a well-considered decision that takes into account all information gathered during the preparation of the decision.

Conditions and restrictions for using shores are provided in Nature Conservation Act. Building exclusion zone of a shore is an area with a certain width that is located on a shore of sea, where it is prohibited to construct new buildings and structures. The width of building exclusion zones of shores and banks is set as - 100 meters on the sea coast and on the shores.

Local authorities must define the boundaries of frequently flooded territories on their sea coast in Comprehensive Plans of municipalities. Building exclusion zones of shores are formed on the frequently flooded territories, involving the frequently flooded territory itself and the dimension of the building exclusion zone defined by the Nature Conservation Act which is 100 m for the sea coast.

The flood risks are handled in spatial planning document by 8 municipalities in South-West part of Estonia (Tab 3)

Table 3 Flood risk management in practice of spatial planning

<b>Name of Measure</b>	<b>Defined in planning documents</b>
Flood risk is generally described in planning documents	Pärnu, Haapsalu, Häädemeeste, Tahkuranna, Audru, Noarootsi, Vormsi, Ridala
The boundaries of frequently flooded territories are defined	Häädemeeste, Noarootsi, Vormsi, Ridala, Tahkuranna
The requirements for further assessment of frequently flooded territories outlined	Tahkuranna, Häädemeeste, Audru
Warning to residents of flood threat assured	Pärnu
The requirements of vertical planning requirements are generally described in planning documents	Tahkuranna, Haapsalu, Audru
The requirements of floor height defined	Tahkuranna, Haapsalu



The additional height requirements for building area	Haapsalu
Water-resistant building materials and constructions suggested	Häädemeeste, Audru, Tahkuranna, Haapsalu
The additional planning requirements for public and industrial buildings specified	Tahkuranna, Audru
The requirements for planning the water flow facilities described	Haapsalu
The requirements for geological studies described/	Haapsalu
Flood protection dykes and previous studies	Häädemeeste, Pärnu
The requirements for electrical construction specified	Audru, Tahkuranna

As case in point flood risk and climate change adaptation measures in municipal spatial planning taken at Pärnu, Haapsalu, Audru, Tahkuranna, Häädemeeste Noarootsi, Vormsi, Ridala municipalities (Tab 3).

The study showed that comprehensive plans in study area will apply for a period of 10 - 24 years, but a Planning Act requires periodic review of local comprehensive plans.

The analysis of the consequences of Hurricane Gudrun led attention to flood risk management. After January 2005 storm a warning system was put up in Pärnu, the equipment of which is located in five different places of the town. After storm the Pärnu municipality planned to construct a dike of 2-3 km long and 2 m high on the shoreline to provide protection from storm surges. However, due to the lack of funding, the project has been abandoned.

Coastal defenses and most coastal protection works do not take long-term climate change forecasts into account as Estonia is still too uncertain with regard to future predictions on the impact of climate change in the Baltic Sea region. The required level of protection is mainly based on historical trends in flooding and erosion and in addition to calls for better governmental reaction, for strengthening the spatial planning and strategic environmental assessment quality.

### **Conclusions and recommendations to develop to improve the effectiveness of the contribution of spatial plans to flood risk management**

Estonia has a very rich nature on account of its advantageous geographical position and landscapes that have been left relatively or completely untouched by human activity. The coastal protection expenditure in Estonia is very low. The local level in spatial planning have little knowledge of the effects of climate change and flood risk management, very little action is taken towards adaptation at the moment. This might partly be because of lack of funds, but it also seems to reflect the lack of dissemination from the topdown and also a lack of discussion among the local actors themselves [9].

Lääne County boasts the biggest percentage of protected areas (about 32%); the percentage of protected areas in Pärnu County is about 24% [10]. Strategic environmental assessment (SEA) of regional and local spatial planning should include flood risk as one of the key environmental criteria against which such plans are assessed where flood risk has been identified. The SEA process provides an opportunity to assess and consider flood risk with respect to other planning and environmental considerations Natura 2000 areas and should be used to show how the sequential approach to managing flood risks has been executed.

A number of measures necessary to plan in the field of nature conservation, improve habitats, particularly those of threatened species, for example, those measures listed in management and action plans of Nature conservation area. Therefore, the consideration of additional measures to reduce flood consequences could be expected.

The location of each flood management measure must be drawn in spatial planning documents, where possible on the basis of studies. The final location will be determined during the next round of decision-making.

Municipalities could work together to assess flood risk issues. Following this approach, different authorities would develop and train specialists in the context of assessing flooding impacts. Planners, decision makers and stakeholders need to guidance and other educational resources to raise awareness of flood risk management in spatial planning.

Spatial planning offer an opportunity to examine the flood risk management can play in contributing to preparing for climate change and minimizing flood risk.

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