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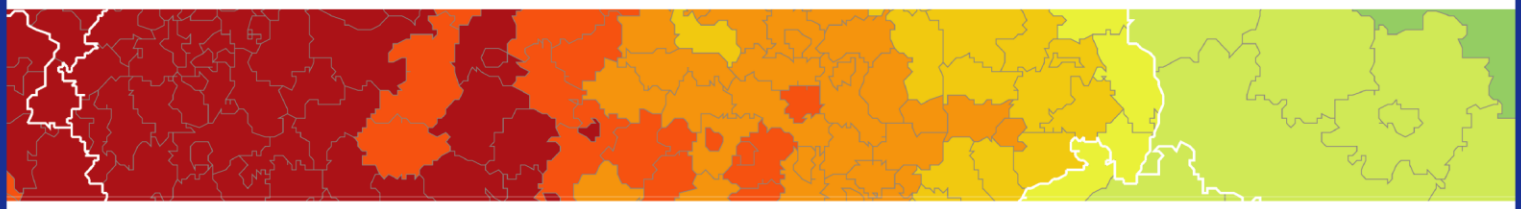

ESPON-TITAN
Territorial Impacts of Natural Disasters

Applied Research

Final Report – Case Studies Report
City of Pori (Finland)

June 2021

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Case Study Report

ESPON-TITAN
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City of Pori (Finland)

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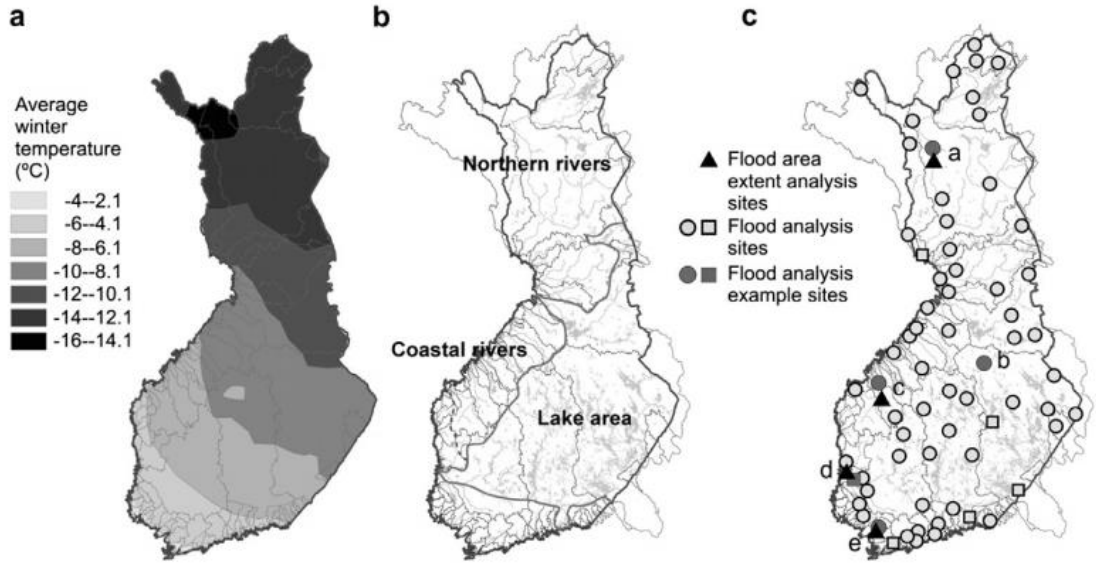
1 Introduction

Pori is the seventh-largest urban area in Finland. It is situated 237 km northwest of the country capital, Helsinki. Pori is also the Satakunta region's capital (pop. 224.028) and the Pori sub-region (pop. 136.905). The city has a population around 84.318 inhabitants in 2.062 km^2 (Density: 101,09 inhabitants/km^2). Located in the Kokemäenjoki river basin, the topographically low-lying delta area is one of the most flood-prone areas in Finland.

This place represents one of the most vulnerable flood risk areas. About 15.000 people live in the flood-prone area. The river is known for harmful winter floods and ice breakup jams. A severe summer flood caused damages worth EUR 22 million in Pori in August 2007. It is considered the most devastating urban flood event ever observed in Finland. At least in Pori, even more attention is necessary to flood protection in the future. Since the modelled water levels in 2070-2099 were higher than in the reference period with all scenarios. In Pori, the difference between the maximum 2070-2099 projection and the reference period was 31–36 cm, depending on the downstream boundary water level.

Figure 1. (a) Average winter temperature (Dec–Feb) in 1971-2000, (b) Watersheds and hydrological regions, and (c) Discharge observation stations



Source: Veijalainen et al. (2010) (a: Finnish Meteorological Institute, 2009; b: based on Korhonen and Kuusisto, 2010)

2 Main characteristic of the administrative structure and planning system

2.1 Brief introduction to the administrative structure

From the point of view of the administrative structure and governance system, Finland is a centralized republic. The highest-level bodies of government in Finland are the Parliament of Finland, the President of the Republic, and the Finnish Government. Parliament (eduskunta), that includes 200 members, enacts laws and decides upon the state budget. Parliament also supervises the operations of the government, and its members are elected every four years.

Regional State Administrative Agencies (aluehallintovirasto) and Centres for Economic Development, Transport and the Environment (elinkeino-, liikenne- ja ympäristökeskus, ELY-keskus) handles the regional administration. Finland has six of them. The agencies handle the implementation and supervision of the law in their regions. The Regional State Administrative Agencies are responsible for basic public services, legal rights, and permits, rescue services and readiness, police, occupational safety, environmental license. In turn, the Centres for Economic Development, Transport, and the Environment. Their tasks include advising businesses, environmental protection, promoting traffic safety, promoting the integration of immigrants.

Local state administration refers to those authorities that handle state duties in a particular area, including Police, Prosecutor, Distraint offices, Local register offices, Employment, and Economic Development Offices, Tax offices, Customs or Legal Aid Offices.

Municipalities represent the local level in Finland. They are self-governing or, in other words, they can decide on their matters. The Municipalities have the power to levy taxes, which means that they can collect municipal tax from their residents. The municipalities are obliged to organize a variety of services for their residents. These include health care, child day-care, and education. Besides, they can offer other services (more information is available on the InfoFinland webpage[1], for each of Finish municipalities).

Each municipal council is responsible for taking their own decisions. Through a municipal election held every four years, people choose the members of the council. The council elects the members of the municipal board whose duty is to prepare and implement council decisions.

[1] https://www.infofinland.fi/en/frontpage

2.2 Brief introduction to the planning system

The general guidance for land-use planning is the Land-Use and Building Act (Maankäyttö- ja rakennuslaki, MAL 132/1999[2], which is under revision, and expected to be ready in March 2021). The development of the regional and municipal planning answer to the national land-use guidelines. These National guidelines are given a more specific and concrete form in Regional and municipal plans and planning decisions. The Ministry of the Environment (Ympäristöministeriö) is responsible for developing steering instruments for land-use. Steering ensures that land-use and planning implement the objectives of, and meet the requirements set, by legislation.

Centres for Economic Development, Transport, and the Environment steer and monitor municipal land-use planning, providing advice on planning issues. There is a monitoring process for the land-use planning situation and the related changes. The state's environment administration is compiling data on municipalities, regional councils, and Administrative Courts. The environment administration has developed the Information System for Monitoring Land-Use Planning and forms for monitoring local plans. These facilitate the compilation and forwarding of data.

The land-use planning system includes:

- National land-use guidelines. The Government sets National land-use guidelines. The Ministry of the Environment is responsible for the related preparations;
- Land-use plans: regional land-use plan, local master plan, local detailed plan;
- Regional schemes and programs, Regional and municipal strategies;
- Municipalities' land policy and building ordinances.

Regional planning (maakuntakaava) includes:

- The regional scheme;
- The regional plan;
- The regional development program.

The regional plan is a map prepared according to the Land-Use and Building Act, and it displays not only the region's land-use and community structure plans, but also outlines building and environmental development in the coming decades. The regional planning provides instructions on municipal land-use planning and other official activities which affect it. Regional plans are formulated and confirmed by the Regional councils.

[2] https://www.finlex.fi/fi/laki/ajantasa/1999/19990132

Several factors impact municipal land-use policies (land-use plans and land policy). These include actual land-use planning processes and others, such as industrial, social, and housing policy.

Municipalities' land-use planning instruments include the following, for example:

- land-use strategies and programs within the municipality;
- a local master plan (yleiskaava) and a local detailed plan (asemakaava);
- land policy;
- building ordinance.

The regional plan defines land-use in the region. The local master plan lays down the objectives of land-use in the municipality. It outlines general development in the municipality, and the use of the land area it covers, for example, the location of residential areas, places of employment, and traffic routes. It is possible to prepare a partial master plan for areas such as shores. Such planning may be more detailed than the local master plan.

The Ministry of the Environment is responsible for the general development and guidance of maritime spatial planning and international cooperation.

Regarding sectoral planning, it is distinguishable maritime spatial planning. The purpose of maritime spatial planning is to promote the sustainable development growth of the different forms of use of the maritime area, sustainable use of natural resources, and achievement of good status for the marine environment. In this sense, the main instrument to face the risks as floods will be the sectoral planning.

Flood Risk Management Act[3] (620/2010) came into force on 30 June 2010 and the Government Decree on Flood Risk Management, on 7 July 2010. The Act aims to reduce flood risks, prevent and mitigate the adverse consequences caused by floods, and promote the level of preparedness for floods. Its purpose is also to help coordinating flood risk management and the river basins management while considering the needs relating to the sustainable use and protection of water resources. Among other things, the Act lays down obligations to perform a preliminary assessment of flood risks, specifies significant flood risk areas, and aids in the preparation of flood risk management plans. Including climate change in planning related to flood risk management. Although planning includes the implementation of flood risk, it does not have enough importance, as it is included in the Flood Risk Management Plan of the Kokemäenjoki river.

[3] https://www.finlex.fi/en/laki/kaannokset/2010/en20100620

3 Hazard profile and economic impacts of natural hazards in the City of Pori

The main risks present in Pori city are river floods and pluvial floods. Climate change is expected to increase floods risk in the river due to increasing autumn and winter floods, while spring snowmelt floods are likely to decrease due to warmer winters with less snow (Veijalainen et al., 2010; Söderholm et al., 2018). Also, coastal floods are projected to increase with rising average sea levels and more frequent storms (Pellikka et al., 2018).

In the case of river floods, the size of the flood risk area in Pori is about 50 km^2. Less than half of this area is built-up. The rest are agricultural and sparsely populated areas. There are about 5.000 apartments and 15.000 inhabitants in the flood risk area. The flood risk area in Pori is not unambiguous, as water can flood the country from many different places. In this sense, the water level is affected by sea level, the magnitude of the flow, and the location, size, and shape of any frazil ice or ice jams. Moreover, the water may be dangerously high even in only one part of the river, and that is why most of the Pori city area is protected by dams which protect the area from floods and more common rises in water levels. Consequently, problems occur mostly in the areas not protected by dams or when there is leakage. Moreover, if the flood protection levees are overtopped, the estimated direct damage in Pori increases to hundreds of millions of euros.

Flooding from the river tends to occur on a 10-20 years regular basis. Due to flood risk management, in the last 50 years no extreme events have occurred. The last big river flood happened in 1974-1975 (from December to February) when the Kokemäenjoki river flooded because of ice jams raising the water level considerably (the flood was named Kekkostulvat). Other severe floods in the past took place in the years 1899, 1936, 1944 and 1951. Some more recent river floods worth mentioning happened in 2005, 2011, 2015 and 2017. In these episodes, the damages were not too severe, as there was no flooding inside the dams and because of better risk management.

The mainly affected area in the case of a river flood is Pori City area surrounding Kokemäenjoki river. In this case, risk comes from the possible leaks of northern areas dams and floods. The most flood-sensitive areas are Sunniemi, the lower areas of Kivin, the area from the Toukari field area to the northwest of the flood protection area, and the area of the islets, as there are no dams. The only way to protect the areas from floods is upstream clot frazil ice booms and water regulation.

The main effects in the case of a river flood in Pori are impacts on the surrounding environment, losses in homes, business and livelihood, as well as contaminants and wastewater flooding. Damage estimates are uncertain as both the extent of the flood and the impacts, many of them indirect (Koks et al., 2015), depend on framings and are unforeseeable. In regards of indirect losses, the total damage of a worst-case river flood in Pori has been estimated to increase to several milliard euros (City of Pori, 2010). The worst-

case scenario, the maximum economic consequences of floods, including direct and indirect impacts, are estimated around 3 milliard euros, of which approximately half is property loss, and the other half, business losses. The reason for the economic damages rise is the city expansions in the 1990s, as before, a lot of the area used to be rural with some industrial sites. However, nowadays there are 15.000 inhabitants in the risk area that might have to be evacuated, and 5.000 apartments which could suffer. In this sense, costs related to property damages, as well as damages to the livelihoods of Pori inhabitants can increase severely. Casualities may occur in the worst-case scenario (5.000, cold; 1,0 m). Fortunately, no lives have yet been lost due to river floods in the City of Pori.

The other risk present in the case study is pluvial floods. The City of Pori is very flat and with the City being protected from river floods by dams by both sides of the river, the stormwater cannot naturally flow into it. As a consequence, the stormwater needs to be pumped into the river from the main ditches by pumping stations. Along with this, there are some natural and man-made retention basins to help to contain water, but problems arise when the discharge capacity of the ditches and the pumping capacity of the pumps are exceeded. The impacts of such risk are smaller and more local than with river floods. Extreme stormwater floods are rare.

On August 12, 2007, Pori experienced a rare heavy rain that passed through the city in a narrow lane, resulting on flood. Therefore, surface waters flooded the streets and residential areas, and the underpass tunnels collapsed because of the water, and divided the city in two. About 1.500 properties suffered water damage, although there was no personal injuries or serious accidents. Waste and stormwater entered the basements of the buildings through sewers, as well as directly from doorways and ramps causing serious damage; consequently, buildings, furniture and vehicles suffered water damage. Rescue service received about 300 pumping requests from citizens to dry their cellars.

As a difference with river floods, in the case of a pluvial flood event, the whole urban area of the City of Pori may be affected. In that case, economic impacts evaluation is made by ad hoc teams working in cooperation with flood teams. In 2007's storm flood, the losses amounted to EUR 21,7 million. For private properties, insurances paid EUR 8,2 million, the city of Pori paid EUR 4 million and the estimate for other damages paid was EUR 3 million. The damages in real estate amounted to EUR 2,2 million, and damages in the street network to EUR 1 million. Other damages identified are EUR 0,3 million in conveyances, EUR 1 million in business interruptions and EUR 2 million in latent damage.

Concerning indirect costs, the main impacts are contaminants and wastewater flooding and the consequences on businesses and industry.

4 Disaster Risk Management (DRM) on the case study level

4.1 General remarks

Legal Framework for managing flood risk planning is implemented in Finland following the Flood Risk Management Act (Laki tulvariskien hallinnasta 620/2010[4]) and the Flood Risk Management Decree (Valtionneuvoston asetus tulvariskien hallinnasta 659/2010[5]). This legal framework is in line with the Directive 2007/60/EC[6] of the European Parliament and Council on the assessment and management of flood risks. The purpose of the law is to reduce flood risks, to prevent and mitigate the harmful consequences of floods, and to promote flood preparedness. Also, this law aims to coordinate flood risk management and other management of the river basin district, considering the needs for the sustainable use of water resources and protection. The Flood Risk Act includes both river and stormwater flooding, as it covers the management of flood risks in general.

Under the Flood Risk Management Act (Laki tulvariskien hallinnasta 620/2010), flood groups are set within risk areas. A flood group should be set in each river basin district and coastal area for which one or more significant flood risk areas have been designated based on a preliminary flood risk assessment. These groups are made up of representatives of the relevant economic, transport and environmental centers (ELY-Centers), provincial associations, municipalities and regional rescue services. The creation of these groups aims to cooperate in the preparation of the flood risk management plan. The tasks of the flood group are to develop the reports prepared for the flood risk management plan; to set flood risk management objectives; and to approve the proposal for the plan and the measures contained therein.

The flood group shall, at the different stages of the preparation of the flood risk management plan, establish adequate interaction with the authorities of the river basin district and significant coastal risk area, as well as with operators, land and water owners, water users and representatives of relevant organizations. As an example, the Kokemänjoki river area flood group[7] has published the Flood Risk Management Plan (2016-2021) for the Kokemäenjoki River Basin[8]. This report covers broadly the flood risk in the Kokemäkijoki river area, stating the Pori area as one of the most risk-prone areas; the report also defines possible damages a flood can cause in the area.

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[4] https://www.finlex.fi/fi/laki/alkup/2010/20100620

[5] https://www.finlex.fi/fi/laki/alkup/2010/20100659

[6] https://www.eea.europa.eu/policy-documents/directive-2007-60-ec-of

[7] https://www.ymparisto.fi/fi-FI/Vesi/Tulviin_varautuminen/Tulvariskien_hallinta/Tulvariskien_hallinnan_suunnittelu/Tulvaryhmat/Kokemaenjoen_vesistoalueen_tulvaryhma(26105)

[8] https://www.doria.fi/bitstream/handle/10024/117987/Raportteja%20104%202015.pdf?sequence=2&isAllowed=y

Other National Legislation that is related to risk management of floods includes: the Dam Safety Act[9] (Patoturvallisuuslaki 494/2009), the Rescue Act[10] (Pelastuslaki 379/2011), the Land Use and Construction Act[11] (Maankäyttö- ja rakennuslaki 132/1999), the Water Act[12] (Vesilaki 578/2011), the Act on Environmental Impact Assessment of Government Plans and Programs[13] (SOVA, Laki viranomaisten suunnitelmien ja ohjelmien ympäristövaikutusten arvioinnista 200/2005) and the Act on Environmental Impact Assessments[14] (Laki ympäristövaikutusten arviontimenettelystä 468/1994).

4.2 Risk assessment

There is a clear differentiation between pluvial floods and river floods in terms of risk assessment. River flood risk assessment is done based on available data on actual floods and the evaluation of climate and water conditions considering long-term climate change. Following the preliminary flood risk assessment, flood risks have been assessed systematically on a nationally uniform basis. Law and Regulation on Flood Risk Management (620/2010 and 659/2010) specify things that the evaluation should include. Therefore, a preliminary flood risk assessment report, which serves as a background document for proposals for significant flood risk areas, was prepared for all Finnish river basins and the sea coast. The report describes, among other things, past and potential future floods with damage data and identified flood risks. In connection with the preparation of the flood risk management plan, an environmental assessment has been carried out following the Act on the Environmental Impact Assessment of Government Plans and Programs (SOVA, 200/2005). The ELY centres are, in cooperation with flood groups and other stakeholders, responsible for preparing the plans, study and assess the environmental impact of the implementation of the management plan and its measures.

The Flood Risk Act (Laki tulvariskien hallinnasta 620/2010) also states that the areas which are deemed as significant risk areas in preliminary studies are required to be planned. In this context, flood hazard maps describing the distribution areas of floods with different probabilities, and flood risk maps showing the possible harmful consequences of such floods, shall be prepared (Figure 2). The city of Pori also prepares risk maps of storm floods.

[9] https://www.finlex.fi/fi/laki/ajantasa/2009/20090494

[10] https://finlex.fi/fi/laki/ajantasa/2011/20110379

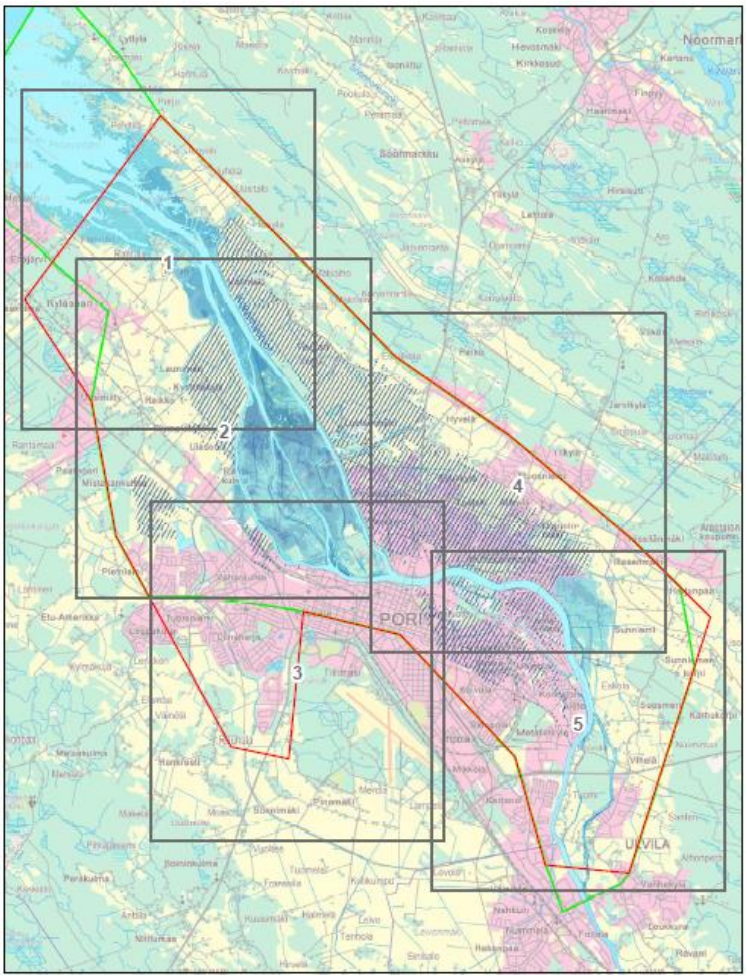
[11] https://www.finlex.fi/fi/laki/ajantasa/1999/19990132

[12] https://www.finlex.fi/fi/laki/ajantasa/2011/20110587

[13] https://www.finlex.fi/fi/laki/ajantasa/2005/20050200

[14] https://www.finlex.fi/fi/laki/alkup/1994/19940468

Figure 2. Flood hazard and flood risk map, floods (open water)



Source: Flood Risk Management Plan for the Kokemäenjoki River Basin For 2016-2021

Within the river basin management plans, risk assessment and spatial planning are integrated.

4.3 Risk management

Flood risk management in Finland has focused on the regulation of water bodies and other means of flood protection, such as maintenance dredging and dykes. Consequently, flood protection measures have been implemented in Pori and other high-risk areas over the centuries. They include dredging, diking, channelling, and dams, walls and embankments, which are linked also to dam safety based on the Dam Safety Act (Patoturvallisuuslaki 494/2009). Since 2008, approximately EUR 10 million have been invested in flood protection and another EUR 5 million will still be invested during the next half-decade. Moreover, control measures include spatial planning and statutory Environmental Impact Assessment (EIA). These measures play a key role in developing adaptive risk management (City of Pori, 2009). In these lines, flood damage can also be significantly reduced by planning land-use wisely and directing construction outside flood areas.

In the case of an event, the first level of action comes from the city administration. Then, if the situation gets worse and an evacuation is needed, emergency personnel come into action. In this line, the city of Pori has its own Dam Safety Plan and act according to this plan, where protocol and roles are defined.

In order to inform the public, the Flood Protection Instructions web page[15] offers several guidebooks on how to prepare for floods, what to do after they occur, and general instruction on flood risks and safety. A book addressing the financial preparations people can take to insure and to protect property against floods is also available on the website. Moreover, in the city of Pori, several telephone numbers are available for citizens in the case of flood danger for people or property, and where people can alert the emergency services if an increase of the water level of the river is noticed.

The main financial mechanisms behind risk management are taxes (Governmental taxes as well as municipal and city-specific taxes). Private individuals can also purchase insurances to insure their property against floods in flood-prone areas. These flood insurances are limited to floods which recur less than every 50 years.

There are some privately established embankment communities in agriculture and sparsely populates areas in which the residents construct private self-financed field drainage areas to protect their lands and crops from flood damages. These areas are not deemed to have sufficient risk or damage consequences in flood incidents for the government to handle the risk management of the area. The government used to compensate for flood damages to a point, but currently it is done through private insurances. The government might grant financial help in establishing these drainage areas if applied, but they are granted on a case-by-case consideration.

[15] https://www.ymparisto.fi/tulvaohjeet

5 Climate Change Adaptation (CCA) in the City of Pori

5.1 General remarks

Since 2005 there is a National Strategy for Adaptation to Climate Change[16], which objective is to reinforce and increase the adaptive capacity of society. For this aim, the measures try to minimize the negative impacts while taking advantage of any favourable impacts. This strategy insists on the integration of adaptative measures, with a sectoral perspective, into planning.

The implementation of indicative measures listed in the adaptation strategy (reported in Finland's Fifth National Communication) has already started in different administrative sectors. For instance, the Ministry of the Environment and the Ministry of Agriculture and Forestry have published implementation programs.

A significant share of the adaptation measures is implemented at the regional and local levels. Various measures promoting the provision for climate change, such as flood protection, have already been taken on at the regional or municipal level for quite a long time, though they have not been seen as adaptation measures as such. By the end of 2012, 16 out of 18 regions had a climate strategy published, which included a certain degree of adaptation. In 2012, approximately 40% of the municipalities were undertaking systematic climate actions and, although their focus has been on climate change mitigation, climate change adaptation has also been promoted. To be able to advance effective adaptation measures, local and regional operations should be further promoted.

About the relation between climate change and water risk, adaptation to climate change measures will be addressed in the River Basin Management Plans to 2021[17], based on the EU Water Framework Directive. One main challenge to achieving good water quality status in surface waters is the reduction of nutrient pollution. The runoff will increase as a result of climate change, causing erosion processes that result in the transport of larger amounts of soil material, rich in nutrients, to surface waters, thus contributing to eutrophication. Adaptive measures for improving nutrient management are needed in many sectors, particularly in agriculture. Additionally, better risk management of accidental events such as overflows from wastewater treatment plants and better management of stormwater is needed.

16 https://www4.unfccc.int/sites/NAPC/Documents%20NAP/Adaptation%20Strategies%20and%20Plans/Finland's%20National%20Adaptation%20Strategy%20-%20an%20integral%20part%20of%20the%20National%20Energy%20and%20Climate%20Strategy.pdf

17 https://ec.europa.eu/environment/water/participation/map_mc/countries/finland_en.htm

The relation between climate change and weather events in Pori is clear. And it is visible in the rise in extreme weather events as the rising average sea levels and more frequent storms (Pellikka et al., 2018) or (STAT, 2013):

- Heat waves will become longer and more frequent, whereas severe cold spells will gradually diminish;
- Heavy rainfall events will intensify in the summertime;
- The number of days with precipitation will increase in the wintertime;
- The snow season will become shorter, and the snow water equivalent will decrease on average, particularly in southern Finland;
- The duration and depth of soil frost will decrease, particularly in snow-free areas like roads and airports. It will also hold for sea and lake ice cover;
- Winters will become cloudier and solar radiation will decrease;
- There will be minor increases in wind speeds in autumn and wintertime. Coastal zones will be affected.

5.2 Climate change impact assessment

Research has provided new information on Finland's vulnerability to climate change. A general assessment of vulnerability across sectors was the basis for the original national adaptation strategy of 2005. Subsequently, there are more detailed studies of vulnerability in sectors or specific environments. The National Climate Change Adaptation Research Programme[18] (ISTO, 2006-2010) funded 30 studies concerning the vulnerability of various sectors and also several synthesis studies. Climate change effects evolve following a non-linear progression. Therefore, to predict future events and their expected characteristics, climate change assessment is based on previous events (e.g.: a river flood in 2007).

The water sector will supposedly be most affected by climate change impacts. The direct costs from heavy rain (10% annual probability) may increase to several million euros, and more infrequent events, such as severe flooding (1% probability, or less), may increase costs to EUR 100 million. Furthermore, the indirect economic costs of extreme weather events may be higher than the direct costs. Due to the multiplier effect, the economic impacts within ten years maybe double (or even more) compared to the direct costs.

[18] https://climate-adapt.eea.europa.eu/countries-regions/countries/finland

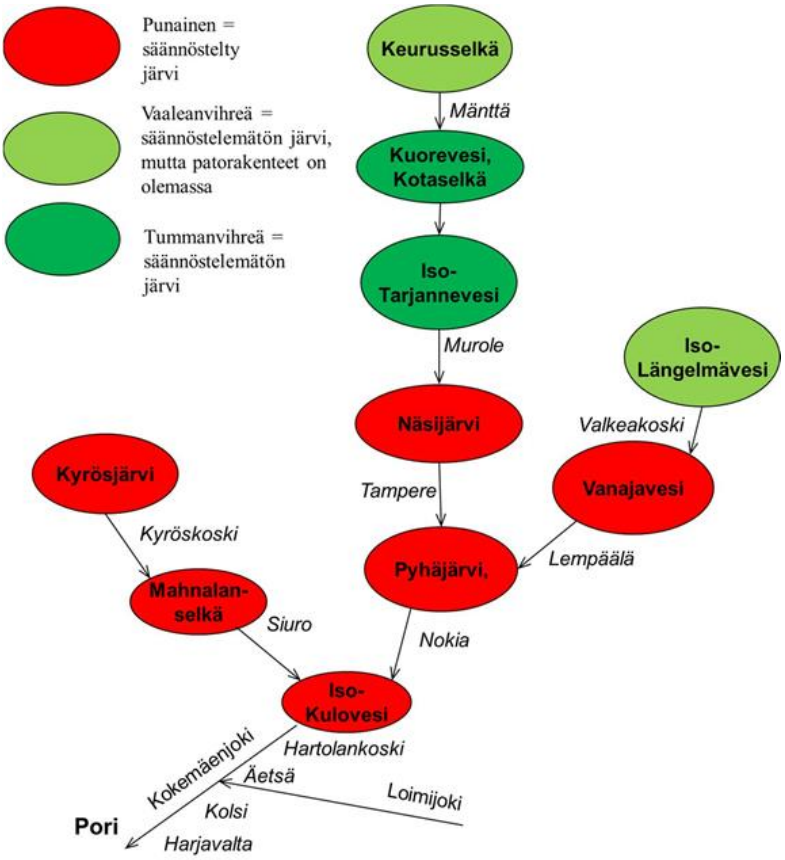
Table 1. Sectoral estimates of the economic impacts of climate change in Finland, and a summary of current research from the Finnish perspective (positive economic impact figures denote a net benefit)

Sector	Economic impacts	State of research
Tourism	By 2020, EUR 107 million; by 2050, EUR 107 million, by 2080, 107 million (changes in net value added)	International research, with Finland involved from 2006. Research conducted within Finland in 2005
Insurance	Weather and climate risks increasing, no overall estimates on economic impacts	No Finnish research
Agriculture	- By 2020, EUR 60 million; by 2050 - EUR 100 million; by 2080, EUR 120 million (changes in net value added) - About 1% of GDP	Latest study conducted within Finland in 2005. European PESETA project in 2009
Forestry	By 2020, EUR 75 million; by 2050, EUR 150 million; by 2080, EUR 250 million (changes in net value added)	Latest figures from 2005, estimates also from the recent VACCIA project
Biodiversity	No economic estimates. An estimate of EUR 10.000 million regarding negative impacts within Europe.	
Health and welfare	No economic estimates	No overall estimates, research also scarce on a global level
Built environment	Costs due to rivers flooding: **- In Pori, EUR 40-50, or up to EUR 100 million (for flooding events occurring once every 50 years)** - 0,2 to 0,4% of GDP	TOLERATE, PESETA, and ClimateCost estimated impacts of river floods; no overall estimates for the built environment
Transport and communications	Overall estimates based only on current costs. For example, weather-induced traffic accidents: about EUR 23 million; pedestrian slipping injuries: about EUR 2,4 billion	The EWENT project and the VTT Technical Research Centre of Finland estimated current costs; there are no Finnish estimates on the overall costs induced by climate change
Energy sector	By 2020, EUR 37 million; by 2050 EUR 73 million, by 2080 EUR 141 million (changes in net value added)	Latest estimates from 2005

Source: https://www.stat.fi/tup/khkinv/nc6_chapter_6.pdf

According to the Kokemäenjoen Flood Risk Management report (river basin level), the declining floods cannot yet be taken as a starting point for planning, even though floods in many parts of Finland will shrink in most climate scenarios due to the amount of snow and spring floods decrease. Climate change impacts beyond the magnitude of the flood risk have not been considered in the development of measures. There are also no potential indirect effects of climate change on flood risk management consideration.

Figure 3. Kokemäenjoen river basin



Source: Pulliainen et al. (2013)

There is an assessment of the resilience of the measures to climate change and the changes caused by climate change to the flood risks in the CLIMWATER project, considered in the planning of Flood Risk Management in Pori.

The evaluation of water course regulation adaptation strategies aims at communicating and integrating the results from the CLIMWATER project into policy making processes by facilitating a dialogue on the need to alter current water regulation policies and practices in response to changing hydrological conditions. This requires a closer cooperation between scientist, policy-makers and key interest groups.

The goal is to reduce the level of overall damages in case of flood expected once in 60 years (due to increased liquid winter-time precipitation) by applying an optimization model to watershed regulation (WSFS-based approach to minimize damages (in EUR) by optimizing regularization).

The first results by the optimization approach are a reduction around EUR 45 million (freeze drive to Kokemäenjoki) from total flood damage in the reference situation (EUR 490 million) (Pulliainen et al., 2013).

5.3 Climate change adaptation

In Pori, climate change adaptation is crucial for sustaining a city close to the sea and a river, which regularly experiences flooding (1/3 of citizens live in the areas where flooding is possible).

Both adaptation and mitigation measures have been applied in the city. For instance: usage of green energy, reduction of waste and recycling, and many others as retention ponds, a reservoir for stormwater, ponds in urban parks, strengthening levees (shelters against river flooding), according to the 21st century awareness of climate change effects. Between them, the most applicable, as stormwater reservoirs and retention ponds, represent the most attractive initiatives for the smaller municipalities with limited resources for implementing climate adaptation strategies in full.

Adaptation to climate change will be addressed in the River Basin Management Plans to 2021, based on the EU Water Framework Directive. A particular conflict is related to the sea level and its impacts on the coastal areas. Even considered as an isostatic land uplift, the northern parts of the Baltic Sea represent a risky area.

The issues that necessarily have to be addressed in the future include what level of coastal protection will be needed, how to cope with severe sea and river flood events, and how much the coastal protection will cost (especially this one). These issues appeared in detail in the Climate Change Adaptation Strategy of the Helsinki Metropolitan Area, published in 2012.

As part of the research project CLIMWATER, which is part of the Finnish Research Programme on Climate Change (FICCA), there are assessment initiatives, as designating flood-prone areas, and flood maps with the impacts of climate change scenarios (ProDOC).

6 Vertical and horizontal cooperation system in DRM and CCA in the City of Pori

In terms of spatial planning, the responsibility for zoning lies with the Ministry of the Environment (Ympäristöministeriö), whose responsibilities include the conditions related to zoning guidance and the development and manufacture of zoning legislation. The Ministry of the Environment, in cooperation with other ministries, provincial associations, and other relevant authorities and bodies, sets the targets.

Besides, participatory and coordinative elements are included in flood risk management within spatial planning also in local areas (City of Pori, 2008), counting on the participation of different local associations. However, they do not engage or successfully include their particular interests into general ideas as the common good or the national interest. For this reason, the state committees have also been focal sites for the spread and exchange of information, knowledge, beliefs, values, and even the construction of collective identities. Therefore, associations have greatly valued an invitation to participate in a state committee and, on the other hand, often fiercely complained about not being invited onto committees in their field.

In terms of climate change, the Coordination Group for Adaptation to Climate Change was reappointed in 2012 to monitor and promote the implementation of the adaptation strategy. Coordination tasks of this group included a broader assessment of the implementation of the adaptation strategy and its revision.

In general terms, the sectoral perspective prevails to facilitate the implementation of the policies in different sectors. Therefore, there is not enough cross-sectoral cooperation in climate change and risk prevention. In the future, cross-sectoral measures should be better integrated with and promoted as part of adaptation measures.

Beyond these particular aspects, at the national level, the Government working group for the coordination of research, foresight, and assessment activities (TEA Working Group) enables the Finnish ministries to cooperate and exchange information smoothly. It serves to strengthen horizontal oversight of research, foresight and assessment activities, improve the information base for decision making and develop new ways of disseminating information on research, foresight and assessment activities to decision-makers and society at long-term.

At the regional level, the responsibilities of a Regional Council about cooperation are:

- The overall development of the region, working in collaboration with the parties involved in the development of central cities and other municipalities, universities and government authorities in the region as well as in other regions, as well as the province of Lapland with the Sami Parliament; cooperation may be drawn up cooperation agreements;

- The launch of the province's transport system plan design process, the management of the related cooperation and coordination of the planning of the province with the rest of the design outside the Helsinki region (The Capital Region);
- Correspondance of the natural resources of regional large-scale, and as regards the environment, plans the launch of the planning process, the management of the related cooperation and coordination of the planning of the province with the rest of the design;
- Preparation of municipalities and other education providers of project proposals urgency of the order in the next financial plan for four years, with the exception of sports training centres projects cooperation among local governments.

7 Lessons learned from the case study

The **weaknesses** of this model can be seen as critical points that need attention and as areas for future development:

On higher levels of the government, the risks of flooding, river and stormwater are acknowledged, although on the local level, occasionally, the problems lose importance when more immediate concerns are presented and the allocation of finances are done.

The river floods in Pori cannot be avoided, but the damages they might cause can be lessened by flood management measures. In this line, the city of Pori raises dykes (the city of Pori has its own dam safety plan for the operation of flood hazards), and dredges rivers. However, this grey-infraestructures-based measures are more likely to alter the balance of the ecosystem, as opposed to nature-based solutions and green infrastructure. Especially with climate change, the conditions might worsen quicker than anticipated, and decisions must be made before the so-called maximum level of measures is met. In this line, a new tributary channel has been under discussion, but it is a very expensive procedure to build, so that its viability is questioned. On the other hand, the city of Pori does not have a specific river flood plan as a general framework to act. Instead, there are specific plans for each situation, losing the broader perspective.

In Pori City area, where the buildings have been built without much consideration or outdated methods concerning Storm Water Management, it is difficult and expensive to transform the area to meet modern standards. It is considerably easier to focus on the new building areas than to reconstruct the old ones. However, old ones represent an important extension of land and need to be addressed as well. In this context, in 2019 a working group was established to seek new solutions for stormwater management.

Besides, these questions are being discussed and different workgroups have been established to find solutions to these issues. The focus is on new solutions and good planning considering the possible future challenges with changing needs and the inevitable climate changes.

When evaluating the successes and bottlenecks of the implementation process for the various adaptation measures, the differences between sectors were clearly highlighted: in some sectors, the impacts of climate change can easily be recognised and uncertainties are either small or relatively easy to deal with, meaning that the necessary adaptation measures are easier to define. In general, an understanding of climate change risks has increased due to the more frequent occurrence of extreme weather events and increasing adaptation research promoting the launching of adaptation measures. There is also an identified need for a more thorough analysis concerning possible synergies and conflicting aspects of climate change adaptation and mitigation objectives in different sectors.

Although the sectoral approach of the Finnish Adaptation Strategy has facilitated implementation and follow-up in different administrative sectors, it has not yet sufficiently encouraged the launch of cross-sectoral cooperation. In the future, cross-sectoral measures should be better integrated with and promoted as part of adaptation measures.

The **strengths** of this model are:

Responding locally to the local problem allows the best resolution of the problem. Thus, the city of Pori has its own dam safety plan and a team to manage dam safety, which directs the city's actions in case of flood hazard. In addition, other actors participate in this risk management: the finnish State participates in supporting measures to protect against floods; the ELY-Centre is responsible for the regulation of the river basin considering flood protection; and, whenever needed, the Kokemäenjoki flood protection management team meets. This shows the good cooperation and communication between the different organizations present in the territory.

Pori city implements preventive measures that moderate and check all the structures to protect from floods. These structures are kept in good conditions and constantly checked (e.g., dams are checked twice a year).

The legal framework regulating flood risk management plans states that updates must be done regularly. This fact sets the obligation to maintain those maps updated and allocates resources to do so.

In Pori, flood hazard maps and risk maps are a very good tool to manage and plan flood protection and flood risks.

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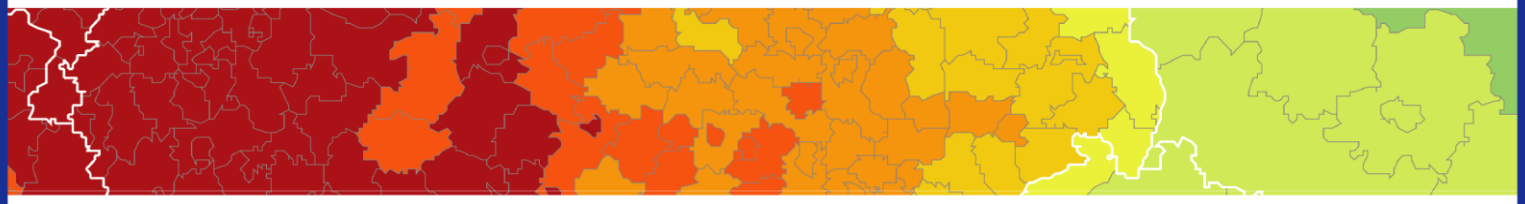

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