SATAKUNTALIITTO

Integrating the ecosystem services of the Kokemäenjoki river valley into land use planning

EUROOPAN UNIONI
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Interreg
Central Baltic

This plan was prepared as a part of SustainBaltic project (ICZM Plans for Sustaining Coastal and Marine Human-ecological Networks in the Baltic Region, CB354). Project enhances the share of the managed coastal networks in the Central Baltic area by the cross-border preparation of the ICZM plans for four case areas in Estonia and Finland. The lead partner in the project is the Department of Geography and Geology in the University on Turku. Other project partners are Finnish Environmental Institute, Regional Council of Satakunta, Estonian University of Applied Sciences (Eesti Maaülikool) and the University of Tallinn (Tallinna Ülikool). SustainBaltic is funded by EU Interreg Central Baltic Programme 2014−2020. The overall budget of the project is 1.3 million Euros, of which 1.023.000 Euros is granted via European Regional Development Fund (ERDF). updated completed ICZM plans can be downloaded from the websites of the partner organizations and at the http://www.utu.fi/SustainBaltic.

Turun yliopisto
University of Turku

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Foreword

In 2016–2018, the Regional Council of Satakunta took part in the SustainBaltic project (ICZM Plans for Sustaining Coastal and Marine Human-ecological Networks in the Baltic Region, CB354) funded by the Interreg Central Baltic 2014–2020 programme, the goal of which is to promote the planning of the sustainable management and use of coastal zones in the northern Baltic Sea region. The fact that coastal zones are located in the transitional zone between the land and the sea makes them sensitive to changes in the current state of both the land and the marine area, highlighting how important it is for sustainable development to carry out planning in a comprehensive manner that also takes the characteristics of the ecosystem into consideration.

In this case plan, the characteristics of the Kokemäenjoki river valley were analysed in the in the perspective of ecosystem-based planning. The aim was to produce information on the ecosystem services provided by the area and promote their acknowledgement in the planning of land use and water resources management in accordance with the principles of sustainable development. Plan demonstrates the applicability of ecosystem services as tool for sustainable development and how this concept can further be linked to current planning practices in Finland.

The case plan was created in collaboration between the Regional Council of Satakunta, the Finnish Environment Institute and the University of Turku's Department of Geography and Geology. This report was prepared by Project Planner Asko Ijäs, M.Sc., from the Regional Council of Satakunta.

Table of contents

Background information and reference material (in Finnish):

1. Leikola N., Kiviluoto S., Nurmi M., Syrjänen K., Kostamo K., Mononen L. & Vihervaara P. 2018: Työraportti SustainBaltic hankkeen vaiheesta A.T1.1 "Integrating obtainable environmental and human activity data into planning processes by GIS analysis tools". Suomen Ympäristökeskus SYKE. 40 s.
2. Mononen L, Vihervaara P. & Ijäs A. 2018: Kokemäenjoen ekosysteemipalvelut. SustainBaltic-hankkeen taustaraportti. Suomen Ympäristökeskus. 37 s.
3. Nordström P., Fagerholm N., Ijäs A., Savola A. & Hietala R. 2018: Kokemäenjokilaakson – ihminen ja luonto -kysely 2018. Turun yliopisto, Maantieteen ja geologian laitos. 81 s.

Photo by: The Regional Council of Satakunta

Introduction (1/3)

Coastal zones are located in the peripheral zones between land and marine areas and hold great significance for both nature conservation and human activity. From the perspective of the sustainable use of coastal zones, it is vital to find ways in which the different forms of land use can be coordinated so that the characteristics of coastal zones can be effectively preserved. To facilitate the achievement of this objective, the European Union has issued a recommendation on Integrated Coastal Zone Management (ICZM, 13/2002/EC), in which the usage needs of both land and marine areas are comprehensively considered and coordinated in accordance with the principles of sustainable development.

River basins are complex ecosystems, some of the key aspects of which are their hydrological and water circulation features, which give rise to the basin's characteristic species and habitat distribution. The vegetation and habitats surrounding waterways and water bodies also affect water evaporation and nutrient sequestration, which is why the land use of these areas can have significant impacts on the current state of the river basin and its ecosystem services (Alahuhta et al. 2010, Grizzetti et al. 2017). The European Commission's Maritime Spatial Planning Directive (2014/89/EU) highlights land-sea interactions as one of the overarching themes of planning. In other words, the sustainable use of maritime and coastal zones requires the integration of both marine- and land-based impact mechanisms into maritime spatial planning. The impacts of human activity can reach far beyond the area where the activity takes place, which is why the ways in which human activity on land impact the state of marine areas need to be assessed on an impact-by-impact basis, taking into consideration factors such as the nature of the activity, the transmission of impacts and impact mechanisms (Balaguer et al. 2008).

Rivers and waterways that drain into the sea are one example of land-sea interaction (Stoms et al. 2005). Through them, the activities carried out in different parts of a river basin often affect the condition and water quality of the entire basin. The resulting changes in water quality are also indirectly reflected in the state of river deltas and the surrounding maritime areas. Because of this, the good environmental status of a marine area cannot be safeguard solely by means of maritime spatial planning, requiring instead the coordination of land use planning, maritime spatial planning and water resources management objectives as well as comprehensive regional planning (Crain et al. 2009).

Introduction (2/3)

In Finland, water resources management and land use planning are carried out as separate processes, which are each steered by dedicated legislation. Although there are plenty of points of convergence between the planning processes and the planning authorities engage in cooperation with one another, there is still considered to be a need in the planning of river basin areas for harmonising planning processes and their objectives as regards the prevention of diffuse loads and flood management, for example (Alahuhta 2010, Lahti 2012).

The ecosystem approach is a planning method that emphasises the comprehensive consideration of an ecosystem's functions and values as part of the planning of human activity and land use (CBD 2004). Compared to traditional planning based on individual nature and cultural values, the ecosystem approach (or more generally ecosystem-based planning, see Slocombe 1993) instead emphasises the safeguarding of the physical, chemical and biological processes that sustain the ecosystem and thus enable the ecosystem to provide benefits to humans (so-called ecosystem services) (Jordan & Benson 2015).

Nature reserves and their sufficiency are often considered crucial for both biodiversity and the basic functioning of ecosystems. On the other hand, as noted by Wiens (2011), biodiversity cannot be safeguarded in practice by means of nature reserves alone, as the functions that facilitate the movement of different species or sustain the functions of ecosystems are connected to larger, regional wholes, for the protection of which the conservation of individual sites is simply inadequate. This difference in scale is apparent particularly in the context of large mammals (which in Finland include large predators and elk), which roam large areas and across different habitats instead of staying within the confines of nature reserves. To ensure the continued occurrence of such species, it is imperative to safeguard not only representative natural habitats, but a sufficiently large number of natural environments overall as well (Maier et al. 2005). The same applies to many regulation and maintenance ecosystem services, which, instead of being tied to individual sites or areas, are more dependent on the quantity of natural environments and their coverage (Iverson et al. 2014).

Introduction (3/3)

In Finland, regional planning plays a crucial role in safeguarding the connectedness of green spaces, the functionality of ecosystems and the provision of ecosystem services, since at this scale the planning process can be carried out in a way that takes into account not only individual sites and natural values, but larger green space complexes (such as core areas) and the functions that sustain ecosystem services as well (Helsinki-Uusimaa Regional Council 2016). However, coordinating different planning processes and making sustainable planning decisions from an environmental perspective requires a wide knowledge base of both the characteristics of the local environment and human activity in the area, so that the significance of the area and its potential uses can be assessed in relation to the area's ecosystems and the functions sustaining them. In this context, the key characteristics related to water basins include functions related to the water basin's hydrology and water circulation as well as their interaction with the biotopes and different habitats of the catchment area (Jordan & Benson 2015).

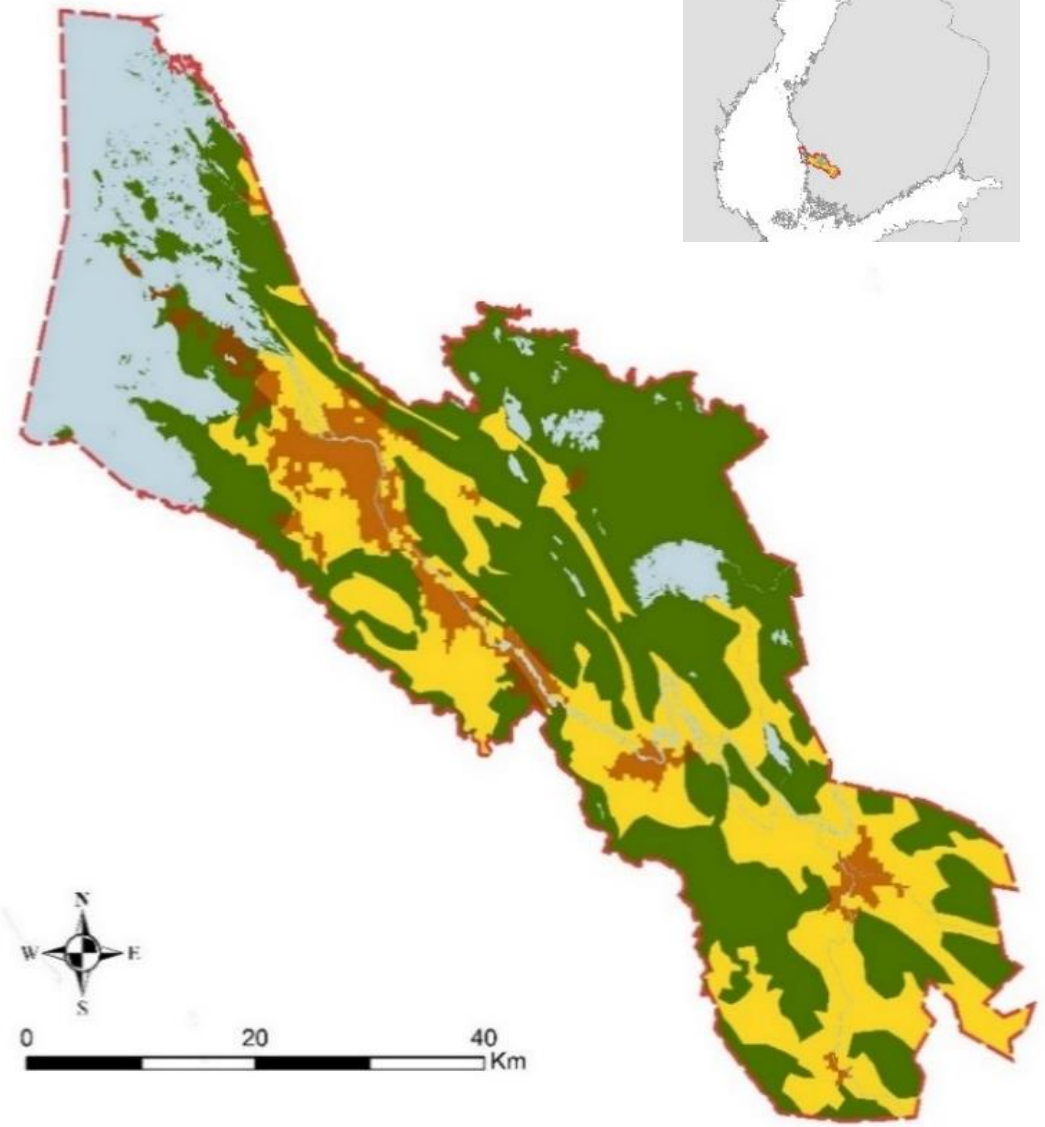
Figure 1. The Yyteri dune area is characterised by extensive sand formations (photo by Tomi Glad)

Background and objectives (1/3)

This plan examines the key concepts of ecosystem-based planning and assesses how they relate to Finland's land use and water resources management planning processes, using the Kokemäenjoki river valley as an example area. The plan presents the area's current planning situation, describes the current state and key values of the area with the help of the basic functions of the local ecosystems and, based on the aforementioned information, provides a general framework for integrating ecosystem-based planning into the planning processes that steer the use of land and marine areas.

Kokemäenjoki is one of the largest river basins in Finland, encompassing an area of 27,000 km^2 in the regions of Satakunta, Häme and Pirkanmaa. The large size of the Kokemäenjoki river basin and the diversity of the needs related to its use impose major demands for land use planning and the coordination of different interests. In the lower parts of the river basin, these include safeguarding the good environmental status of waters both around the river and in the Bothnian Sea coastal zone, ensuring the preservation of the area's history and cultural values as well as issues related to flood protection (Gaia et al. 2017). To emphasise land-sea interaction, the scope of this examination is limited to the lower parts of the river basin, encompassing the lower parts of the Kokemäenjoki river basin in accordance with the border of the Satakunta region (hereinafter referred to as the Kokemäenjoki planning area).

Figure 2. Definition of the planning area (base maps provided by the Regional Council of Satakunta and the National Land Survey of Finland 12/2017)



Background and objectives (2/3)

During 2016−2017, Gaia Consulting prepared a vision for the future of the entire Kokemäenjoki river basin up to the year 2050 (Gaia 2017), which defined both short- and long-term objectives for improving the state of the river basin and developing human activities in the area. The vision is a comprehensive impression of how interest groups see the role of the river basin developing in the coming decades and what kind of usage needs are associated with the area now and in the future. The natural and cultural values of the Kokemäenjoki river basin, the area's importance for people's well-being and the local economy all rely heavily on the good environmental status of the waterway and the aquatic ecosystem, which is why preserving it is a crucial aspect of how the visions' target state for 2050 is to be achieved.

The vision for 2050 is not a binding document based on legislation, due of which it does not steer decision-making in the same way as the land use or water resources management planning system. Instead, the vision defines the shared mindset of the river basin area's interest groups in regard to how the area should be developed and which themes should be promoted in the utilisation of the river basin. In this way, the vision harmonises objectives related to land use planning and water resources management and proportions them to the needs of local interest groups and businesses as regards issues such as the recreational use of the area, the development of business operations or the preservation of biodiversity.

Figure 3. Vision 2050 for the future of Kokemäenjoki watershed (Gaia 2017)

Background and objectives (3/3)

The plan describes the current state of the planning area from the perspective of its landscape structure and ecosystem services and examines how these concepts are linked to the planning of land use and water resources management. As regards the marine and coastal zone, the plan highlights potential drivers for change through which operations in the river basin may impact the Satakunta marine area. The preparation of the plan also involved the drafting of preliminary reports on the natural values of Southwest Finland and the ecosystem services of the River Kokemäenjoki (Leikola et al. 2017, Mononen et al. 2018). These preliminary reports examine existing geospatial data sets concerning the current state of the area and their deficiencies in regard to the definition of the green space network and the assessment of ecosystem services.

The plan is divided into four chapters: chapter 2 examines the current land use of the planning area and its central steering methods. Chapter 3 provides a brief introduction to the principles of ecosystem-based planning and its points of convergence with the concepts of green structure and ecosystem services. Chapter 4 describes the characteristics of the planning area and identifies the ecosystem services produced by different natural environments. Chapter 5 assesses the area's drivers for change, based on Finland's National Assessment of the Economics of Ecosystem Services (Jäppinen & Heliölä 2015). The area's ecosystem services and drivers for change are only described in general terms, with the aim of highlighting the importance of the ecosystem's functions for people and sustainable development.

Figure 4. Arantilankoski rapids (Photo by: Asko Ijäs)

2. The planning situation in the Kokemäenjoki area

Photo by: The Regional Council of Satakunta

Coastal areas in land use and maritime spatial planning (1/2)

Integrated Coastal Zone Management (ICZM) planning is based on the United Nations' sustainable development programme (Agenda 21, Earth Summit 1992), which was adopted at the UN Conference on Environment and Development held in Rio de Janeiro in 1992. The biodiversity of coastal zones and the pressure to allocate land for various forms of human activity place an emphasis on the importance of careful planning, so that the environmental impact caused by human activity can be prevented, thereby facilitating the sustainable use of coastal zones.

The European Union applies the principles of sustainable use and management of coastal zones in the bloc's own legislation through 1) the Maritime Spatial Planning Directive (2014/89/EU) and 2) the Recommendation on Integrated Coastal Zone Management (2002/413/EC). One of the cross-cutting themes of the Maritime Spatial Planning Directive is land-sea interaction, which emphasises the significance of coastal zones and the human activity conducted there for the good environmental condition and sustainable use of marine areas. However, coastal zone management is not part of actual maritime spatial planning, and instead the directive emphasises the importance of having a national planning system in place to control land use in coastal zones. In practice, this means that the planning authorities of each member state have the right to decide on the use of their own coastal zones, and therefore legally binding decisions concerning coastal zones cannot be made as part of maritime spatial planning.

In Finland, land use planning is based on the Land Use and Building Act, which provides the framework for land use planning at various administrative levels and determines the main steering methods for the planning work at each level. The objective of the Act is to ensure that the use of land and water areas and building activities on them create preconditions for a favourable living environment and promote ecologically, economically, socially and culturally sustainable development. (Section 1 of the Land Use and Building Act). The Finnish land use planning system consists of 1) the National Land Use Guidelines, whose principles are further applied to practical planning with the help of 2) regional land use plans, 3) local master plans and 4) local detailed plans. The aim of this system is to ensure that the strategic decisions made on a national level are taken into account in regional and municipal level planning.

Coastal areas in land use and maritime spatial planning (2/2)

The amendment to Finland's Land Use and Building Act concerning maritime spatial planning came into force in October 2016. A maritime spatial plan is a general plan, the aim of which is to promote sustainable growth in Finland's marine areas and coordinate the various utilisation needs with regard to these areas while taking into consideration the current state and capacity of the marine ecosystem (Kaituri ym. 2017). Maritime spatial planning complements the Finnish land use planning system by providing the state and regions with the opportunity to conduct land use planning in the marine areas outside of our territorial waters (Kaituri et al. 2017).

The Land Use and Building Act grants regions and municipalities the right to create statutory land use plans not only for coastal zones, but for archipelagos and territorial waters as well, thereby allowing them to control the utilisation and sustainable use of these areas. The principles of integrated coastal zone management have been made part of the regional and municipal planning systems, and no separate coastal zone plan is therefore required. However, coastal zone planning can be used as a strategic planning tool for the purpose of producing information to support land use planning, the organisation of water resources management and general regional development, for example. Strategic planning helps create a foundation for turning the developmental principles established by regions and municipalities, for example, into concrete goals and for assessing the potential environmental impact of general planning policies (Laitio & Maijala 2010).

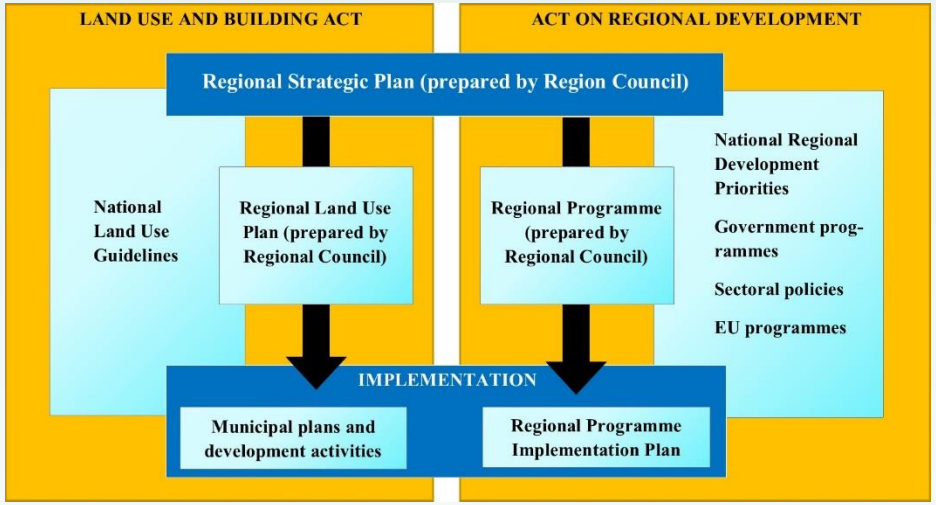


Figure 5. The regional planning system (adapted by the Regional Council of Satakunta 2016)

The planning situation in the Kokemäenjoki river basin (1/3)

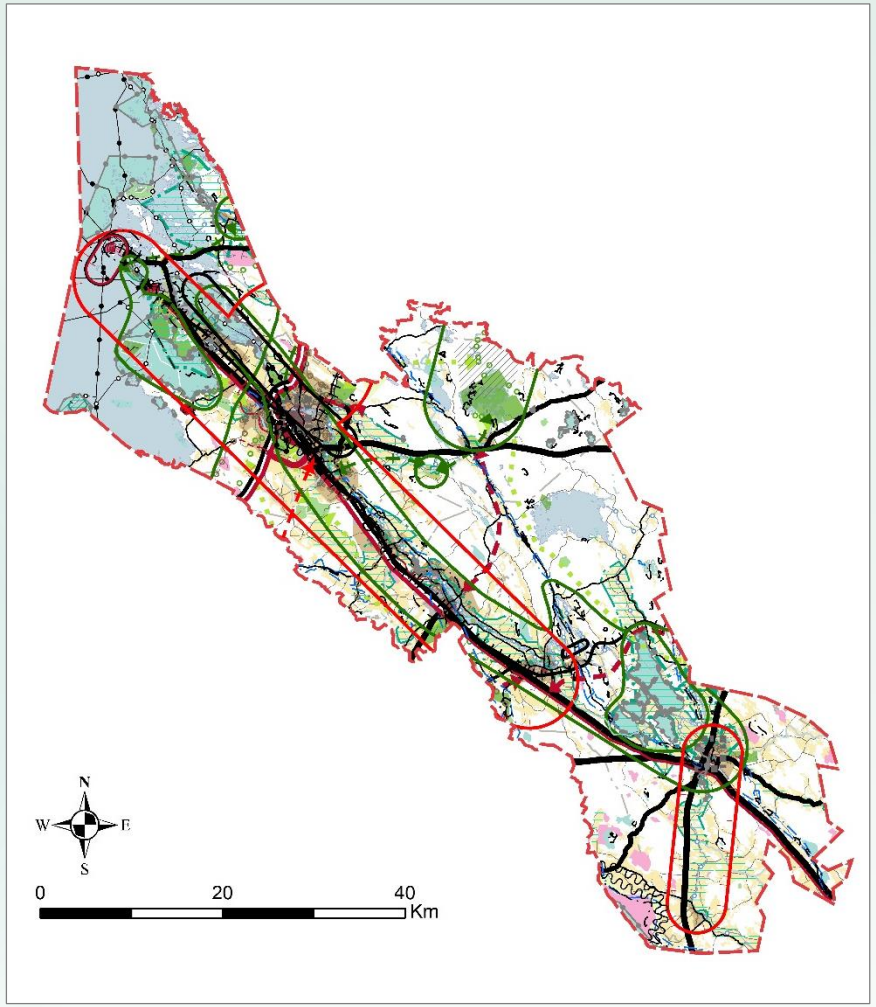
Regional land use planning

The regional land use plan is part of the region's planning system, which supports the ecologically, socially and economically sustainable use of the area at a regional level, and applies the strategic objectives of the National Land Use Guidelines to the planning performed at regional level. The party responsible for the preparation of the regional land use plan is the regional council, and they are drafted with input from a wide variety of local interest groups.

The comprehensive regional land use plan of Satakunta was approved by the Ministry of the Environment on 30 November 2011 and became enforceable by the decision of the Supreme Administrative Court of Finland on 13 March 2013. The regional land use plan considers land use in the entire region and seeks a balance between a wide range of themes concerning land use, regional development and the conservation of natural and cultural environments, to name a few. The comprehensive regional land use plan of Satakunta has been supplemented with two regional phase plans, which supplement the original plan as regards themes considered significant for the area. The 1st regional phase plan, dealing with wind energy, was approved by the Ministry of the Environment on 3 December 2014 and became enforceable by the decision of the Supreme Administrative Court of Finland on 6 May 2016. The 2nd regional phase plan is currently in the proposal phase. It deals with the development of peat production and solar energy as well as the acknowledgement of national and regional landscape areas, among other things.

The regional land use plan of Satakunta designates a variety of functions related to both building and regional development as well as nature conservation and recreational use for the Kokemäenjoki planning area. Housing and industrial functions are concentrated along the main channel of River Kokemäenjoki in the area between Pori and Kokemäki, reflecting the importance of the waterway for both people's well-being and business operations.

The planning situation in the Kokemäenjoki river basin (2/3)



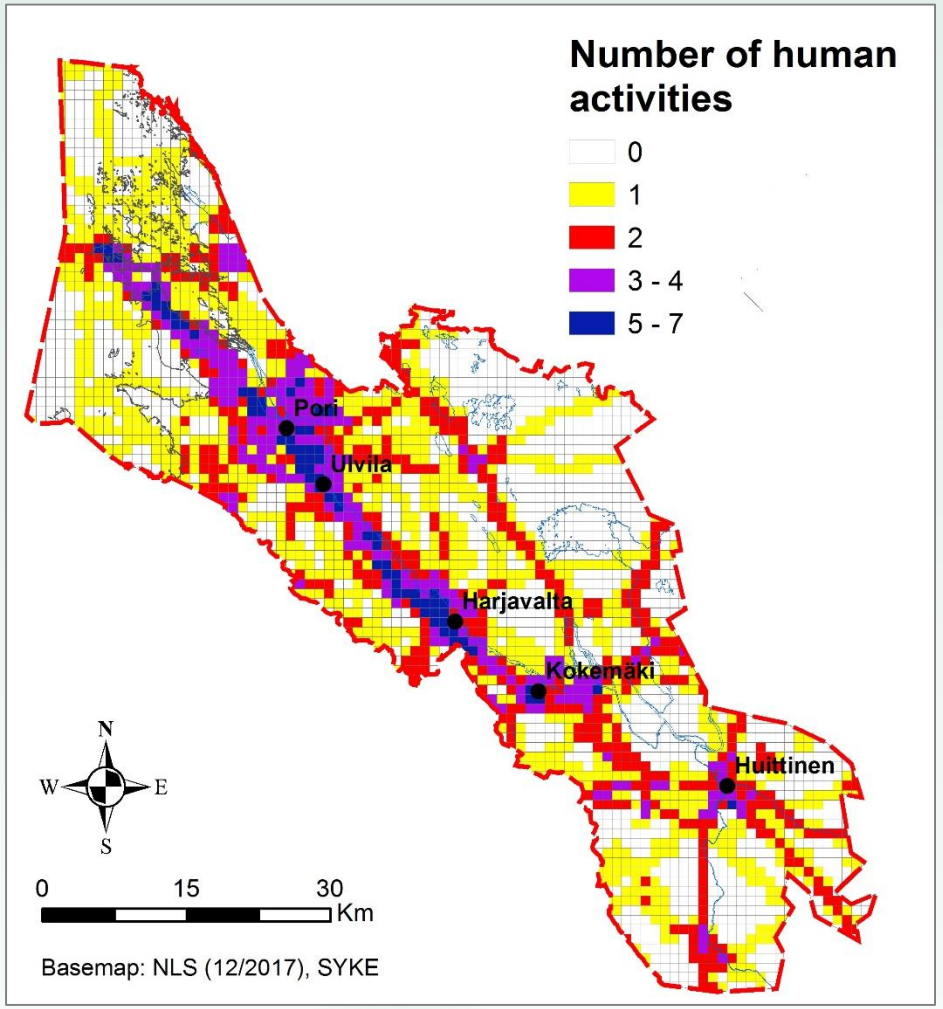


*Figure 6. A) Notations of the regional land use plan of Satakunta, and B) the number of planning notations enabling construction or changes in the environment in different parts of the area (1 km * 1 km squares)*

The planning situation in the Kokemäenjoki river basin (3/3)

Master planning

Local master plans allow municipalities to steer land use and the development of the community structure in their area and preserve the notable natural, cultural and recreational use values of their areas. Local master planning is usually based on the municipality's need to develop the community and coordinate different interests in accordance with the principles of sustainable development.

In addition to the regional land use plan, a total of 52 local master plans have been prepared or are currently under preparation for the Kokemäenjoki planning area. Together, these plans encompass 67% of the region's total area. The development of the planning area's population centres, excluding Meri-Pori, is subject to statutory local master plans. Fewer statutory local master plans have been prepared for areas outside of population centres, and in these areas land use is steered by the notations of the regional land use plan.

In addition to local master plans, the use of the planning area's coastal zones and holiday building therein are also steered by a number of detailed shore plans.

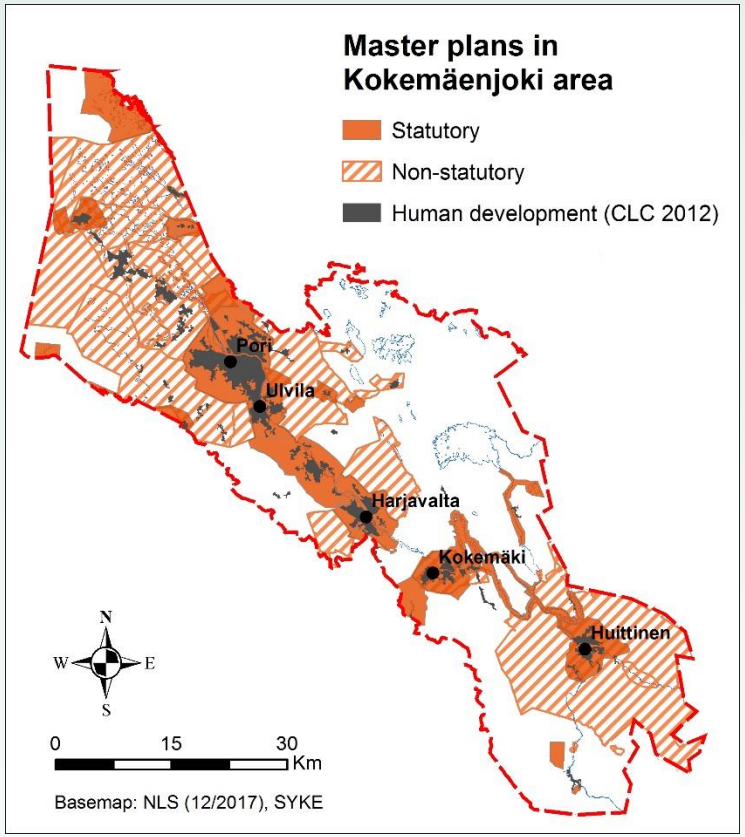


Figure 7. The master planning situation (including plans under preparation) and key population centres in the planning area

Organisation of water resources management in the Kokemäenjoki planning area (1/2)

Finland's water resources management is based on the European Union's Water Framework Directive (WFD, 2000/60/EC) and Marine Strategy Framework Directive (MSFD, 2008/56/EC). The Directives have been implemented into Finland's national legislation with the Act on the Organisation of River Basin Management and the Marine Strategy (1299/2004), which defines the general framework for the organisation of water resources management and the preparation of river basin management plans. River basin management plans include the details of the current state of the river basin, assess the impacts of human activity in different parts of the waterway and present measures for improving the state of waters and developing monitoring.

The purpose of water resources management is to prevent the deterioration of the good environmental status of surface and groundwaters and to achieve at least a good environmental status for all water resources. The environmental status of waters assessed as being excellent or good must not be allowed to deteriorate. This objective is achieved through the planning and implementation of measures for improving the environmental status of waters and monitoring the impacts of measures. Objectives related to the marine strategy, flood risk management and nature conservation are also taken into account in water resources management.

For the purpose of organising water resources management, mainland Finland has been divided into five national river basin districts (RBD), each of which is subject to a dedicated river basin management plan that takes into consideration the characteristics of the river basin area and local human activities. The River Kokemäenjoki is part of the River Kokemäenjoki - Archipelago Sea - Bothnian Sea river basin district, the current river basin management plan and supplementary programmes of measures of which have been prepared for 2016–2021 (Westberg et al. 2015, Kipinä-Salokannel 2015).

Figure 8. The River Kokemäenjoki - Archipelago Sea - Bothnian Sea river basin management plan (left) and the programme of measures for the lower parts of the River Kokemäenjoki - the River Loimijoki (right).

Organisation of water resources management in the Kokemäenjoki planning area (2/2)

In addition to river basin management plans, which concern surface waters, Finland also has a separate marine strategy for the management of marine areas, the aim of which is to preserve the good environmental status of marine areas in accordance with the MSFD. The party responsible for the marine strategy is the Ministry of the Environment, which prepares the strategy in collaboration with the Ministry of Agriculture and Forestry and the Ministry of Transport and Communications. However, the preparation of the strategy is also contributed to by an extensive, cross-administrative working group, the key participants of which include the Finnish Environment Institute and regional Centres for Economic Development, Transport and the Environment (ELY Centres). Similarly to the river basin management plans, Finland's current marine strategy (Laamanen 2016) covers the period of 2016−2021.

Coastal zones, which encompass an area's coastal waters from the shoreline to one nautical mile out at sea, are thus part of the planning area of both the local river basin management plan and the marine strategy. In addition to the overlap in the planning area, there are also points of convergence in the objectives of river basin management plans and the marine strategy due to the fact that river basins (such as the River Kokemäenjoki) have a significant impact on the status of the marine area. In practice, river basin management plans and the marine strategy are coordinated with the help of an interaction process and through the integration of measures that facilitate the positive development of coastal waters into the marine strategy as well. This way, water resources management measures also form the basis for objectives related to achieving a good environmental status of the marine area.

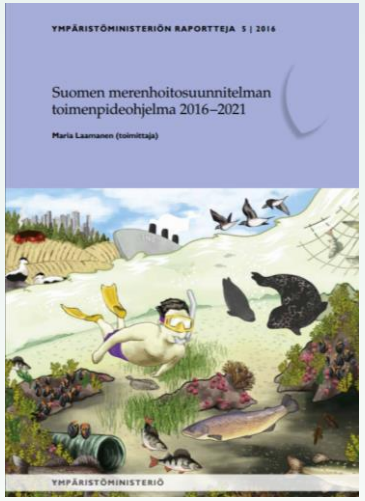


Figure 9. Programme of measures of the Finnish marine strategy 2016–2021

3. The green network and ecosystem services as part of land use planning

Photo by: Asko Ijäs

The principles of ecosystem-based planning (1/3)

The ecosystem approach (or ecosystem-based planning) is a planning process that comprehensively promotes the sustainable use of land areas, water bodies and natural resources while also ensuring the preservation of an area's characteristics and endemic species (Slocombe 1993, CBD 2000). There is no single established way of implementing the ecosystem approach. Instead, one can find several definitions for it in relevant literature, which differ from one another in terms of how local interest groups are taken into account in decision-making affecting the area or how important the identification of ecosystem services is considered for the purpose of planning, for example (Waylen et al. 2014).

In their publication, Jäppinen et al. (2004) examine the principles of the ecosystem approach and their practical application in relation to Finland's planning system. Compared to traditional land use planning, the ecosystem approach emphasises an area's natural characteristics and the functions that sustain them as the basis for planning. The objective of the planning should be the utilisation of the planning area and its natural resources in a way that does not hinder the ecosystem's ability to recover from changes caused by potential disturbances (Jäppinen et al. 2004). In practice, this means that the state of ecosystems or natural biodiversity cannot be preserved with the help of individual planning solutions alone. What is required instead is comprehensive planning that transcends traditional administrative boundaries.

The ecosystem approach is also intrinsically linked to the assessment of ecosystem services, a concept that has also been introduced to land use planning in recent years (see, for example, Tammi et al. 2017). Ecosystem services allow for the assessment of ecosystems as a factors that sustain an area's nature and natural resources and their value as sources of people's social and cultural well-being. Human activity and the deteriorating effect that it has on the current state of the environment also indirectly impacts an area's ecosystem services, which is why identifying the processes that sustain ecosystem services also enables the assessment of ecosystems' vulnerability to changes, for example.

The principles of ecosystem-based planning (2/3)

In addition to the concept of ecosystem services, ecosystem-based planning is also closely linked to the definitions of green infrastructure and green structure, both of which emphasise the importance of an ecosystem's basic functions for biodiversity and human well-being (Similä et al. 2017). In this plan, the concepts of green structure and green infrastructure are used convergently to mean a network of natural environments (such as forests, mires) and water bodies that provides and sustains various ecosystem services (Helsinki-Uusimaa Regional Council 2015).

Finland does not have any binding legislation that would require the characteristics or ecosystem services of a green space network to be considered in land use planning or the planning of the use of natural resources, for example (Similä et al. 2017). However, Finland's national land use guidelines emphasise the importance of maintaining ecological connections and preserving the functionality of a green space network that supports recreational use, for example. One way of measuring the functionality of an ecosystem is through the ecosystem services provided by the area. This kind approach allows the functionality of the ecosystem to be examined not only in terms of its direct benefits, but also in terms of its health impacts or the functions that sustain the biodiversity of natural environments. Instead of providing direct economic benefits, these functions may have significant indirect impacts on both people's well-being and the area's capacity for providing similar ecosystem services in the future.

The majority of ecosystem services measure environmental features that are considered valuable for business operations or the well-being of the local populace, for example. The majority of these (such as agricultural and forestry production potential, the area's recreational use value, cultural values) are already considered insofar as possible in land use planning (e.g. Saastamoinen et al. 2014). When it comes to individual services, ecosystem-based planning may not necessarily provide any significant added value if the current planning processes already strive for the preservation of these values and types of usage. Instead of individual factors, the added value offered by ecosystem-based planning and the mapping of ecosystem services is more closely tied to the comprehensiveness of the planning and the aim of producing the broadest possible overview of the current state of the area's ecosystem and the factors that sustain its functions (Jäppinen & Heliölä 2015, Tammi et al. 2017).

The principles of ecosystem-based planning (3/3)

The functionality and interconnectedness of green spaces are scale-specific concepts that can, depending on the aims established, be examined at species, landscape or ecosystem level (McDonald et al. 2005). The scale used also affects the size of the core areas and ecological connections of the environment being examined. In regional level planning, the ecological network is examined at landscape level, with the aim of preventing the fragmentation of continuous natural environment complexes (in Finland, these include large forests and mires in particular) (McMahon 2000). Green structure and landscape ecology analyses and the mapping of ecosystem services can help identify these types of extensive, regionally unique ecological networks, which, instead of being important in terms of individual species or habitats, are vital for the region's green space network, the key mechanisms that regulate and sustain the ecosystem and the ecosystem services of the entire region (Helsinki-Uusimaa Regional Council 2015).

Figure 10. The landscapes of the Kokemäenjoki river valley are characterised by a mosaic of agricultural and forestry areas and the diversity of human activity (Photo by Tomi Glad /Regional Council of Satakunta)

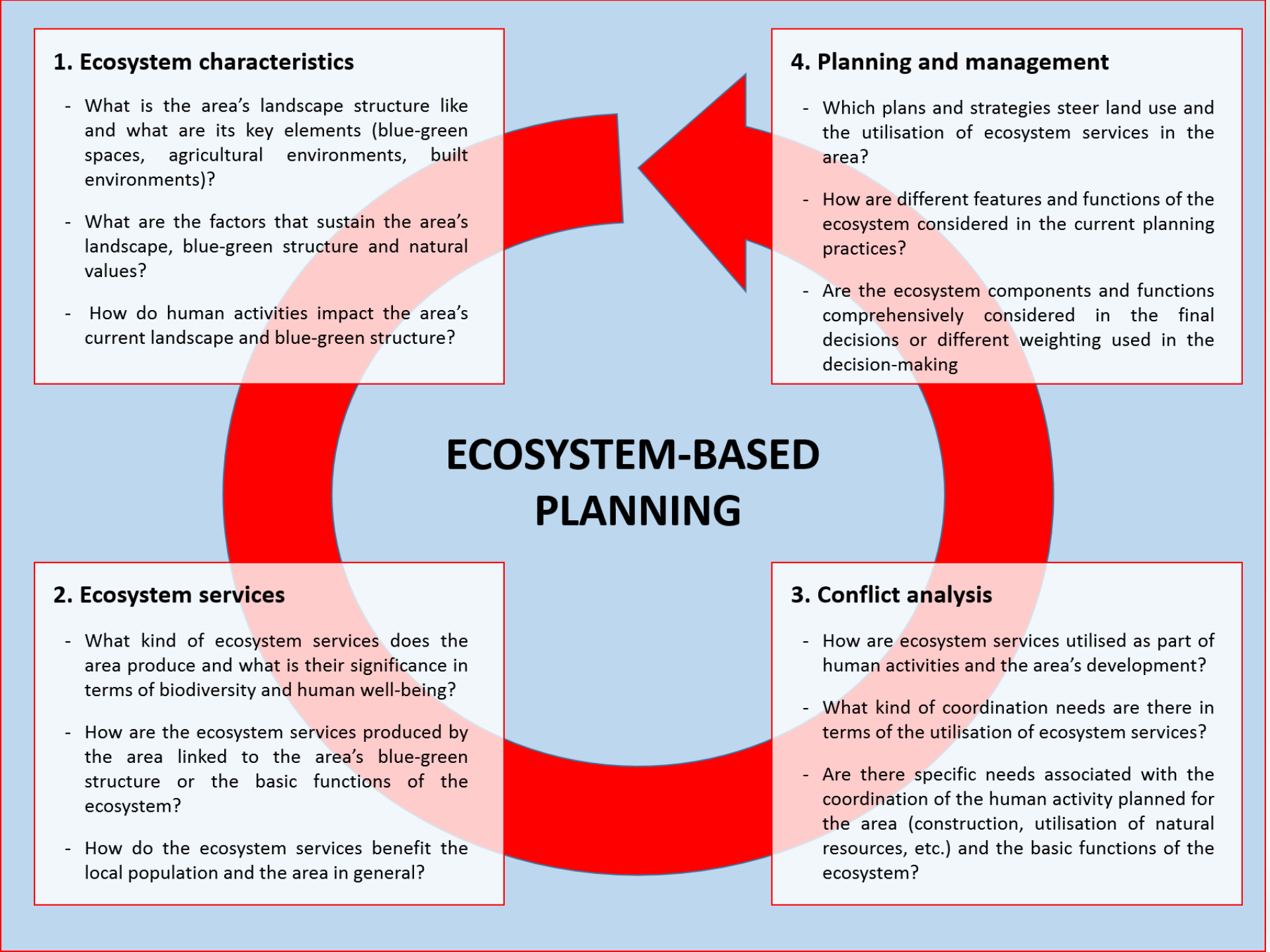


Figure 11. Ecosystem services in relation to land use planning and environmental decision-making

Ecosystem services as an indicator of the importance of the environment (1/3)

Ecosystem services mean benefits produced by the environment that are important for people's well-being (Maes et al. 2012). In addition to preserving biodiversity, ecosystem services also promote human health (natural purification and filtering processes, recreation) and material well-being (availability of food and resources). The aim of the concept of ecosystem services is to raise values related to biodiversity, the functioning of the ecosystem and the social environment to the forefront alongside economic perspectives, allowing these values to be comprehensively examined as part of land use planning and the environmental impact assessment of different activities. From the perspective of land use planning, the identification and mapping of ecosystem services enables the effective coordination of the myriad values associated with a given area, which contributes to sustainable land use and utilisation of natural resources.

In the assessment of ecosystem services, the benefits provided by ecosystems are usually divided into three categories based on their nature and significance (CICES 2010). These categories are:

1. provisioning services (including agricultural production, fish, berries)
2. regulation and maintenance services (including nutrient and carbon sequestration)
3. cultural services (including recreational use, cultural history).

Although the concept of ecosystem services is used to refer primarily to the human benefits provided by the natural environment, the habitats of a given area and thus the distribution of its ecosystem services are also affected by the area's physical and geological characteristics. For example, the soil and hydrological characteristics of a river basin affect the occurrence of different habitats in different parts of the river basin and the distribution of the species found in these areas. Human activity (such as building, soil extraction, groundwater utilisation) has strong impacts on both natural environments and an area's physical characteristics, which in turn often have notable impacts on the quantity and quality of ecosystem services produced by the area.

Ecosystem services as an indicator of the importance of the environment (2/3)

Ecosystem services are described using indicators that measure either a given ecosystem service as is, its benefits to people or the natural characteristics relevant to the service (Mononen 2017). In practice, measuring the benefits of an individual ecosystem service is often difficult, if not impossible. This is especially true for regulation and maintenance services as well as some cultural ecosystem services, which is why they are usually measured by their production potential. An ecosystem service's production potential is defined by linking the ecosystem service to the biological or physical and chemical characteristics of the ecosystem, which are further used to evaluate the benefits of the ecosystem service.

The extent to which ecosystem services can be sustainably utilised is steered by land use and human activity in the area. Ecosystem services benefit individuals, communities, companies, different levels of administration and society as a whole. However, the benefits of ecosystem services manifest in widely varying ways, which makes it challenging to consider them in decision-making (Norton 2016). While some ecosystem services provide notable benefits to people even at a local level (e.g. the recreational use values of local forests), others (such as carbon sequestration) are only visible on a global scale, making it impossible to measure their benefits on a local or regional scale. Partly due to their scale, these ecosystem services grow in significance when moving from local planning to national decision-making and strategy work, which is the level at which general policies for ensuring the sustainable use of natural resources and promoting various business operations are defined.

Ecosystem services as an indicator of the importance of the environment (3/3)

		Ecosystem services	Scale	Landscape component
Provisioning services	Food	Berries and mushrooms	+	Forest
		Game	+	Forest
		Fish and crayfish	+	Water
		Crops	+	Agriculture
		Animal production	+	Agriculture
		Clean water	+	Water
	Raw materials	Wood	+	Forest
		Genetic resources	+++	Forest/agriculture/water
	Energy	Bioenergy	+	Forest/agriculture
Regulation and maintenance services	Purification, sequestration and storage of harmful substances	Regulation of waste and toxins	++	Agriculture/forest
		Air quality	+(+)	Forest
		Water filtration	++	Agriculture (forest?)
		Nutrient sequestration	+(+)	Agriculture (forest?)
		Noise regulation	+	Forest
	Regulation of masses and liquid flows	Erosion regulation	++	Agriculture
		Flood management	++	Agriculture (forest?)
	Maintenance of physical, chemical and biological conditions	Pollination	+	Forest/agriculture
		Growth environments	++	Water
		Soil quality	++	Agriculture
		Nitrogen sequestration	++	Agriculture
		Climate regulation	+++	Forest/agriculture
Cultural services	Physical and spiritual interaction with nature	Recreation	+	Forest/agriculture/water
		Nature tourism	+(+)	Forest/agriculture/water
		Science and education	+	Forest/agriculture/water
		Natural heritage	++	Agriculture
		Landscape	+	Agriculture
		Art and popular culture	+	Agriculture

Figure 12. Nationally notable ecosystem services in Finland (Mononen et al. 2015), their scale and the landscape components most relevant to them in the Kokemäenjoki planning area. The ecosystem services are divided into three categories according to their scale: + = the ecosystem service provides immediate benefits in the local environment (local scale), ++ = the ecosystem service sustains the basic functions of the ecosystem, but does not provide concrete benefits to the local population (regional scale), +++ = the ecosystem service sustains the basic functions of the biosphere, but its benefits to society cannot be measured (national/international scale). As regards landscape components, the table lists the landscape component(s) most relevant for each ecosystem service, which are important in terms of the benefits of the ecosystem service and whose changes affect them.

4. Ecosystem services of the Kokemäenjoki planning area

Photo by: Visa Vehmanen

Current state of the planning area and definition of ecosystem services (1/3)

In this section, the Kokemäenjoki planning area is examined by dividing the planning area into four landscape components, which differ from one another both in terms of their characteristics and human activity. These components are:

1. forest and mire areas (natural environments, *green infrastructure*)
2. water bodies (*blue infrastructure*)
3. agricultural areas and cultural environments (*yellow infrastructure*)
4. built areas (*grey infrastructure*).

Natural environments and water bodies define an area's blue-green structure, which also plays a major role in the provision of the area's ecosystem services. Conversely, agricultural areas and areas of significant human activity are characterised by a clear cultural influence, and the natural environments in these areas have already been changed as a result of human activities. Due to the impact of human activities, the ecosystem services of these areas differ significantly from those of natural environments.

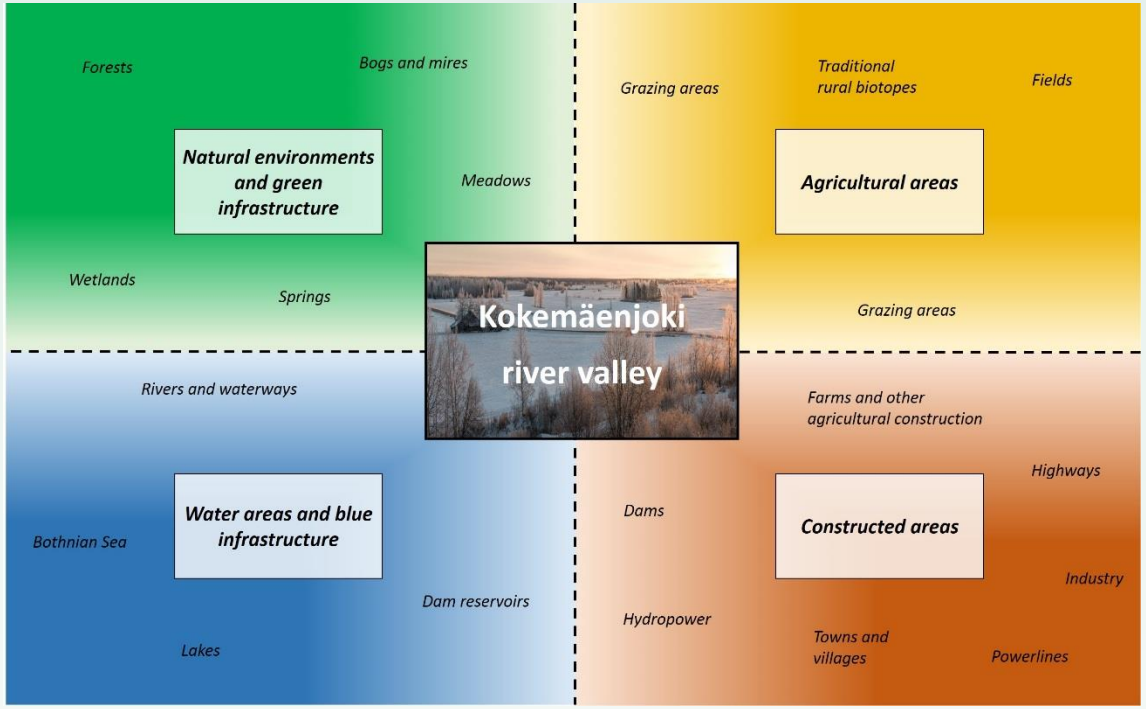


Figure 13. The landscape and ecosystem components used in the plan and their key characteristics.

Current state of the planning area and definition of ecosystem services (2/3)

The ecosystem services that natural environments provide for people are linked to the basic functions of the ecosystem and thus to the complex network formed by natural environments. Green infrastructure refers not only to the concrete green structure of a given area, but also to the area's capacity for preserving the functioning of the ecosystem alongside human activity (Naumann et al. 2011). Despite the abundance of forest and mire areas in Finland, human activity still has broad-ranging impacts on the current state of natural environments, which is why regional ecological planning and the planning of the green structure should focus not only on quantitative targets, but on factors related to the quality of natural environments as well (Similä et al. 2017).

For this plan, biodiversity was assessed with the help of a two-stage process, in which areas notable in terms of species were examined in relation to the coherence of natural environments. Nature reserves are generally considered crucial for an area's green structure (Helsinki-Uusimaa Regional Council 2015). In addition to nature reserves, the overview of areas notable in terms of biodiversity was supplemented with sites that have notable natural values associated with them, but that have not been protected yet. The location of these areas was further examined in relation to the occurrence of continuous natural environments. The continuity of natural environments was examined with the help of morphological spatial pattern analysis (MSPA, Vogt et al. 2007). MSPA helped identify the area's extensive natural environment complexes, which were then categorised based on their area. The source material for the analysis consisted of CLC 2012 data, from which the land use classes of natural environment were distinguished (see classification in Regional Council of Kymenlaakso 2017). Water bodies larger than 100 hectares were excluded from the analysis, as they were assessed to function as obstacles for species characteristic to land environments. Since the purpose of the analysis was to assess the location of extensive natural environments in relation to other components of the landscape structure (agricultural areas, built environments, water bodies), the border width used in the identification of core areas was small (40 m) compared to the survey carried out by the Regional Council of Kymenlaakso (2017), for example.

Current state of the planning area and definition of ecosystem services (3/3)

The structural continuity and characteristics of agricultural areas were examined by identifying continuous field areas ideal for agriculture based on information recorded in the field plot register (Agency for Rural Affairs 2017) and GTK's soil maps. In the analysis, the field plots were used to form larger wholes based on their size, which can be assessed as being ideal for agriculture due their combined area and soil characteristics (see method description in Regional Council of Tampere Region 2016).

The planning area's ecosystem services were assessed utilising the latest research publications and existing research and geospatial data on the planning area. The ecosystem services, both obvious and less well-known ones, were identified with the help of the CICES (Common International Classification of Ecosystem Services) system. In this plan, the aim has been to link the ecosystem services to the four main components of the area's landscape structure (forest and mire areas, agricultural areas, water bodies, built areas) based on which of them each ecosystem service's production potential is most dependent on or which of the area's characteristics is most crucial for the provision or utilisation of the ecosystem service.

The SustainBaltic project also involved the preparation of a separate report on the natural values and areas of high biodiversity value of Southwest Finland (Leikola et al. 2018), which was also used as background material for this plan. This report also includes a more detailed description of the geospatial data sets and information resources that describe the natural values of the Kokemäenjoki planning area.

General description of the planning area (1/2)

The Kokemäenjoki planning area (size approximately 2,900 km^2) is located in the central part of Satakunta, divided between the areas of nine municipalities (Merikarvia, Eurajoki, Pori, Ulvila, Nakkila, Harjavalta, Kokemäki, Huittinen, Säkylä). The area examined in the plan stretches from the shore of the Bothnian Sea up to 60 km inland, encompassing 1) the main channel of River Kokemäenjoki, 2) the lower parts of Lake Loimijoki and 3) the Kokemäenjoki delta and the bordering shallow marine areas (so-called marine impact area).

The seaside outer border of the planning area has not been precisely defined, as the area of effect of the nutrient and solids load transported by the river depends on the flow rate of the river, among other factors. As regards the marine area, the plan focuses primarily on the interaction between the River Kokemäenjoki and the Bothnian Sea as well as the assessment of the environmental impacts of activities carried out in land areas.

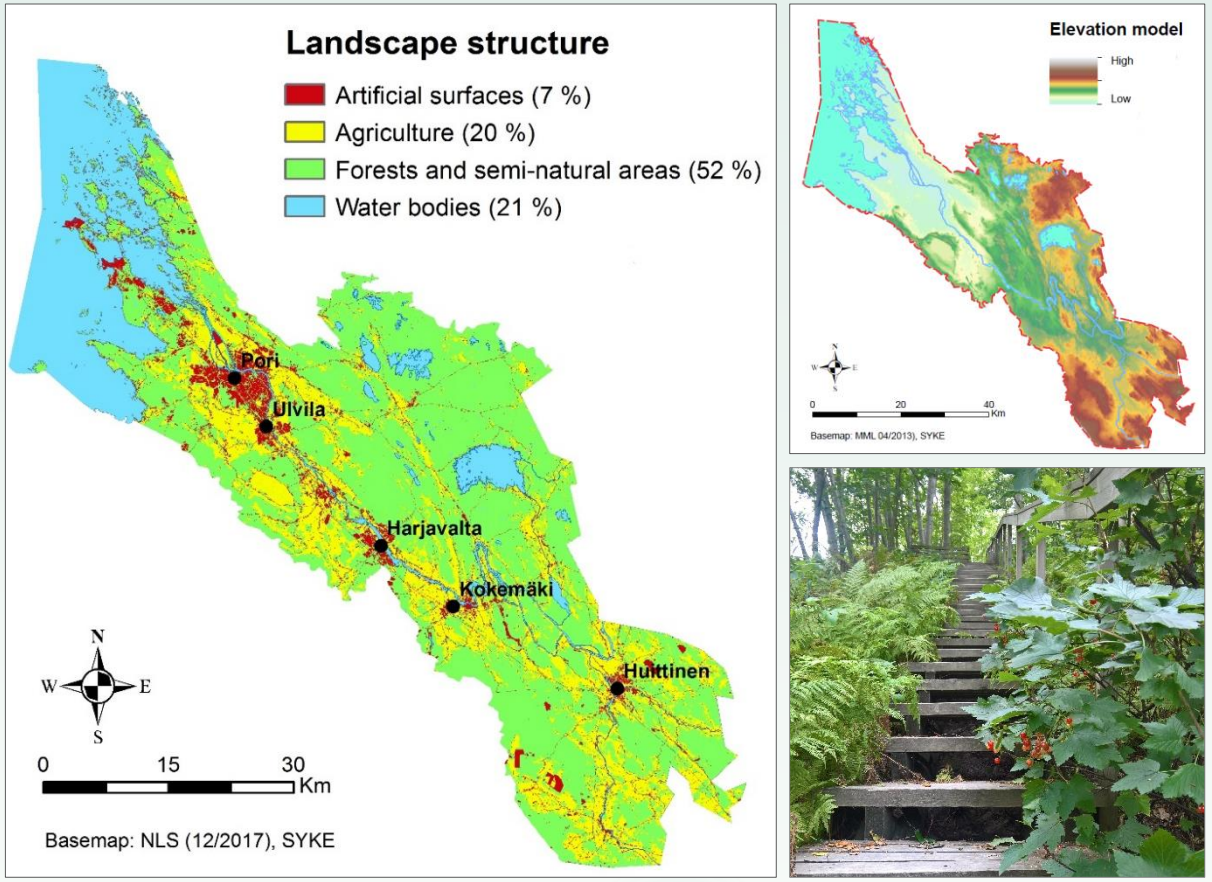


Figure 14. Landscape structure (left) and elevation model (upper right) of the Kokemäenjoki planning area and vegetation characteristic of the lush parts of the river valley as found in Paratiisinlehto in Harjavalta.

General description of the planning area (2/2)

In the regional landscape division, the planning area is primarily part of the agricultural region of lower Satakunta, which is characterised by flat terrain and fertile plains suitable for agriculture, bordered by outlying forest and mire areas (Alatalo & Salo-Ettala 2014). In terms of its elevation model, the planning area is notably flat, with the highest terrain formations located in the southeast in the areas of Säkylänharju and Lintukankangas as well as Kullaa in Ulvila. Along with the Kokemäenjoki river valley, the planning area's landscape is dominated by a stretch of eskers extending from Virttaankankaa in Säkylä in the southeast to Pori in the northwest. In terms of its soil, the planning area is dualistic. The river valley is characterised by areas of fine clay and sand soil, which are ideal for agriculture due to their particle size and nutrient sequestration ability. Conversely, the soil in the areas bordering the river valley, around the eskers, is primarily composed of coarse gravel and moraine, due to which the flora of these areas is characterised by pine- and spruce-dominated herb-rich forests and small mires.

The planning area's settled areas, industrial functions and agriculture are primarily clustered near River Kokemäenjoki. The Kokemäenjoki river valley and the Bothnian Sea coastal zone are some of the oldest settled areas in Finland, from where people started to spread to different parts of Satakunta in the middle ages (Uusi-Seppä & Nummelin 2015). This is reflected in both the area's current settlement and its notable cultural and historical sites, the occurrence of which serves as an indicator of the area's past land use.

Figure 15. Saint Henry's Chapel in Kokemäki (photo by the Regional Council of Satakunta)

Natural environments: characteristics (1/3)

The Kokemäenjoki planning area consists of the Kokemäenjoki river valley, which displays a strong cultural influence, and the outlying, sparsely populated forest and mire areas. Natural environments (forests, mires, rocky areas, etc.) encompass 52% of the planning area's total area (including the Bothnian Sea marine area), with the most extensive green zones located in 1) the Kullaa area in Ulvila and 2) on the south side of the river valley, north of Lake Pyhäjärvi in Säkylä. Both of these green zones also extend beyond the planning area and are part of the more expansive green space network of Satakunta.

The planning area's natural environments are characterised by fresh and dry coniferous and mixed forests, with lusher forest types (including deciduous forests, herb-rich forests) clustered around water bodies and the vicinity of the Bothnian Sea coastal zone. The majority of the area's forests are approximately 40–60 years old. There are only a few mature forest left, fragmented into small stands in different parts of the planning area.

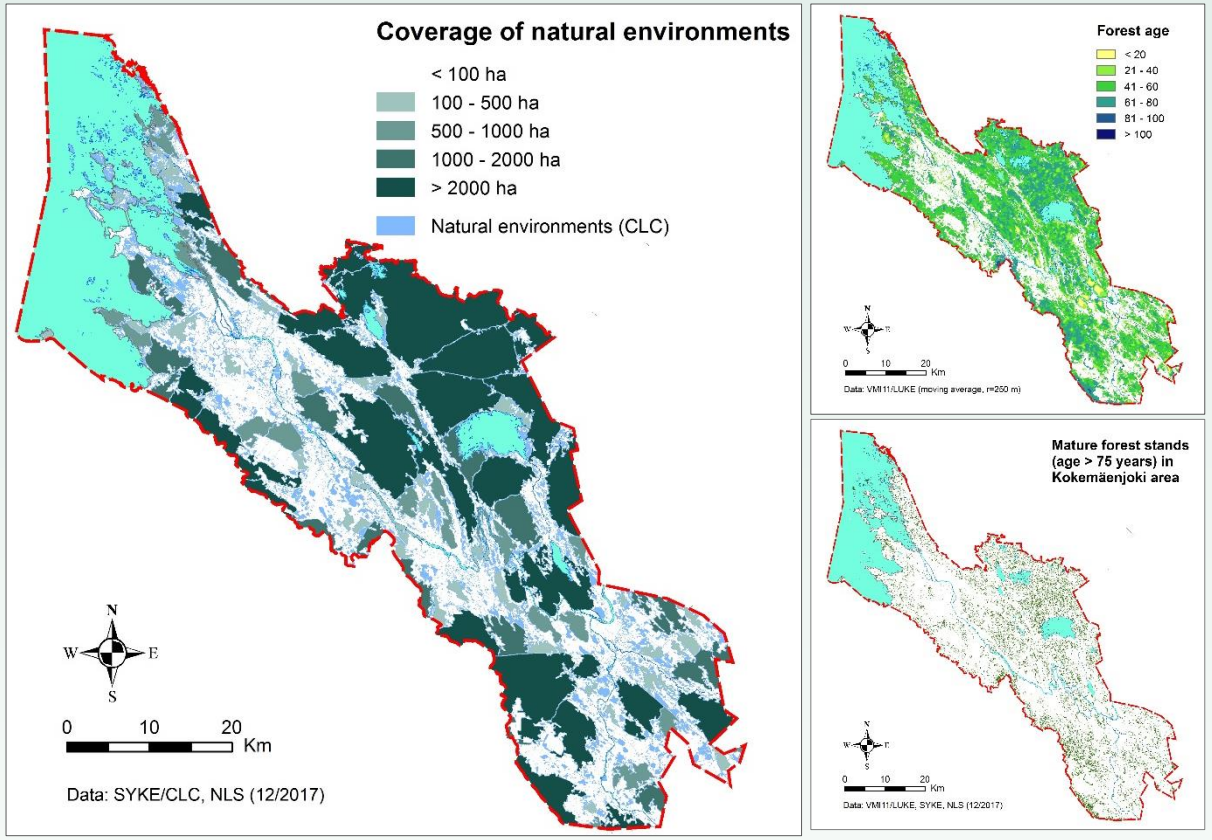


Figure 16. Coverage of natural environments (left), forest age (upper right) and forest stands over the age of 75 (lower right) in the planning area.

Natural environments: characteristics (2/3)

The Finnish Environment Institute (SYKE) has conducted an analysis of forests of high biodiversity value in Finland (Mikkonen et al. 2018). In this analysis, the biodiversity value of forests was assessed based on a decaying wood index calculated for forest stands, in addition to which factors such as sightings of threatened species, habitats of special importance in accordance with the Forest Act and the area's connectivity to other valuable forest patches were taken into account. Based on this analysis, the most valuable forest areas in the planning area are located in the Kullaa area and the vicinity of the Bothnian Sea coastal zone. The biodiversity value of the forests in these areas is raised by the high average age of the forests and the diversity of the species found therein, resulting from favourable conditions in terms of nutrient or moisture.

The largest mires in the planning area were drained in the 20th century for forestry or agricultural use by trenching, and later for peat production use as well. However, some continuous mire areas have been preserved in the area of the Puurijärvi-Isosuo National Park. Due to the slow pace at which natural environments develop into mires, the new mires that form in coastal areas due to post-glacial rebound and in inland areas as a result of the overgrowing of water bodies or paludification are typically small (smaller than one hectare on average).

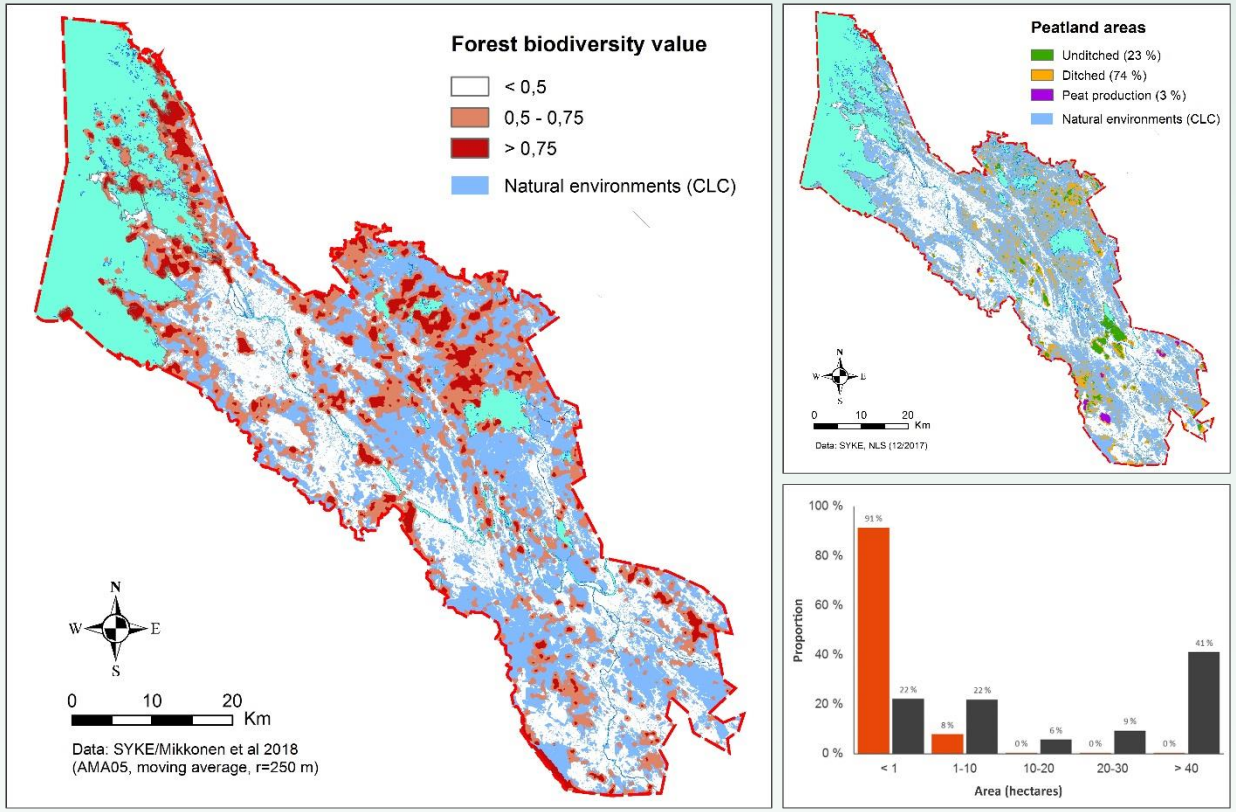
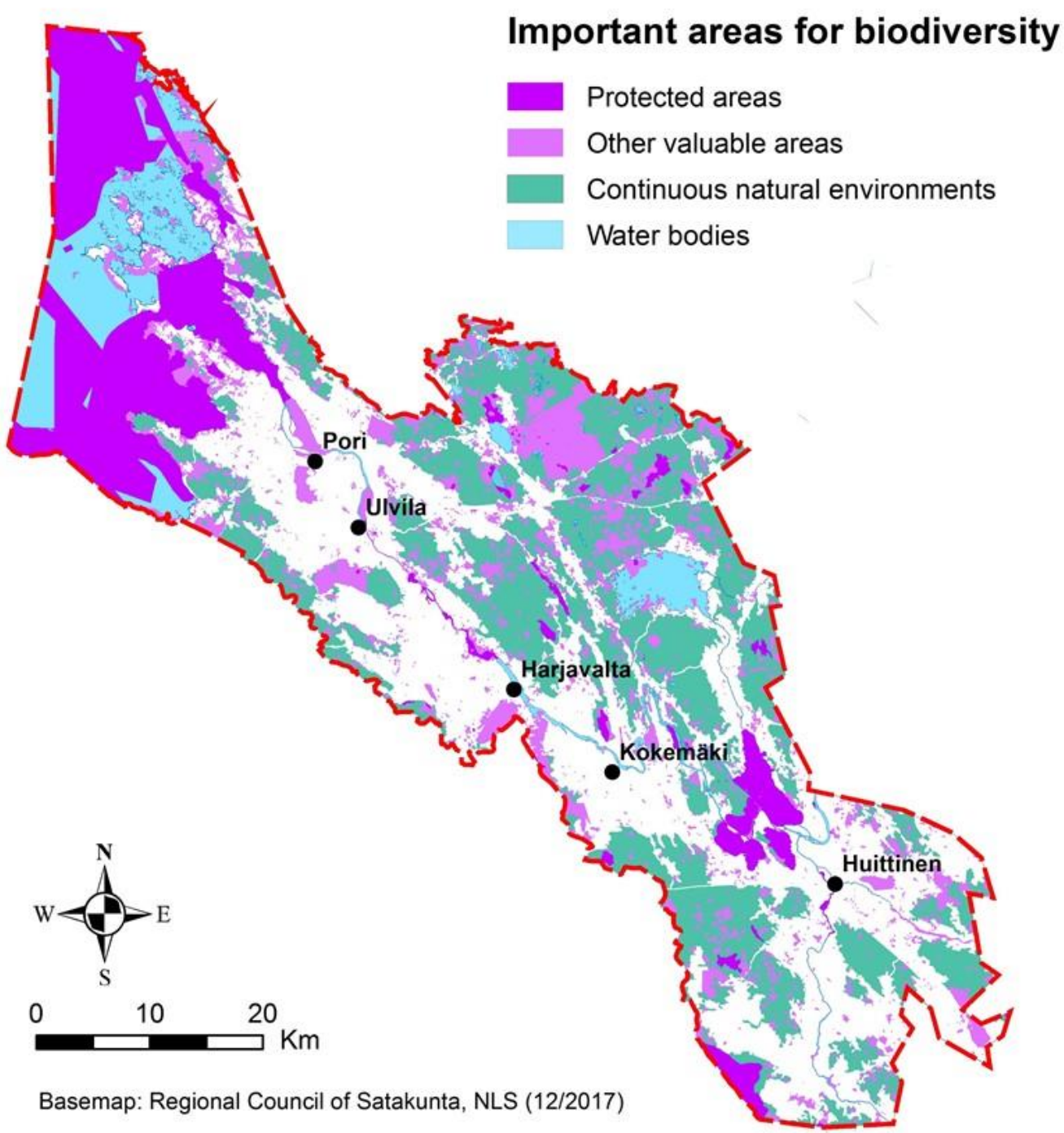


Figure 17. Forest biodiversity (left), peatland areas (upper right) and number and area distribution of un-trenched mire areas (lower right)

Natural environments: characteristics (3/3)

1. **Protected sites and areas**
   - nature reserves on state-owned land
   - nature reserves on private land
   - nature conservation programme areas (excluding nationally valuable landscapes)
   - Natura 2000 network areas
   - areas marked as protected in the regional land use plan of Satakunta (notation S)
   - internationally (IBA) and nationally (FINIBA) important bird and biodiversity areas.
2. **Other valuable areas**
   - the regional land use plan's recreational use areas (notation V)
   - national urban parks
   - natural environments assessed as valuable in Satakunta's nature conservation report (Hakila 2000)
   - un-trenched mire areas of over 10 hectares
   - valuable forest areas in accordance with the Forests of high biodiversity value analysis (Mikkonen et al. 2018) (site value > 0.75, variant AMA05).
3. **Continuous natural environments and water bodies**
   - natural environments of over 500 hectares (MSPA)
   - water bodies and waterways.



Natural environments: ecosystem services (1/2)

Forest and mire environments encompass approximately 60% of the planning area's total land area, and the majority of the ecosystem services produced by the planning area are based on these habitats. In terms of natural environments and the ecosystem services that they provide, the Kokemäenjoki planning area is notably dualistic in nature. On one hand, the area is characterised by extensive and sparsely populated forest and mire areas, which are subject to only very few interests related to area development or human activity, other than in regard to the natural resources that they contain (wood, peat, sand). On the other hand, the central parts of the area are an extensive mosaic composed of agricultural areas, cultural environments and the River Kookemäenjoki waterway, where the impacts of human activity are greater and which already have plenty of functions related to housing and industry. Due to the area's soil and moisture conditions, the latter also contain a diverse range of natural environments. However, these environments are notably smaller in area and more fragmented than the aforementioned forest and mire areas.

In forests and mires, human activity is not a prerequisite for the provision of ecosystem services, even though the majority of Finland's forests are used for forestry. Wood as a material and energy source is a central ecosystem service. Finland's public right of access allows anyone to pick berries and collect other non-wood forest products in mires and forests, which also serves as a form of recreation that increases people's well-being (Finnish Environment Institute 2017). In addition to offering these kinds of provisioning services, mire and forest ecosystems also play a role in many regulation and maintenance services. Diverse environments sustain animal and plant habitats, thus preserving the ecosystem's functioning and ability to recover from changes. Forests and mires are especially important for climate regulation, as they sequester carbon dioxide from the air, thus mitigating climate change (Matero et al. 2003). Vegetation and the roots of plants also affect water circulation by absorbing the moisture that flows through the ecosystem. Some of this water is used by plants themselves, while the rest is sequestered in the soil or drained to water bodies. Water sequestration in the soil also prevents erosion and nutrient leaching to water bodies.

Natural environments: ecosystem services (2/2)

The ecosystem services provided by forests and mires are extremely varied, both in terms of their scale and the benefits that they offer. In the Kokemäenjoki planning area, ecosystem services that provide visible benefits include various provisioning services, the most important of which for the local economy are the wood produced by forests, the berries and game utilised by the local population and the extensive groundwater reserves, which account for a notable proportion of Satakunta's total groundwater reserves and whose formation is tied to the area's eskers. In addition to provisioning services, forests and mires are also used for recreation and the development of local nature tourism. In terms of recreational use and tourism, factors contributing to the planning area's notability include the accessibility of the area's forest and mire sites, in regard to which notable characteristics include 1) the area's national parks (Puurijärvi-Isosuo, Bothnian Sea), 2) other sites that support recreational use in particular (including the Pori National Urban Park) and 3) the forests and mires located in the vicinity of population centres, which are highly accessible to people.

The provisioning and cultural ecosystem services of both forests and mires are based on the good environmental status of the area's natural environments, which is in turn sustained by several regulation and maintenance ecosystem services (including nutrient sequestration, noise and erosion regulation, water cycle regulation). While regulation and maintenance services do not provide concrete benefits to the area's population in and of themselves, they contribute to the ecosystem's ability to recover from changes occurring in the environment, because of which they are crucial for the area's provisioning and cultural ecosystem services. Regulation and maintenance services that sustain the functioning of ecosystems cannot usually be attributed to any individual characteristic or part of the area. Instead, preserving the functionality of the ecosystem requires comprehensive consideration of the network of green spaces and the habitats therein, with the aim of safeguarding both the ecological quality of individual habitats and the preservation of regionally notable, continuous natural environments alongside human activity and the utilisation of the area's natural resources.

Water bodies and waterways: characteristics (1/4)

In Satakunta, the Kokemäenjoki river basin consists of the River Kokemäenjoki, which starts from Lake Liekovesi and drains to the Bothnian Sea on the north side of Pori. There are also a number of smaller rivers in Satakunta that drain into the River Kokemäenjoki (including Harjunpäänjoki, Kauvatsanjoki and Loimijoki). The lower parts of the Kokemäenjoki river basin and the Loimijoki catchment area have notably fewer lakes than the Pirkanmaa-side of the river basin. Due to the small number of lakes, the Kokemäenjoki area is characterised by large variations in flow rate, with extensive flooding occurring especially in the spring and autumn (Centre for Economic Development, Transport and the Environment for Southwest Finland 2015). The planning area's floods are linked particularly to the flow rate of the River Loimijoki, the area of which has few lakes, and the flow rates of the Kokemäenjoki's nearest catchment areas. On the Pirkanmaa side, water flow is slowed down by lakes, which also reduces the area's effect in regard to the flooding of the River Kokemäenjoki (Dubrovin et al. 2017). The flooding is most severe around the junction of the Kokemäenjoki and Loimijoki in Huittinen as well as around Pori, which are both designated as national areas of potential significant flood risk.

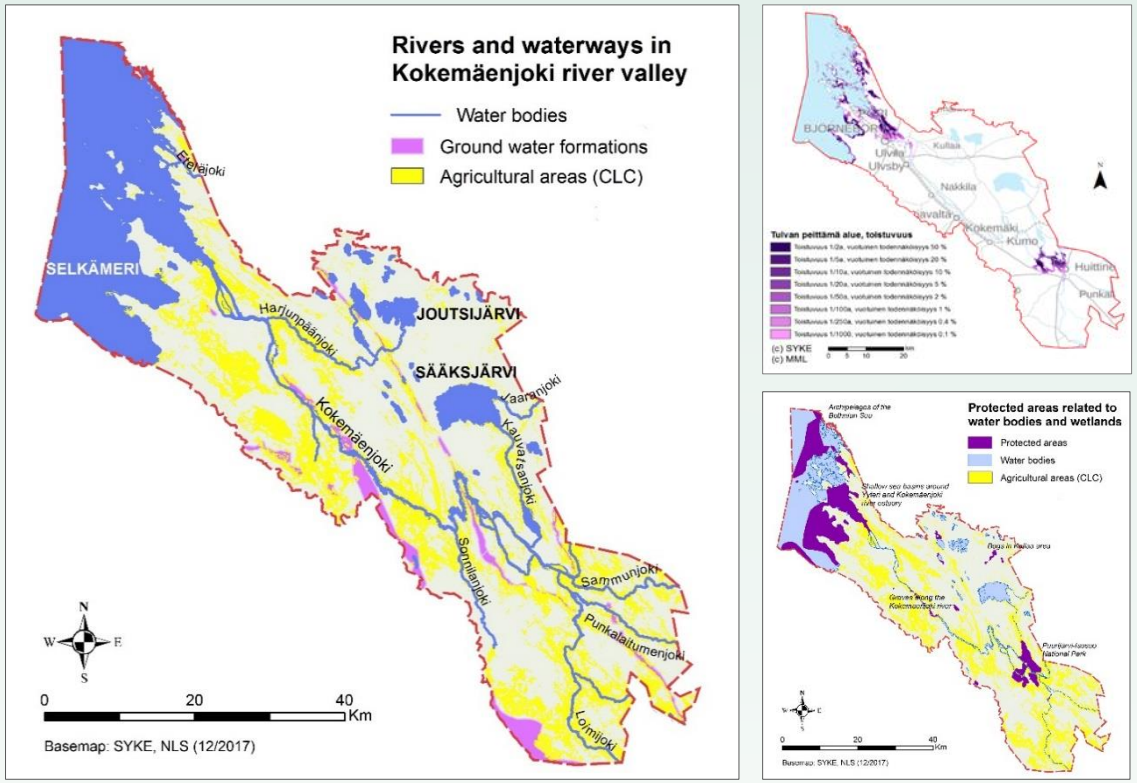


Figure 18. Parts of the Kokemäenjoki river basin (left), flood risk areas (upper right) and protected areas related to water bodies and wetlands (lower right).

Water bodies and waterways: characteristics (2/4)

The soil in the vicinity of the River Kokemäenjoki and the area's other waterways is composed mainly of fine clay and mineral soils, which, in addition to being ideal for agriculture, offers potential growth sites for plants and animals that prefer lush habitats. Due to the soil being rich in nutrients and perpetually moist, the planning area's waterways are bordered by a diverse range of habitats, the most notable of which include Paratiisinlehto in Harjavalta and the herb-rich forests in Puurijärvi-Isosuo National Park.

In addition to the surface waters, the Kokemäenjoki planning area has extensive groundwater reserves, which are play a notable role in the Satakunta area's water supply. The formation of groundwater in the planning area is tied to the area's eskers, with the most extensive groundwater reserves located in the southern and central parts of the planning area, in the areas of Säkylänharju, Koomankangas and Hiittenharju. In the Hiitteenharju area, the impact of human activity is also visible in the area's groundwaters, the chemical condition of which is currently poor.

Figure 19. Key water resources management challenges in the Kokemäenjoki-Loiminjoki river basin (Kipinä-Salokannel 2015, only in Finnish)

Water bodies and waterways: characteristics (3/4)

The Kokemäenjoki river valley has long been settled, which has left its mark on the river environment. Human activities that have had an impact on the river include the clearance of fields, flood protection measures, regulation and waterway construction (power plants and the cleaning out of water bodies) (for a summary of the use of the river basin, see, for example, Kipinä-Salokannel 2015). The total length of the River Kokemäenjoki between the southeast parts of the planning area and the river delta is 57.5 meters. The entire drop height of the area is nowadays utilised by five hydropower plants, the largest of which are the Harjavalta and Kolsi hydropower plants. In addition to hydropower, the reservoirs are utilised in the regulation of the River Kokemäenjoki, with the aim of preventing flooding and its impacts on the area's population.

The River Kokemäenjoki is one of the most nutrient-loaded waterways in Finland, as a result of which the ecological status of the majority of the area's water bodies is either satisfactory or poor. In terms of human activities, the condition of the Kokemäenjoki river basin is affected particularly by diffuse pollution from agriculture, which accounts for approximately 80% of the waterway's total nutrient load and thus largely defines the river basin's ecological status (Kipinä-Salokannel 2015). The water quality of the River Kokemäenjoki is affected especially by the nutrient loading from the Loimijoki area, the impact of which is visible in the entire lower course of Kokemäenjoki. Nutrient leaching in the Limijoki area is increased by the soil's susceptibility to erosion and the fact that a large proportion of the catchment area's total area is composed of agricultural areas. Conversely, the ecological status of the lakes located in the Kullaa area remains good, which is party explained by their location in an area dominated by forests and mires, with little in the way of human activity (Kipinä-Salokannel 2015).

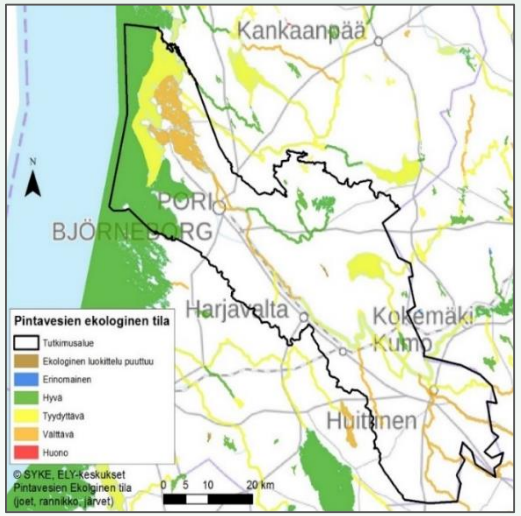


Figure 20. Ecological status of waters in the Kokemäenjoki planning area (only in Finnish)

Water bodies and waterways: characteristics (4/4)

The River Kokemäenjoki drains into the Bothnian Sea on the north side of the city of Pori, forming the largest river delta in Finland, which also serves as a habitat for a very diverse range of species. The coastal zone is characterised by shallow bays formed as a result of post-glacial rebound, which are outlined by lush coastal forests. The ground rises at a rate of approximately 3.5–6.5 mm per year in Satakunta (Johansson et al. 2014), which is reflected in the shallowing of the Kokemäenjoki river delta and coastal bays as well as in the rising of new land areas from the sea. The land areas rising from the sea gradually change from open coastal meadows via lush bushes and deciduous forests to rugged spruce and pine forests, creating a set of different zones typical for a coast affected by post-glacial rebound (Svensson & Jeglum 2000). The vegetation of the Kokemäenjoki river delta increases moving from the sea to the delta, transitioning from the aquatic plant life typical of shallow marine areas to costal meadows and reed beds, followed by lush coastal herb-rich forests dominated by deciduous trees (Ahlman 2008) The Kokemäenjoki river delta and the shallow bays outlining it are nowadays extensively protected on the basis of both the coastal plant life and the area's diverse range of bird species.

Both the Kokemäenjoki river delta and the outlying archipelagos are very shallow marine areas, which have only continued to grow shallower in recent years as a result of both post-glacial rebound and the solids carried by the River Kokemäenjoki. In the delta and the outlying Pihlavanlahti Bay, the continuing shallowing of the marine area can nowadays be seen in factors such as the increasing prevalence of common reeds and the expansion of the reed beds from the river delta towards the open sea. Despite the fact that its nutrient load and harmful substances load have decreased, the River Kokemäenjoki continues to have a notable impact on the characteristics of the Bothnian Sea coastal zone and the state of the marine area. As regards the Bothnian Sea coastal zone, the most notable impact mechanism is the nutrient and solids loading resulting from the river water, the impacts of which extend all the way to Satakunta's outer archipelago (Alaluhta 2008). At the coast of Satakunta, the waters of the River Kokemäenjoki flow primarily to the north, and the impact of the river waters is thus most notable in the north side of the river delta, in the marine areas of Ahlainen in Pori and Pooskeri in Merikarvia (KVVY 2016).

Water bodies and waterways: ecosystem services (1/3)

In terms of the functioning of the ecosystem and ecosystem services, water bodies play two different roles. On one hand, water bodies provide a wide range of ecosystem services that benefit the people living in the area and sustain the state of the ecosystem. On the other hand, water bodies serve as a link between an area's natural environments, tying together the ecosystem services provided by the area's other ecosystems. Due to the latter role, changes observed in the condition of an individual water body may be reflective of changes affecting the entire river basin. For example, the condition of the Kokemäenjoki river delta and the outlying marine areas indirectly reflects changes in the condition of the entire river basin as regards water circulation or nutrient sequestration, for example.

The most notable ecosystem service provided by the Kokemäenjoki river basin is clean water, which is utilised directly, but also sustains the area's other ecosystem services. Other ecosystem services provided by water bodies include fish and crayfish, plants (such as the common reed) that can be used as fodder and the recreational opportunities related to water areas, which are a central part of Finnish cultural heritage and leisure (Sievänen & Neuvonen 2011, Alahuhta et al. 2015). The River Kokemäenjoki and the planning area's other water bodies are very important for both the local population's recreation and regional nature tourism (e.g. Satakunta University of Applied Sciences 2016, Regional Council of Satakunta 2018). The area's coasts are nowadays used extensively for holiday housing, in addition to which the waters of the Kokemäenjoki are used for activities such as swimming, kayaking and fishing.

The Kokemäenjoki planning area's surface and groundwater reserves are very important for the regional water supply of Satakunta. In 2008–2013, the general water supply plants of the Kokemäenjoki and Loimijoki pumped up an average of 30,000 m^3 of water per day. In addition to water supply, the river basin's waters are utilised as industrial process water, in hydropower generation and as irrigation water in agricultural areas (Kipinä-Salokannel 2015). The utilisation of the planning area's water bodies is most extensive in the areas bordering the Kokemäenjoki river bed and the area between the coast of the Bothnian Sea and the town of Kokemäki, which is also where the proportion of built areas is the highest.

Water bodies and waterways: ecosystem services (2/3)

The River Kokemäenjoki plays a major role in both hydropower and industry, which has also had an impact on the current state of the river basin and its ecosystem services. The regulation and damming of the river have affected the occurrence of migratory fish (salmon, sea trout, migratory whitefish and river lamprey) in particular and thus also the area's potential for professional and recreational fishing. The ecological status of the water was at its poorest in the 1970s, when fish stocks were affected by the high amounts of harmful substances in the water and water construction that hindered their movement. The river's fish stocks have since recovered as a result of the development of emissions monitoring, restoration efforts in the river basin and fish plantings. However, the migration of fish from the Bothnian Sea up the River Kokemäenjoki is still hindered by dams, with the first obstruction being the dam of the Harjavalta hydropower plant.

The majority of the provisioning and cultural ecosystem services associated with water bodies are either directly or indirectly linked to the purity and good ecological status of the water. River basins themselves have few functional processes through which water bodies can maintain the good ecological condition of an area. Instead, the ecological status of water bodies is closely tied to the regulation and maintenance services provided by the catchment area's other ecosystems (Kniivilä et al. 2013). The ecosystem services provided by water bodies are thus affected by the use of the entire catchment area, making it practically impossible to separate them from the area's other ecosystem services.

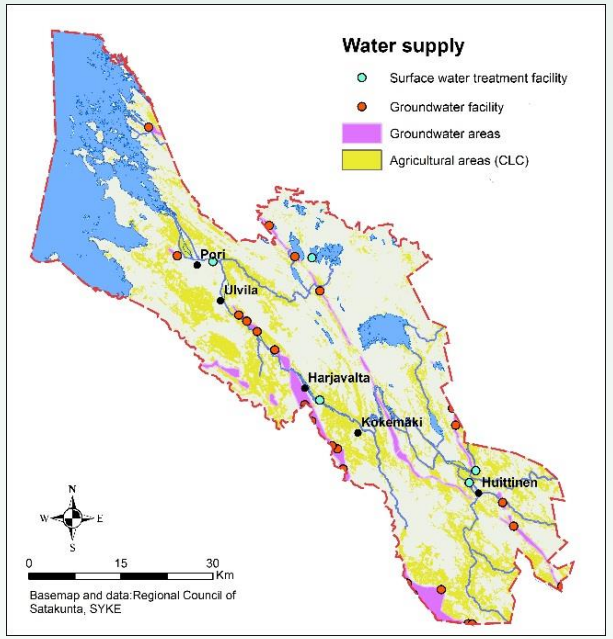


Figure 21. Notable water supply sites in the regional land use plan of Satakunta (Regional Council of Satakunta 2011)

Water bodies and waterways: ecosystem services (3/3)

The quality of the waters entering the Kokemäenjoki river basin is affected by the filtering and purification processes used in agricultural areas as well as by point and diffuse loading caused by land use and human activity. While agriculture is the largest source of diffuse pollution in terms of both nitrogen and phosphorus, nutrient loading is also contributed to by other human activity such as sparsely populated areas and forestry (Huttunen et al. 2016). Due to the large size and total flow rate of River Kokemäenjoki, the purification processes used in agricultural and forestry areas and the regulation of the nutrient loading caused by human activity also have major impacts on the ecological condition of the Kokemäenjoki river delta and the outlying marine areas as well as the ecosystem services that they provide.

The hydrology of the Kokemäenjoki planning area is characterised by large variations in flow rate and the resulting susceptibility to flooding. Lakes and rivers are crucial for regulating flooding, as they both store water and slow down its movement (Baron et al. 2002, Brauman et al. 2007). The outlying mires and forests also play an important role in water sequestration, because of which increasing the number of natural environments can help prevent flooding resulting from rains and melt water, especially in urban environments. The Kokemäenjoki river valley's agricultural areas consist primarily of old, low-lying and flat seabeds, making them susceptible to variations in the water level and thus seasonal flooding. Before the arrival of people, regular flooding is most likely to have played a key role in the development of the area's natural environments, spreading nutrients throughout the river valley.

In addition to the area's natural ecosystem services, factors that have contributed to the flow rate variation and flooding of the Kokemäenjoki include the efforts to clean out rivers and change their courses carried out in the area in the 20th century, in connection to which the river bed was also straightened for the purpose of speeding up log floating, amongst other measures. These changes have contributed to increasing the river's flow rate, which is also a factor in flooding. Nowadays flooding poses risks particularly for human activity and agriculture, which is why measures such as regulation and flood protection are carried out to prevent it.

Agricultural areas: characteristics (1/2)

Agricultural areas and cultural environments account for approximately 20% of the planning area, dominating a large proportion of the plains bordering the River Kokemäenjoki. The soil in these areas consists primarily of fine clay or sand, which are ideal for agriculture due to their particle size and nutrient sequestration capacity. The area's farming culture is very old, and the majority of the area's fields were cleared before the 19th century (Louekari 2013). Due to the old settlement and faming culture, practically all areas optimal for agriculture have already been cleared to serve as fields or otherwise converted for human use.

The area's agriculture is centred around grain growing and the production of specialised plants (including malting barley, potato, sugar beet), with over 60% of the area's fields devoted primarily for these purposes. In addition to plant production, the southeast parts of the planning area are notable pork production areas, which is reflected in the number of pig farms in the area. Cultivation in the planning area is primarily intensive and based on the utilisation of extensive fields, which partly explains why organic production accounts for such a small share of the area's agriculture.

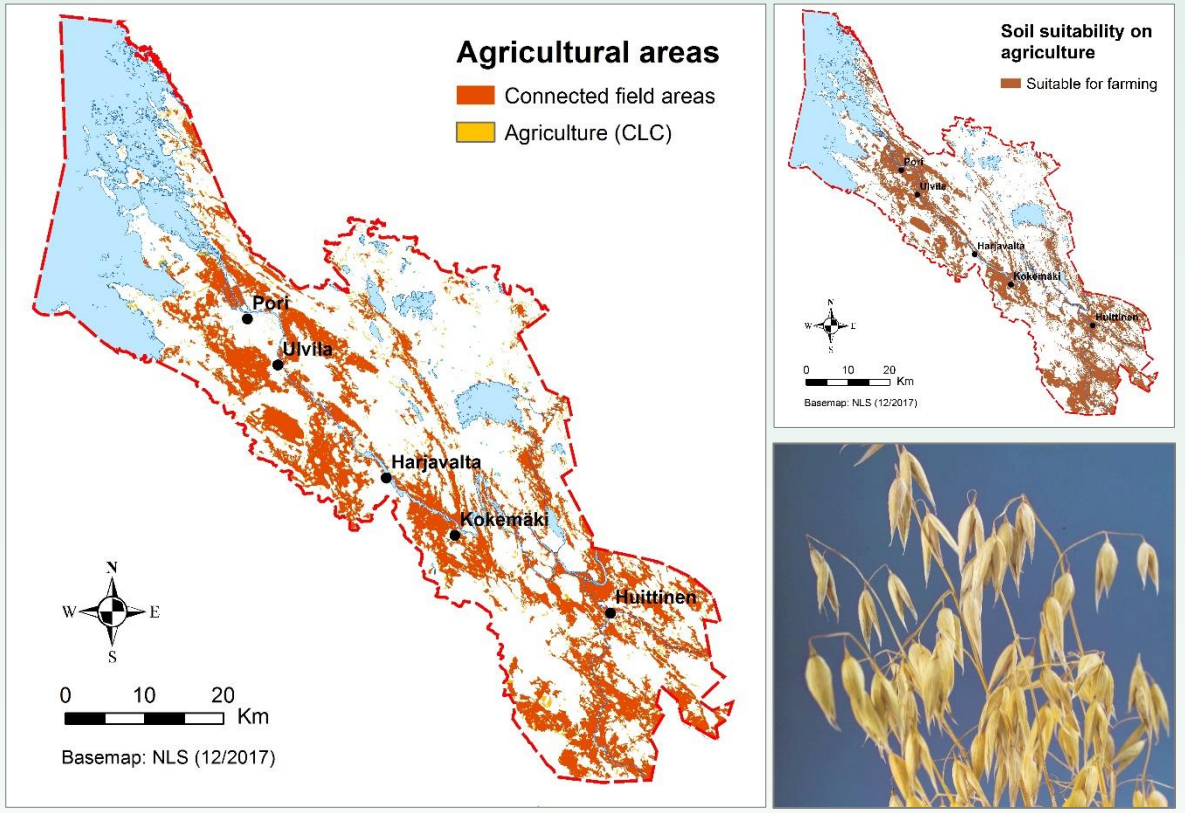


Figure 22. Agricultural areas (left) and the suitability of the soil for agriculture (upper right) in the Kokemäenjoki planning area

Agricultural areas: characteristics (2/2)

The diverse cultural history of the riverside, the expansive fields and the outlying forests all contribute to providing the Kokemäenjoki planning area with a characteristic and nationally notable landscape, which is why the area was designated a nationally significant landscape area in a recent assessment. Both the cultural history and landscape values of the planning area are primarily tied to agricultural environments and the cultural and historical importance of the river valley.

The importance of the Kokemäenjoki river valley as an old settlement and transport route is reflected in the area's diverse cultural heritage. The planning area's cultural environments consist of old rural architecture, which is supplemented by the coastal archipelago culture and the stone districts and industrial environments of Pori. The majority of the Kokemäenjoki river valley's culturally and historically notable sites and landscapes are located in its agricultural areas. Conversely, the valley's outlying mineral soil areas have notably fewer such values.

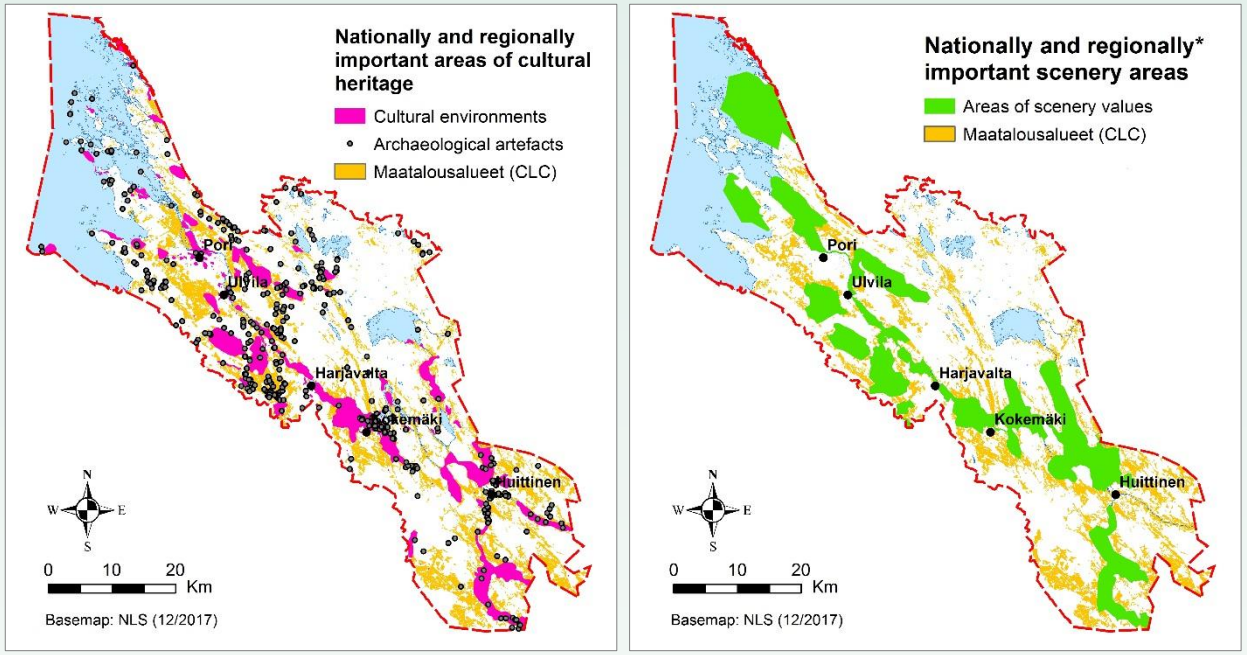


Figure 23. The planning area's nationally and regionally notable cultural environments and landscape areas

Agricultural areas: ecosystem services (1/2)

Agroecosystems can be defined as natural environments that have been deliberately simplified by people for purpose of the production of specific goods of value to humans (Swift et al. 2004). In practice, provisioning services (such as the production of grains or cattle) play a notably larger role in agricultural areas than they do in natural environments, since the vegetation and habitats of these areas have been deliberately shaped in a way that supports provisioning services (Kniivilä et al. 2013). On the other hand, agroecosystems and the shaping thereof can also create habitats for threatened species (such as the many species found in cultural environments). Characteristics associated with farming culture can be seen as valuable from the perspective of cultural history or the general landscape, for example, increasing the notability of an area through recreational use or aesthetic values (Arovuori & Saastamoinen 2013).

Agroecosystems do not function independently. Instead, their functions and ecosystem services are closely linked to the area's natural environments and blue-green structure. Many ecosystems services important for agriculture, such as pollination, pest control and nutrient circulation, are dependent not only on the characteristics of agricultural areas themselves, but the surrounding natural environments as well. On the other hand, agricultural activities and the shaping of the land for cultivation can also affect the ecosystem services of surrounding areas by changing the habitats that they contain, their ability to sequester nutrients and nutrient leaching, for example.

The agricultural environments of the Kokemäenjoki planning area are closely linked to the quality of waters and nutrient loading in different parts of the river basin. In practice, the nutrient leaching affecting the area's waters can be divided into diffuse loading from agricultural areas and point loading from agricultural buildings (including cattle shelters, manure storage). The Kokemäenjoki planning area's agricultural areas are estimated to account for 50–80% of the river basin's nitrogen and phosphorus load, with the figure varying somewhat in different parts of the area (Kipinä–Salokannel et al. 2015). An agroecosystem's capacity for sequestering nutrients can be assessed based on the area's vegetation, inclination and cultivation history. Fields in the planning area deemed to be at high risk of nutrient loading typically share a specific set of traits, such as susceptibility to flooding due to the flatness of the area, high soil phosphorus fertility resulting from a long cultivation history and small soil particle size, which contributes to erosion susceptibility (Kipinä–Salokannel et al. 2015).

Agricultural areas: ecosystem services (2/2)

In terms of ecosystem services, one of the notable characteristics of the Kokemäenjoki planning area is its long cultivation history, which increases the cultural ecosystem services provided by the area as regards recreational use, aesthetics and art, for example. Cultural ecosystem services are characterised by their subjectivity, i.e. people's appreciation for them varies depending on personal background and view of life, as a result of which their value cannot be explicitly defined. Instead of being based on natural values, the landscape, aesthetic and cultural history values of the Kokmäenjoki planning area in particular can be attributed to the area's old architecture and the complex of expansive riverside fields. However, the significance of these values is notably smaller in the planning area's forested areas, the cultural ecosystem services of which are more clearly related to recreational use and outdoor activities.

Figure 24. An irrigation device in operation in the fields along the River Kokemäenjoki (photo by Asko Ijäs)

Built environments and human activity (1/2)

Human activity in the planning area is strongly centred around vicinity of the main channel of the River Kokemäenjoki, which is also where the area's largest town and village centres are located. According to population statistics, the planning area was home to a total of 120,000 inhabitants in 2016 (SYKE/YKR). Over half of the area's population lives in Pori, the capital city of the Satakunta region. Other notable population centres in the planning area include Ulvila, Nakkila, Harjavalta, Kokemäki and Huittinen, which are all located along the River Kokemäenjoki. In addition to the river, the towns are connected by highway 2, which runs from Pori to Helsinki. Beyond the aforementioned city and town centres and the suburbs of Meri-Pori and Nakkila, housing in the area is sparse, consisting primarily of individual farms and small village centres.

In addition to the settlements clustered along the River Kokemäenjoki, the area's land use is characterised by extensive holiday home building. Unlike regular housing, the area's holiday homes are more evenly spread out throughout the entire planning area, though focused on the shore of the Bothnian Sea, along the River Kokemäenjoki and the shores of the area's large lakes (such as Sääksjärvi, Joutsijärvi and Palusjärvi).

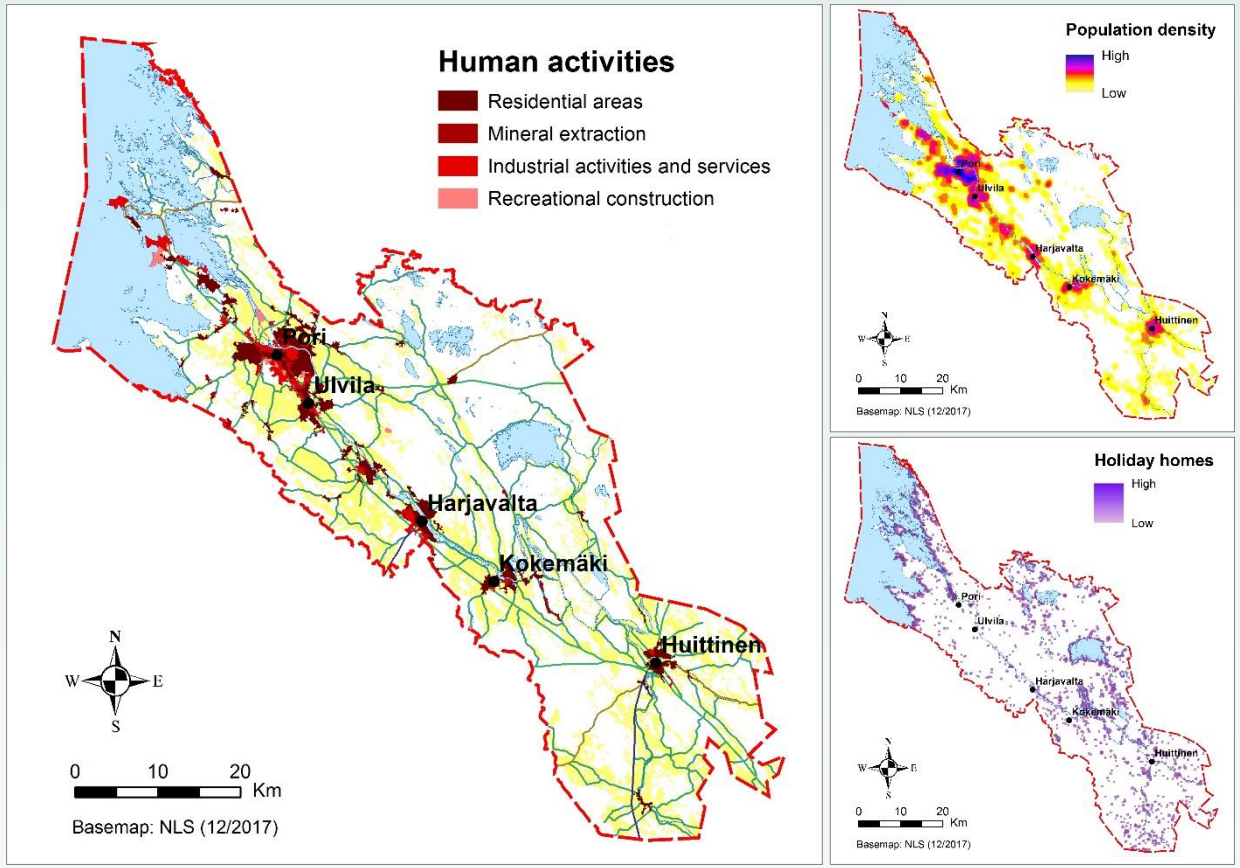


Figure 25. Areas of human activity (left), population density (upper right) and number of holiday homes (lower right) in the planning area

Built environments and human activities (2/2)

During the 20th century, the Kokemäenjoki riverside developed into a notable energy production and heavy industry cluster, the key areas of which include the harbour areas of Mäntyluoto and Tahkonluoto, the Suurteollisuuspuisto Industrial Park in Harjavalta and the hydropower plants built in the area in the 1920s–1940s. In the early 20th century, the River Kokemäenjoki served the needs of the cotton and paper industries in particular, functioning as an important raw material transport route.

As human activity increases, so too does its disruptive impact on the surrounding environment, which may, alongside changes in habitats resulting from construction, also affect the occurrence of various species and biotopes. In the Kokemäenjoki planning area, the negative impacts of human activity are greatest in the vicinity of the river, where the rate of human activity is contributed to by extensive residential construction and industrialisation as well as the road connections running across the area. Conversely, in areas outside of the river valley, disturbances caused by human activity are less prevalent, resulting primarily from forestry and the recreational use of the areas. Due to forestry, the local network of forest roads remains quite dense even in the sparsely populated parts of the planning area, encompassing practically the entire area.

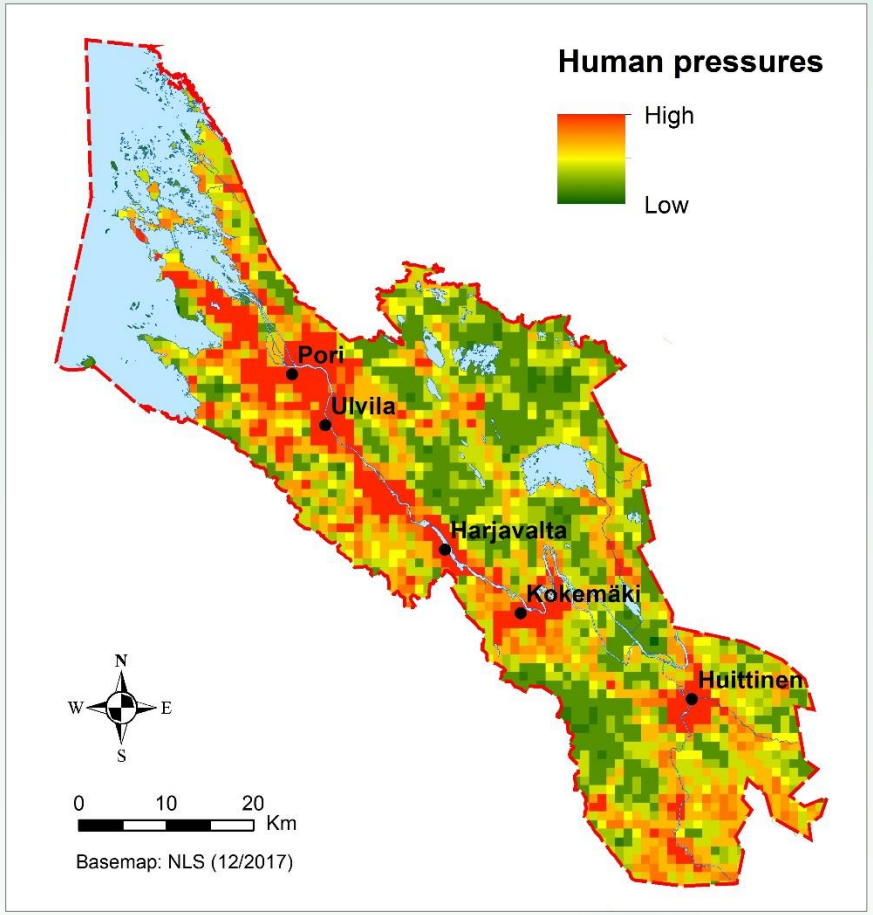


Figure 26. Human pressures in the Kokemäenjoki river valley area (Leikola et al. 2018)

Built environments: ecosystem services

In built environments with high population density, ecosystem services can contribute to the pleasantness of the living environment by regulating noise and air quality, purifying harmful substances from urban sources and through the recreational use of natural environments, for example (Saarela & Söderman 2008, City of Helsinki 2017). In urban areas, the pleasantness of the living environment is also improved by the presence of trees (see e.g. Kellomäki et al. 1984). The vicinity of local forests and water bodies also affects housing prices (Tyrväinen 1997). The green-blue structure can also play an important role as a habitat for different species and a maintainer of genetic diversity in urban environments, where areas are usually characterised by built environments (Väre & Krisp 2005). In urban environments, the prevalence of impermeable surfaces has a deteriorating effect on the quality of rainwater, as the water is not filtered through the soil before draining into local water bodies (Sillanpää 2013).

Apart from the city centre of Pori, housing in the Kokemäenjoki planning area is quite sparse, with the area's population centres being small in area in relation to the surrounding agricultural and forest areas. As a result, the fragmenting effect of the built environments is quite small on the regional scale. Additionally, the majority of the planning area's population centres have been built quite spaciously, leaving many natural environments between the residential areas, which locals can utilise for hiking and outdoor exercise, for example.

Figure 27. Kirjurinluoto is the most important recreational area in Pori (photo by the Regional Council of Satakunta)

5. Drivers affecting the provision of ecosystem services

Photo by: Tomi Glad

Drivers affecting land use in the Kokemäenjoki planning area (1/7)

Natural environments and their ecosystem services provide diverse benefits to people, thus contributing to well-being and economic development. On the other hand, land use and the utilisation of ecosystem services also have impacts on the current state of the environment. The extent and significance of these impacts are dependent on how strongly the changes occurring in the environment affect the ecosystem's capacity to provide ecosystems services important for the well-being of the environment or its capacity to recover from changes. Identifying the preconditions between human well-being and the environment's capacity to recover is also crucial for sustainable development, which centres around the utilisation of the ecosystem services provided by natural environments in a way that does not threaten the functioning of the ecosystem (Barbier et al. 1987).

Drivers affecting ecosystem services describe phenomena that affect the functioning of an ecosystem and its capacity to deliver services important for the environment or human well-being (Nelson et al. 2006). The main drivers affecting ecosystem services and the sustainable use of ecosystems in Finland have been identified as part of the national assessment of ecosystem services (Jäppinen & Heliölä 2015, Figure 30). However, the impact of individual drivers varies considerably by area, which is why characteristics related to the nature, population and economy of the area being examined should also be taken into account when using the general classification.

Land use in the Kokemäenjoki planning area is strongly centred around the immediate vicinity of the River Kokemäenjoki and the Bothnian Sea coastal zone, emphasising the need to coordinate functions affecting land and aquatic ecosystems, carry out planning in a comprehensive manner and reconcile the objectives of land use and water resources management. The city centre of Pori notwithstanding, the majority of the planning area consists of agricultural and forest areas, as a result of which the significance of drivers related to urbanisation and the densification of the city structure is small in the area. The population of the agricultural parts of the planning area has declined during the 21st century, whereas the population of the city of Pori and the areas surrounding it has increased.

Drivers affecting land use in the Kokemäenjoki planning area (2/7)

Direct drivers

1) Land use changes

- Forests: large-scale timber production continues, but with new more sustainable management.
- Mires: drainage for timber production, arable use or peat production.
- Agriculture: more intensive use of arable areas vs abandonment of semi-natural grasslands.
- Urban areas: densification of infrastructure.

2) Climate change

- Rising average temperatures and rainfall.
- Decreasing snow cover.
- More frequent storms and floods.
- Accelerating rates of decomposition and nutrient cycling.

3) Nutrient loading in water bodies

- More efficient nutrient use in agriculture.
- Effective cleaning of sewage waters.
- Leaching of nutrients from forestry and peat production.

4) Invasive species

- Increasing number of alien species due to climate change and human translocations.
- Arrival of new plant and animal diseases.

Indirect drivers

5) Demographic drivers

- Growing population in larger cities vs. abandonment of rural areas.

6) Economic drivers: consumption, production, and globalisation

- High and increasing energy consumption.
- Increased production of bioenergy.
- Decreased amount of municipal waste placed in landfills.
- Increasing tourism and nature-based recreation.

7) Socio-political drivers

- Targets for reducing greenhouse gas emissions.
- Targets for the conservation and sustainable use of biodiversity and natural resources.
- Reduced eutrophication of inland waters by improving water quality standards of the EU Water Framework Directive.
- Moving towards environmentally targeted taxation.
- EU environmental legislation, financial support and policies to promote environmentally sustainable practices.

8) Cultural drivers

- Rising popularity of voluntary nature conservation.
- Rising popularity of both local and ethical food production.

9) Science and research

- Possible reduction in carbon dioxide emissions due to advancing technologies.
- Increasing importance of environmental business and biotechnological innovations (Cleantech).

Figure 28. The main drivers affecting ecosystem services in Finland (Jäppinen & Heliölä 2015).

Drivers affecting land use in the Kokemäenjoki planning area (3/7)

The number of farms in Satakunta declined steadily throughout the 1990s and 2000s, with agricultural operations being centralised into larger units (Figure 31). The depopulation of agricultural areas and the ageing of the population will continue to affect the Kokemäenjoki planning area and its ecosystem services in the future as well. Larger unit sizes enable the utilisation of more efficient fertilisation and environmental protection measures, which decrease the impacts of agriculture on water bodies and facilitate the achievement of water resources management targets. On the other hand, the increasing efficiency and centralisation of agriculture may have a negative impact on the occurrence of species considered characteristic of the cultural environment, which are dependent on the fringe areas of agricultural areas and on cultural environments.

The agricultural environments and the riverside built environments of the Kokemäenjoki planning area reflect the area's history of settlement and its importance to the local economy. The area's diverse history and surviving built and cultural heritage carry a wide range of cultural meanings, which are notable not only in terms of national identity, but for their value to the local population and regional nature tourism as well. The changes affecting agricultural areas and the decreasing of resources allocated to the maintenance of cultural environments are significant risk factors in terms of the preservation of these values, as the values associated with many cultural environments (such as built heritage, the landscape) are the result of human activities and remain dependent on continued human activity. Decreasing human activity in cultural environments quickly increases overgrowth, which also reduces the number of species that prefer open areas and steers the area's landscape into a more forested direction.

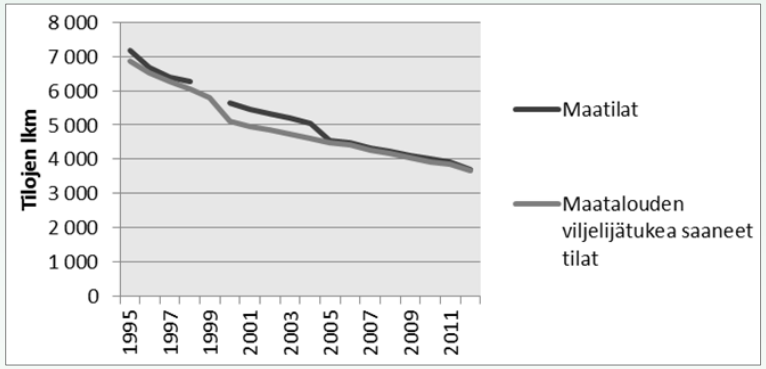


Figure 29. Development of the number of farms in Satakunta (based on Agency for Rural Affairs 2016, only in Finnish)

Drivers affecting land use in the Kokemäenjoki planning area (4/7)

Satakunta's Regional Strategy (Regional Council of Satakunta 2017) highlights climate change, the eutrophication of water bodies and challenges related to the maintenance of built heritage as key challenges related to the development of the region, the management of which and preparation for which should be taken into consideration in the region's land use and development. Due to the flatness of the land and the area's susceptibility to flooding, land use and human activity in the Kokemäenjoki planning area are greatly affected by water and nutrient cycling as well as the hydrological characteristics of the river basin. This also makes the area particularly vulnerable to climate change, which may give rise to new threats to the area's land and water ecosystems, in addition to affecting the ecosystem services of these areas and the utilisation thereof. It has been estimated that climate change will increase flow rates in the Bothnian Sea coastal zone and water bodies that drain into the sea, particularly in the winter. Coupled with milder winters, this may accelerate nutrient cycling and thus increase the nutrient load on waterways (Hakala et al. 2011).

The prevention of nutrient loading is already a key priority in the water resources management of the Kokemäenjoki river basin (Kipinä-Salokannel 2015). The nutrient load of the Kokemäenjoki river basin is primarily caused by diffuse sources, namely built living environments as well as agricultural and forestry areas. Because of this, managing nutrient cycling requires extensive collaboration between nature conservation and land use planners. One of the central development challenges in this regard is how to more effectively integrate water resources management objectives into land use planning. In their study, Alahuhta et al. (2010) provide several recommendations on how water resources management targets could be integrated into the notations of regional land use plans and how the loading calculations and assessments carried out as part of water resources management could be more effectively considered in land use planning. However, implementing these measures will require the coordination of water resource management and land use planning processes from an early stage and for both sides to improve information flow and availability as well as their expertise, so that the interests and goals of each party can be integrated into both planning processes.

Drivers affecting land use in the Kokemäenjoki planning area (5/7)

In recent years, declining biodiversity has been highlighted as one of the key challenges in terms of the functionality of ecosystems and the availability of ecosystem services (IPBES 2018). In the Kokemäenjoki planning area, the central issues in regard to coordinating the utilisation of natural resources with efforts to preserve biodiversity are related particularly to the natural values of forest and mire areas as well as their endemic species, some of which have declined in numbers throughout Finland in recent years (Rassi et al. 2010). In Finland, nature conservation is based not on ecosystem-level planning, but on species- and habitat-level protection, with the goal of preserving sites of high biodiversity value and steering activities that change the environment so that they are carried out primarily outside of these areas. However, as noted by Similä et al. (2017), among others, this type of site-specific nature conservation has proven ineffective in preventing the decline of biodiversity. After all, biodiversity and ecosystem services are bound not to any individual sites, but instead to the general well-being of an area's natural environments and the functioning of the local ecosystem, which is why the management of natural values and ecosystem services should focus on the comprehensive acknowledgement of environmental issues and assessment at regional level instead of the protection of individual sites (Similä et al. 2017).

Figure 30. Rocky pine-dominated forest in Joutsijärvi recreational area (photo by Asko Ijäs)

Drivers affecting land use in the Kokemäenjoki planning area (6/7)

The regional land use plan of Satakunta designates very little construction or other land use that would change environmental characteristics for forest- and mire-dominated areas. Housing is sparse in these areas, due to which they are not subject to any significant development pressures. However, the natural resources of these areas are already being utilised regularly, which also affects their environmental condition and ecosystem services. From an economic standpoint, the area's most notable natural resources include wood and other forest products, peat, which is primarily tied to mires, and the area's sand, gravel and groundwater resources. The utilisation of each of these resources has its own environmental impacts, which are taken into account insofar as possible in sector-specific planning and regulated by dedicated sectoral legislation. However, related information needs can also be highlighted in land use planning, which also involves identifying area complexes of high biodiversity value and coordinating the interests associated with different forms of land use through extensive interaction and cooperation with interest groups. It should also be noted that the forest and natural values associated with the Kokemäenjoki planning area extend beyond the current planning area itself, being seamlessly linked to the forests of entire Southwest Finland and the continuity of the network of mire areas in relation to the extensive mires of Ostrobothnia and Suomenselkä.

Human impact on the environment and ecosystems is often the result of the combined effect of a number of different actions, with the impacts of individual actions occurring in different places and at different times accumulating and manifesting as visible impacts. The indirect and cumulative nature of these impacts poses challenges for land use planning as well, as it is impossible to assess the impacts of all actions, as a result of which decisions have to be made based on limited information. Information uncertainty is a particularly notable issue in regard to phenomena that extend far into the future (such as climate change), the prediction of which practically always requires one to make assumptions about the current functions of ecosystems and the future changes thereof. For making these types of forecasts, it is crucial to have as much information as possible about the current state of the area being examined, particularly in regard to its natural environments and the ecosystem services that they provide.

Drivers affecting land use in the Kokemäenjoki planning area (7/7)

To make it possible to carry out land use planning based on sufficient information about an area's natural environments, an effort should be made to ensure the quality and sufficient regional coverage of basic research concerning the area's natural environments as part of social development. Such research has been subject to significant budget cuts in recent years, in addition to which funds have been directed from the production of basic data to a more application-oriented direction. The change in the funding system will also affect the shared understanding of the characteristics of Finland's natural environments and the functioning of ecosystems, which will in turn affect the amount of information available to serve as the basis for practical planning. The impact of this particular driver on land use planning is impossible to predict, as it will take a long time for the reduction in available research data to be reflected in practice.

6. Summary, received feedback and recommended follow-up measures

Photo by: Visa Vehmanen

Summary, received feedback and recommended follow-up measures (1/3)

Finland's Land Use and Building Act (132/1999) provides regional councils and municipalities the opportunity to prepare legally binding plans not only for land areas, but regional waters as well. The Finnish land use planning system offers a potential tool for the comprehensive consideration of ecological, social and economic values in land use and maritime spatial planning. However, this is only possible insofar as the values and usage needs of the area being examined can be systematically compared and the factors relevant to their sustainable utilisation assessed.

River basins are sensitive to changes caused by human activity throughout the entire catchment area of the water body, due to which preserving the good ecological status of a river basin requires comprehensive planning. In the Kokemäenjoki planning area, changes occurring in the river basin affect not only the river valley and its characteristics, but the Bothnian Sea as well, which links the planning of the area's maintenance and use to the targets set for the state of the marine area and maritime spatial planning. With the help of ecosystem services, the area's importance to biodiversity, recreational use and the local economy can be made visible, enabling different perspectives to be more extensively considered as part of land use planning.

Ecosystem services and ecosystem-based planning serve as a framework through which the different values and usage needs associated with the area can be comprehensively analysed, taking into consideration both the key values associated with the area and the functions that sustain its ecological condition. From the perspective of practical planning, an approach based on ecosystem services can be used to evaluate the objectives set for land use and maritime spatial planning, nature conservation and water resources management as well as assess the possibilities of coordinating them.

This plan defines the key concepts associated with ecosystem-based planning and examines how they relate to land use and water resources management planning processes in the area of the Kokemäenjoki river valley. The plan does not aim to provide a comprehensive view of the area's ecosystems services or their coordination. Instead, the plan defines the starting points for the development of ecosystem-based planning based on the area's current land use and the plans that steer it.

Summary, received feedback and recommended follow-up measures (2/3)

The principles of ecosystem-based planning were discussed in several regional experts groups in connection with the planning process (the cooperation group for regional planning in Satakunta on 6 March and 8 May 2018, the regional river basin working group of the River Kokemäenjoki on 7 February 2018). Furthermore, feedback on the draft plan was collected via e-mail from the Finnish steering group of the SustainBaltic project in September 2018. The e-mail survey was responded to by a total of seven people from four different organisations (the ELY Centre for Southwest Finland, Finnish Forest and Park Services, the Regional Council of Southwest Finland, the Central Union of Agricultural Producers and Forest Owners (MTK)).

In the feedback collected, ecosystem-based planning was seen as a potential starting point for considering sustainable use. The feedback also highlighted perspectives that affect the practical implementation and effectiveness of ecosystem-based planning. These perspectives were related to 1) the definition of the concept of ecosystem services (so-called terminological challenges), 2) the description of the area's current condition and ecosystem services (i.e. challenges related to information production) and 3) the integration of the principles of ecosystem-based planning into current planning processes (i.e. challenges related to the application of information). Additionally, the meetings involved general discussion on the role of ICZM planning in the Finnish planning system and on the role of the plans implemented in the SustainBaltic project in relation to the general land use planning system.

Ecosystem services is a broad concept that is defined in different ways in different contexts. The nebulous nature of the concept was clearly highlighted in the feedback received during the planning process, with some feedback even questioning whether the assessment of ecosystem services offers any added value for practical planning. In Finland, ecosystem services is currently a notably researcher-oriented concept that is seldom used by planners and the meaning of which remains somewhat unclear (Rinne & Primmer 2016). As such, integrating ecosystem-based planning into practical planning would require more thorough definition of the associated concepts and their linking into formal planning processes. This is a problem associated not only with the Kokemäenjoki planning area, but the development of the general land use planning system and legislation overall (see e.g. Similä et al. 2017).

Summary, received feedback and recommended follow-up measures (3/3)

In ecosystem-based planning, an area is examined on the basis of larger units than in traditional land use planning, which poses its own challenges in regard to the data used in the assessment as well. The Kokemäenjoki planning area has been the subject of a great deal of research in recent years, focusing on subjects such as the hydrology of the river basin as well as the geology and cultural values of the area. Some of the key challenges associated with the practical application of this research data have to do with its particularity, location-specificity and availability, which all limit the utilisation potential of the data for landscape-level analysis. The majority of the studies focus on specific parts of the area, and the data cannot be extrapolated to a more broader research area. Solving these challenges requires further research in the Kokemäenjoki planning area and the expansion of the available knowledge base in regard ecosystem services related to water circulation, nutrient sequestration and recreational use, for example.

The preparation of the present plan also involved the drafting of a preliminary report on the ecosystem services of the Kokemäenjoki planning area and the geospatial data sets available for their assessment (Mononen et al. 2018). One of the central challenges in the drafting of this report was problems related to the availability of existing data. The work carried out for the plan should be continued with an analysis of the area's ecosystem services, which would in turn enable the assessment of the synergy and coordination needs related to values and human pressures and thus more detailed planning. This research should focus particularly on comprehensive examination and land use planning, so that available data concerning the current condition of the area can be more effectively transferred from research articles to practical planning and decision-making.

7. References

Photo by: The Regional Council of Satakunta

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