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**MAIA**  
Mapping and Assessment for  
Integrated ecosystem Accounting

The MAIA country fact sheets summarize the state of affairs on natural capital accounting (NCA) in the countries connected to the MAIA project. They serve as an accessible overview and entry point for collaboration. The factsheets describe the needs from policy, society, science and business for the use of NCA, give an overview of the ongoing and published research -including knowledge gaps- in the country, include contact details and an overview of national partners and stakeholders involved in the accounts. Information in this document is based on MAIA Deliverables and exchanges, and the content is reviewed, co-authored and updated by MAIA-liaison persons in the participating country. This version was updated on August 5<sup>th</sup> 2022.

# Country fact sheet: **Finland (FI)**

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## Summary

In Finland, the focus of natural capital and ecosystem accounting has been on the development of various methods and frameworks from a research perspective. No official ecosystem accounts have been published so far. Physical marine ecosystem accounts, monetary accounts for recreational ecosystem services and thematic accounts for freshwater and urban areas are examples of latest research. The Eurostat initiative to update Regulation (EU) 691/2011 and the SEEA-EA are expected to increase policy demand for natural capital accounting in Finland.

Lack of mandate is maybe the main barrier for the development and implementation of ecosystem accounts in Finland. Moreover, finding common language between natural scientists, economists and statisticians takes time. Development of harmonized, IUCN GET-compliant hierarchical ecosystem classification for Finland, should be one of the key priorities. Data-based quantification of fresh water assets is currently not possible as data is fully or partly missing. The Marine condition account needs refining. Some problems are linked to contradictory or non-feasible guidelines. For instance, the concept of so-called *Green water footprint* or *Soil water consumption* are encountered to be very theoretical and hard to apply in the Finnish national context.

The primary need is to get mandate from ministries to start providing ecosystem accounts. Statistics Finland, SYKE and Luke will need additional personnel to incorporate the SEEA-EA in their daily activities. Automatisations of the workflow and closer collaboration with expert networks are needed.

## Country policy priorities for developing natural capital accounts

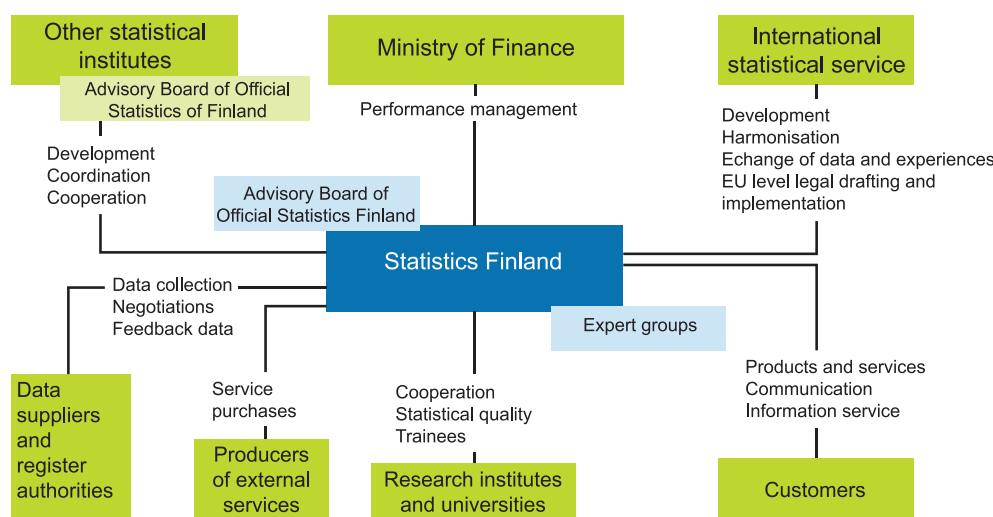
Based on MAIA D5.1 (Annex 4 section 3)

Currently there is no official mandate for natural capital accounting or ecosystem accounting in Finland. Methodological development for piloting ecosystem and water accounting has been a bottom up process. The Eurostat initiative to update Regulation (EU) 691/2011 and the SEEA-EA are expected to increase demand for natural capital accounting from the policy side in Finland.

The official statistical main authority in Finland is Statistics Finland under auspices of the Ministry of Finance (Fig 1). The two other official statistical authorities providing data and information on ecosystems for Statistics Finland are Finnish Environment Institute (SYKE) under auspices of the Ministry of the Environment, and Natural Resources Institute Finland (Luke) under auspices of the Ministry of Agriculture and Forestry. Statistics Finland is the main representative in Eurostat, and in the negotiations on implementation of the SEEA-EA framework in Finland in the future.

Currently there is no official mandate for natural capital accounting or ecosystem accounting. Methodological development for piloting ecosystem and water accounting has been a bottom up process. Experimental ecosystem accounting has been focused, in particular, on ecosystem extent, condition, and economic accounts, thematic accounts on biodiversity and urban. The Eurostat initiative to update Regulation (EU) 691/2011 proposes new mandatory modules for environmental accounting including ecosystem accounts. The System of Environmental Economic Accounts - Ecosystem Accounting was adopted as an international statistical standard by the UN Statistical Commission in 2021. These two drivers are expected to increase demand for ecosystem accounting from the policy side in Finland.

The Ministry of the Environment has paid attention to improve monitoring of biodiversity and ecosystems (including ecosystem services) by increasing data interoperability. Ecosystem accounting has been selected as one case study in a new Finnish Ecosystem Observatory (FEO) project, where for instance Earth observation data is planned to be operationalized to support provisioning of statistical data. FEO also applies FAIR data principles.



**Figure**

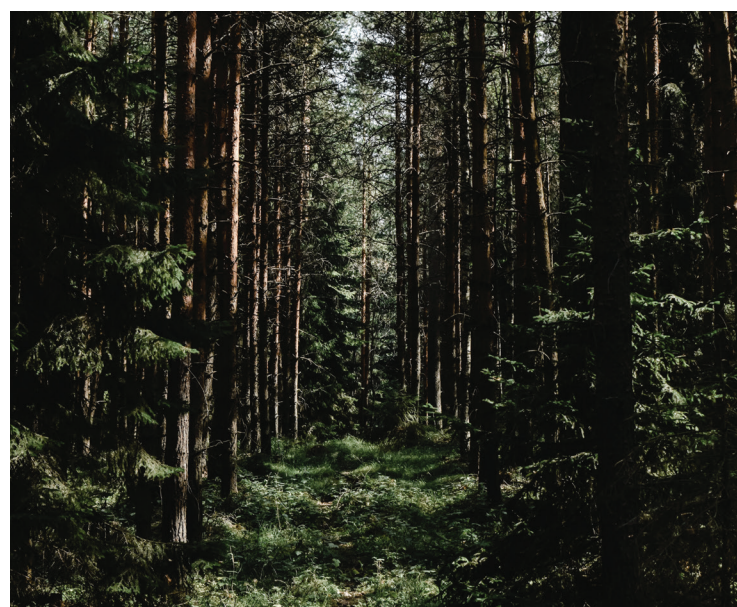
Statistics Finland's position and interest groups (achieved 11.12.2020, ([https://www.stat.fi/org/tilastokeskus/toimintaymparisto\\_en.html](https://www.stat.fi/org/tilastokeskus/toimintaymparisto_en.html)))

## Pilot accounts under development

### Summary table of accounts

Account		Ecosystem Types / Ecosystem Services	Link to research
Accounts for ecosystem assets	Ecosystem extent account	<b>Marine</b>	
	Ecosystem condition account	<b>Marine</b>	
	Ecosystem monetary asset account	<i>Forest*</i>	Hurskainen et al., 2021
Accounts for ecosystem services	Ecosystem services supply and use table - physical terms	<b>Marine</b>	Lai and Saikkonen, 2020
	Ecosystem services supply and use table - monetary terms	<b>Recreation</b>	Lankia et al., 2020
Thematic accounts		<b>Emissions of N and P to water</b>	In press: Weckström and Salminen
		<b>Biodiversity in forests</b>	<a href="https://github.com/PKullberg/EEA_and_BD/tree/master/ELITE_index">https://github.com/PKullberg/EEA_and_BD/tree/master/ELITE_index</a>
		<b>Water abstraction and use*</b>	Salminen et al. 2018
		<b>Water consumption and wastewater</b>	Weckström et al. 2020
		<b>Regional water asset accounts and water use accounts*</b>	In press: Salminen and Mattsson
		<b>Urban pilot accounts for Helsinki, Tampere and Pirkkala</b>	<a href="https://www.syke.fi/en-US/Research_Development/Research_and_development_projects/Projects/Developing_pilot_accounts_for_marine_freshwater_and_urban_ecosystems_and_packaging_materials_ENVECO">https://www.syke.fi/en-US/Research_Development/Research_and_development_projects/Projects/Developing_pilot_accounts_for_marine_freshwater_and_urban_ecosystems_and_packaging_materials_ENVECO</a>

Scale	State of development
<b>National</b>	<b>Finished</b>
<i>Regional</i>	<i>Ongoing</i>
<u>Local</u>	<b>None ongoing or published</b>
*Highlighted in the fact sheet	



## Summary overview of highlight accounting projects

### Novel methods for the accounting of forest ecosystems

#### Scale

National.

#### Involved and funding partners

Research funded by Eurostat Action Grants (2019), involving Finnish Environment Institute (SYKE) and Natural Resource Institute Finland (Luke).

#### (Policy) Goal of the study

The most important ecosystem service in Finland in monetary terms is timber production, and the demand for timber is ever increasing. Thus, investigating the tradeoffs between timber production and other ecosystem services such as carbon sequestration is critical. Ensuring sustainable supply of these services requires first accurate and spatially explicit information throughout time on forest ecosystem extent and condition, before the forests capacity to produce ecosystem services can be modelled. In this study the possibilities of developing spatially explicit indicators measuring forest ecosystem condition with the support of machine learning, remote sensing, and spatial analysis methods was investigated.

#### Ecosystems under study

Forest ecosystems.

#### Methods and data used for the study (if relevant indicators used)

First, a literature review on forest ecosystem condition indicators, including assessment of possibilities for producing wall-to-wall maps of these indicators with remote sensing data (e.g. airborne laser scanning, aerial and satellite images) and existing spatial data (e.g. national multi-source forest inventory maps), was conducted. A case study was made to test if introducing machine learning methods, such as deep learning, will improve the prediction results of selected forest variables and indicators compared to traditional remote sensing modeling methods presently used in forest inventories. Existing forest inventory data, topographic map database and spatial analysis methods was used to calculate condition indicators characterizing fragmentation of forest ecosystems.

#### Link to the research

[https://www.syke.fi/en-US/Research\\_Development/Research\\_and\\_development\\_projects/Projects/Novel\\_methods\\_for\\_the\\_accounting\\_of\\_forest\\_ecosystems\\_and\\_circular\\_materials\\_ENVECO](https://www.syke.fi/en-US/Research_Development/Research_and_development_projects/Projects/Novel_methods_for_the_accounting_of_forest_ecosystems_and_circular_materials_ENVECO)

#### Reference

Hurskainen, P., Salminen, J., Balázs, A., Johansson, A., Kangas, A., Karppinen, T.K.M., Laturi, J., Mäyrä, J., Pohjola, J., Savolainen, H., Tuominen, S., Vihervaara, P., Virkkunen, H. 2021. Novel methods for the accounting of forest ecosystems and circular materials (2019-FI-ENVECO). Methodological Report, 73 pp. Available at: [https://www.syke.fi/en-US/Research\\_Development/Research\\_and\\_development\\_projects/Projects/Novel\\_methods\\_for\\_the\\_accounting\\_of\\_forest\\_ecosystems\\_and\\_circular\\_materials\\_ENVECO](https://www.syke.fi/en-US/Research_Development/Research_and_development_projects/Projects/Novel_methods_for_the_accounting_of_forest_ecosystems_and_circular_materials_ENVECO)



## From Marine Ecosystem Accounting to Integrated Governance for Sustainable Planning of Marine and Coastal Areas

### ➤ Scale

Finland, Estonia and Latvia.

### ➤ Involved and funding partners

Research funded by InterReg Central Baltic (2020), involving Finnish Environment Institute (SYKE), Pellervo Economic Research (PTT), University of Tartu, Baltic Environmental Forum.

### ➤ (Policy) Goal of the study

The study will develop and test novel concepts of ecosystem services mapping, environmental accounting and sustainability assessment in the marine realm. Overall goal is the refinement of the existing marine extent and condition accounts, from extending the concepts to cover ecosystem processes and functions. This study also advances the ecosystem services modelling methodology of the threats impacting marine ecosystem service supply.

### ➤ Ecosystems under study

Marine ecosystems.

### ➤ Methods and data used for the study (if relevant indicators used)

The study uses existing georeferenced data on marine environments, from underwater mapping programmes in Finland, Estonia and Latvia. Ecosystem service supply and use will be also evaluated for a range of ecosystem components and anthropogenic activities, depending on data availability. In addition, questionnaires and questionnaire mapping programmes (e.g. Harava and Maptionnaire) will be used for describing the use and feedbacks to extent and condition in monetary terms. Machine learning modelling methodologies will be applied for the actual modelling of the ecosystem services, and geospatial analyses for defining the use and feedbacks to the marine ecosystem.

### ➤ Link to the research/reference

[https://www.syke.fi/en-US/Research\\_Development/Research\\_and\\_development\\_projects/Projects/From\\_Marine\\_Ecosystem\\_Accounting\\_to\\_Integrated\\_Governance\\_For\\_Sustainable\\_Planning\\_of\\_Marine\\_and\\_Coastal\\_Areas\\_MAREA](https://www.syke.fi/en-US/Research_Development/Research_and_development_projects/Projects/From_Marine_Ecosystem_Accounting_to_Integrated_Governance_For_Sustainable_Planning_of_Marine_and_Coastal_Areas_MAREA)



## Environmental and ecosystem accounting as tools for sustainability analysis.

### ➤ Scale

Multiple: Helsinki capital area, Uusimaa region, Finland.

### ➤ Involved and funding partners

Maj and Tor Nessling Foundation, Nordic Council of Ministries.

### ➤ (Policy) Goal of the study

On national scale, Finland has abundant water resources and the volumes of abstracted water are well below the available fresh water resources. However, water resources are unevenly distributed across the country as is their use (abstraction) for various human activities. That said, methodologies are needed to generate regional accounts on water assets and water abstraction to allow sustainability analyses on varying sub-national scales. For such sustainability analyses, two sets of data are needed: (i) sub-national asset accounts on groundwater and fresh surface water, and (ii) regional water use accounts.

### ➤ Ecosystems under study

Fresh surface water and groundwater ecosystems.

### ➤ Methods and data used for the study (if relevant indicators used)

National water use accounts are used as the basis for sub-national water accounts; compilation of sub-national water use tables in a manner similar to national water accounts would be laborious and challenging. Therefore, methods that allow generation of such accounts based on estimation from national accounts is suggested. For this purpose, different statistics and data on regional entrepreneurial, economic activities and population, are used. For the regional water asset accounts, databases on water assets together with spatial data are used.





# Knowledge gaps and difficulties for developing natural capital accounts

*Based on MAIA D3.2 (Annex 4 section 1)*

Lack of clear organizational mandate and structure to divide the work, together with proper resource allocation, are arguably the main barriers for operationalization of ecosystem accounts in Finland. Development of harmonized IUCN GET-compliant and EU Ecosystem Typology compliant hierarchical ecosystem classification for Finland, should be one of the key priorities. Data-based quantification of fresh water assets is currently not possible as data is fully or partly missing. The Marine condition account needs refining. Some problems are linked to contradictory or non-feasible guidelines. For instance, the concept of so-called Green water footprint or Soil water consumption are encountered to be very theoretical and hard to apply in the Finnish national context.

Until recently, there has not been much policy demand for operationalizing ecosystem accounts, but this is rapidly changing as Ministries of Finance, Agriculture and Forestry, and Environment, have voiced out the importance of accounting for natural capital. This is reflected for example in the new National Biodiversity Strategy and an action plan to 2030, and the Strategy of the National Commission on Sustainable Development 2022–2030. Establishing a bottom-up Finnish ecosystem accounting community of practice was also started with the first national workshop held in June 2022. The main remaining difficulties for operationalization relate to lack of resources, clear organizational mandate and structure to divide the work, and data gaps. Other problems are specific to certain accounts. They are described below.

**MARINE:** In the marine realm, marine ecosystem extent and condition accounts have been piloted for the whole Finnish marine area. Extents can be refined every year, as georeferenced data accumulates and the extents can be modelled in more detail. What will be developed further next year, are the marine condition accounts. Currently, condition is defined only based on anthropogenic activities (pressures), which have an impact on ecosystem extents, via degraded habitat condition. In order to define the condition in more detail, the reference condition of the marine environment should be modelled separately, and in addition to the potential for reaching ecosystem extent under good environmental status (condition).

**ECOSYSTEM EXTENT & CONDITION:** At the moment, Finland lacks an ecosystem extent account for terrestrial areas. The main difficulty in developing this account is the lack of national harmonized spatial dataset on Finnish ecosystems. Existing global- and continental-scale ecosystem maps are too coarse and lack ecological detail for many important and endangered ecosystems. Although national spatial data for some ecosystem types exist, they differ in spatial scale, mapping accuracy and updating frequency, and are a mixture of raster and vector data. In the SEEA-EA framework, the extent account defines the spatial extent of ecosystems, and forms the basis where upon other accounts such as ecosystem condition and ecosystem service supply and use are compiled. Therefore, development of harmonized, IUCN GET-compliant hierarchical ecosystem classification for Finland, balanced between ecological detail and mapping feasibility, should be one of the key priorities in natural capital accounting for Finland. Compilation of national extent accounts would be a straightforward task when this data is available.

**FRESHWATER:** Finland is abundant in water resources and there are over 180 000 fresh water bodies in the country. Groundwater is also present and abstracted for human consumption (by households) beyond aquifers classified important for water supply, the total number of which is roughly 3900 and represent not more than 4 % of the total land surface of Finland. Data-based quantification of fresh water assets is currently not possible as data is fully or partly missing for the above categories; for instance, depths of freshwater bodies and productivities of groundwater aquifers are not known for all formations. For groundwater outside the above mentioned aquifers even estimations cannot be made.

Some problems are linked to contradictory or non-feasible guidelines. For instance, the concept of so-called Green water footprint or Soil water consumption are very theoretical. They may be applicable to regions/countries, where urban or human-generated environments dominate. However, in countries like Finland where semi-natural forested areas are dominant and large natural protection areas exist, they are less applicable. Also the idea of used fresh water returned to the sea being calculated as water consumption is very problematic for countries with large coastal settlements. The concept mixes spatial data with the concept of accounting, which is very problematic. The details of the problems that arise can be found in the Finnish papers (Lai et al., 2018; Oinonen et al., 2019; Salmi et al., 2018).



## Support needs for developing natural capital accounts

Based on MAIA D3.2 (Annex 4); D5.1 (Annex 4)

The primary need is to get mandate from ministries to start providing ecosystem accounts. Statistics Finland, SYKE and Luke will need additional personnel to incorporate the SEEA-EA in their daily activities. Automation of the workflow and closer collaboration with expert networks are needed.

The EU-funded research and development work done in Finland for ecosystem accounts has been a success, but operationalizing the accounts, i.e. regular production of official statistics, needs support from other (domestic) funding sources.

Statistics Finland expects that the incorporation of ecosystem accounting into their normal work, as suggested by the revised SEEA-EA guidance, would require approximately 4-5 extra persons to yearly contribute to the accounting process in Finland. At SYKE and Luke this has not been evaluated but probably similar resources would be needed.

Automatisation of indicator production workflows is needed. Utilisation of remote sensing data and machine-learning interpretation methods, for instance for land-cover change, should be further studied. Thematic accounts, such as biodiversity, need closer collaboration with expert networks who are developing harmonized biodiversity observation systems and measures, such as EBVs of GEO BON, and overall monitoring schemes in the forthcoming EU Biodiversity Partnership.

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## Involved partners and stakeholders

Based on D5.1 (Annex 4 section 2);  
European NCA stakeholder day

Government	Research	Private sector or NGO
Statistics Finland	Natural Resources Institute Finland (Luke)	
Ministry of Environment	University of Helsinki	
Metsähallitus	Finnish Environment Institute (SYKE)	
	Institute for Economic Research (VATT)	

