Co-creating Urban / Municipal Ecosystem Accounting: Experiences from two pilot projects*

Leena Kopperoinen, Laura Costadone, Tin-Yu Lai, Pekka Hurskainen

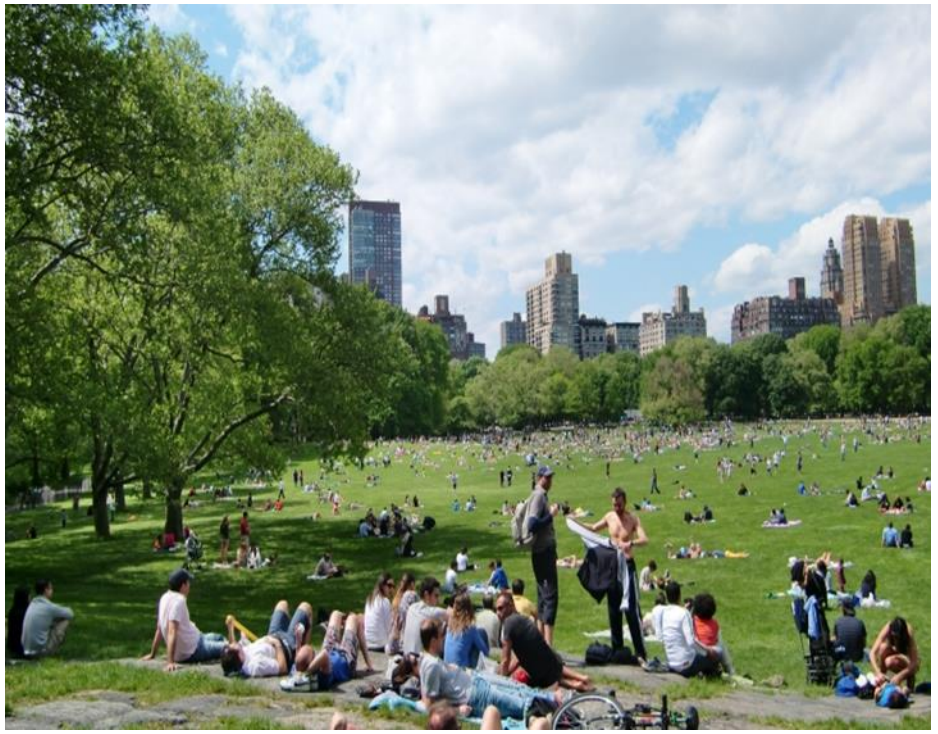
Finnish Environment Institute

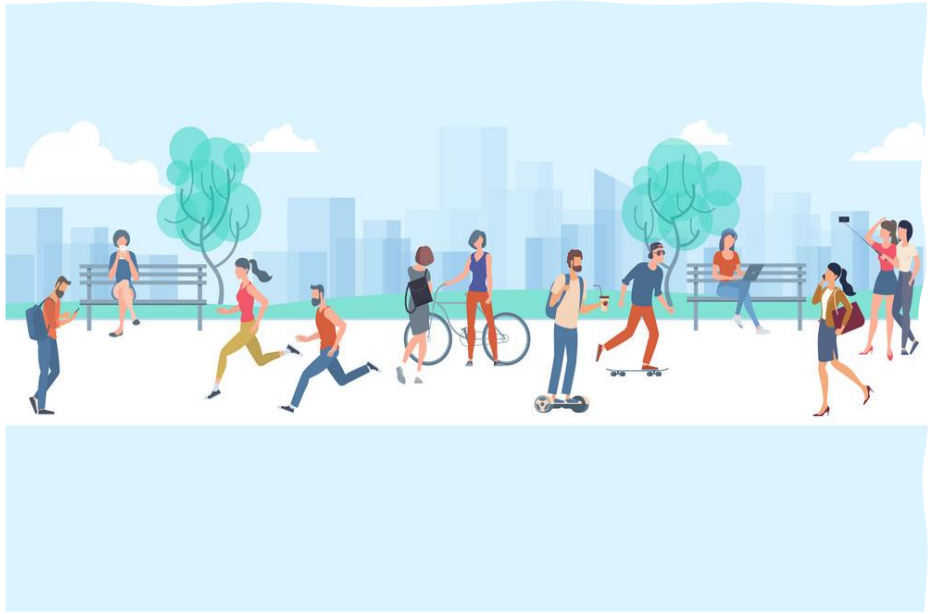
* This work was supported by the **Eurostat Action Grant of the European Union** 2020-FI-ENVECOPACK, grant number 101023419 and the **Sustainable Cities Working Group** of the **Nordic Council of Ministers** (Nordic urban experimental ecosystem accounting pilot project 2021-2022).

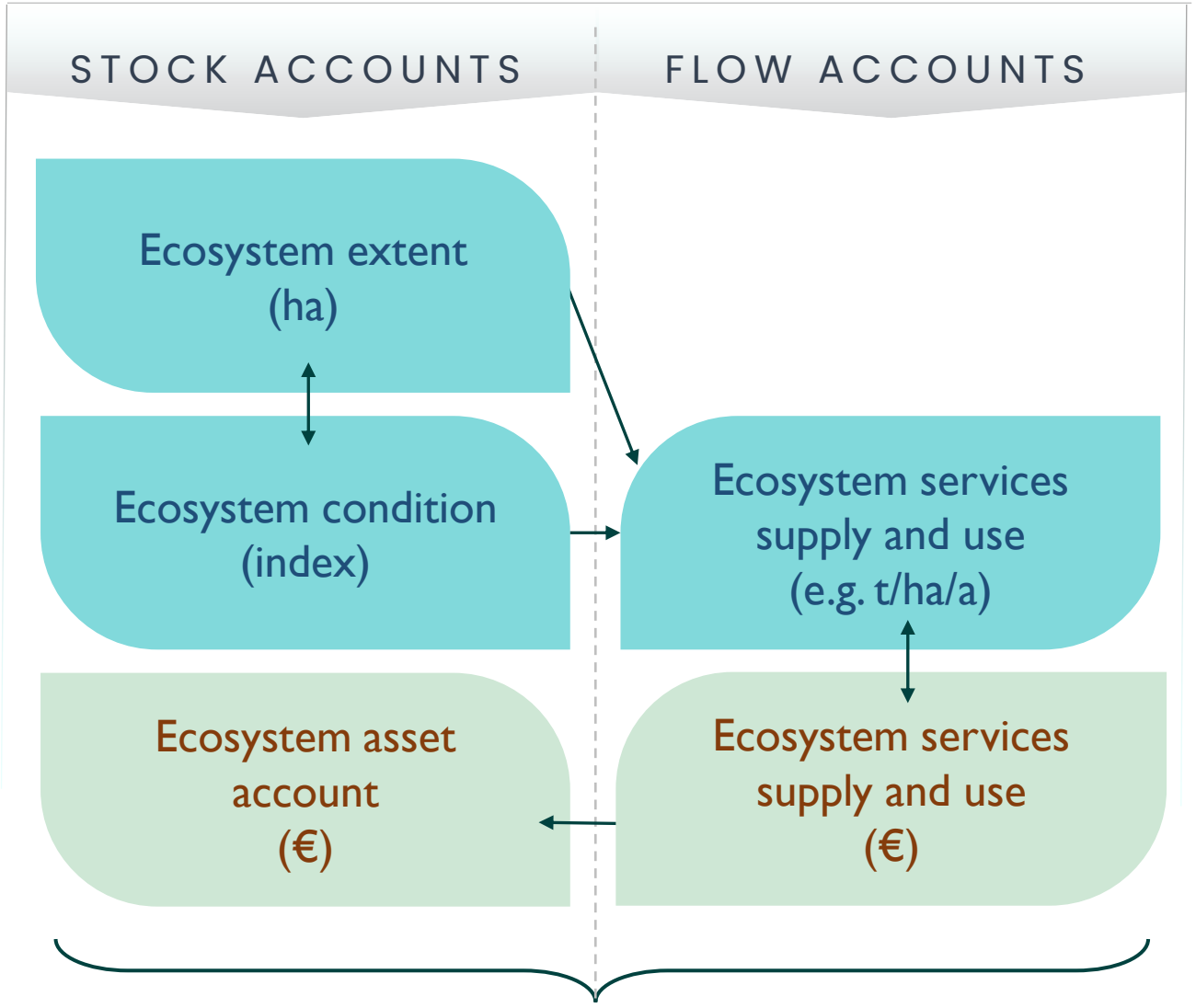
Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Why Urban / Municipal Ecosystem Accounts?

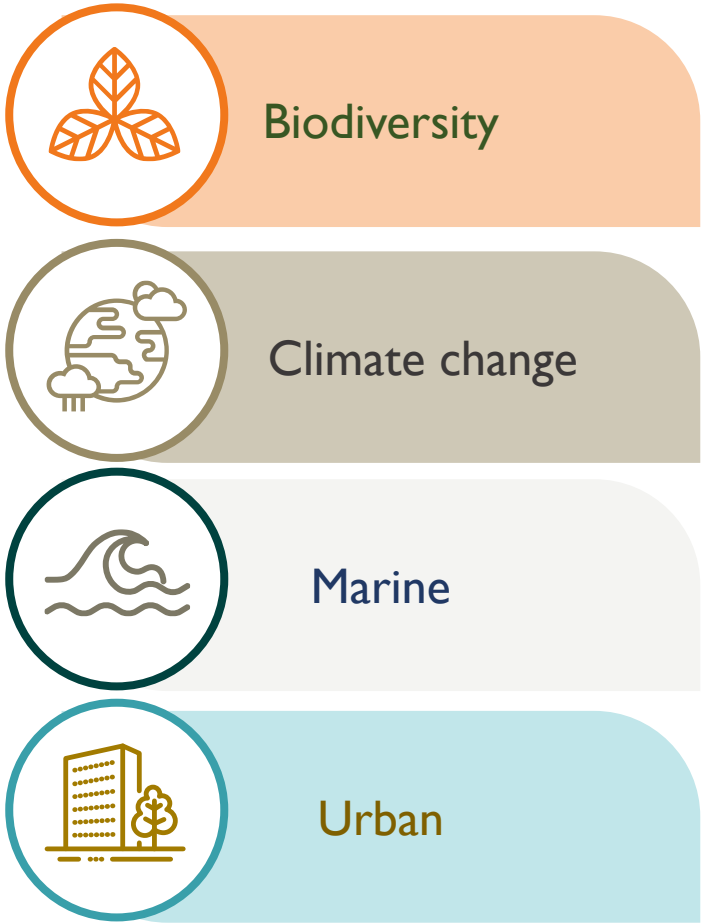
- Urban green and blue spaces are crucial components of urban ecosystems providing numerous ecosystem services important for human welfare and environmental sustainability
- Planning, conservation and managing of urban green and blue spaces are instrumental to the transition towards sustainable urban planning
- Ecosystem accounts can support strategic municipal planning and policy setting and can facilitate mainstreaming biodiversity, ecosystems and ecosystem services into planning development and decision-making







CORE ACCOUNTS



THEMATIC ACCOUNTS

- **Physical accounts** are accepted as UN statistical standard
- **Monetary accounts** are accepted as internationally recognized statistical principles

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Usefulness of Ecosystem Accounting

- Ecosystem accounting (EA) provides an integrating decision-support tool for assessing the contribution of ecosystems to the economy and people and better recording the impacts of economic and other human activity on the environment
- It makes the connection between natural assets and human benefits
  - The ecosystem **extent accounts** measure the area covered by each ecosystem type and how the area changes over reporting periods
  - The ecosystem **condition accounts** record information about the health and state of ecosystems in terms of selected characteristics
  - The **ecosystem services flow accounts** record the supply of and demand for ecosystem services in both physical and monetary terms
  - The **monetary ecosystem asset accounts** record information on stocks and changes in stocks of ecosystem assets

United Nations et al. 2021. System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Overview of municipal pilots

- Co-creation with municipalities in the implementation of urban EA approaches targeted at the local policy needs and critical issues
- Testing the suitability of different existing spatial datasets and methods for the purpose of urban EA
  - To compile an ecosystem extent account following SEEA-EA standard and EU ecosystem typology
    - Pirkkala: Urban green and forest extent
    - Helsinki: Urban green extent
    - Tampere: Complete ecosystem extent
  - To compile physical and monetary accounts of ecosystem services supply and use
    - Pirkkala: the educational and recreational value of green areas, using PPGIS surveys
    - Helsinki: the value of nature-based recreation in green areas using movement, eco-counter and survey data
    - Tampere: the value of green areas in attenuating stormwater runoff

Ecosystem extent accounts

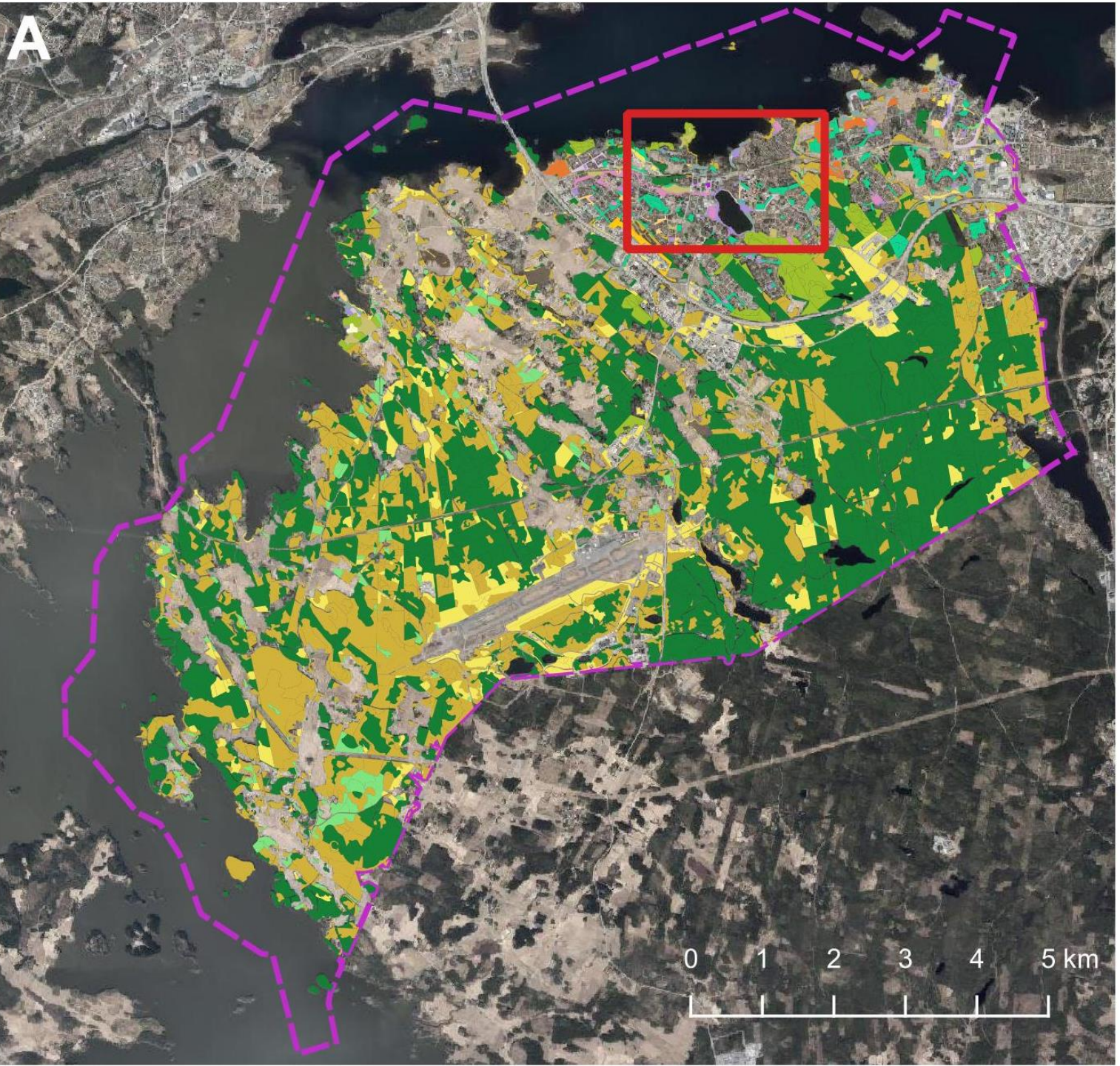
Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

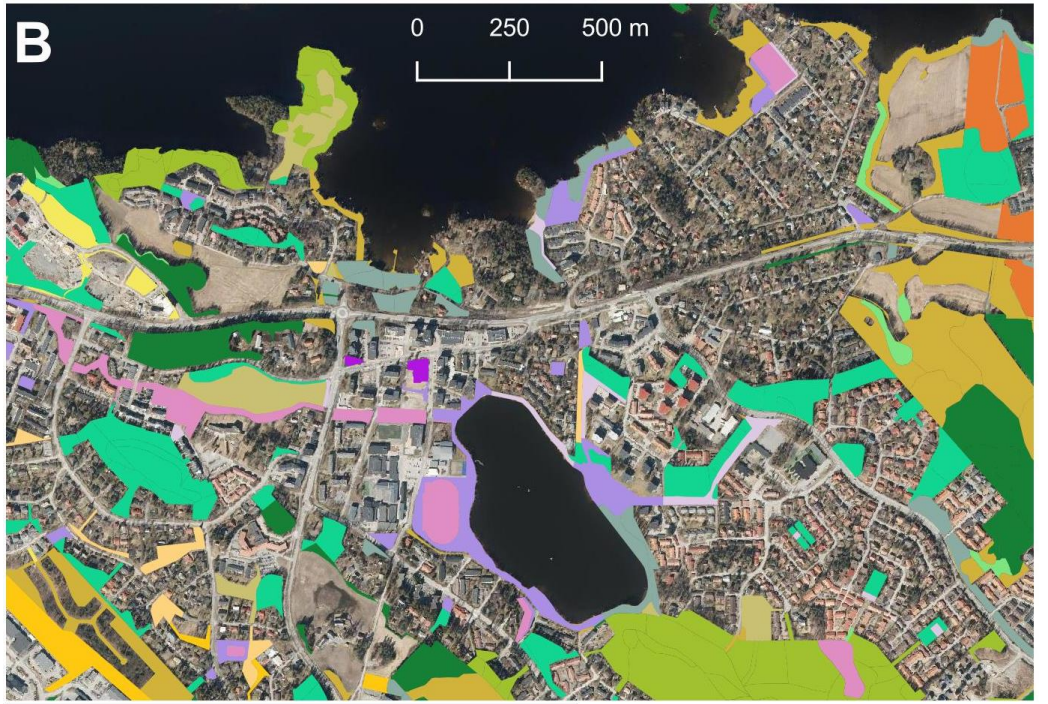
Datasets used for pilot extent accounts

Dataset	Used for	Datatype	Spatial resolution or scale	Spatial extent	Temporal extent	Update frequency	Source
Municipal administrative boundaries	ecosystem accounting area	Polygon	1:10 000	Finland	2020	on demand	NLS, TK
Pirkkala urban greenspace maintenance classes	Pirkkala	Polygon	unknown	Pirkkala (town plan area)	2021	on demand	Pirkkala municipality
Gridded forest resource data (*Hila*)	Pirkkala	Polygon	16 x 16 m	Finland	2013 - 2022	continuous / on demand	Finnish Forest Centre (SMK)
Forest stands (*Metsävarakuviot*)	Pirkkala	Polygon	unknown	Finland	2022	continuous / on demand	SMK
Forest mask of forests under commercial forestry and protected areas (*Metsämaski*)	Pirkkala	Polygon	unknown	Finland	2022	continuous / on demand	SMK
Canopy height model	Pirkkala	Raster	1 x 1 m	Finland	2008-2022	continuous, 1-2 times per year	SMK
CORINE Land Cover (High-res accounting layers)	Tampere	Raster	20 x 20 m	Finland	2012, 2018	6 years	Syke
Urban Atlas	Helsinki	Polygon	1: 10 000	Seven cities and their metro areas	2018	6 years	Syke, EEA
Register of public areas (YLRE) including urban greenspace maintenance classes	Helsinki	Polygon	unknown	Helsinki	2022	on demand	City of Helsinki

Software

- QGIS
- R
- GDAL
- SAGA



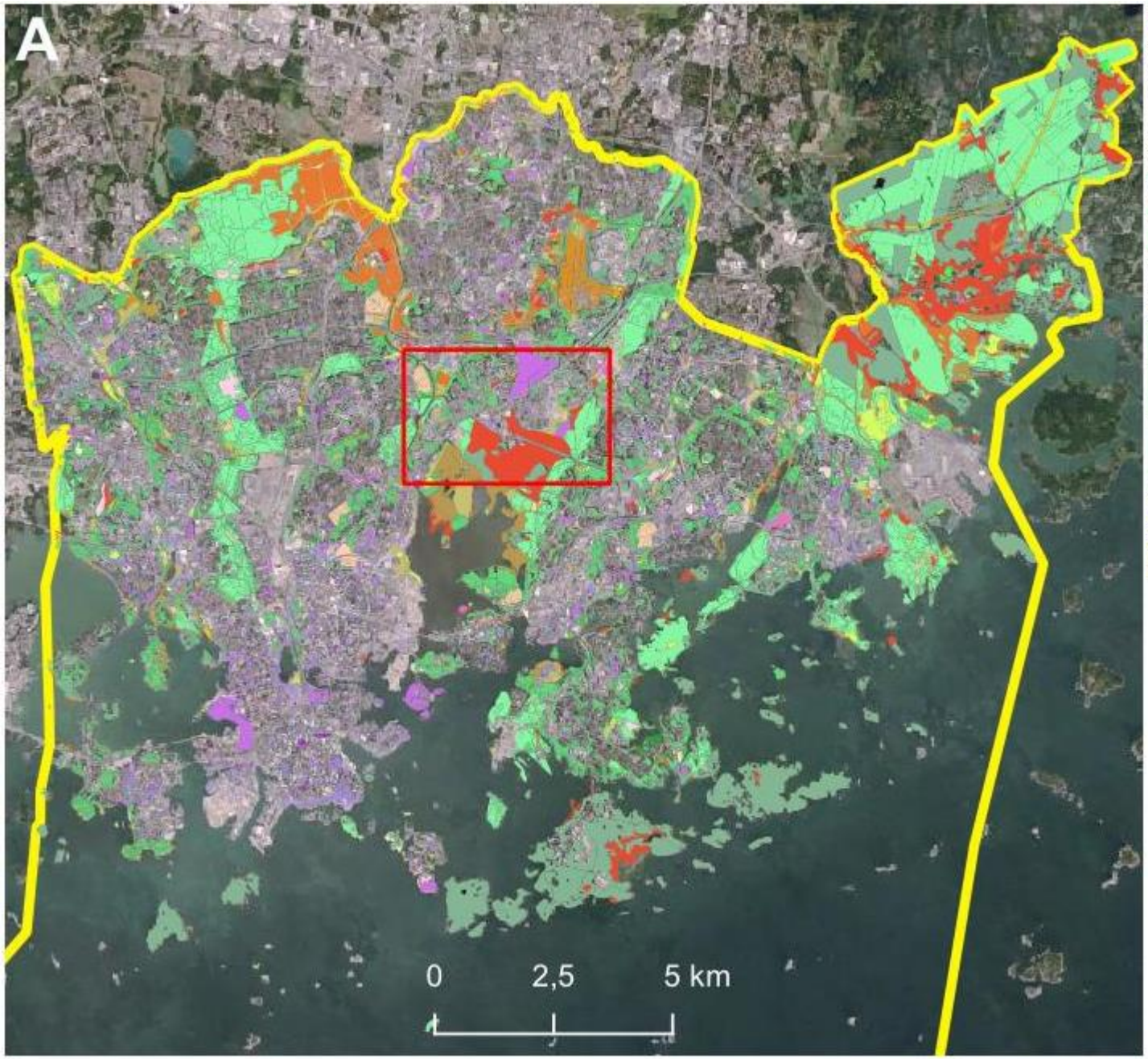


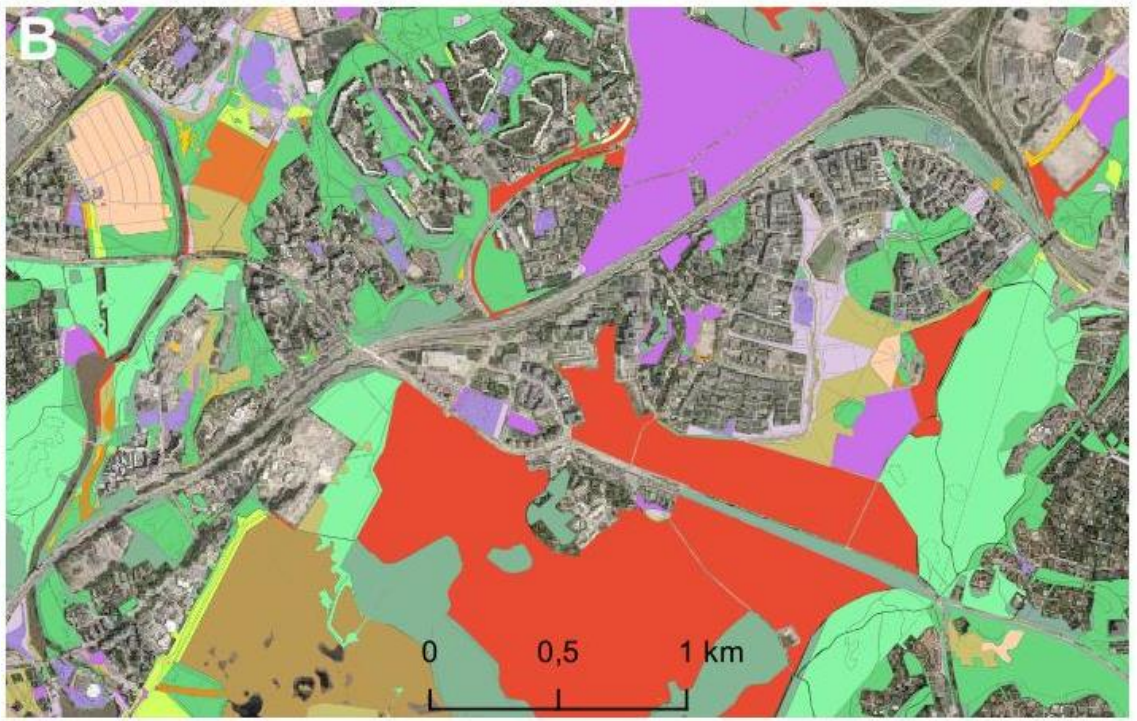
Pirkkala Forest and Urban Green Extent 2022

- 1.4.1 High-value urban parks
- 1.4.2 Recreational urban parks
- 1.4.3 Protective/Buffer Green-space
- 1.4.4 Sports and recreation sites
- 2.1.1 Cropland important for landscape
- 3.1.1 Meadows/pastures important for landscape
- 3.1.2 Recreational meadows
- 3.1.3 Open space
- 3.2.1 High nature value meadows
- 4.1.1 Broadleaved deciduous forest
- 4.2.1 Coniferous forest
- 4.4.1 Mixed forest
- 4.5.1 Transitional forest and woodland shrub
- 4.6.1 Nearby urban/semiurban forests
- 4.6.2 Recreational forests
- 4.6.3 Protective/Buffer Forests
- Ecosystem accounting area

Pirkkala

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute



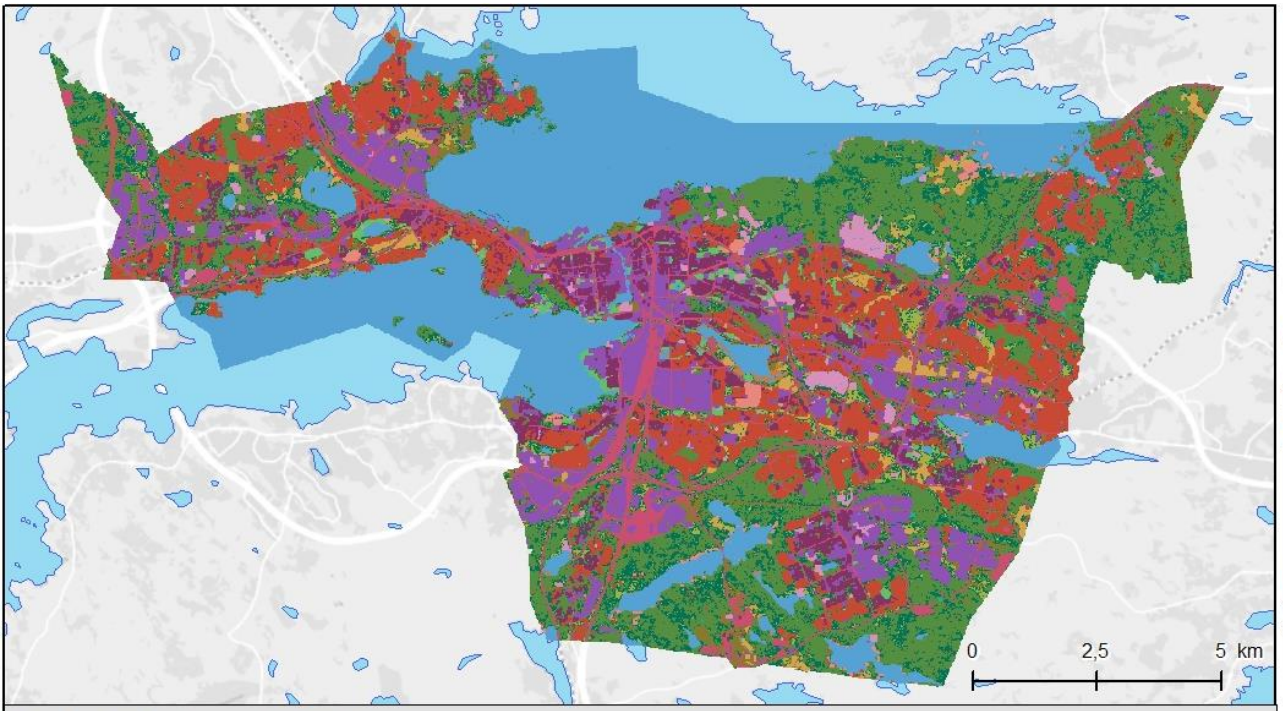


Helsinki Urban Green Extent 2022

- 1411 High-value urban parks
- 1412 Recreational urban parks
- 1413 Protective/Buffer greenspace
- 1421 Camping sites
- 1422 Sport sites and play-ground
- 1423 Allotment and community gardens
- 1424 Bathing beaches
- 1425 Recreational meadows
- 1431 Other urban green
- 2111 Cropland important for landscape
- 2121 Other cropland
- 3111 Meadows/pastures important for landscape
- 3112 Open space
- 3113 Other lawns and meadows
- 3211 High nature value meadows
- 4111 Nearby urban/semiurban forests
- 4211 Recreational forests
- 4311 Protective/Buffer forests
- 4411 Commercial forest
- 4511 High nature value forests
- 4611 Other forests
- 7111 Reedbeds

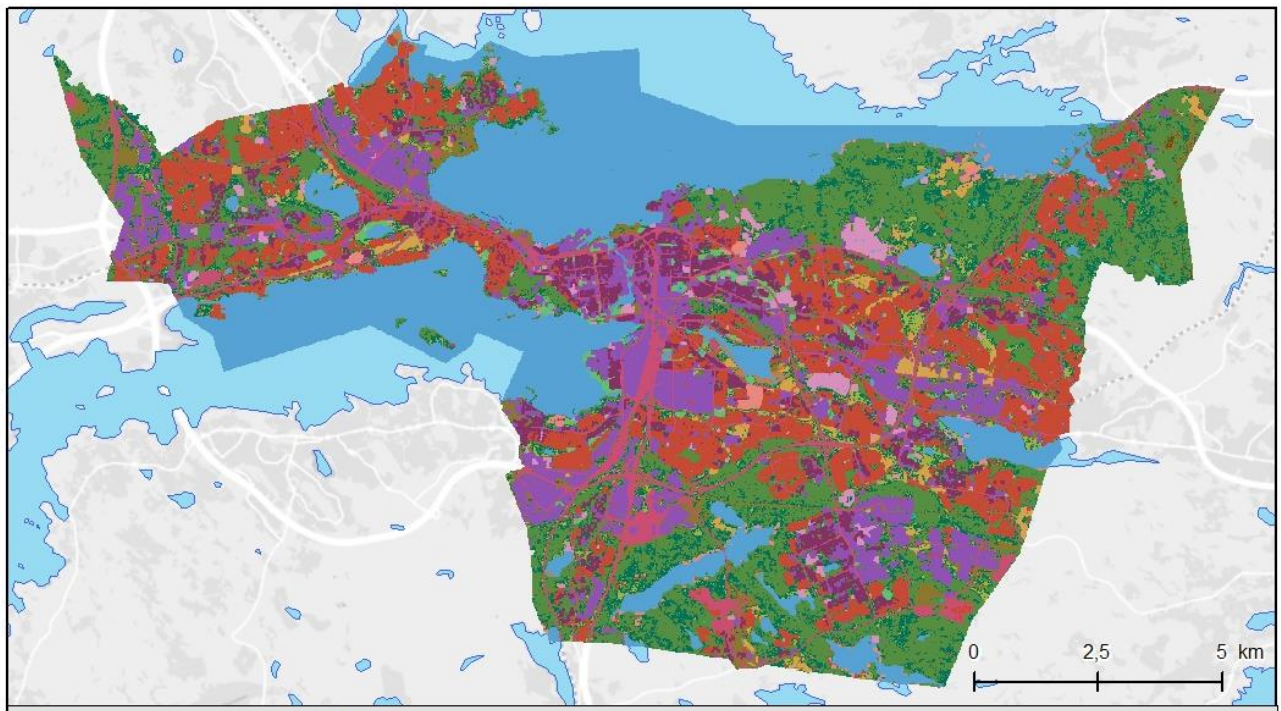
Helsinki

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute



Tampere ecosystem extent 2012

- 1.1.1 Continuous settlement area
- 1.2.1 Discontinuous settlement area
- 1.5.1 Commercial and industrial areas
- 1.3.1 Infrastructure
- 1.4.1 Parks
- 1.4.3 Summer cottages
- 1.4.2 Sports and recreation sites
- 2.1.1 Cropland and pasture
- 4.1.1 Broadleaved deciduous forest
- 4.2.1 Coniferous forest
- 4.4.1 Mixed forest
- 4.5.1 Transit. woodland/forestry
- 11.2.1 Coastal dunes, beaches & sandy/muddy shores
- 6.1.1 Bare rock
- 7.1.1 Inland marshes on mineral soil
- 7.2.1 Mires, bogs and fens
- 8.1.1 Rivers and lakes



Tampere ecosystem extent 2018

- 1.1.1 Continuous settlement area
- 1.2.1 Discontinuous settlement area
- 1.5.1 Commercial and industrial areas
- 1.3.1 Infrastructure
- 1.4.1 Parks
- 1.4.3 Summer cottages
- 1.4.2 Sports and recreation sites
- 2.1.1 Cropland and pasture
- 4.1.1 Broadleaved deciduous forest
- 4.2.1 Coniferous forest
- 4.4.1 Mixed forest
- 4.5.1 Transit. woodland/forestry
- 11.2.1 Coastal dunes, beaches & sandy/muddy shores
- 6.1.1 Bare rock
- 7.1.1 Inland marshes on mineral soil
- 7.2.1 Mires, bogs and fens
- 8.1.1 Rivers and lakes

Opening extent of each ET in hectares

Closing extent of each ET in hectares

Cross-tabulate and calculate ET change matrix

Populate the ecosystem extent account table

Tampere

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Tampere ecosystem extent account 2018

Tampere ecosystem extent account 2018																		
Ecosystem type, level 3	1.1.1 Continuous settlement area	1.2.1 Discontinuous settlement area	1.5.1 Commercial and industrial areas	1.3.1 Infrastructure	1.4.1 Parks	1.4.3 Summer cottages	1.4.2 Sports and recreation sites	2.1.1 Cropland and pasture	4.1.1 Broadleaved deciduous forest	4.2.1 Coniferous forest	4.4.1 Mixed forest	4.5.1 Transitional woodland/forestry	11.2.1 Coastal dunes, beaches and sandy and muddy shores	6.1.1 Bare rock	7.1.1 Inland marshes on mineral soil	7.2.1 Mires, bogs and fens	8.1.1 Rivers and lakes	Total
Opening extent (2012)	920	2559	1785	1042	166	91	251	235	308	3299	1480	707	1	8	38	6	3991	16889
Additions to extent	21	59	13	48	0	0	8	0	1	1	4	65	0	0	0	0	0	221
Reductions in extent	0	0	0	50	0	0	0	16	5	79	47	24	0	0	0	0	0	221
Net change in extent	21	59	13	-2	0	0	8	-16	-4	-78	-42	40	0	0	0	0	0	0
Closing extent (2018)	941	2618	1798	1040	167	91	259	219	304	3221	1438	747	1	9	38	6	3990	16889

- From 2012 to 2018, total of 100 ha of cropland, pasture and forest were converted to impervious ETs (settlements and other artificial areas)
- These conversions constituted 0.8 % of the total land extent in the ecosystem accounting area

Lessons learnt from the extent pilots

- Urban green maintenance classes are defined based on their **land use or land management**, instead of ecological or ecosystem characteristics
- Cross-walking the **maintenance classes to ecosystem types** is not straightforward – works best for urban greenspace subtypes (level 3 or 4)
  - Croplands, grasslands and forests could only be crosswalked to a higher level
- Extent accounts require **harmonized, validated, comparable time-series data covering all ecosystem types**. We are not aware of any municipal spatial data that fulfills this criteria.
  - At the moment, CLC high-resolution accounting layers are recommended if a full extent account is needed.
- **Full compliance with SEEA EA standard and EU Ecosystem typology could not be achieved** for any of the pilot extent accounts.
- Populating the accounts from different data sources is **possible but very tedious**
  - The data is **scattered**, it is **not fit for purpose** and collected in **different years**
  - **Harmonization** not trivial task, **uncertainties** in the source data are propagated to the accounts, **quantifying** the uncertainties difficult
  - **Manual work** very hard to avoid, difficult to **replicate** the results
- The pilots were very useful in pointing out **data gaps** for municipal EA.

Pirkkala-Piloting ecosystem service accounts

- Quantifying and valuing the educational and recreational services provided by **urban green and forests of Pirkkala**, through two PGIS surveys

Educational survey

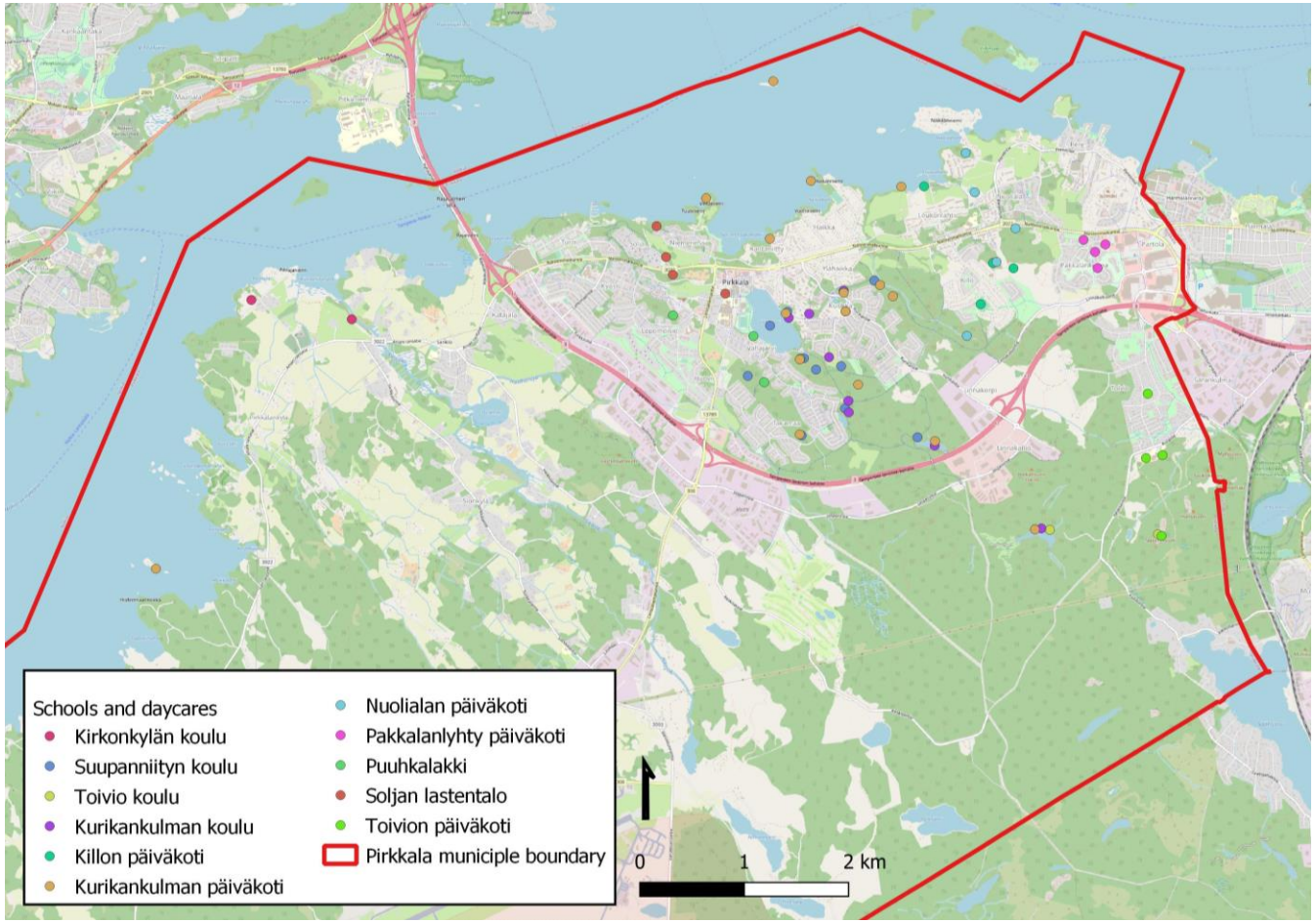
- Survey target: To a teacher / manager of schools and daycares
- Survey time: 2021 autumn - 2022 spring
- Educational trip / visit during past 12 months (visiting location, no. of visits, no. of students, time spent, activity done, COVID effect, etc)

Recreational survey

- Survey target: resident who made recreational visits in Pirkkala
- Survey time: 2022 autumn
- Recreational visits during past 12 months (visiting location, frequency of visits in different seasons, time spent, activity done, travel cost etc.)

Summary of the educational survey

Visiting places of responding schools and daycares



	Schools	Daycares
Survey participation (no. of units)	4 out of 8 (elementary +1 unified +1 middle)	7 out of 13
No. of students / children covered	1146 out of 3156 (36.3%)	582 out of ? (50% used for calculation)
Yearly visits no. based on the survey	5,268-6,600	35,147-46,459
Yearly visiting time (in hours) based on the survey	7,812-9,701	80,197-117,222
Yearly no. of visits per person (min-max, based on diff. school/daycare)	2.2-11.8	22.4-147.8
Average visiting hours per person per year	6.8-8.5	167-259
Note	2 schools and 5 daycares noted that the marked places were not comprehensive. COVID effect (±)	
Yearly no. of visits , approximate for Pirkkala	14,508-18,175	66,481 – 85,292
	80,989 – 103,467	
Yearly visiting hours, approximate for Pirkkala	21,515-26,717	160,933 – 253,846
	181, 908 – 280,563	

Resulting ecos. service supply and use account

		Economic unit				Ecosystem type																		
		Sectors				1. Settlements and other artificial areas				2. Cropland	3. Grassland				4. Forests and woodlands							Current wa	9. Water		
		Education sectors		Recreation sector	Total	1.4 Urban greenspace				2.1 Annual cropland	3.1 Modified grassland			3.2 Natural and semi-natural grassland	4.1 Broadleaved deciduous forest	4.2 Coniferous forest	4.4 Mixed forests	4.5 Transitional forest and woodland shrub	4.6 Other forests			8.1 Rivers	9.1 Lakes and ponds	Other ecosystem types	
	unit	School	Day-care			1.4.1 High-value urban parks	1.4.2 Recreational urban parks	1.4.3 Protective/Buffer Green-space	1.4.4 Sports and recreation sites	2.1.1 Cropland important for landscape	3.1.1 Meadows and pastures important for landscape	3.1.2 Recreational meadows	3.1.3 Open space	3.2.1 High nature value meadows	4.1.1 Broadleaved deciduous forest	4.2.1 Coniferous forest	4.4.1 Mixed forest	4.5.1 Transitional forest and woodland shrub	4.6.1 Nearby urban/semiurban forests	4.6.2 Recreational forests	4.6.3 Protective/Buffer Forests	8.1.1 Rivers	9.1.1 Lakes and ponds		Total
Supply																								
ES2: Educational services based on minimum visiting numbers (physical terms 1, Pirkkala level)	No. of visit					-	10,465	3,667	4,825	-	991	-	1,525	-	149	25,062	4,238	1,323	6,073	14,501	112	-	2,313	5,744	80,989
ES2: Educational services based on minimum visiting time (physical terms 2, Pirkkala level)	Visiting hours					-	19,789	3,667	46,772	-	991	-	1,525	-	149	46,606	5,882	1,323	11,060	26,911	336	-	2,644	14,252	181,908
ES2: Educational services based on minimum visiting time (monetary term, Pirkkala level, calculated based on unit value = 0.6 EUR/hour)	EUR					-	11,874	2,200	28,063	-	595	-	915	-	89	27,963	3,529	794	6,636	16,146	202	-	1,586	8,551	109,145
ES2: Educational services based on minimum visiting time (monetary term, Pirkkala level, calculated based on unit value = 2.1 EUR/hour)	EUR					-	41,558	7,700	98,221	-	2,082	-	3,203	-	312	97,872	12,353	2,779	23,226	56,513	706	-	5,552	29,930	382,007
Use																								
ES2: Educational services based on minimum visiting numbers (physical terms 1, Pirkkala level)	No. of visit	14,508	66,481	-	80,989																			
ES2: Educational services based on minimum visiting time (physical terms 2, Pirkkala level)	Visiting hours	21,515	160,393	-	181,908																			
ES2: Educational services based on minimum visiting time (monetary term, Pirkkala level, calculated based on unit value = 0.6 EUR/hour)	EUR	12,909	96,236	-	109,145																			
ES2: Educational services based on minimum visiting time (monetary term, Pirkkala level, calculated based on unit value = 2.1 EUR/hour)	EUR	45,181	336,826	-	382,007																			

- Valuation methods: price for the ecosystem service is obtained from markets for similar goods and services----environmental education program / excursion / outdoor activities of an education center or association
  - Price ranges between 1.3-14 EUR/hour
  - Need to deduct related cost, e.g., wage for the instructor, equipment cost etc.-> get resource rent
  - Resource rent: 17% (Estonian study) and 60% is used to show the example, preliminary estimation
  - with Finnish data ranges between 14% - 60%

Discussion

Survey Considerations and Limitations

- Error in marking the location>influences the linkage to ecosystem types
  - Choose a good map survey platform is important
- The number of visits might be underestimated, compared to non-GIS recreational survey, as it will be hard to mark all the location
- Marked point vs. visited path or area
- How to repeat the survey for accounting/policy purpose

Further application

- Link the survey results (quantified services----no. of visit, visiting time) to other kinds of value> e.g., health benefit
- The educational related value can be further explored

Integrating mobility data in urban recreation ecosystem accounting: a pilot study of Helsinki, Finland

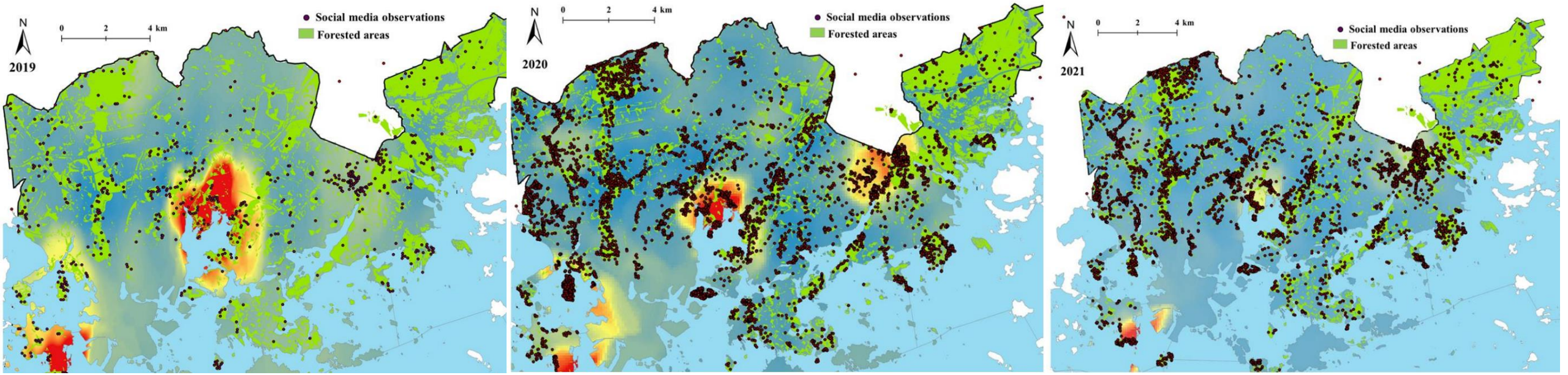
SYKE

Aim of the study

- Use a novel approach to develop an urban ecosystem account to estimate the value of the recreational services provided by green spaces within the municipality of Helsinki, Finland
- The main objectives were to test the use of anonymized and aggregated social media, movement (STRAVA) and counter data (Ecocounter) for the quantitative assessments of recreational visits
- We also used survey data to validate the movement data

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Social media: Flickr & iNaturalist



Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

From STRAVA data to an ecosystem service account: Method

LVVI national outdoor recreation survey:
- Average number of close-to-home outdoor recreational visit (not overnight)
- By age, gender, and urban

Statistics Finland:
- Number of people living in Helsinki
- By age, gender

Total recreational visits of people living in Helsinki
(rough estimation of visits in Helsinki)

Strava:
Relative importance of different ecosystem types based on visiting numbers

Ecosystem services physical account:
Number of visits in Helsinki by ecosystem type (recreational service supply by different ecosystem types and recreational services demand by households)

Existing recreational study in Finland:
Value EUR/visit

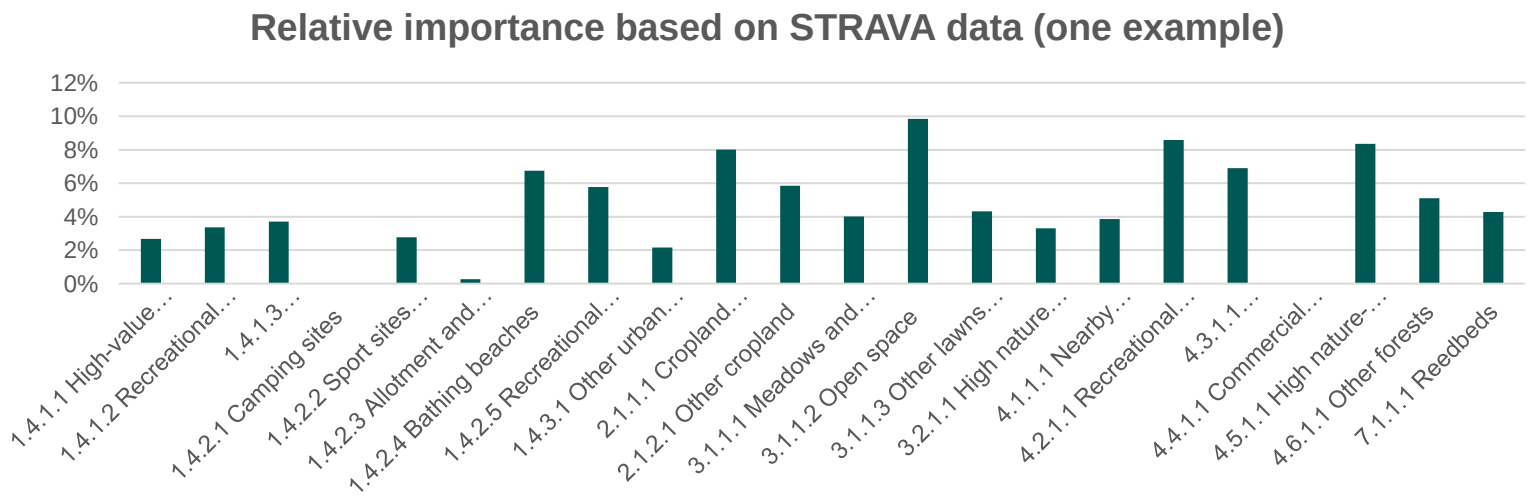
Ecosystem services monetary account:
Value of recreational service supply by different ecosystem types and demand by households

20

Ranges of estimated recreational service

	All close to home visit				Visit of walking distacne+Viechle<0.5hr			
	For all Helsinki population		For Helsinki popuation between age 15-80		For all Helsinki population		For Helsinki popuation between age 15-80	
	lower bond	higher bond	lower bond	higher bond	lower bond	higher bond	lower bond	higher bond
No. of Visit (million)	111.46	114.32	91.34	92.58	103.62	104.92	84.92	85.64
Value of the recreaional service (Million EUR)								
If value per vist= 1.9 EUR (average travel cost)	211.78	217.21	173.55	175.90	196.89	199.35	161.35	162.72
If value per vist= 5.8 EUR (consumer surplus)	646.47	663.05	529.79	536.97	601.02	608.55	492.54	496.73

- Number of visits (by physical unit of recreational services): range depends on the national average by age, gender or urban region
- Unit value just shows one example from Lankia et al. (2020)



21

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

An example of ecosystem service supply and use account

	Economic unit	Ecosystem extent																					
	Household	1.4.1.1 High-value urban parks	1.4.1.2 Recreational urban parks	1.4.1.3 Protective/Buffer Greenspace	1.4.2.1 Camping sites	1.4.2.2 Sport sites and playgrounds	1.4.2.3 Allotment and community gardens	1.4.2.4 Bathing beaches	1.4.2.5 Recreational meadows	1.4.3.1 Other urban green	2.1.1.1 Cropland important for landscape	2.1.2.1 Other cropland	3.1.1.1 Meadows and pastures important for landscape	3.1.1.2 Open space	3.1.1.3 Other lawns and meadows	3.2.1.1 High nature value meadows	4.1.1.1 Nearby urban/semiurban forests	4.2.1.1 Recreational forests	4.3.1.1 Protective/Buffer forests	4.4.1.1 Commercial forest	4.5.1.1 High nature-value forests	4.6.1.1 Other forests	7.1.1.1 Reedbeds	Total
Relative importance based on STRAVA data (one example)		2.67%	3.38%	3.72%	0.00%	2.78%	0.27%	6.76%	5.78%	2.15%	8.02%	5.86%	4.02%	9.84%	4.33%	3.31%	3.86%	8.59%	6.90%	0.00%	8.36%	5.10%	4.28%	
Supply Account																								
Number of visit(million)		2.98	3.76	4.14	0.01	3.10	0.30	7.53	6.44	2.40	8.94	6.53	4.48	10.97	4.82	3.69	4.30	9.58	7.69	0.00	9.32	5.69	4.77	111.46
Value (million EUR)		5.65	7.15	7.87	0.01	5.88	0.57	14.31	12.24	4.56	16.98	12.41	8.52	20.84	9.17	7.02	8.18	18.19	14.62	0.00	17.70	10.81	9.07	211.78
Use Account																								
Number of visit(million)	111.46																							
Value (million EUR)	211.78																							

- At least three different ways to estimate the relative importance based on STRAVA data

22

Data Considerations and Limitations

- Compiling a recreation account is challenging because of the difficulties in obtaining comprehensive data on the use and values related to green spaces.
- Traditional approaches to gather data on people's recreational preferences related to urban green spaces include the use of surveys or GPS-based campaigns and map-based surveys based on public participation geographic information systems (PPGIS).
- These approaches provide in-depth information on people's preferences, use of natural areas, and valuation from the study target, but are often time-consuming limited in frequency and duration.

More considerations

- Recently, the wide-spread use of GPS-enabled mobile devices and online platforms collecting geolocated user-generated data provide new opportunities for understanding human-nature interactions
- Free (most are free!) and large spatio-temporal availability
- Next steps….collect more data to better validate crowdsourced data and its prediction to total recreational visits

Example account
City of Tampere

TAMPERE REGION

A terrible sight in the morning in Tampere: the streets are flooded after heavy rains

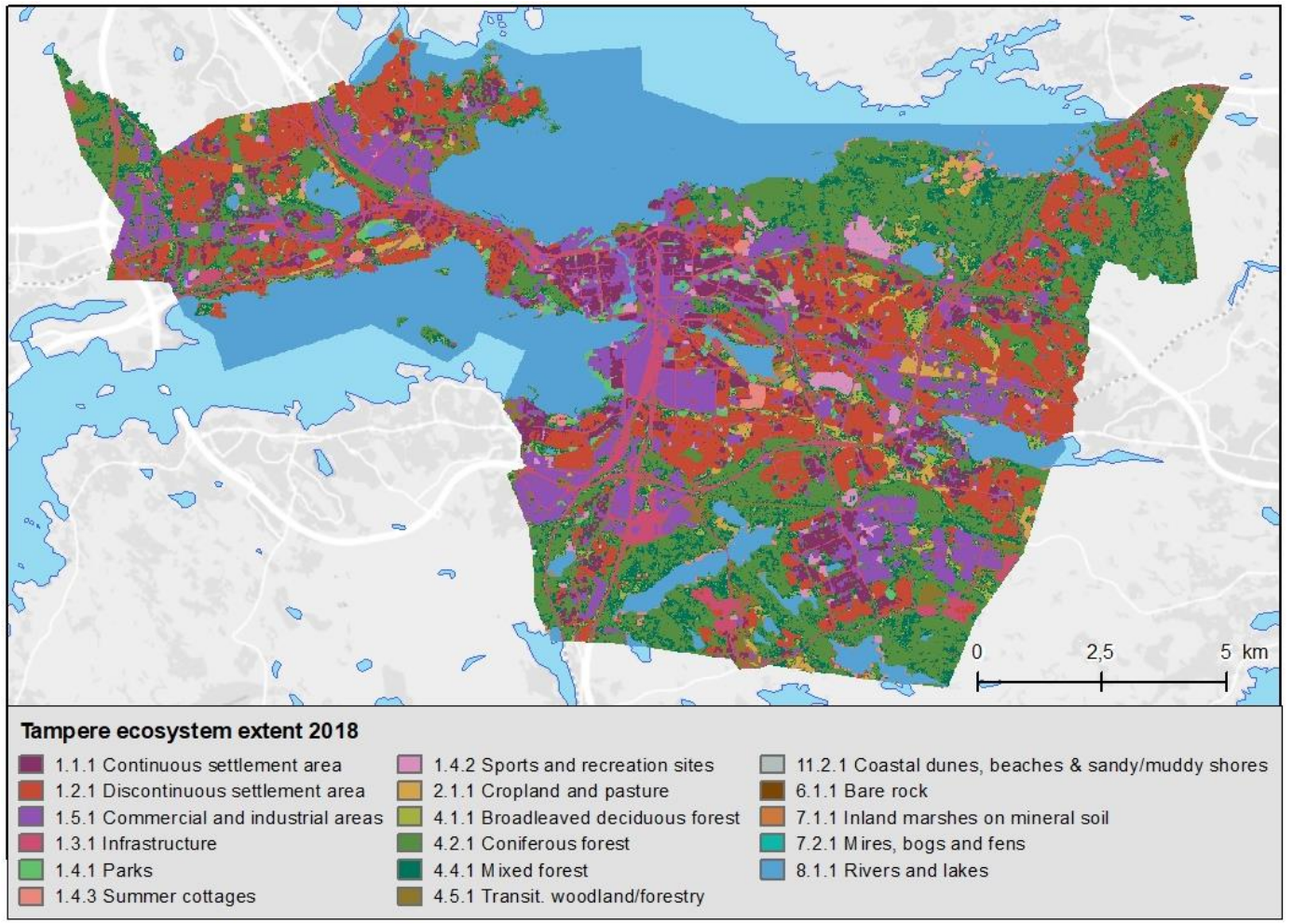
At worst, there was up to 70 centimeters of water on the streets.

Joona Laukkanen
24.8. 8:37 am

THE CENTER OF TAMPERE flooded on Wednesday morning as a result of heavy rains overnight.

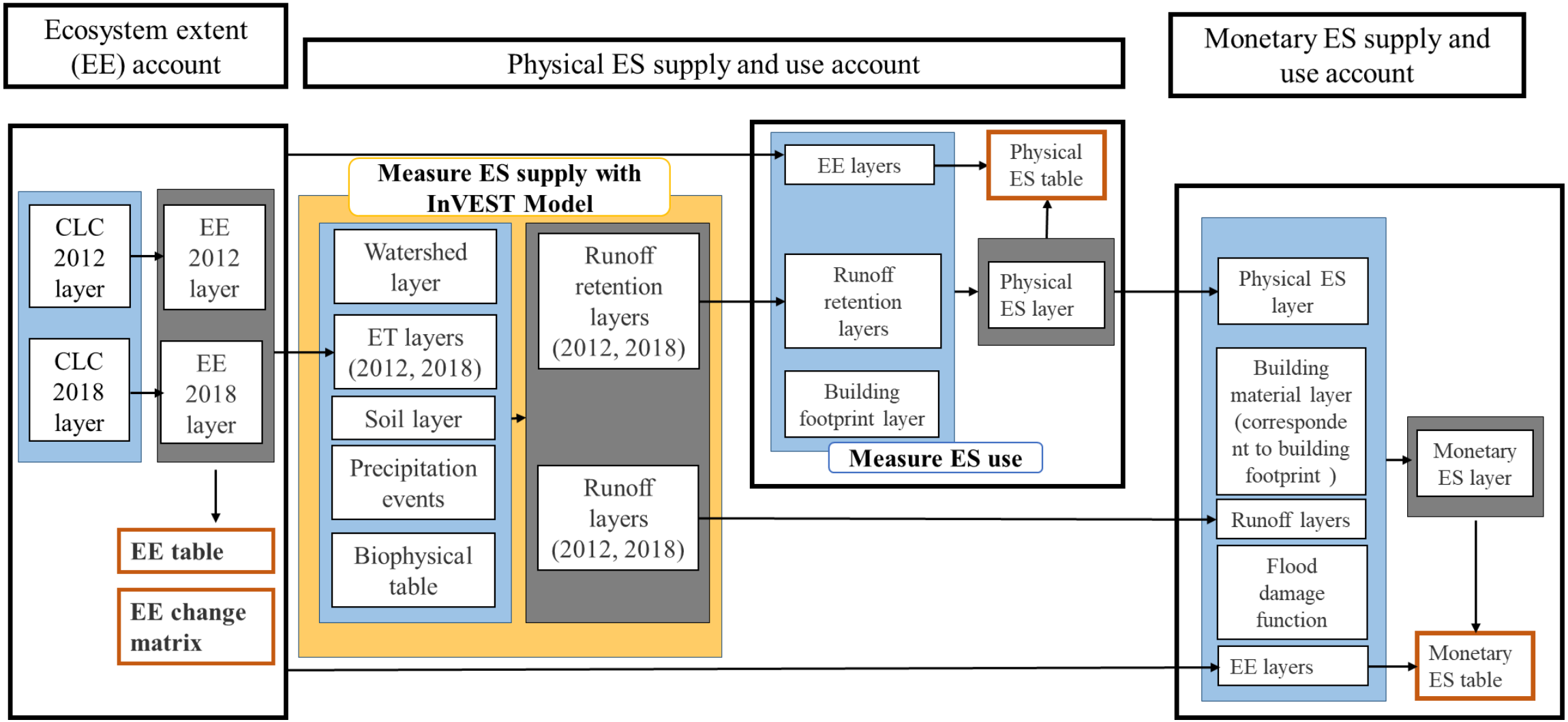
The water rose to a considerable height in the low points of the streets, says **Pauli Keskinen , fire chief on duty at the Pirkanmaa rescue service, to** Ilta-Sanom. Aamulehti was the first to report on the floods .

This is what it looked like on Satakunnakatu in the morning. PHOTO: PIRITTA PALOKANGAS / AAMULEHTI

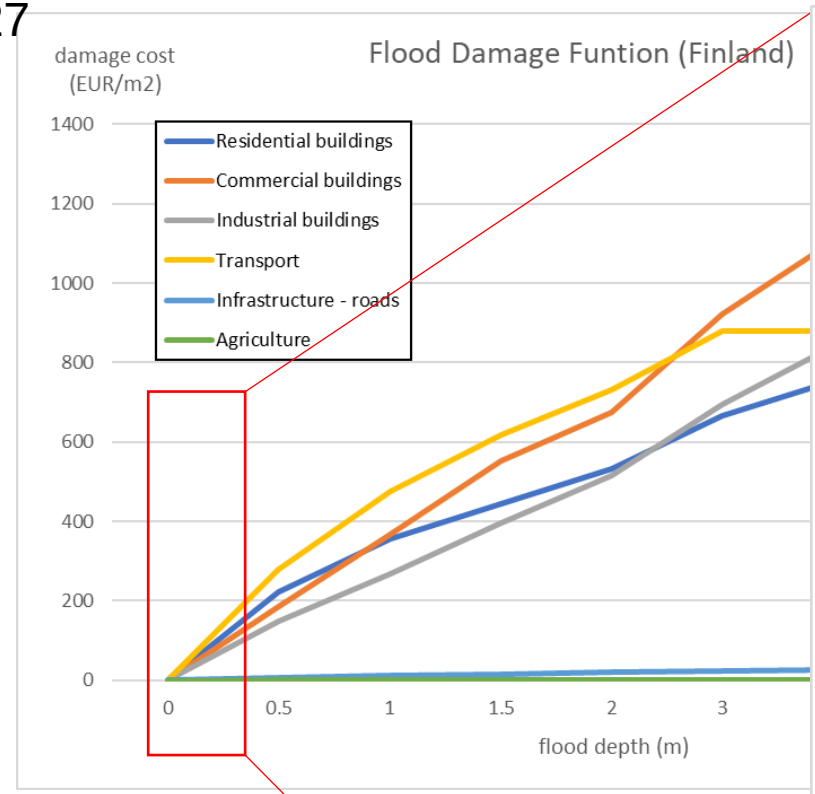


Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

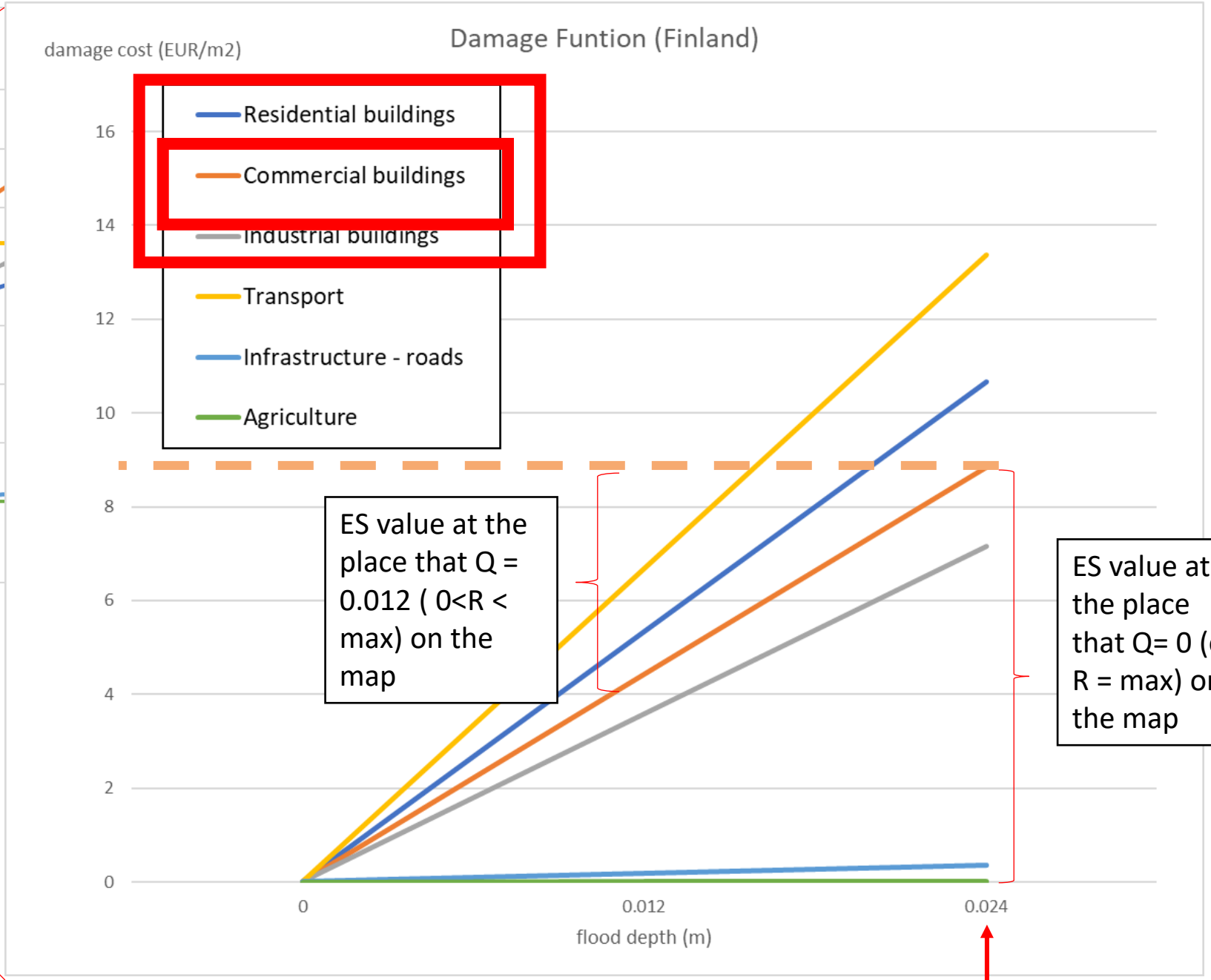
Flood mitigation ecosystem service



Ecosystem accounting area: A watershed covering the core city area of Tampere



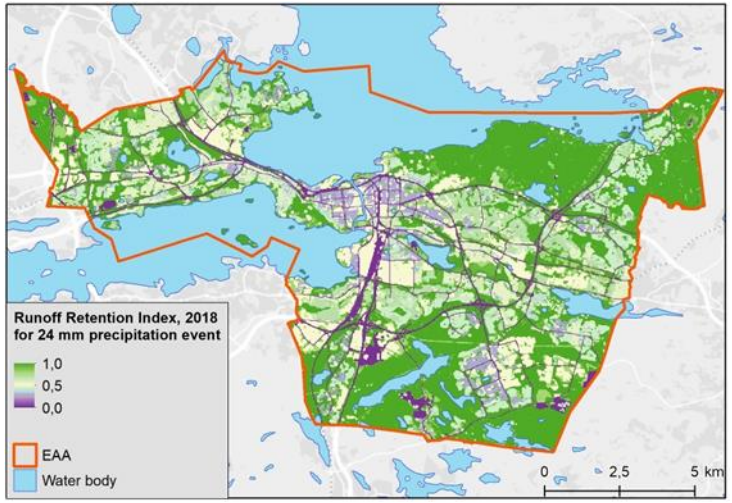
Global function adjusted to Finland (Huizinga et al. 2017)

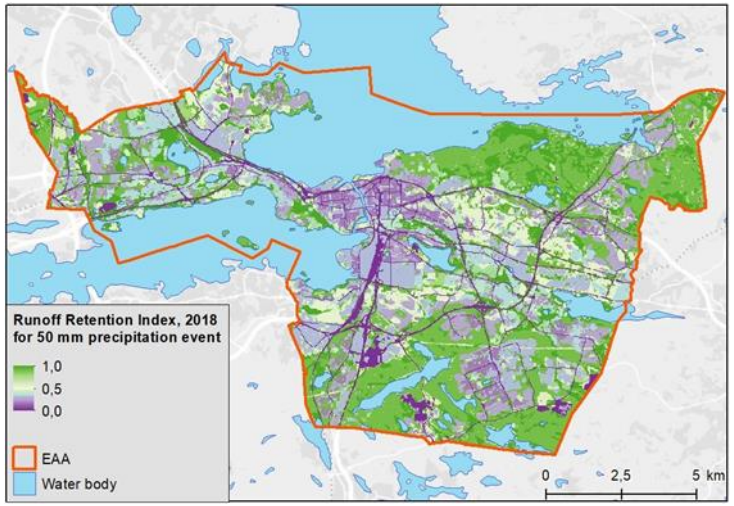


The highest runoff/flood(Q) from InVest

Summary of Results: Change from 2012 to 2018

Ecosystem types: impervious ecosystem types (continuous and discontinuous urban fabric, commercial and industrial units, sport and leisure areas): +100 hectares (0.8 % of total accounting extent). Building areas in other ecosystem types also increase.





Scenarios in 2018	Rain event depth (mm)	Runoff volume	Runoff retention volume	Building areas that are free from flood if the flood event happens	Flood mitigation ES: Building areas benefiting from ES	ES value	Potential damage cost if flood event happens
Baseline scenario (compare to 2012 rain event)	24	1.50%	-0.30%	9.67%	6.03%	6.92%	6.14%
Climate change scenario (close to actual situation)	50	254.50%	77.60%	-6.97%	6.03%	40.33%	231.02%

- Flood mitigation ecosystem service's actual use increases due to some new building areas located in pervious ecosystem types
- In addition, the potential damage cost also increases
- The classification of impervious ecosystem types

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

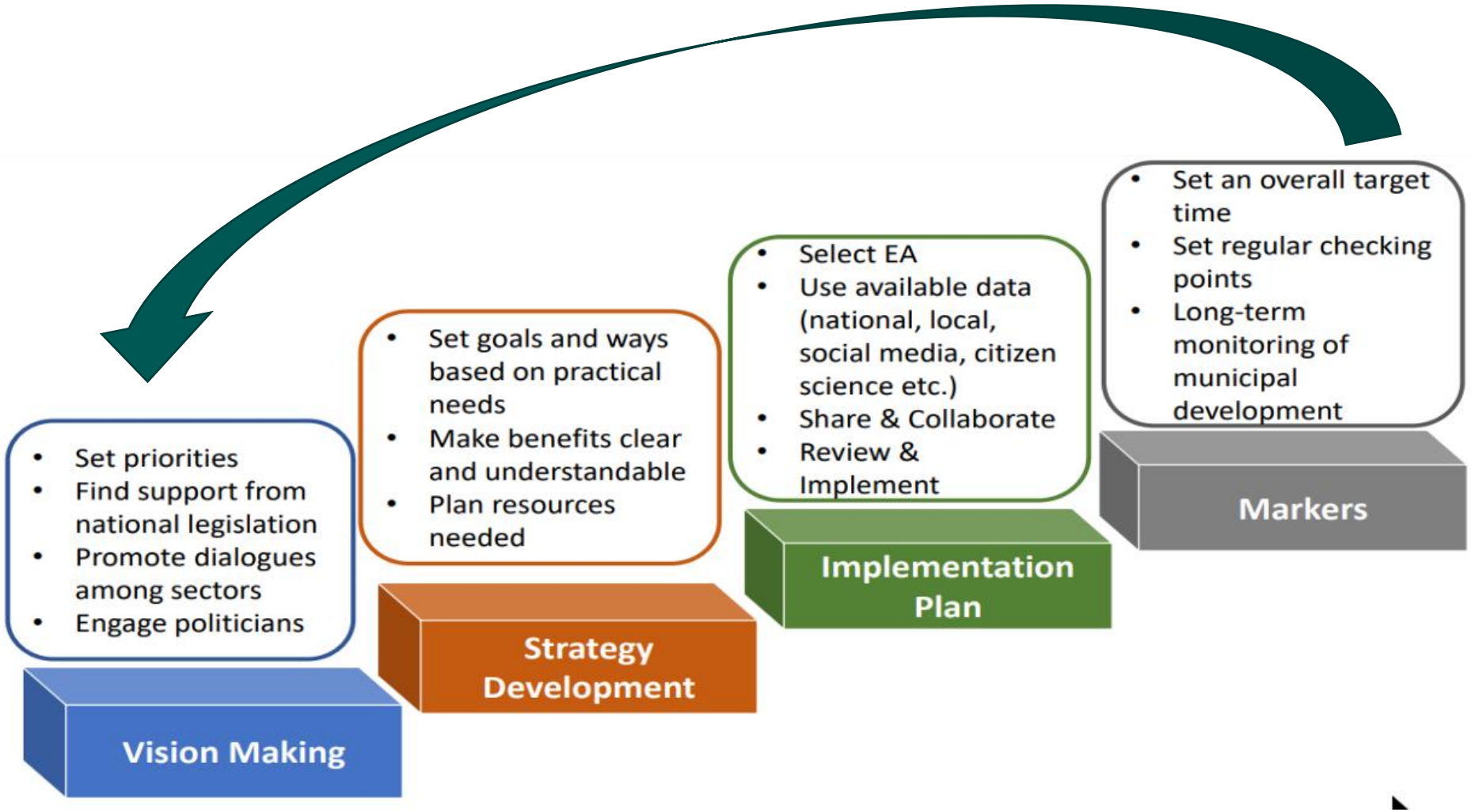
Ecosystem service supply and use account in 2012 and 2018 (climate scenario)

		Economic Unit				Economic Asset																
	unit	Industrial Sectors	Commerical sectors	Household	Total	1.1.1 Continuous settlement area	1.2.1 Discontinuous settlement area	1.5.1 Commercial and industrial areas	1.3.1 Infrastructure	1.4.1 Parks	1.4.3 Summer cottages	1.4.2 Sports and recreation sites	2.1.1 Cropland and pasture	4.1.1 Broadleaved deciduous forest	4.2.1 Coniferous forest	4.4.1 Mixed forest	4.5.1 Transitional woodland/forestry	11.2.1 Coastal dunes, beaches and sandy and muddy shores	6.1.1 Bare rock	7.1.1 Inland marshes on mineral soil	7.2.1 Mires, bogs and fens	8.1.1 Rivers and lakes	total
2012 -24 mm scenario ES supply and use Table																						
Supply																						
Flood mitigation ES: Buidling area benefit from	m2					1,728,266	3,028,677	3,588,091	69,398	2,304	35,998	101,943	373	327	15,492	12,993	20,882	-	0	-	-	8,111	8,612,853
Value of flood mitgation ES	EUR					7,007,856	21,379,483	12,689,194	143,085	10,539	196,992	526,033	4,556	1,896	97,327	73,949	150,770	-	0	-	-	16,162	42,297,841
Use																						
Flood mitigation ES: Buidling area benefit from	m2	2,094,224	1,674,572	4,844,058	8,612,853																	
Value of flood mitgation ES	EUR	6,287,704	6,962,639	29,047,498	42,297,841																	
2018-50mm scenario ES supply and use Table																						
Supply																						
Flood mitigation ES: Buidling area benefit from	m2					1,853,214	3,176,858	3,744,531	75,553	3,884	36,185	119,430	3,258	2,571	21,005	25,875	61,471	-	0	-	-	8,192	9,132,027
Value of flood mitgation ES	EUR					9,267,511	29,564,402	17,121,699	197,434	41,803	343,047	889,002	84,485	80,754	320,243	285,341	1,131,686	-	0	-	-	27,287	59,354,695
Use																						
Flood mitigation ES: Buidling area benefit from	m2	2,176,324	1,782,245	5,173,457	9,132,027																	
Value of flood mitgation ES	EUR	8,362,673	9,658,515	41,333,506	59,354,695																	

The inpretation of the value: if the flood event is happen once per year, this is yearly value. If the flood event happen X time per year, the value need to mulitply X. if the flood event happen every X year, the value need to devided by X.

In the supply table, the building area located at "Rivers and lakes" ecosystm types results from the resolution of ecosystem extent data. Theses buiding areas actually lcoated in other ecosystem types but very close to "Rivers and lakes"

Roadmap for Urban / Municipal EA in Process



- Draft roadmap published in Kopperoinen et al. 2022
- Co-developing further in the Nordic conference in Stockholm, Sweden 1-2.12.2022
- Refinement in a follow-up project to enable take-up in all municipalities
- Scientific manuscript in process

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

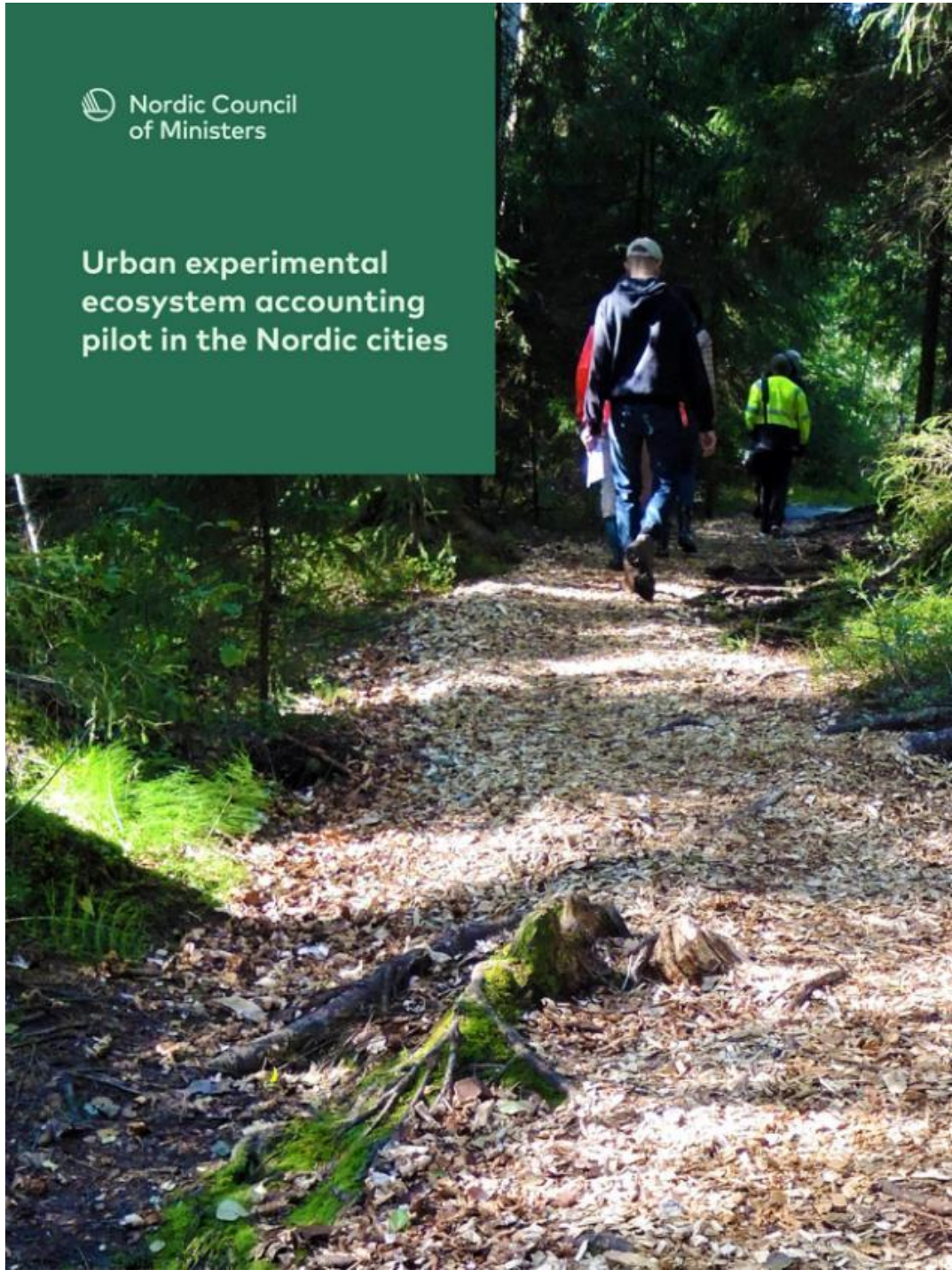
First outputs

*Kopperoinen L, Barton DN, Costadone L, Hurskainen P, Kruse M, Lai T-J. 2022. Urban experimental ecosystem accounting pilot in the Nordic cities.**

- *Nordisk verktygslåda: https://pub.norden.org/nord2022-025/*
- *Ecosystem Accounting Pilot: https://pub.norden.org/temanord2022-557/*

Costadone L, Lai T-J, Hurskainen P, Kopperoinen L. (2023). Co-creating urban ecosystem accounting: physical and monetary accounts of flood mitigation services provided by urban blue-green spaces. Ecosystem Services. In review.

*Produced in collaboration with the "sister" project to ENVECOPACK WP3: Nordic urban experimental ecosystem accounting pilot project 2021-2022, funded by the Sustainable Cities Working Group of the Nordic Council of Ministers.



More information:

leena.kopperoinen@syke.fi - Urban / municipal ecosystem accounting development in general

pekka.hurskainen@syke.fi - Urban / municipal ecosystem extent accounts

laura.costadone@syke.fi - Urban / municipal physical ecosystem services accounts

tin-yu.lai@syke.fi - Urban / municipal monetary ecosystem services accounts

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute