

Application of ES in Green Infrastructure and in infill development planning

-a case study from the City of Järvenpää

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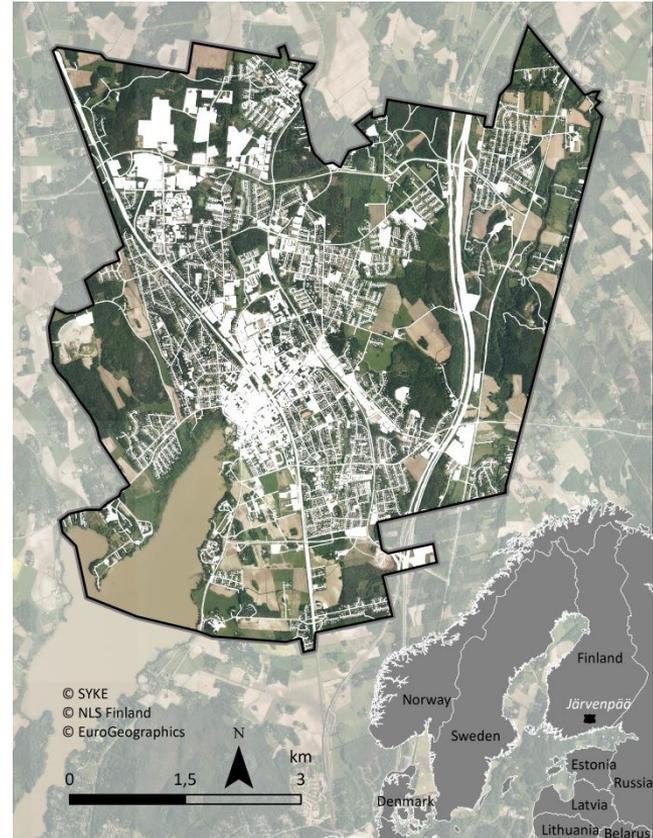
STUDY AREA AND MAIN PLANNING QUESTION

The City of Järvenpää, Southern Finland, is a compact city (40 km², around 40 000 inhabitants) with fast expected population growth

- 2017 over 2.5 %

As a result, there is an exceptionally strong need to provide housing for new inhabitants.

Surrounding municipalities prevent city to grow outside so the construction must be achieved by compressing the urban structure (i.e. infill development)



STUDY AREA AND MAIN PLANNING QUESTION

City planners were keen on not causing negative impacts by the infill development on natural values and ecosystem services provided by green and blue areas.

SYKE & city of Järvenpää started a project to evaluate the values of GI:

- Map the **supply** of ES in the area (**PHASE I**).
- Map the **demand** for ES in the area (**PHASE II**).
- Map the connectivity of GI (**PHASE III**).

Applicability of the results in spatial planning:

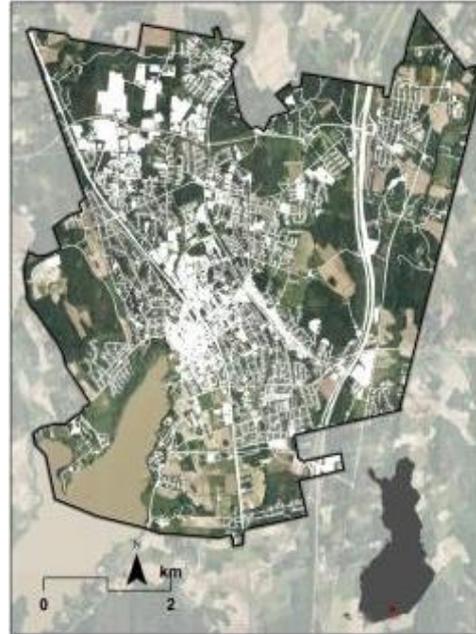
- Detailed spatial data of the ES and GI to support planning
- Evaluate the pre-selected infill sites in terms of natural values (**PHASE IV**)
- Test a Spatial decision supporting tool to enhance the integration of urban GI and residential infill development (**PHASE V**)



PHASE I: Map ES in the area (supply)

CICES 4.3 (modified)

Provision	Cultivated crops
	Wild plants, animals and their outputs
	Ground water for drinking
Regulating & maintenance	Hydrological cycle and water flow maintenance
	Pollination and seed dispersal
	Maintaining nursery populations and habitats
	Micro and regional climate regulations
Cultural	Recreation
	Education
	Aesthetic and cultural heritage
	Symbolic, Sacred and/or religious
	Existence and bequest



- Forest
- Agricultural area
- Meadow
- Community garden
- Allotment garden
- Urban park
- Lot green
- Green buffer zone
- Permeable sport facility
- Recycle area
- Wetland
- Water area



SYKE the local planners

Identification of most important ES to be mapped together with

Review and compilation of the relevant background information and spatial data from the national and city archives.

Delineation of green and blue areas with sufficient spatial accuracy required for planning purposes.

GreenFrame method (GF)

GF provides an overview of the potential provision of ES using qualitative (i.e. expert opinions) and quantitative data.

It is especially tailored for planning processes due to its flexibility, transparency and operational possibilities.

	Cultivated crops	Wild plants, animals and their outputs	Ground water for drinking	hydrological cycle and water how maintenance	Pollination and seed dispersal	Maintaining nursery populations and habitats	Micro and regional climate regulations	Recreation	Education	Aesthetic and cultural heritage	Symbolic, Sacred and/or religious	Existence and bequest
Conservation areas	0	2	2	3	2	3	2,5	3	3	2	3	3
Valuable landscapes	3	1,5	1	1	2	2	1	2	2	3	2	2
Cultural heritage sites of built environments	2	1	0	1	2	1	1	3	1,5	3	2	2
Traditional biotopes	2	2	0	1	3	3	1	2	2	3	2	3
Areas of valuable environment according to Finnish forest act	0	2	1,5	2	2	3	1	2	3	2	2	3
Bogs	0	2	2	3	1	3	2	2	3	2	3	3
Important bird areas	0	1	0	1	1	3	1	2	3	2	2	3
Ground water formation areas	0	1	3	3	1	1	1	1	1	1	1	2
Agriculture areas with high nature values	3	1	0	1	2	2	1	2	2	2	2	2
Ecological condition of surface waters	0	2	3	2	0	3	0	3	3	2	2	3
Recreation areas	1	2	1	1	1	1	1	3	2	2	2	2

3	2	1	0	-1	-2	-3
Very favourable	Favourable	Slightly favourable	No effect or neutral effect	Slightly harmful	Harmful	Very harmful

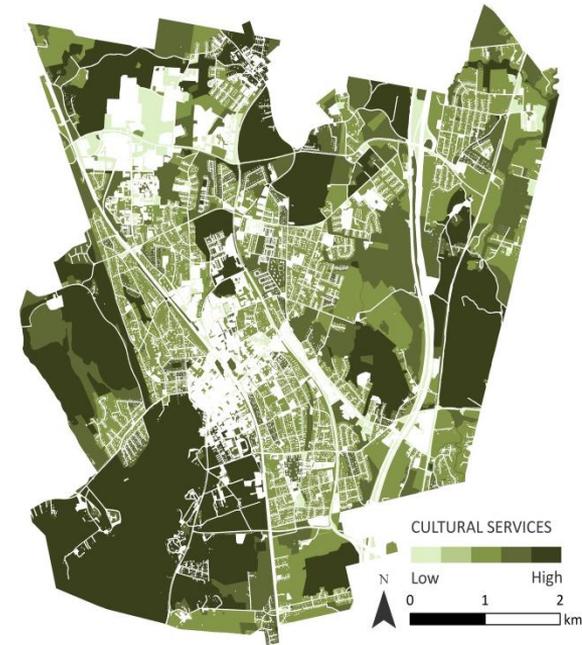


Quantitative data
e.g. ground water yield (m³)



SYKE

Kopperoinen et al. (2014): *Using expert knowledge in combining green infrastructure and ecosystem services in land use planning: an insight into a new place-based methodology.*



PHASE II: Map the demand of ES in the area

We applied **Participatory GIS** methods to evaluate the ES demand using **workshop**, **surveys** and **online questionnaire**.

PGIS allows various groups to participate for the identification of ES 'hotspots' on a map by integrating their perceptions, knowledge and values related to ecosystem services

PHASE II: citizen workshop

Participants were provided instructions and a short background description of the ES

Participants marked areas providing ES on a map.



12.5.2015

Miten erilaiset viher- ja vesialueet ovat teille tärkeitä?

Merkitkää ruutuun kunkin viheralueityypin kohdalle, millaisia luonnon tarjoamia hyötyjä koette saavanne kyseiseltä alueelta seuraavalla menetelmällä:

- Merkitse 0, jos alue ei tuota sinulle kyseistä hyötyä / ei ole tärkeä,
- Merkitse 1, jos viheralueen tyyppi (/ luokita - PÄÄTÄ) on sinulle jonkin verran tärkeä kyseisen hyödyn tuottajana ja
- Merkitse 2, jos alue on sinulle erittäin tärkeä kyseisen hyödyn tuottajana

1. Virkistyttyminen

Viher- ja vesialueilla voi virkistyttyä monin eri tavoin ympäri vuoden, esimerkiksi tarkkailemalla luonnon tapahtumia ja eläimiä, uimalla, kävelemällä, kipeilemällä, veneilemällä, onkimalla, lumikenkäilemällä, luistelemalla ja lukusilla muilla tavoilla. Missä ympäristössä mieluiten virkistydyt?

2. Luonnosta oppiminen

Luonto toimii oppimisympäristönä meille kaikille. Jokin luontokohte voi olla esimerkiksi lajistoltaan tai pinnanmuodoiltaan omakeinainen tai edustava, mutta sen ei välttämättä tarvitse olla harvinaisen sopiakseen opetuskohteeksi. Mitä ympäristöjä pidät tärkeinä luonnosta oppimiseen?

3. Luonnon kauneus

Luonnonkauniit kohteet voivat olla yksittäisiä kauniita paikkoja, laajempia maisema-alueita tai vaikkapa reittejä, jotka kulkevat kauniissa ympäristössä. Miten eri ympäristöt tuottavat sinulle esteettisiä elämyksiä?

4. Luonnon taiteellinen innoittavuus

Luonto voi inspiroida ihmisiä taiteellisesti esimerkiksi valokuvaamaan, maalaamaan, kirjoittamaan, runoilemaan tai säveltämään. Missä määrin eri ympäristöt inspiroivat sinua?

5. Identiteetti-arvo

Useilla paikoilla on omaa ainutlaatuisuutta, joihin ihmiset liittyvät henkilökohtaisiksi merkityksiä ja jotka lisäävät niin sanottua **paikan tuntua** ja kiinnittymistä ympäristöön. Millä luontokohteilla on sinulle erityinen merkitys, joka saa sinut tuntemaan yhteenkuuluvuutta ympäristösi?

6. Henkinen voimaantumisen

Eri luontoympäristöt voivat olla hyviä paikkoja rauhoittumiseen, mietiskelyyn, latautumiseen tai voimien keräämiseen. Millä tavoin eri viheralueet ovat sinulle tällä tavoin **henkisesti voimaannuttavia**?

- Recreation
- Education
- Cultural heritage
- Aesthetic
- Artistic inspiration
- Identity
- Spiritual meaning
- Sacred meaning
- Bequest value
- Symbolic meaning
- Nature's products
- Local climate regulation
- Water flow maintenance

PHASE II: Content of the survey

Survey regarding the important educational sites was sent out to schools and kindergartens.

In the survey the respondents were asked to mark on a map nature sites, routes or areas that are used for educational purposes.

Respondents were also asked to mark areas that they would be willing to use with explanation why it is not possible.

PHASE II: Results of the survey

36 % of the schools and kindergartens answered to the survey.

Total of 107 areas were marked on a map by respondents

- 86 were used on education
- 21 were not used (would be willing to use)

Reason for not to use the area was mainly related to distance



Delineations provided by schools and kindergartens

-  used for educational purposes
-  willingness to use for educational purposes

0 1 000 2 000 m

© SYKE, City of Järvenpää

PHASE II: Content and results of the online survey

We also utilized the results from the PGIS online survey from 2006 (Kyttä & Kahila 2006) regarding the quality of environment in the area.

Survey was not specifically tailored for ecosystem services, but some of the answers could be classified into CICES ES categories.

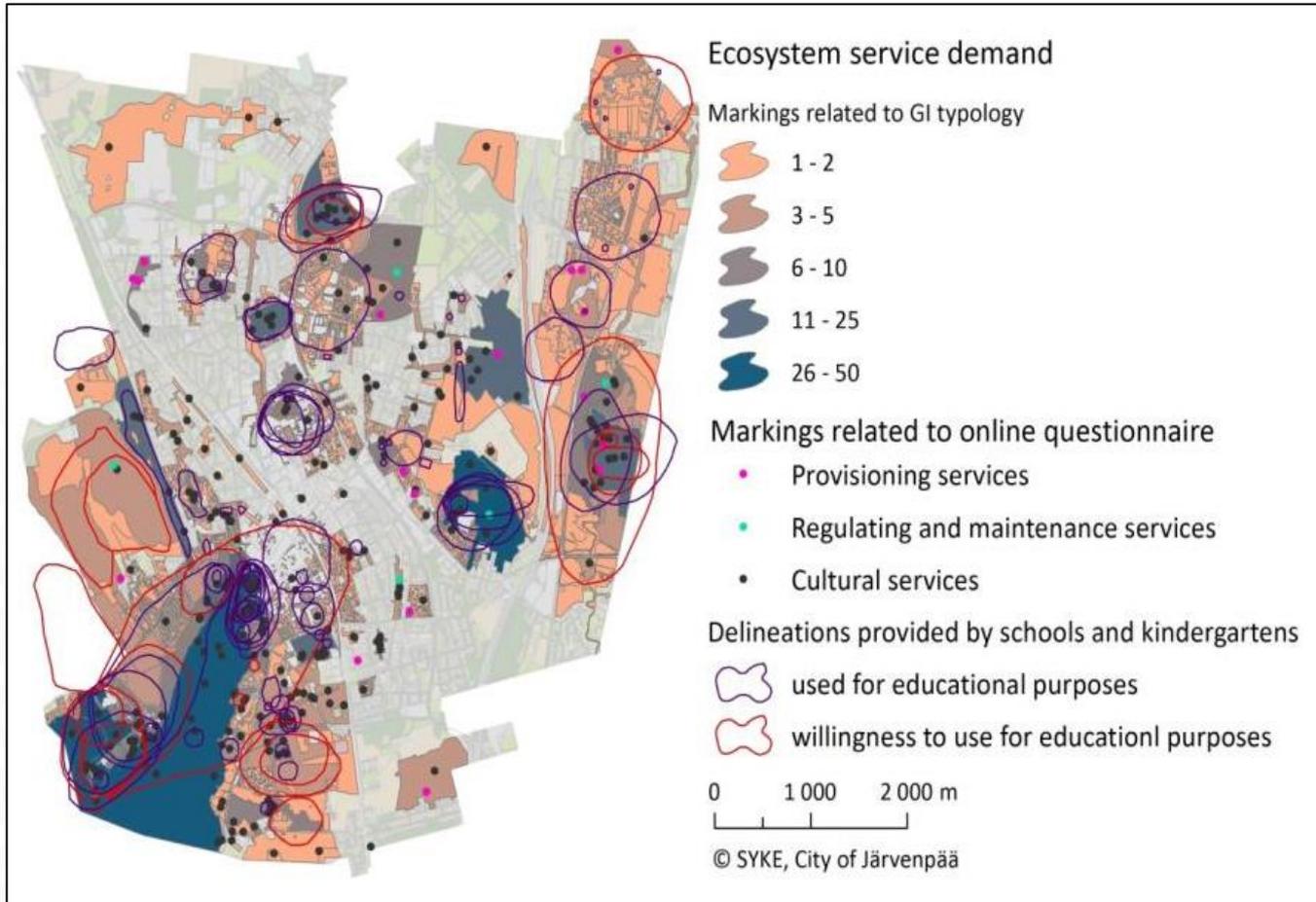
Total of 291 markings related to cultural ecosystem services.



RESULTS OF THE PPGIS ONLINE SURVEY

- Recreation
- Cultural heritage
- Aesthetic
- Spiritual meaning
- Bequest value

PHASE II: compilation of the ES demand on a map



PHASE II: Experiences on citizen involvement methods

Citizen workshop

Workshop was held in the city hall in 2015 on a weekday evening.

Workshop was advertized in the city web-pages, in local newspaper and by sending out flyers in the previous week.

However, only eight citizen appeared to the workshop.

- Citizen union representatives participated and provided important knowledge of the area
- Preparations were time consuming

Structure of the workshop was succesfull and participants understood the concept of ecosystem services

Survey for schools and kindergartens

36 % answer rate is actually quite good.

- According to SurveyMonkey statistics 20-30 % answer rate is generally quite good

Geographical coverage was good.

Survey was easy and quick to carry-out.

Online questionnaire

Good experiences from the online surveys.
(mobile & web based)

Nowdays it is difficult to get people to participate in-situ.



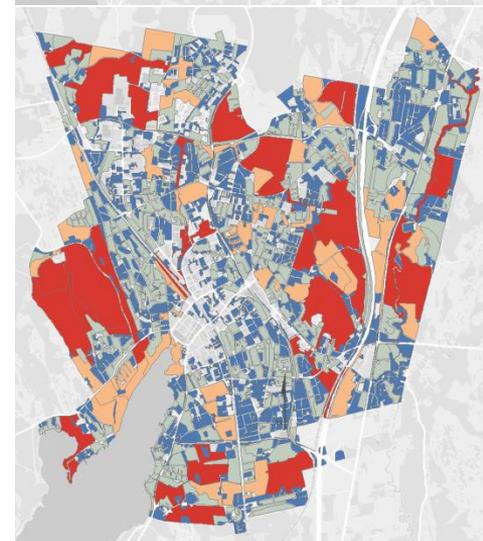
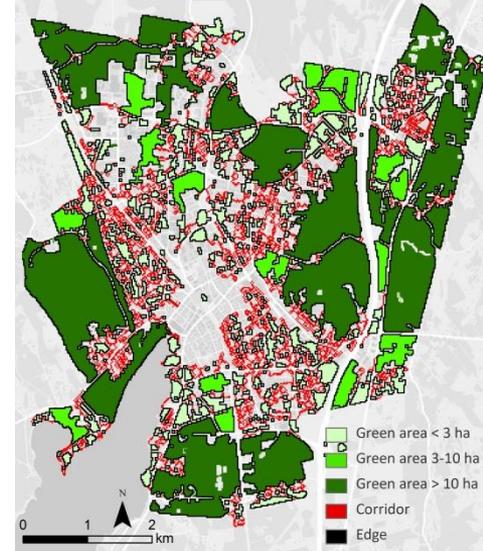
PHASE III: Map the GI using connectivity

Connectivity of GI is linked to ecological processes providing ES.

- In practice, maintaining or increasing connectivity safeguards biodiversity and ES

We mapped the physical structure and importance of different green areas to maintain overall GI

1. Morphological Spatial Pattern Analysis (MSPA) that classifies GI to green core areas, corridors and edge areas.
2. Graph theoretical approach to assess the connectivity importance of the certain patch to the overall connection

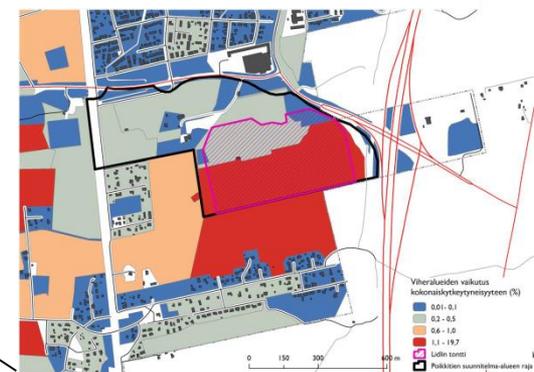
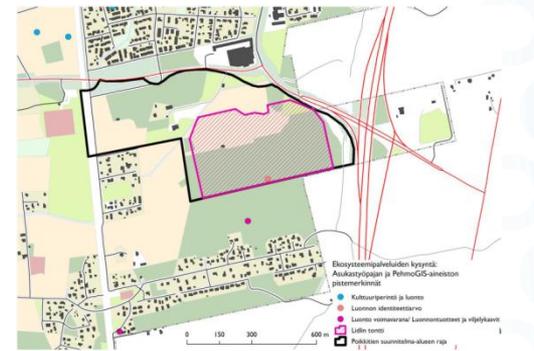
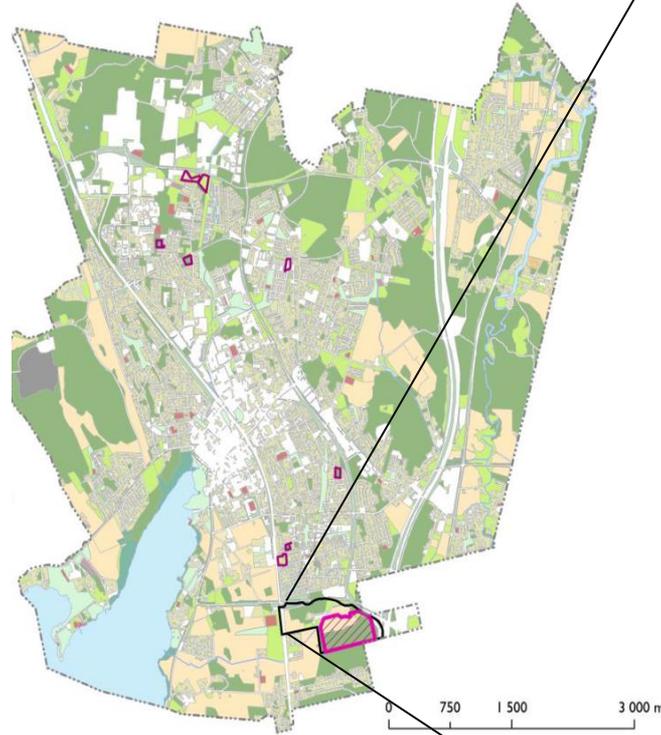


Applicability of the results

Evaluation of the pre-selected potential infill sites mainly based to existing grey infrastructure.

- Environmental evaluation not included

Most of the sites were residential infill sites, but there were one larger logistic area



Applicability of the results

Integration of residential infill development and urban GI

In the final phase we tested the spatial multi-criteria analysis (SMCA) aiming to enhance the integration of urban greenspaces and residential infill development.

We applied a GIS-based Multi-Attribute Value Theory (MAVT) approach, which is a widely-used technique for supporting the decision making especially in the environmental field and urban planning (Ferretti and Comino, 2015, Huang et al., 2011).

Practitioners from different sectors participated including: master planning (3 people), town planning (1), health and welfare (1), children and youth services (1), maintenance of green areas (1), forestry (1), and the environment sector (1).

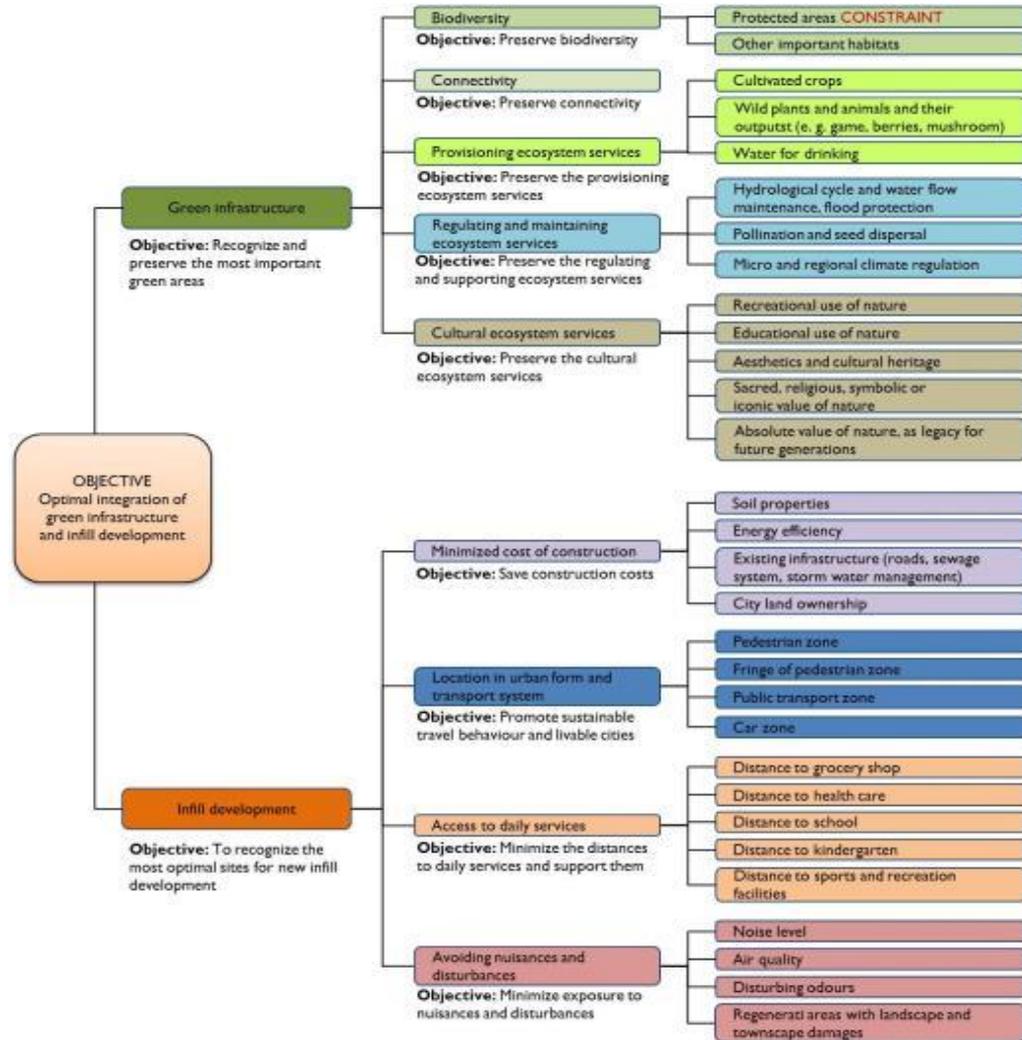
Ferretti, V. & Comino, E. 2015. An integrated framework to assess complex cultural and natural heritage systems with Multi-Attribute Value Theory. *Journal of Cultural Heritage*, 16, 688-697.

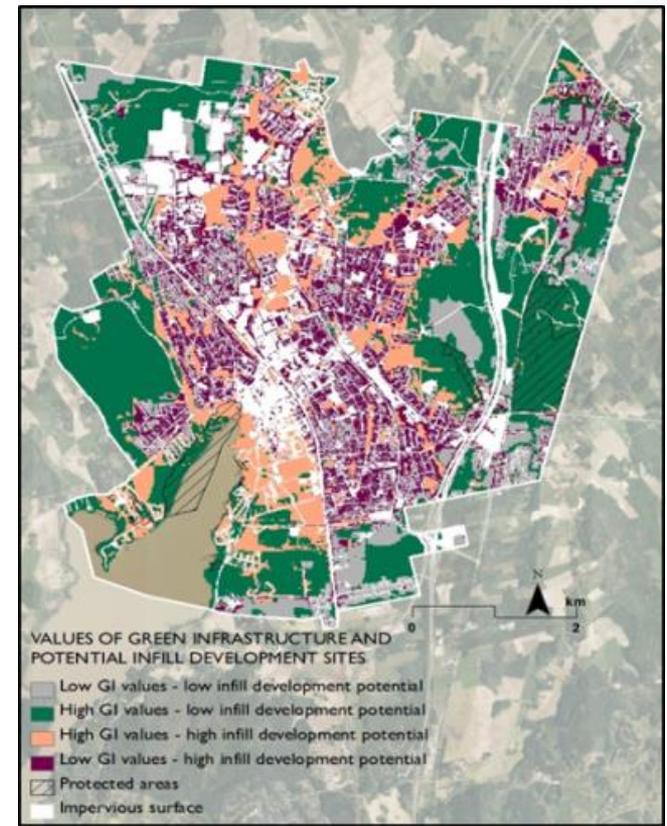
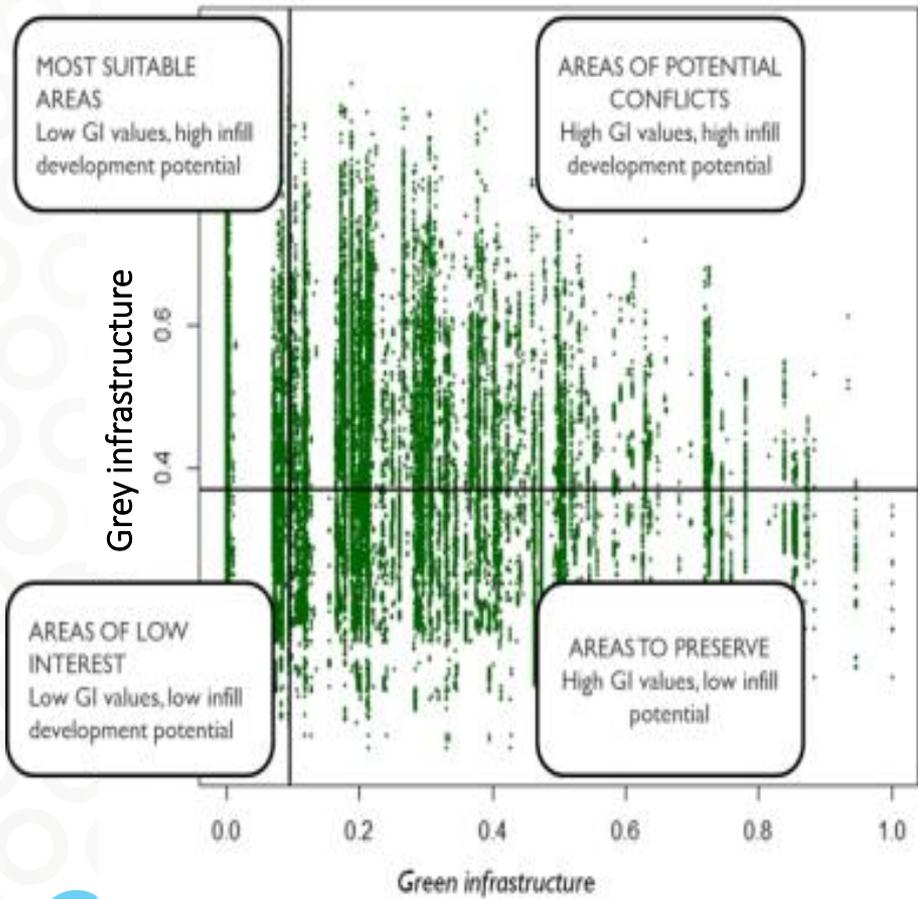
Huang, I. B., Keisler, J. & Linkov, I. 2011. Multi-criteria decision analysis in environmental sciences: Ten years of applications and trends. *Science of The Total Environment*, 409, 3578-3594.

Objectives and criteria were hierarchically structured and decided with practitioners

Practitioners weighted the criteria numerically between 0-100 based on the importance of the criteria's impact on the objectives.

Scored criteria were integrated to spatial data to show the results on a map





Results and practitioners experiences of the SMCA method

The decision tree was seen useful way to structure the factors having impact to the infill development

- It also provided a visual way to understand the challenge to weight different criteria against each other.

Map representing different potential for infill development was considered an illustrative approach for presenting the results.

- More cross-tabulated spatial classes would be needed.

The practitioners understood the overall concept and its objectives.

- However, they found difficulties in scaling the weights for different criteria against each other without seeing the on the results.
- On the fly map was suggested

The practitioners saw the results as logical and a good representation of their city's values from the perspective of green infrastructure.

The practitioners saw much potential in the method to improve infill development planning.

- A major benefit mentioned was that the SMCDA method brought people from different sectors of the city to the same table to discuss the complex systems and different factors affecting infill development

The resulting maps were considered to be a useful way to communicate with the decision-makers.

- The possibility to compare environmental values with the infill potential was considered to be especially valuable, since the map provides knowledge about the areas with an environmentally high value that should be preserved.

The practitioners were enthusiastic about applying similar method widely (e.g. with local residents' associations and other stakeholders) for the new master plan

- However, there were concern about resources, since the method requires researcher-facilitated workshops and advanced GIS knowledge.

Tiitu et al. 2018. Balancing urban green space and residential infill development: A spatial multi-criteria approach based on practitioner engagement [*Under review: in Journal of Environmental Assessment Policy and Management*]



Thank you

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