ReNature

Promoting research excellence in nature-based solutions for innovation, sustainable economic growth and human well-being in Malta.

Assessing the effectiveness of urban ecosystems to prioritise nature-based solutions in a high-density urban area

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ReNature

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Green Infrastructure

- *What can be considered as being **effective** green infrastructure?*

Source: Balzan (2020)

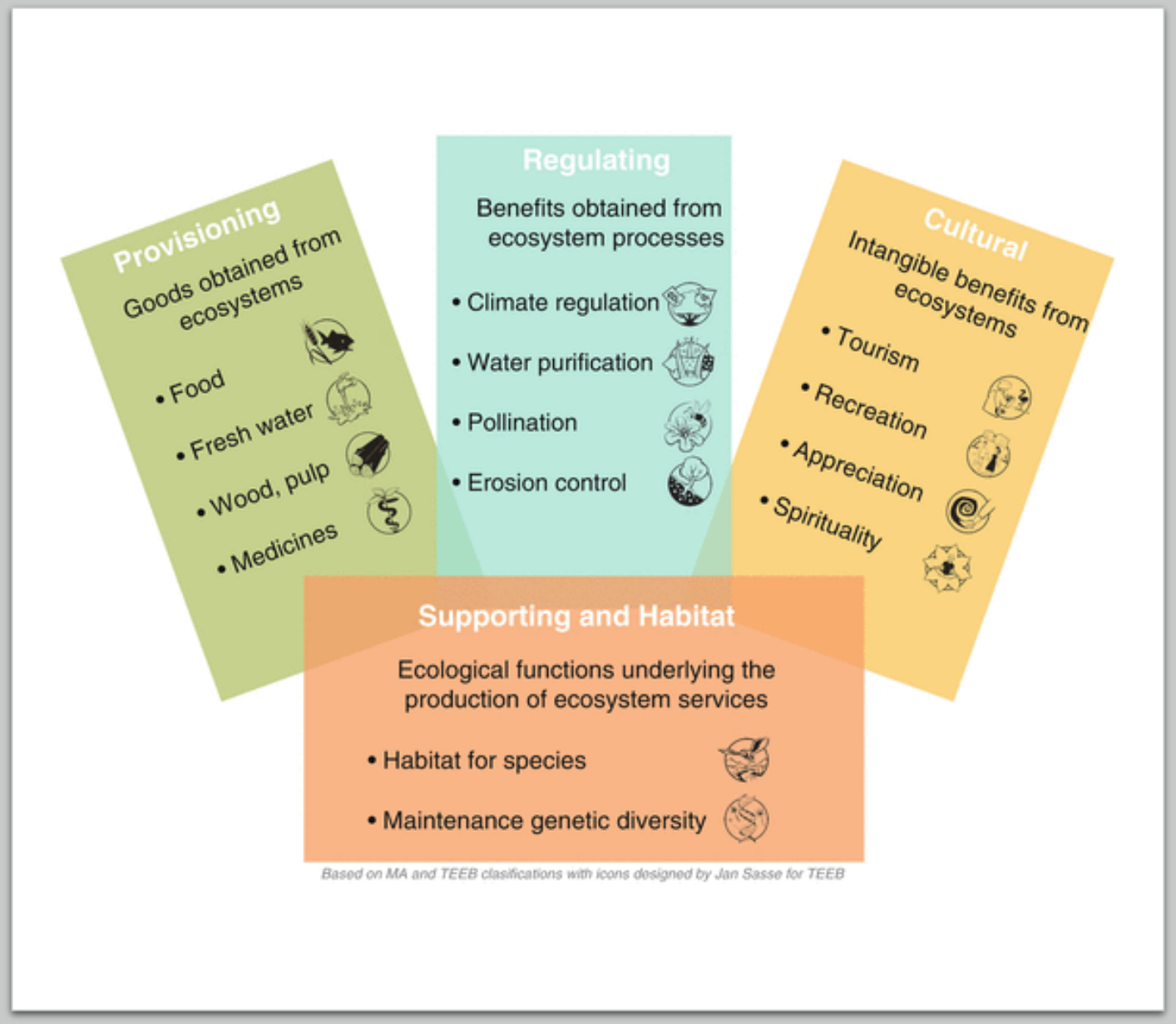
- *Green infrastructure is a **strategically planned network of natural and semi-natural areas** with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation.*

- This network can improve environmental conditions and therefore citizens' health and quality of life whilst supporting a green economy and enhances biodiversity.

Source: Balzan (2020)

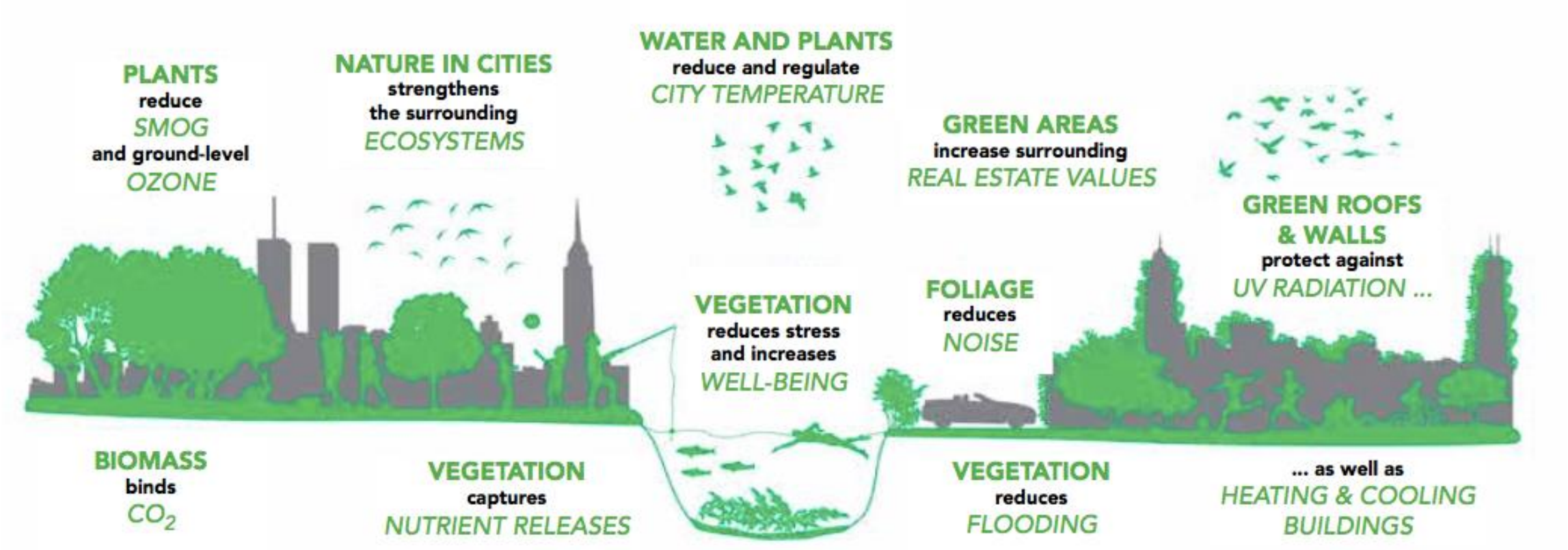
Source: [presentation J. Rockström and P. Sukhdev at EAT conference]

Graphics by Jerker Lokrantz/Azote



Urban ecosystem services

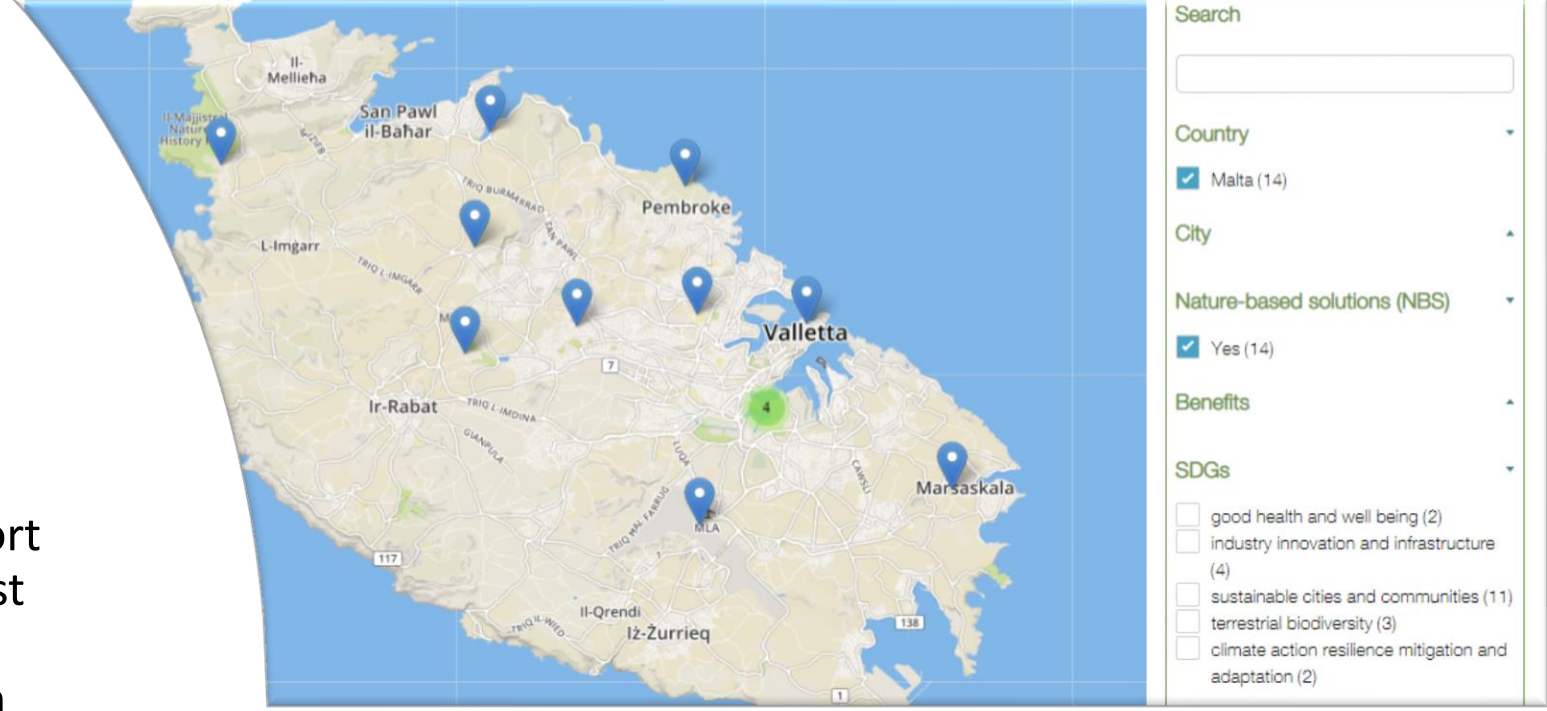
- Source: Gómez-Baggethun et al., 2013



Source: cocity.se

Prioritising nature-based solutions

- How to prioritise and plan for NbS?
- Ecosystem service assessments can support planning processes by identifying the most effective decisions on the protection, enhancement and establishment of green infrastructure to lead to measurable improvement in human well-being.
- However, the implementation of ecosystem services concepts in urban planning has remained low, and actions aimed at supporting ecosystem services are often not supported by an appropriate knowledge-base (e.g. Cortinovis and Geneletti, 2018; La Rosa et al., 2016).



Establishing an experimental green roof in association with a greywater recycling system

Country: Malta | City: Paola | Population: population

start: 2015 | Timeframe: 1 Year

Phase: Complete | Nature-based solutions (NBS) : Yes | Budget: N/A | Initiator: MCAST and the Global Water Partnership – Mediterranean (GWP-Med)

Website source: https://mcast.edu.mt

Latitude: 35.8772 | Longitude: 14.5059

BENEFITS

- ✓ reduced drought risk cooling effect uhi mitigation
- ✓ biodiversity conservation or increased biodiversity
- ✓ ecosystem restoration and or improved ecological connectivity
- ✓ increased quality and quantity of green and blue infrastructure
- ✓ education knowledge exchange and learning

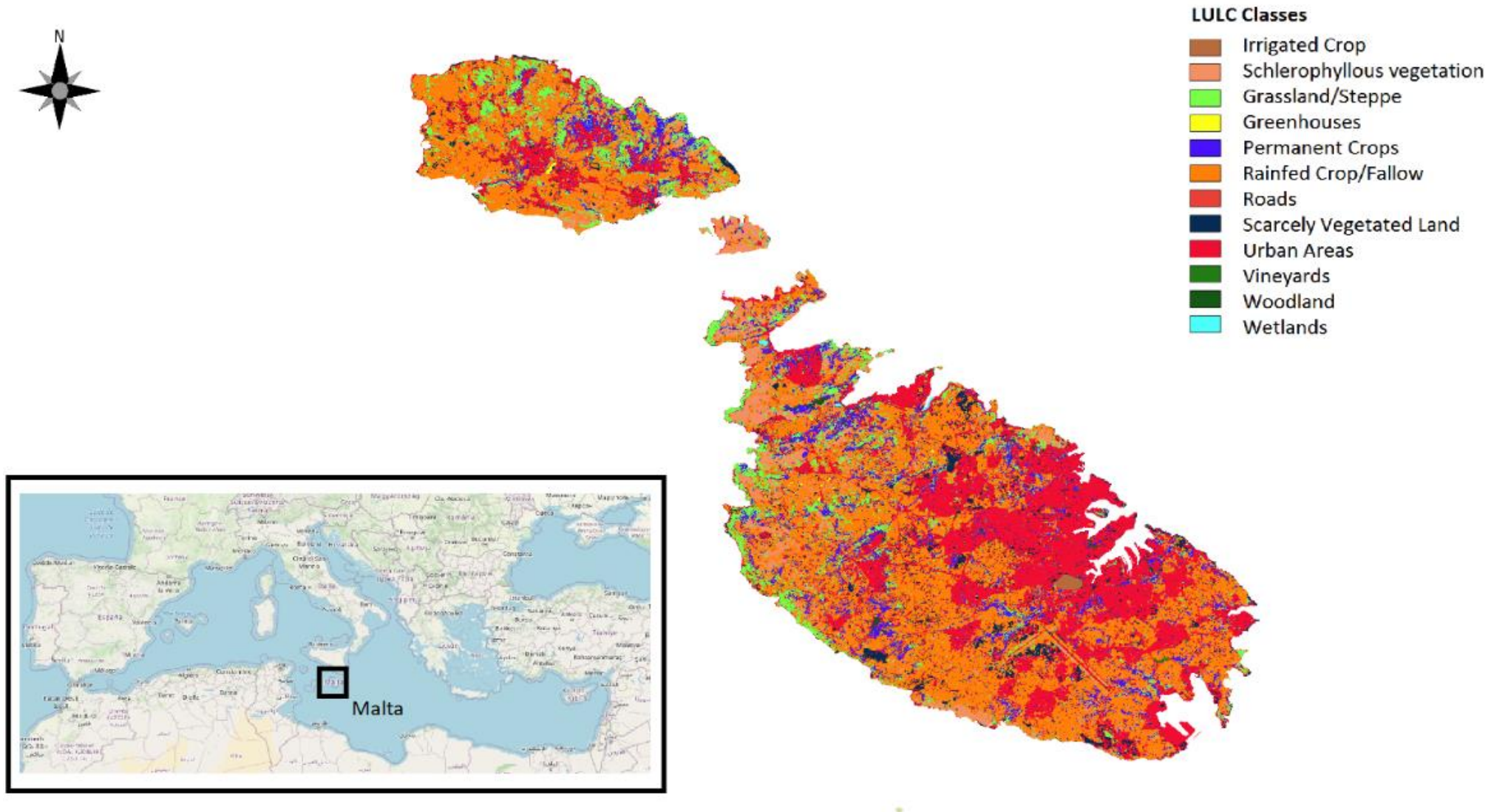
ORIGINAL PROBLEMS

- ✗ low air quality
- ✗ drought and heat risk
- ✗ low availability of green infrastructure
- ✗ negative environmental impacts on human health
- ✗ limited knowledge about biodiversity

SDGS

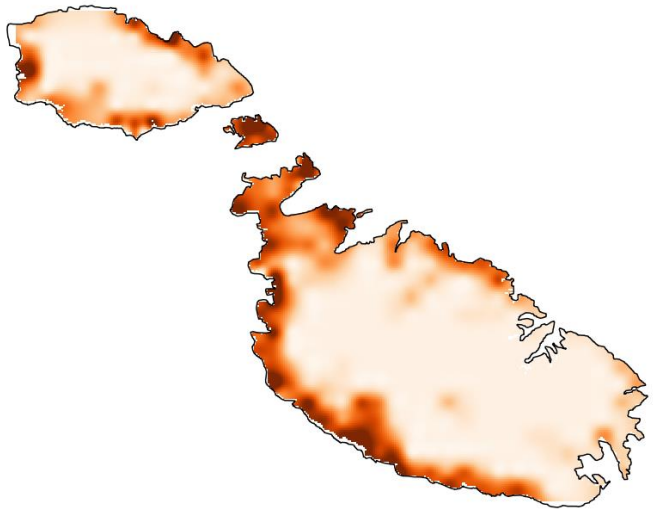
- ✓ industry innovation and infrastructure
- ✓ sustainable cities and communities

The ReNature NbS Compendium : http://renature-project.eu/compendium



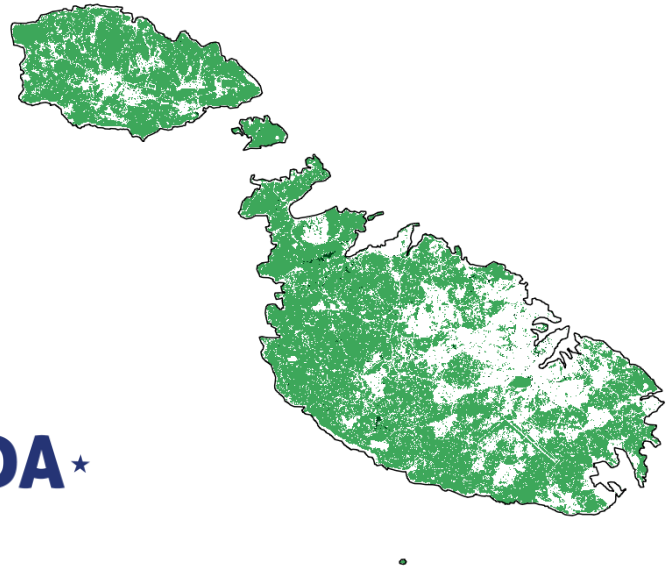
Balzan et al. (2018; Land Use Policy)

Source: Balzan et al., 2018, Land Use Policy

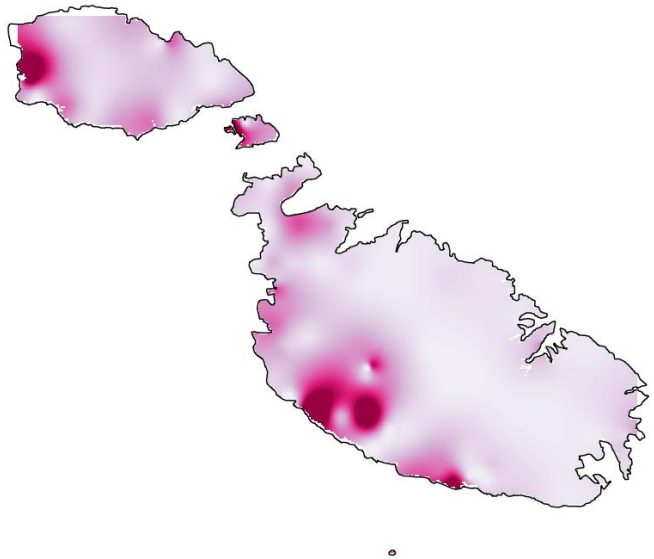


Habitats of Conservation value (Supporting ES)

Crop (Provisioning ES)

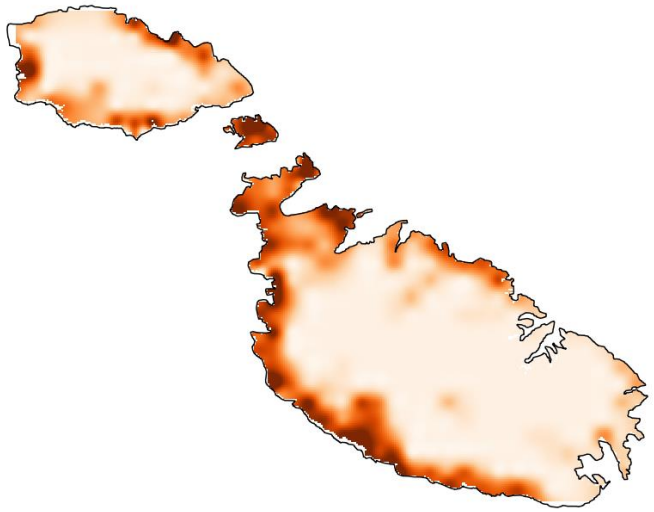


Air pollution [NO_2] removal (Provisioning ES)



Aesthetic value (Cultural ES)

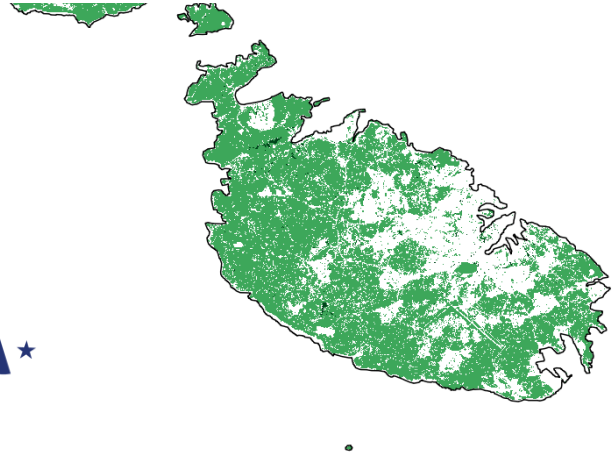
Source: Balzan et al., 2018, Land Use Policy



Habitats of Conservation value (Supporting ES)

Crop (Provisioning ES)

Distribution of ecosystem service supplies?



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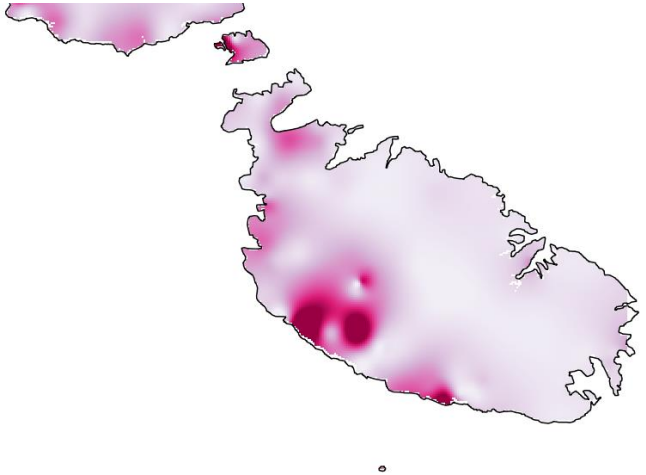


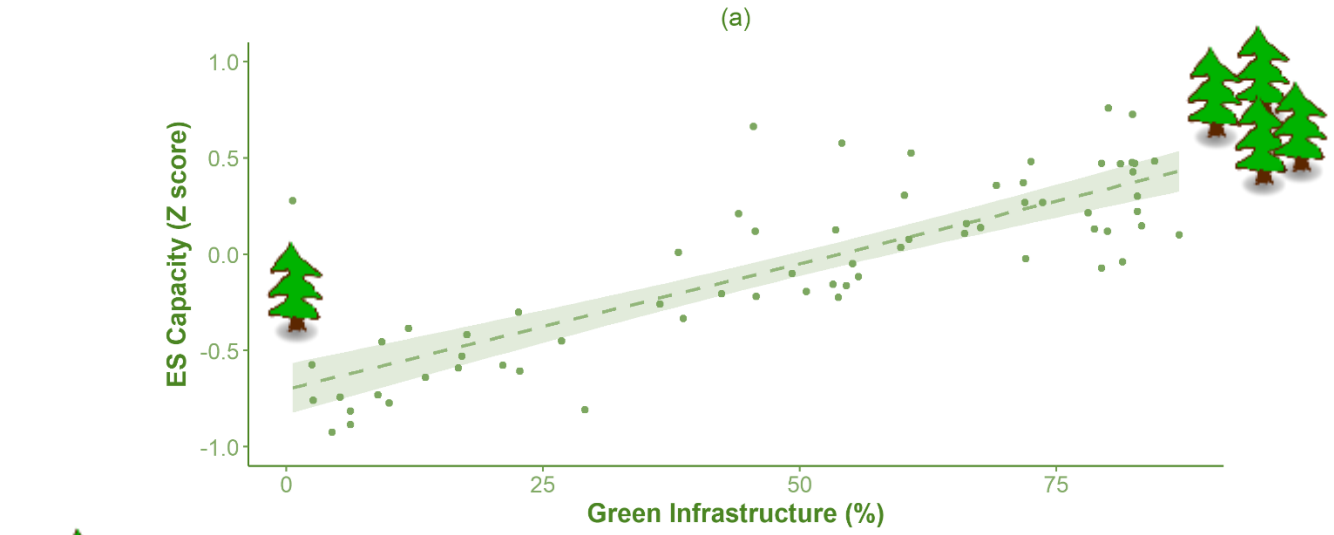
Aesthetic value (Cultural ES)

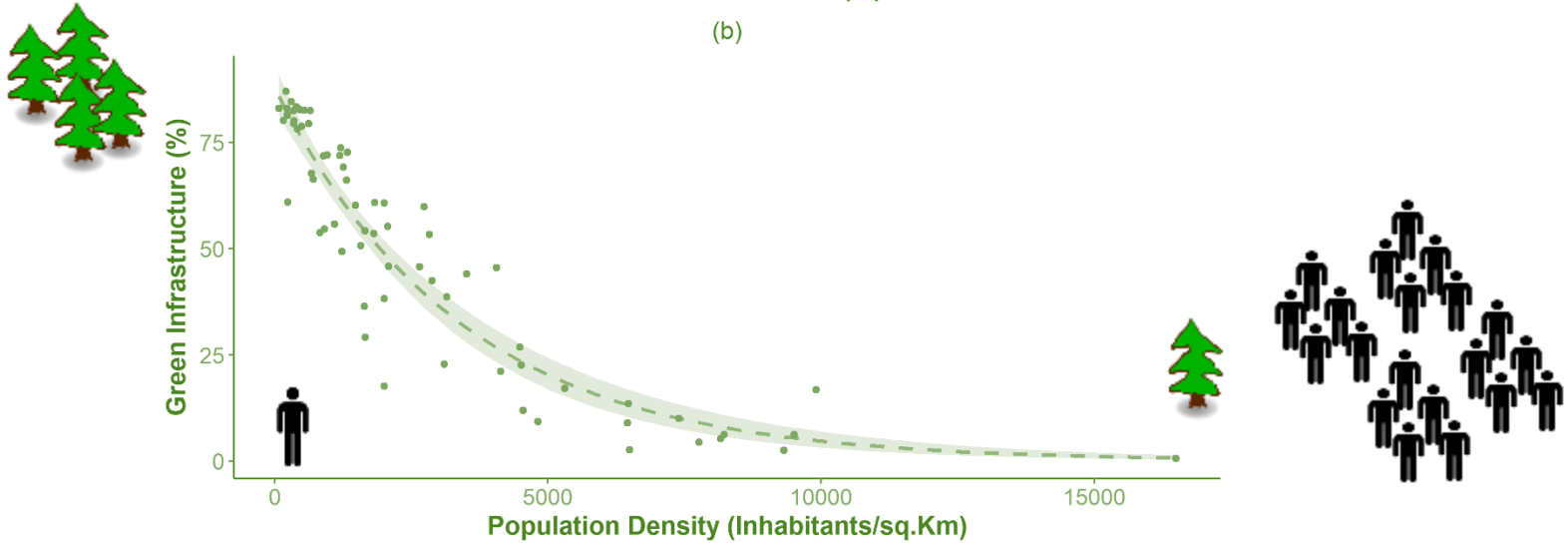
ESMERALDA

Linking ES capacity to GI availability

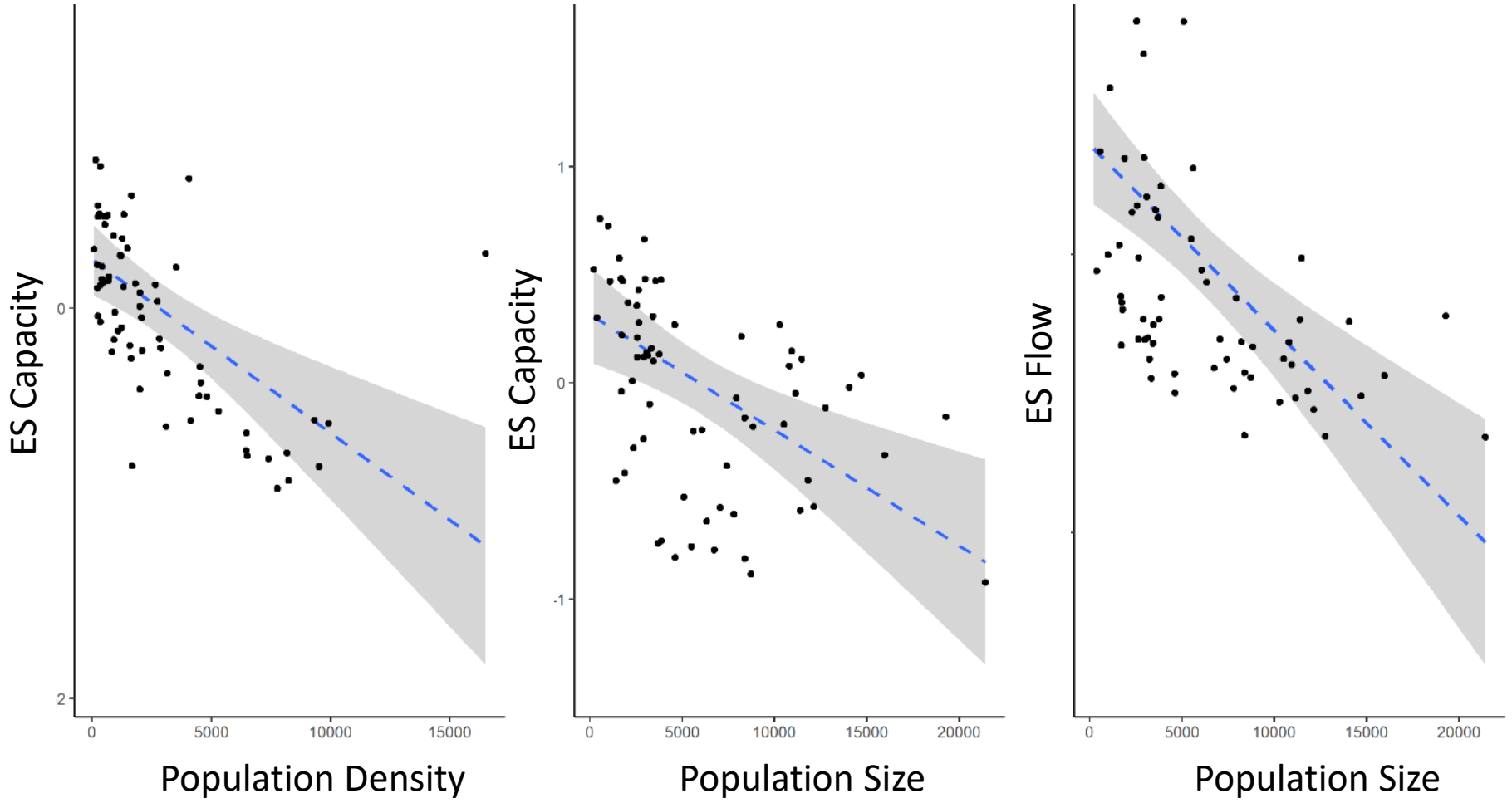
a) ES capacity is directly associated with GI land cover

b) GI availability declines with an increase in population density





Balzan et al. (2020; Research Ideas and Outcomes)



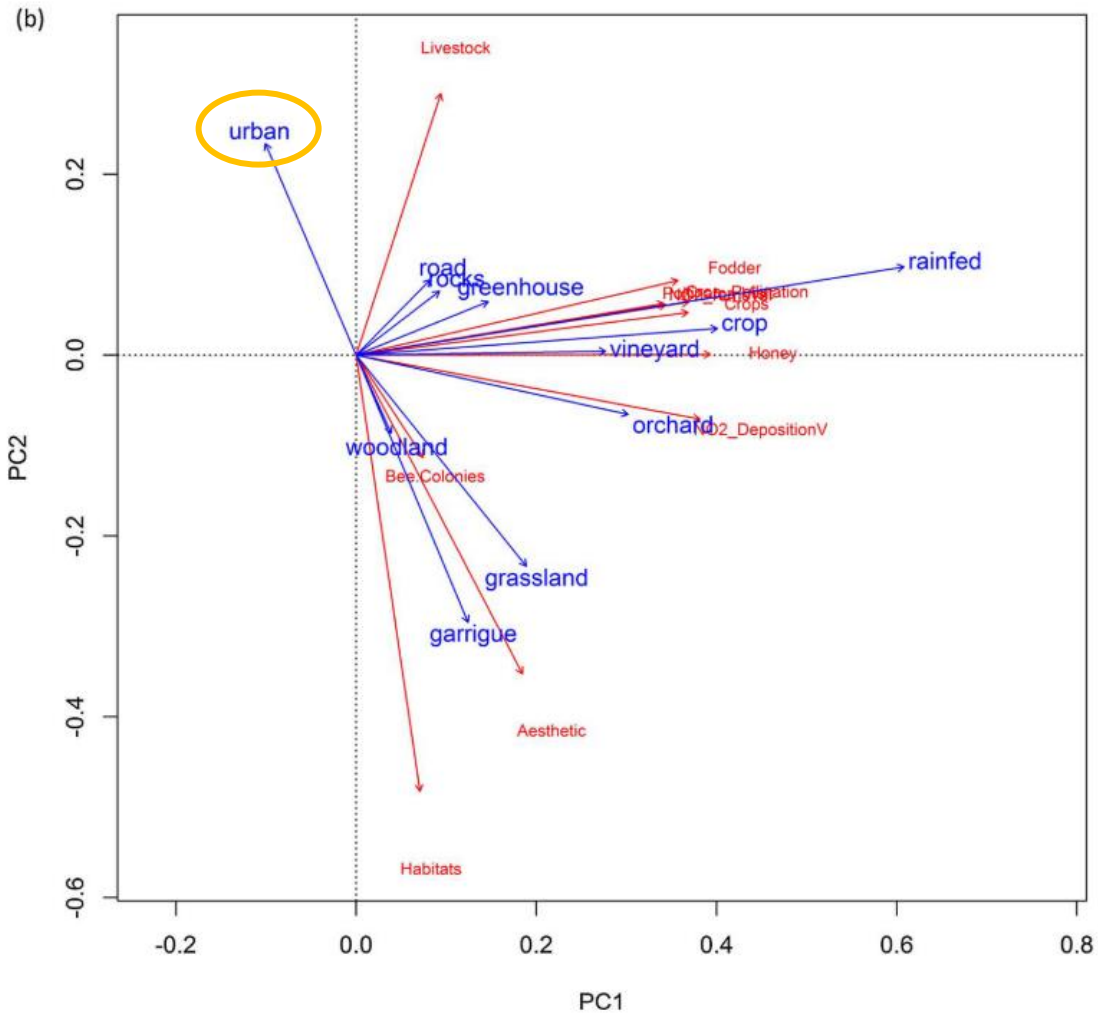
Scatterplots presenting the association between (a) ES capacity and population density, (b) ES capacity and population size and (c) ES flow and population size for local councils in Malta. Lines represent the linear regression function and 95% confidence intervals plotted on the scatterplot.

Source: Balzan 2017

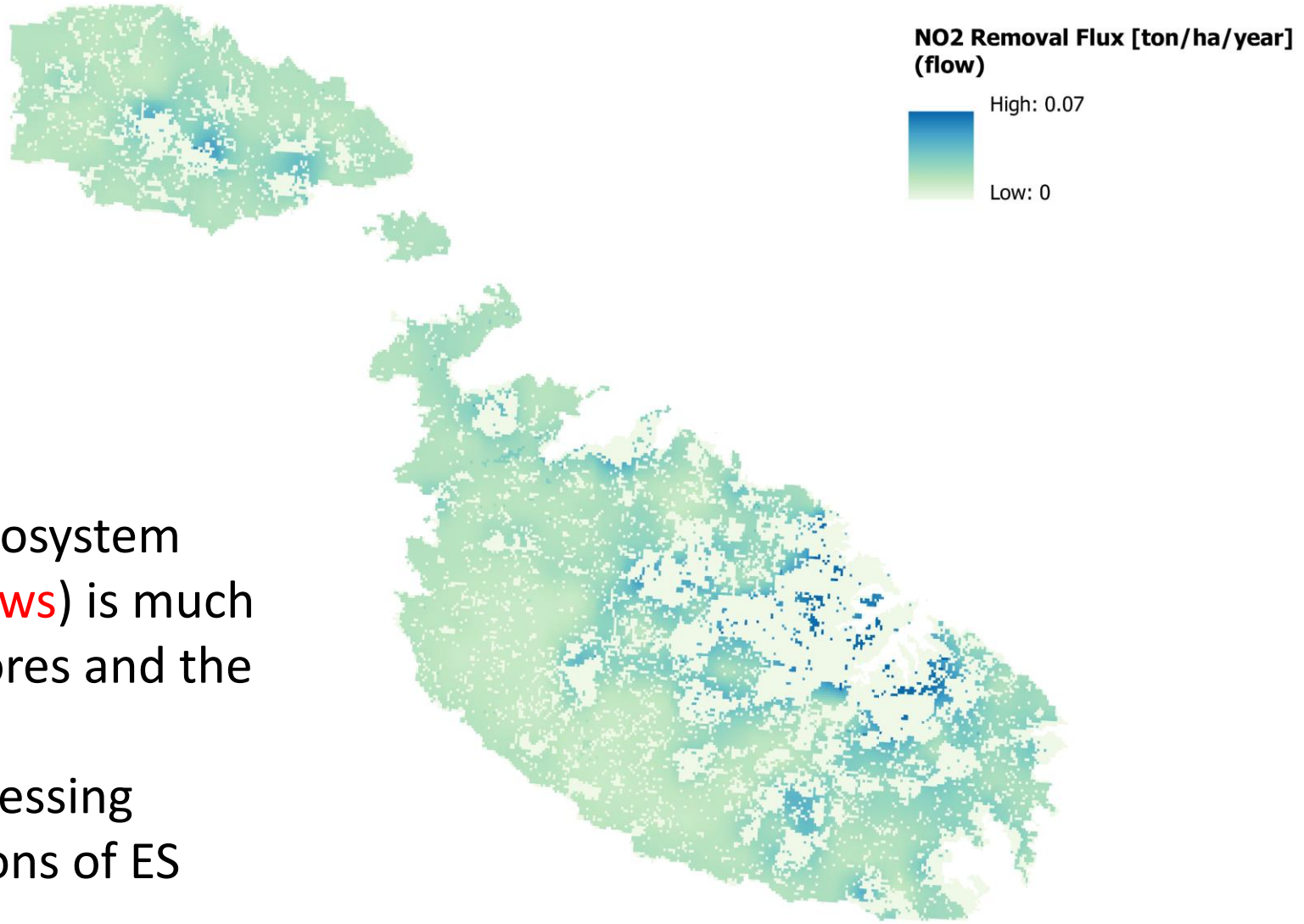
Source: Balzan et al., 2018, Land Use Policy

Urban ecosystem services

- Urban areas as coldspots of *ES capacities?*
- Principal component analysis used to assess the ability of different land use land cover (LULC) categories to deliver multiple ecosystem services (red)
- Length of arrow is proportional to correlation between environmental variable and ordination.



Source: Balzan et al., 2018, Land Use Policy

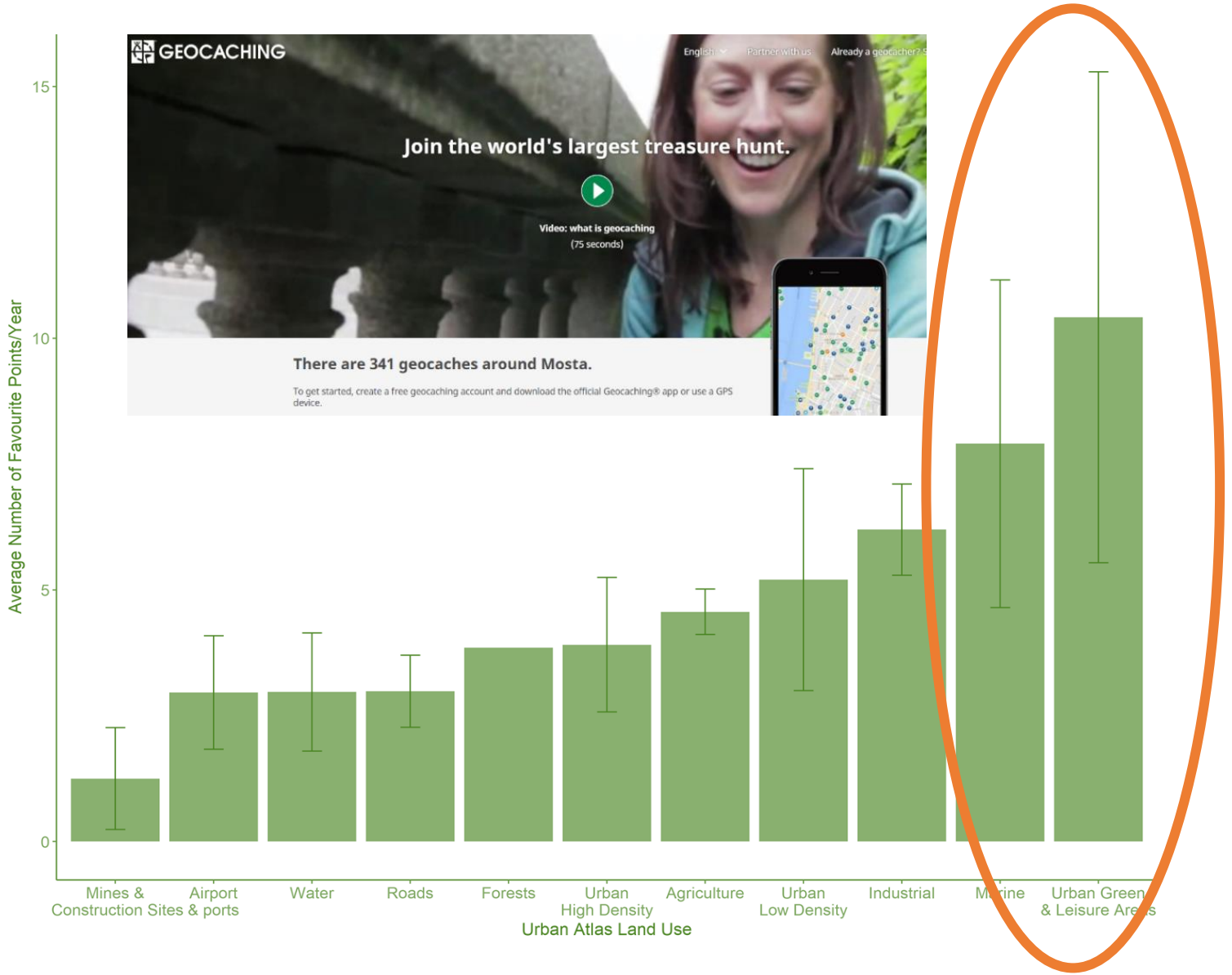


- But, the rate of ecosystem service use (ES flows) is much higher in urban cores and the peri-urban area!
- Importance of assessing different dimensions of ES supplies and use

Source: Balzan & Debono, 2018, One Ecosystem

Recreational value

Mean number of favourite points (± standard error of the mean) for the reclassified Urban Atlas land use categories



- But, the rate of ecosystem service use (ES flows) is much higher in urban cores and the peri-urban area!
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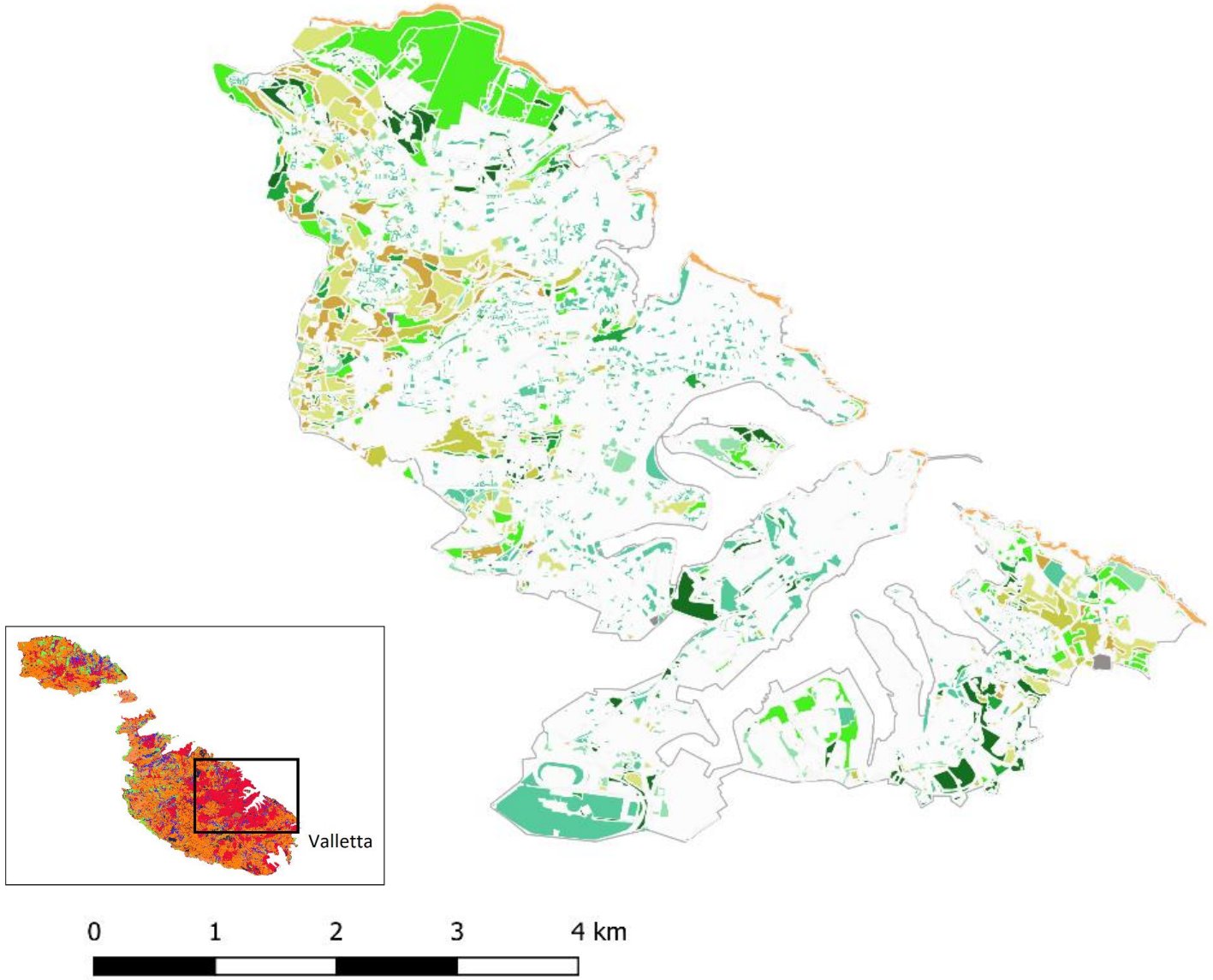
Urban Ecosystem Services

- The surface area of the Valletta urban agglomeration case-study is 22.21 Km^2 (or just 7.03% of the land surface of the Maltese Islands). The total population of the localities overlapping with the study area is 129,760, with an average population density of 6,658 ± 4,629 persons per km2.
- A total of 15 ecosystem services mapped.



European Commission

Source: Balzan et al., submitted

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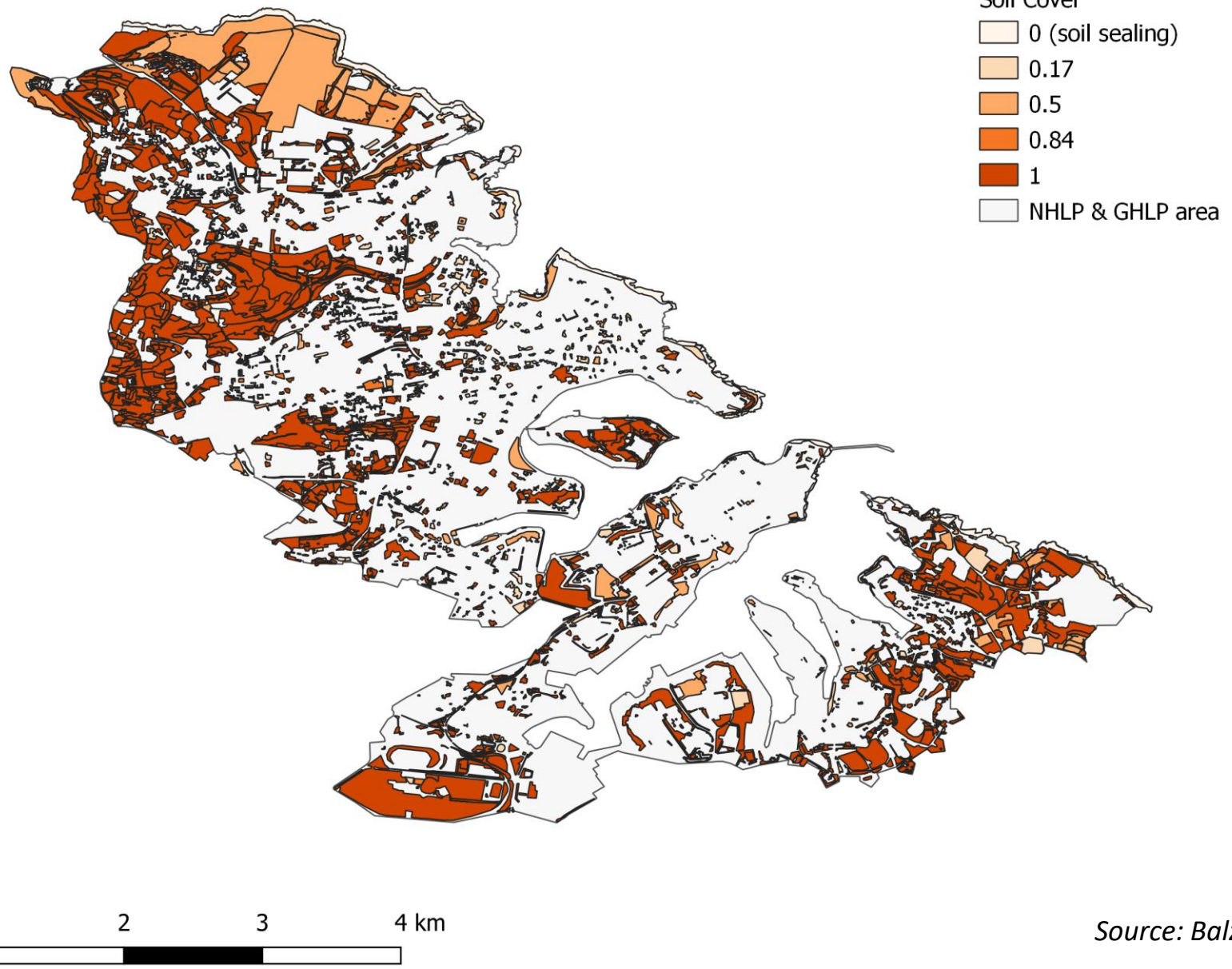
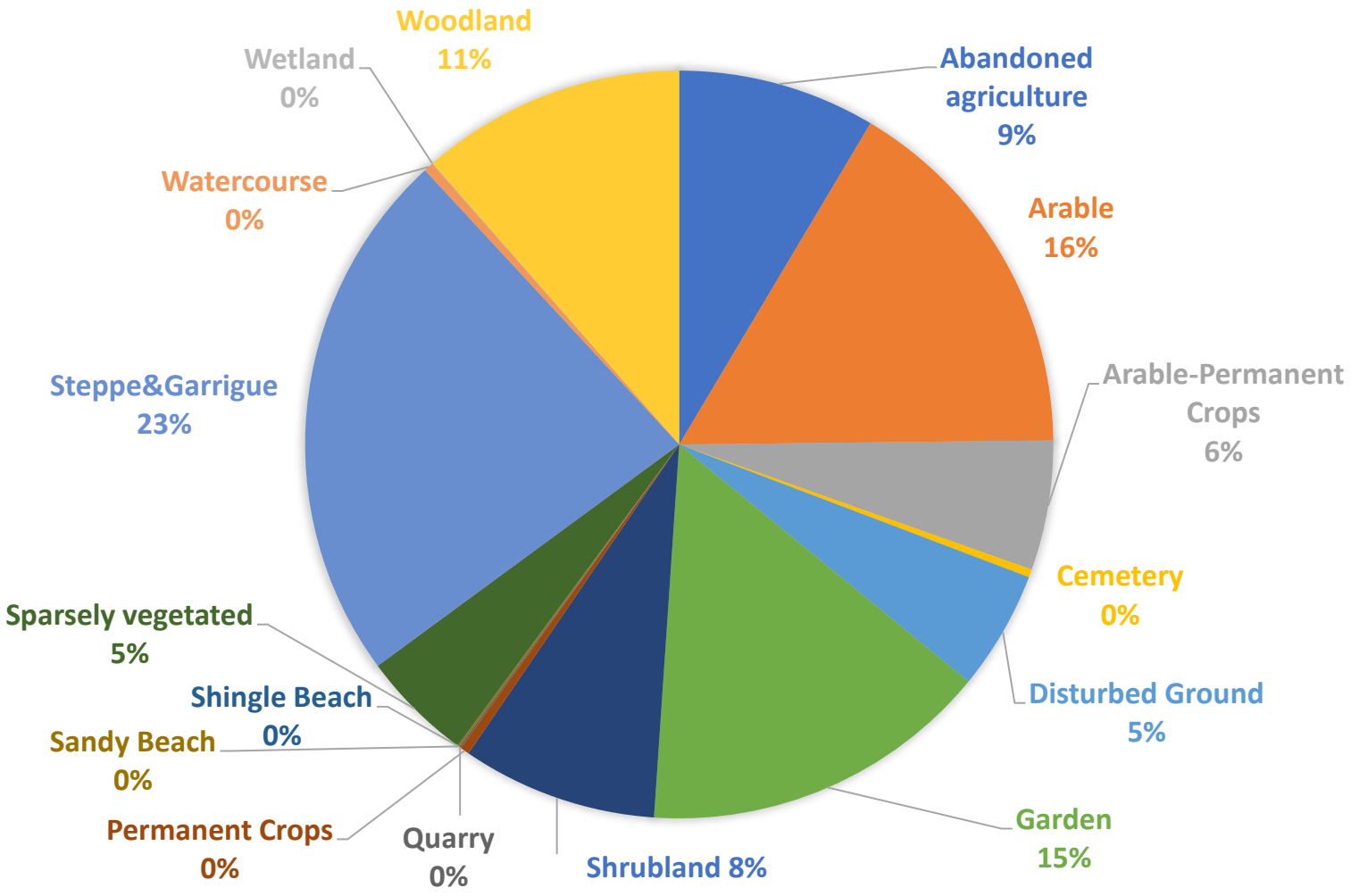
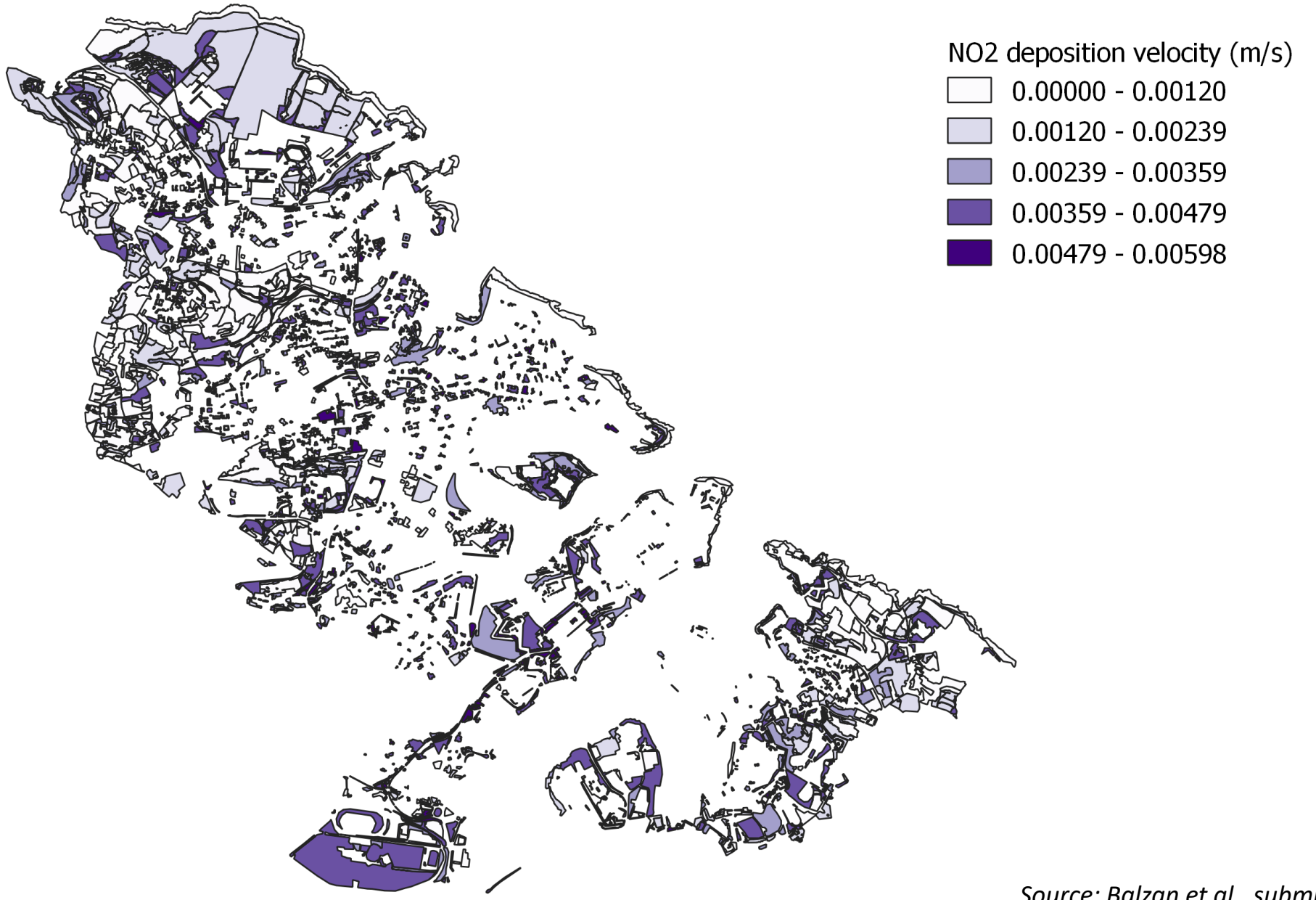


Source: Balzan et al., submitted

	Relative contribution of UGI types to ES supplies within the study area (Source: Balzan et al., submitted.)			
UGI Category	**Noise Abatement**	**Carbon Storage**	**NO_2 Removal capacity**	**Cooling Effect**
Abandoned agriculture	2.17%	5.48%	5.03%	9.50%
Arable	4.56%	7.13%	6.28%	11.91%
Arable-Permanent Crops	4.70%	3.20%	2.87%	3.63%
Cemetery	0.10%	0.10%	0.12%	0.12%
Disturbed Ground	3.90%	4.11%	3.48%	5.48%
Garden	**29.26%**	**22.91%**	**23.08%**	**15.47%**
Maquis & Shrubland	**26.44%**	**18.84%**	**14.77%**	**16.66%**
Permanent Crops	0.75%	0.53%	0.54%	0.55%
Quarry	0.00%	0.05%	0.02%	0.03%
Sandy Beach	0.00%	0.00%	0.01%	0.09%
Shingle Beach	0.00%	0.01%	0.01%	0.06%
Sparsely vegetated	0.00%	0.21%	0.22%	0.78%
Steppe & Garrigue	6.82%	6.04%	23.52%	13.70%
Watercourse	0.00%	2.10%	2.08%	4.24%
Wetland	0.00%	0.10%	0.14%	0.08%
Woodland	**21.29%**	**29.19%**	**17.82%**	**17.68%**



Source: Balzan et al., submitted



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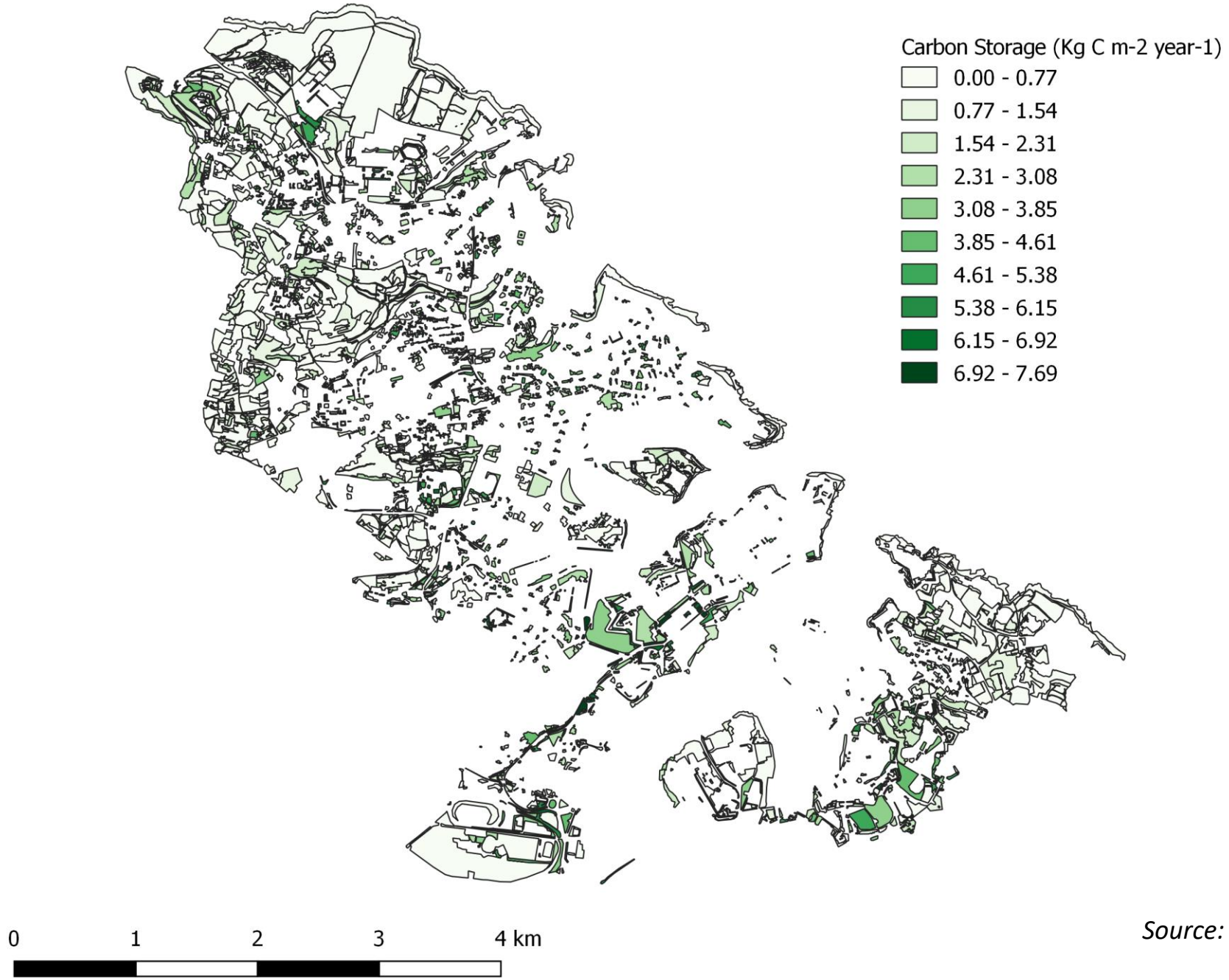

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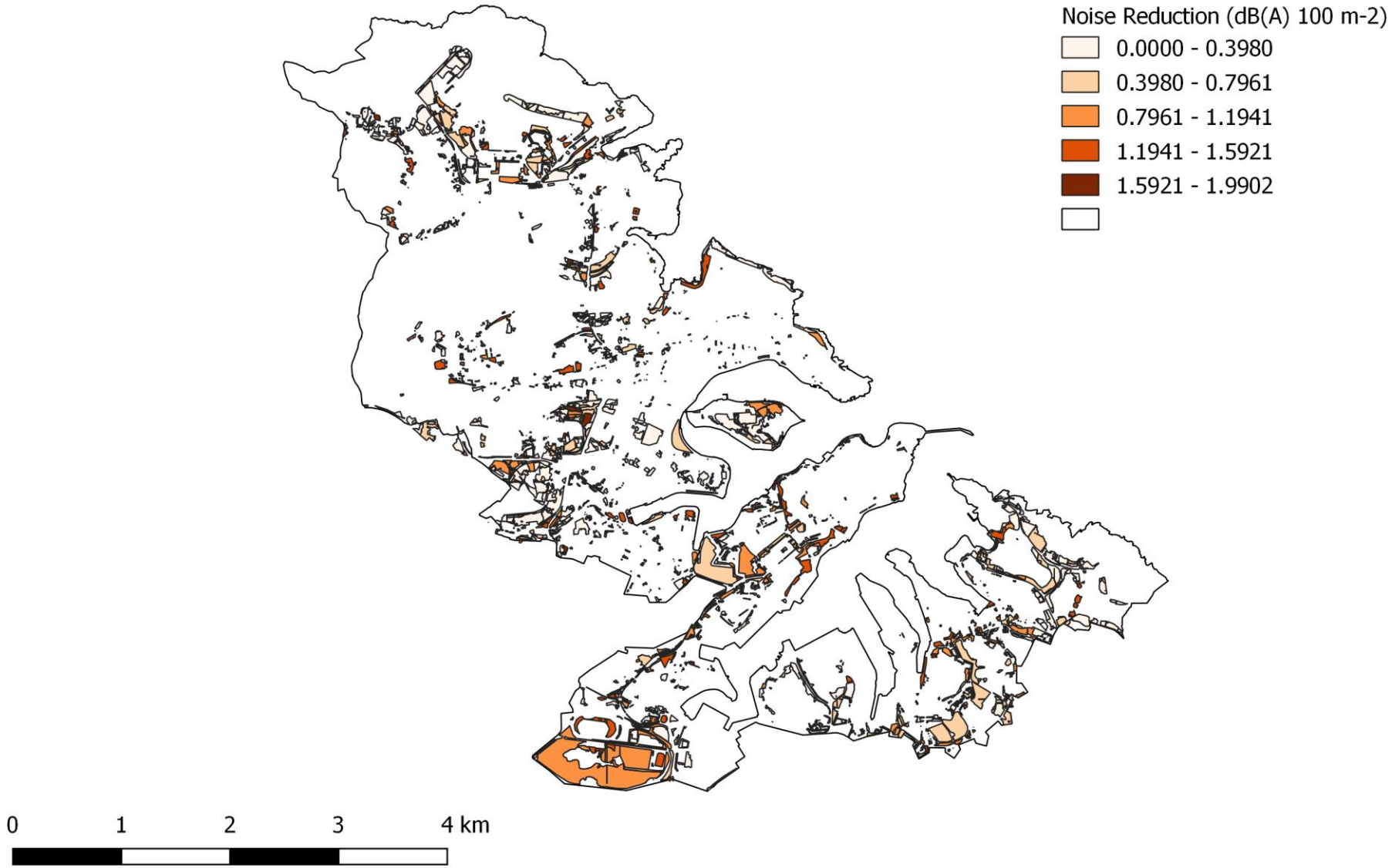

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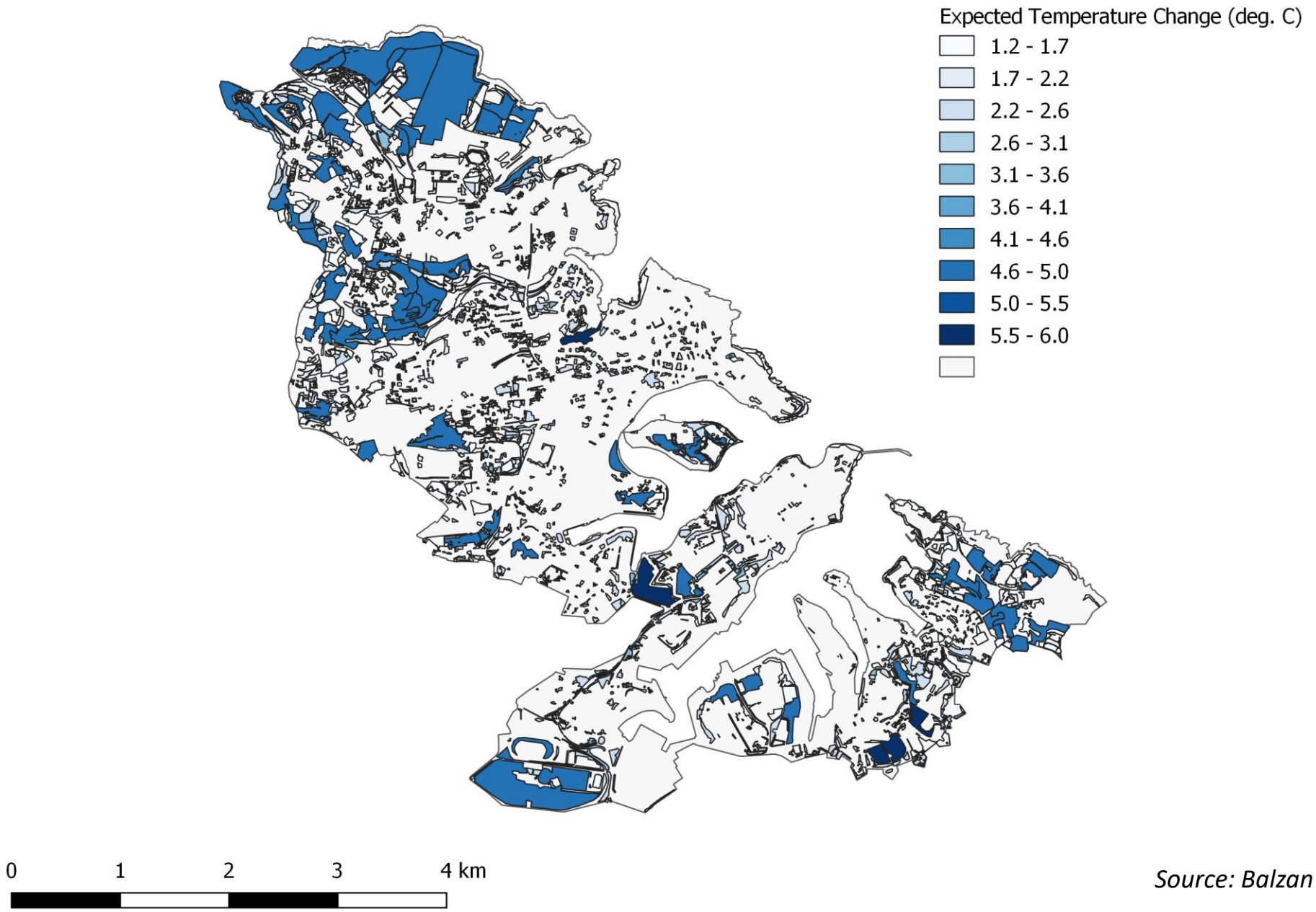
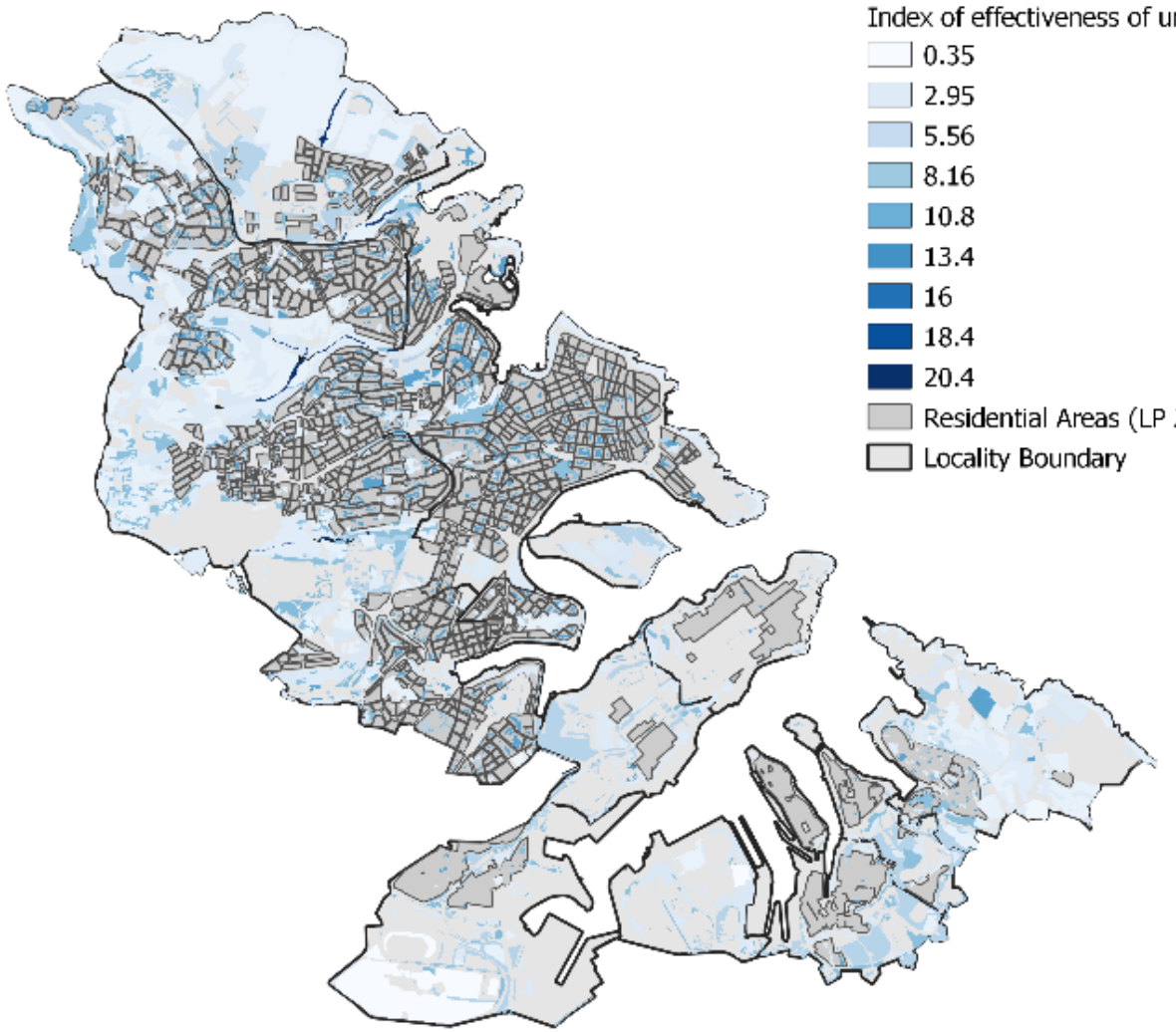
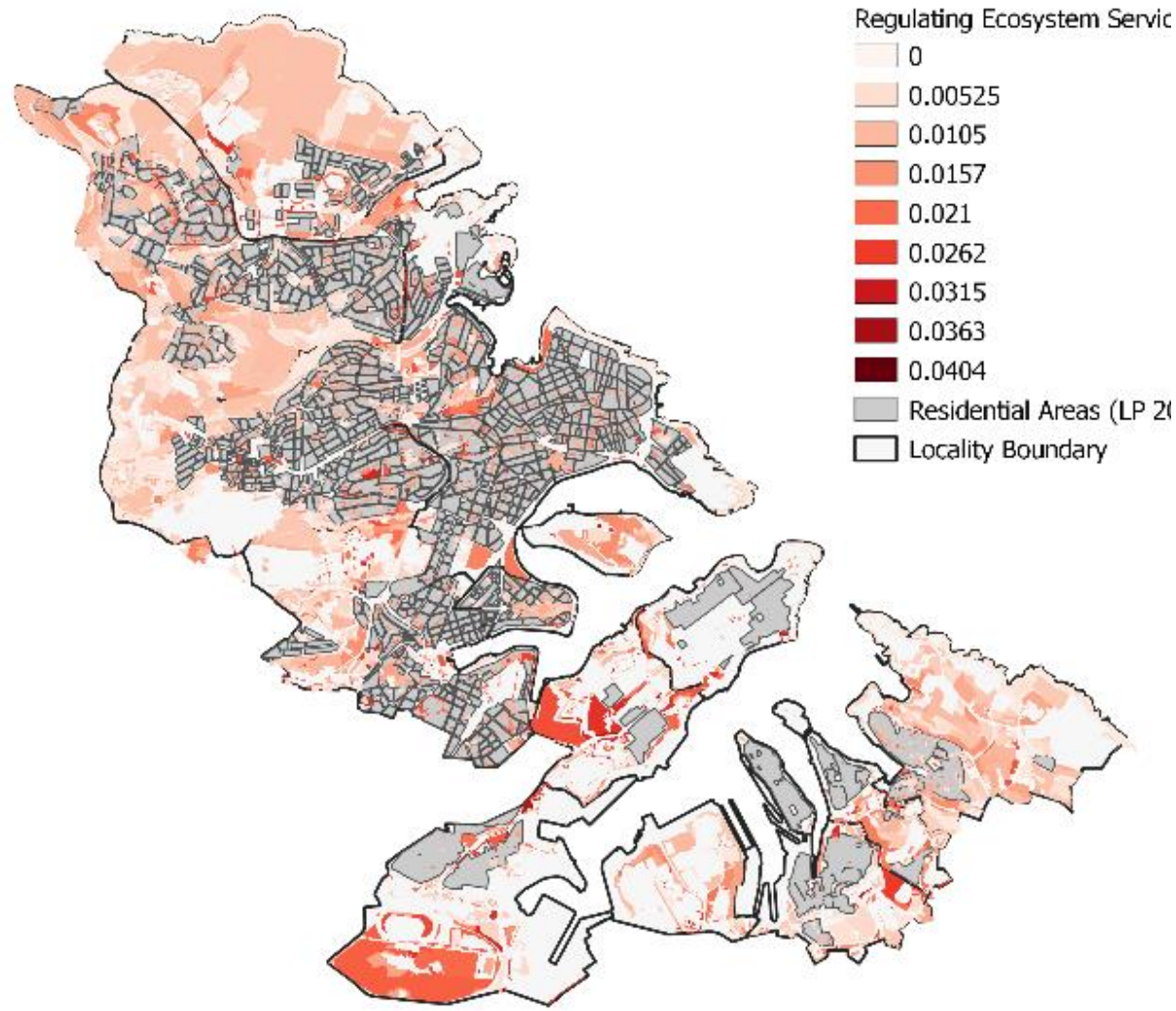


Source: Balzan et al., submitted

Index of Effectiveness



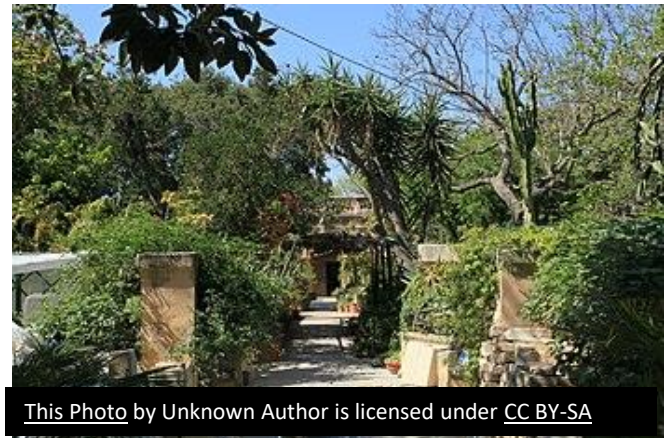
Regulating Ecosystem Services



- The ***index of effectiveness of urban ecosystems*** is a measure of relative contribution of urban ecosystems to ecosystem service provision based primarily on ecosystem condition (preliminary data shown here).
- The less land required to produce an urban ecosystem service, the more effective the urban ecosystem.

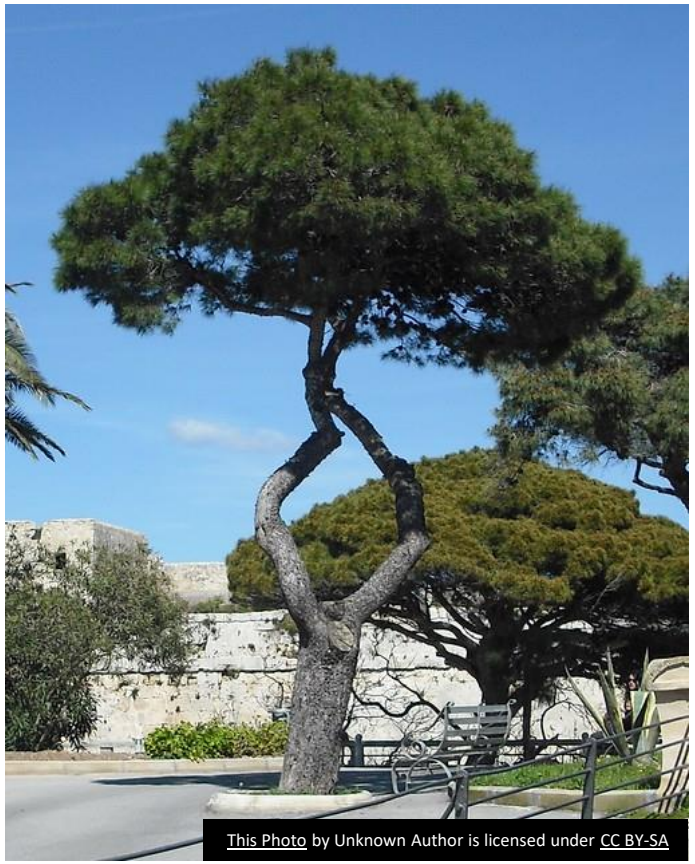
Source: Balzan et al., submitted

High index of effectiveness values recorded for:



Private gardens

Green streets



Urban woodlands and afforested areas

Permanent crops

Prioritising NbS interventions

- Prioritise policies that protect existing urban gardens, and nature-based interventions that increase tree and soil cover to increase regulating ecosystem services in high-density urban cores;
- Prioritise the protection of private gardens, which contributed significantly to ecosystem service capacities;
- However, these measures cannot be considered as a replacement of the existing green infrastructure network as, because of their diversity, urban ecosystems lead to different non-material uses of ecosystems.

Source: Balzan et al. (2020)

Thank you!

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