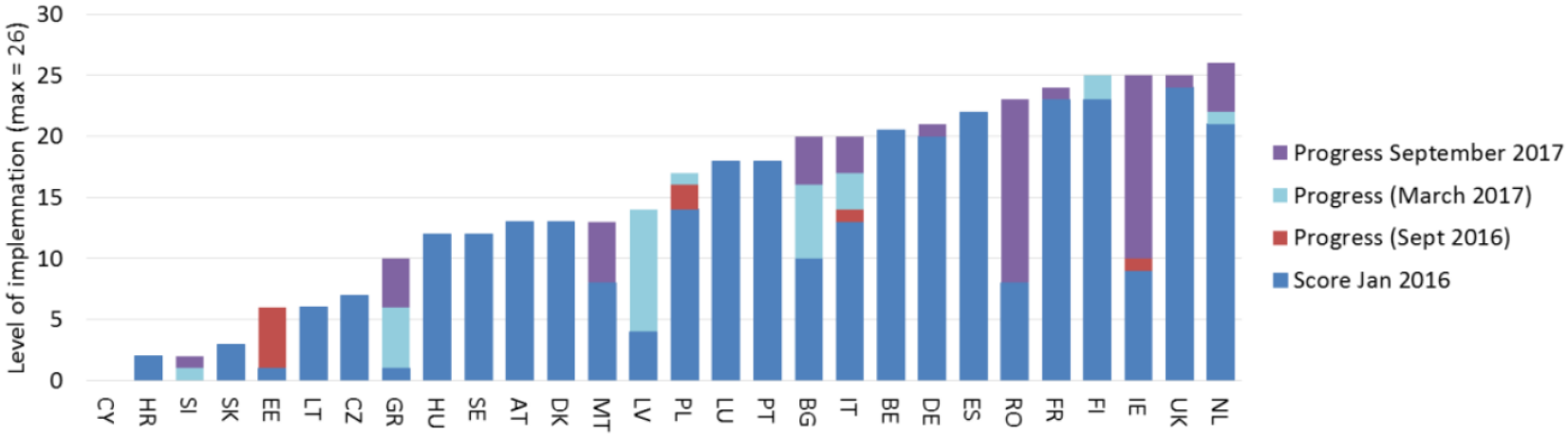
ADAM MICKIEWICZ UNIVERSITY IN POZNAŃ

Ecosystem Services in Polish Urban Areas

Damian Łowicki

Introduction

MAES barometer. Status of MAES process in the EU member states



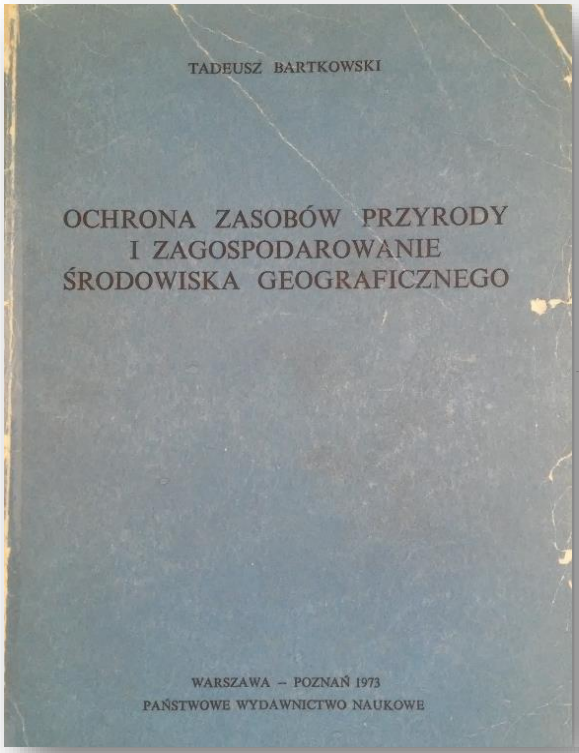
Source: L. Kopperoinen et al., 2018

What factors determine the development of ES approach in individual countries?

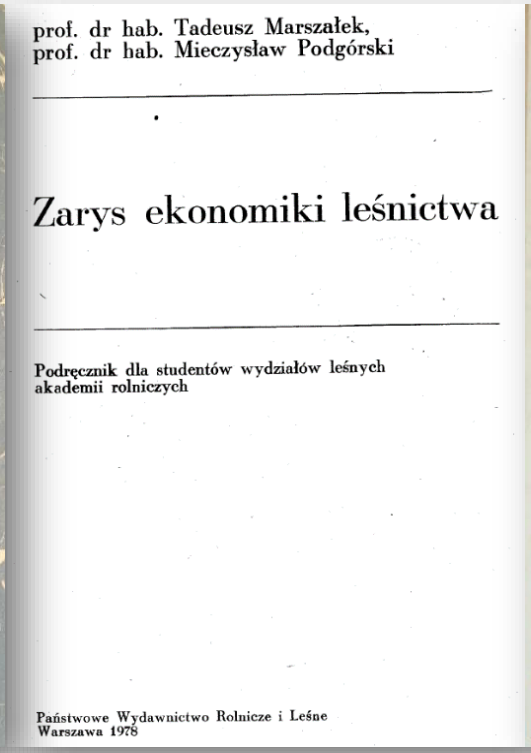
What are the prospects for the practical use of the ES at a regional and local level?

What can be done to facilitate the uptake of ES?

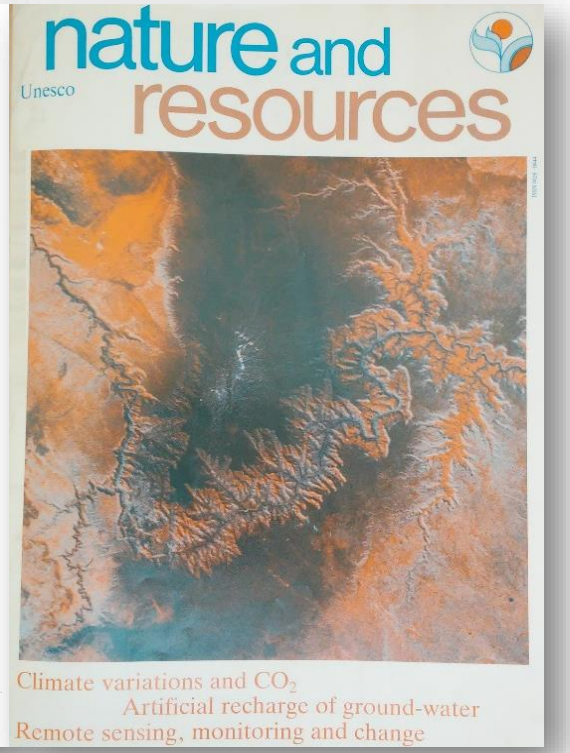
Precursors of the ES approach in Poland



1973



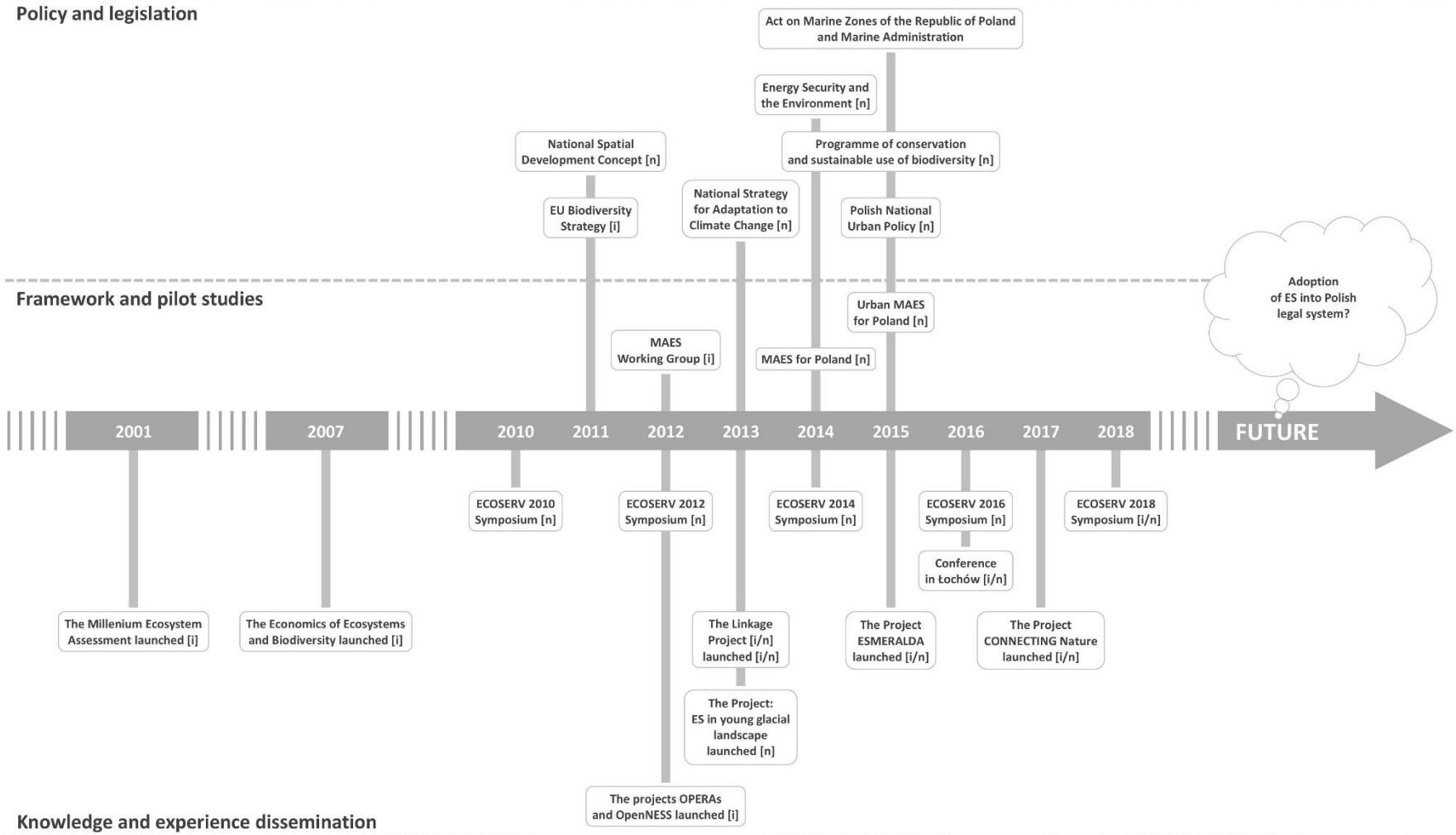
1978



1995

"… it is necessary to develop geographical information in such way as to enable the transition to economic valuation. It is the first step towards research, in which it will be possible to establish relationships between physical-geographic parameters and their economically tangible impact" (T. Bartkowski, 1973)

Milestones for ES approach in Poland



[i] – international impulses; [n] – national impulses. Source: M. Stępniewska et al., Ecosystem Services 33 (2018) 59–67

Scientific drivers

Conferences

ECOSERV 2010, 2012, 2014, 2016

Economics and Environment 37(2010), 42(2012), 51(2014), 59(2016), 60(2017)

Ecoserv

Poznań 2016

Poznań 2014

Poznań 2012

Poznań 2010

Save the date 6-8.07.2020!

Eco serv
Poznań 2020

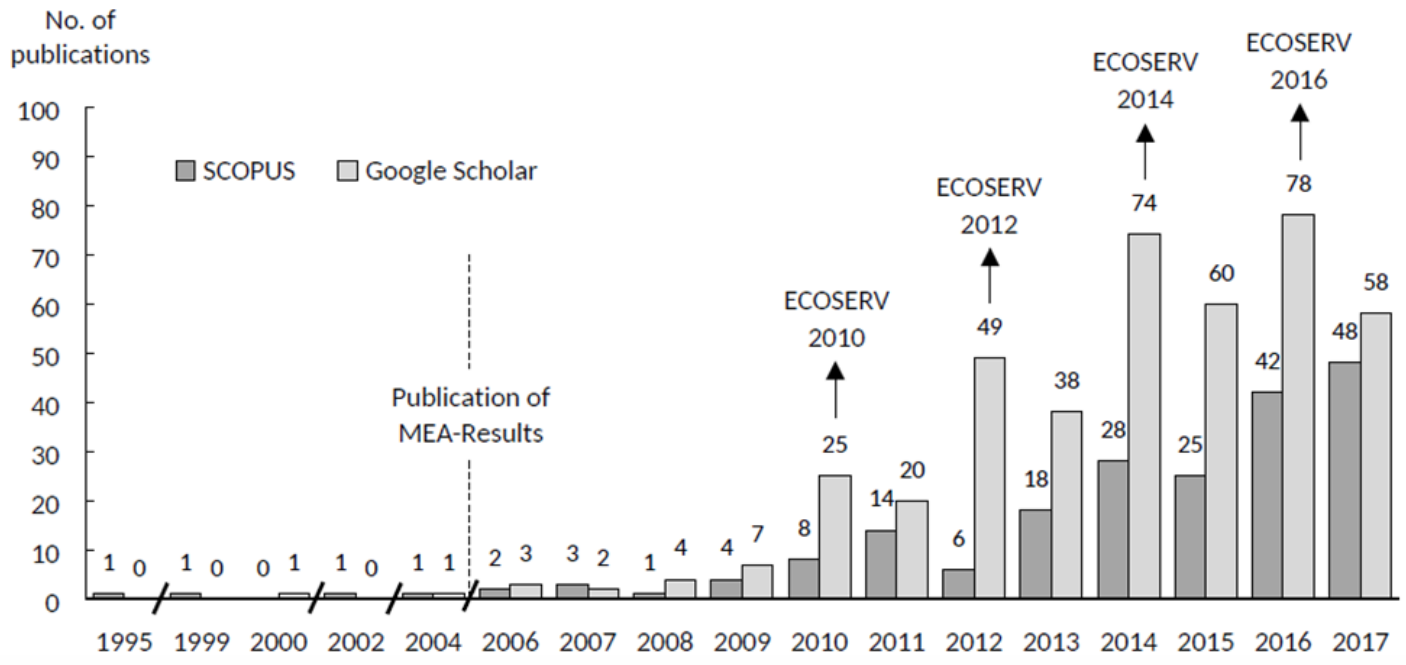
SOCIETY FOR URBAN ECOLOGY
SURE

Connecting Nature

Symposia ECOSERV 2020
and CONNECTING Nature
within the 3rd SURE World Congress
Poznań NBS Expo 6-8 July 2020

Scientific drivers

Publications



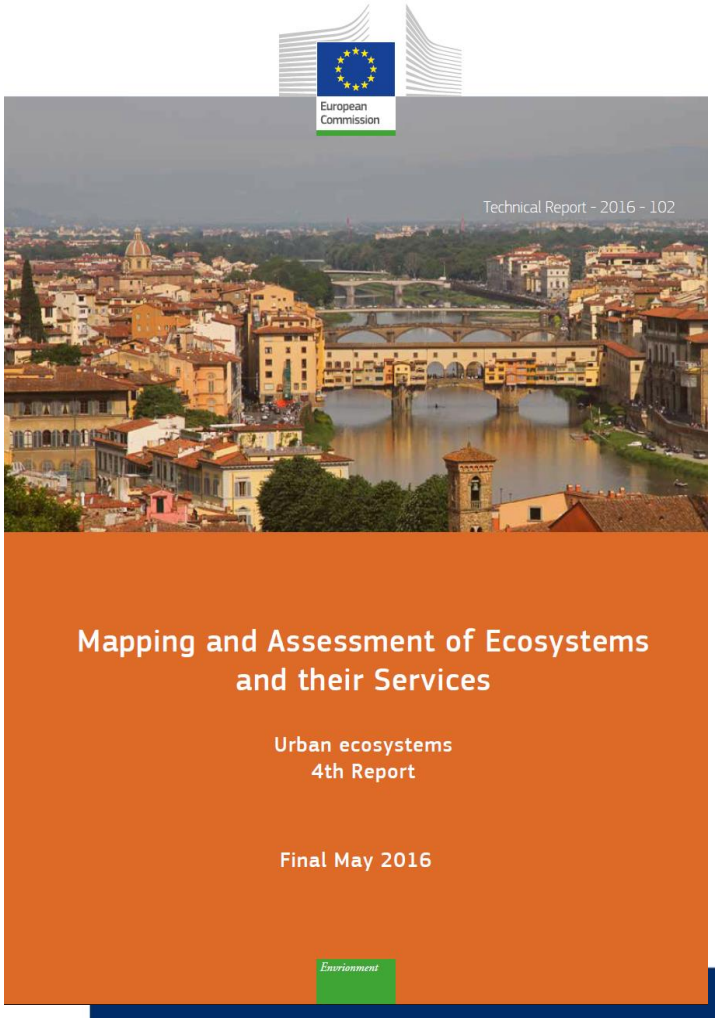
Number of ES-related documents published by authors affiliated in Poland in the years 1995-2017

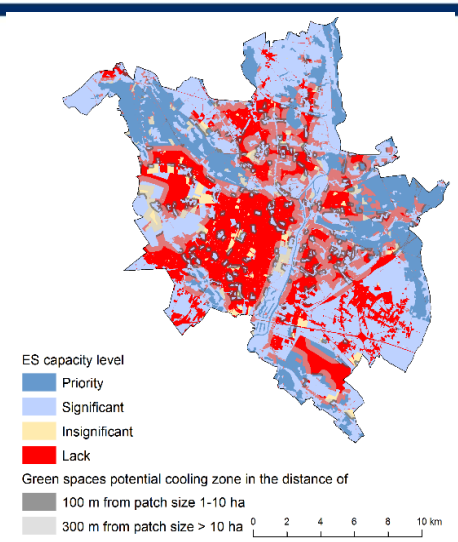
(Based on SCOPUS and Google Scholar, access 02.2018)

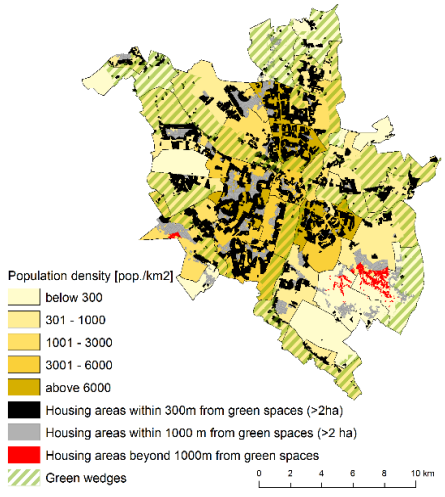
Source: M. Stępniewska et al., Ecosystem Services 33 (2018) 59–67

Administrative drivers

Case study from Poznań in the EU MAES urban pilot







Source: J. Maes et al., 2016

Administrative drivers

Mapping and assessment of ES in Integrated Environmental Monitoring Programme

IEMP Base Station	Research catchment	Area [km^2]
Wolin	Gardno Lake	2,6
Storkowo	Parsęta river	74,0
Puszcza Borecka	Łękuk Lake	13,3
Wigry	Czarna Hańcza river	7,4
Koniczynka	Struga Toruńska river	35,2
Różany Strumień	Różany Stream	10,1
Kampinos	Olszowiecki Channel	20,2
Święty Krzyż	no-name stream	1,3
Roztocze	Świerszcz stream	46,5
Szymbark	Bystrzanka stream	13,0
Karkonosze	Wrzosówka stream	93,2

Source: A. Kostrzewski et al., 2014

This action allows elaborating operational indicators based on empirical biophysical data.

Perception of ES approach by pracitioners

The regional conference “Ecosystem services in spatial planning”, June 2017, Poznań

I. Before today's conference, have you ever heard of ecosystem services?

☐ YES Where? .....
When? .....

☐ NO

☐ NO, but I've heard of the benefits from ecosystems for people
Which ones? Please, name three that are the most important from your point of view:
1. .....
2 .....
3. .....

II. Do you think that taking ES into consideration in spatial planning may be of practical importance? Specify this on a scale between 1 and 5:

☐ 1 – no importance ☐ 2 – low importance ☐ 3 – medium importance
☐ 4 – high importance ☐ 5 – very high importance

Why do you think so?

.....

If you think that it has any importance, please give an example of an application from the point of view of your work:

.....

III. To what degree the below barriers may limit the application of the ecosystem services approach in spatial planning? Specify them on a scale between 1 and 5 (1 means "no importance" and 5 – "very high importance"):

Organizational and legal barriers	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Lack of knowledge	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Access to data	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Others – which ones?.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

IV. Are you professionally engaged in spatial planning?

☐ YES, in public administration work ☐ NO
☐ YES, in other work

V. Please indicate at what level you are involved in spatial planning:

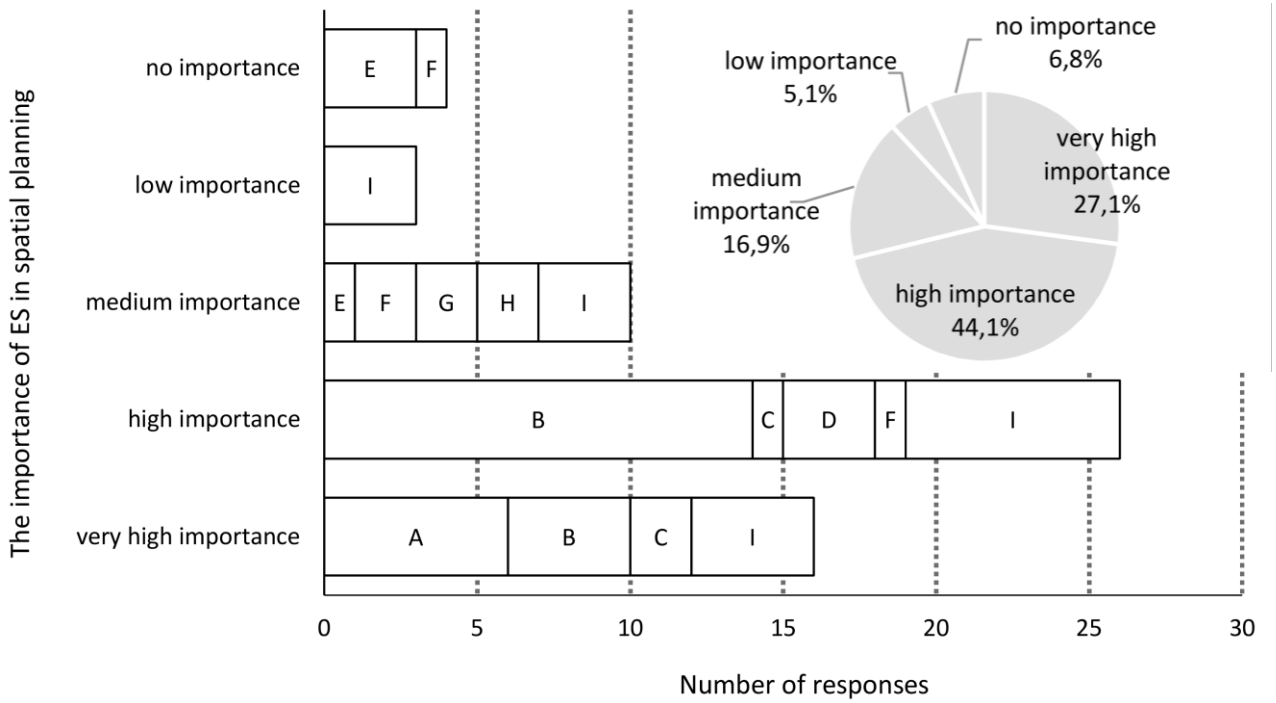
☐ local ☐ regional ☐ national (central)
☐ I don't deal with spatial planning

Source: Department of Integrated Geography, 2017

Perception of ES approach by practicioners

The reasons for the ES implementation

“Do you think that taking ES into consideration in spatial planning may be of practical importance? Why do you think so?”

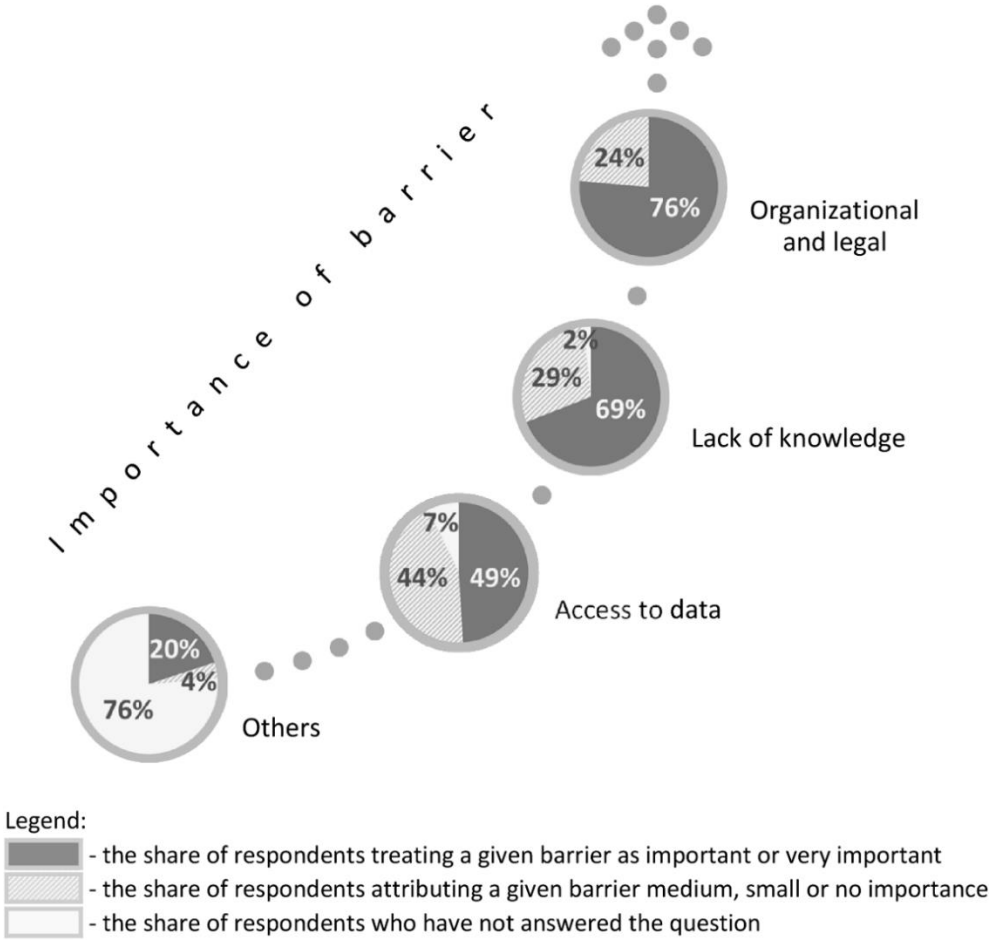


A – supporting sustainable development; B – additional arguments for environmental protection in decision-making process; C – assessment of investment impacts; D – solving conflicts between stakeholders; E – lack of transparent methodology of measuring ES; F – lack of legal regulations; G – lack of knowledge and insufficient education; H – it depends on goals and practices of decision-makers; I – no justification for assessment.

Source: M. Stępniewska et al., Ecosystem Services 33 (2018) 59–67

Perception of ES approach by practicioners

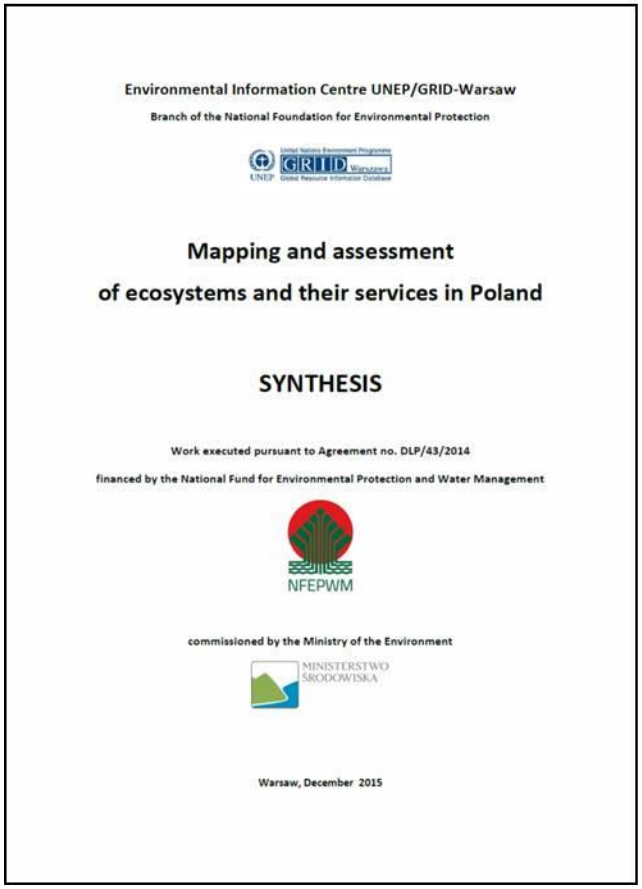
The main barriers for the ES implementation



The arrow indicates the increasing importance of barriers. Source: M. Stępniewska et al., Ecosystem Services 33 (2018) 59–67

Administrative drivers

Expertises commissioned by the Polish Ministry of Environment



Environmental Information Centre UNEP/GRID-Warsaw

Branch of the National Foundation for Environmental Protection

Mapping and assessment of ecosystems and their services in Poland

SYNTHESIS

Work executed pursuant to Agreement no. DLP/43/2014

financed by the National Fund for Environmental Protection and Water Management

NFEPWM

commissioned by the Ministry of the Environment

MINISTERSTWO ŚRODOWISKA

Warsaw, December 2015

„Mapping and assessment of ecosystem services in Poland", 2014 – 2015

The study was commissioned by the Ministry of the Environment according to the agreement No.DLP / 4/2015 of 23 March 2015

MINISTRY OF THE ENVIRONMENT

Urban MAES - Ecosystem Services in Urban Areas

ABSTRACT

from the Department of Integrated Geography, Adam Mickiewicz University, Poznań

UAM

October, 2015

„Urban MAES – Ecosystem Services in Urban Areas" , 2015

Method used

Spatial proxy method – tier 2

Models that relate ES indicators to land cover, abiotic and possibly biotic variables by way of calibrated empirical relationships

MAES Poland – step1

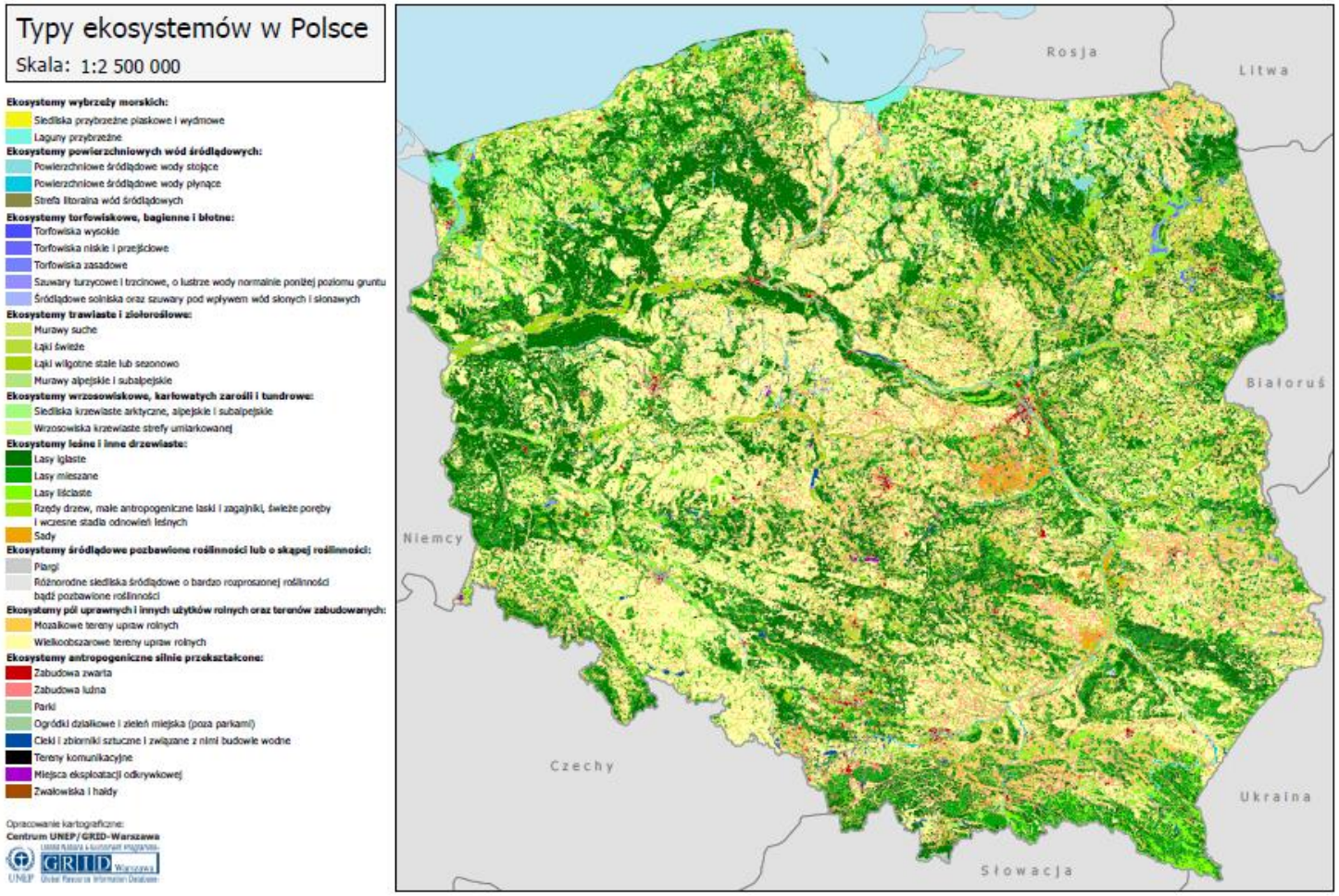
Types of ecosystems occurring in Poland (63 ecosystem types)

No.	BAU CODE	Ecosystem type in Poland CODE (based on EUNIS lev. 2)	Ecosystem type in Poland NAME	EUNIS level 2 CODE	EUNIS level 2 NAME	EUNIS level 3 CODE	EUNIS level 3 NAME	CLC-3 CODE	CLC-3 NAME
1	B1.331	B1	Coastal dunes and sandy shores	B1	Coastal dunes and sandy shores			331	Beaches, dunes, and sand plains
2	C1.512	C1	Surface standing waters	C1	Surface standing waters			512	Water bodies
3	C2.511	C2	Surface running waters	C2	Surface running waters			511	Water courses
4	C3.331	C3	Littoral zone of inland surface waterbodies	C3	Littoral zone of inland surface waterbodies	C3.5	Littoral zone of inland surface running waters	331	Beaches, dunes, and sand plains
5	D1.411	D1	Raised and blanket bogs	D1	Raised and blanket bogs			411	Inland marshes
6	D1.412							412	Peatbogs
7	D2.411	D2	Valley mires, poor fens and transition mires	D2	Valley mires, poor fens and transition mires			411	Inland marshes
8	D2.412							412	Peatbogs
9	D4.411	D4	Base-rich fens and calcareous spring mires	D4	Base-rich fens and calcareous spring mires			411	Inland marshes
10	D4.412							412	Peatbogs
11	D5.411	D5	Sedge and reedbeds, normally without free-standing water	D5	Sedge and reedbeds, normally without free-standing water			411	Inland marshes
12	D5.412							412	Peatbogs

Source: Mapping and assessment of ecosystem services in Poland. Environmental Information Centre UNEP/GRID Warsaw, 2015.

MAES Poland – step2

Delimitation of basic assessment units



Source: Mapping and assessment of ecosystem services in Poland. Environmental Information Centre UNEP/GRID Warsaw, 2015.

MAES Poland – step3

Classification of ecosystem services (34 types)

ES Type	ES Code	Name of ES	ES description	*CICES v.4.3*
Provisioning	Z.1	Nutrition - cultivated crops	Plant outputs s for nutrition	*Nutrition-Biomass-Cultivated crops*
	Z.2	Nutrition - reared animals	Animal outputs for nutrition	*Nutrition-Biomass-Reared animals and their outputs*
	Z.3	Nutrition - wild plants and mushrooms	Natural plant outputs for nutrition - berries, mushrooms, edible plants	*Nutrition-Biomass-Wild plants, algae and their outputs*
	Z.4	Nutrition - wild animals	Natural animal outputs for nutrition: game hunting (venison), fishing (wild fish), wild bees (honey from wild beehives)	*Nutrition-Biomass-Wild animals and their outputs*
	Z.5	Nutrition - fish from aquaculture	Natural animal outputs for nutrition: fish from aquaculture	*Nutrition-Biomass-Animals from in-situ aquaculture*
	Z.6	Biomass- based energy resources (biofuels - excluding fuel timber)	Plant-based energy resources - energy plants, straw, plant byproducts and plant waste (excluding fuel timber and peat)	*Energy-Biomass-based energy sources- Plant-based resources*
	Z.7	Biomass-based energy resources. Production of fuel timber	Timber for generating energy (incl. heat)	*Energy-Biomass-based energy sources- Plant-based resources*
	Z.8	Organic resources (materials) - production of fodder	Fodder for reared animals	*Materials – Biomass-Materials from plants, algae and animals for agricultural use*

Source: Mapping and assessment of ecosystem services in Poland. Environmental Information Centre UNEP/GRID Warsaw, 2015.

MAES Poland – step4

Matrix of ecosystem services

KOD USŁUGI / KOD BAU	Z.1	Z.2	Z.3	Z.4	Z.5	Z.6	Z.7	Z.8	Z.9	Z.10	Z.11	Z.12	Z.13	Z.14	R.1	R.2	R.3	R.4	R.5	R.6	R.7	R.8	R.9	R.10	R.11	R.12	R.13	R.14	R.15	K.1	K.2	K.3	K.4	K.5
B1.331	0	0	0	0	0	0	0	0	0	0	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	4	1	3	0	5
C1.512	0	3	0	5	5	2	0	1	1	0	1	5	0	0	1	3	0	5	1	3	0	3	0	0	nd	4	5	5	3	5	4	3	0	4
C2.511	0	2	0	3	0	1	0	1	1	0	1	5	5	0	0	3	0	5	3	2	0	2	0	0	nd	3	5	5	4	4	4	3	0	4
C3.331	0	0	0	1	0	1	0	0	0	0	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	4	4	3	0	4
D1.411	0	0	0	2	0	0	0	1	0	0	4	0	2	0	1	0	3	5	1	1	2	3	1	0	2	5	5	5	4	4	4	4	0	5
D1.412	0	0	1	2	0	0	0	1	0	0	4	0	3	0	1	0	3	5	1	1	2	3	1	0	2	5	5	5	4	4	4	4	0	5
D2.411	0	1	0	2	0	1	0	2	0	0	5	0	3	0	2	0	3	5	1	2	5	5	2	0	3	5	5	5	4	4	3	3	0	5
D2.412	0	0	0	2	0	1	0	2	0	0	5	0	5	0	2	0	3	5	1	2	5	5	2	0	3	5	5	5	4	4	3	3	0	5
D4.411	0	1	0	2	0	1	0	2	0	0	5	0	3	0	2	0	3	5	1	2	5	5	2	0	4	5	5	5	4	4	3	3	0	5
D4.412	0	0	0	2	0	1	0	2	0	0	5	0	5	0	2	0	3	5	1	2	5	5	2	0	4	5	5	5	4	4	3	3	0	5
D5.411	0	0	0	2	0	0	0	2	0	0	2	0	1	0	1	0	3	5	2	2	5	4	1	0	2	5	5	5	3	4	4	4	0	5
D5.412	0	0	0	2	0	1	0	2	0	0	2	0	5	0	1	0	3	5	2	2	5	4	1	0	4	5	5	5	3	4	4	4	0	5
D6.231	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	1	2	0	0	2	1	3	0	1	1	1	2	4	3	2	2	0	4
D6.411	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	2	3	2	1	5	3	1	0	1	5	5	5	3	5	2	2	0	5
E1.321	0	1	1	2	0	0	0	3	0	0	1	0	3	4	0	0	1	1	2	2	1	3	4	1	1	3	5	1	2	4	4	4	0	4
E1.333	0	0	0	1	0	0	0	0	0	0	1	0	3	4	0	0	1	1	2	1	0	1	1	0	2	1	0	0	1	1	1	1	0	0
E2.231	0	5	1	3	0	1	0	5	5	0	2	0	0	0	3	1	2	3	1	3	3	1	4	2	3	2	1	3	5	1	4	3	1	0
E3.231	0	3	1	3	0	1	0	3	3	0	3	0	0	0	3	0	2	3	1	2	4	5	5	2	3	3	2	4	4	3	3	3	3	3
E4.321	0	2	1	1	0	0	0	4	4	0	2	0	0	0	1	0	1	1	0	1	1	3	3	2	1	2	5	1	2	3	3	4	0	5

Source: Mapping and assessment of ecosystem services in Poland. Environmental Information Centre UNEP/GRID Warsaw, 2015.

MAES Poland – step5

Detailed analyses

A. Indicators – provisioning services

ES Code	Name of ES	Description of ES	Indicators of potential to deliver service (avg. values according to multi-annual data) (physical and/or conversion units)	Indicators of production and supply of goods and services in a given year or period (physical and/or conversion units)
Z.1	Nutrition - cultivated crops	Plant outputs s for nutrition	Surface and structure of arable lands (ha, %), area and structure of crops (ha, %), multi-annual average yield and harvest (kg and t/ha). Qualitative parameters: soil bonitation, soil-agri complexes, valorisation of agricultural production space.	Primary production - yield (t/ha), crops (t). Global indicators recalculated to an area unit: physical (ha) or conversion (conversion ha).
Z.2	Nutrition - reared animals	Animal outputs for nutrition	Head count and density in physical and conversion units (n/ha, SD/ha)	Production of meat, milk, eggs, production "en course" - growth of herd. Purchase and commercial slaughter, self-supply, captured fish (t, thous. l, kg/ha/year). Global indicators recalculated to an area unit: physical or conversion.
Z.3	Nutrition - wild plants and mushrooms	Natural plant outputs for nutrition - berries, mushrooms, edible plants	Available amount of forest undergrowth - the so-called non-timber forest outputs (kg/ha, thous. PLN)	Collected and/or purchased forest undergrowth products (kg/ha/year, t/ha/year, thous. PLN)
Z.4	Nutrition - wild animals	Natural animal outputs for nutrition: game hunting	Area of water (habitat), fish stock (t, thous., ha, km^2, n/ha, kg/ha, thous. PLN)	Caught fish, venison, honey harvest (kg/ha/year, t/ha/year, thous. PLN)

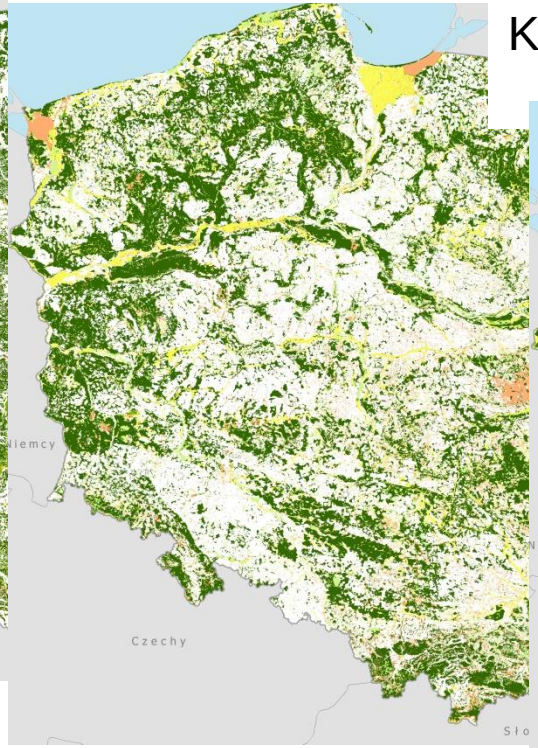
Source: Mapping and assessment of ecosystem services in Poland. Environmental Information Centre UNEP/GRID Warsaw, 2015.

MAES Poland – step6

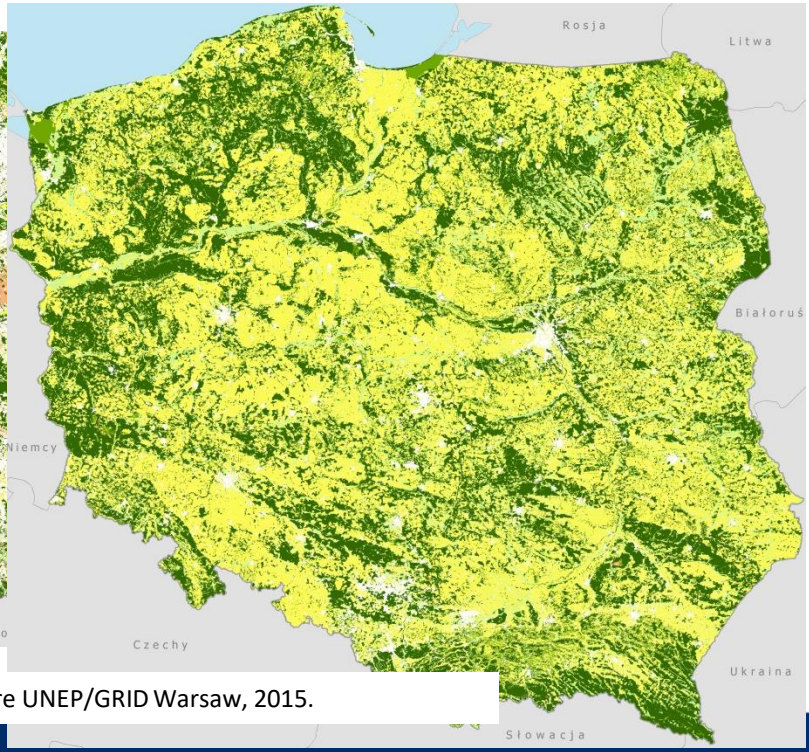
Analyses of ecosystem state and connectivity

Z1. Nutrition - cultivated crops

R2. Shaping local climate



K3. Education and scientific research



Source: Mapping and assessment of ecosystem services in Poland. Environmental Information Centre UNEP/GRID Warsaw, 2015.

URBAN MAES for Poland

Stage 1

- Metodological approach to analyse ecosystem services on urban areas in Poland in relation to green infrastructure concept;
- Classification of ecosystems and ecosystem services on urban areas;
- Identification of data spatial scale impact on ecosystem services assessment – Poznań Agglomeration case study.

Stage 2

- Comparison of spatial distribution of ecosystem services in 10 Metropolitan Areas of Poland;
- Recommendation for implementing ecosystem services concept in local and subregional planning documents:
  - studies of condition and direction of spatial development,
  - local spatial plans,
  - plans of urban functional areas of voivodeships.

Ecosystem services in cities

The EU's biodiversity strategy up to 2020.

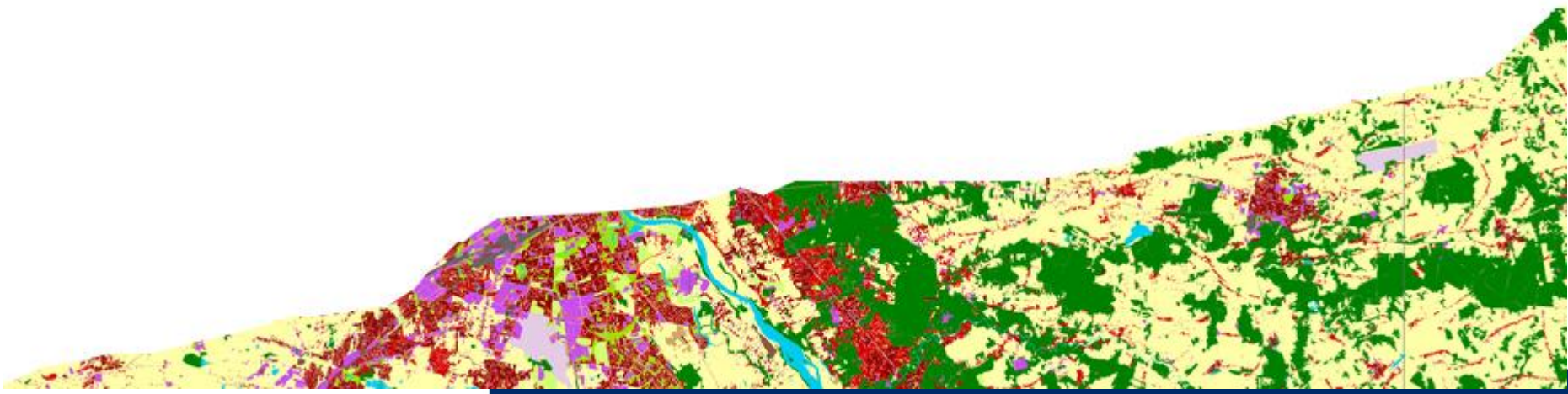
- *Ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems.*

The National Urban Policy 2023, October 2015.

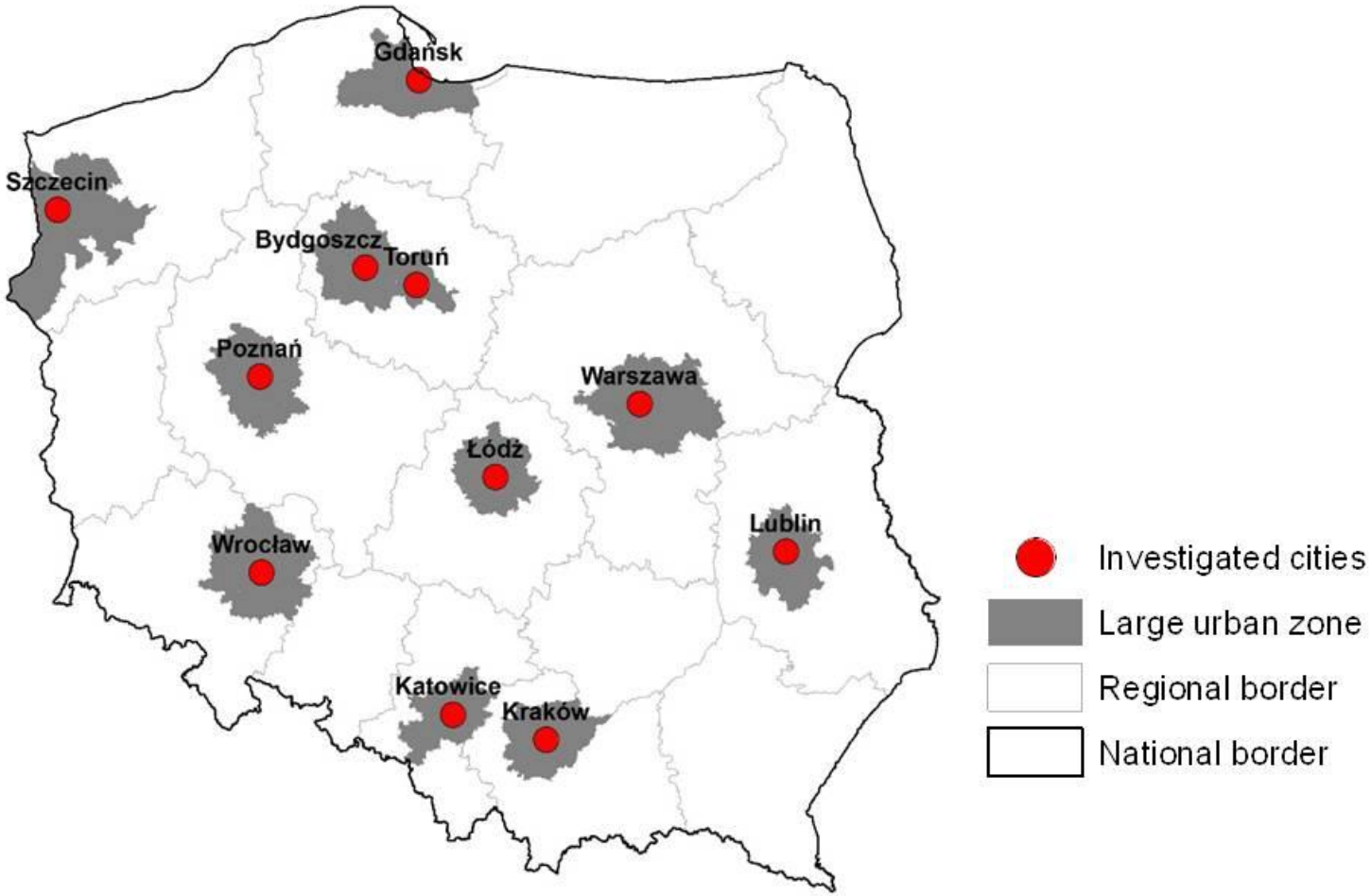
- *Forming urban space should be carried out taking into account the importance of green areas, affecting the microclimate and slowing stormwater runoff from sealed surfaces.*
- *It is important to stop pressure on biologically active areas in the cities and improve availability of green infrastructure for urban residents.*

Land use/land cover data

- Urban Atlas
  http://www.eea.europa.eu/data-and-maps/data/urban-atlas
  The European Urban Atlas is part of the local component of the GMES/Copernicus land monitoring services. It provides land use maps for 305 Large Urban Zones and their surroundings (more than 100.000 inhabitants as defined by the Urban Audit).
- Corine Land Cover 2012
  http://land.copernicus.eu/pan-european/corine-land-cover/clc-2012



Larger Urban Zones (LUZ) in Poland



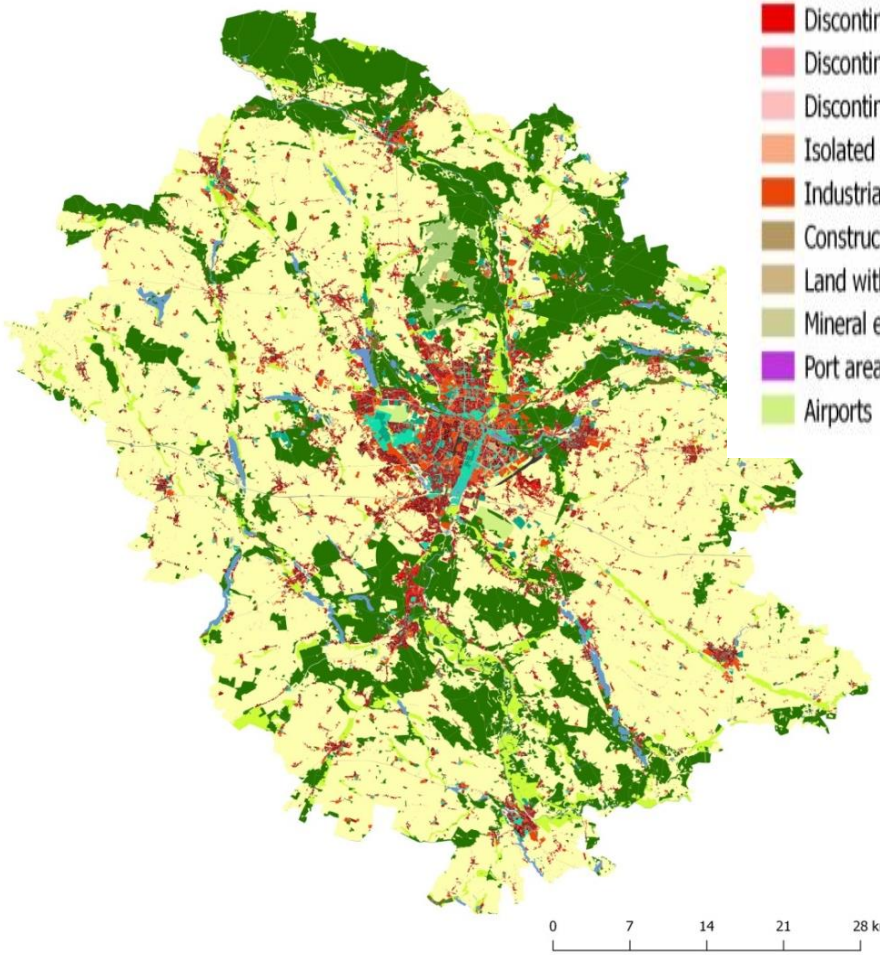
Urban MAES - Ecosystem Services in Urban Areas, Department of Integrated Geography, Adam Mickiewicz University in Poznań, unpublished.

Main characteristics of the LUZ

Larger Urban Zones	Total area [thous. sq. km]	Population in 2015 [mln. inhabitants]
Wrocław	4,6	1,1
Szczecin	**6,0**	0,8
Gdańsk-Sopot-Gdynia	3,3	1,2
Poznań	3,7	1,1
Bydgoszcz-Toruń	4,8	0,9
Łódź	2,9	1,1
Warszawa	5,2	**2,9**
Katowice	**2,6**	2,6
Kraków	3,0	1,3
Lublin	2,9	**0,6**
Sum	39,0	13,5
Poland	312,7	38,4
% of Poland	12,5	35,2

Urban MAES - Ecosystem Services in Urban Areas, Department of Integrated Geography, Adam Mickiewicz University in Poznań, unpublished.

The example of ecosystem mapping for Poznan



- Continuous Urban Fabric (S.L. > 80%)
- Discontinuous Dense Urban Fabric (S.L. : 50% - 80%)
- Discontinuous Medium Density Urban Fabric (S.L. : 30% - 50%)
- Discontinuous Low Density Urban Fabric (S.L. : 10% - 30%)
- Discontinuous Very Low Density Urban Fabric (S.L. < 10%)
- Isolated Structures
- Industrial, commercial, public, military and private units
- Construction sites
- Land without current use
- Mineral extraction and dump sites
- Port areas
- Airports
- Railways and associated land
- Fast transit roads and associated land
- Other roads and associated land
- Green urban areas
- Sports and leisure facilities
- Meadows and pastures
- Natural grasslands
- Inland wetlands
- Beaches, dunes, sand
- Agricultural + Semi-natural areas
- Forests
- Water bodies

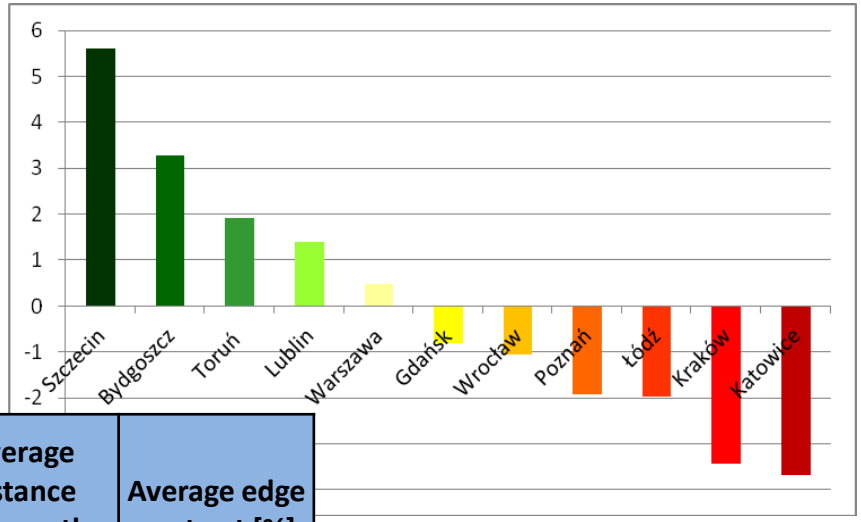
Urban MAES - Ecosystem Services in Urban Areas, Department of Integrated Geography, Adam Mickiewicz University in Poznań, unpublished.

Selected types of ecosystem services in cities

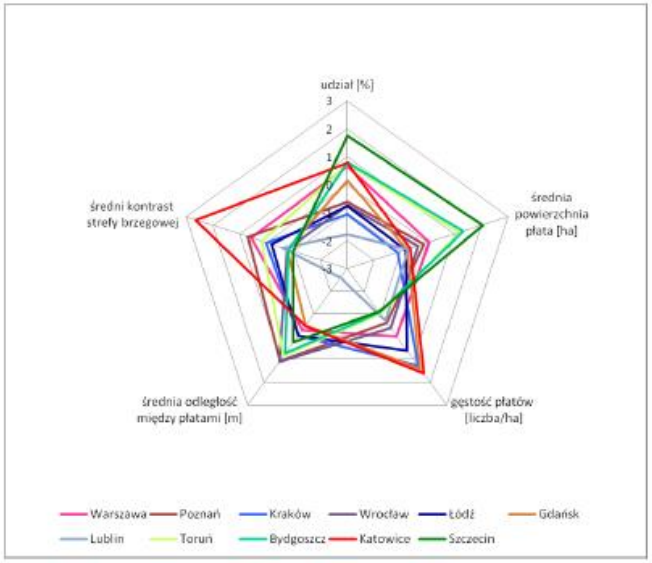
Ecosystem service according to CICES v4.3	Indicator	Units	Data sources
Regulating rain water runoff	Share of sealed surface	[%]	Urban Atlas, literature
Local climate regulation	Radiation temperature	[^{0}C]	LANDSAT TM, literature
Physical use for recreation	Part of dense built-up (housing) areas adjacent to green infrastructure	[m]	Urban Atlas, literature
Supporting material flow (valley retention, mitigation of rising wave)	Share of green infrastructure in zones in danger of floods	[%]	Urban Atlas, National Water Management Authority
Biogeochemical barrier	Share of some types of land cover based on their location in relation to the water bodies (matrix)	[%]	Urban Atlas, literature

Urban MAES - Ecosystem Services in Urban Areas, Department of Integrated Geography, Adam Mickiewicz University in Poznań, unpublished.

The spatial structure of green infrastructure



Agglomeration	Share of GI [%]	Average patch area [ha]	Patch density [amount/ha]	Average distance between the patches[m]	Average edge contrast [%]
Lublin	**19,42**	42,92	0,45	**42,92**	38,48
Kraków	25,75	**29,97**	0,86	192,1	43,51
Łódź	28,42	39,33	0,72	191,92	41,87
Wrocław	28,55	55,13	0,52	**259,19**	37
Poznań	29,51	62,65	0,47	256,49	49,3
Gdańsk-Sopot-Gdynia	36,25	40,94	0,89	166,11	36,92
Warszawa	40,81	69,19	0,59	177,02	48,39
Toruń	41,43	106,5	0,39	243,98	44,93
Katowice	41,82	45,03	**0,93**	166,92	**65,77**
Bydgoszcz	42,08	111,29	0,38	237,42	36,6
Szczecin	**50,33**	**135,42**	**0,37**	209,45	**35,21**



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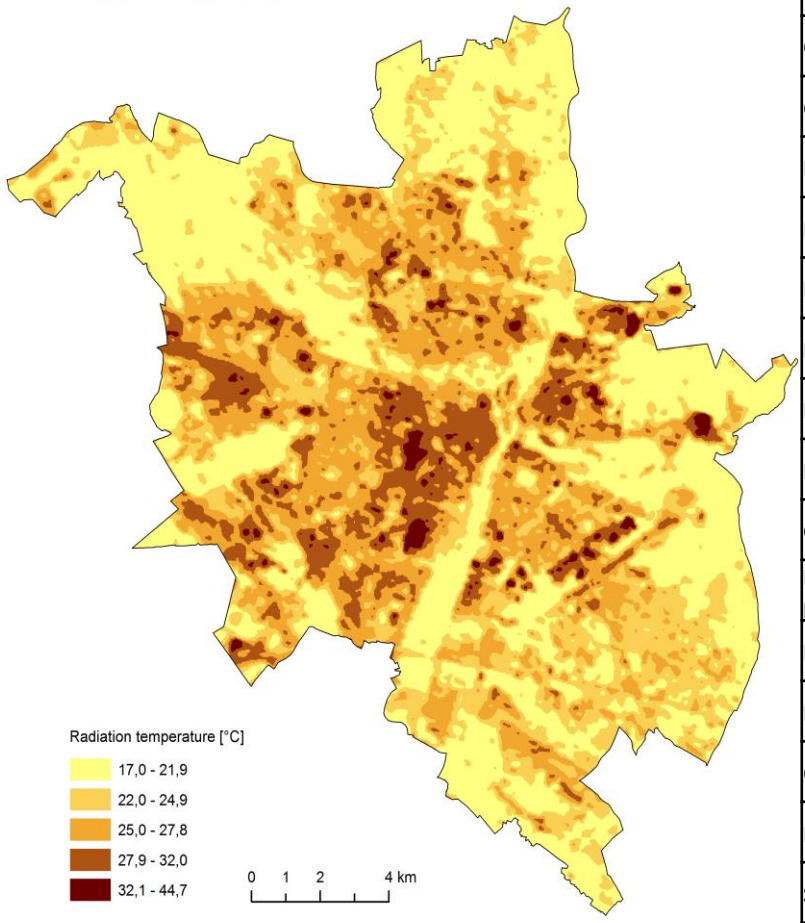
The diversity of radiation temperature



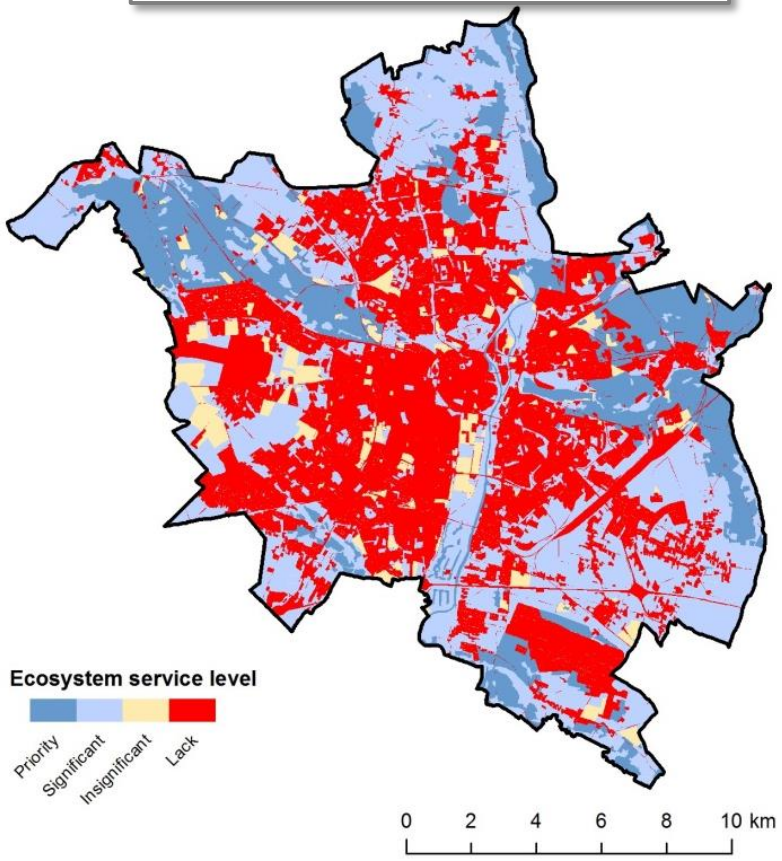
Source: Landsat TM, June 2010

Land use	Min_T	Max_T	Ave_T	SD_T
Agricultural + Semi-natural areas	17.4	37.5	23.0	2.3
Airports	23.2	32.8	28.2	2.1
Construction sites.	20.5	32.0	25.5	2.2
Continuous Urban fabric (S.L. > 80%).	19.2	35.5	27.3	2.1
Discontinuous Urban Fabric (S.L.: 50% - 80%)	18.3	33.2	25.6	1.9
Discontinuous Urban Fabric (S.L.: 10% - 30%)	18.3	30.7	23.9	1.9
Discontinuous Urban Fabric (S.L.: 30% - 50%)	18.3	27.8	23.2	1.7
Discontinuous Urban Fabric (S.L.: <10%)	20.1	21.0	21.5	0.4
Fast transit roads and associated land	20.5	31.1	25.5	1.8
Forests	17.0	37.5	20.8	2.0
Green urban areas	17.4	34.0	23.8	2.6
Industrial, commercial, public, military and private units, roads and associated land	17.9	44.7	27.5	3.4
Isolated structures	18.3	31.1	22.4	1.9
Mineral extraction and dump sites	19.7	31.5	24.6	3.1
Other roads and associated land	17.4	41.7	25.7	3.0
Railways and associated land	18.3	35.9	25.6	3,0
Sports and leisure facilities	18,3	32,8	24,6	2,3
Water bodies	17,0	32,0	20,8	2,2

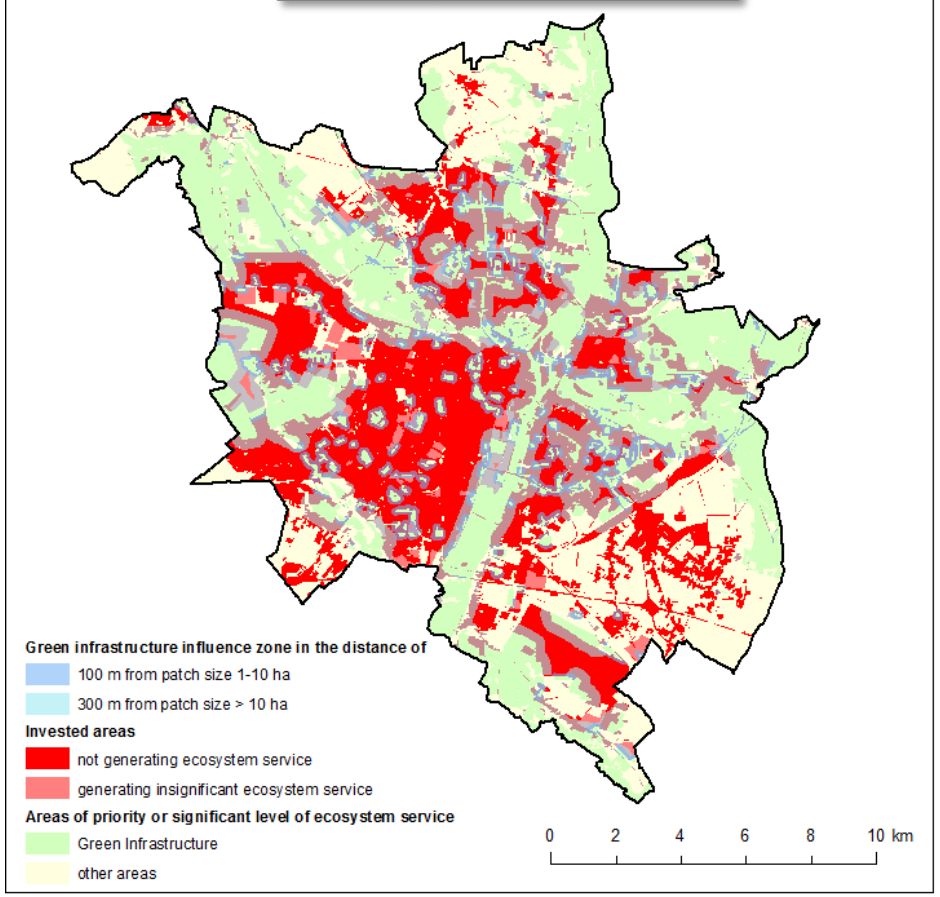
Łowicki, Lupa 2014. Department of Integrated Geography, Adam Mickiewicz University in Poznań, unpublished.

Mitigation of urban heat island effect

Level of ecosystem services



Cooling effect of GI



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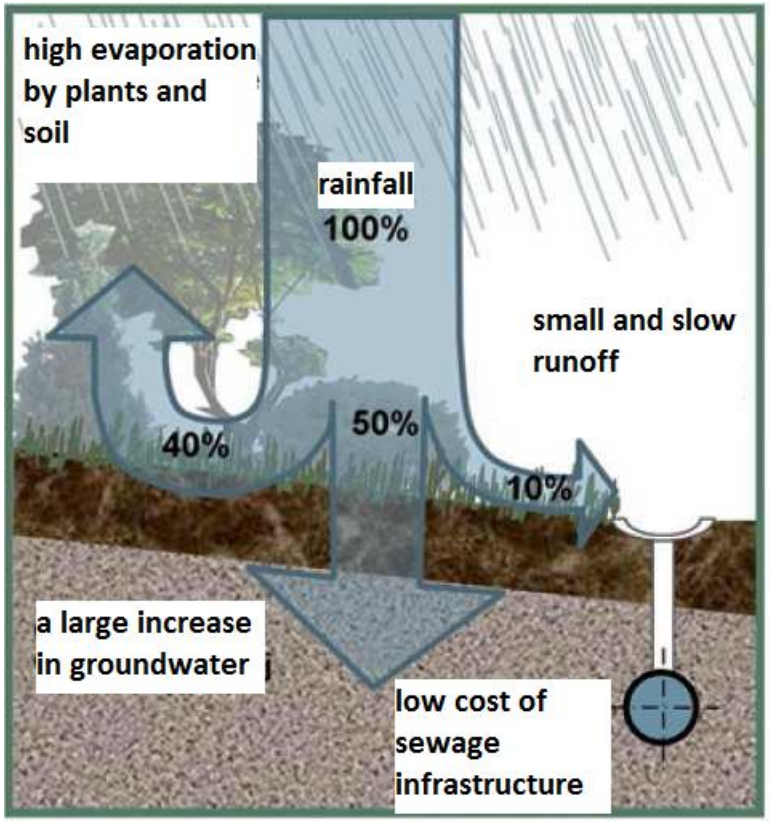
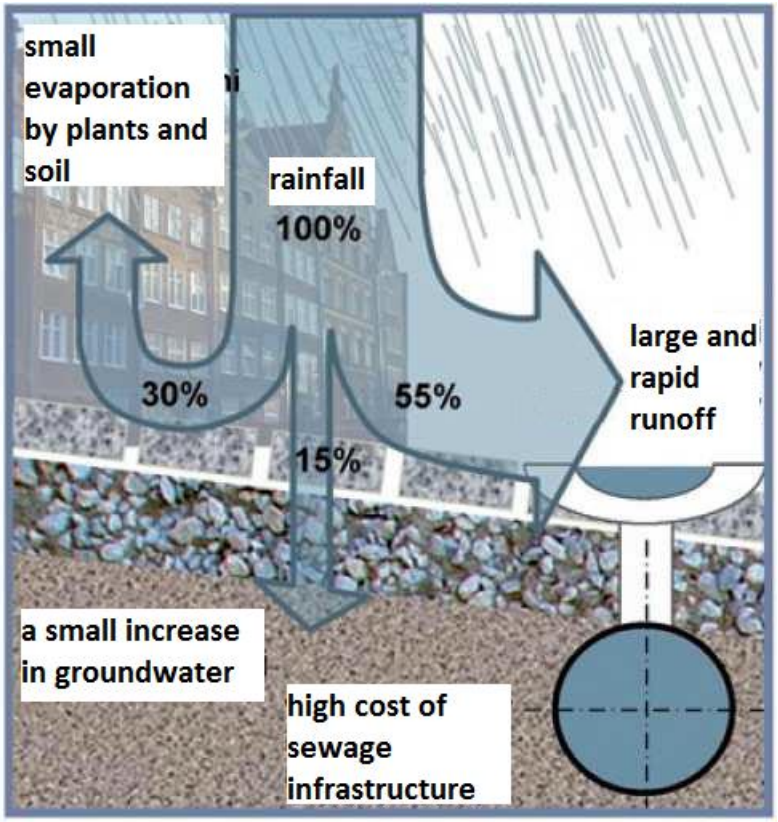
Infiltration of water



UNSEALED SURFACE

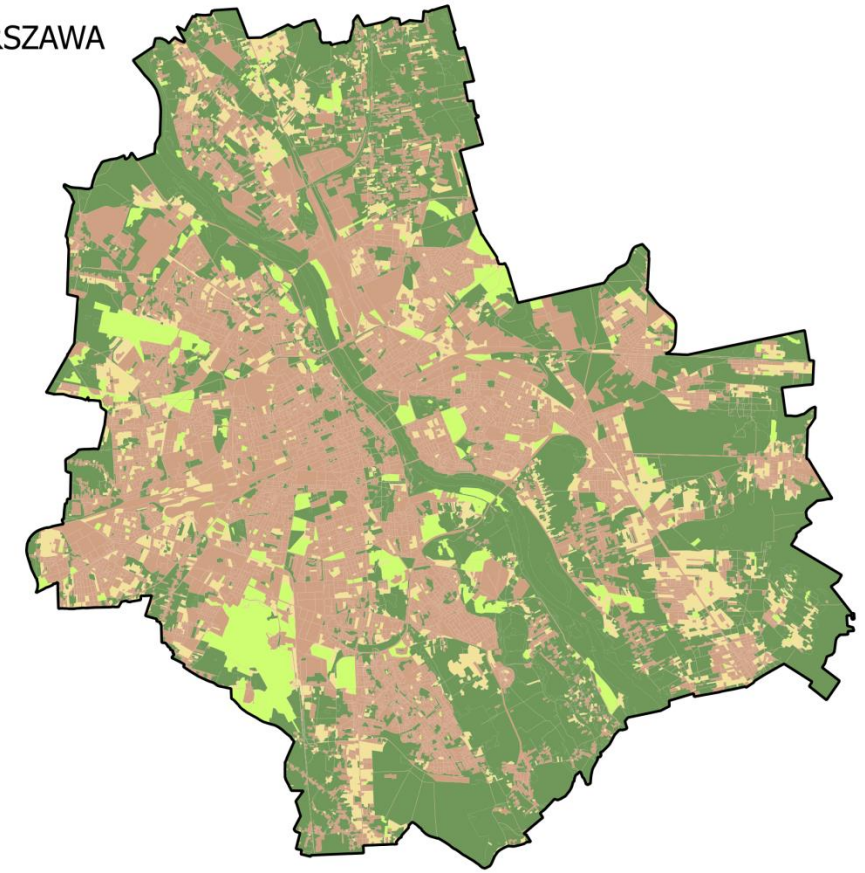


SEALED SURFACE

Source: Januchta-Szostak (2012)

Rainwater capturing

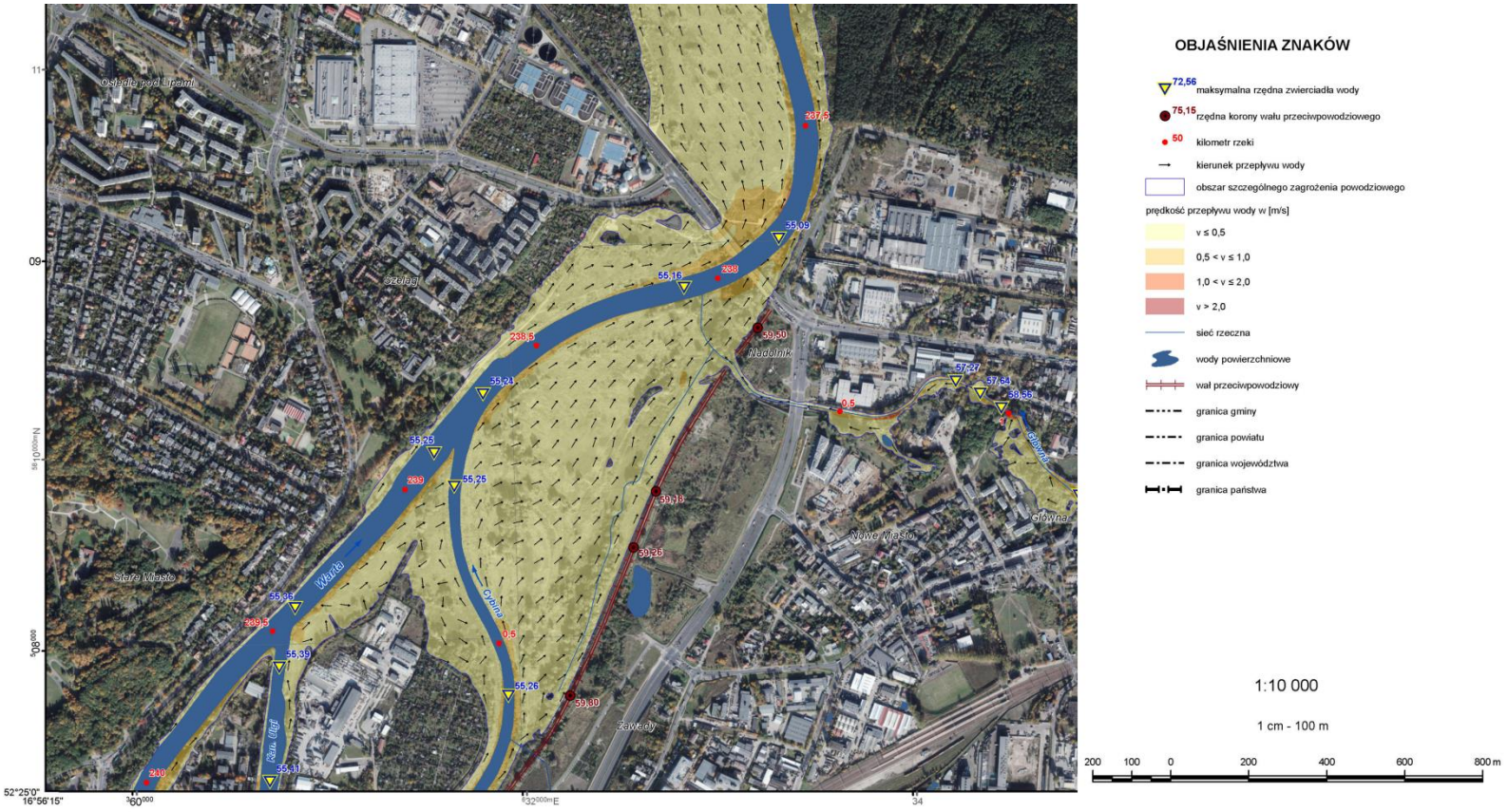
Service levels	Land use types
Priority	water bodies, forests, agricultural + semi-natural areas, wetlands , green urban areas, very low discontinuous density urban fabric (S.L.: <10%)
Important	Discontinuous low and medium density Uurban fabric (S.L.: 10% - 50%), sports and leisure facilities, mineral extraction and dump sites, airports
Slight	Construction sites, discontinuous dense urban fabric (S.L.: 50% - 80%), land without current use
Lack	Continuous urban fabric (S.L. > 80%), Industrial, commercial, public, military and private units, roads and associated land, railways and associated land



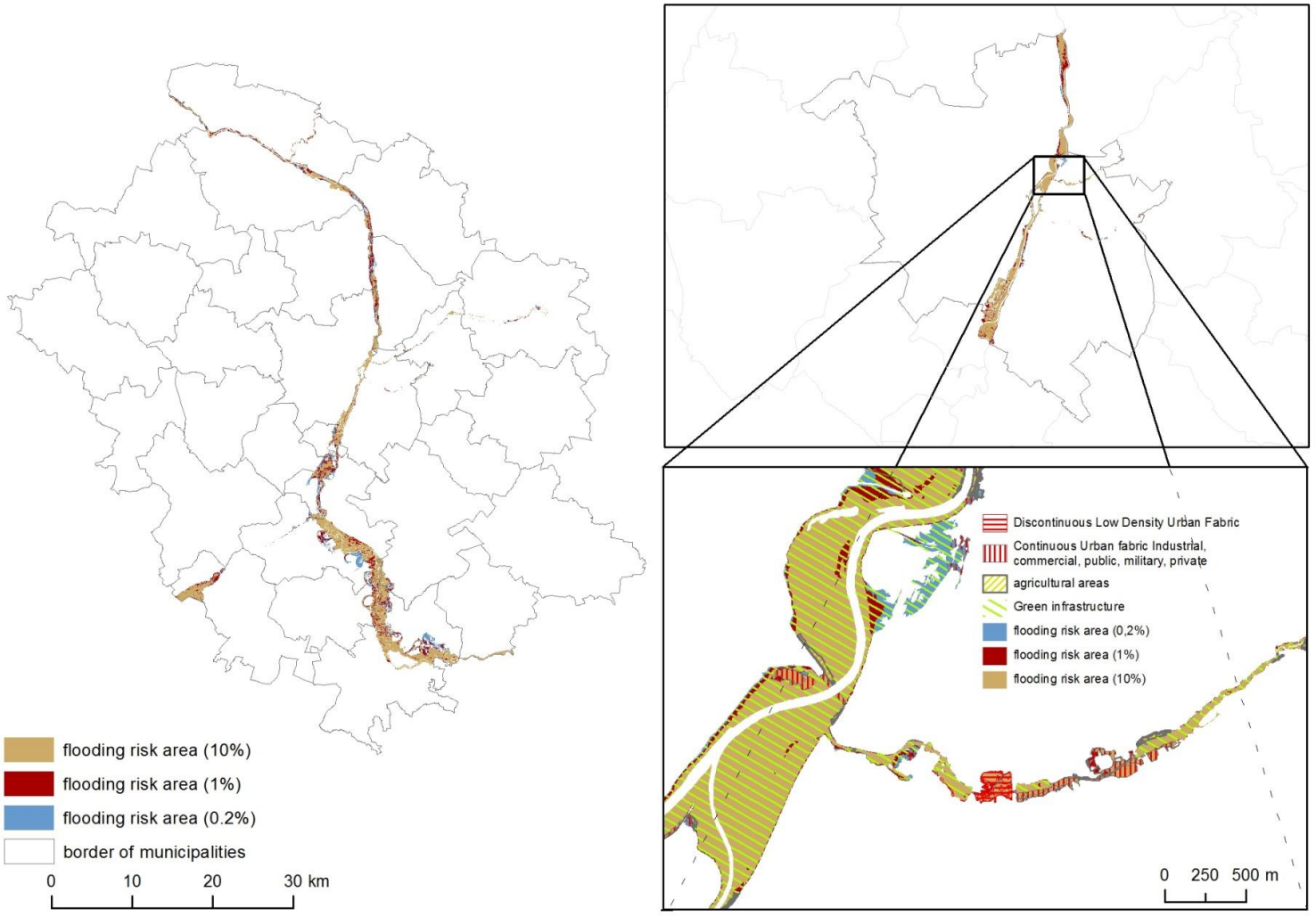
Mitigation of flooding

Flood risk/threat maps (vector datasets)

Resources of the National Water Management Authority (Poland)
http://mapy.isok.gov.pl/imap/ - open access only for maps in PDF format



Mitigation of flooding



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Biogeochemical barrier

Literature review to set analysis criteria.

Selection of land use types that have priority and significant level of potential to supply ES: the individual land use types were allocated with the level of ecosystem services: P – priority, I – significant, N – insignificant, B – lack.

Grouping the land cover patches taking into account distance to water bodies and watercourses (contact with water bodies or lack of contact with water bodies) and location in/out flood zones - GIS spatial analysis.

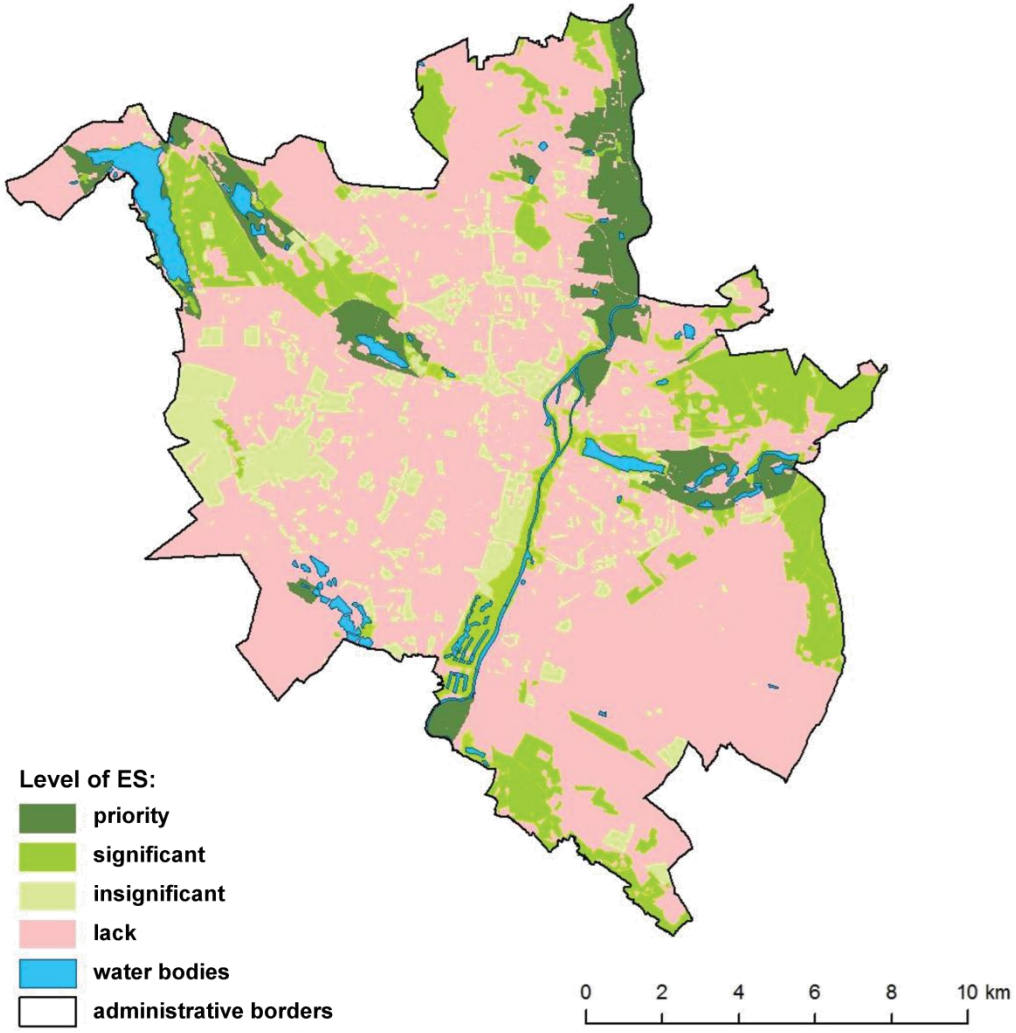
Assigning the above mentioned “levels of potential to supply ES” to land cover patches in given research area (GIS spatial analysis).

Visualization of areas of different potential to supply analysed ES and calculation of their share in given research area.

The capacity to deliver service of biogeochemical barrier

LEVEL OF ES	LAND COVER TYPE	LOCATION
PRIORITY	Forests, natural grassland and pastures, wetlands	Areas directly adjacent to the water and located in flood risk zones
SIGNIFICANT	Forests, natural grassland and pastures, wetlands	On other areas
	Green urban areas, sports and leisure facilities	Areas immediately adjacent to the water and located in flood risk zones
INSIGNIFICANT	Green urban areas, sports and leisure facilities	On other areas
LACK	Continuous urban fabric, agricultural, semi-natural areas, industrial and commercial units, etc.	

Spatial distribution of ecosystems potential to filtration of surface pollution in Poznan



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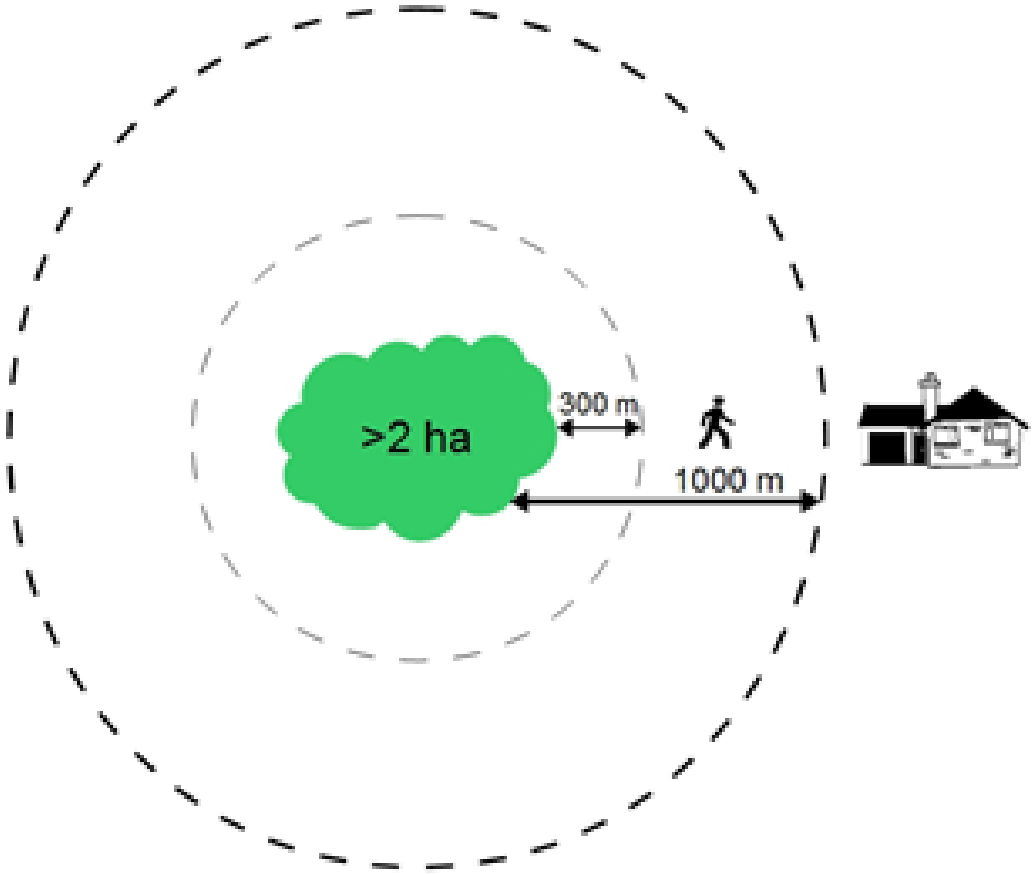
The physical use for recreation



Criteria:

Surface
The area of green infrastructure> 2 ha

Distance
The distance to the green infrastructure
1 km = 15 minutes walking route
300m = 5-6 min walking route

Piece of green infrastructure

Distance from built-up areas

Protection of ecosystem services

Protection Areas / Protected values and associated ecosystem services	Natura 2000	National Park	Reserve	Landscape Park	Area of protected landscape	Ecological ground	Nature-landscape complex	Documentation site	Nature monument
Environmental value *Maintaining nursery populations and habitats*									
Cultural value *Cultural Heritage*									
Historical value *Cultural Heritage*									
Landscape and aestetic value *Aestetic Services*									
Turism and recreation *Physical use for recreation*									
Educational values *Education Service*									
Scientific value *Science Service*									
Total number	1	5	4	5	3	1	1	2	5

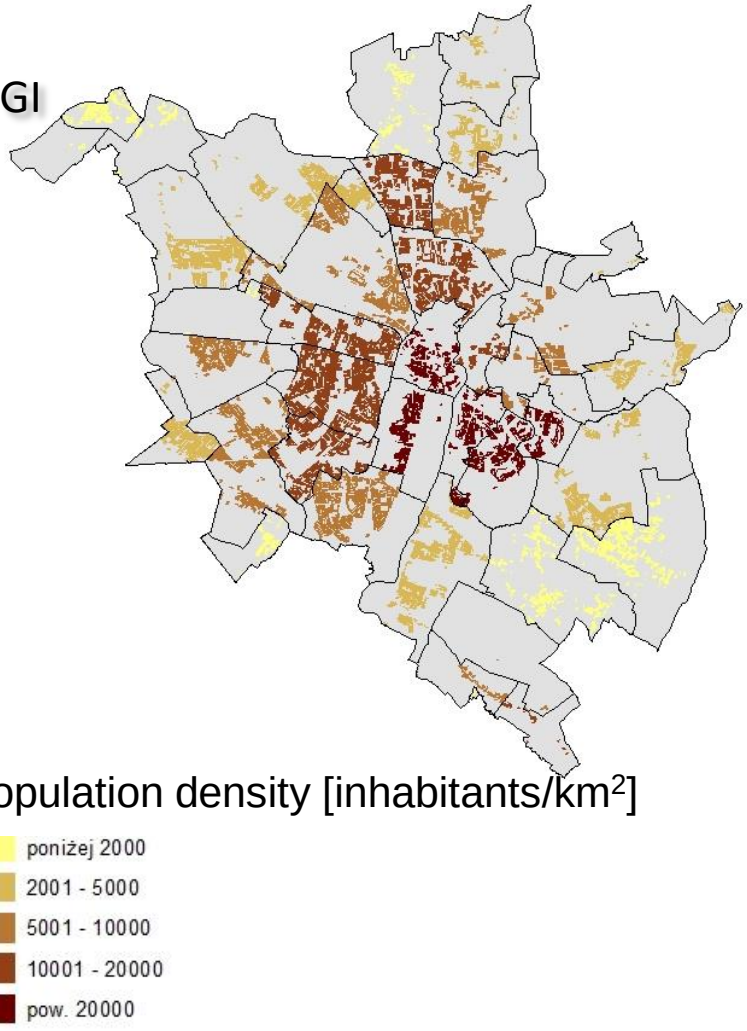
Protected ecosystem services directly indirectly

Demand for ecosystem services

Indicators proposal :

- Population density
- The share of inhabitans living to far to GI
- Areas threatened by flooding
- Air pollution.

City	Population	Population density [number/km^2]
Warszawa	1735442	3359
Kraków	761873	2334
Łódź	706004	2411
Wrocław	634487	2169
Poznań	545680	2085
Gdańsk	461489	1764
Szczecin	407180	1354
Bydgoszcz	357652	2035
Lublin	341722	2317
Katowice	301834	1835
Gdynia	247820	1836
Toruń	203158	1758



Share of dense settlement to far to GI

City	Share of dense settlement [%]	
	Distance 300-1000 m	Distance > 1000 m
Łódź	38	0,9
Warszawa	29	0,8
Wrocław	27,9	0,4
Poznań	26,4	4,3
Miasta Konurbacji Górnośląskiej	25,5	0,9
Bydgoszcz	22,9	0
Lublin	21,2	2,2
Kraków	20,6	0,2
Trójmiasto	19,9	0,2
Szczecin	18,8	0
Toruń	17	1,3

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Lublin	21,2	2,2
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Trójmiasto	19,9	0,2
Szczecin	18,8	0
Toruń	17	1,3

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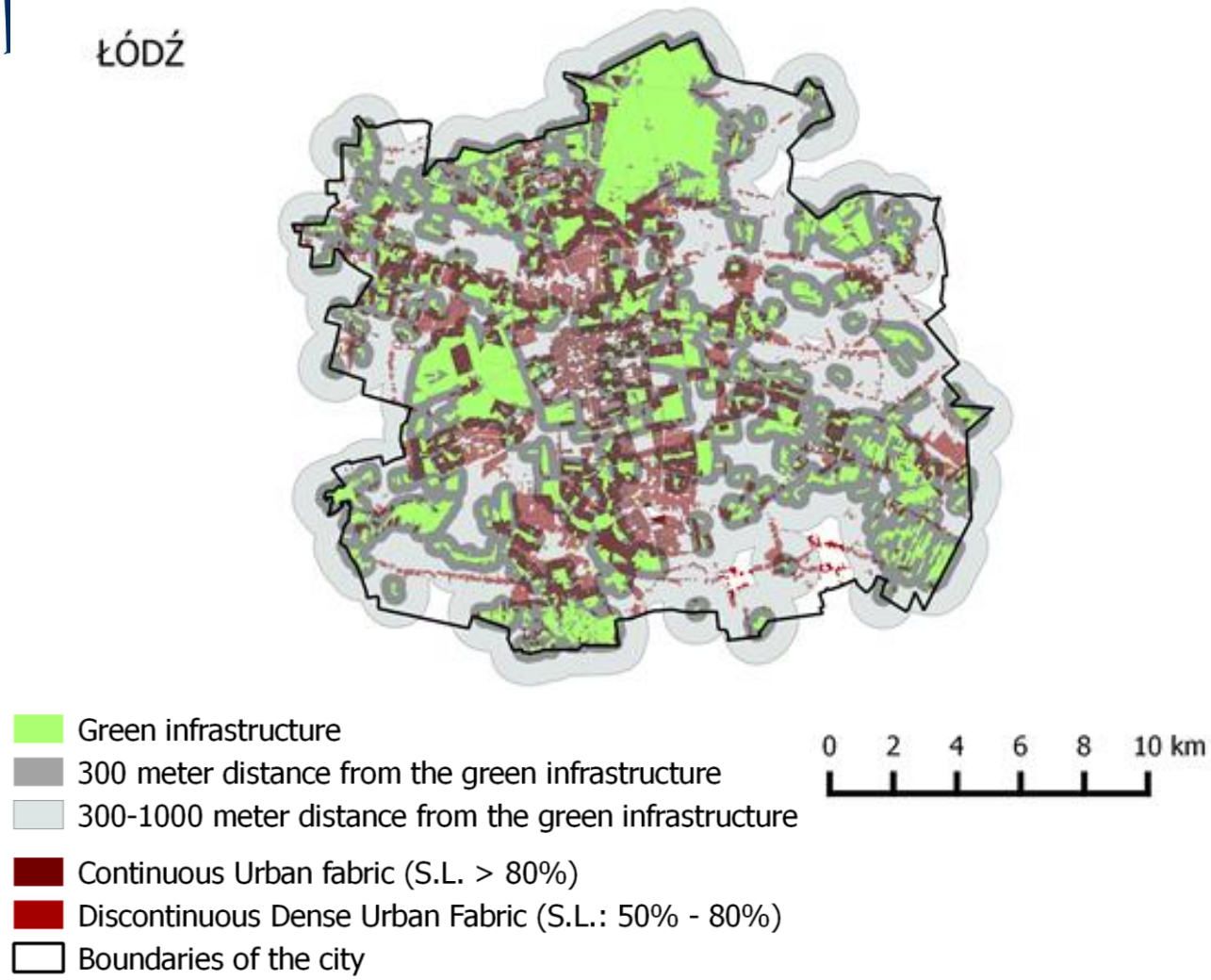
Availability of ecosystem services



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Comparison of agglomeration

- **Abundance of green infrastructure**
  - the most rich in green infrastructure is the agglomeration of Szczecin (> 50%), and the poorest is Lublin (<20%);
- **Mitigation of urban heat island effect**
  - in Szczecin nearly half of the city's ecosystems have a priority level of service. At the other side are Kraków, Wrocław and Łódź, where the percentage of such ecosystem ranges of about 10%;
  - 2/3 of the Łódź highly invested areas lies outside the impact zone GI local climate, while most preferred is the indicator in Torun, where less than 40%.
- **Rainwater capturing**
  - the share of sealed areas ranges from about 25% in Szczecin to about 45% in Warsaw;
  - more important is the spatial differentiation in the structure of the sealed area of the city.
- **Reduction of flood wave**
  - in Szczecin, Wrocław, Toruń there is 10-17% of the area at risk of flood, in Łódź and Katowice less than 1%.
- **Availability of green infrastructure**
  - within a 300 meters from the green infrastructure (patch size. > 2ha) is 61% of dense development in Łódź, 70% in Warsaw,> 80% in Tri-City, Szczecin and Toruń;
  - more than 95% of dense development is within 1 km from the green infrastructure in all analysed cities.

Implementation of the concept in planning documents

1. Protection and minimalization of pressures on ecosystems

2. Improving the condition of ecosystems and increasing level of ecosystem services

3. Improving access to ecosystem services

Conclusions

1. The process of the uptake of ES approach in Poland is growing gradually.
2. The ES uptake is driven mainly by scientific drivers, as well as international and national. Administrative drivers are not enough.
3. With regard to the scientists, the most important stimulus are large international research projects. Stimulus and efforts from the European Union are of mobilising importance for the administration.
4. There is deficit in knowledge on the practical way of using of ES approach at a regional and local level.

Conclusions

6. There is a need to urgently undertake actions such as implementation of effective procedures (administrative, legal, technical) of exchange and sharing of data for the benefit of a wide range of recipients.

7. There is a need to involve the stakeholders into the planning process.

8. The biophysical methods used in Poland strongly dominate. The social and economic methods should be developed.

Thank you for your attention

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