

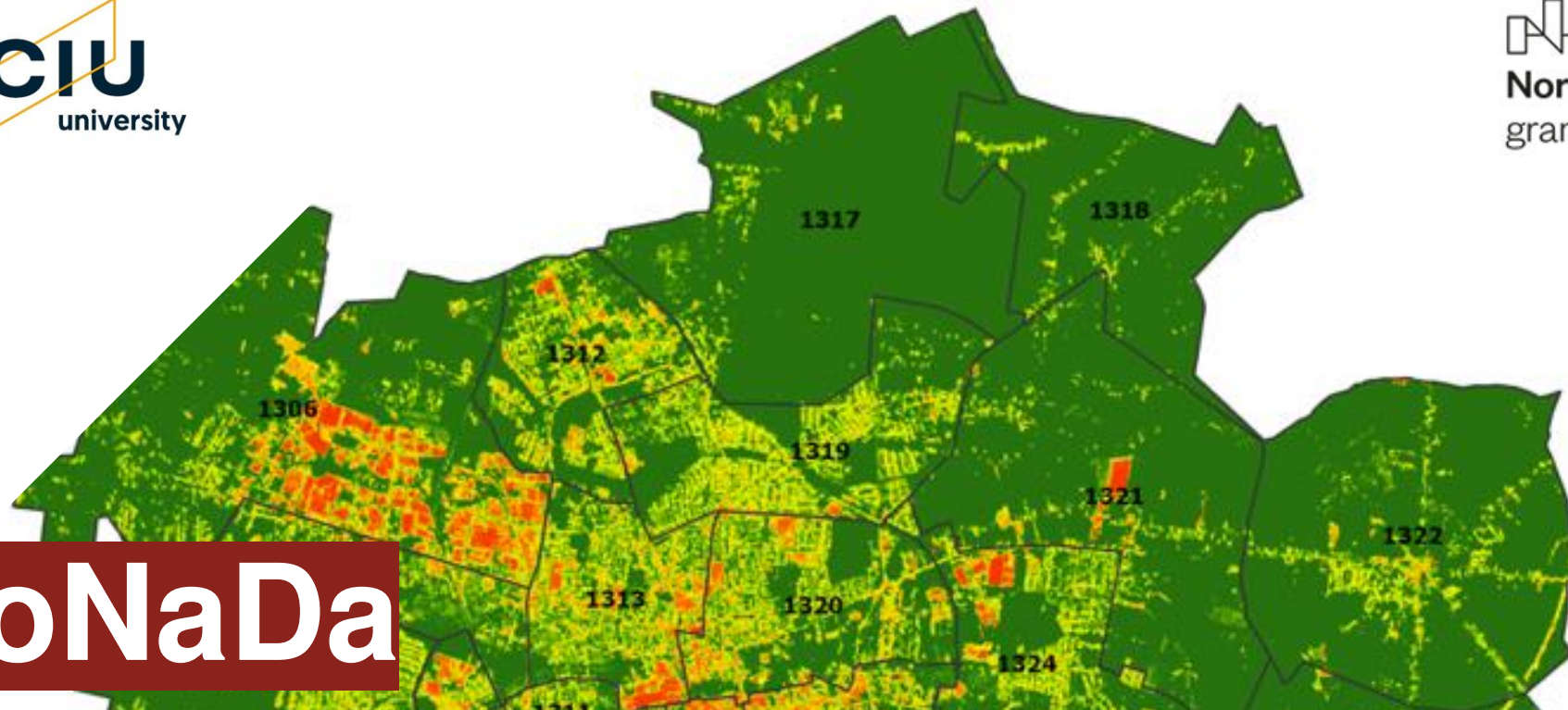


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LODZ UNIVERSITY OF TECHNOLOGY

EDUCATION, RESEARCH, INNOVATION



InCoNaDa

Enhancing the user uptake of Land Cover / Land Use information derived from the integration of Copernicus services and national databases





InCoNaDa

Applied Research

POLNOR 2019

Source of funding / operator



Consortium



Institute of Geodesy
and Cartography



NIBIO
NORWEGIAN INSTITUTE OF
BIOECONOMY RESEARCH

Norwegian Institute of
Bioeconomy Research
(NIBIO)



IOŚ-PIB

The Institute of
Environmental
Protection – National
Research Institute
(IOŚ-PIB)



Lodz University of Technology

Lodz University of
Technology, Institute
of Architecture and
Urban Planning



Eversis Sp. z o.o.

Project Abstract

The main goal of InCoNaDa is to improve the user uptake of land cover and land use information derived from the integration of Copernicus Land Monitoring Services (CLMS) and national databases.

Research objectives:

- 1) to determine the most accurate land cover map based on a time series of Sentinel-2 data using machine learning approaches;
- 2) to design and develop web-based application enabling to query the enhanced LCLU database as well as to integrate and extract statistics from the CLMS adjusted to the user needs;
- 3) to proof if and how enhanced LCLU database and CLMS can be used in spatial planning;
- 4) to proof if and how the enhanced LCLU database and CLMS can be used in the agricultural management and environmental monitoring;
- 5) to demonstrate the usefulness of the enhanced LCLU database and CLMS for reporting GHG emissions and removals from the land use, land use changes and forestry (LULUCF).



Aim: to improve the user uptake of Land Cover / Land Use (LCLU) information derived from the integration of Copernicus Land Monitoring Service (CLMS) and national databases.

Objective: to
examine the usefulness of CLMS
for urban and spatial planning

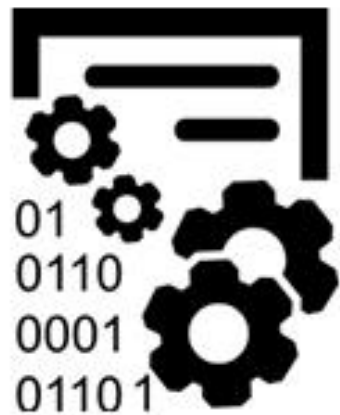
Investigation of
biologically active surface

Investigation of public access
to green urban areas

Investigation of mapping
changes in urban and
spatial planning

Developing a web-based application enabling the integration of LCLU data derived from the national databases and CLMS products for Poland

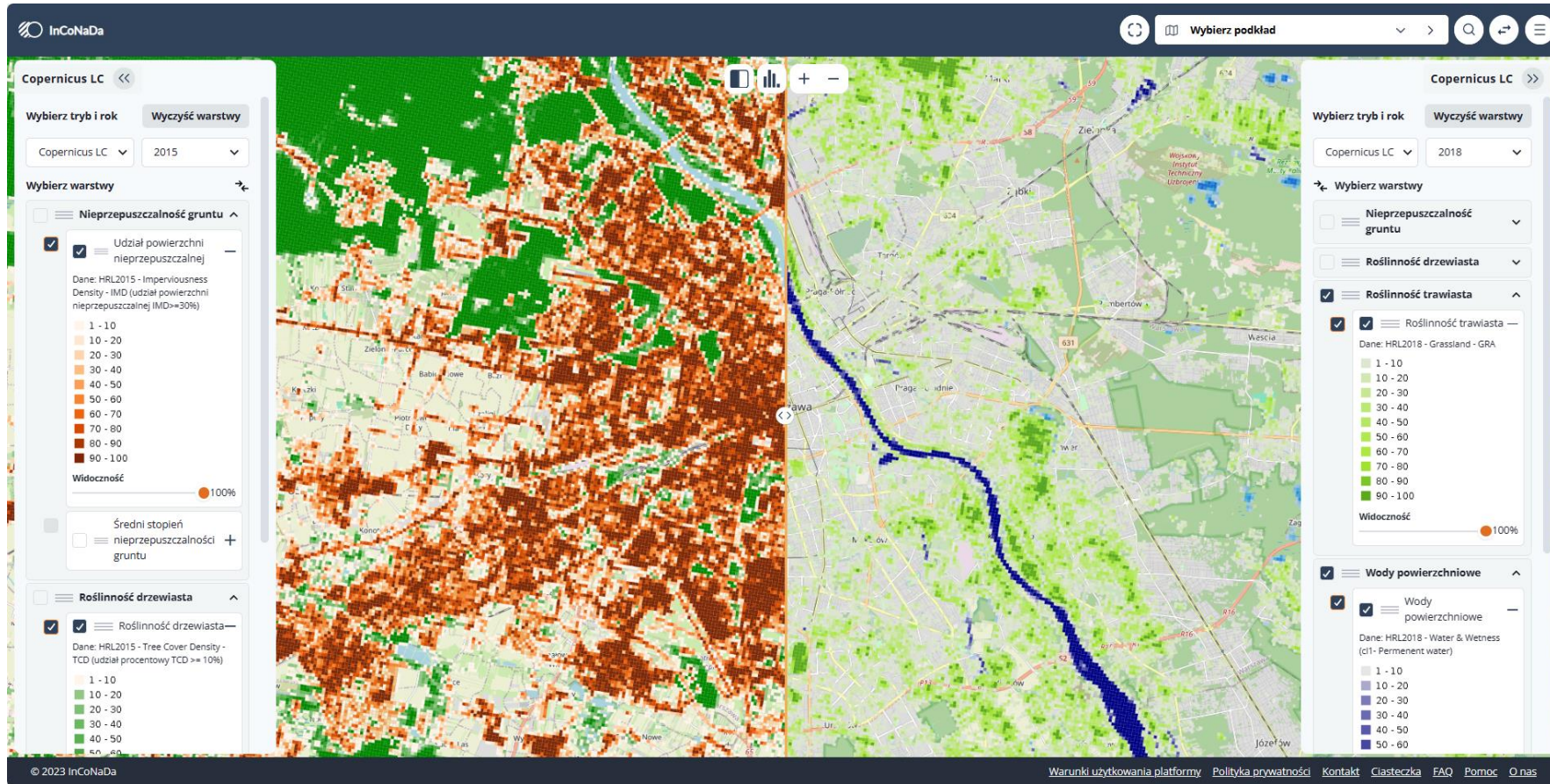
Visualization of the numeric data as map layers



<https://app.inconada.eu/>



Developing a web-based application enabling the integration of LCLU data derived from the national databases and CLMS products for Poland.



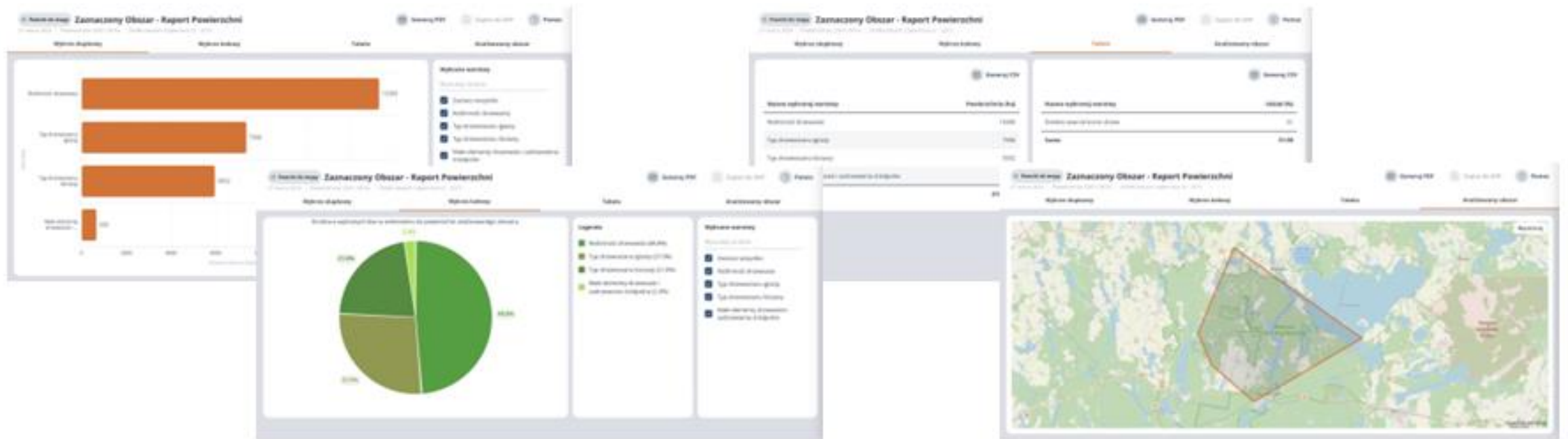
<https://app.inconada.eu/>





Developing a web-based application enabling the integration of LCLU data derived from the national databases and CLMS products for Poland.

Interactive reports based on the selected Area of Interest



<https://app.inconada.eu/>



PUBLICATIONS



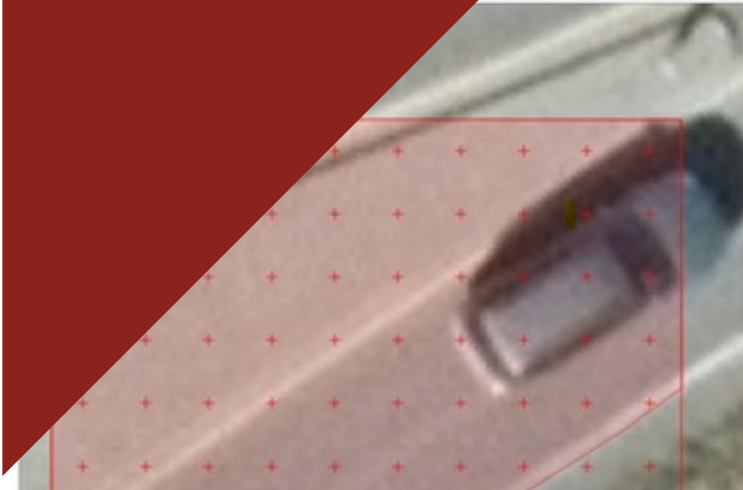
➤ *Article*
Accuracy of the Copernicus High-Resolution Layer Imperviousness Density (HRL IMD) Assessed by Point Sampling within Pixels

Geir-Harald Strand

sciendo HOUSING ENVIRONMENT 47/2024 WSPÓŁCZESNA ARCHITEKTURA MIESZKANIOWA W PRZESTRZENI MIASTA / CONTEMPORARY HOUSING ARCHITECTURE IN CITY SPACE e-ISSN 2543-8700 <https://doi.org/10.2478/he-2024-0009>

MONIKA MARIA CYSEK-PAWLAK*, MICHAŁ CZAJKOWSKI**, JAKUB MISIAK***

➤ **Przekształcenia zabudowy mieszkaniowej jako element kształtujący kierunek przemian urbanistycznych w Łodzi**
Transformations of Housing Development as an Element Shaping the Direction of Urban Changes in Łódź

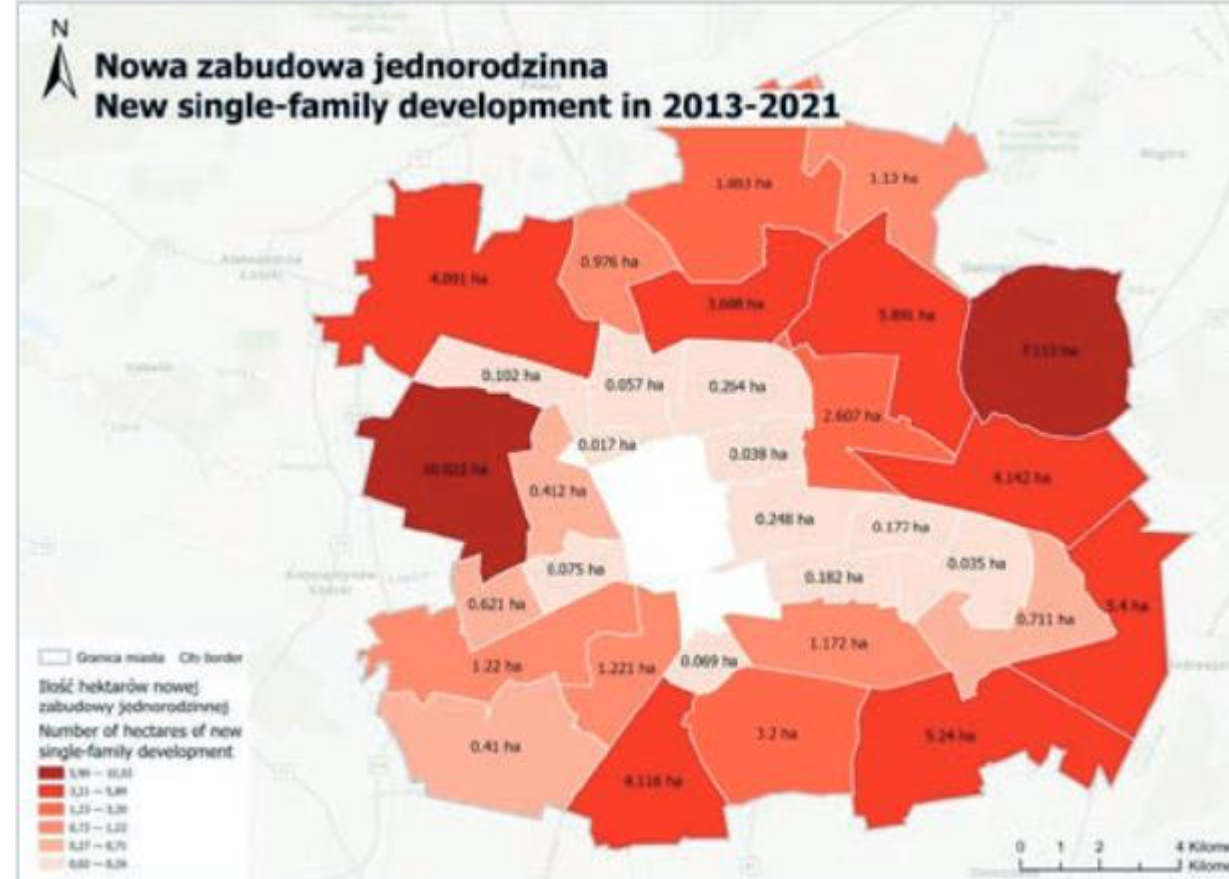


Dimensions:
Pixel size: 10
Pixel area: 100

Sealed soil:
Human-produced surface that is essentially impenetrable by rainfall

Imperviousness:
The proportion of a pixel that is sealed

Estimated imperviousness





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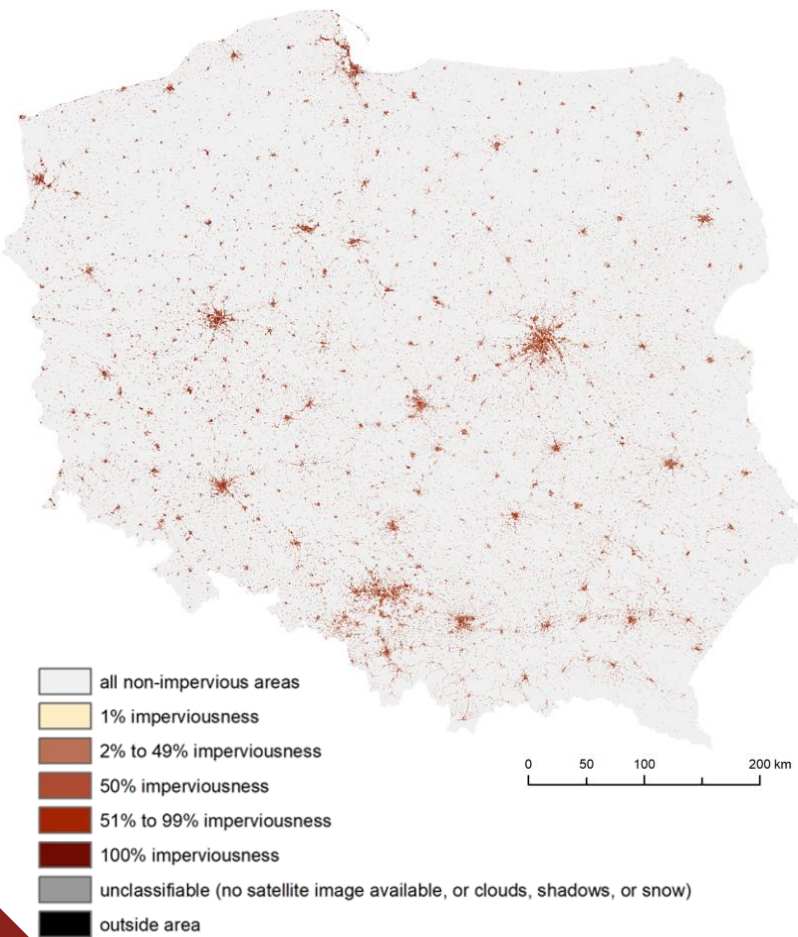
Norway
grants

Lódz

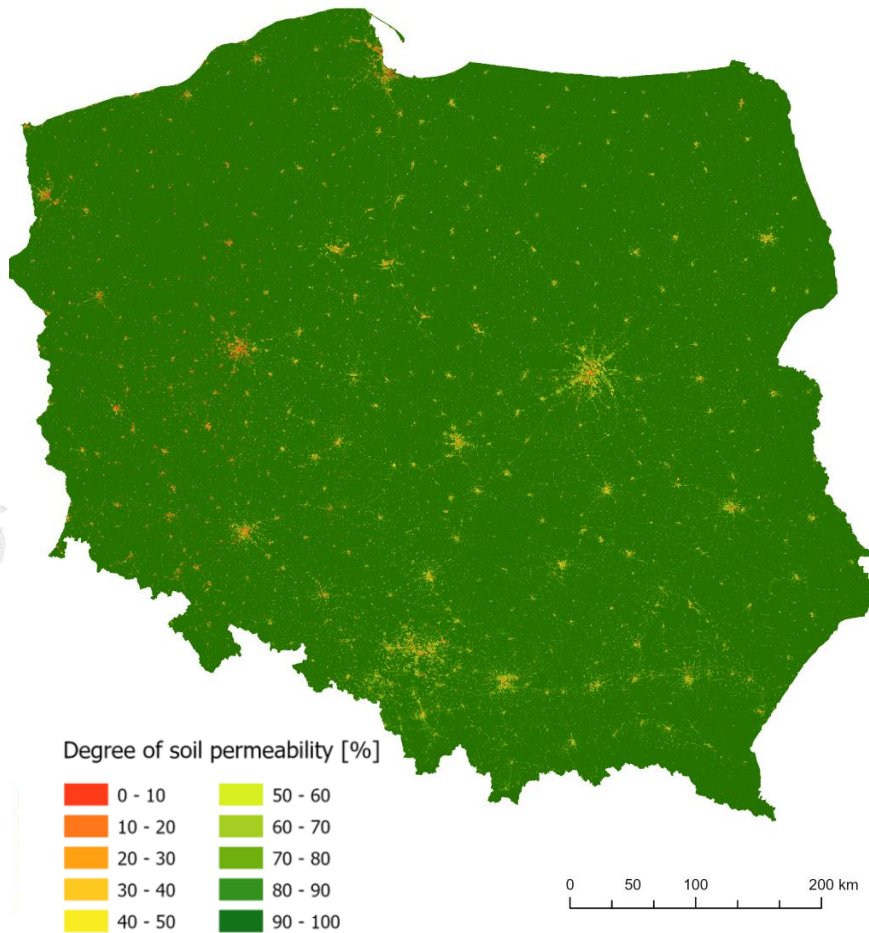
Investigation of biologically active surface



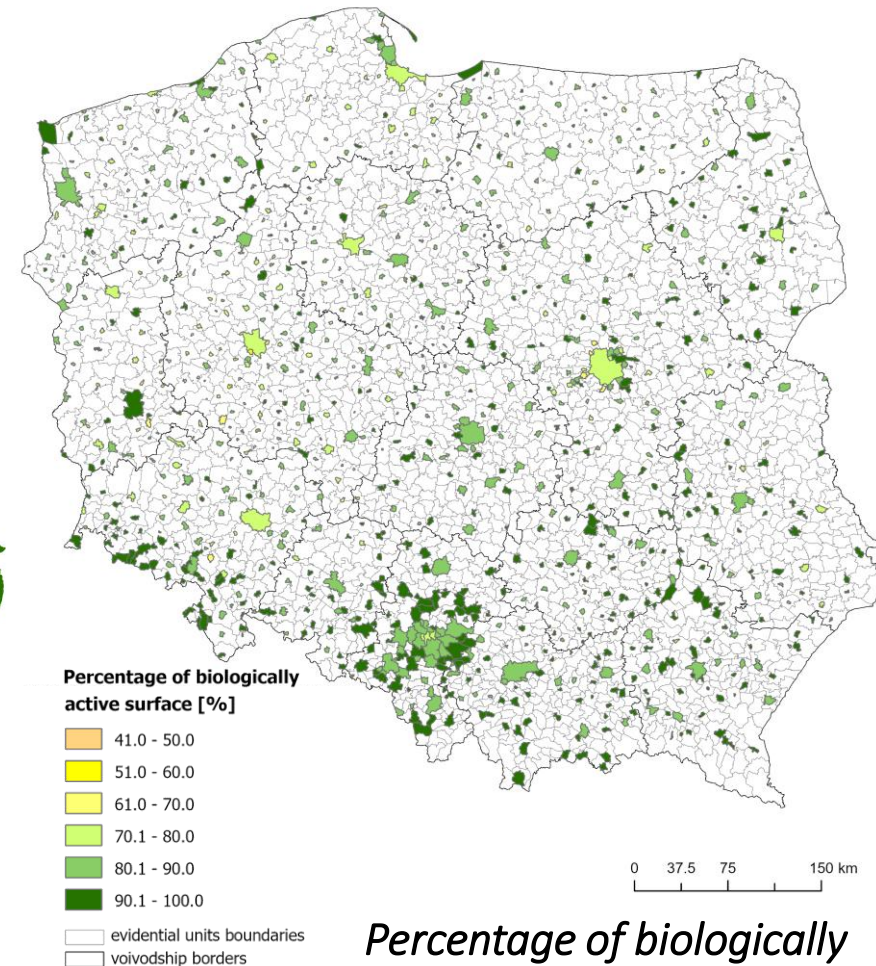
HRL-Imperviousness



*HRL-Imperviousness 2018
data for Poland*



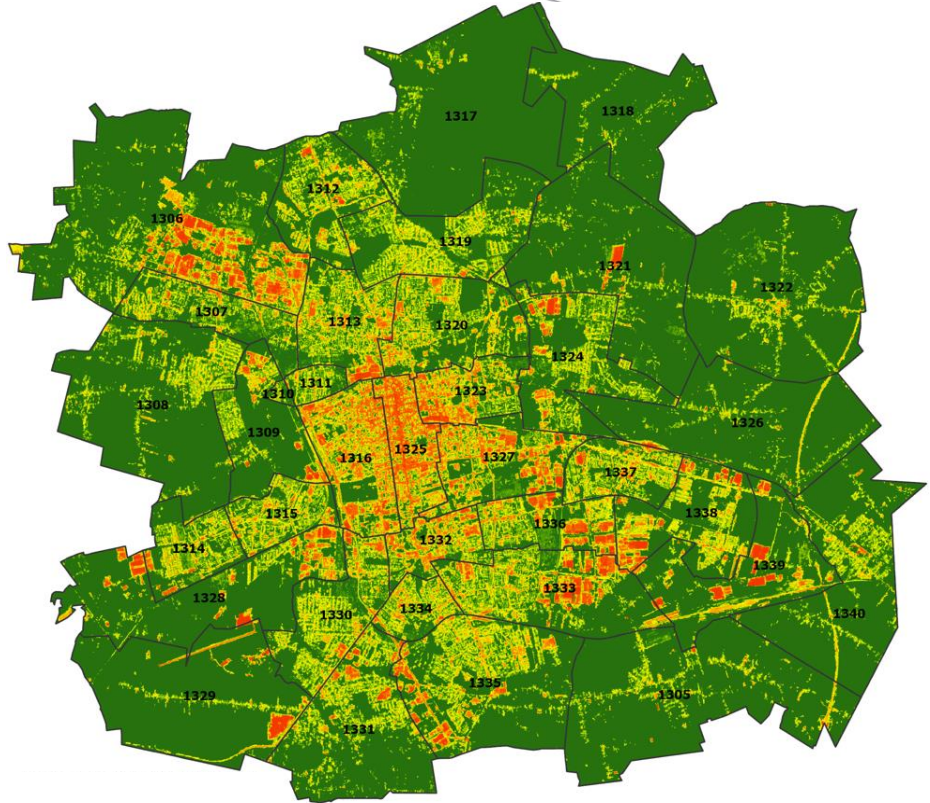
Biologically active areas



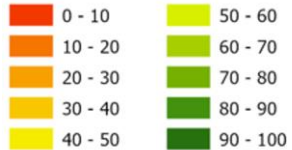
Percentage of biologically active surface in urban municipalities and cities in urban-rural municipalities



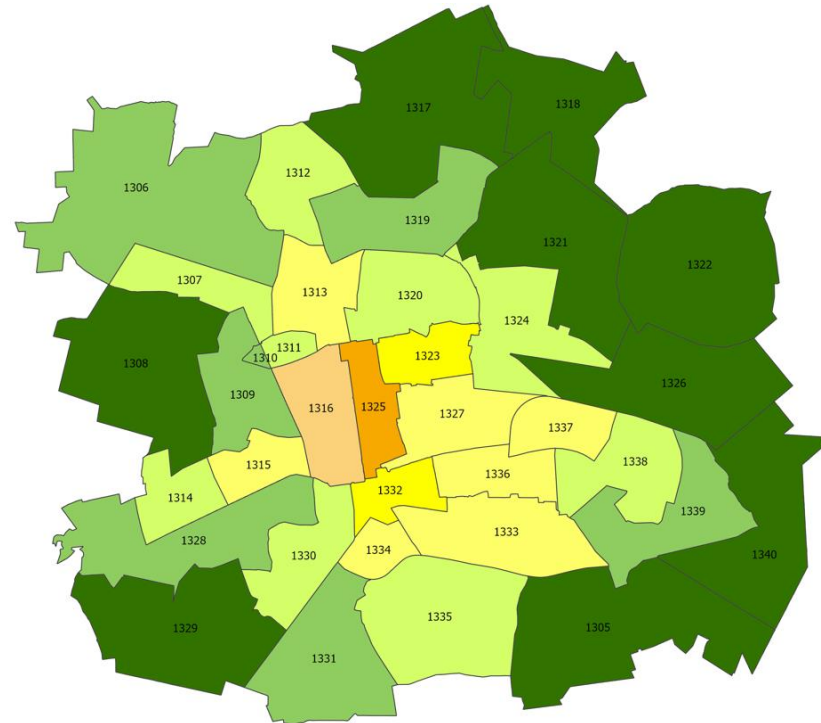
Investigation of biologically active surface within the Lodz auxiliary units



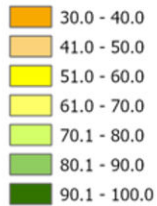
Degree of soil permeability [%]



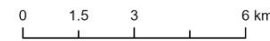
1329 auxiliary unit code
□ auxiliary unit boundary



Percentage of biologically active surface [%]



1329 auxiliary unit code
□ auxiliary unit boundary



biologically active surface within the Lodz auxiliary units

Percentage of biologically active surface within the Lodz auxiliary units

Auxiliary unit	Auxiliary unit code	Percentage of biologically active area [%]
Łagiewniki	1317	98.3
Wzniesień Łódzkich	1318	98.0
Mileszki	1326	95.6
Dolina Łódki	1321	95.4
Wiskitno	1305	95.2
Nowosolna	1322	95.2
Nad Nerem	1329	93.6
Złotno	1308	92.4
Andrzejów	1340	92.1
Lublinek-Pienista	1328	86.4
Ruda	1331	84.4
Zdrowie-Mania	1309	84.1
ŁÓDŹ	-	83.1
nr 33	1339	82.9
im. Józefa Montwiła-Mireckiego	1310	82.4
Bałuty Zachodnie	1306	81.6
Julianów-Marysin-Rogi	1319	80.8
Stoki-Sikawa-Podgórze	1324	79.7
Chojny	1335	78.8
Teofilów Wielkopolska	1307	77.8
Radogoszcz	1312	77.5
Retkinia Zachód-Smulsko	1314	76.2
Bałuty Doły	1320	74.5
Olechów-Janów	1338	73.3
Koziny	1311	73.1
Rokicie	1330	72.2
Chojny Dąbrowa	1333	69.7
Karolew-Retkinia Wschód	1315	68.3
Widzew Wschód	1337	67.6
Piastów-Kurak	1334	66.0
Bałuty-Centrum	1313	64.3
Zarzew	1336	61.2
Stary Widzew	1327	61.1
Górniak	1332	56.3
Śródmieście Wschód	1323	56.0
Stare Polesie	1316	47.9
Katedralna	1325	34.2



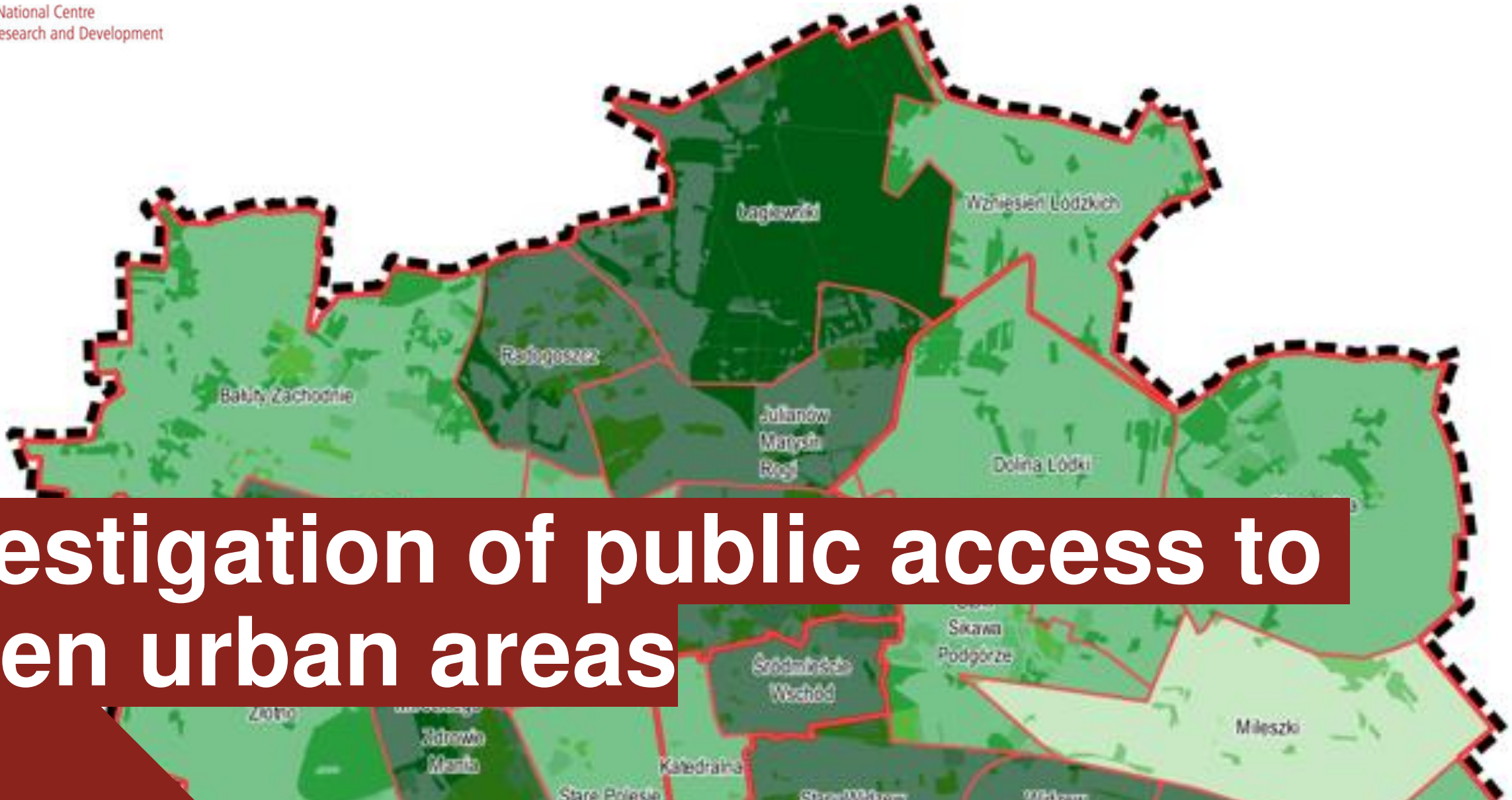
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Norway
grants

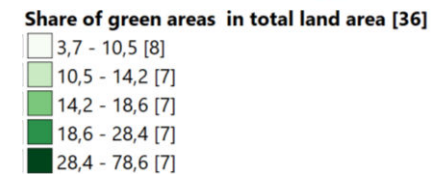
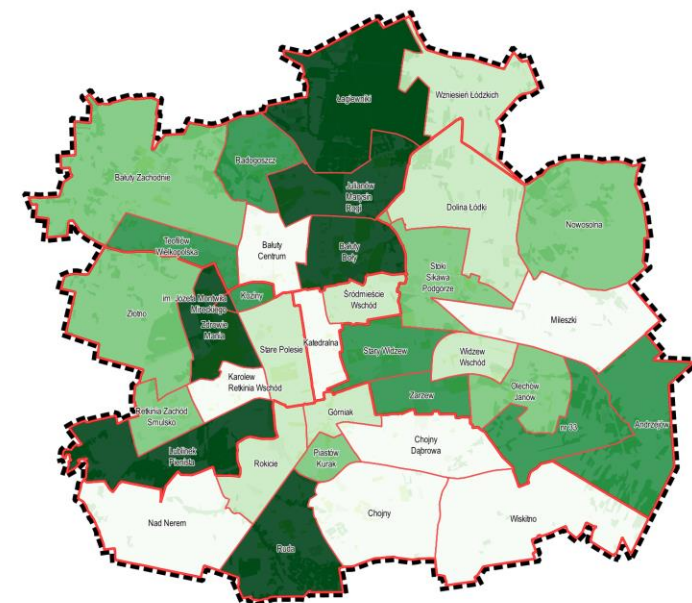


Investigation of public access to green urban areas



Share of green urban areas and forests in total land area

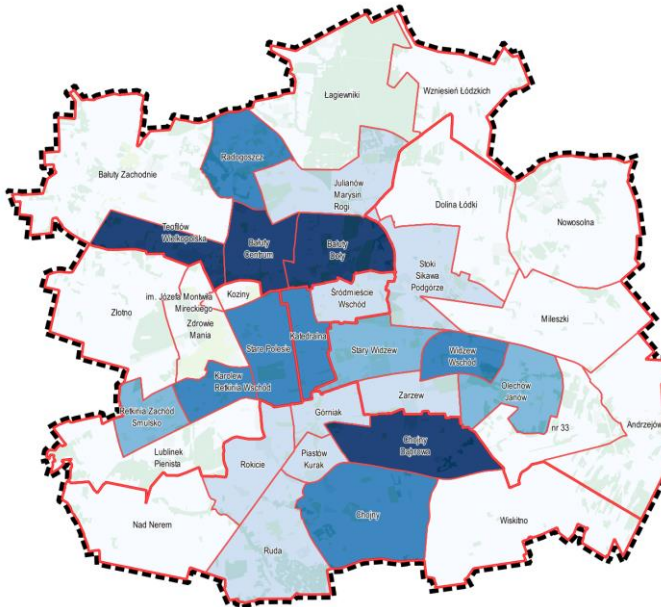
Auxiliary unit	Auxiliary unit code	Auxiliary unit area [ha]	Green urban areas	Sports and leisure facilities	Forests	Share of green areas in total land area [UA]	ZP+ZC (green urban areas)	ZD (sports and leisure facilities)	LS + LZ (Forests)	Share of green areas in total land area [MPU]	difference - share of green areas in total land area
Katedralna	1325	364	3,59%	0,09%	0,00%	3,68%	4,19%	0,37%	0,00%	5%	0,88%
Wisłotno	1305	1671	0,02%	0,00%	4,01%	4,03%	0,08%	0,00%	8,25%	8%	4,31%
Nad Nerem	1329	1336	0,00%	0,01%	4,80%	4,81%	0,72%	0,00%	7,92%	9%	3,83%
Mieszki	1326	1252	0,11%	0,07%	6,40%	6,58%	0,12%	0,00%	10,22%	10%	3,77%
Karolew-Retkinia Wschód	1315	322	4,62%	3,00%	0,00%	7,62%	5,40%	2,11%	0,03%	8%	0,07%
Chojny-Dąbrowa	1333	850	1,57%	3,73%	2,47%	7,77%	3,12%	2,72%	3,80%	10%	1,86%
Bałuty-Centrum	1313	523	4,99%	5,03%	0,00%	10,02%	4,26%	2,63%	0,52%	10%	-0,25%
Chojny	1335	1204	4,30%	3,17%	3,06%	10,53%	2,98%	1,36%	6,81%	12%	1,03%
Rokicie	1330	597	2,13%	7,43%	1,24%	10,79%	2,29%	5,61%	1,30%	9%	-1,38%
Stare Polesie	1316	586	8,98%	1,87%	0,00%	10,85%	7,94%	0,00%	0,01%	10%	-0,79%
Górniak	1332	296	8,27%	3,75%	0,00%	12,02%	5,75%	2,48%	0,00%	9%	-3,29%
Śródmieście-Wschód	1323	349	4,76%	6,60%	0,68%	12,04%	2,37%	3,35%	0,52%	8%	-3,99%
Wzniesień Łódzkich	1318	946	0,00%	0,46%	11,76%	12,22%	0,00%	0,25%	19,77%	20%	8,19%
Widzew-Wschód	1337	360	6,14%	2,47%	5,01%	13,62%	3,25%	1,70%	5,17%	12%	-1,79%
Dolina Łódki	1321	1409	0,04%	3,90%	10,20%	14,15%	0,00%	3,45%	20,40%	24%	9,85%
Nowosolna	1322	1557	0,31%	4,43%	12,36%	17,10%	0,07%	4,24%	13,69%	18%	1,03%
Retkinia Zachód-Smulsko	1314	378	4,51%	9,33%	3,64%	17,48%	6,89%	8,08%	2,49%	17%	-0,02%
Olechow-Janów	1338	665	2,49%	1,54%	13,52%	17,55%	3,96%	1,23%	14,40%	20%	2,32%
Piastów-Kurak	1334	218	5,13%	12,50%	0,00%	17,63%	4,91%	8,94%	0,18%	15%	-2,47%
Stoki-Sikawa-Podgórze	1324	802	4,83%	8,28%	5,01%	18,13%	5,75%	6,17%	8,35%	21%	2,79%
Bałuty Zachodnie	1306	2154	2,52%	2,88%	13,04%	18,44%	1,84%	2,53%	12,50%	17%	-1,45%
Złotno	1308	1468	0,27%	1,00%	17,38%	18,65%	2,73%	0,94%	18,98%	23%	4,05%
Andrzejów	1340	1197	0,77%	0,20%	18,71%	19,68%	0,07%	0,09%	21,78%	22%	2,37%
Zarzew	1336	412	11,71%	9,08%	0,00%	20,78%	10,73%	8,19%	0,00%	19%	-1,71%
nr 33	1339	799	0,00%	1,26%	21,31%	22,57%	0,80%	0,99%	19,04%	21%	-1,74%
Stary Widzew	1327	591	12,96%	11,45%	0,00%	24,41%	10,20%	5,45%	0,33%	20%	-4,28%
Teofilów-Wielkopolska	1307	458	7,46%	15,40%	1,58%	24,44%	5,03%	11,36%	1,12%	19%	-5,56%
Koziny	1311	107	22,99%	4,66%	0,00%	27,65%	20,04%	2,84%	0,00%	23%	-4,77%
Radogoszcz	1312	587	12,52%	4,72%	11,21%	28,44%	4,38%	3,56%	8,55%	17%	-11,86%
Julianów-Marysin-Rogi	1319	827	12,61%	2,23%	14,93%	29,77%	7,08%	1,59%	13,79%	23%	-7,21%
Ruda	1331	1007	3,26%	2,41%	25,58%	31,25%	3,59%	1,58%	19,06%	25%	-6,73%
Bałuty-Doty	1320	673	22,39%	8,41%	2,11%	32,91%	19,27%	5,48%	1,51%	27%	-5,53%
Lublinek-Pienista	1328	1081	0,12%	3,14%	29,94%	33,20%	4,38%	2,51%	27,74%	35%	1,59%
Im. Józefa Montwiła-Mireckiego	1310	26	2,76%	39,67%	0,00%	42,43%	0,00%	33,05%	0,00%	33%	-9,38%
Zdrowie-Mania	1309	568	36,67%	15,12%	15,71%	67,50%	45,71%	6,29%	1,47%	59%	-8,45%
Łagiewniki	1317	1684	0,21%	3,54%	74,87%	78,62%	0,44%	2,93%	72,19%	76%	-2,88%





Green urban areas (m2) per capita and Number of inhabitants per ha of green urban areas

District	Auxiliary unit	Auxiliary unit area [ha]	number of inhabitants (2018)	Green areas (m2) per capita	Number of inhabitants per ha of green urban areas (ua)
GÓRNA	Wisłtino	1671	3445	195,31	51
BAŁUTY	Bałuty Zachodnie	2154	7002	567,35	18
BAŁUTY	Teofilów-Wielkopolska	458	42946	26,08	383
POLESIE	Złotno	1468	8431	324,90	31
POLESIE	Zdrowie-Mania	568	3011	1273,04	8
POLESIE	im. Józefa Montwiła-Mireckiego	26	1618	67,39	148
POLESIE	Koziny	107	9930	29,88	335
BAŁUTY	Radogoszcz	587	30790	54,21	184
BAŁUTY	Bałuty-Centrum	523	44680	11,74	852
POLESIE	Retkinia Zachód-Smulsko	378	25980	25,44	393
POLESIE	Karolew-Retkinia Wschód	322	35891	6,84	1463
POLESIE	Stare Polesie	586	32734	19,44	514
BAŁUTY	Łagiewniki	1684	1669	7933,27	1
BAŁUTY	Wzniesień Łódzkich	946	1314	879,22	11
BAŁUTY	Julianów-Marysin-Rogi	827	11462	214,76	47
BAŁUTY	Bałuty-Dół	673	40349	54,86	182
WIDZEW	Dolina Łódki	1409	2302	865,80	12
WIDZEW	Nowosolna	1557	4147	642,06	16
ŚRÓDMIEŚCIE	Śródmieście-Wschód	349	17451	24,10	415
WIDZEW	Stoki-Sikawa-Podgórze	802	10590	137,32	73
ŚRÓDMIEŚCIE	Katedralna	364	35699	3,75	2664
WIDZEW	Mileszki	1252	1961	419,79	24
WIDZEW	Stary Widzew	591	21095	68,39	146
POLESIE	Lublinek-Pienista	1081	5537	648,33	15
GÓRNA	Nad Nerem	1336	1069	601,63	17
GÓRNA	Rokicie	597	16647	38,72	258
GÓRNA	Ruda	1007	11325	278,01	36
GÓRNA	Górniki	296	17622	20,17	496
GÓRNA	Chojny-Dąbrowa	850	46761	14,13	708
GÓRNA	Piastów-Kurak	218	19307	19,93	502
GÓRNA	Chojny	1204	32059	39,53	253
WIDZEW	Zarzew	412	19811	43,19	232
WIDZEW	Widzew-Wschód	360	37254	13,16	760
WIDZEW	Olechów-Janów	665	21043	55,47	180
WIDZEW	nr 33	799	1079	1670,79	6
WIDZEW	Andrzejów	1197	5673	415,18	24
			629684	491,76	318



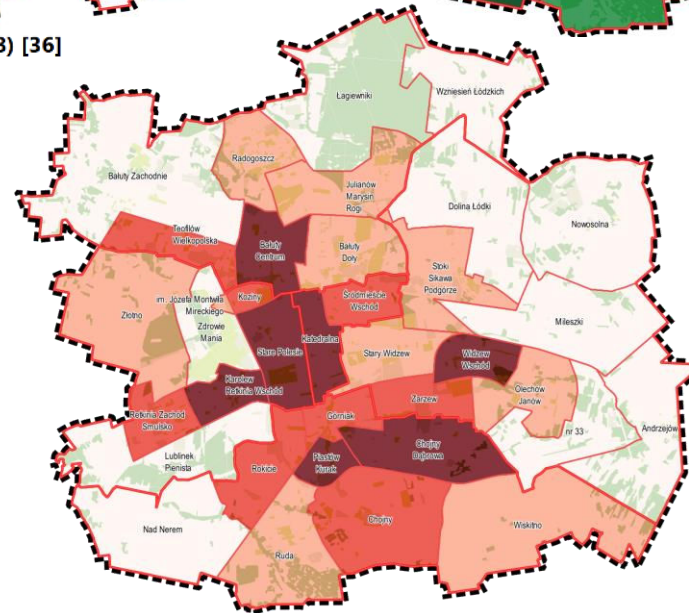
number of inhabitants (2018) [36]

- 1069 - 10000 [15]
- 10000 - 20000 [8]
- 20000 - 30000 [3]
- 30000 - 40000 [6]
- 40000 - 46761 [4]



Green areas (m2) per capita [36]

- 4 - 20 [8]
- 20 - 50 [7]
- 50 - 200 [7]
- 200 - 600 [6]
- 600 - 7933 [8]



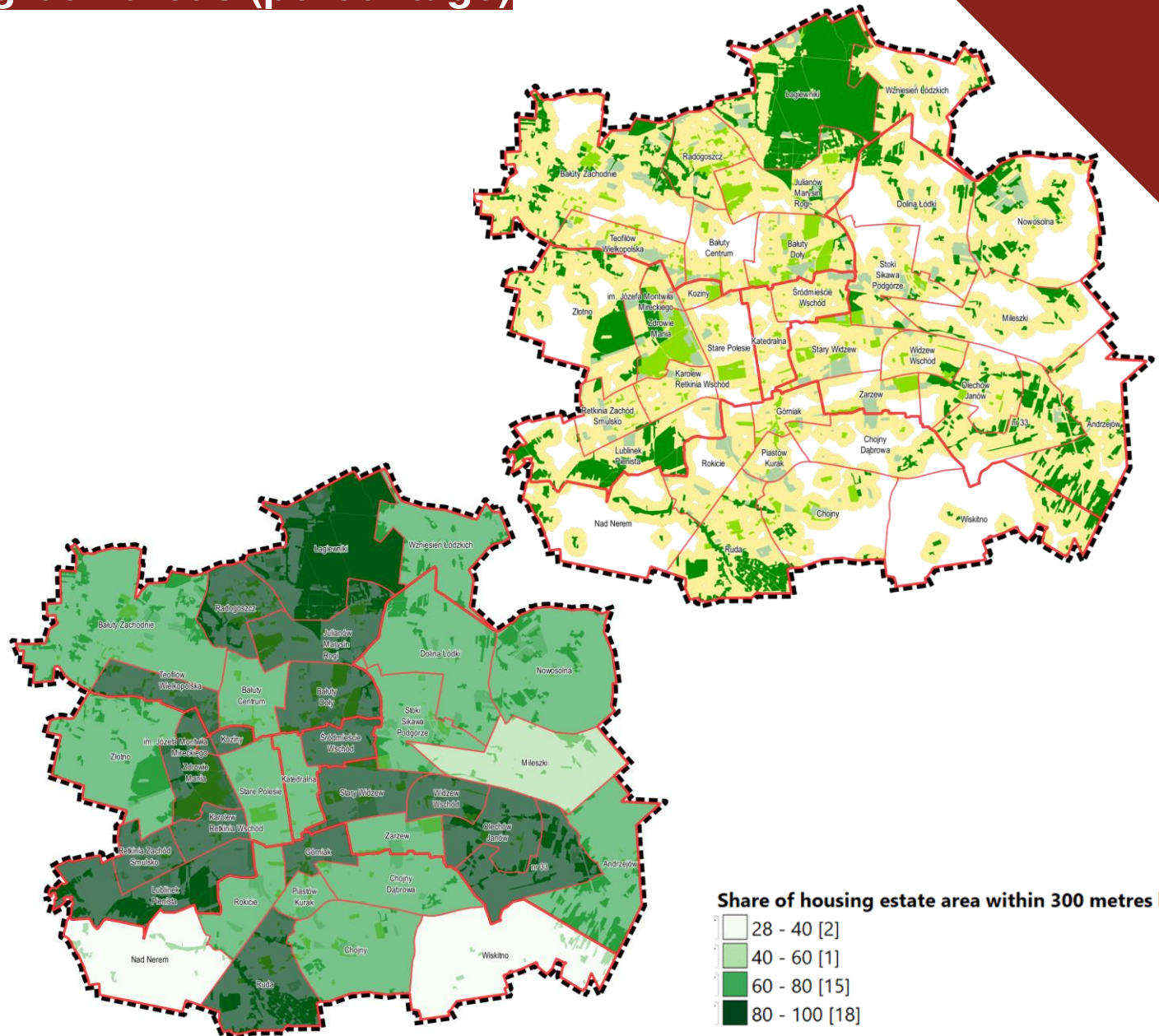
inhabitants per ha of green urban areas

- 1 - 25 [11]
- 25 - 200 [10]
- 200 - 500 [8]
- 500 - 2664 [7]



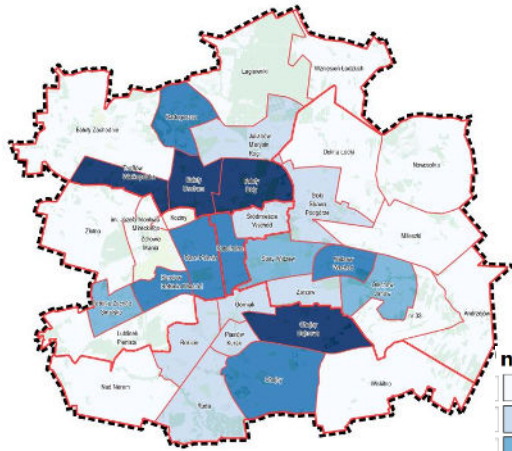
Share of housing estate area within 300 metres linear distance to urban green areas (percentage)

District	Auxiliary unit	Auxiliary unit code	Auxiliary unit area [ha]	Share within 300 metres linear distance to urban green areas
GÓRNA	Wisłtino	1305	1671	28%
GÓRNA	Nad Nerem	1329	1336	40%
WIDZEW	Mieszki	1326	1252	55%
GÓRNA	Chojny	1335	1204	61%
BAŁUTY	Bałuty-Centrum	1313	523	61%
POLESIE	Stare Polesie	1316	586	62%
GÓRNA	Chojny-Dąbrowa	1333	850	62%
WIDZEW	Nowosolna	1322	1557	64%
WIDZEW	Dolina Łódki	1321	1409	67%
WIDZEW	Zarzew	1336	412	68%
WIDZEW	Andrzejów	1340	1197	68%
BAŁUTY	Wzniesień Łódzkich	1318	946	72%
WIDZEW	Stoki-Sikawa-Podgórze	1324	802	74%
GÓRNA	Rokicie	1330	597	75%
POLESIE	Złotno	1308	1468	75%
ŚRÓDMIĘSCIE	Katedralna	1325	364	75%
BAŁUTY	Bałuty Zachodnie	1306	2154	77%
GÓRNA	Piastów-Kurak	1334	218	79%
WIDZEW	Olechów-Janów	1338	665	81%
WIDZEW	Stary Widzew	1327	591	83%
GÓRNA	Górniak	1332	296	84%
POLESIE	Lublinek-Pienista	1328	1081	85%
WIDZEW	nr 33	1339	799	87%
POLESIE	Karolew-Retkinia Wschód	1315	322	87%
ŚRÓDMIĘSCIE	Śródmieście-Wschód	1323	349	91%
BAŁUTY	Julianów-Marysin-Rogi	1319	827	92%
WIDZEW	Widzew-Wschód	1337	360	92%
BAŁUTY	Teofilów-Wielkopolska	1307	458	92%
BAŁUTY	Bałuty-Doły	1320	673	94%
POLESIE	Retkinia Zachód-Smulsko	1314	378	95%
GÓRNA	Ruda	1331	1007	97%
POLESIE	Koziny	1311	107	97%
BAŁUTY	Łągiewniki	1317	1684	99%
BAŁUTY	Radogoszcz	1312	587	99%
POLESIE	Zdrowie-Mania	1309	568	100%
POLESIE	im. Józefa Montwiła-Mireckiego	1310	26	100%





Green urban areas (m2) per capita and Number of inhabitants per ha of green urban areas



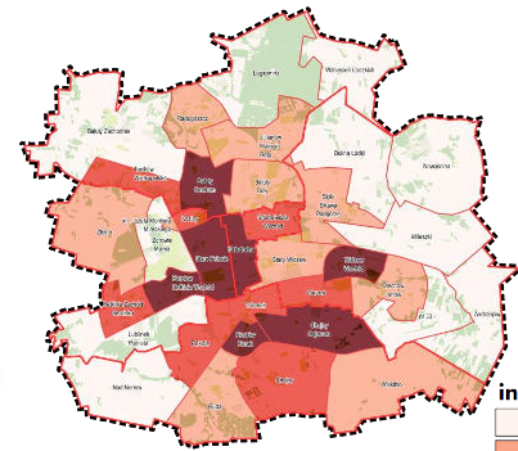
number of inhabitants

- 1069 - 10000 [15]
- 10000 - 20000 [8]
- 20000 - 30000 [3]
- 30000 - 40000 [6]
- 40000 - 46761 [4]



Green areas (m2) per capita

- 4 - 20 [8]
- 20 - 50 [7]
- 50 - 200 [7]
- 200 - 600 [6]
- 600 - 7933 [8]



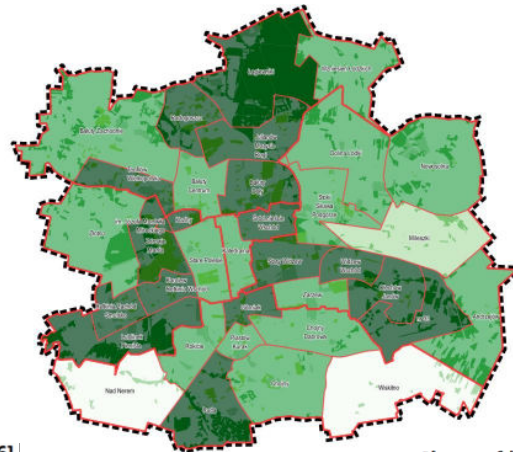
inhabitants per ha of green urban areas

- 1 - 25 [11]
- 25 - 200 [10]
- 200 - 500 [8]
- 500 - 2664 [7]



Share of green areas in total land area [36]

- 3,7 - 10,5 [8]
- 10,5 - 14,2 [7]
- 14,2 - 18,6 [7]
- 18,6 - 28,4 [7]
- 28,4 - 78,6 [7]

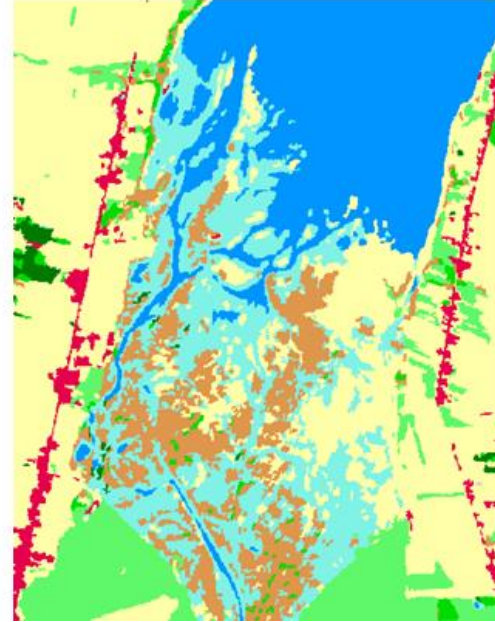
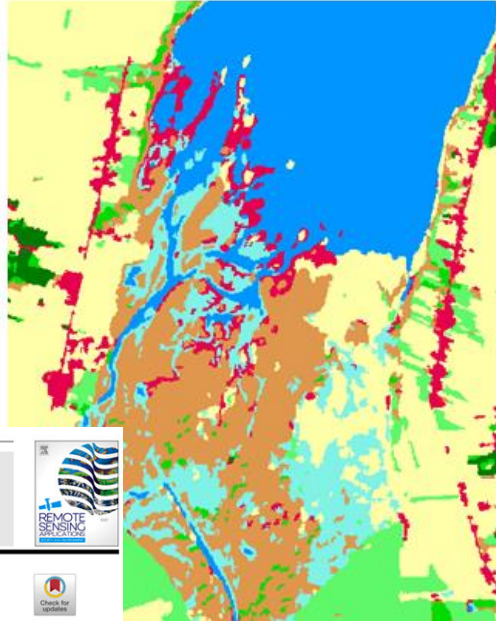


Share of housing estate area within 300 metres I

- 28 - 40 [2]
- 40 - 60 [1]
- 60 - 80 [15]
- 80 - 100 [18]



Land cover classification and change detection using Sentinel-2 data



- sealed surfaces
- woodland broadleaved
- woodland coniferous
- shrubs
- permanent herbaceous
- periodically herbaceous
- wetlands and mosses
- non-vegetated
- water bodies

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The impact of selection of reference samples and DEM on the accuracy of land cover classification based on Sentinel-2 data

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Open Access Article

Can a Hierarchical Classification of Sentinel-2 Data Improve Land Cover Mapping?

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Technical Note

Transformation of a Classified Image from Pixel Clutter to Land Cover Map Using Geometric Generalization and Thematic Self-Enrichment

Geir-Harald Strand^{1,*}, Eva Solbjørg Flo Heggem¹, Linda Aune-Lundberg¹, Agata Hościło² and Adam Waśniewski³





CONCLUSION

- Geospatial technologies play a critical role in identifying urban planning trends and facilitating spatial planning in Łódź.
- The analysis of CLMS data offers valuable insights for comparative urban studies, from local to international levels, underscoring the significance of standardized and consistent datasets (but the quality of data is too low to make spatial decisions based on this source)
- Orthophotomap monitoring data, verified by students, provided a detailed understanding of the city's development structure and dynamics, highlighting the increasing demand for multi-family housing.
- GIS technology enabled the analysis of the impact of housing investments on Łódź's urban landscape and supports the prediction of future development trends and spatial planning needs.
- The study underscores the necessity for continuous data monitoring and collaboration with academic institutions to ensure effective spatial planning and sustainable urban development in Łódź.



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