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Methods for assessing adaptation to climate change activities focused on urban green infrastructure

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Green approach to climate change adaptation

Ecosystems as infrastructure, which has a wide variety of benefits compared to single function grey infrastructure such as water, sewerage, electricity or transport networks.

Advantages of green infrastructure

- Multifunctionality (environmental, social, economic)
- Integration (cooperation with other sectors)
- Landscape connectivity
- Multi-scale solutions and diversification (multi-objectivity)

Project objectives:

- To identify methods for evaluating green infrastructure measures undertaken in an urban area
- To assess the relevance of their application in analysing the impact of the measure on climate change adaptation at local level

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 (European Commission)

Urban green infrastructure components

- Parks
- Urban forest parks
- Ecological areas and protected areas
- Street trees, verges and hedges
- Urban squares
- Communal urban areas
- Playgrounds
- Pocket gardens
- Allotment gardens
- Community gardens
- Cemeteries and church gardens
- Green school grounds
- Walking and cycling trails
- Areas used for sports, leisure and recreation
- Lawns and flower meadows

- Rain gardens
- Green roofs
- Green facads
- Green tracks
- Green stops
- Permeable surfaces for car parks
- Retention ponds
- Bioretention basins and ditches
- Urban wetlands
- Continuous waterfronts
- Rivers and reservoirs
- Floodplains
- Vacant and disused land

Green infrastructure – impact and monitoring

Environmental Impact

Climate, energy and emissions

- Lowered local temperature,
- Increased protection against flooding (%)

Biodiversity

- Increased number of species present,
- Reduced biodiversity loss

Revitalisation of abandoned and post-industrial areas

- Increased share of transformed post-industrial space

Social and cultural impacts

Health and well-being

- Improved physical health
- Reduced excess heatwave deaths

Access to public green and blue spaces

- Number of people using green areas

Quality of life, happiness

- Assessment of life satisfaction.

Involvement of inhabitants

Involvement in the implementation of green projects

- Share of residents involved in such projects

Ownership and responsibility

- Share or number of people owning or caring for green areas

Sharing and adopting GI solutions in the community

Possibility and transferability

Integrated management

- number of decision-makers involved in the planning and implementation process from different disciplines/sectors

Long-term viability of activities/projects and monitoring (duration)

City budget

- % of budget allocated to planning, implementation and maintenance of green spaces

Transfer of activities

- Number of activities/projects/results transferred into practice or disseminated

Negative aspects

Inconvenience to residents associated with green infrastructure:

- mosquitoes, ticks, mice, nesting birds,
- plants emitting allergenic pollen

Impact of green infrastructure - climate

Reduction of heat stress

Cooling effect of different forms of GI (compared to a concrete surface): grass (2-4°C), trees (5-7°C). The effect also depends on the size and intensity of tree cover.

Reduction of flood risk

- Rainwater retention (a single tree can retain 6.7 cubic meters of water per year)

The volume of retained rainwater during heavy rainfall depends on:

- Structure of the greenery (number, density, size, species composition)
- Plant health status
- Spatial configuration

Evaluation of GI: Quality standards

- **Green roof standards**
  - Minimum substrate layer thickness (exceeds 12 cm for residential and office buildings, 8 cm on large industrial buildings) (Green Roof Strategy for Hamburg)
  - Standard for water retention capacity of a green roof (Urban strategies for the implementation of green roofs – Germany)

- **Standards for a small-scale urban surface retention system** (complex of buildings with different functions) - management of design rainfall volume in line with the assumptions of a given location (housing estate in Gdynia)

- **Biotope Area Factor (BAF)** – indicator defining the absorbent properties of a surface. Determines the relationship between the ecologically effective surface area and the total surface area (the Berlin Landscape Programme - concept for improving the microclimate in the city center)

- **Map of Tree Crowns for Warsaw** (tool for Urban Greens Management)
  - Number of trees planted - number and location of trees with a minimum height of 3 m (9 million)
  - Coverage of trees with a crown area of 7 sq m (32%); species of trees

Evaluation of GI: Green space availability indicators

AVAILABILITY of blue-green areas

- Area of installed green infrastructure (green roofs, green walls, rain gardens, community gardens, etc. [sq m] or
- Area of new green infrastructure solutions [sq.m./year]
- Area of green and blue infrastructure in the city [sq m]
- Share of parks, greens and residential green areas in the total area of the city [%]
- Relative change in the area of blue-green infrastructure in the city [%]
- Surface area of urban ventilation corridors [ha]
- Forest coverage [%]

Evaluation of GI: Green space accessibility indicators

AVAILABILITY of blue-green areas

- Number of squares and plazas transformed into so-called "climate squares and plazas" [units]
- Share of 'green stops' in the total number of public transport stops [%]
- Area of green space per inhabitant [m/person]

ACCESSIBILITY of blue-green areas

- Number of blue-green infrastructure facilities accessible to residents [units]
- Surface of green areas accessible for residents [sq km]

Evaluation of GI: Green space accessibility indicators

ACCESSIBILITY of blue-green areas (Close access)

- Share of residents living more than 300 m from recreational urban green space [%]
- Share of residents with access to green spaces of a given size within a given distance [%]
- Maximum distance to the closest green space from the residence
- Ratio of green areas to the number of residents with access to these areas (within a certain distance)

Conclusions

- The use of social and environmental performance indicators and green infrastructure quality standards seems to be an appropriate approach for assessing climate change adaptation related to the introduction and maintenance of green infrastructure in urban spaces.
- A unified approach to assessing the adaptation may be difficult due to the inter-city variation in urban climate risks and urban policy goals for adaptation to changing climate conditions.
- The scale of the measures to be introduced depends on the financial possibilities of the city.
- Local indicators defined by a range of different stakeholders will provide a better understanding, while the development of indicators at regional level may be an appropriate approach to assessing closely located areas.
- Classification and prioritization of the elements of GI of the city and the selection of appropriate measures for their evaluation in terms of adaptation effects will be carried out in case study.

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Thank you for your attention!

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