



Narodowe Centrum
Badań i Rozwoju



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Lecture 2: **Adaptation to climate change, general issues.**

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What is meant by adaptation to climate change?

Adaptation - "the process of adapting to the current or expected climate and its effects". The aim of adaptation will therefore be to reduce the susceptibility (e.g. of cities) to climate change. An important element is also the adaptability of specific communities; to achieve it, various types of institutions are used which are able to manage changes - having appropriate financing and technological resources, as well as having knowledge in the field of adaptation to climate change.¹

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Climate change mitigation.

Mitigating the effects consists in the reduction of factors that contribute to specific climate changes by, for example, assimilating a certain amount of greenhouse gases - thanks to the use of appropriate NBS solutions, or reducing the emission of these gases. Mitigating climate effects is an essential element in the process of adapting cities to climate change. Without the process of conducting mitigating actions - the process of adapting cities to climate change may be ineffective. However, it should be remembered that, for example, reducing greenhouse gas emissions only in selected countries, if it is not carried out by countries with the highest CO₂ emissions, will be ineffective.²

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What is meant by resilience to climate change?

¹Satterthwaite D., Huq S., Pelling M., Reid H., Lankao P., 2007, *Adapting to Climate Change in Urban Area.*, The possibilities and constraints in low- and middle-income nations. Human Settlements Discussion Paper Series, Theme: Climate Change and Cities – 1, London <http://www.iied.org/HS/topics/accc.html>

²Satterthwaite D., Huq S., Pelling M., Reid H., Lankao P., 2007, *Adapting to Climate Change in Urban Area.*, The possibilities and constraints in low- and middle-income nations. Human Settlements Discussion Paper Series, Theme: Climate Change and Cities – 1, London <http://www.iied.org/HS/topics/accc.html>

Resilience - "the ability of social, economic and environmental systems to deal with a dangerous event, trend or disruption, react or reorganize in a way that preserves their essential function, identity and structure, while maintaining the ability to adapt, learn and transform".³

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Adaptation of cities with gray infrastructure.

Gray infrastructure plays an important role in adapting cities to climate change. It can take the form of specially profiled roads and sidewalks that allow water, e.g. rainwater, to run off to special retention reservoirs. Sidewalks can be raised, which allows the population to move around during storms. These roads or sidewalks can be made of a special type of materials to allow water to permeate freely. Another simple tool is to use the right colors in the city space - bright facades, white gravel on the roof, which prevents them from overheating.

In the event of heat waves, special rooms equipped with air conditioning are organized, where the population can cool down and wait out the hottest hours of the day.

Breakwaters, retention reservoirs, flood embankments, and flood gates protect cities against river floods, or those related to the risk of flooding the areas in close proximity to the coast.

However, the use of gray infrastructure is limited: it works in one direction - it is used only in a specific direction of activities, its implementation in urban structures is also associated with large financial outlays (you also need to add the maintenance costs of this type of infrastructure).

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Adaptation of cities to climate change with the help of nature-based solutions (NBS).

It is more and more often said that the best tool for adapting cities to climate change will be solutions based on nature, as these are flexible (compared to gray infrastructure), multi-faceted solutions (their impact is not limited only to activities aimed at protecting a given

³Cortekar J., Bender S., Brune M., Groth, 2016, *Why climate change adaptation in cities needs customised and flexible climate services*, Climate Services, 4, p. 42-51

space against consequences of some kind of cataclysm, but also perform mitigating, social, economic and natural functions). They are also much cheaper than solutions based on gray infrastructure (both in implementation and in subsequent maintenance). In order to improve the efficiency of these tools, they should be used as components integrated with gray infrastructure.

Definition of what solutions based on nature are:

According to the IUCN definition, these are: "*activities aimed at the protection, sustainable management and restoration of natural or modified ecosystems that effectively and adaptively solve social problems, while ensuring human well-being and benefits for biodiversity*"

In turn, according to the European Commission, these are "*activities inspired by nature, supported by it or copied from it, which are aimed at helping societies to solve various environmental, social and economic challenges in a sustainable manner*"⁴

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The main goals of solutions based on nature.

Four main goals for NBS solutions have been developed.

1) Sustainable urbanization.

- This applies to activities leading to the so-called sustainable urban development and protection / improvement of the natural environment. By purifying water and air and creating spaces for recreation.
- Carrying out activities aimed at revitalizing degraded urban spaces - positively influencing the local community by creating new jobs and reaping the benefits of implementing NBS solutions.
- Adaptation of cities to climate change and mitigation of the effects of these changes.
- Ensuring equal access for city residents to recreational areas (social justice), which is also to contribute to the improvement of their physical and mental health.⁵

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⁴ Nature-based solutions for adapting to water-related climate risks <https://www.oecd-ilibrary.org/docserver/2257873den.pdf?expires=1648220140&id=id&accname=guest&checksum=02B5E628049CFDF9F54F955FB798F3EF>

⁵ https://www.epa.ie/pubs/reports/research/horizon2020/Nature-Based_Solutions_&_Re-Naturing_Cities.pdf

An example of such an approach is the "Freshkills Park" project in New York, at the site of a garbage dump on Staten Island. More at the link:

https://www.youtube.com/watch?v=TFm_EynqyYk

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Rebuilding degraded ecosystems.

Reconstruction of degraded ecosystems damaged by uncontrolled urbanization, industrialization, expansion of infrastructure as well as monocultural and large-scale agriculture. It aims at improving the efficiency of ecosystem services and increase the benefits resulting from them for local communities. This contributes to the adaptation of cities to climate change - e.g. through measures to rebuild coastal ecosystems (mangrove forests, coral reefs or sea dunes to counteract the effects of rising sea and ocean levels). Another process will be the afforestation of wastelands or degraded areas, which is to counteract such processes as erosion and landslides, and the increase of biodiversity in a given area.⁶

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An example of such a solution is the reconstruction of the seafront in Seattle, USA. More about the project at the link: <https://www.asla.org/2017awards/320768.html>

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Adaptation to climate change.

It is important to carry out activities aimed at adapting cities to climate change through the implementation of nature-based solutions (NBS) and the integration of the so-called gray and green infrastructure. Increasing the metabolic efficiency of the city by closing metabolic cycles therein - food production, water circulation, gas assimilation – e.g. CO₂, etc. Applying a new approach to city design by using solutions based on biomimicry or

⁶https://www.epa.ie/pubs/reports/research/horizon2020/Nature-Based_Solutions_&_Re-Naturing_Cities.pdf

ecological urban planning. An example of such activities may be the rehabilitation of rivers in cities by, for example, creating ecosystems and restoring floodplains.⁷

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An example of such an approach is the restoration of mangrove forests in Sanya, China. More about this project at the link:<https://www.asla.org/2020awards/178.html>

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Mitigation of the effects of climate change (while building resilience) and management of the risks resulting from it.⁸

Implementation of greenery in urban structures is to be carried out in such a way that fulfills multifaceted roles, such as: risk management, production of ecosystem services as well as social and economic roles. These solutions are also multifunctional and affect many aspects of city management, for example, the installation of green roofs is designed to both retain rainwater and prevent excessive heating of the roofs.⁹

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An example of such an approach is, among others, a comprehensive plan made for Copenhagen to protect the city from flooding due to heavy rainfall. More about the project on the website: <https://www.asla.org/2016awards/171784.html>

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7 priority actions of nature-based solutions.

Nature Based Solutions (NBS) are used in specific activities:

- a) Introduction of NBSs onto brownfields. This action is related to the revitalization of

⁷https://www.epa.ie/pubs/reports/research/horizon2020/Nature-Based_Solutions_&_Re-Naturing_Cities.pdf

⁸https://www.epa.ie/pubs/reports/research/horizon2020/Nature-Based_Solutions_&_Re-Naturing_Cities.pdf

⁹https://www.epa.ie/pubs/reports/research/horizon2020/Nature-Based_Solutions_&_Re-Naturing_Cities.pdf

specific areas. Urban, post-industrial, post-rail and post-transport areas are used here.¹⁰ You can transform both large spaces and those occupying small areas, the so-called micro space.

- b) Actions aimed at creating the well-being of city dwellers. By creating recreational or biologically active areas in urban areas (especially where we have denser buildings). New solutions should be designed in a flexible, simple and cheap way - so that they can be easily modified according to the current needs of the residents. A good example will be the adaptation of the former landfill space for the city of New York - "Freshkills Park".
- c) Coastal protection activities. Climate change is becoming especially dangerous for coastal urban spaces. Restoring coastal ecosystems can help to increase the protection of coastal urban spaces, but also increase the share of ecosystem services, and hence the tangible economic and social benefits. NBSs in coastal areas protect them from floods and the effects of soil erosion. Creation of e.g. artificial salt marshes is used here.
- d) Activities with the functions of managing watersheds in specific areas. The essential components here will be: rainwater retention or reclamation of drainage basins.
- e) NBS solutions can also be an important element of sustainable energy management in cities. Nature-based solutions can reduce the amount of energy used in a city. The use of green roofs or green walls can provide additional insulation for the building. Natural processes (physiological processes of plants) are also used to cool and purify the air and water. Energy generation - an example of a building in Hamburg whose facades are covered with photobioreactors filled with algae suspension.
- f) Actions to protect existing ecosystems. Improvement of the ability to cope with disruptions caused by the effects of climate change in the world.
- g) Carbon sequestration activities. Using plants to capture, reduce and store carbon dioxide.

¹⁰https://www.epa.ie/pubs/reports/research/horizon2020/Nature-Based_Solutions_&_Re-Naturing_Cities.pdf

9) Using a multi-faceted approach. Solutions based on nature are multifunctional and have various forms, because it is the so-called "collective concept" for other tools.¹¹

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Activities (EbA) - the use of ecosystem services in adaptation to climate change. These activities use the potential of local communities. This scope also includes activities related to education.¹²

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An example of such activity is a project for the benefit of the local community affected by Hurricane Katrina. More about the project on the website:

https://www.asla.org/2018awards/455517-Homeplace_Conversation.html

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Activities (EbM) - aimed at developing global, long-term benefits influencing climate change mitigation. Such solutions are used outside the cities. They consist in restoring entire ecosystems - e.g. forests.¹³

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An example of such a solution is the project for Galveston Island State Park. More about the project at the link: <https://www.asla.org/2017awards/324291.html>

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Activities (CAS) - Understanding the key ecological mechanisms and features that support the ability of ecosystems to adapt to change.

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An example of this is an artificial floating wetland project for the city of Baltimore in the USA. More about the project on the website: <https://www.asla.org/2018awards/454005->

¹¹Seddon N, Chausson A, Berry P, Girardin CAJ, Smith A, Turner B., 2020, Understanding the value and limits of nature-based solutions to climate change and other global challenges, .Phil. Trans. R. Soc. B, 375, 20190120

¹²Cohen-Shacham E., Walters G., Janzen C. and Maginnis S. (eds.), 2016, Nature-based Solutions to address global societal challenges, Gland, Switzerland

¹³Cohen-Shacham E., Walters G., Janzen C. and Maginnis S. (eds.), 2016, Nature-based Solutions to address global societal challenges, Gland, Switzerland

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Actions (Eco-DRR) - consisting in minimizing the effects of a disaster through proper preparation of local communities for it. An example is the restoration of coastal ecosystems.¹⁴

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The newly designed parks on the Hudson River in New York might be a good example here, more about these projects can be found on the website:

https://www.asla.org/2018awards/454576-Brooklyn_Bridge_Park.html

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¹⁴Cohen-Shacham E., Walters G., Janzen C. and Maginnis S. (eds.), 2016, *Nature-based Solutions to address global societal challenges*, Gland, Switzerland