Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

The Effect of Blue Green Infrastructure for New Development of Town and Cities

Silpa. N, Anbuchezian Ashokan

Department of Civil Engineering, Annapoorana Engineering College, Seeragapadi, India.
Email: principalaecsalem@gmail.com

Cities and their residents are impacted by the growing effects of climate change in various ways. Urban areas, infrastructure, and green places are all destroyed by extreme weather events. The goal of measures made to strengthen cities' resilience and adaptation to climate change is to lessen or eliminate negative effects or to boost the advantages of hazards. They vary in personality and shape according on the degree of economic and social development as well as the availability of financial, institutional, human, and intellectual resources. The methods and equipment utilised in planning and urban development are very crucial. The creation of contemporary systems of blue-green urban infrastructure is a crucial component of adaptation actions. Experience over the past several years has demonstrated the variety of practical initiatives based on natural remedies. Both the provisions of climate change policies and the realisations that may be seen in the urban environment reflect them.

The study focuses on structuring urban space, highlighting the value of environmental services, and strengthening resilience to climate change via planning and implementation initiatives. The study is concentrated on Polish cities that have developed Urban Adaptation Plans (MPA). The purpose of this paper is to outline the blue-green infrastructure projects covered by the MPA, discuss the opportunities for their implementation, and demonstrate how they contribute to urban spaces' increased appeal, better quality of life, and increased local community awareness and participation.

Keywords: Blue Green Infrastructure, Urban, Cities, Development, Life.

1. Introduction

The rate of climate change is accelerating [1]. Urban locations are where this is most obvious. Cities, which have the highest concentration of structures and habitations, are particularly vulnerable to the inconvenience brought on by these changes. Extreme weather events including hot (heat) and low (frost) air temperatures, downpours and heavy rains, storms, gusty winds, flooding, flash floods, and droughts, which devastate metropolitan areas and green spaces and are mirrored in the landscape, can have an impact on humans.These phenomena have an impact on a variety of municipal functions, including public space, infrastructure, construction, communication, transportation, the power sector, production, and resident safety. Additionally, they have an impact on the local natural environment and cultural heritage [2].Recognizing the issue, more and more cities are adopting measures to adapt to climate

change. Urban adaptation strategies are developed to address a wide variety of concerns, thus they vary in character and structure as a result.

This variety is influenced by the amount of financial, institutional, human, and intellectual resources, as well as the economic and social development of the nation and the area.In addition to following the law, it is essential to have the necessary organisational and financial resources. The main goal of these initiatives is to safeguard against the harmful consequences of climate change, strengthen urban resilience, and seize the benefits they bring. They want to include local residents in shaping the future of the environment and urban areas while also enhancing the standard of living for those who live there.Activities for adaptation may also be thought of as a strategy to make cities more appealing and secure. The creation of contemporary systems of blue-green urban infrastructure is a crucial component of adaptation actions (BGI). The past several years' experience has demonstrated the variety of applied solutions based on natural capital. Both the provisions of climate policies and the realisations discernible in the urban landscape reflect them.

The paper's main objectives are to increase climate change resistance, highlight the value of ecological services, and reshape urban space. The study is concentrated on Polish cities that have developed Municipal Adaptation Plans (MAP). The paper's goal is to outline the blue-green infrastructure initiatives covered by the MAP, their methods of implementation, and how they contribute to bettering urban environments, creating public awareness of them, and involving nearby communities.

2. Materials and Methods

2.1 Polish preparation for climate change and strategic measures

At the international, national, regional, and local levels, the capacity to manage climate hazards has emerged as a crucial development goal. Numerous climate change policies and adaptation initiatives have been enacted at the EU level. Regarding planning, policy, and implementation of climate change adaptation goals for cities, the Paris Agreement [8] and the 2030 Agenda for Sustainable Development [15] have offered substantial obstacles for many nations.All Member States were required under the policy framework established by the EU Council to create long-term national policies, adopt Integrated National Climate and Energy Plans, and ensure that these documents are coherent with one another. As a result, the problem of climate change has progressively come to be recognised as one of the key components of the state and Polish cities' development strategies.

The EU White Paper Adapting to Climate Change: Toward a European Framework for Action, COM 2009 [17] or the "Cancun Adaptation Framework" (CAF), developed in 2007-2010 within the framework of COP16, were among the EU documents that had a significant influence on the development of adaptation policy in Poland. Package for the EU Adaptation Strategy, COM 2013 [5]. The most significant Polish document became "SPA 2020 – Strategic Adaptation Plan for Sectors and Areas Sensitive to Climate Change by 2020, including a perspective up to 2030", adopted in 2013. This document replaced the "Strategy for Responsible Development for the period up to 2020, including a perspective up to 2030" (SRD) adopted in 2017 [14] and the "Ecological Policy of the State 2030" (PEP2030) of 2019

[13]. It was the first piece of its sort in Poland that dealt specifically with the problem of coping with continuous climate change.

It emphasised the necessity of implementing statutory, organisational, educational, or scientific measures to ensure the sustainable development and efficient operation of the Polish economy and society under changing climatic conditions [9] and programmes on electromobility, green technologies, implementation of green-blue infrastructure investments, air pollution reduction, prosumer energy development, drought mitigation in Poland, etc. The creation of Municipal Climate Change Adaptation Plans was made possible by all of these papers, programmes, and initiatives.

2.2Strategic and execution methodology for Municipal Climate Change Adaptation Plans (MPA)

Based on a methodological framework and guidelines established by the Ministry of the Environment [2], a group of experts prepared documentation using participatory methods in collaboration with members of local communities, public officials, managers of urban networks and real estate, activists, scientists, and businesspeople. The documentation included a diagnosis of the current situation, identification of the cities' active areas as well as an analysis of their vulnerability.Its goal was to determine how vulnerable the biggest Polish cities were to climate change in order to develop plans for countering those threats and strengthening the cities' resilience to, among other things, "urban" floods caused by sudden and intense precipitation, floods from river flooding, protracted droughts and the resulting lack of or restricted access to water, heat waves, and strong winds and storms.

Another goal was to inform and increase awareness of the predicted hazards among urban people as well as local authorities.This was the first time in Europe that such a comprehensive measure was done to increase the resilience of major cities to climate dangers. Additionally, it was the first time in Poland that threats to cities posed by climate change were coherently identified on this scale, that the regions most susceptible to changes were highlighted, and that adaptation strategies aimed at reducing the negative effects of those changes were identified.

The scope of the activities taken (a few dozen cities at once), the Ministry of the Environment's support for the authorities and local administration, and the participation of residents, authorities, and specialists laid the groundwork for the actions taken to be effective. The Urban Adaptation Plans evolved into a tool for creative and innovative policymaking aimed at increasing cities' resilience to ongoing environmental changes, as well as an instrument of urban policy enabling application for funds for projects (resulting from the MAP) aimed at climate change adaptation.

2.3 The MAP-derived blue-green infrastructure measurements

The MAP's actions have been broken down into three categories: organisational (concerning changes in how cities operate in terms of management of institutions, pertinent services, space, and resident behaviour), technical, and informational and educational (aimed at promoting knowledge about climate change and good practises for adaptation) (consisting of realisation of investments of adaptation nature, including blue-green infrastructure of the city and changes in its buildings). The majority of the actions were multifaceted and interdisciplinary, covering various time and space contexts and action-taking methodologies, from investments like

building infrastructure to soft measures that will have an impact on increasing awareness of climate change adaptation, potential threats, or changes in urban community behaviour.

It was anticipated that their implementation, particularly in the areas of modernising flood protection systems, effectively managing water resources, and coordinating systems for green and blue infrastructure, would lead to improvements in the operation and administration of the city.In order to improve housing, recreation, and investment conditions, determine the comfort and quality of life in the city, and lower the dangers associated with climate change, suggested environmental, economic, and spatial improvements in urban infrastructure or green spaces were made [3]. The creation, improvement, and reshaping of blue-green infrastructure (BGI) systems was a significant component of the activities of urban adaptation strategies. They sought to improve current resources and operational blue-green infrastructure solutions while also creating and developing new components. Their goal was to lessen the adverse consequences of climate change on populated regions, infrastructure, green spaces, public buildings, and residential areas.In order to achieve systems of linkages between green spaces, ecosystem services, and rainwater management, as well as to increase public knowledge of the advantages of BGI, the solutions have to be complicated.

Some of the suggested adaption measures seek to boost ecosystem services or gradually raise the standard of the urban environment. The following are examples of "micro-interventions" in urban space:

– so-called "green architecture" solutions (green roofs, walls, and vertical gardens);

– creating bioretention surfaces for urban meadows and rain gardens in public spaces;

– the introduction of so-called „refuge areas" (fog curtains, sprinklers, fountains, temporary canopies);

– renewing and introducing greenery in selected urban spaces (green courtyards, squares, pocket parks);

– development and revitalisation of degraded public areas and spaces,

– implementation of nature and education trails, etc.

Some of the actions had a direct connection to promoting environmental education for sustainable development and boosting public awareness of climate hazards. The implementation of educational, informational, and promotional projects; training in the area of health protection in extreme weather situations; organisation of campaigns and social actions aimed at enlightening locals and rousing society to pro-ecological activities; and others were among these activities.

It was believed that by 2030, all adaptation strategies outlined in the MAP would have been put into practise in Polish cities. They may be effective because people are aware that the solutions they choose will affect not just how comfortable daily living is, but also the citizens' health and even survival.

2.4 Activities for adaptation – a MAP experience of Polish cities

The chances to utilise mechanisms connected to investment funding (EU, national, and regional) have been the basis for the implementation actions carried out by Polish cities thus

far. Some of them are the continuation of concepts used even before the Urban Adaptation Plans were adopted. Many of the active projects are in the BGI sector. The Infrastructure and Environment Operational Programme 2014-2020, one of whose main action directions is „environmental protection, including adaptation to climate change," is where a sizable portion of them are put into practice [7].

The ones that promote strategies for naturally retaining, purifying, and distributing water in cities are prominent among these investments in sustainable water management. Cities favour systemic approaches as well as targeted activities, which leads to a variety of programmes, initiatives, or implementation projects. Their job is to make cities more comfortable to live in, to make cities more appealing, and to get local communities more involved.These are directories of ethical conduct and ecological patterns that have demonstrated how climate change might be managed in certain contexts and with particular dangers. They also contain a number of recommendations and actions for blue-green infrastructure that will offer practical and technical assistance for the execution of investments. Due to the universality of the regulations in the catalogue, a variety of organizations—including housing cooperatives, private property owners, and governmental organizations—will be able to put them into practise. For instance, Bydgoszcz and Wroclaw produced such catalogues.

The "Deszczówka.info" service and a manual on how to utilise environmentally friendly solutions that city residents may use were produced in ód. Such initiatives offer assistance to potential investors, locals, and those who want to actively participate in adaptation efforts.Environmental protection, particularly adaptation to climate change, is one of the directions of priority measures in the Infrastructure and Environment Operational Programme 2014-2020, which was created through a systematic approach and spot actions [7]. The ones that promote strategies for naturally retaining, purifying, and distributing water in cities are prominent among these investments in sustainable water management. Cities favour systemic approaches as well as targeted activities, which leads to a variety of programmes, initiatives, or implementation projects. Their job is to make cities more comfortable to live in, to make cities more appealing, and to get local communities more involved.

These include catalogues of good practices and ecological behavior patterns, which have shown how climate change can be dealt with in specific situations and with specific risks. They include a set of blue-green infrastructure advice and actions that will provide substantive and technical support for investment implementation. The catalogue's rules, thanks to their universality, will be possible to implement by various entities, including housing cooperatives, individual property owners, as well as public institutions. Such catalogues were prepared, for example, in Bydgoszcz and Wrocław. In Łódź, the „Deszczówka.info" service and a guide on how to apply nature-friendly solutions that can be used by city residents were developed. Such activities provide support for investors, residents and those who want to actively engage in adaptation activities.

These included „Silesian Rain Gardens" and „Rain Parcel" in Katowice, a vertical garden in ZielonaGóra, a small estate park in Opole or „Mid-settlement Oases" in SiemianowiceŚląskie. The Foundation also conducted workshops and green lessons at schools, presenting ways to create gardens retaining water and explaining the purpose of their implementation in urban areas. All strategic and implementation adaptation activities undertaken so far in Polish cities

allow for the conclusion that the main chances for their effectiveness have been connected with: – increased safety and health protection of the population (efficient water management systems, extensive flood protection systems, etc.);

– improving the comfort of urban living and increasing the attractiveness of urban spaces (introducing blue-green infrastructure solutions into urban spaces, reducing thermal risks, etc.);

– ensuring the cohesion and sustainability of the natural spatial network of towns and cities (taking care to protect and ensure appropriate conditions for the development or maintenance of appropriate quality standards of individual elements of the natural environment and their interrelations);

– ensuring coherence of spatial planning with climate change adaptation aspects (spatial planning solutions, flexibility of spatial planning);

– raising awareness, responsibility, and involvement of all adaptation actors in the city – local authorities, municipal services, city dwellers and civil society organisations

– in the implementation of actions (adequate education covering the issue of climate change, indicating specific methods to protect against it considering local specificities);

– development of rapid response and warning systems to prepare to cope with risks and limit damage (implementation of a system for monitoring and early warning of threats to infrastructure, agriculture, and elements of the natural environment).

3. Conclusions

-implementation BGI adaptation initiatives put a strong emphasis on sustainable and effective urban development, boosting the aesthetic appeal of urban areas, expanding the quality of life in cities, and increasing local community knowledge and engagement. They primarily deal with architecture, urban planning, the development of green buildings, transportation infrastructure, the adaptation of public spaces, and the potential of recreational and leisure zones.Their adoption is a consequence of economic, social, and environmental concerns in addition to the need to reduce the effects of climate change. By putting such safeguards in place, one may lessen the dangers brought on by numerous hazards while also opening up fresh possibilities for future climate change adaptation. It was feasible to draw conclusions from the experience of cities with MAPs that planning and execution activities based on natural capital:

– must not be restricted to a closed catalogue of solutions, but must allow for individualization of practises;

– should be cross-sectoral, multi-level, flexible, and consistent with other strategic and implementation actions; – must be tailored to the unique characteristics and conditions of the city, their unique local identity, individual risks, and difficulties, and their effectiveness is based on taking into account the needs and opinions of the inhabitants;

– should be based on a systemic approach, complemented by targeted actions

- must be supported by appropriate legal, planning, financial, organisational instruments, responsible for creating operational programmes and action plans from which investment and non-investment projects result.

The creation of adaption plans for 44 Polish cities served as a foundation for starting new initiatives as well as continuing those that had already been started. Other Polish cities may implement development policies aimed at combating climate change using the information and experience obtained during the preparation of the adaptation policy.

The things done are just the start. According to the "National Environmental Policy 2030" of 2019, the Polish Ministry of Climate launched a new initiative called "City with Climate" in 2020. Its objective is to mobilise cities to take steps to enhance the quality of life for those who live there as well as to aid cities in their transition to climate neutrality and climate resilience. More than 250 Polish communities have submitted applications for the ministry's study project, which compares local statistics on trash management, air quality, green areas, sustainable transportation, and water and sewage management.

This offers a chance to gather information for an adaptation strategy that is more environmentally friendly. Their implementation helps to create an image of Polish cities as innovative, up for challenges, adaptable, and change-ready towns of the future.

References

[1] Adaptation activities in the city – an opportunity for development, educational publications of the project: „Climate change adaptation plans in 44 Polish cities". EPE Ministry of the Environment. Warsaw 2019, <www.44.mpa.pl> [accessed 19.03.2021].

[2] Adaptation Manual for Cities. Guidelines for preparing a Municipal Climate Change Adaptation Plan. Ministry of the Environment. Warsaw 2014, <https://klimada.mos.gov.pl/wpcontent/uploads/2015/09/Podr%C4%99cznik-adaptacji-dla-miast1.pdf> [accessed19.03.2021].

[3] Climate change adaptation plans in 44 polish cities. Ministry of the Environment. Warsaw 2017-2019, <http://www.44mpa.pl/> [accessed 19.03.2021].

[4] Development and implementation of a strategic adaptation plan for the sectors and areas vulnerable to climate change. Klimada Project. Institute of Environmental ProtectionNational Research Institute. 2011-2013, <http://klimada.mos.gov.pl/en/about-project/>[accessed 01.03.2021].

[5] EU Adaptation Strategy Package. COM 2013, <https://ec.europa.eu/clima/policies/adaptation/what_en#tab-0-1> [accessed 01.03.2021].

[6] Green Budget of the City of Katowice. 2020, <https://www.katowice.eu/dlamieszkańca/zaangażuj-się/konsultacje-społeczne/zielonybudżet> [accessed 19.03.2021].

[7] Infrastructure and Environment Operational Programme 2014-2020.<https://www.pois.gov.pl/strony/o-programie/projekty/> [accessed 19.03.2021].

[8] Paris Agreement, United Nations 2015, <https://unfccc.int/sites/default/files/english_paris_agreement.pdf> [accessed 19.03.2021].

[9] Polish National Strategy for Adaptation to Climate Change (NAS 2020) with the perspective by 2030. Ministry of the Environment. Warsaw 2013, <https://bip.mos.gov.pl/fileadmin/user_upload/bip/strategie_plany_programy/Strategiczny_plan_adaptacji_2020.pdf> [accessed 19.03.2021].

[10] Reducing stormwater costs through Low Impact Development (LID) strategies and practices.U.S. Environmental Protection Agency. EPA. Washington D.C. 2007,

[11] Special Report on Global Warming of 1.5 ºC. Intergovernmental Panel on Climate Change (IPPC). 2018, < https://www.ipcc.ch/sr15/> [accessed 19.03.2021].
[12] The Cancun Adaptation Framework (CAF), agreed at the UNFCCC COP 16 in 2010. Report of the Conference of the Parties on its sixteenth session. Cancun 2010, <https://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=4> [accessed19.03.2021].
[13] The 2030 National Environmental Policy, Ministry of climate. Warsaw 2019, <https://bip.mos.gov.pl/fileadmin/user_upload/bip/strategie_plany_programy/Polityka_Ekologiczna_Panstwa/Polityka%20Ekologiczna%20Pa%C5%84stwa%202030%20ENG_wersja%20internet.pdf> [accessed 20.02.2021].
[14] The Strategy for Responsible Development for the period up to 2020 (including the perspective up to 2030) SRD. Warsaw 2017,<file:///C:/Users/Alisia/Downloads/SOR_2017_streszczenie_en.pdf> [accessed 08.03.2021].
[15] Transforming our world: the 2030 Agenda for Sustainable Development, Resolution adopted by the General Assembly on 25 September 2015, <https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E> [accessed 20.02.2021].
[16] Urban-Industrial Areas in the Light of Climate Change on the Example of Cities in the Central Part of the Metropolis GZM. J. Gorgoń ed. [w:] Works&Studies No.89, Cz. Rosik-Dulewskaed. Institute of Environmental Engineering of the Polish Academy of Science. Zabrze 2019.
[17] White paper - Adapting to climate change: towards a European framework for action. European Commission COM (2009) 147 final. Brussels 2009