Green Infrastructure in Spatial Planning

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Adaptation to climate change is becoming one of the main paradigms for how cities function and develop. The significant role of green infrastructure (GI) as a tool for cities to adapt to climate change is increasingly emphasized among practitioners of spatial planning and in the research literature. Green infrastructure should be understood as "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. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas".

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1. Introduction

The need to adapt to climate change is emphasized in the Strategy of the European Union [1][2]. Increasing the resilience of European Member States is to take place through "[achieving] coordination and coherence at the various levels of planning and management through national adaptation strategies" [2]. As a response, the Polish government published the "Strategic Adaptation Plan for Sectors and Areas Sensitive to Climate Change in Poland until 2020, with a perspective until 2030" (SPA 2020) [3]. At the regional and local level, strategic documents are being developed to define the directions of activities adapting cities to climate change.

The constant pressure of changes and the need to transform cities, caused by dynamic processes within urban structures and the impact of the environment, necessitates new abilities. Some urban centers quickly and effectively adapt to new challenges, but in others, the dynamics of the environment lead to regression or stagnation [4]. Adaptation is an auxiliary concept in planning activities and in directing the process of better managing the current conditions and those expected to change while limiting the negative effects [5]. This allows the desired balance and durability of the city's functional structure to be achieved. Thus, the adaptive capacity of cities is manifested by responding to disturbances and absorbing unpredictable disturbances without a significant change in the structure and functions, or by effectively creating new ecosystem structures in a short time after the disturbance occurs. The harmonious development of the urban environment can be achieved by introducing greenery as a new infrastructure that better shapes the space in the city [6] and allows for a gentler adaptation to climate change.

Green infrastructure should be understood as "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. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings" [7]. An urban planning process focused on the inclusion of green spaces can contribute to the provision of ecosystem services and to benefits for the local community while also improving the quality of the environment and adapting cities with green infrastructure to climate change [8].

The Sustainable Development Goals adopted by the United Nations under the Agenda 2030 set new expectations for the future, focusing on sustainability, fairness and inclusiveness [9]. Hence, one of the key and multidimensional challenges of Upper Silesia is a just transition involving the transformation of the economy toward a low- and zero-emission economy, while reducing the social costs associated with the pro-environmental shaping of urban development. Changes in the energy sector toward a low-emission economy (energy transformation) will entail consequences on the labor market and in the structures of mining, conventional energy and related industries in the production chains. This can bring about negative social effects and, in coal regions, even changes in cultural identity [10]. The need to restructure the raw materials and energy sector, which still generates huge amounts of air pollution and greenhouse gases, is dictated by climate change and its global consequences [11].

Reorienting the development paths [12][13] of this region requires the search for new development concepts and technological changes conducive to sustainable socioeconomic transformation, as well as efforts to respect elements of the natural environment [14]. An important dilemma in defining new development paths in post-mining regions is posed by the need to revitalize [15][16] and transform the existing functions performed by post-industrial areas [16][17][18][19]. The emergence of problems related to designating new functions for post-mining areas generates the need to change local and regional land-use strategies [20] and to seek a balance between social and economic needs [21][22]. Therefore, research is being conducted on post-industrial cities in terms of opportunities and threats affecting the possibility of changing development conditions [23][24].

2. Green Infrastructure in Spatial Planning

The European Commission recognizes green infrastructure as a strategic tool for the protection of biodiversity and ecosystem services and as an important solution for adapting and mitigating the effects of climate change [7][25][26]. In addition, nature-based solutions, green infrastructure and ecosystem adaptation are of strategic importance for the challenges of climate change and the resilience of cities, including society itself [27]. They provide benefits in terms of adapting areas in order to minimize the effects of climate change, regulating the hydrological network, water management and the impact on land value. In addition, these solutions contribute to reducing soil erosion, filtering pollutants, food production, increasing recreational areas and improving the health of the population [28], as well as protecting biodiversity or restoring degraded biodiversity [29][30]. The negative effects of extreme climatic phenomena and natural disasters (floods, forest fires, avalanches) can be reduced using functional floodplains, riparian forests, protective forests in mountain areas or barrier beaches [7]. In cities, it is recommended to implement green infrastructure in the form of protected areas and other natural areas, restorative habitats, ecological corridors, green bridges, flower meadows or green roofs and walls [31], reducing both the outflow of rainwater [32] and heat island effect [33][34]. As a consequence, urban heat islands [35][36] have a negative impact on the comfort of living and healthy ecosystems (human health), generating problems related to energy management in the city [36] and natural wind flow [37][38].

The role of green infrastructure as a tool for adapting urban areas to climate change was emphasized by Gill et al. [39], who considered it a crucial policy instrument in urban planning at all levels. Irga et al. analyzed the popularity of targeted policy instruments aimed at implementing green infrastructure in Australia in the form of green roofs and green walls [40]. In the literature on the subject, attention has been paid to the aspects of planning and the successful implementation of green infrastructure, which is determined by the availability of planning tools [40], the interest shown by particular parties, the institution implementing the project, participants and coordination of the listed factors. Matthews et al. emphasized that the implementation of green infrastructure as a tool for adapting to climate change depends on the available areas for greening, the morphology of the area and the characteristics of individual species, but above all, on management and community involvement in the decision-making process [41].

Salata drew attention to the inconsistency of concepts describing adaptation, which are most often hidden under scientific terms referring to vulnerability, adaptability and resilience. She attempted to identify, classify and define the main determinants based on scientific and political documents dealing with the issues of practical adaptation regarding green infrastructure planning [5]. She outlined the key strengths and weaknesses of building urban resilience [42], which improves cities' capacities to cope with contemporary challenges [43]. In addition, she emphasized that GI is one of the most appropriate and effective ways to improve the microclimate and counteract the urban heat island effect [44][45].

Adapting cities to climate change and mitigating climate change has become, on the one hand, an important part of policy, and on the other, an indispensable strategic action at all levels of spatial planning and management [44][46][47][48][49]. In addition, spatial planning in the field of adapting to climate change should be promoted on a local and regional scale, inducing a synergy effect, for example, in the field of biodiversity protection [50]. Hurlimann and March [51] presented six reasons why spatial planning can address adaptation, while Wilson [52] focused on the role of local development plans in the UK as a means of promoting adaptation to climate change. Such an approach is crucial in adapting cities and creating their resilience to climate change [7][52][53][54][55].

A number of factors facilitating and hindering the successful implementation of green infrastructure projects can be found in the literature. Taking into account the possibilities in the field of design, management of organizational structures, obtaining funds or involving beneficiaries in the implementation of green infrastructure, it can be stated that there is no universal recipe ensuring the successful implementation of a project [55]. Structural/operational barriers characterize the group's functioning, organizational structures and procedures in accordance with the existing regulations, principles and directions of long-term policies. They may force the introduction of changes in project management during its implementation due to the difficulties arising from the determination of property ownership [56] or the ineffectiveness of the system's response procedures to bottom-up opinions. Regulatory and legislative barriers are characteristic of the policy tools (obsolete or limited) at the disposal of organizations at many administrative levels. These barriers are caused by inconsistent and frequently changing relevant legal regulations, which, in turn, leads to a lack of connections between strategic and planning documents [56] or cumbersome administrative procedures related to the required documentation or applications for investment co-financing. The influence of cultural and behavioral barriers stems from customs, values, beliefs, interests and personal relationships between decision-makers [56]. They are related to the low level of awareness and social acceptance resulting from the different priorities and concerns of landowners and the potential negative impact on adjacent areas [57]. The above types of barriers appear in the context of each investment, i.e., the environment in which the organization operates, and the values and priorities represented by a given society [58]. When long-term processes of environmental change come into contact with short terms of office, it usually results in populist political decisions and expectations of spectacular results. There are also barriers due to the use of human, technical and financial resources that hinder the integration of a new initiative with the development strategy developed by a given administrative unit [59]. The fragmentation in how green infrastructure projects are implemented and the lack of continuity in financing result in an inability to create a common vision of development that seeks to create a system of natural, recreational and landscape connections. It should be noted that particular groups of barriers may occur at any stage of the implementation of green infrastructure projects or may constitute an obstacle preventing the implementation of projects.

The concept of green infrastructure has become one of the most efficient and effective planning tools for mitigating and adapting to climate change [5]. This tool increases the resilience of cities and reduces their vulnerability to the effects of climate change, thus enabling sustainable development. In order to obtain the most effective benefits from the use of green infrastructure, activities in the field of urban planning and management should be integrated [60][61]. The physical and organizational aspect of spatial planning should integrate socioecological interactions, changing the approach to a more ecosystem-based one.

However, it should be take into consideration that setting new paths for the development of post-industrial cities in the Katowice Conurbation is dictated primarily by the possibility of re-development of the post-mining areas studied, on the one hand, in the natural aspect, by preserving biodiversity and strengthening ecosystem services [62][63][64][65][66], and on the other hand, in terms of social transformation, economic and spatial development of the city and even the region [65][67]. Over the last 30 years, the image of Silesian Voivodeship and the Katowice Conurbation located within it has changed from one of a region dominated by heavy industry (especially hard coal mining) to that of a region with a diverse structure of industrial sectors and services, including metropolitan services and functions [68][69].

The development of post-industrial areas in the central part of the Silesian Voivodeship using the principles of green infrastructure has, so far, been carried out in the following areas: leisure and recreation (revitalization and afforestation, allotment gardens), education (education paths), nature (flower meadows, planting native plants, retention of rainwater), tourist (walking paths, bicycle routes) and investment (pocket parks, green balconies and roofs) [10][70][71][72][73]. Therefore, strengthening the resilience of cities to the effects of climate change induces a change in the approach to issues related to planning green areas and sustainable land use, migration and unemployment, social inclusion and exclusion, the commercial and residential real estate market and the scale of post-industrial areas and wastelands.

References

1. European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Empty. Forging a Climate-Resilient Europe—The New EU Strategy on Adaptation to Climate Change. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0082&from=EN (accessed on 20 March 2023).

2. European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions—An EU Strategy on Adaptation to Climate Change. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52013DC0216 (accessed on 20 March 2023).

3. Ministry of Climate and Environment. Strategic Adaptation Plan for Sectors and Areas Sensitive to Climate Change in Poland until 2020, with a Perspective until 2030. Available online: https://bip.mos.gov.pl/fileadmin/user_upload/bip/strategie_plany_programy/Strategiczny_plan_adaptacji_2020.pdf (accessed on 20 March 2023).

4. Drobniak, A.; Janiszek, M.; Plac, K. Zielona gospodarka i zielona infrastruktura jako mechanizmy wzmacniania gospodarczo-środowiskowego wymiaru prężności miejskiej. Res. Pap. Wroc. Univ. Econ. 2016, 443, 57–69.

5. Salata, K.-D.; Yiannakou, A. A Methodological Tool to Integrate Theoretical Concepts in Climate Change Adaptation to Spatial Planning. Sustainability 2023, 15, 2693.
6. Szulczewska, B. W pułapkach zielonej infrastruktury. In Zielona Infrastruktura Miasta; Pancewicz, A., Ed.; Wydawnictwo Politechniki Śląskiej: Gliwice, Poland, 2014; pp. 9–30.
7. European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Green Infrastructure (GI)—Enhancing Europe’s Natural Capital; European Commission: Brussels, Belgium, 2013.
8. Nakamura, F. (Ed.) Green Infrastructure and Climate Change Adaptation: Function, Implementation and Governance; Ecological Research Monographs; Springer Nature: Singapore, 2022; ISBN 9789811667909.
9. United Nations. Transforming Our World: The Agenda 2030 for Sustainable Development. 2015. Available online: https://sustainabledevelopment.un.org/post2015/transformingourworld/publication (accessed on 20 March 2023).
10. Pytel, S.; Sitek, S.; Chmielewska, M.; Zuzańska-Żyśko, E.; Runge, A.; Markiewicz-Patkowska, J. Transformation directions of brownfields: The case of the Górnośląsko-Zagłębiowska Metropolis. Sustainability 2021, 13, 2075.
11. Hansen, J.; Johnson, D.; Lacis, A.; Lebedeff, S.; Lee, P. Climate impact of increasingatmospheric carbon dioxide. Science 1981, 213, 957–966.
12. Krzysztofik, R.; Runge, J.; Kantor-Pietraga, I. Paths of Environmental and Economic Reclamation: The Case of Post-Mining Brownfields. Pol. J. Environ. Stud. 2012, 21, 219–223.
13. Görmar, F.; Harfst, J. Path renewal or path dependence? The role of industrial culture in regional restructuring. Urban Sci. 2019, 3, 106.
14. European Commission; Directorate-General for Climate Action. Going Climate-Neutral by 2050: A Strategic Long-Term Vision for a Prosperous, Modern, Competitive and Climate-Neutral EU Economy; Publications Office: Strasbourg, France, 2019.
15. Prach, K.; Řehounková, K.; Řehounek, J.; Konvalinková, P. Ecological restoration of central european mining sites: A summary of a multi-site analysis. Landsc. Res. 2011, 36, 263–268.
16. Adesipo, A.A.; Freese, D.; Zerbe, S.; Wiegleb, G. An approach to thresholds for evaluating post-mining site reclamation. Sustainability 2021, 13, 5618.
17. Mihaylov, V.; Runge, J.; Krzysztofik, R.; Spórna, T. Paths of evolution of territorial identity. The case of former towns in the katowice conurbation. Geogr. Pannon. 2019, 23, 173–184.
18. Vaishar, A.; Lipovská, Z.; Šťastná, M. Small towns in post-mining regions. In Post-Mining Regions in Central Europe Problems, Potentials, Possibilities; Wirth, P., Mali, B.Č., Fischer, W., Eds.; Oekom: München, Germany, 2012; pp. 153–167.
19. Mert, Y. Contribution to sustainable development: Redevelopment of post-mining brownfields. J. Clean. Prod. 2019, 240, 118–212.

20. BenDor, T.K.; Metcalf, S.S.; Paich, M. The dynamics of brownfield redevelopment. Sustainability 2011, 3, 914–936.
21. Syrbe, R.U. Recultivation and sustainable development of post-mining landscapes. In Legislation, Technology and Practice of Mine Land Reclamation; Hu, Z.Q., Ed.; CRC Press: London, UK, 2015; pp. 489–492.
22. Chang, J.; Feng, S. Strategies on redevelopment of mining city industrial wasteland. Urban. Dev. Stud. 2008, 2, 54–57.
23. Loures, L. Post-industrial landscapes as drivers for urban redevelopment: Public versus expert perspectives towards the benefits and barriers of the reuse of post-industrial sites in urban areas. Habitat Int. 2015, 45, 72–81.
24. Loures, L.; Vaz, E. Exploring expert perception towards brownfield redevelopment benefits according to their typology. Habitat Int. 2018, 72, 66–76.
25. European Commission Biodiversity Strategy-Environment—European Commission. Available online: https://ec.europa.eu/environment/nature/biodiversity/strategy_2020/index_en.htm (accessed on 20 March 2023).
26. European Commission Biodiversity Strategy for 2030—Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions—EU Biodiversity Strategy for 2030 -Bringing Nature Back into Our Lives. Available online: https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en (accessed on 20 March 2023).
27. Pauleit, S.; Zölch, T.; Hansen, R.; Randrup, T.B.; Konijnendijk van den Bosch, C. Nature-Based Solutions and Climate Change—Four Shades of Green. In Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Theory and Practice of Urban Sustainability Transitions; Kabisch, N., Korn, H., Stadler, J., Bonn, A., Eds.; Springer International Publishing: Cham, Switzerland, 2017; pp. 29–49. ISBN 978-3-319-53750-4.
28. Bertram, C.; Rehdanz, K. The role of urban green space for human well-being. Ecol. Econ. 2015, 120, 139–152.
29. García, A.M.; Santé, I.; Loureiro, X.; Miranda, D. Spatial Planning of Green Infrastructure for Mitigation and Adaptation to Climate Change at a Regional Scale. Sustainability 2020, 12, 10525.
30. European Environment Agency. Green Infrastructure and Territorial Cohesion. The Concept of Green Infrastructure and Its Integration into Policies Using Monitoring Systems; EEA Technical report No 18; Publications Office of the European Union: Luxembourg, Copenhagen, 2011; Available online: https://www.eea.europa.eu/publications/green-infrastructure-and-territorial-cohesion (accessed on 20 March 2023).
31. Janiszek, M. Zielona infrastruktura jako koncepcja rozwoju współczesnego miasta. Stud. Miej. 2015, 19, 99–108.
32. Vanuytrecht, E.; Van Mechelen, C.; Van Meerbeek, K.; Willems, P.; Hermy, M.; Raes, D. Runoff and Vegetation Stress of Green Roofs under Different Climate Change Scenarios. Landsc. Urban Plan. 2014, 122, 68–77.

33. Santamouris, M. Cooling the Cities—A Review of Reflective and Green Roof Mitigation Technologies to Fight Heat Island and Improve Comfort in Urban Environments. Sol. Energy 2014, 103, 682–703.
34. Griessler Bulc, T.; Ameršek, I.; Dovjak, M. Green Infrastructure in Settlements and Cities of the Future—Two Cases Studies; green roof and treatment wetland. Sanit. Inženirstvo 2014, 8, 67–80.
35. Priya, U.K.; Senthil, R. A review of the impact of the green landscape interventions on the urban microclimate of tropical areas. Build. Environ. 2021, 205, 108190.
36. He, B.J.; Wang, J.; Liu, H.; Ulpiani, G. Localized synergies between heat waves and urban heat islands: Implications on human thermal comfort and urban heat management. Environ. Res. 2021, 193, 110584.
37. Al-Sallal, K.A.; AboulNaga, M.M.; Alteraifi, A.M. Impact of urban spaces and building height on airflow distribution: Wind tunnel testing of an urban setting prototype in Abu-Dhabi city. Archit. Sci. Rev. 2001, 44, 227–232.
38. Alobaydi, D.; Mohamed, H.; Attya, H. The impact of urban structure changes on the airflow speed circulation in historic Karbala, Iraq. Procedia Eng. 2015, 118, 670–674.
39. Gill, S.; Handley, J.; Ennos, R.; Nolan, P. Planning for Green Infrastructure: Adapting to Climate Change. In Planning for Climate Change; Davoudi, S., Crawford, J., Mehmood, A., Eds.; Routledge: London, UK, 2009; pp. 273–285. ISBN 978-1-84977-015-6.
40. Irga, P.J.; Braun, J.T.; Douglas, A.N.J.; Pettit, T.; Fujiwara, S.; Burchett, M.D.; Torpy, F.R. The Distribution of Green Walls and Green Roofs throughout Australia: Do Policy Instruments Influence the Frequency of Projects? Urban For. Urban Green. 2017, 24, 164–174.
41. Matthews, T.; Lo, A.Y.; Byrne, J.A. Reconceptualizing Green Infrastructure for Climate Change Adaptation: Barriers to Adoption and Drivers for Uptake by Spatial Planners. Landsc. Urban Plan. 2015, 138, 155–163.
42. Galderisi, A.; Limongi, G.; Salata, K.D. Strengths and weaknesses of the 100 Resilient Cities Initiative in Southern Europe: Rome and Athens' experiences. City Territ. Archit. 2020, 7, 16.
43. Salata, K.-D.; Yiannakou, A. The Quest for Adaptation through Spatial Planning and Ecosystem-Based Tools in Resilience Strategies. Sustainability 2020, 12, 5548.
44. Salata, K.-D.; Yiannakou, A. Green Infrastructure and climate change adaptation. TeMA J. Land Use Mobil. Environ. 2016, 9, 7–24.
45. Yiannakou, A.; Salata, K.-D. Adaptation to Climate Change through Spatial Planning in Compact Urban Areas: A Case Study in the City of Thessaloniki. Sustainability 2017, 9, 271.
46. Davoudi, S. Framing the Role of Spatial Planning in Climate Change; GURU Electronic Working Paper 43; Newcastle University: Newcastle upon Tyne, UK, 2009; Available online: http://www.ncl.ac.uk/guru/publications/working/documents/EWP43.pdf (accessed on 20 March 2023).
47. Davoudi, S.; Crawford, J.; Mehmood, A. (Eds.) Planning for Climate Change: Strategies for Mitigation and Adaptation for Spatial Planners; Earthscan: London, UK; Sterling, VA, USA, 2009.
48. Measham, T.G.; Preston, B.; Smith, T.; Brooke, C.; Gorddard, R.; Withycombe, G.; Morrison, C. Adapting to climate change through local municipal planning: Barriers and challenges. Mitig. Adapt. Strat. Glob. Chang.

2011, 16, 889–909.

49. Jabareen, Y. Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. Cities 2013, 31, 220–229.
50. Lukat, E.; Tröltzsch, J.; Cazzola, G.; Kiresiewa, Z.; Blobel, D.; Terenzi, A.; Peleikis, J.; Latinos, V.; Purdy, R.; Hjerp, P. Regional and Local Adaptation in the EU since the Adoption of the EU Adaptation Strategy in 2013; European Union: Brussels, Belgium, 2016.
51. Hurlimann, A.C.; March, A.P. The Role of Spatial Planning in Adapting to Climate Change. Wiley Interdiscip. Rev. Clim. Change 2012, 3, 477–488.
52. Wilson, E. Developing UK Spatial Planning Policy to Respond to Climate Change. J. Environ. Policy Plan. 2006, 8, 9–26.
53. Busayo, E.T.; Kalumba, A.M.; Orimoloye, I.R. Spatial Planning and Climate Change Adaptation Assessment: Perspectives from Mdantsane Township Dwellers in South Africa. Habitat Int. 2019, 90, 101978.
54. Bruneniece, I.; Klavins, M. Normative Principles for Adaptation to Climate Change Policy Design and Governance. In Climate Change Management; Knieling, J., Filho, W.L., Eds.; Springer: Berlin/Heidelberg, Germany, 2013; pp. 41–65.
55. Smit, B.; Pilifosova, O. Adaptation to Climate Change in the Context of Sustainable Development and Equity. In Climate Change 2001: Impacts, Adaptation, and Vulnerability—Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change; McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J., White, K.S., Eds.; Cambridge University Press: Cambridge, UK, 2001; pp. 877–912.
56. Mendis, S.; Mills, S.; Yantz, J. Building Community Capacity to Adapt to Climate Change in Resource-Based Communities; Working Paper; Canadian Forest Service: Saskatoon, SK, Canada, 2003.
57. Engles, N. Adaptive capacity and its assessment. Glob. Environ. Change 2011, 21, 647–656.
58. Gallopín, G.C. Linkages between vulnerability, resilience, and adaptive capacity. Glob. Environ. Change 2006, 16, 293–303.
59. Nelson, D.R.; Adger, W.N.; Brown, K. Adaptation to Environmental Change: Contributions of a Resilience Framework. Annu. Rev. Environ. Res. 2007, 32, 395–419.
60. Lennon, M.; Scott, M. Delivering ecosystems services via spatial planning: Reviewing the possibilities and implications of a green infrastructure approach. Town Plan. Rev. 2014, 85, 563–587.
61. Schiappacasse, P.; Müller, B. Planning Green Infrastructure as a Source of Urban and Regional Resilience—Towards Institutional Challenges. Urbani Izziv 2015, 26, 13–24.
62. De Groot, R.S.; Alkemade, R.; Braat, L.; Hein, L.; Willemen, L. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex 2010, 7, 260–272.

63. Connop, S.; Vandergert, P.; Eisenberg, B.; Collier, M.J.; Nash, C.; Clough, J.; Newport, D. Renaturing cities using a regionally-focused biodiversity-led multifunctional benefits approach to urban green infrastructure. Environ. Sci. Pol. 2016, 62, 99–111.
64. Sonter, L.J.; Ali, S.H.; Waston, J.E.M. Mining and biodiversity: Key issues and research needs in conservation science. Proc. Biol. Sci. 2018, 285, 20181926.
65. Rahmonov, O.; Abramowicz, A.K.; Pukowiec-Kurda, K.; Fagiewicz, K. The link between a high-mountain community and ecosystem services of juniper forests in Fann Mountains (Tajikistan). Ecosyst. Serv. 2021, 48, 101255.
66. Chmielewska, M.; Lamparska, M. Post-industrial tourism as a chance to develop cities in traditional industrial regions in Europe. Sociol. Românească 2011, 3, 67–75.
67. Horváth, G.; Csüllög, G. The Role of Ecotourism and Geoheritage in the Spatial Development of Former Mining Regions. In Post-Mining Regions in Central Europe Problems, Potentials, Possibilities; Wirth, P., Mali, B.Č., Fischer, W., Eds.; Oekom: München, Germany, 2012; pp. 226–240.
68. Krzysztofik, R.; Kantor-Pietraga, I.; Kłosowski, F. Between Industrialism and Postindustrialism—The Case of Small Towns in a Large Urban Region: The Katowice Conurbation, Poland. Urban Sci. 2019, 3, 68.
69. Krzysztofik, R. The socio-economic transformation of the Katowice conurbation in Poland. In Growth and Change in Post-Socialist Cities of Central Europe; Routledge: Oxfordshire, UK, 2021; pp. 195–216.
70. Kantor-Pietraga, I.; Zdyrko, A.; Bednarczyk, J. Semi-Natural Areas on Post-Mining Brownfields as an Opportunity to Strengthen the Attractiveness of a Small Town. An Example of Radzionków in Southern Poland. Land 2021, 10, 761.
71. Gałas, S.; Gorgon, J.; Gałas, A. Impact of cities adaptation to climate change on water resources management on the example of selected cities of the Silesian Agglomeration. IOP Conf. Ser. Earth Environ. Sci. 2020, 444, 012017.
72. Wyrzykowska, A. The Land Use of Decommissioned Coal Mines Areas in the Upper Silesian Agglomeration (Poland). Archit. Civ. Eng. Environ. 2020, 15, 57–70.
73. Gieroszka, A.; Trząski, L.; Kopernik, M. Rewitalizacja Miejskich Dolin Rzecznych Jako Istotny Aspekt Polityki Miejskiej Doświadczenia z Realizacji Projektu REURIS w Katowicach; GIG: Kraków, Poland, 2014.