Urban Transformations

PERSPECTIVE Open Access

Urban environmental acupuncture as a tool to support nature-based solution implementation: does it deliver what it promises?

Jessica Marie Hemingway[1*]

*Correspondence:
Jessica Marie Hemingway
j.hemingway@ioer.de
[1]Leibniz Institute of Ecological Urban and Regional Development, Weberplatz 1, 01217 Dresden, Germany

Abstract

Urban environmental acupuncture (UEA) is a novel approach designed to engage with a variety of stakeholders to successfully implement nature-based solutions in dense urban areas. The Interreg Central Europe project SALUTE4CE piloted this concept through small-scale, low-budget interventions in four cities: Chorzow (Poland), Erfurt (Germany), Alessandria (Italy), and Liptovski Mikulas (Slovakia). The pilot projects were designed to be quickly implementable, utilizing abandoned or undesirable sites, with the potential to catalyze both physical and social transformation. Interviews with local actors in these cities after project implementation provided valuable feedback, which was used to develop principles of urban environmental acupuncture. While the limited number of interviews means these findings offer only initial insights, they are largely supported by existing research. Nevertheless, this perspective provides important lessons that can inform future transformation projects and help evaluate the success of the UEA approach. The key contributions of this work are the introduction of urban environmental acupuncture concept, deriving principles of UEA based on feedback from local stakeholders and offering insights in future design and evaluation of similar nature-based solution initiatives in dense urban environments. This perspective helps to establish the potential of UEA as a tool for engaging diverse stakeholders and catalyzing sustainable urban transformation (specifically expansion of nature-based solutions) through low-cost interventions.

Policy and practice recommendations

•To maintain low project costs, strategic decision-making is needed regarding the types of nature-based, the condition of the sites before construction, the infrastructure to be placed on the site as well as activation of volunteers in project activities.

•Within the Central European cities examined, small, underutilized, and abandoned spaces are abundant and offer a way forward in implementing nature-based solutions.
•To improve rapid implementation of nature-based solution implementation, processes within cities should be streamlined (e.g. bundling projects, easing planning requirements for micro projects).
•To further promote implementation beyond initial nature-based solution projects, catalyze broader transformations (e.g. include the public in planning and implementation processes, identify sites for future UEA implementation, integrate UEA in planning documents, obtain letters of commitment from politicians).

Science highlights

•The UEA principles provide actionable knowledge concerning nature-based solution implementation within dense urban areas, which can be developed and tested further.
•By developing and examining UEA principles, the need to learn from local, experiential knowledge to enrich the quality and impact of investigations is recognized.
•The success of the UEA principles in practice should be reflected upon with local practitioners, as this feedback loop can help refine the principles and improve implementation of nature-based solutions.
•Co-creation is important for further UEA research to improve planning and governance of nature-based solutions. Examination of UEA outside of the European context in more dense areas is needed to expand the applicability of the concept globally.

Keywords Urban environmental acupuncture, Co-creation, Urban transformation, Urban planning, Nature-based solutions

What is urban environmental acupuncture?

Urban environmental acupuncture or UEA was developed for and used to guide the SALUTE4CE project to specifically implement nature-based solutions. It stems from urban acupuncture, a heuristic or planning concept derived from traditional Chinese medicine, referring to planning actions which stimulate a city's nervous system via micro interventions with the intention to have a catalytic effect on the urban fabric as a whole (McGuirk 2014). The underlying idea of urban acupuncture and undoubtedly its chief message is that through implementation of many small interventions concrete changes take place, like a ripple effect helping to cure or enhance the entire system (Casagrande 2013; de Solà-Morales 2008; Lerner 2014). In early implementation, urban acupuncture was not focused on ecological sustainability but rather on urban regeneration. It has since developed further to include sustainability, climate change and urban greening initiatives (Balicka et al. 2021a; Apostolou 2015; Lastra and Pojani 2018). Most similar to UEA, eco-acupuncture is defined as a unique process to co-create visions to bring vision to interventions and catalyze rapid transformation (Ryan 2013). UEA is different, as it is specifically focused on nature-based solution implementation. UEA as utilized in the SALUTE4CE project, addressed barriers toward nature-based solution implementation specifically low city budgets, a lack of open sites for such nature-based solution implementation and the need to react quickly toward climate change impacts such as extreme heat or flooding.

What are the research gaps addressed?

The SALUTE4CE project and principles provide a good example of how nature-based solutions can be embedded in current planning and political frameworks. Specifically, the project addresses research gaps in the field of urban transformation by demonstrating approaches to multi-stakeholder co-creation and shared understandings of problems. Importantly, the project and principles move beyond conceptual solutions to provide actionable knowledge on *how* local collaboration and co-creation can enhance capacity building and support the implementation of nature-based solutions – areas that have previously identified as being critical research gaps (Connop et al. 2016; Wickenberg, McCormick, and Olsson 2021; Wolfram, Borgström, and Farrelly 2019; Frantzeskaki 2019). The project also addresses the necessity to generate new ways for engaging diverse stakeholders (Wolfram 2016) to increase adaptive capacity and overcome financial and implementation barriers. Furthermore, by creating and evaluating the principles of urban environmental acupuncture (UEA), this perspective piece addresses the need to learn from local, experiential knowledge to enrich the quality and impact of investigations, while also measuring the success of these principles in practice, by reflecting on them with local practitioners (Durose, Richardson, and Perry 2018). Overall, the SALUTE4CE project and its principles make important contributions toward bridging the gap between conceptual urban transformation models and their operational implementation.

Where has urban environmental acupuncture been implemented?

Despite their clear benefits, the implementation of nature-based solutions faces barriers such as a lack of political leadership, interagency cooperation, and guidance on integrating green infrastructure with grey infrastructure (Alex and Jim 2012; Deely et al. 2020). Challenges within design professionals include navigating regulations, financing, and fostering innovation (Zungia-Teran et al. 2020). The crucial role of resident inclusion and engagement in planning has been repeatedly emphasized as essential for overcoming obstacles and promoting the successful implementation of nature-based solutions (Zungia-Teran et al. 2020; 2020; Haaland and Konijnendijk van den Bosch 2015; Alex and Jim 2012). The SALUTE4CE project funded through Interreg Central Europe from 2019 until 2022 attempted to address these barriers with the goal to protect and develop natural resources through increasing the capacities of the public sector and related entities, to improve the integrated environmental management of green and blue infrastructure in functional urban areas. The countries included in the project were the Czech Republic, Poland, Slovakia, Germany, and Italy with the following backgrounds in research, city administration, botany, and local regional development. Co-creation was conducted across countries, academic disciplines, and professions for a number of deliverables including; an action planning concept, 4 local action plans, methodologies for selecting UEA sites and nature-based solutions. Sixteen pilot projects were implemented and were diverse, they included; elementary school gardens, pocket parks, an urban orchard, green facades, roof gardens, planter pots and urban meadows and varied in size (e.g. 300 m2, 600 m2, 1,600 m2). A commonality among all four pilot projects was a focus on climate change adaptation especially in relation to heat regulation, air quality, and high precipitation events (Hemingway et al. 2022). The public played an integral part in selecting, designing and in some cases implementing the sites, living labs

were conducted in the 4 pilot project countries. To advance the implementation of UEA training courses were co-produced in all 4 pilot project countries including an e-learning course with the option to obtain certification, a handbook and guideline on implementing UEA as well as lectures at universities and online and in-person training for practitioners. A review of each principle and the experience of practitioners is provided including suggestions on how to further improve UEA implementation.

Principle I: maintain low budgets through Strategic decision-making

Often small scale acupuncture projects are implemented because they are associated with being low cost (Balicka et al. 2021a; Benton et al. 2021). In the face of shrinking city budgets and increasing operating costs, it was thought that UEA offered a practical and operable solution within European cities (SALUTE4CE 2019). Despite the obvious logic that smaller green infrastructure projects cost less than large projects, more detailed information was sought concerning the practicality of this assumption. While interviewees felt UEA was indeed low budget, they also highlighted some important considerations to keep in mind.

Project partners agreed that construction costs of UEA sites are significantly lower as this is directly related to the UEA sites. One of the city officials compared the cost of a UEA site as being €93,000 compared to €400,000 for a larger public park. Another interviewee pointed out although individual projects are low cost they had not calculated a cost per square meter. There has been some evidence to suggest that large scale projects are in fact less expensive when scaled down per parcel (Local Housing Solutions 2023). However, where government budgets are constrained and implementing costly urban greening projects is impossible, UEA is still an actionable option. Interviewees also suggested considering the type of nature-based solutions chosen because may have a large impact on implementation costs. Take the example of a green meadow in Germany, it is much less expensive to create 10,25 € per Square Meter)(Witt 2018) than a green wall in Germany which costs €250 per square meter including technology and planting (Wiesneth 2021). Interviewees also recommended considering physical characteristics of potential sites at the time of acquisition. Sites needing little to no preparation before pilot project construction are less costly than those requiring debris removal or soil replacement for example. For international projects, it may be wise to consider the hourly wages across countries in the project budget. The average labor costs per hour worked can vary greatly (i.e. Germany €37.30, Italy €28.50, Poland €11.20 and Slovakia €14.00 (Statistisches Bundesamt 2022).

What is more, the addition of equipment such as benches and playground equipment have the potential to increase project costs dramatically. In Germany, the cost of a climbing rope is upwards of €5,200 euros, a climbing net pyramid €10,400, larger balancing and climbing facilities may cost upwards of €28,000 ("Was Kosten Spielgeräte Für Den Öffentlichen Bereich?" 2023). This may be country dependent, as costs in Germany tended to be more extensive than other project partner countries (i.e. Slovakia, Italy, Poland).

Finally, one interviewee referred to the unaccounted-for savings that may result from UEA implementation which we could not measure in the SALUTE4CE project. For instance, UEA interventions designed to mitigate the effects of climate change such as flooding and extreme heat may help to avoid expenses related to climate change damage

later - what is more, less demand for gray infrastructure and traditional irrigation systems which may result in lower economic cost. Indeed a combination of blue, green and grey measures has been found in the literature to be optimal where space is limited (Alves et al. 2020) and multiple co-benefits of green infrastructure have also been identified including climate adaptation (i.e. flood control), social, ecological and economic benefits (Elmqvist et al. 2015). Where costs should stay low, deliberate, and conscious decisions should be made to do so, either by avoiding the implementation of costly measures or equipment, or through other creative measures such as involvement of volunteers (e.g. site implementation, maintenance or donations (e.g. equipment, funding). Support for involvement of citizens in nature-based solution projects can be widely found (Rosso et al. 2022; Campbell-Arvai and Lindquist 2021). The small nature of UEA sites is conducive to resident involvement because the sites are less demanding than larger greenspaces. Based on this principle UEA could be implemented as intended as low budget interventions however it is through conscious decision-making and creative solutions that the budgets can remain low.

Principle II: leverage small, underutilized, and abandoned urban spaces to expand implementation of nature-based solutions

Small and underutilized spaces within cities have been identified as having the potential to expand the distribution of green space within dense urban areas (Peschardt et al. 2012). In some cases, re-wilding may have already occurred naturally or the spaces are simply abandoned or underutilize and may lend themselves to further nature-based solution development (Mathey and Rößler 2021; Preston et al. 2023; Hemingway et al. 2019). Abandoned urban micro-spaces may promote biodiversity (Villaseñor et al. 2020) by increasing wildlife habitat (Lima et al. 2023) and attracting less common animal species to colonize cities (Beaugeard, Brischoux, and Angelier 2021). They may also provide recreational spaces for urban dwellers (Hofmann et al. 2012) or contribute toward urban infrastructure as elements of storm-water management for example (Kirnbauer et al. 2013). Interviewees from all four project partner cities confirmed small, underutilized, and abandoned sites are indeed abundant and obtainable (i.e. each city identified potential sites using decision-making criteria developed in the project). Where ownership of the sites belonged to the cities themselves, obtainability was simpler than with privately owned sites (Hemingway et al. 2022). Interviewees also confirmed current spatial configurations due to former spatial development are conducive toward further development of UEA sites. Within post-industrial landscapes there has been a discussion on how to improve urban landscapes by re-developing them (Loures 2015). Restoring the natural environment in postindustrial cities has been found to be a good method of regenerating the economy, social conditions and urban infrastructure (Power 2018). The sentiment among project partners is that currently these derelict micro-spaces are perceived as undesirable for private developers. As such, these small sites are easily available and obtainable compared to larger sites. There is evidence that as density increases the desirability of micro-spaces also increase. In Tokyo, Japan, micro-bars, restaurants, housing and other diverse services can be found weaved into the dense urban structures (McReynolds 2023). In highly dense old city centers in China micro-spaces are preferred as they are conducive to communication and embedded into the city; they are seen as revitalizing the city and further cultural traditions (Song 2022).

Not only are these sites abundant and obtainable they are locally embedded and can easily be identified by local residents as a way to expand and embed nature-based solutions in dense urban areas. It was emphasized by interviewees that local residents had played an important role in the selection and identification of potential UEA sites. Technological advances such as social media in conjunction with Geographic Information System (GIS) tools had assisted citizens in co-identifying and selecting sites together with local practitioners. Citizen input utilizing GIS has been found to be useful in targeting conflict areas, less valued areas for redesign and management and beloved sites which should be protected (Rall, Hansen, and Pauleit 2019). GIS also has the potential to connect green spaces, help integrate UGI, improve collaboration and enhance a socially inclusive planning process (Rall, Hansen, and Pauleit 2019). All project partners organized living labs to promote and help organize UEA implementation. This could be seen as organizational policy instrument as local actors were mobilized via partnerships, agreements and social networks (Molenveld, Voorberg, and Brinkman 2020). Not only was citizen knowledge useful in identifying potential UEA sites but interviewees felt it likely improved citizen acceptance of the measures in the long-run. Indeed, locally initiated actions to implement greenspace have been shown to improve the physical quality of the space but also enhance social inclusion (Vaňo, Stahl Olafsson, and Mederly 2021). It was recommended that citizens also be involved in the maintenance of the micro UEA sites, however, the effectiveness of this could not be examined. This is related to the temporary funding of such research projects and highlights the need for funding to go beyond project implementation so that the impacts of such project can be evaluated. In the cities examined small, underutilized and abandoned sites were abundant and obtainable, and could be used to implement nature-based solutions. The principles could be expanded to highlight the practicality of engaging the public in these types of small and locally embedded project including identifying and selecting the sites.

Principle III: improve rapid deployment of UEA by streamlining implementation processes

Small-scale localized projects have been identified as a potential method of renewing and recovering cities. Bio-urban healing is one example where a development process occurs bridging modern society with nature (Casagrande 2020). Small scale planning projects have been said to be innovative as compared to traditional large-scale forms of urban renewal planning because they can be implemented quickly in response to community needs (Balicka et al. 2021a). Which is relevant in the contemporary world where the needs and challenges of the urban centers are quickly changing.

More recently, a shift has taken place from top-down to bottom-up approaches partially dependent upon volunteerism; the countries examined in this project were at various stages of this process (ROSOL 2010). Public and private actors can be "enabled or activated" to provide services such as greenspace where city budgets do not allow (ROSOL 2010). While valuable to the planning process citizen (public) participation (e.g. living-labs, online voting platforms) can be time consuming and costly which needs to be taken into consideration during project planning. One of the interviewees felt that the intensive public participation required within the SALUTE4CE project while implementing UEA was time consuming and slowed the process of green infrastructure implementation. However, they did see the added value and importance the public was making in the planning process. Despite the small-scale nature of UEA, the

same formal planning practices need to be performed as with larger green sites. This may include: project planning, project cost estimations, gaining city approval, preparation of the tender and the public procurement process. The public procurement process was highlighted by interviewees to be a cumbersome and time-consuming process. Public procurement refers to the process of public authorities, such as governments or local authorities, to purchase labor, goods or services from companies (European Commission 2023). Within the European Union (EU) over 250,000 public authorities spend 14% of their GDP (~€2 trillion) on purchases such as services, labor and supplies (European Commission 2023). The EU encourages authorities to take into account the environment, social considerations and innovation when procuring services for the public (European Commission 2023).

The public tender in some cases did not seem to be appealing to potential bidders either because the projects were so small that they were not profitable enough or the contractor did not possess the necessary expertise (i.e. to construct a green façade). The COVID-19 pandemic amplified the difficulties of the public procurement process as well (e.g. labor shortage, bans on public meetings, illness). Despite the pandemic and other challenges, the implementation and construction of UEA sites themselves were reported to be indeed rapid. In one extreme case, the public procurement process lasted more than one year. All 16 pilot projects could be implemented within the three-year project duration. UEA was also implemented transnationally, and a number of decision-making tools had to be co-created beforehand. Thus, under less tricky conditions (i.e. implementation by a single entity or municipality, decision-making tools already provided) the interventions should be able to be implemented quicker. Planning preparation for the UEA projects may take up to three months. Small scale interventions such as rain gardens, bioswales, cisterns, permeable pavements, tree filter boxes and green roofs could potentially be constructed in a matter of days or weeks while larger projects may take years (Rutgers 2018).

Ownership of the sites also made a difference in the rapidity of implementation. In cases where the city already possessed the sites, investments could be realized more quickly (i.e. avoiding ownership agreements). Within the SALUTECE case studies we found that land owned by the city could be converted to greenspace without directly competing with development. However, interviews conducted in the Republic of Korea showed that this was not the case (Song et al. 2024), suggesting this may be highly dependent on the local settings. Regardless, public sector funds and other incentives can be offered to the private sector to revamp abandoned sites into green lots. Private households possess a large amount of property which can be utilized as urban greenspace as well. In that case, the private homeowners would also need to be convinced or such project incentivized (McDonald et al. 2023). In conclusion, UEA projects can indeed be implemented quickly however certain factors may slow their implementation such as the demands of public participation (however this is necessary as it is identified as important in shaping urban transformations), fulfilling planning requirements like in all urban planning projects and certain factors out of one's control such as pandemics. The development of new policies could help to fast track UEA projects for example bundling multiple projects during the tender and public procurement process and easing formal planning requirements for micro-projects.

Principle IV: catalyze broader urban transformations

UEA, as a form of urban acupuncture, should influence change beyond interventions and trigger positive chain reactions improving the entire system as a whole (Lerner 2014; de Solà-Morales 2008). According to Lerner, "no matter how good [planning] may be, a plan by itself cannot bring about immediate transformation. Almost always, it is a spark that sets off a current that begins to spread. This is what I call good acupuncture - true urban acupuncture"(Lerner 2014). An effort was made to examine the potential of positive chain reactions resulting from the project and its pilot projects. Based on interviews, a number of factors could be identified pointing toward the potential transformation beyond the pilot projects implemented. First, the identification of UEA sites together with the public has garnered interest and motivation to further UEA implementation in the future. Only a small portion of the potential UEA sites identified could be implemented resulting in many more already available sites for further UEA development. Moreover, UEA has been integrated into a number of strategic planning documents. According to city officials, plans exist to apply for funding for further implementation through city, European Union and other European funds. Interviewees indicated that the action plans already having developed within the SALUTE4CE project could be useful for programming and securing future financial investments. Letters of commitment have been signed by respective cities to take certain actions, such as establishment of a working group and implementation of UEA sites. The general sentiment among project partners was that citizens, students, politicians, and fellow practitioners reacted positively to the UEA concept. Interviewees witnessed increased concern regarding environmental protection and climate change in general, suggesting that a demand for this type of action exists. All the project partners indicated within the interviews that either formal or informal plans exist to continue with UEA into the future. The SALUTE4CE has provided an implementation framework for nature-based solutions by co-creating decision-making tools e.g. selection of sites criteria, a hand-book, guidelines and various training materials and demonstrating UEA implementation via 16 pilot projects. The interviews showed that the intention exists to continue with UEA implementation however more research is need to examine whether or not this has taken place.

Conclusion

Pilot projects were designed to be quickly implementable, utilizing abandoned or undesirable sites, with the potential to catalyze both physical and social transformation. Based on feedback from interviews, UEA did in fact deliver what it promised as the projects could be implemented as intended. However, based on stakeholder feedback intentional decisions can improve outcomes. For example, maintaining low budget projects requires strategic decision-making regarding the types of nature-based solutions implemented, involvement of volunteers and the quantity and types of outdoor equipment. Furthermore, current planning systems could be altered to streamline implementation processes making implementation of UEA quicker. The principles provide actionable knowledge specifically addressing embedding nature-based solutions into planning and political frameworks and the urban fabric itself. The principles also help to overcome barriers such as low budgets, expanding nature-based solutions where there is little space to do so, and pushing for further transformation of dense urban spaces.

Co-creation is essential if UEA is to be implemented because projects are locally embedded, volunteers may also play an important role in identifying potential UEA

sites, implementing and maintaining them as well as keeping project costs low. But most importantly, the projects must be accepted and embraced by the public to further expand nature-based solution implementation i.e. urban transformation. The engagement of local stakeholders, including representatives of municipalities, experts, research scientists and the public played an important role in the success of SALUTE4CE projects and will likely play an important role in future UEA implementation. The adoption of UEA to implement nature-based solutions also provides a forward-thinking vision for how urban transformation can take place. The "ripple effect" metaphor can help to address the improvements of the urban fabric via concrete, context specific changes which should cumulate and lead to an overall improvement of the urban fabric. Co-creation is also important in maintaining the principles in UEA implementation for example, low budgets may be maintained via voluntary work, identification of UEA sites has been successful in the past by including the public. Co-creation will also be important in improving the principles in the future for example to streamline implementation processes it will be necessary to collaborate with city administrators and politicians.

More research is needed examining the long-term impacts of UEA projects (e.g. climate adaptation, improved well-being, cost-savings related to grey infrastructure) and whether the sites are maintained in the long-term (e.g. is quality maintained, barriers and success factors). The principles provided can be used to implement nature-based solutions and they may also be further elaborated or expanded. The principles may also be used among co-creators to assess implementation of nature-based solution projects. Further research, testing and documentation of current principles developed here may improve the planning and governance of nature-based solutions. Examination of UEA outside of the European context in more dense areas is needed to expand the applicability of the concept globally.

Appendix

Reflecting on UEA principles with Central European Cities having implemented UEA.

City Interviewed	Date	Interviewee Occupation	Other attendees
Liptovsky Mikulas, Slovakia	February 22, 2022	City project management	Two other assistants (provided opinions and translation help)
Chorzow, Poland	February 22, 2022	City director (development and external funds)	One other city employee attended
Impulse Region Germany	February 24, 2022	"Impulse Region" office	Attended alone
Alessandria, Italy	February 24, 2022	City Employee	Attended alone but spoke to other employees beforehand

Source: Author

Acknowledgements
Thank you to the interviewees from Chorow, Poland, The impulse region, Germany, Alessandria, Italy and Liptovski Mikulas, Slovakia for their input on implementing urban environmental acupuncture.

Author contributions
The author collected data, conceived and designed the article, conducted analysis and wrote the paper. The urban environmental concept was conceived within the SALUTE4CE project.

Funding
This article is based on results of the "Integrated environmental management of SmAL Green Spots in FUnTional Urban ArEas" – SALUTE4CE project supported by the European Union, European Regional Development Fund (ERDF), Interreg Central Europe, Priority: Natural and cultural resources from 01.04.2019–31.03.2022. Grant number CE1472.
Open Access funding enabled and organized by Projekt DEAL.

Data availability
Some data and reports can be viewed here: https://programme2014-20.interreg-central.eu/Content.Node/SALUTE4CE.html.

Declarations

Competing interests
No potential conflict of interest

Received: 16 November 2023 / Accepted: 20 September 2024
Published online: 11 October 2024

References

Alex YH, Jim CY. Citizen attitude and expectation towards Greenspace Provision in Compact Urban Milieu. Land Use Policy. 2012;29(3):577–86. https://doi.org/10.1016/j.landusepol.2011.09.011.

Alves A, Vojinovic Z, Kapelan Z, Sanchez A, and Berry Gersonius. Exploring Trade-Offs among the multiple benefits of Green-Blue-Grey Infrastructure for Urban Flood Mitigation. Sci Total Environ. 2020;703(February):134980. https://doi.org/10.1016/j.scitotenv.2019.134980.

Apostolou M. 2015. Urban Eco-Acupuncture Methods: Case Study in the City of Athens. In, 932–40. Porto, Heli, Greece: HAL achives-ouvertes. https://halshs.archives-ouvertes.fr/halshs-01798506

Balicka J, Storie JT, Kuhlmann F, Wilczyńska A, and Simon Bell. 2021. Tactical Urbanism, Urban Acupuncture and Small-Scale Projects. In *Urban Blue Spaces Planning and Design for Water, Health and Well-Being*, 1st ed., 1–25. Routledge. https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9780429056161-19/tactical-urbanism-urban-acupuncture-small-scale-projects-jekaterina-balicka-joanna-tamar-storie-friedrich-kuhlmann-anna-wilczy%C5%84ska-simon-bell

Balicka J, Storie JT, Kuhlmann F, Wilczyńska A, and Simon Bell. 2021a. Tactical Urbanism, Urban Acupuncture and Small-Scale Projects. In *Urban Blue Spaces Planning and Design for Water, Health and Well-Being*, 1st ed., 1–Alex, Y.H., and C.Y. Jim. 2012. Citizen Attitude and Expectation towards Greenspace Provision in Compact Urban Milieu. *Land Use Policy* 29 (3): 577–86. https://doi.org/10.1016/j.landusepol.2011.09.011

Beaugeard E, Brischoux François, Frédéric, Angelier. Green Infrastructures and ecological corridors shape avian biodiversity in a small French City. Urban Ecosyst. 2021;24(3):549–60. https://doi.org/10.1007/s11252-020-01062-7.

Benton JS, Cotterill S, Anderson J, Macintyre VG, Gittins M, Dennis M, Lindley SJ, and David P. French. Impact of a Low-Cost Urban Green Space Intervention on Wellbeing behaviours in older adults: a natural experimental study. Wellbeing Space Soc. 2021;2(January):100029. https://doi.org/10.1016/j.wss.2021.100029.

Campbell-Arvai V, and Mark Lindquist. From the ground up: using Structured Community Engagement to identify objectives for urban green infrastructure planning. Urban Forestry Urban Green. 2021;59:127013.

Casagrande M. 2013. Biourban Acupuncture. Scientific Network for High-Quality Research, Theory Making, Education and Practice. *International Society of Biourbanism* (blog). 2013. http://www.biourbanism.org/biourban-acupuncture/

Casagrande M. 2020. From Urban Acupuncture to the Third Generation City. In *Nature Driven Urbanism*, edited by Rob Roggema, 131–53. Contemporary Urban Design Thinking. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-26717-9_7

Connop S, Vandergert P, Eisenberg B, Collier MJ, Nash C, Clough J. and Darryl Newport. 2016. Renaturing Cities Using a Regionally-Focused Biodiversity-Led Multifunctional Benefits Approach to Urban Green Infrastructure. *Advancing Urban Environmental Governance: Understanding Theories, Practices and Processes Shaping Urban Sustainability and Resilience* 62 (August): 99–111. https://doi.org/10.1016/j.envsci.2016.01.013

Deely J, Hynes S, Barquin J, Burgess D, Finney G, Silio A, Manuel J, Bailly D, and Johanna Balle-Beganton. Barrier Identification Framework for the implementation of blue and Green Infrastructures. Land Use Policy. 2020;99. https://doi.org/10.1016/j.landusepol.2020.105108.

Durose C, Richardson L, and Beth Perry. Craft Metrics to Value Co-production. Nature. 2018;562(October):32–3. https://doi.org/10.1038/d41586-018-06860-w.

Elmqvist T, Setälä H, Handel SN, van der Ploeg S, Aronson J, Blignaut JN, Gómez-Baggethun E, Nowak DJ, Kronenberg J, de Groot R. Benefits of Restoring Ecosystem Services in Urban Areas. Open Issue. 2015;14(June):101–8. https://doi.org/10.1016/j.cosust.2015.05.001.

European Commission. 2023. Internal Market, Industry, Entrepreneurship and SMEs. Public Procurement. 2023. https://single-market-economy.ec.europa.eu/single-market/public-procurement_en

Frantzeskaki N. Seven lessons for Planning Nature-based solutions in cities. Environ Sci Policy. 2019;93(March):101–11. https://doi.org/10.1016/j.envsci.2018.12.033.

Haaland C, Cecil Konijnendijk van den Bosch. Challenges and strategies for Urban Green-Space Planning in cities undergoing densification: a review. Urban Forestry Urban Green. 2015;14(August):760–71.

Hemingway J, Mathey J, Wirth P. 2019. Urbane Akupunktur Ein Ansatz zur städtischen Grünentwicklung? *Transitioning Cities*, Städtisches Grün - städtisches Blau, no. 3: 76–78.

Hemingway J, Mathey J, Wirth P. 2022. Guideline for developing & implementing action plans in cities or urban areas based on application of UEA (Urban Environmental Acupuncture). Dresden. Social Science Open Access Repository. https://doi.org/10.26084/pgyh-bk23

Hofmann M, Westermann JR, Kowarik I, Elke van der, Meer. Perceptions of Parks and Urban Derelict Land by Landscape Planners and residents. Urban Forestry Urban Green. 2012;11(3):303–12. https://doi.org/10.1016/j.ufug.2012.04.001.

Kirnbauer MC, Baetz BW, Kenney WA. Estimating the stormwater attenuation benefits derived from planting four monoculture species of deciduous trees on vacant and underutilized Urban Land parcels. Urban Forestry Urban Green. 2013;12(3):401–7. https://doi.org/10.1016/j.ufug.2013.03.003.

Lastra A, Pojani D. Urban acupuncture' to alleviate stress in Informal settlements in Mexico. J Urban Des. 2018;23(5):749–62. https://doi.org/10.1080/13574809.2018.1429902.

Lerner J. Urban acupuncture: celebrating pinpricks of Change that Enrich City LIfe. Washington, Covelo, London: Island; 2014.

Lima GF, Jeater W, Correa Santos RM, Albertin B, Martínez-Miranzo FL, Souza, and Fabio Angeoletto. Backyards are a way to Promote Environmental Justice and Biodiversity Conservation in Brazilian cities. Diversity. 2023;15(7). https://doi.org/10.3390/d15070815.

Local HS. 2023. The Pros and Cons of Large Scale Small Scale and Scattered Site Development. 2023. https://localhousingsolutions.org/about-lhs/
Loures Luís. 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. Special Issue: Exploratory Spat Anal Urban Habitats. 2015;45(January):72–81. https://doi.org/10.1016/j.habitatint.2014.06.028.
Mathey J, and Stefanie Rößler. 2021. Approaches to Developing Urban Wastelands as Elements of Green Infrastructure. In *Urban Wastelands: A Form of Urban Nature?* edited by Francesca Di Pietro and Amélie Robert, 273–94. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-74882-1_13
McDonald RI, Myla FJ, Aronson T, Beatley E, Beller M, Bazo R, Grossinger K, Jessup, et al. Denser and greener cities: Green Interventions to achieve both urban density and nature. People Nat. 2023;5(1):84–102. https://doi.org/10.1002/pan3.10423.
McGuirk J. Radical cities: across Latin America in search of a New Architecture. Verso; 2014.
McReynolds J. 2023. Understanding Tokyo's Land Use: The Power of Microspaces. *Mercatus Research Paper*, January, 34.
Molenveld, Willems J, Voorberg A, Brinkman G. Diverging ambitions and instruments for Citizen participation across different stages in green infrastructure projects. Urban Plann. 2020;5(1):22–32. https://doi.org/10.17645/up.v5i1.2613.
Peschardt K, Schipperijn J, Stigsdotter UK. Use of Small Public Urban Green Spaces (SPUGS). Urban Forestry Urban Green. 2012;11:235–44. https://doi.org/10.1016/j.ufug.2012.04.002.
Power A. Regional politics of an urban age: can Europe's former Industrial Cities create a New Industrial Economy to Combat Climate Change and Social Unravelling? Palgrave Commun. 2018;4(1):97. https://doi.org/10.1057/s41599-018-0120-x.
Preston PD, Rachel M, Dunk GR, Smith, and Gina Cavan. Not all Brownfields are Equal: a Typological Assessment reveals hidden Green Space in the City. Landsc Urban Plann. 2023;229(January):104590. https://doi.org/10.1016/j.landurbplan.2022.104590.
Rall E, Hansen R, and Stephan Pauleit. The added value of public participation GIS (PPGIS) for urban green infrastructure planning. Urban Green Infrastructure – Connecting People Nat Sustainable Cities. 2019;40(April):264–74. https://doi.org/10.1016/j.ufug.2018.06.016.
ROSOL MARIT. Public participation in Post-fordist Urban Green Space Governance: the case of Community Gardens in Berlin. Int J Urban Reg Res. 2010;34(3):548–63. https://doi.org/10.1111/j.1468-2427.2010.00968.x.
Rosso F, Cappa F, Spitzmiller R, and Marco Ferrero. Architectural, Environmental, Managerial and Legal Considerations towards an Integrated Framework: A Case Study in the Mediterranean Region. Environ Challenges. 2022;7:100402. https://doi.org/10.1016/j.envc.2021.100402. Pocket Parks towards More Sustainable Cities.
Rutgers EDU. 2018. Green Infrastructure Implementation. Sustainable Jersey. February 2018. http://water.rutgers.edu/Projects/GreenInfrastructureChampions/4_GI_ImplementationAction.pdf
Ryan C. Eco-acupuncture: Designing and Facilitating pathways for Urban Transformation, for a resilient low-Carbon Future. J Clean Prod. 2013;50(July):189–99. https://doi.org/10.1016/j.jclepro.2012.11.029.
SALUTE4CE. 2019. Interreg Central Europe Application Form, SALUTE4CE Version 2. CE1472.
Solà-Morales Mde. 2008. *A Matter of Things*. Vol. nai010 publishers.
Song S. 2022. Analysis of the Influencing Factors of the Vitality of Small and Micro Spaces in the Old Urban Area of the City. *2022 8th International Conference on Education Technology, Management and Humanities Science (ETMHS 2022)*. https://webofproceedings.org/proceedings_series/ART2L/ETMHS%202022/ZY509.pdf
Song J, Hemingway J, Park CS. Perspective swap from Central Europe to East Asia: how relevant Is Urban Environmental acupuncture in small-scale Green Space Development in the context of the Republic of Korea? Land. 2024;13(3). https://doi.org/10.3390/land13030298.
Statistisches Bundesamt. 2022. Labour Cost Comparison across EU Countries (Annual Estimate of Labour Costs). DSTATIS. May 2022. https://www.destatis.de/Europa/EN/Topic/Population-Labour-Social-Issues/Labour-market/EU_LabourCostPerHourWorked.html
Vaňo S, Olafsson AS, Mederly P. Advancing Urban Green Infrastructure through Participatory Integrated Planning: a case from Slovakia. Urban Forestry Urban Green. 2021;58(March):126957. https://doi.org/10.1016/j.ufug.2020.126957.
Villaseñor NélidaR, Luna A, Chiang H, Jaime Hernández, Martín AH, Escobar. Vacant lands as refuges for native birds: an opportunity for Biodiversity Conservation in cities. Urban Forestry Urban Green. 2020;49(March):126632. https://doi.org/10.1016/j.ufug.2020.126632.
Was Kosten. Spielgeräte Für Den Öffentlichen Bereich? 2023. 2023. https://www.spielplatzrechner.de/wissen/spielgeraete/kosten-spielgeraete-oeffentlichen-bereich/
Wickenberg Björn, McCormick K, and Johanna Alkan Olsson. Advancing the implementation of Nature-based solutions in cities: a review of Frameworks. Environ Sci Policy. 2021;125:44–53. https://doi.org/10.1016/j.envsci.2021.08.016.
Wiesneth B, NOT A WALLFLOWER – THE GREEN FACADE ON THE NEW DREES & SOMMER OFFICE BUILDING. 2021. CERTAINLY. *Drees & Sommer* (blog). 2021. https://www.dreso.com/de/en/news/details/certainly-not-a-wallflower-the-green-facade-on-the-new-drees-sommer-office-building
Witt C. 2018. 11.000 Euro Für Blumenwiesen in Werdohl. 2018. https://www.come-on.de/lennetal/werdohl/bluetenmeer-werdohler-ortsteile-10305294.html
Wolfram M. Conceptualizing urban transformative capacity: a Framework for Research and Policy. Curr Res Cities. 2016;51(January):121–30. https://doi.org/10.1016/j.cities.2015.11.011.
Wolfram M, Borgström S, and Megan Farrelly. Urban transformative capacity: from Concept to Practice. Springer Ambio. 2019;48(5):437–48. https://doi.org/10.1007/s13280-019-01169-y.
Zungia-Teran AA, Staddon C, de Vito L, Gerlak AK, Ward S, Schoeman Y, Hart A, and Giles Booth. Challenges of mainstreaming Green infrastructure in built Environment professions. J Environ Planning Manage. 2020;63(4):710–32. https://doi.org/10.1080/09640568.2019.1605890.

Publisher's note