

Limiting Soil Sealing and Depaving: Local Actions for Regenerating Public Spaces to Build Green Infrastructures

*Original*

Limiting Soil Sealing and Depaving: Local Actions for Regenerating Public Spaces to Build Green Infrastructures / Aimar, Fabrizio - In: Green Infrastructure. Planning Strategies and Environmental Design. / Giudice B., Novarina G., Voghera A..  
- STAMPA. - Cham : Springer, 2023. - ISBN 978-3-031-28771-8. - pp. 127-137 [10.1007/978-3-031-28772-5\_11]

*Availability:*

This version is available at: 11583/2978967 since: 2023-05-31T16:03:22Z

*Publisher:*

Springer

*Published*

DOI:10.1007/978-3-031-28772-5\_11

*Terms of use:*

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

*Publisher copyright*

(Article begins on next page)

The Urban Book Series

Benedetta Giudice  
Gilles Novarina  
Angioletta Voghera *Editors*

# Green Infrastructure

Planning Strategies and Environmental  
Design

 Springer

# The Urban Book Series

## Editorial Board

Margarita Angelidou, Aristotle University of Thessaloniki, Thessaloniki, Greece


Fatemeh Farnaz Arefian, The Bartlett Development Planning Unit, UCL, Silk Cities, London, UK

Michael Batty, Centre for Advanced Spatial Analysis, UCL, London, UK

Simin Davoudi, Planning & Landscape Department GURU, Newcastle University, Newcastle, UK

Geoffrey DeVerteuil, School of Planning and Geography, Cardiff University, Cardiff, UK

Jesús M. González Pérez, Department of Geography, University of the Balearic Islands, Palma (Mallorca), Spain

Daniel B. Hess , Department of Urban and Regional Planning, University at Buffalo, State University, Buffalo, NY, USA

Paul Jones, School of Architecture, Design and Planning, University of Sydney, Sydney, NSW, Australia

Andrew Karvonen, Division of Urban and Regional Studies, KTH Royal Institute of Technology, Stockholm, Stockholms Län, Sweden

Andrew Kirby, New College, Arizona State University, Phoenix, AZ, USA

Karl Kropf, Department of Planning, Headington Campus, Oxford Brookes University, Oxford, UK

Karen Lucas, Institute for Transport Studies, University of Leeds, Leeds, UK

Marco Maretto, DICATeA, Department of Civil and Environmental Engineering, University of Parma, Parma, Italy

Ali Modarres, Tacoma Urban Studies, University of Washington Tacoma, Tacoma, WA, USA

Fabian Neuhaus, Faculty of Environmental Design, University of Calgary, Calgary, AB, Canada

Steffen Nijhuis, Architecture and the Built Environment, Delft University of Technology, Delft, The Netherlands

Vitor Manuel Araújo de Oliveira , Porto University, Porto, Portugal

Christopher Silver, College of Design, University of Florida, Gainesville, FL, USA

Giuseppe Strappa, Facoltà di Architettura, Sapienza University of Rome, Rome, Roma, Italy

Igor Vojnovic, Department of Geography, Michigan State University, East Lansing, MI, USA

Claudia Yamu, Department of Built Environment, Oslo Metropolitan University, Oslo, Norway

Qunshan Zhao, School of Social and Political Sciences, University of Glasgow, Glasgow, UK

The Urban Book Series is a resource for urban studies and geography research worldwide. It provides a unique and innovative resource for the latest developments in the field, nurturing a comprehensive and encompassing publication venue for urban studies, urban geography, planning and regional development.

The series publishes peer-reviewed volumes related to urbanization, sustainability, urban environments, sustainable urbanism, governance, globalization, urban and sustainable development, spatial and area studies, urban management, transport systems, urban infrastructure, urban dynamics, green cities and urban landscapes. It also invites research which documents urbanization processes and urban dynamics on a national, regional and local level, welcoming case studies, as well as comparative and applied research.

The series will appeal to urbanists, geographers, planners, engineers, architects, policy makers, and to all of those interested in a wide-ranging overview of contemporary urban studies and innovations in the field. It accepts monographs, edited volumes and textbooks.

**Indexed by Scopus.**

Benedetta Giudice · Gilles Novarina ·  
Angioletta Voghera  
Editors

# Green Infrastructure

Planning Strategies and Environmental  
Design

*Editors*

Benedetta Giudice  
Interuniversity Department of Regional  
and Urban Studies and Planning  
Politecnico di Torino  
Torino, Italy

Angioletta Voghera  
Interuniversity Department of Regional  
and Urban Studies and Planning  
Politecnico di Torino  
Torino, Italy

Gilles Novarina  
Laboratoire Architecture Environnement  
and Cultures Constructives  
École Nationale Supérieure  
d'Architecture—Université Grenoble Alpes  
Grenoble, France

ISSN 2365-757X

The Urban Book Series

ISBN 978-3-031-28771-8

<https://doi.org/10.1007/978-3-031-28772-5>

ISSN 2365-7588 (electronic)

ISBN 978-3-031-28772-5 (eBook)

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2023

Chapters 1 and 6 are licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>). For further details see license information in the chapters.

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Chapter 11

## Limiting Soil Sealing and Depaving: Local Actions for Regenerating Public Spaces to Build Green Infrastructures



Fabrizio Aimar

**Abstract** Green Infrastructure (GI) is part of nature-based solutions to mitigate and adapt the local microclimate and climate of urban areas to climate change. In Italy, the lack of green elements in urban spaces of medium-sized cities calls for improvement of the urban ecological network due to citizens' demands for better well-being and health. This chapter indicates the need to launch a national campaign to deseal over-paved public urban spaces and plant new green elements by 2030 as public space design actions. Limiting and then stopping soil sealing is the first condition to rethink public spaces in Italian, and even European, cities in a more holistic and resilient way. Secondly, encouraging citizen activism towards urban GI is strategic in resilient policies to improve connectivity and networking of the social fabric, as confirmed by the reported international and national cases. In this regard, GI is considered a multi-benefit solution that should be planned according to new digital tools in planning and architecture. The aim is to identify the most critical areas within the urban context that need to be depaved to accommodate green canopies, trees, green roofs, and other solutions with an approach potentially replicable in Italian and European cities.

**Keywords** Depaving · Heat island effects · Soil sealing · Nature-based solutions · Urban resilience

### 11.1 Introduction

“Green infrastructure is a planned network of natural and semi-natural areas in urban areas strategically designed to solve problems with storm water management, heat stress, air quality, and biodiversity, to name just a few examples. Urban trees, green roofs and facades, and constructed wetlands are some common examples.” according to Johnson’s definition (2019).

To support this description, semi-natural and artificial surfaces contribute significantly to higher summer temperatures in cities caused by their low albedo. This

---

F. Aimar (✉)

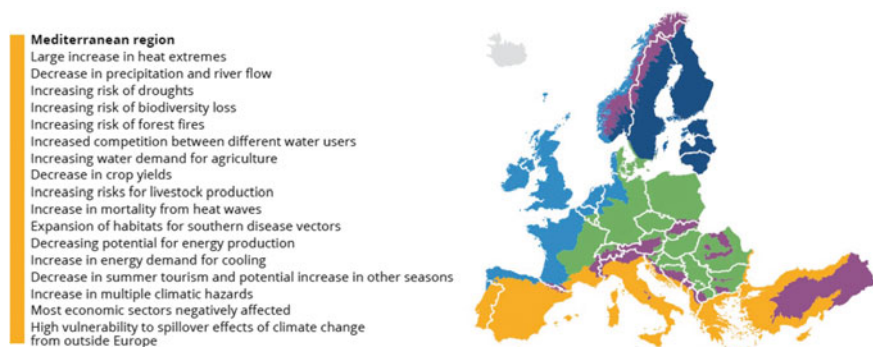
Department of Architecture and Engineering, Faculty of Architecture and Design, Polis University, Rr. Bylis 12, 1051 Tirana, Albania  
e-mail: [fabrizio\\_aimar@universitetipolis.edu.al](mailto:fabrizio_aimar@universitetipolis.edu.al)

issue, known as the ‘urban heat island effect’, can produce “a monthly maximum UHI intensity varying from 1.7 to 4.5 °C” (Currà et al. 2019, p. 731), where “the temperature increase is more evident in the densest urban areas, near street level” (ibid., p. 731). Consequently, higher electricity supplies are becoming more and more necessary for air-conditioning work and living spaces “from 20 to 45% in the Mediterranean climate” (ibid., p. 731), with peak quantities and costs that could, however, be avoidable. Moreover, the rise in temperatures and sunlight contribute to the formation of tropospheric ozone, combined with “chemical reactions between oxides of nitrogen (NO<sub>x</sub>) and volatile organic compounds (VOC).” (EPA 2021). All these factors are just some of those related to the Mediterranean region due to the impacts of climate change in Europe, according to Fig. 11.1 of the 2018 European Commission Communication (European Commission 2018, p. 3) (Fig. 11.1).

As a consequence, depave can promote the removal of unnecessary pavement from urban areas (e.g., asphalt and concrete) to recreate green spaces to host new green elements and vegetation (i.e., trees and shrubs) with the aim of mitigating the multiple and interrelated impacts of climate change.

Although the discourse around soil sealing seems more interrelated to ensuring food security (FAO, IFAD, UNICEF, WFP, & WHO 2021) in the framework of continued population growth (JRC-ESDAC 2014; Gardi et al. 2015) and limiting hydrogeological risk (D’Ambrosio et al. 2021) under the main challenge of climate change (Aimar & Repetto, in press) also health care and the quality of public spaces should be more considered in the coming city of the future.

In terms of health care and climate change-related issues, “mortality for populations in the EU has been estimated to increase by 1–4% for each degree of increase in temperature above a (locally specific) threshold.” (European Commission 2014, p. 56). For instance, in Turin, Italy, “considering the period from 15 May to 15 July, again for the over-65 age group, the excess mortality observed over that expected is approximately 6 deaths per day on heatwave days. The overall excess mortality [...] was 155 (an increase of about 33%) in the presence of a heat wave, while it was



**Fig. 11.1** Climate change impacts in the Mediterranean region of Europe. Source <http://eur-lex.europa.eu>, © European Union, 1998–2022



zero in the absence of a heat wave.” (ARPA Piemonte 2015). Even when death does not occur, heat-associated pathologies may occur, such as dehydration and hypernatremia, heat-related cutaneous eruption, cramps, oedema, lipotimia, stress, and burn (Ministero della Salute, CCM 2019, pp. 11–16).

In addition, Italy is the second country in the European Union (EU) to record the risk of more premature deaths associated with exposure to PM<sub>2.5</sub> and O<sub>3</sub> concentration levels in 2019, raising first in the rank of those attributable to NO<sub>2</sub> exposure (EEA 2021a). 63,710 deaths are estimated out of 364,200 in the EU-27 (i.e., 17.5% of the total) (ibid.). The worst affected area is confirmed to be the Po Valley, with the highest concentrations of particulate matter with a diameter below 2.5 and 10  $\mu\text{m}$ , as well as ozone (EEA 2021b). PM<sub>10</sub> concentrations are hazardous to health and cause decreased lung function (De Donno et al. 2018), while PM<sub>2.5</sub> causes reddening of the eyes and skin, tumours, cardiovascular and human respiratory system dysfunctions (Xing et al. 2016).

In light of the above, the Guidelines on best practices to limit, mitigate, or compensate soil sealing by the European Commission (2014) propose a connection between health and the quality of public spaces. They mention that “the temperature under a tree is an average of 3 °C lower than the temperature of a pavement exposed to direct sunshine when the ambient temperature is around 30 °C.” (European Commission 2014, p. 55). Specifically, they highlight how “a tree with a crown of 10 m in diameter evaporates 400 l/day, consumes 280 kWh of solar energy, and cools with a power comparable to that of more than 10 air conditioners.” (ibid. 2014, p. 56). Moreover, “a tree captures an estimated 100 g net of fine dust per year (average value).” (ibid. 2014, p. 16).

Green Infrastructure (GI) would provide several other physical, psychological, aesthetic, and social benefits associated with vegetation. These include shading from the sun’s rays in the summertime, protection against strong winds, evapotranspiration of rain on leaves, restoration of local habitat for the urban wildlife (small amphibians, reptiles, birds, and mammals), and reduction of road noise.

In a practical way, the abovementioned Guidelines continue stating that the “calculations for the city of Valencia indicate that 10 ha of vegetation are required to generate a drop in temperature of 1 °C; 50 ha and 200 ha of vegetation are required to reduce the temperature by 2 °C or 3 °C, respectively. With a size of some 135 km<sup>2</sup>, approximately 1.5% of the city should be turned green in order to reduce the temperature by 3 °C (Van Zoest and Melchers 2006).” (European Commission 2014, p. 56). It follows that 2 km<sup>2</sup> of new green is needed to reduce the temperature by 3 °C for the city of Valencia, Spain.

What is mentioned above clarifies the need to act on the local scale to provide effective measures to counter these pathologies and limit the impacts of climate change in urban areas. Amongst those, this paper wants to propose an extensive depave of public spaces to create new areas useable for GI through their redesign. This project-based process needs to be based on urban planning measures in order to limit, mitigate, or compensate for the extreme effects of solar irradiance through new digital approaches.

## 11.2 Depaving as a Strategy to Implement GI in Urban Spaces

Land consumption occurs by artificial land cover due to buildings, infrastructures, solar parks, caves, and landfill areas, for instance. In Italy, the Italian Institute for Environmental Protection and Research (ISPRA) reported that about 64% of land consumption between 2012 and 2020 took place in a context of medium/low artificial density and 21.6% in a predominantly artificial context (Munafò 2021). Therefore, prevention measures seem necessary to avoid fragmented landscapes as well as residual urban areas.

Starting from a literature review (e.g., Taylor & Francis, Elsevier, and Springer journals and books, etc.), the early goal should evaluate how to manage the transiency of the soil sealing, from “zero balance” to its permanent arrest. Indicators for territorial evaluations would be individuated into a multicriteria spatial decision support system. Organising land use in the next planning policies could be carried out with big data and spatial analysis led by simulation tools. Investigations could involve several city plans, using high-resolution layers/CORINE to define sealed soil levels, as well as existing databases and GIS/web-GIS tools to explore geomatics, spatial analysis, and urban/land morphology, amongst others. A Geographic Information System can help map the solar irradiation potential by processing a digital elevation model (DEM) of the area under analysis, as well as the variations. Moreover, the urban traffic plans and maps, as well as changes in land surface temperature measured by the Copernicus Sentinel-3 satellite over the short to mid-term, should be consulted to better calibrate potential strategies and related actions.

One of the possible research outcomes concerns the creation of a software tool useful to determine a ‘zero balance’ between urban/periurban transformation areas and the re-naturalised ones, both at the municipal and provincial scale. This one would also help to determine a precise ratio between permeable/sealed areas and suggest measures as depave of the over-paved areas to be included in the local policies. Areas that could potentially be suitable for this are portions of churchyards, public schoolyards, market spaces, redundant parking spaces for vehicles, and existing avenues. The action will aid the increasing and/or creation of Green and Blue Infrastructures and their sustainable planning and management, mapping and protecting existing lands with high-production capacity (Land Capability Classification—classes I, II, and III). It could be a possible upgrade of two ongoing projects: the LIFE SAM4CP one, when combined with the existing Playsol simulator, and the SOS4LIFE project, to specify programs of urban soil desealing with analytic data.

According to the National System for Environmental Protection (SNPA) data, the 2019 report still confirms “a low incidence of public green areas on the municipal territory: if we consider the municipalities with two-thirds of the provincial capitals, the percentage value is lower than the average of the 109 municipalities (3.03%), and [...] in 82 cities, this indicator does not reach 4%. In as many as 32 provincial capitals, the percentage is less than or equal to 1%” (Chiesura et al. 2020, p. 7). In particular, the report affirms that “particularly low values (less than or equal to

0.5%) are concentrated in the South and the Islands, and some cities in the Centre” of Italy (*ibid.*). Among this group, there are Genoa, Imperia, Belluno, Lucca, Pistoia, Massa, Grosseto, Arezzo, Viterbo, Teramo, Foggia, Lecce, Brindisi, Crotone, Enna, Syracuse, Nuoro, and Sassari (*ibid.*, p. 8).

Consequently, a large campaign of depaving, combined with the plantation of new green elements, could be planned for the public spaces of most relevant cities and towns in Italy (e.g., regional and provincial capitals), according to the ongoing modifications imposed by the global climate change. As pointed out by Bastin et al. (2019), Turin will, in fact, suffer from an annual temperature increase of 2.1 °C by 2050, where its increase during the warmest month will be 7.7 °C, while that of the coldest month will be 1.7 °C of 2.5 °C by 2050, where the warmest month’s temperature gain will be 7.2 °C and that of the coldest month 3.6 °C. Finally, Rome will undergo an annual temperature increase of 2.5 °C by 2050, where the temperature growth of the warmest month is 5.5 °C and that of the coldest month is 2.8 °C. In a nutshell, Turin and Milan will experience the current climate of Dallas, Texas (U.S.A.), while Rome that of Adana (Turkey).

All these data are to be understood and used as design inputs for more resilient cities, whose ultimate goal is the well-being of citizens and communities rather the merely GDP growth (Ripple et al. 2020). These objectives refer to the United Nations Sustainable Development Goals, in particular to the targets 3.9, 11.3.1, and 15.3 (UN 2015).

### 11.3 Best Practices and Community-Based Approaches in Depaving Private and Semi-public Urban Spaces

The community-based approach to depaving is already widespread in Anglo-Saxon countries such as Great Britain, the U.S.A., Australia, and Canada, and in Europe in France and Germany. For instance, the Depave association, based in Portland, Oregon (U.S.A.), “empowers disenfranchised communities to overcome social and environmental injustices and adapt to climate change through urban re-greening. Depave transforms over-paved places and creates resilient community greenspaces [...]” (Depave n.d.).

However, Depave Paradise is operating as a project of Green Communities Canada, which was established in Peterborough in 2012. During this period, it has desealed 14,565 m<sup>2</sup> in 28 cities, with a benefit of 5485 m<sup>3</sup> of stormwater diverted annually (Depave Paradise 2022). In the same line, the Mayor of London in the UK provided “A Guide to Community-Led Depaving Projects” entitled “Grey to Green” (Mayor of London 2019), which refers that “a community planting event is a great way to involve the local community in the fun parts of the project.” (*ibid.*, p. 10).

In Italy, the option of depaving “and planting trees on grey areas” (Pastore et al. 2020, pp. 90–91) is envisaged by the project ‘ForestaMi’ by the Metropolitan City of Milan, the Municipality of Milan, Parco Nord, Parco Agricolo Sud, and ERSAF.

It asserted that “21% of new trees will instead be housed in grey areas, i.e. on paved soils” (ibid., p. 116), in which “a ‘top-down’ quantitative estimation work” is to be placed side by side with a “bottom-up listening and mapping work of the Milan Metropolitan City territory.” (ibid., p. 112). The numbers of the pilot project mention “130,407 square metres of car parks and squares to be depaved” in “19 Areas for forestation measures on impermeable soil” by 2030 (ibid. p. 225).

Before planting, an analysis of the soil after the depaving process should be carried out to check for the presence of pollutants such as lead or hexavalent chromium. Using native plants is recommended in order to create an urban habitat for native plant and animal species that can reduce water volumes for irrigation and fertiliser quantities. Such low-cost measures would allow the implementation of ecological infrastructures aimed at increasing biodiversity in the urban environment.

As recommended by The Nature Conservancy, “finance and policy to enable tree planting for public health” should be developed more to sustain this practice (McDonald et al. 2017).

In terms of policies, these bottom-up approaches could be part of the studies and analyses includable in the amendments to the clauses of the bill DDL S.2383, “Limiting land consumption and reuse of the built-up land” [“Contenimento del consumo di suolo e riuso del suolo edificato”] (Senato della Repubblica 2017), in particular to the article 2.1, point g. It suggests, concerning environmental compensation, “the adoption [...] of measures to recover, restore, or improve, [...] the functions of already sealed soil through its de-permeabilisation and to restore the natural condition of the soil.” (ibid., p. 5). The bill is still being examined by Commissions no. 9 ‘Agriculture and agri-food production’ and 13 ‘Territory, environment, environmental goods’ of the Senate of the Italian Republic as of 2017. Likewise, the development of new Green Infrastructures “... could also be considered in the revision of Interministerial Decree 1444/68 on urban standards.” (Munafò 2021, p. 40).

In terms of funding, more studies should be carried out to understand the costs of the correct management of these urban GI. Planting has to be followed by proper management of the plant elements, ensuring appropriate pruning, health treatments and replacement of dead, felled, or decaying ones. The management is a sensitive issue, both in terms of funds and workforce available to municipalities. By the way, the white paper issued by The Nature Conservancy estimated that “spending just \$8 per person per year, on average, in an American city could meet the funding gap and stop the loss of urban trees and all their potential benefits.” (McDonald et al. 2017).

For instance, in Asti, Piedmont, Italy, joint surveys carried out by the Landscape Observatory, together with Legambiente Asti and Valtriviera, highlighted the occurrence of a good number of dead/felled or decaying trees in two local avenues in March 2019. In Corso Torino avenue, 42 out of a total of 203 specimens need to be replaced in about 900 m (Osservatorio del Paesaggio per il Monferrato e l’Astigiano 2019a), while out of a total of 204 trees in the 720-m-long Corso Matteotti avenue, as many as 84 were found to be dead, absent, and/or in a serious condition of decay (Osservatorio del Paesaggio per il Monferrato e l’Astigiano 2019b) (Fig. 11.2).

Appropriate replanting will be carried out by the Municipality of Asti in participation with the retailers of the two avenues to remedy this situation through “concrete



**Fig. 11.2** Some photos of the arboreal surveys in the tree-lined avenues of Asti in March 2019. From left to right, a missing tree (Maple *negundo*) in a plot later cemented over or left green, while on the right, a felled flowering cherry tree. *Photos courtesy Osservatorio del Paesaggio per il Monferrato e l'Astigiano*

actions of sharing management activities to achieve effective rooting and development of the trees over time.” (Osservatorio del Paesaggio per il Monferrato e l'Astigiano 2019a).

## 11.4 Green Infrastructures Projects

Next, some international design examples of urban greening through the inclusion of Green Infrastructure are proposed. In Tirana, the capital of Albania, the adoption of green specimens when resurfacing driveways is carried out by the goodwill of the municipality as the urban Green Plan is absent. The chosen trees (mostly birches, but also magnolias, maples, sycamores, etc.) are selected on the basis of the available road section and planted usually 6 m apart (Fig. 11.3).

In Italy, Law No. 10 of 14 January 2013, titled ‘Rules for the development of urban green spaces’, imposes some legal obligations that can be leveraged for the enhancement of Green Infrastructure, synergistically with the design of urban public space. Article 2, in this regard, states that “Two months before the natural expiration of the term of office, the mayor shall make known the arboreal balance of the municipality, indicating the ratio between the number of trees planted in publicly owned urban areas at the beginning and the end of the term of office, respectively, giving an account of the state of consistency and maintenance of the urban green areas under the mayor’s jurisdiction” (Italian Parliament 2013).

To cite some Italian examples of mid-sized cities, in Pescara, Marche, the planting of 140 specimens in 14 city streets and squares follows the strategy of “... restoring the failures that have been created, especially on streets and squares, enhancing the greenery in some public areas” (Il Tirreno 2019). In 2019, stone pine, wax-leaf privet,



**Fig. 11.3** Project for new Green infrastructure added to the renewal of the road surface and pedestrian pavement in Rruga Dora D'Istria in Tirana, Albania. The width of the pavement is 2 m, while the distance between the two tree boxes is around 5 m. *Source* the author

Callery pear, judas-tree, *Carpinus Orientalis*, and common *Hibiscus* were planted, and other specimens of *Viburnum Lucidum* followed in 2022.

In Novara, Piedmont, "... thousands of new trees were planted, resulting in a very high number of trees in the city, more than 30,000." (Novara Today 2021). In March 2021, 420 more trees were being planted by the Municipality of Novara. Plantings included Norway and field maple, London plane, ash, hackberries, tilia, tulip tree, plum, elm, oak, *Aesculus*, pear, hawthorns, crepe myrtle, sweetgums, and hornbeam. Furthermore, "In addition to laying, the work also includes triennial maintenance with punctual watering." (ibid.) as a correct ex-post management strategy.

However, despite calls for urban forestation and obvious needs, ISTAT found a modest increase in the urban green/inhabitant ratio, from 31.1 (2011) to 31.7 (2017) (ISTAT 2017).

## 11.5 Conclusions

As the discussion makes clear, soil plays a central role as a microclimate regulator in urban and suburban areas. Indeed, its virtuous management can mitigate the adverse effects of 'urban heat islands' on human health thanks to the Green Infrastructures deployment (GI). Urban greenery is a bio-compensation measure that also ensures energy saving, reducing energy bills related to heating and cooling during the winter and summer seasons.

Depaving could be a valid project strategy to be implemented in the urban planning agenda to obtain usable land for planting a network of green elements, in addition to the green roofs and vertical gardens; however, the latter are not the subject of this



chapter. Moreover, it can be useful for achieving the targets 11.6, 11.7 and 11.b of the Sustainable Development Goal 11 “Make cities and human settlements inclusive, safe, resilient and sustainable” (UN 2015). These scalar measures, therefore, go from the size of the street to the city to add value, creating a better urban dimension thanks to the redesign of public spaces. From this perspective, Green Infrastructures should be considered multi-benefit solutions, instrumental in creating adaptive and resilient thinking through shared outlooks with citizens.

In this regard, ensuring biodiversity through the provision of ecosystem services is fundamental in designing future cities with high population density and low emissivity. Therefore, starting from a census of existing green elements in the urban and peri-urban context, the interdisciplinary collaborative work between architects, planners, and agronomists becomes necessary to intervene in the public space in a conscious and targeted manner through the selection of the most suitable and native plant species.

In addition, other similar cities in Europe can benefit from the study and calculations led by Van Zoest and Melchers (2006) for Valencia, Spain, such as Turin (130.17 km<sup>2</sup>) and Rimini, in Italy (135.79 km<sup>2</sup>), Seville, in Spain (140 km<sup>2</sup>) and Nîmes, in France (161.85 km<sup>2</sup>), amongst others.

## References

- Aimar F, Repetto D (in press) Consumo di Suolo a ‘saldo-zero’ e occupazione netta di terreno pari a zero: verso un’Architettura Zero-Volume. In: Medas B, Melis B, Boarin P, Corrias P (eds) Insight into the catalogue of the Italian Pavilion “Resilient Communities” at the architecture Biennale 2021. D Editore, Roma
- ARPA Piemonte (2015) Prime valutazioni degli impatti dell’ondata di caldo. Available via <https://www.quotidianosanita.it/allegati/allegato5494422.pdf>. Accessed 06 June 2022
- Bastin JF, Clark E, Elliott T et al (2019) Correction: understanding climate change from a global analysis of city analogues. PLoS ONE 14(10):e0224120. <https://doi.org/10.1371/journal.pone.0224120>
- Chiesura A, Mirabile M, Adamo D et al (2020) Il Verde pubblico. In: SNPA (ed) Qualità dell’Ambiente Urbano. XV Rapporto. Edizione 2019. Report SNPA 13/2020
- Currà E, Cecere C, Coch H et al (2019) Energy behavior of compact Urban fabric. In: Asdrubali F, Desideri U (eds) Handbook of energy efficiency in buildings. Butterworth-Heinemann, pp 675–810. <https://doi.org/10.1016/B978-0-12-812817-6.00042-5>
- D’Ambrosio R, Longobardi A, Mobilia M et al (2021) Sustainable strategies for flood risk management in urban areas. Enhancing city resilience with Green Roofs. UPLanD—J Urban Plann Landscape Environ Des 5(2):87–98. <https://doi.org/10.6092/2531-9906/7759>
- Depave (n.d.) Our works. Available via <https://depave.org>. Accessed 07 June 2022
- Depave Paradise (2022) About. Available via <https://depaveparadise.ca/>. Accessed 07 June 2022
- De Donno A, De Giorgi M, Bagordo F et al (2018) Health risk associated with exposure to PM<sub>10</sub> and benzene in three Italian Towns. Int J Environ Res Public Health 15:1672. <https://doi.org/10.3390/ijerph15081672>
- European Commission, Directorate-General for Environment (2014) Guidelines on best practice to limit, mitigate or compensate soil sealing. Publications Office. <https://doi.org/10.2779/75498>
- European Commission (2018) Document 52018DC0773. Communication from the Commission to the European Parliament, the European Council, the Council, the European economic and

- social Committee, the Committee of the regions and the European Investment Bank. A Clean Planet for all A European committee long-term vision for a prosperous, modern, competitive and climate neutral economy. COM/2018/773 final. Brussels. Retrieved from <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52018DC0773>. Accessed 12 June 2022
- European Environment Agency (EEA) (2021a) Health impacts of air pollution in Europe, 2021. <https://doi.org/10.2800/08097>
- European Environment Agency (EEA) (2021b) European air quality index. Available via <https://www.eea.europa.eu/themes/air/air-quality-index>. Accessed 07 June 2022
- FAO, IFAD, UNICEF, WFP & WHO (2021) The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO. <https://doi.org/10.4060/cb4474en>
- Gardi C, Panagos P, Van Liedekerke M et al (2015) Land take and food security: assessment of land take on the agricultural production in Europe. *J Environ Planning Manage* 58(5):898–912. <https://doi.org/10.1016/j.landusepol.2011.07.003>
- Il Tirreno (2019) Alberi, al via 140 piantumazioni a Pescara: ecco dove. Available via <https://www.ilpescara.it/green/alberi-pescara-piantumazioni-strade-interessate-28-gennaio.html>. Accessed 05 July 2022
- Italian National Institute of Statistics (ISTAT) (2017) Tavole di Dati. Ambiente Urbano. Available via <https://www.istat.it/it/archivio/207482>. Accessed 05 July 2022
- Johnson D (2019) Circular cities of the world: what can green infrastructure do? The conversation. Available via <https://theconversation.com/circular-cities-of-the-world-what-can-green-infrastructure-do-119273>. Accessed 07 June 2022
- Joint Research Centre—European Soil Data Centre (JRC-ESDAC) (2014) Soil sealing and food security (loss of potential agricultural production capability). Available via <https://esdac.jrc.ec.europa.eu/content/soil-sealing-food-security-loss-potential-agricultural-production-capability#tabs-0-description=1>. Accessed 06 June 2022
- Mayor of London (2019) Grey to green. A guide to community-led depaving projects. Available via [https://www.london.gov.uk/sites/default/files/grey\\_to\\_green\\_guide.pdf](https://www.london.gov.uk/sites/default/files/grey_to_green_guide.pdf). Accessed 09 June 2022
- McDonald R, Aljabar L, Aubuchon C et al (2017) Funding trees for health. Finance and policy to enable tree planting for public health. Available via <https://www.nature.org/en-us/what-we-do/our-insights/perspectives/funding-trees-for-health/>. Accessed on 16 June 2022
- Ministero della Salute, Centro Nazionale Prevenzione e Controllo Malattie (Ministero della Salute, CCM) (2019) Piano Nazionale di Prevenzione degli effetti del caldo sulla salute. Linee di Indirizzo per la Prevenzione. Ondate di calore e inquinamento atmosferico. [National Plan for Prevention of Heat Effects on Health. Guidelines for Prevention. Heat waves and air pollution.] Available via [https://www.salute.gov.it/imgs/C\\_17\\_pubblicazioni\\_2867\\_allegato.pdf](https://www.salute.gov.it/imgs/C_17_pubblicazioni_2867_allegato.pdf). Accessed 06 June 2022
- Munafò M (2021) Consumo di suolo, dinamiche territoriali e servizi ecosistemici. [Land consumption, land cover changes, and ecosystem services] Edition 2021. Report SNPA 22/21
- Novara Today (2021) Novara, saranno piantati 420 nuovi alberi in città. Available via <https://www.novaratoday.it/green/nuove-piantumazioni-alberi-novara.html>. Accessed 05 July 2022
- Osservatorio del Paesaggio per il Monferrato e l'Astigiano (2019a) Proseguo operativo per la riqualificazione dei Viali alberati di Asti e programmazione secondo sopralluogo in Corso Matteotti ad Asti. Available via [http://www.osservatoriodelpaesaggio.org/AZIONI%20SVOLTE/2019/Sopralluogo%20Viali%20alberati%20\(Asti%2022%2003%2019\)/Comunicato%20stampa/CS%20-%20Secondo%20Sopralluogo%20Viali%20astigiani%20\(Asti%2022%2003%2019\).htm](http://www.osservatoriodelpaesaggio.org/AZIONI%20SVOLTE/2019/Sopralluogo%20Viali%20alberati%20(Asti%2022%2003%2019)/Comunicato%20stampa/CS%20-%20Secondo%20Sopralluogo%20Viali%20astigiani%20(Asti%2022%2003%2019).htm). Accessed 17 June 2022
- Osservatorio del Paesaggio per il Monferrato e l'Astigiano (2019b) Resoconto del secondo sopralluogo agli alberi in Corso Matteotti ad Asti. Available via [http://www.osservatoriodelpaesaggio.org/AZIONI%20SVOLTE/2019/Sopralluogo%20Viali%20alberati%20\(Asti%2022%2003%2019\)/Comunicato%20stampa/CS%20-%20Resoconto%20Sopralluogo%20alberi%20Corso%20Matteotti%20\(Asti%2022%2003%2019\).pdf](http://www.osservatoriodelpaesaggio.org/AZIONI%20SVOLTE/2019/Sopralluogo%20Viali%20alberati%20(Asti%2022%2003%2019)/Comunicato%20stampa/CS%20-%20Resoconto%20Sopralluogo%20alberi%20Corso%20Matteotti%20(Asti%2022%2003%2019).pdf). Accessed 17 June 2022



- Parlamento Italiano (2013) Legge 14 gennaio 2013, n. 10. Norme per lo sviluppo degli spazi verdi urbani. Available via <https://www.gazzettaufficiale.it/eli/id/2013/02/01/13G00031/sg>. Accessed 05 July 2022
- Pastore MC, Boeri S, Gambino D et al (2020) Forestami. Report 2020. Available via [https://forestami.org/wp-content/uploads/2021/03/report\\_2020.pdf#page=18](https://forestami.org/wp-content/uploads/2021/03/report_2020.pdf#page=18). Accessed 16 June 2022
- Ripple WJ, Wolf C, Newsome TM et al (2020) World scientists' warning of a climate emergency. *Bioscience* 70(1):8–12. <https://doi.org/10.1093/biosci/biz088>
- Senato della Repubblica (2017) Disegni di legge. Atto Senato n. 2383. XVII Legislatura. Available via <https://www.senato.it/leg/17/BGT/Schede/Ddliter/46877.htm>. Accessed 09 June 2022
- United Nations (UN) (2015) Transforming our world: the 2030 Agenda for sustainable development. Available via <https://sdgs.un.org/2030agenda>. Accessed 06 June 2022
- United States Environmental Protection Agency (UN EPA) (2021) Ground-level ozone basics. Available via [https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics#:~:text=Tropospheric%2C%20or%20ground%20level%20ozone,volatile%20organic%20compounds%20\(VOC\)](https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics#:~:text=Tropospheric%2C%20or%20ground%20level%20ozone,volatile%20organic%20compounds%20(VOC)). Accessed 07 June 2022
- Van Zoest J, Melchers M (2006) Leven in stad. Betekenis en toepassing van natuur in de stedelijke omgeving. KNNV Uitgeverij Utrecht (quoted in Technische commissie bodem, 2010)
- Xing YF, Xu YH, Shi MH et al (2016) The impact of PM<sub>2.5</sub> on the human respiratory system. *J Thorac Dis* 8(1):E69–E74. <https://doi.org/10.3978/j.issn.2072-1439.2016.01.19>