Chapter 9
Remote Sensing and GIS for Modelling Green Roofs Potential at Different Urban Scales

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ABSTRACT

Urban greening is an essential dimension of sustainable urban development. Through green planning, cities can develop strategies towards climate change and mitigation actions and reduce emissions. This chapter aims to evaluate the combined use of remote sensing data and GIS to produce different levels of sustainable indicators, starting from the city level to the neighborhood and the building levels. Green roofs can be part of the solution through the ecosystem services provided. Its benefits are evaluated for the different urban scales through scenario analysis. The impact in the outdoor thermal comfort is assessed at the neighborhood level, while the overall potential to improve energy efficiency is evaluated at the building level. The methodology is implemented in the city of Lisbon, Portugal through a pilot

DOI: 10.4018/978-1-7998-2249-3.ch009

case study. The results can provide rationales for the city when formulating new incentives to encourage the uptake of green roofs in Lisbon.

INTRODUCTION

The United Nations' 2030 Agenda for Sustainable Development (SD) defined 17 SD goals for the next fifteen years. The aim is to achieve a better and more sustainable future, by addressing global challenges like poverty, inequality, climate, environmental degradation, prosperity, peace, and justice (United Nations, 2016). Among these goals, Goal 11 is dedicated to Sustainable Cities and Communities, and its targets include, among others, increasing the number of cities and human settlements that adopt and implement integrated policies and plans for mitigation and adaptation to climate change.

Green infrastructures such as trees, plants, or forests are vital assets that through spatial planning can help cities adapt to climate change (Demuzere et al., 2014; Zölch et al., 2016). They provide services like managing high temperatures and flooding or reducing greenhouse gas emissions through direct carbon sequestration (Chen, 2015; Jayasooriya & Ng, 2014; Klemm, Heusinkveld, Lenzholzer, & van Hove, 2015; Muñoz-Vallés et al., 2013; Norton et al., 2015; Yang & Wang, 2017). Green infrastructures also have other social, economic and environmental benefits like improving health and well-being by filtering air pollutants and increase recreational opportunities, reducing buildings energy usage and heating and cooling costs by providing shading and wind-blocking, or fostering biodiversity through habitats provision (Camps-Calvet et al., 2016; Connop et al., 2016; Elmqvist et al., 2015; EPA - United States Environmental Protection Agency, 2014; Tzoulas et al., 2007).

Sustainable development requires green spaces but, in densely built city centers, unoccupied land is rarely available, and green spaces are few and far between (Haaland & van den Bosch, 2015; Jim, 2004). The loss of green urban areas during the last decades and the consequent soil sealing opened the way to novel mitigation strategies for restoring the environment and protect human health. Typically, open green spaces are the most desired interventions; nevertheless, available space is generally sparse for this purpose. However, roofs are valuable empty grey spaces that can be used to compensate for the lack of permeable land and help cities adapt to climate change (Bates et al., 2013; Francis & Lorimer, 2011; Haaland & van den Bosch, 2015; Santos et al., 2016). Green Roofs (GR) are strategies to promote urban greenspace, and that can be explored in a sustainable development context. GR constitute a solution to restore the environmental quality in densified neighborhoods, providing benefits for the buildings, and for the community as well (Getter & Rowe, 2006; Jim, 2013), in the context of energy transition in the built environment.