



# Indicators to support healthy urban gardening in urban management

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## HIGHLIGHTS

- Urban gardening can contribute to human health by creating cohesive communities involved with their living environment.
- Healthy and sustainable food production links ecosystem health to human health in the case of urban gardening.
- Indicators may identify and pursue synergies between ecosystem and human health targets of different stakeholders.
- Standardized indicators can be used to compare, evaluate and monitor the effects of urban sustainable development actions.

## GRAPHICAL ABSTRACT



Indicators of physical (orange boxes) and experience-based (green boxes) benefits of urban gardening.

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## ABSTRACT

Urban gardening is part of a trend towards more parks and green areas in cities, consumption of organic, locally grown products, and a closer relationship with one's own living environment. Our literature review shows that urban gardens provide opportunities for physical activity and allow people to consume homegrown fruit and vegetables. Urban gardens may also reduce stress levels of gardeners and improve social cohesion. In this way, they can help to prevent health problems. Good quality of urban soil and the functioning of soil ecosystems are indispensable prerequisites for these. We developed a framework that shows how ecosystem health and human health are interconnected in urban gardening, by placing it in the context of urban green space management and valuation. This study yields a set of indicators, which can be used to assess soil ecosystem services and health impacts. They may provide a basis for the evolving dialogue in decision-making processes and partnership activities in urban management. Recognizing the potential effects and discussing what is important to whom, might be enough to find synergies. Importantly, the initiators of urban gardens are often citizens, who seek support from other stakeholders. The social network established by gardens may contribute to health-enabling, cohesive communities involved with their living environment. To maximize health benefits, it is useful to make the urban gardens accessible to many people. This study suggests that urban gardens deserve a position in urban green space management as they may help to address societal challenges like urbanization, health and well-being in aging populations and climate adaptation.

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## 1. Introduction

There is increasing interest in green space supporting healthy living because of rapid urbanization, climate change and aging of populations (EU, 2015; WHO, 2015a; WHO, 2015b; EEA, 2016; WHO, 2016). We

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previously showed that green spaces may contribute to human health and well-being by creating a living environment that promotes physical activity (Claessens et al., 2014). In addition, they facilitate stress reduction and social contacts (Claessens et al., 2014; Hartig et al., 2014; WHO, 2016). Recently, it has been suggested that urban gardens have similar and additional health benefits by facilitating healthy food consumption and socially cohesive communities (Alaimo et al., 2016; Al-Delaimy and Webb, 2017) although quantitative evidence is still scarce (Soga et al., 2017). In this paper, we define health indicators to assess and evaluate these benefits based on a literature review. We also identified health-relevant ecosystem and management indicators. Altogether, these indicators may identify and pursue potential synergies between ecosystem and human health targets of different stakeholders. Together, they can make a stronger case for urban green management actions.

The initiators of urban gardens are often citizens, who seek (financial) support from the local government. Urban managers are confronted with the costs of these activities and the potential risks of soil pollution. They have to motivate costs and land use in the context of competing land use and social services, e.g. the provisioning of adequate housing. The typical scenario has been for gardens to be established on land which is considered to have little market value. At the end of the crisis, however, governments might withdraw their support and focus instead on profitable real estate development on former garden plots. One way to motivate the preserve of the gardens, is to focus on the benefits that they may offer for the living environment, and thereby for public health. Like green spaces, they may contribute to an attractive environment to exercise, play, relax and meet people. Stimulating these kinds of activities is the aim of many evidence-based health interventions, as they are known determinants of public health (Staatsen et al., 2017). Healthy behavior may prevent the development of chronic diseases and associated health care costs. Another way is to point towards the optimal use of urban nature resources ('natural capital') which can facilitate the city and its citizens to advance socially and economically, which are also considered to be aspects of public health. Thus, urban gardening may be regarded as a behavior based environmental health intervention. But what is the evidence of these kind of positive effects of urban gardening and how do we measure them? Ideally, local governments and other stakeholders are able to weigh costs against social profits, including health. Defining indicators of positive effects is a first step towards such a valuation.

The World Health Organization recently proposed a set of indicators to provide cities with systematic approaches to quantifying and monitoring their green space access (WHO, 2016). We evaluated if the known health effects and associated indicators of green spaces also make sense for urban gardens, which we consider as a specific kind of urban green space. The food aspect of urban gardening may provide an extra link to healthy behavior, i.e. by stimulating the consumption of vegetables and fruits. It could also add to sustainability goals of cities, like 'responsible production and consumption' (<http://www.un.org/sustainabledevelopment>, visited November, 3 2017). Therefore, urban gardening may offer some extra or alternative benefits as compared to green space in general.

Indicator sets are often derived from a conceptual framework to define, frame and communicate the issue under consideration (EEA, 2005; WHO, 2015b; WHO, 2016). We aimed to develop a framework connecting concepts of health and ecosystems for urban gardening in the context of urban green space management. Provisioning of health was regarded as an 'ecosystem service', i.e. the contribution of ecosystems to human well-being. This approach is becoming more and more common and matches with the natural capital principle mentioned above (Tzoulas et al., 2007; Pretty, 2011; Reis et al., 2015). However, different academic traditions and research methods, specialized language and the lack of common theories constitute a major obstacle to interdisciplinary studies. Nonetheless, such studies are necessary if the challenges faced by those involved in urban planning and management are to be addressed fully (Tzoulas et al., 2007). One of these challenges is

to meet the Sustainable Development Goals of the United Nations. Indicators can be used to compare, evaluate and monitor the effects of policies addressing these goals.

The associations between green space and human health have been summarized in several frameworks (Tzoulas et al., 2007; James et al., 2009; URBAN-NEXUS, 2012; Claessens et al., 2014; Hartig et al., 2014). Hartig et al. (2014) described how exposure to green spaces may lead to health benefits (i.e. by improved air quality, more physical activity, social cohesion and stress reduction). However, we aimed to place these 'exposure-effect' relations in the broader context of urban management. An international project previously developed such a framework for green spaces, based on discussions between researchers, professionals and urban actors (URBAN-NEXUS, 2012). Their framework was adapted from Tzoulas et al. (2007) and James et al. (2009). It was based on perspectives of stakeholders with different backgrounds and it pointed out how to bring science into practice. Therefore, we chose this model and tailored it to urban gardening. Like the original framework, it defines four contexts; 1) physical factors including ecosystems, 2) health effects by the experience of urban gardening 3) management and 4) valuation. Management refers to urban planning and development and includes organizational aspects of urban gardening. Valuation refers to appraisal of social profits in cost-benefit analyses, for instance. Although we acknowledge the importance of this context, it was outside the scope of this article. Our literature review focused on the health effects of urban gardening. Results in terms of health-relevant management factors were also taken into account. The framework was used to structure our research and to define the indicators in a systematic way.

## 2. Methods

### 2.1. Definitions and framework development

We defined urban gardening as 'all noncommercial types of food production in or linked with the urban environment', see definitions below. Health was defined as 'the ability to adapt and self manage in the face of social, physical, and emotional challenges' (Huber et al., 2011). In line with this definition, health was categorized in 'physical health', 'psychological (or emotional) health' and social health, with the latter broken down in 'socio-economic health' and 'community health', like in the framework of 'URBAN NEXUS'. As described in the introduction, the framework was adapted to describe urban gardening as a specific type of urban green space use (see Fig. 1). Therefore, in the 'experience box' the word 'urban green space' was replaced by 'urban gardening', the word 'allotments' was added to 'green infrastructure' in the 'management box' and we added a box called 'lifestyle' to illustrate the behavioral change potential of urban gardening. The main keywords used in the literature research and the word 'soil pollution' were also added to further define the ecosystem and health benefits considered in this study (see italics). Indicators have been defined as 'an expression of the link between (living) environment and health, targeted at an issue of specific policy or management concerns and presented in a form which facilitates interpretation for effective decision-making' (Briggs et al., 1996). They serve as an interpretation and communication tool to support the development of policies and evaluate these policies once they are implemented. Not only indicators of health impacts were defined, but also of ecosystem services and management aspects that predict the potentials of urban gardening and may reveal supportive management actions.

### 2.2. Literature search for (indirect) health effects

A literature search of electronic databases [Scopus, Medline, Psycinfo and Embase] and Google Scholar was performed in June, 2014, and supplemented with a quick scan of major new publications in 2017. The focus was on articles or reports of (potential mechanisms of) health benefits in gardeners of urban gardens. The selection of key-words was based on the mechanisms described by Hartig et al. (2014), but we

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