Contents lists available at ScienceDirect





journal homepage: www.elsevier.com/locate/scitotenv



The soil–water system as basis for a climate proof and healthy urban environment: Opportunities identified in a Dutch case-study



Jacqueline Claessens *, Dieneke Schram-Bijkerk, Liesbet Dirven-van Breemen, Piet Otte, Harm van Wijnen

National Institute for Public Health and the Environment (RIVM), PO Box 1, NL-3720 BA Bilthoven, The Netherlands

HIGHLIGHTS

- Underpinned guidelines for climate resistant planning do not exist.
- The benefits of greenery are difficult to express in averages.
- Finding communal interests will generate support for climate adaptation.
- · Goals regarding water storage can be linked with goals for cooling and well-being.

ARTICLE INFO

Article history: Received 27 June 2013 Received in revised form 27 February 2014 Accepted 27 February 2014 Available online 20 March 2014

Keywords: Water storage capacity Human health Urban areas Green spaces Climate adaptation Soil

ABSTRACT

One of the effects of climate change expected to take place in urban areas in the Netherlands is an increase in periods of extreme heat and drought. How the soil can contribute to making cities more climate proof is often neglected. Unsealed soil and green spaces increase water storage capacity and can consequently prevent flooding. The planning of public or private green spaces can have a cooling effect and, in general, have a positive effect on how people perceive their health. This paper reviews existing guidelines from Dutch policy documents regarding unsealed soil and green spaces in the Netherlands; do they support climate adaptation policies? Scientific literature was used to quantify the positive effects of green spaces on water storage capacity, cooling and public health. Finally we present a case study of a model town where different policy areas are linked together. Maps were made to provide insight into the ratio of unsealed soil and the number of green spaces in relation to existing guidelines using Geographical Information Systems (GIS). Maps marking the age and socialeconomic status of the population were also made. The benefits of green spaces are difficult to express in averages because they depend on many different factors such as soil properties, type of green spaces, population characteristics and spatial planning. Moreover, it is not possible to provide quantifications of the benefits of green spaces because of a lack of scientific evidence at the moment. Based on the maps, however, policy assessments can be made, for example, in which site a neighborhood will most benefit from investment in parks and public gardens. Neighborhoods where people have a low social-economic status have for example fewer green spaces than others. This offers opportunities for efficient adaptation policies linking goals of several policy fields. © 2014 Elsevier B.V. All rights reserved.

1. Introduction

Over the coming decades climate change is expected to result in greater periods of heat and drought in The Netherlands as well as in more intensive rainfall and flood risks. In urban areas this may have negative effects on people's living environment and health. It is precisely in urban areas, where a large part of the land is sealed by buildings and asphalt, that extreme weather conditions have a greater impact (EEA, 2012). In extreme weather events the water is not able to penetrate into the soil and has to be eliminated through the sewage system

E-mail address: Jacqueline.claessens@rivm.nl (J. Claessens).

and surface waters. Eight percent of land in The Netherlands is sealed, making it the country with the most sealed land in the EU after Malta (Prokop et al., 2011).

Until now, measures to mitigate the effects of e.g. climate change in cities, focus mainly on infrastructural- and technical solutions without concern for the natural soil–water system. However, sustainable use of soil-ecosystems offers a variety of opportunities to contribute to solutions for societal challenges. In practice, these opportunities are still underexploited. A recent study by the EEA recommends a combination of different measures – 'gray' measures such as technological and engineering projects, 'green' ecosystem-based approaches using nature, and so-called 'soft' measures such as policies to change governance approaches (EEA, 2013). The capacity of the soil as a carrier of greenery plays thus an important role in climate-resistant planning.

^{*} Corresponding author at: National Institute for Public Health and the Environment (RIVM), PO Box 1, 3720 BA Bilthoven, The Netherlands. Tel.: +31302743783.

Green infrastructure has a large number of environmental, economic and social benefits (EPA, 2010; Wong et al., 2012). These benefits vary from improvement of air quality, flood protection, improvement of human health, encouragement of economic development, education and urban heat island mitigation. Water storage, cooling and health effects are the benefits we focus on in this study (Figs. 1 and 2). Greenery provides cooling (Döpp, 2011), as a result of which the so-called urban heat island (UHI) effect is possibly reduced in towns and the quality of life improved (EEA, 2012). In addition, greenery increases water storage capacity (EEA, 2012) and several positive health effects have been described (e.g. de Vries and Verheij, 2003; Maas et al., 2009b; Mitchell and Popham, 2007; Lee and Maheswaran, 2011). However, evidencebased quantifications of the positive effects of greenery are – to our knowledge – lacking.

The aim of this article is to demonstrate and discuss the potential benefits of green space and the natural soil–water system for contributing to major societal challenges in urban environment with regard to water storage, cooling and health effects (Figs. 1 and 2). It is generally believed that climate change, among others, will undeniably affect the quality of urban life. The question is not only the scale and seriousness of the effects but also how society will anticipate and which measures can be taken now. Finding communal interests between the different benefits of greenery is an important aspect of successful adaptation policy.

Dutch policy makers expressed the need for a quantification of the positive effects of green space to underpin their climate adaptation policies. Commissioned by the Dutch Ministry of Infrastructure and the Environment we (first) explored existing guidelines regarding unsealed soil, green spaces and water storage in the Netherlands; do they support climate adaptation policies? Secondly we quantified the benefits of a sophisticated green space soil policy with regard to water storage, cooling and health. Finally (three) we determined the availability of urban green, a key factor for the quality of urban life, for a Dutch model city. In this case study different policy areas are linked together. The results of this study are also presented in a Dutch report by Claessens et al. (2012).

2. Material and methods

2.1. The benefits of greenery and guidelines

Scientific literature was reviewed to describe the benefits of greenery and a natural soil–water system for the quality of life in urban areas. We focused at effects on water storage capacity, cooling and health. For health effects, we used 2 existing reviews: one by the Dutch Health Council and Advisory Council of Environmental Planning (2004) and an update by Maas et al. (2009a) (both in Dutch). Some more recent, international references have been added as the evidence for health effects is rapidly emerging. In addition, a search was done in Dutch policy documents to find guidelines for soil and greenery in urban areas.

2.2. Case study Hilversum

Using Geographical Information System (GIS) analyses for a model town, this study looked at the percentage of unsealed land, the location of open green spaces and access to the green spaces at district level. This was then linked to the age distribution in the various districts and the mean monthly income (as an indicator of social-economic status). The differences between districts were investigated, and statistical tests were done to see whether the differences were significant. The Pearson's correlation coefficients between the surface of green space and the age structure/socioeconomic status were calculated, using IBM



Fig. 1. Water storage capacity and cooling effects of green spaces in urban environments.

Download English Version:

https://daneshyari.com/en/article/6330567

Download Persian Version:

https://daneshyari.com/article/6330567

Daneshyari.com