Evaluating hydrological and socio-economic impacts of green/blue space projects for storm water management

Evaluation des effets hydrologiques et socio-économiques des espaces verts/bleus pour la gestion des eaux de pluie

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RÉSUMÉ

Les régions et villes européennes doivent faire face à des nombreuses questions liées à l'eau : gestion des eaux pluviales, qualité de l'eau, impact des sécheresses sur les milieux aquatiques. Pour répondre durablement à ces questions, il est évident que l'eau doit être intégrée dans le développement urbain et dans les politiques d'aménagement du territoire. L'objectif général du projet pour la coopération interrégionale Aqua-Add (Mieux intégrer l'eau dans les projets urbains) est de déployer le potentiel de l'eau dans les paysages urbains (potentiel économique, social et environnemental). Dans ce contexte, l'approche hydrologique et un modèle hédonique des prix sont intégrés et appliqués afin de vérifier les effets hydrologiques et socio-économiques des différentes solutions pour la gestion des eaux de pluie, et de faciliter le débat avec les acteurs de l'aménagement. L'objectif de cette étude est d'évaluer les effets hydrologiques et socio-économiques des espaces verts/bleus pour la gestion des eaux de pluie dans les villes moyennes. Nous présentons et étudions ici plus particulièrement l'étude de cas de Imperia (Italie).

ABSTRACT

European regions and cities face important challenges related to water management, including storage, discharge, quality and periodic stress. To address these challenges, it is evident that water must become an integral part of urban planning policies and their implementation. The international co-operation project Aqua-Add (Deploying the added value of water in local and regional development) aims to deploy the potential of 'water' (economically, socially and environmentally) in urbanized landscapes and to improve the implementation of water measures in local and regional urban planning. In this framework, hydrologic and hedonic-pricing simulation modelling approaches are integrated and applied in order to demonstrate the potential environmental, social and economic impacts of different water management scenarios as well as to facilitate more informed decision making across stakeholders. The objective of this paper is to assess the hydrological as well as socio-economic implications of green/blue space projects for storm water management in medium-sized cities. In particular, the case study of Imperia (Italy) is here presented and discussed.

KEYWORDS

Green/blue spaces, hydrologic impact, socio-economic assessment, urban planning, water management

1 INTRODUCTION

European regions and cities face important challenges related to water management, including storage, discharge, quality and periodic stress. To address these challenges, it is evident that water must become an integral part of urban planning policies and their implementation. The international co-operation project Aqua-Add (Deploying the added value of water in local and regional development; http://www.aqua-add.eu/) aims to deploy the potential of 'water' (economically, socially and environmentally) in urbanized landscapes and to improve the implementation of water measures in local and regional urban planning. Relevant sub-objectives of the project concern the exchange of experiences and good practices, including soft testing of stakeholder involvement, the assessment of the socio-economic impact of "green/blue spaces" in urban areas, and the achievement of practical and successful business models for water projects (Saraiva et al., 2014). Eight case studies are implemented in the project: Aveiro (PT), Bremerhaven (DE), Copenhagen (DK), Debrecen (HU), Eindhoven (NL), Imperia (IT), Lyon (FR) and Sofia (BU). The objective of this paper is to assess the hydrological as well as socio-economic implications of green/blue space projects for storm water management in medium-sized cities. In particular, the case study of Imperia (Italy) is here presented and discussed.

2 METHODS

In this framework the potential environmental and socio-economic impacts of green/blue spaces are evaluated based on both hydrological analysis and hedonic-pricing simulaiton at the urban catchment scale.

As for the hydrological component, the analysis of observed precipitations and storm water runoff data is performed in order to point out the extreme rainfall-runoff event conditions. Secondly, a field survey is carried out in order to localize the failures of the urban drainage network. Finally, a feasibility study is performed to design potential technical solutions for sustainable storm water management.

As for the socio-economic component, the Sustainable Urbanizing Landscape Development (SULD; http://suld.web.ua.pt/) model is developed and applied for the Imperia case study (Roebeling et al., 2014b). SULD is a GIS-based optimization model that builds on hedonic pricing theory and is based on a classic urban-economic model with environmental amenities (see Mills, 1981; Wu and Plantinga, 2003). SULD calculates the equilibrium price for housing as a function of demand and supply, determining the location of residential development, development density, population density, housing quantity, living space and real estate value. In turn, impacts of location-specific green/blue space, infrastructure and socio-economic scenarios can be assessed (Roebeling et al., 2007, 2014a).

3 RESULTS

The Imperia case study area comprises the district of Oneglia, which covers urban residential and industry/commerce areas of about 140 ha. Figure 1 provides the land use map of the study area at Imperia (IT), including the main environmental amenities (numbers), urban centres (white dots) and road network. The city contains few urban parks (7.0ha) and forest (5.5ha) areas, though is surrounded by open-space/agricultural-areas and the Mediterranean Sea as well as crossed by the Impero river (see Figure 1). As for the main infrastructure, a railway line goes through the urban area from the south-western corner towards the central-eastern area; the railway station cuts the Oneglia historical centre in half.

Results from the hydrological analysis point out the high-frequency of pluvial flooding events in the area of concern as well as identify the flood risk areas and the critical sections of the combined sewer system. In order to address the flooding problems associated with the failure of the combined sewer system, a renovation project of the Oneglia railway area is proposed. The project involves the realization of a green/blue corridor (named Oneglia-project) that provides storage and retention – thus locally solving the storm water management problem of the district. At the same time the Oneglia-project is designed as a multi-functional area with cultural and recreational services that enhance urban quality of life. Furthermore, the requalification of the (to be ceased) railway track/bridge into a bus and bicycle lane as well as the relocation of the (to be ceased) railway station to the Northeast of the city along the (to be opened) new railway track are foreseen.

The application of SULD to the Imperia case study allowed assessing the impact of the Oneglia-project, on the location of residential development, housing quantity, residential development density, population density, population composition, household living space and real estate values. Figure 2

provides the maps of the simulation results: the socio-economic analysis is reported for the base (current condition) and Oneglia-project scenarios, and the observed differences between these scenarios are also illustrated highlight the key changes. Four major tendencies regarding the establishment of green/blue spaces foreseen in the Oneglia-project can be derived. First, the city becomes more compact (5% reduction in urban residential area) as people are willing to accept smaller housing when able to live closer to the attractive Oneglia-project area. Second, population density increases as green/blue spaces attract more people to the area surrounding the Oneglia-project – with moderate to large increases in household densities in the area between the Oneglia-project and the new railway station (up to +15%) as well as in the North and South of the Oneglia-project (up to +12%). Third, there is an appreciation in real estate values as people are willing to pay more when living closer to the Oneglia-project area – with small, local, increases in real estate values between Oneglia-project and the new railway station (up to +6%) and around Oneglia-project (up to +5%). Finally, changes in demographic distribution patterns will occur as higher income households are attracted to these areas – with high income households being attracted to the area North-East of the Oneglia-project and middle income households being attracted to the area near the new railway station in the North-West.

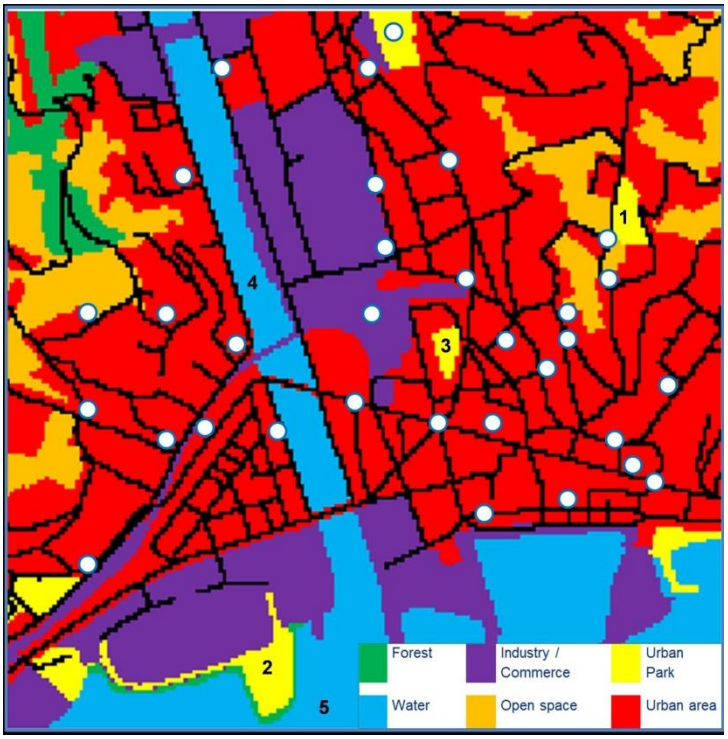

Figure 1. Land use map of the study area at Imperia (IT). The main environmental amenities (numbers) and urban centres (white dots) are indicated.

4 CONCLUSIONS

The scenario simulation results, their visualization and reflected insights showcase the potential of the Sustainable Urbanizing Landscape Development (SULD) decision support tool to improve urban planning practices, in terms of drafting plans, public discussion and monitoring. In particular, SULD facilitates the implementation of sustainable urban drainage solutions within urban planning policies. It enriches public discussion and adds transparency to the urban planning processes. So, it encourages stakeholders to reflect about their reality and future possibilities – effectively engaging them in the design of urban development plans where the value of water and green spaces assume a forefront position. Such a multidisciplinary and participative approach, including communication with and involvement of stakeholders, is needed to move from the traditional urban drainage design to a more water-sensitive approach.

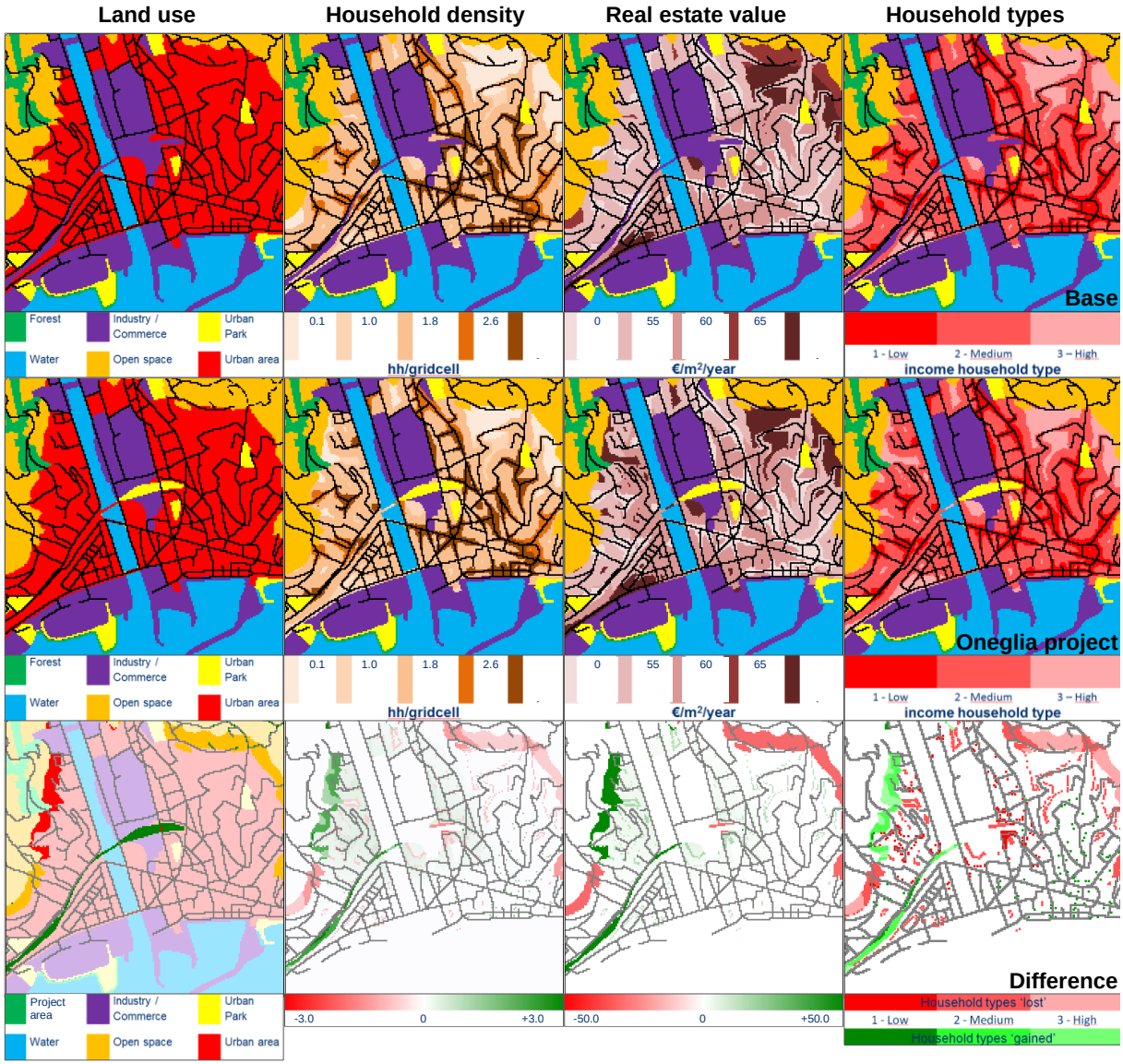

Figure 2. Base and Oneglia-project simulation results and maps of the differences.

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