



## Research paper

# Assessing spatial benefits of urban regeneration programs in a highly vulnerable urban context: A case study in Catania, Italy



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## HIGHLIGHTS

- Relation between urban development and sustainability is crucial for planning.
- A method for spatially quantifying the benefits of regenerating areas is proposed.
- A limited number of regeneration areas produce relevant benefits.
- Benefits rely on the characteristics of regeneration areas and urban environments.

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## ABSTRACT

The relationship between sustainable urban development and environmental sustainability is crucial to every strategy of urban transformation, renewal and regeneration. In particular, urban regeneration entails programmes of urban transformation that involve the rehabilitation of existing parts of a city, re-use previously built-up area and abandoned buildings, and redevelop blighted urban spaces to increase urban sustainability. Few existing studies have evaluated the real environmental outcomes and effectiveness of regeneration programmes in terms of physical variables such as newly provided green spaces, access to public transportation, climate change or seismic-risk reduction.

This paper proposes a method for spatially quantifying the benefits of regenerating areas with reference to environmental and urban factors, such as reduction of seismic risk, increase in accessibility and diversity of land use. Each aspect is evaluated by spatial indicators, calculated at different geographical units that steadily increase in size, in order to understand the effects of a single regeneration area and of a number of concurrent areas. The work focuses on the municipality of Catania (Italy), a high-density urban context, with a general lack of green spaces, and high levels seismic risk exposure.

Results show that positive benefits can be extended from regeneration areas to contiguous relevant portions of the city, and that even a limited number of regeneration areas can produce relevant benefits. These benefits rely on the combination of characteristics of regeneration areas and urban environments in which they are located, such as population density, presence/accessibility of urban services, and land-use diversity.

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## 1. Urban regeneration for the design of sustainable cities

An increasing body of literature highlights the role of sustainability approaches for the definition of policies and practices of urban transformation (Newman & Jennings, 2008; Evans, 2012; Vojnovic, 2014). Examples of planning strategies, policies and pro-

grammes for sustainable cities include the re-use of previously dismissed urban land and abandoned buildings and the redevelopment of blighted urban spaces. As a direct consequence, these actions can reduce soil sealing, decrease the demand for new developments in peri-urban areas, and increase the appeal of urban centres (Couch & Dennemann, 2000; Turcu, 2012).

Among the different policies available in the toolkits of urban planners and designers, urban regeneration is often considered one of the most effective instruments that can be used to solve a wide range of urban problems and to find long-term solutions for economic, physical, social and environmental concerns in the contemporary city (Roberts, 2000; Alpopi & Manole, 2013). Urban

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regeneration is a multidisciplinary field of research, policy-making and practice, including, among other elements, city planning, urban design, housing, transportation, the economy, community development and sustainability studies (Leary & McCarthy, 2013). Moreover, it is characterized by a comprehensive and integrated vision, which leads to the resolution of urban issues and seeks to promote development in urban communities interested in transformation (Roberts, 2000).

A number of urban regeneration programmes have recently been developed across Europe as a holistic strategy for achieving greater quality of urban planning and design, despite challenging levels of social inequality and a proliferation of blighted urban spaces. These programmes are characterized by a very high level of complexity of economic, physical, social, political and environmental processes, and are based on urban-development policies involving the rebuilding or reconfiguration of urban spaces (Paddison, 2012). General principles and models of good practice for urban regeneration are widely recognized, but urban-regeneration programmes should always be adapted to their specific geographical contexts and urban-development models adopted by local administrations (Kleinhaus, 2012).

Urban regeneration programmes oriented towards urban sustainability (Evans, 2012) should, in particular, be aimed at addressing a set of issues affecting urban areas, such as:

- improving living conditions in residential districts (Alpopi & Manole, 2013);
- increasing the energy performance (Deakin, Campbell, & Alasdair, 2012) and anti-seismic response of existing urban fabric (Güzey, 2016);
- redeveloping public spaces and enhancing the provision of public services and related ecosystem services (Privitera, Martinico, La Rosa, & Pappalardo, 2013); and
- Modernizing urban infrastructure (Huston, Rahimzad, & Parsa, 2015).

Urban regeneration programmes should be implemented not only at neighbourhood level, but also on a city-wide scale. Finding an appropriate scale for regeneration programmes is fundamental to their effectiveness: on an urban scale, interrelations between different components of urban fabric can be better taken into account in order to achieve a higher-quality urban environment. Built-up area density, land-use types, and mobility are some of the features that should be considered at city level when developing sustainable planning strategies (Callender, 2012). However, most urban-regeneration programmes are characterized by a very localized scale of intervention: they are often planned and designed at neighbourhood or district level, and tend not to be included in broader land-use plans made by municipalities (Moccia, 2009; Wang et al., 2014; Zheng, Shen, & Wang, 2014). Considering urban regeneration as a part of the broader urban-planning process rather than sectorial projects could provide benefits for the entire urban context.

Despite the consolidated and central role of urban-regeneration programmes in planning sustainable cities, few studies have quantitatively evaluated real environmental outcomes and the effectiveness of regeneration programmes in terms of physical variables, such as newly provided green spaces, access to public transport, climate change and seismic-risk reduction (Laprise, Lufkin, & Rey, 2015; Villagra, Rojas, Ohno, Xue, & Gómez, 2014; Zheng et al., 2014). Furthermore, to the best of our knowledge, approaches to a spatial evaluation of the positive effects of urban regeneration remain an unexplored field of research in urban planning studies. In the current study, we seek to understand how regeneration programmes can produce positive effects (in terms of urban sustainability) for parts of cities that are larger than the

areas to be actually regenerated, thereby providing benefits to a higher number of people. In other words, we explore if and to what extent the positive effects of regeneration programmes can spread out from the single areas to be regenerated to wider urban contexts (such as entire districts or neighbourhoods).

Starting from these considerations, this paper argues on behalf of the effects of regeneration programmes, and proposes a method that can be used to quantify spatially the benefits of Regeneration Areas (RAs), with reference to the above-mentioned environmental and urban factors. The study focuses on a real planning process carried out in Catania (Italy). Among the different land-transformation mechanisms provided by the new city master plan, several regeneration programmes are included, especially in peripheral areas of the city that are mainly characterized by environmental, urban and social forms of blight. The following benefits are evaluated:

- reduction of seismic risk (in terms of exposure to seismic risk);
- increased access to urban functions; and
- increased diversity of land use.

These benefits have been highlighted because they represent the most relevant sustainability objectives for regeneration programmes (Zheng et al., 2014; Güzey, 2016), especially for the case study of the municipality of Catania. Each of the aforementioned aspects was evaluated using spatial indicators calculated by GIS. All indicators were calculated at different geographic units that steadily increase in size, in order to understand the effect of a single regeneration project and of a number of concurrent projects within the considered geographical units (see Section 3).

In Section 2, the paper introduces the regeneration programmes for the city of Catania and, in Section 3, a method is proposed for evaluating the positive effects of RAs. The results of the application of this method are reported in Section 4 and discussed in Section 5, in the light of current literature about urban regeneration and sustainability issues.

## 2. Case study: master plan and regeneration program in Catania (Italy)

Urban regeneration represents an important challenge for the municipality of Catania, a medium-sized city in one of the larger metropolitan areas in southern Italy (Fig. 1). It is characterized by a high-density urban fabric, a lack of urban green spaces and public services, and high levels of traffic congestion due to the massive use of private transportation. The urban fabric is also very vulnerable to seismic, geological and climate-change risks. Due to these and other aspects, the city is ranked as one of the most congested and least sustainable in Italy (La Greca, Barbarossa, Ignaccolo, Inturri, & Martinico, 2011).

At the end of 2009, the municipality started to develop a new master plan, which was intended to address the condition of crisis affecting the city and the metropolitan area, by enhancing the city's overall environmental quality and reducing its high level of congestion (Martinico, La Rosa, & Privitera, 2014; La Greca & Barbarossa, 2014). The core elements of the master plan are:

- the design of a compact, mixed-use urban form that uses land efficiently;
- the attribution of a key role to green spaces as nodes of a green infrastructure and elements of climate change adaptation policies;
- the implementation of an urban green infrastructure to enhance soil permeability and reduce urban heat islands by protecting non-urban areas with a high level of evapotranspiring surfaces; and

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