



# Land transformation of Italy due to half a century of urbanization



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## ABSTRACT

The research presented in this paper has analyzed 50 years of urban evolution in Italy and noted a considerable difference of geographic patterns of settlement growth compared to other countries of the World. The model of sprawl, recognized as international standard and a territorial disease, largely concerns the industrialized countries, but also developing countries, and in particular the entire European area, but distribution patterns in southern Europe, especially in countries in the Iberian, Mediterranean and Balkan areas, are significantly different from those found in northern Europe and other continents. Our study has investigated and diagnosed the forms of urban growth focusing on the Italian model, one of the most significant in Western Europe and for which we propose an alternative definition (urban sprinkling). It is important to highlight that the damage caused on the landscape, environment and communities by urban sprinkling is much more serious and irreversible than what notoriously caused by urban sprawl. Furthermore, there has been a drastic change in numerous rural, mountain and coastal landscapes, which today are profoundly different from those historically appreciated by culture and international tourism. The settlement configuration called “sprinkling” introduces the difficult methodological and planning aspects of its retrofit (de-sprinkling), a true challenge for land management, arguing that the even partial inversion of many negative effects is basically impossible in the short term; whereas, in a medium-long term, organized and politically coordinated programmes can tackle the various issues.

## 1. Introduction

In most countries worldwide, urban development has taken the form of “sprawl” which characterizes human settlements distributed over vast and very low-density areas. This model of growth, now a standard and for years recognized as a territorial disease (Squires, 2002; European Commission, 2006; The Worldwatch Institute, 2007; Ewing, 2008; Angel et al., 2012; Barrington-Leigh and Millard-Ballb, 2015; Paleari, 2017) largely concerns the entire European continent, but distribution patterns in southern Europe, especially in countries in the Iberian, Mediterranean and Balkan areas, are significantly different from those found in northern Europe and other continents. Our study has investigated and diagnosed these forms of urban sprawl focusing on the Italian model, one of the most significant in Western Europe and for which we propose an alternative definition.

In particular, this study, started in 2006 and completed in 2015, analyzes how settlements have evolved in Italy over fifty years following World War II, highlighting new dynamics and the foregoing significant structural differences with other European countries.

In order to understand these differences, a very brief historical overview of the events that led to the present-day physiognomy of the Italian urban landscape since the post-World War II period is necessary. At the end of the forties, the “Marshall Plan” (Raftopoulos, 2009), the ensuing “Fanfani law” and the INA Housing program brought about radical changes in the country through the construction of a large number of residential buildings and the rapid expansion of cities. From 1949–1963, 20,000 building sites were opened and over 350,000 dwellings erected: 2800 dwellings per week were built during peak years. In the following decades, public housing efforts gradually dropped almost down to zero, while investment in “market” housing, i.e. housing sold freely, increased significantly. From the mid-sixties, it was clear that the extremely strong economic pressure on land exerted by this process would produce uncontrolled and even illegal building. Indeed, a farsighted politician of the time, Fiorentino Sullo, proposed a reform involving the total acquisition by municipalities of the land to be used for new buildings in order to avoid speculation. At the time, the government rejected this proposal vehemently and so Italy drifted towards the unsustainable land use model that has persisted to the

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present day. Moreover, from the 80s onwards, regional, provincial and municipal planning efforts have grown increasingly weaker and urbanization has sprawled freely, especially in rural plains, river valleys and hill and piedmont areas. This has led to its systematic encroachment on vast areas at hydrogeological risk, with drastic consequences for the safety of settlements which each year show their extremely high vulnerability, owing to ongoing climate change too. The consequence has been a sharp drop in quality of life for the population, strongly underscoring the negative aspects of highly sprawled settlements (Peiser, 1989; Frumkin, 2002; Carruthers and Ulfarsson, 2003; Safirova et al., 2007; Travisi et al., 2010; Güneralp and Seto, 2013; Güneralp et al., 2017; Batty, 2013) high energy management costs, difficulty in providing services and public transport and therefore generalized dependency on private mobility. Furthermore, there has been a drastic change in numerous rural, mountain and coastal landscapes which today are profoundly different from those historically appreciated by culture and international tourism. Another effect is the lower quality of national ecosystems having a world-renowned biodiversity, due to the severe environmental fragmentation caused by the shrinking of habitats and the proliferation of roads of all sorts resulting from urban dispersion (Collinge, 1996; Romano, 1999; Fahrig, 2003; Irwin and Bockstael, 2007; Bennett and Saunders, 2010; Battisti et al., 2012).

The study we present in this paper has allowed us to assess the development dynamics of Italian urbanized areas over the past 50 years in a measured, yet not sampled manner, with a level of detail of 1:20,000 for the section pertaining to the 50 s and of 1:10,000 for the one following 2000. We have used several indicators to understand qualitative and quantitative phenomena tied to urban growth and then outline prevailing models in various Italian areas.

We have highlighted various threshold values and regional dynamics converging on these values over a timespan of great statistical significance. The indicators used have helped us assess “settlement patterns” in the various parts of the country that, as is well known, is marked by huge economic, social and cultural differences between north and south that government policies have never succeeded in bridging. One significant result is the development of a new model, as an alternative to sprawl, called “sprinkling” which better reflects the features and functional structure of present-day Italian settlements (Romano et al., 2017). This model is far less controlled and increasingly more difficult to manage and remedy in the long run than sprawl (Hennig et al., 2015).

One of the most important aspects is the correlation between urban expansion and demographic change: our study has shown that it is negligible at local, but significant at regional and national levels. Another important result concerns the extent of urbanization in the country's protected areas and landscape units, which are key for animal species of global conservational importance, but at risk today owing to increased environmental isolation caused by buildings and roads.

Today, Italy has acknowledged the absolute need to re-organize urban areas to curb their expansion and make them more environmentally, socially and economically sustainable. Understanding the foregoing models, which this study has helped us to do, is essential in order to calibrate future rules based on settlement patterns in the various regions.

## 2. Materials and methods

The main issue in this study was finding a historical dataset updated to the post-World War II period that was as homogenous as possible for the entire country. As we lacked digital data with these features, our choice fell on the only existing maps that helped us extrapolate urbanized areas almost semi-automatically using GIS techniques. This is why, in the study presented in this paper, we used Italian maps published on a scale of 1:25,000 by the Italian Military Geographical Institute (IGMI) between 1949 and 1962 (Romano and Zullo, 2012, 2014). These maps are part of the 25 V Series, plotted on a scale of

1:20,000, organized in 3545 elements (tables) 7°30′ longitude and 5′ latitude in size, in Gauss's conformational representation and part of the national geodetic system (international ellipsoid oriented to Rome Monte Mario – ED40) with a kilometeric grid in the Universal Transverse of Mercator conformational projection (ED50 European data).

The information on all the regions has been extracted in original from the IGM sections. The historical urbanized areas in Friuli Venezia Giulia, Lombardy and Emilia Romagna have been obtained from regional geoportals and are referred to 1950 in the case of Friuli (Moland project – Monitoring Land Use, Cover Dynamics, <http://irdat.regione.fvg.it/WebGIS/>) (Lavalle et al., 2000; Kasanko et al., 2006), while for the other two regions they were obtained by means of photo-interpretation during the IGMI-GAI flight of 1954 (<http://geo.regione.emilia-romagna.it/geocatalogo/>; <http://www.cartografia.regione.lombardia.it/rlregisdownload/>).

From these sources we have been able to extrapolate urbanized areas in the 50s, formed by areas covered by buildings plus all ancillary areas (parking areas, streets within neighborhoods, goods storage and handling areas and various other structures).

However, there is no standard definition of “urbanized areas” at national level. The same regional land use maps contain different categories, making them difficult to interpret using the same definitions. In a recent study, Romano and Zullo (2013) used a classification that included all the territorial spaces, both physical and artificial, which however had only been subjected to the impact of “urban” anthropic activities. They were therefore considered “urbanized land”: built-up land and land used for ancillary settlement functions, such as public and private gardens, sports facilities, unpaved roads and other service areas, either permeable or impermeable to water.

The results obtained from historical maps on 1:25,000 were then compared with those of urbanized areas available in vector format from regional Land Use Maps (LUM) generally derived from photo interpretation on a nominal scale of 1:10,000 or 1:5,000, updated between 2002 and 2007 (Table 4 in Supplementary material). Considering the time difference in the updating of the primary data a 5% tolerance should be allowed for ensuing assessments.

The sources that we have just listed were used to describe the phenomena that occurred from post-WW2 until 2000, even (Bossard et al., 2000) though the Corine Land Cover (CLC) data are available for this last chronological section. The data were not used in this phase because totally unsuitable for capturing the phenomenon of extremely scattered Italian urbanization in an acceptably accurate manner. Using the CLC methodology, the minimum mappable unit is equal to 25 ha (equivalent to a circle of 2.8 mm on a scale of 1:100,000) and the minimum width of the polygons is 100 m (1 mm on a nominal scale). Furthermore, prevalent and secondary surfaces for each of these areas, identified by means of photointerpretation of the digital orthophotos of flight IT2000, were used. The surface covering the greatest area within a circle having a 400-m radius was used as the prevalent surface. This resulted in an analysis that was quite approximate in terms of identification, and thus delimitation, of urbanized land: areas below 25 ha and housing agglomerations having boundaries of less than 100 m (scattered housing, small aggregates) do not appear in the final calculation, while the secondary road network (state, provincial, municipal roads) cannot be considered for obvious technical reasons. Another limit is the fact that only changes in surfaces greater than 5 ha can be highlighted, which although functional on a national scale, is not a very detailed scale. This can be very effective in the case of work on a national or even regional scale in countries with aggregate urbanization (Germany, Great Britain), but completely insufficient for a survey on the Italian regional spatial scale marked by extremely small settlements consisting of numerous tiny agglomerations or even individual buildings spread over a huge surface (Fig. 3). This is evidenced by the fact that urban density in Italy, derived from 2006 CLC data, is equal to 5.2% (and hardly varies when analyzing the latest CLC data of 2012–5.3%), while the same parameter derived from regional maps

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