Integrated Statistical Data for Planning Social Housing in the City of Taranto

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Abstract. Housing is often considered a crucial element in determining the level of income and social well-being, in recognition of the ways in which housing shortages, or the use of poor-quality housing, are statistically linked to income levels and can negatively affect on people's well-being (Rolfe et alii, 2020). So, planning social housing isn't just a question of houses, but it claims for a deep understanding of people living conditions, social and economic dynamics. That's why is necessary to integrate different statistical data to develop a model of social and economic living conditions of people to address better and context-based housing policies. The paper analyses methods and tools to integrate appropriate statistical data to guide housing policies in the case of the city of Taranto, selecting those most useful for determining supply and demand to guide urban planning in subsequent participatory and implementation paths. Planning social housing not just to improve physical spaces, but to interpret the needs of living.

Keywords: Housing policies · Statistical integration · Urban planning

1 Introduction

1.1 Contemporary Social Housing Demand

In the first half of the twentieth century, the subject of public buildings played a central role in the construction of the utopia of modernity. The issue of the right to housing was at the center of the programs of most of the national states. With the post-war building expansion, the issue seemed to lose importance in the widespread idea that everyone had free access to the housing market. In Italy, while the share of public intervention in residential construction suffered a substantial collapse that is still significant today, at the same time savings were encouraged for the purpose of buying a home.

The contribution is the result of joint reflections by the authors, with the following contributions attributed to F. Rotondo (paragraphs 1 and 4) and to P. Perchinunno (paragraphs 2 and 3).

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According to ISTAT data[1] in Italy in 2011, the incidence of owned homes was 72.5% of the total, in the Puglia Region it was 74.4% and in the Municipality of Taranto at 72.4%. But if the homeowner has certainly contributed to the increase in the level of well-being of the Italian population, it has made the contrast more and more striking with those who are not able to access this market and no longer have available adequate housing policies neither at the national level, nor at a regional level.

The housing problem is a topical issue in the Italian social and political debate due to the emergence of new and more widespread forms of discomfort caused by the difficulty of accessing the residence by a growing and varied number of people, often with characters other than those attributable to those which traditional Public Residential Building was aimed at. It is a complex and not easily delimited concept that includes situations with different characteristics based on intensity and type of discomfort suffered.

The new housing issue is the result of profound changes that have first affected the supply side of housing, which have favored the expansion of home ownership, with the consequent contraction of the rental sector (both social and private) and the significant increase in house prices. On the demand side, housing poverty is the result of demographic and social transformations that are affecting all Western societies, but also the production system, with heavy repercussions on the growth of social vulnerability [1].

The fundamental prerequisite for defining possible strategic lines of intervention for housing policy is to separate the choices relating to public housing, capable of absorbing only a limited part of housing demand, with respect to measures to cope with needs of the so-called gray band. It is necessary to implement innovative interventions, carried out in agreement between the public and private sectors, aiming above all at the normalization of costs and the market, land and housing in ownership and lease [2].

In many cases, housing deprivation is closely linked to conditions of economic poverty. A form of hardship can also be identified in situations that refer mainly to the economic condition, to the title of use of the accommodation and therefore to the trend in rent. In essence, it is a question of considering all those families who at the moment may not even live in a condition of overt hardship, but who risk seeing their situation worsen and falling back into the categories previously examined.

It is a condition that affects the elderly, single parents with children, newly arrived immigrants, single-income families, people with job mobility, young people and university students; people who do not fall within the poverty standards provided for access to public housing but who are unable to deal with the current housing market.

For example, for owner families, the risk is linked to the presence of variable rate mortgages which, in the event of a rise in interest rates, could bring the mortgage payment above the sustainability threshold (30% of income). With regard to rent, the risk can be identified in the difficulty in accessing a rented house if it were required to change residence.

[1] ISTAT, 2011, Censimento Popolazioni e abitazioni (www.istat.it). ISTAT is the Italian Institute of Statistics.

For these reasons it was decided to use indicators capable of integrating the housing conditions expressed within the ISTAT Population and Housing Census and those related to the demographic structure.

As will be better illustrated below, a model based on fuzzy logic has been constructed, capable of summarizing the available data on the housing and demographic conditions of the municipality of Taranto to understand the distribution of housing deprivation, integrating it with other data relating to economic and social phenomena.

2 Identifying Indicators of Housing Difficulty

2.1 Introduction

The subject of the case of study arises from the necessity to identify geographical areas characterized by situations of residential deprivation in the city of Taranto (South of Italy). With the aim of analyzing the phenomena of residential poverty on a geographical basis, the work makes use of the data deriving from the most recent Population and Housing Census 2011 carried out by ISTAT; such information allows the geographical analysis in sections according to the census, albeit disadvantaged by the lack of the most recent data. The geographical units of the survey are the 962 census sections for the city of Taranto (of which 915 sections represent all of the data relevant to housing, while the remaining sections are either uninhabitable areas or destined for other uses, for example parks or universities).

With regards to the choice of housing poverty indices there is, therefore, a consideration of various aspects associated to housing conditions along with the quality of housing. The indices were chosen with the aim of identifying the level of residential poverty and were calculated to align elevated levels on the indices with elevated levels of poverty[2]. Connected to the phenomena of residential poverty is the evaluation of the *classification of social and housing status.*

2.2 The Total Fuzzy and Relative Method

At the city level, policies can be addressed by investigating condition of unavailability of housing services and quality, to understand better some peculiar aspect of distribution of housing difficulty.

[2] **Index 1** - Incidence of the elderly population: population aged over 70 compared to the total population.**Index 2** - Incidence of the population by educational qualification: population with a qualification below middle school compared to the total population.**Index 3** - Incidence of the illiterate population: illiterate population compared to the total population.**Index 4** - Incidence of empty houses: number of empty houses compared to the total number of houses.**Index 5** - Incidence of period buildings: number of buildings built before 1960 compared to the total number of buildings.**Index 6** - Incidence of residential buildings with poor or poor state of conservation: number of buildings with poor or mediocre state of conservation compared to the total number of buildings.

The approach chosen in order to arrive at the synthesis and measurement of the incidence of relative poverty or residential deprivation in the population in question is the so-called *Total Fuzzy and Relative*, "which utilizes the techniques of the *Fuzzy Set* in order to obtain a measurement of the level of relative poverty within a population, beginning from statistical information gathered from a plurality of indicators" [3].

The TFR approach consists in the definition of the measurement of a degree of membership of an individual to the fuzzy totality of the poor, included in the interval between 0 (not poor) and 1 (poor). Mathematically, such a method consists of the construction of a function of membership to "the fuzzy totality of the poor" which is continuous in nature, and "able to provide a measurement of the degree of poverty present within each unit". Supposing the observation of k indicators of poverty for every family, the function of membership of i-th family to the fuzzy subset of the poor may be defined thus:

$$f(x_i) = \frac{\sum_{j=1}^{k} g\left(x_{ij}\right) w_j}{\sum_{j=1}^{k} w_j} \quad i = 1, \ldots n \tag{1}$$

For the definition of the function $g(x_{ij})$ please refer to other works [4, 5].

2.3 The TFR Application

The application of the TFR (*Total Fuzzy and Relative*) method begins from the presupposition of synthesizing the five indices elaborated in "*fuzzy*" values which are able to measure the degree of membership of an individual to the totality of the poor (social-housing discomfort), included in the interval between 0 (with an individual not demonstrating clear membership to the totality of the poor) and 1 (with an individual demonstrating clear membership to the totality of the poor). The data arising from various census sections are classified into 5 different typologies of social-housing discomfort in accordance with the resulting fuzzy value:

- Absence of social housing discomfort
- Mild social housing discomfort
- Presence of social housing discomfort
- Significant social housing discomfort
- Relevant social housing discomfort.

According to the set of indicators considered, a differing division of the total 962 census sections for conditions of social and housing discomfort is produced. In relation to the set of indicators of housing and social hardship, 25.8% of the surveyed Sects. (236 sections) showed blurred values representative of the absence of social housing deprivation, 38% had mild social housing deprivation compared to 17.4% of the sections that highlight the presence of social housing deprivation, 12.3% of significant social housing deprivation and only 6.4% with significant social housing deprivation (Fig. 1).

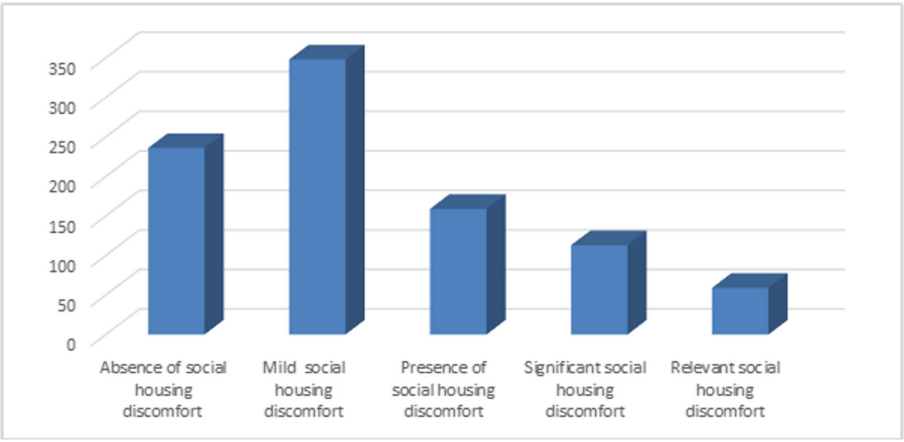


Fig. 1. Composition of absolute values of the census sections of Taranto for socio-housing discomfort.

Analyzing the location of the census sections by "neighbourhood" in terms of percentage composition in the different categories under examination, it is possible to identify areas with lower levels of residential discomfort, such as the quarters named "Lama, Talsano, San Vito" or some parts of the "Borgo".

The neighbourhoods in which a percentage of sections with situations of severe housing problems are detected are, however, "Città vecchia", the historical city centre, Montegranaro, an urban area adjacent to the city centre and Tamburi, the quarter nearest to the big steel plant (Fig. 2).

3 Identification of Cluster of Degraded Areas in the City of Taranto

3.1 The SATScan Model

In order to examine the possibility of applying such methods to regeneration programs it is necessary to introduce a physical reference to urban spaces. In the field of epidemiological studies a range of research groups have developed different typologies of software; these are all based on the same approach, but usually differ from each other in terms of the shape of the window.

Among the various methods of zoning are SaTScan [6] that uses a circular window, FlexScan [7], the Upper Level Scan Statistics [8] and AMOEBA [9].

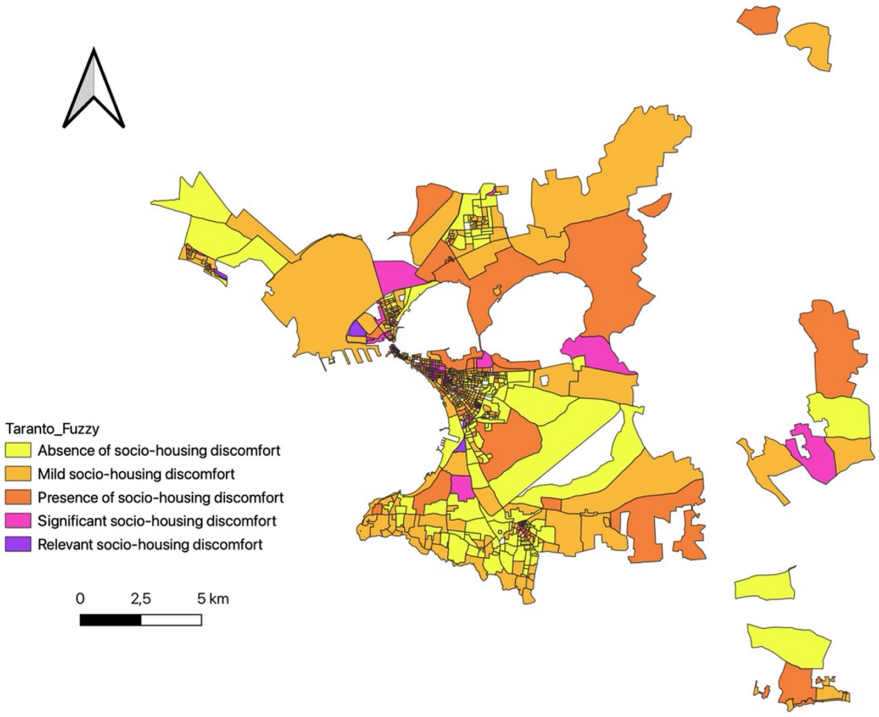


Fig. 2. Composition of percentage values of the census sections of Taranto for socio-housing discomfort in 2011.

SaTScan scans the region of interest with a moving window and compares a smoothing of the intensity inside and outside it: units belonging to contiguous windows with similar intensity are aggregated into a cluster. Multiple different window sizes are used. The window with the maximum likelihood is the most likely cluster, that is, the cluster least likely to be due to chance. A p-value is assigned to this cluster.

In the following description of the SatScan method, it is assumed that the region under investigation can be divided into sub-areas with no common points, along with the existence of precisely one subset Z (constituted by the union of one or more areas) and two independent Poisson processes defined on Z and Z^c, respectively indicated with X_z and $X_z{}^c$ whose intensity functions are:

$$\lambda_Z(x) = p\mu(x) \text{ and } \lambda_{Z^c}(x) = q\mu(x) \tag{2}$$

where p and q describe the individual probability of occurrence, respectively inside and outside the Z zone.

The intensity function of the "background" has a significant digit that varies depending on the particular application considered: for example, in epidemiological investigations, it models the spatial distribution of the population at risk.

The null hypothesis $H_0 : p = q$ that the probability of occurrence within the area considered is not higher than outside, is resolved by the use of the following ratio of

likelihoods:

$$\Lambda_Z = \frac{\max_{p>q} L(Z,p,q)}{\max_{p=q} L(Z,p,q)} = \frac{\left(\frac{y_Z}{\mu(Z)}\right)^{y_Z}\left(\frac{y_G-y_Z}{\mu(G)-\mu(Z)}\right)^{y_G-y_Z}}{\left(\frac{y_G}{\mu(G)}\right)^{y_G}} \tag{3}$$

where y_Z and y_G respectively represent the number of events observed within the Z zone and the entire region under study, while $\mu(Z)$ and $\mu(G)$ are usually approximated by the consistency of the population "at risk" respectively within Z and the whole region under investigation.

The advantage of proceeding according to this method is that the most probable cluster is detected by the highest value of the likelihood ratio seen as a function of Z,

$$\Lambda = \max_Z \Lambda_Z \tag{4}$$

where Z is a suitable collection of subset of G, or at least a collection of putative spatial clusters. In this case, SaTScan operates by locating a circular window of arbitrary radius, and calculating the probability of urban poverty, inside the circle, or the probability of urban poverty, outside the circle, and consequently by optimizing the dimension of the radius.

3.2 Identification of Housing Difficulty Clusters

Through the use of the SaTScan model, different clusters of housing demonstrating hardship may be identified, consisting of a number of different sections of a census. The p-value demonstrates the presence of four main clusters. The level of housing hardship identified and defined by the internal average (Fig. 3 and 4).

In the Fig. 3a the quarters named Città Vecchia and Porta Napoli; in the Fig. 3b the quarter named Tamburi. They are the three quarters nearest to the largest steel plant in Europe steel Plant now owned by the company "Arcelor Mittal". The steel plant was identified as the main cause of air pollution by the court of Justice of Taranto in 2012.

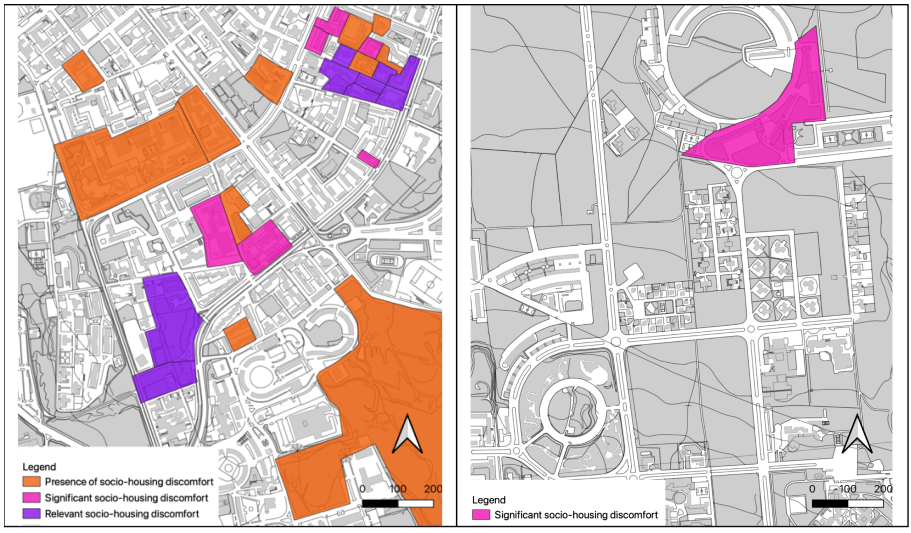
In the Fig. 4a the quarter named Montegranaro, the first residential expansion of the modern city. In the Fig. 4b the quarter named Paolo VI, the largest public housing district in the city.

In the Fig. 5 we illustrate photos of some buildings put in evidence by the SaTScan model. This is the oldest quarter of the city built during the Magna Graecia period and always inhabited during all the following centuries. It is the island where the city was born and where the identity of the Taranto community is concentrated despite the abandonment that characterized it after the seventies. It is the objective of a great urban regeneration process financed by the national state which, however, is struggling to start due to the complexity of the restoration interventions to be carried out and the complexity of the bureaucratic machine involved. In the Fig. 5b buildings in via Lisippo in the quarter named Tamburi. These are houses built for a temporary use some decades ago and then remained active until now, with the consequences which can be imagined. In the Fig. 5c, buildings in via Via Lago Varano, in the quarter named Montegranaro, the typical example of the first modernist architecture in the city.



(a) (b)

Fig. 3. SaTScan model for the identification of cluster of socio-housing discomfort in the city of Taranto.



(a) (b)

Fig. 4. SaTScan model for the identification of cluster of socio-housing discomfort in the city of Taranto.

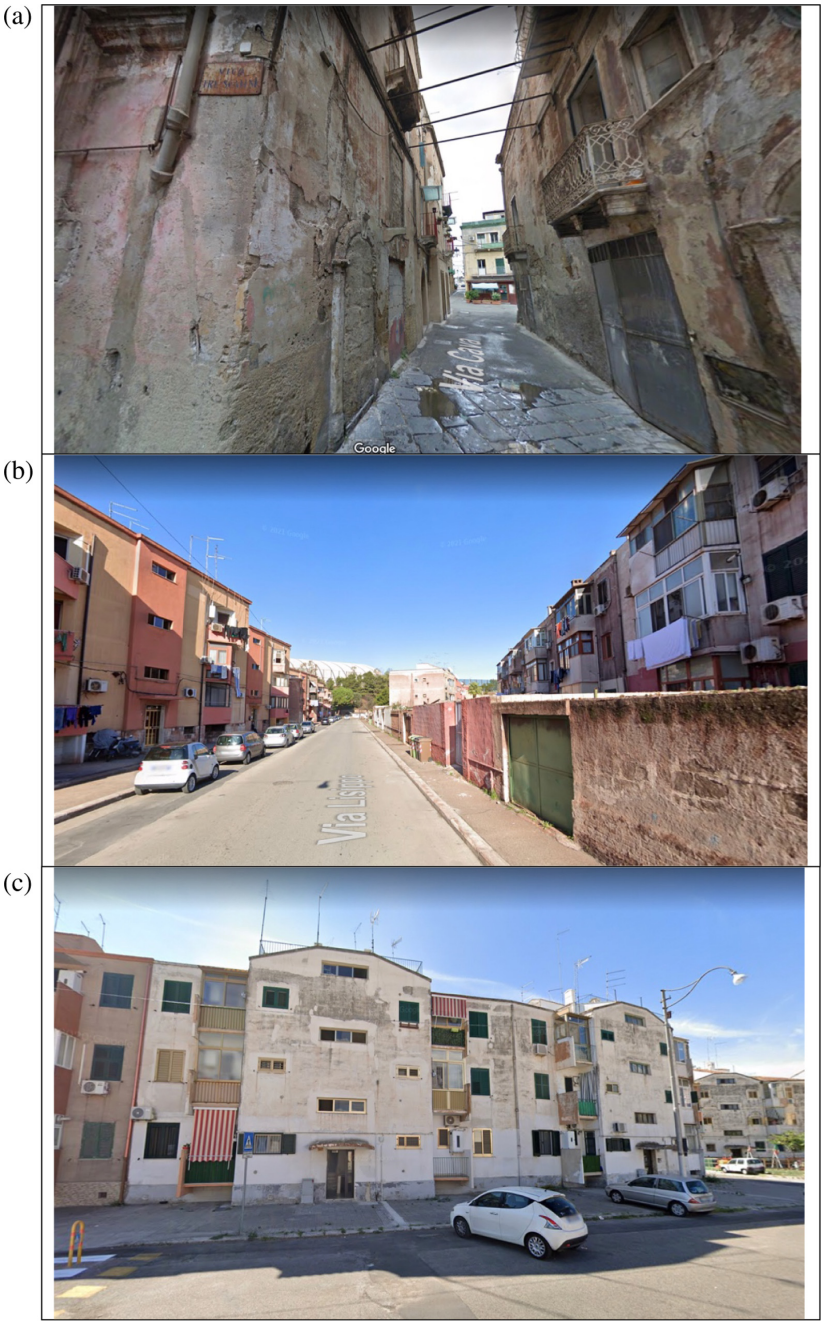


Fig. 5. Photos of some buildings put in evidence by the SaTScan model. In the figure a via Cava in Città Vecchia (Source Google Street view: https://www.google.it/maps/).

4 Concluding Remarks

As described in the introduction, housing deprivation is a multiple phenomenon strictly related to urban poverty and social and economic disease.

In the case of Taranto, is always important to understand the welfare level, the quality of urban environment, because the city is always characterized by a significant conflict between health and work, due to the presence of the most famous European steel factory [10]. The paper doesn't treat the subject of urban environmental quality, because -even if the topic of steel production and its consequences relevant- we should not forget that anyway the demand of housing services it appropriately still on the desk of local decision makers, just because living, studying, acting socially, working, must go on despite to further questions.

The proposed methodologies identify areas where there is a high disadvantaged index.

As we have noted above, a comparison of the two methods shows that the *Seg*-DBSCAN method is more accurate in identifying the spatial units in which there are housing problems. The future advancement of our work will be to seek a cluster validity index for spatial data, which considers the noise points, that is valid from a statistical point of view and that allows the accurate measurement of the *Seg*- DBSCAN method.

The applications with SaTScan or *Seg-DBSCAN* methodology in order to identify hot spots of housing hardship raises certain considerations for future research in the social field and for urban planning of regeneration areas, particularly relevant to the European Union policy agenda.

Starting from information obtained by the cluster intersection of housing hardship, it could be possible to obtain useful indications for planning urban regeneration policies, making decisional process more transparent and scientifically valid. The preliminary question leading towards the identification of town planning and architectonic solutions to the problem of urban regeneration, in a historical moment characterized by a lack of public resources for investment, focuses on the identification of areas characterized by the highest level of urban poverty to direct the choices of political decision-makers in a transparent, thought-out and objective manner. The model used in this study is able to provide, in the opinion of the authors, relevant data for the identification of such areas.

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