TeMA

Journal of Land Use, Mobility and Environment

The climatic, social, economic and health phenomena that have increasingly affected our cities in recent years require the identification and implementation of adaptation actions to improve the resilience of urban systems. The three issues of the 15th volume will collect articles concerning the challenges that the complexity of the phenomena in progress imposes on cities through the adoption of mitigation measures and the commitment to transforming cities into resilient and competitive urban systems.

TeMA is the Journal of Land Use, Mobility and Environment and offers papers with a unified approach to planning, mobility and environmental sustainability. With ANVUR resolution of April 2020, TeMA journal and the articles published from 2016 are included in the A category of scientific journals. From 2015, the articles published on TeMA are included in the Core Collection of Web of Science. It is included in Sparc Europe Seal of Open Access Journals, and the Directory of Open Access Journals.

THE CITY CHALLENGES AND EXTERNAL AGENTS. METHODS, TOOLS AND BEST PRACTICES

Vol.15 n.3 December 2022

print ISSN 1970-9889 e-ISSN 1970-9870
University of Naples Federico II

TeMA Journal of
Land Use, Mobility and Environment

THE CITY CHALLENGES AND EXTERNAL AGENTS. METHODS, TOOLS AND BEST PRACTICES

3 (2022)

Published by
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realized by CAB - Center for Libraries at “Federico II” University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

The cover image shows the Irpinia hills at sunset, highlighting the enhancement of two renewable energy sources: sun and wind.
The photo was taken by Giuseppe Mazzeo in August 2022, in S. Andrea di Conza, Avellino, Italy.

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science and complex systems.
With ANVUR resolution of April 2020, TeMA Journal and the articles published from 2016 are included in A category of scientific journals. From 2015, the articles published on TeMA are included in the Core Collection of Web of Science. TeMA Journal has also received the *Sparc Europe Seal* for Open Access Journals released by *Scholarly Publishing and Academic Resources Coalition* (SPARC Europe) and the *Directory of Open Access Journals* (DOAJ). TeMA is published under a Creative Commons Attribution 4.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

TeMA Journal of Land Use, Mobility and Environment

THE CITY CHALLENGES AND EXTERNAL AGENTS. METHODS, TOOLS AND BEST PRACTICES

3 (2022)

Contents

EDITORIAL PREFACE: TEMA JOURNAL OF LAND USE MOBILITY AND ENVIRONMENT

The city challenges and external agents. Methods, tools and best practices 3(2022)

ROCCO PAPA
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples Federico II, Italy
ORCID: https://orcid.org/0000-0003-3355-1418
e-mail: rpapa@unina.it

The challenge that the complexity of the ongoing phenomena imposes on cities involves not only adopting mitigation measures aimed at reducing the adverse effects of these phenomena; this challenge requires scholars, researchers, technicians, and decision-makers to transform cities into resilient, competitive urban systems rapidly. The three issues of the 15th volume collect articles concerning the climatic, social, economic and health phenomena that have increasingly affected our cities in recent years and, hence, require the identification and implementation of adaptation actions to improve the resilience of urban systems.

Before delving into the issue's contents, we would like to highlight that the TeMA journal, since 2007, has supported the global exchange of academic knowledge and that Editorial decisions have never been affected by the origins of the manuscript, including the nationality, ethnicity, race, or religion of the authors. Thus, for the sake of knowledge and with the purpose of improving understanding, cooperation, and relationship, our position is to continue considering papers for publication from worldwide authors and institutions. Our established editorial policies, of peer review and declaration of competing interests, will guarantee to avoid publication of inappropriate or propaganda contents.

For this Issue, the section "Focus" contains two contributions. The first article of the section titled "Assessing territorial vulnerability. Testing a multidisciplinary tool in Moncalieri, Italy", by Simone Bltramino (Politecnico di Torino, Italy) and thirteen other authors, develops in a mathematical framework the assessment of territorial vulnerability which integrates several indicators grouped into three factors defined as sensitivity, pressures, hazards, weighted according to a participatory procedure. In turn, the classification of vulnerability to the case study is useful in identifying strategies and actions to increase territorial resilience.

The second article, titled "Resilient marginal cities by encouraging intermodality strategies. Analysis of the Campanian marginal cities with criteria for intermodal business model" by Irina di Rucco (University of Insubria, Italy), focuses on peripheral and decentralized areas and potential business models that can improve their connectivity and intermodality to other urbanised areas. An application to the Campania region is proposed, encouraging intermodality with alternative and ICT-connected transport systems. This study is an initial approach to identifying strategies to develop inland territories for first and last-mile connections.

The section "LUME" (Land Use, Mobility and Environment) contains eight contributions. The first is titled "How Urban Food Gardening fits into city planning. Evidences from Italy" by Anna Forte, Enrico Gottero, Claudia Cassatella (Politecnico di Torino, Italy). This research proposes a tool to measure local vulnerability from a multi-risk approach. The municipality of Moncalieri, Italy, was used as a case study within the research activities of the Responsible Risk Resilience Centre from the Polytechnic of Turin to test the vulnerability matrix.

The second article of the section, titled "Landscape and the city. A new vision for enhancing sustainability issues" by Donatella Cialdea, Antonio Leone e Vito Muscio (University of Tuscia, Italy), presents a study regarding an Agricultural Park proposal located within Bari Municipality (Apulia Region, Southern Italy). The role of Nature Based Solutions and agricultural activities are investigated to improve soil permeability and contribute to reducing climate change-related hazards.

The third contribution, titled "Travel mode choice and its responsiveness to the needs of commuters with disability in the Accra Metropolitan Assembly", by Prince Kwame Odame (University of Cape Coast, Ghana). The research explores the living conditions of Ghana's disabled community. The lack of literature on the extent

of ease in using transport services does not offer a holistic picture of persons with disability daily living situations, given the role of public transport services in connecting persons with disability to the main urban services and structures.

The fourth article, titled "Circular Living. A resilient housing proposal" by Domenico Scarpelli, Giovanna Mangialardi, Emanuela Braì (Politecnico di Bari, Italy), studies the relationships and opportunities deriving from the application of the circular economy approach to create a resilient housing system by adopting a qualitative research method. In turn, the pillars of the circular economy in the document aim to act as a new tool to support the development of resilient social housing solutions aimed at stimulating the response to the housing crisis and at the same time regeneration at the urban and territorial scale.

The fifth paper, titled "Landscape and urban planning approach within regional spatial planning system. The case study of Moscow oblast" by Alesya Goncharik, Elina Krasilnikova (Sevastopol State University), presents landscape and urban planning systemic tools for transforming the spatial and planning structure of the macro-region - the Moscow region, offering opportunities for the physical and spatial restructuring of regional landscapes into a single green infrastructure of the region.

The sixth contribute, titled "Port buffer areas seen by the city: for a more sustainable logistics?" by Ilaria Delponte, Valentina Costa, Ennio Cascetta, Armando Cartenì, Vittorio Marzano (University of Naples Federico II, Italy), concerns the stakeholders' engagement process conducted to evaluate most suitable areas and relevant features to host these activities before freight vehicles reach the proper port area, thus reducing externalities on ordinary traffic flows.

The seventh paper of the section, titled "Climate variation in metropolitan areas in Italy Spatial self-containment, contiguity and space-time relations" by Ginevra Baletto (University of Cagliari, Italy), explores possible different ways of aggregating areas to a proper urban dimension. Authors considers two aggregations (Metropolitan Cities and Labor Market Area) to identify the most suitable geographical dimension both for the observation of the phenomenon and for the policy targets of climate neutrality. This is done analysing the spatial autocorrelation of climate-related variations in space and time.

The last paper of the section, titled "Energy saving and efficiency in urban environments: integration strategies and best practices" by Carmen Guida (University of Naples Federico II, Italy), is the first step of a wider research aimed at developing an expert system to support decision-making by identifying energy-consuming areas and proposing potential transformation scenarios due to urban characteristics.

The section "Covid-19 vs City-22" collects one papers, titled "The weapons of the city against pandemic assaults" by Maria Angela Bedini, Fabio Bronzini (Università Politecnica delle Marche, Italy). The paper presents some proposals for the protection from Covid risk, with a flexible reorganization of the times, spaces of the city and the territory

The Review Notes section proposes four insights on the themes of the TeMA Journal. The first section, "Climate adaptation in the Mediterranean: storms and droughts", by Carmen Guida, aims at delving into the most severe effects due to storms and droughts in the Mediterranean region.

The second contribution, "Accelerate urban sustainability through policies and practices on the mobility system in Italy", by Federica Gaglione, examines how sustainable mobility constitutes that important link in the chain of city development and above all in facing challenges ranging from climate change to social ones.

The third section, "Planning for Sustainable Mobility in Italy" by Gennaro Angiello, provides an overview of the objectives, strategies and actions covered in the sustainable urban mobility plans recently developed by the Metropolitan Cities of Palermo and Cagliari. The fourth contribution, "Sustainable cities and communities: the road towards SDG11", by Stefano Franco, aims at highlighting the costs associated to the UN Sustainable Development Goals. The hight investment costs and the gap that still divides cities from the achievement of the sustainable targets shed lights on the need to incentivize both public and private investments. Finally, "The interventions of the Italian Recovery and Resilience Plan: Tourism for more competitive cities", by Sabrina Sgambati, deepens the topic of tourism in urban areas in the Italian Recovery and Resilience Plan, highlighting the measures promoted to improve the tourism sector as an element of competitiveness for Italian cities.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 355-375
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9069
Received 10th April 2022, Accepted 17th October 2022, Available online 30th December 2022

www.tema.unina.it

Assessing territorial vulnerability

Testing a multidisciplinary tool in Moncalieri, Italy

Simone Beltramino[a], Mattia Scalas, David Javier Castro Rodriguez, Grazia Brunetta[b]*, Franco Pellerey, Micaela Demichela, Angioletta Voghera, Andrea Longhi, Guglielmina Mutani, Ombretta Caldarice, Gaetano Miraglia, Erica Lenticchia, Luigi La Riccia

[a] Responsible Risk Resilience Interdepartmental Centre, Interuniversity Department of Regional and Urban Studies and Planning (DIST) Polytechnic of Turin, Turin, Italy.
e-mail: simone.beltramino@polito.it
ORCID: https://orcid.org/0000-0003-0872-951X

[b] Responsible Risk Resilience Interdepartmental Centre, Interuniversity Department of Regional and Urban Studies and Planning (DIST) Polytechnic of Turin, Turin, Italy.
e-mail: grazia.brunetta@polito.it
ORCID: https://orcid.org/0000-0003-1868-2700
* Corresponding author

Abstract
The challenge to make cities and human settlements inclusive, safe, and resilient, including mitigation and adaptation strategies against disaster, is a central issue in achieving sustainability. This research proposes a tool to measure local vulnerability from a multi-risk approach. The municipality of Moncalieri, Italy, was used as a case study within the research activities of the Responsible Risk Resilience Centre from the Polytechnic of Turin to test the vulnerability matrix. The tool consists of a mathematical framework for the territorial vulnerability assessment that integrates multiple indicators clustered into three factors defined as sensitivity, pressures, and hazards, weighted according to a participatory procedure. Space-dependent analyses using the Geographical Information System were developed from the multiple nested indicators to project the vulnerability index onto a homogeneous grid in the territory of interest. Thematic maps referring to the systemic vulnerability by different sensitivity components were generated. The tool not only contributes to increasing the awareness of territorial vulnerability but also offers support to resilience-based decision-making in designing technical measures of policies at a local scale. Further research is required to implement the framework in different scenarios and develop the model's temporal behaviour.

Keywords
Urban resilience; Spatial planning; Vulnerability; Geographical Information Systems; Multi-risk.

How to cite item in APA format
Beltramino, S. et al. (2022). Assessing territorial vulnerability. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 355-375. http://dx.doi.org/10.6092/1970-9870/9069

1. Introduction

Contemporary challenges and uncertainties expose cities and local communities to multiple and non-linear risk factors that require a spatial planning approach to integrate the dimensions of complexity and unpredictability. This situation calls for new methods and tools to frame territorial vulnerability (Brunetta et al., 2019) and thus enhance resilience (Galderisi, 2012) and adaptation in the context of sustainable development goals (Brunetta & Caldarice, 2020). Central to spreading awareness and building adaptation policies is the availability of specific data and analysis to measure resilience. In this sense, vulnerability assessment is the first part of operationalizing resilience, often interpreted as a buzzword and a term challenging to put into an operational context (Brunetta et al., 2020).

Operationalizing the concept of resilience in urban planning procedures remains an open question due to the lack of empirical knowledge on measuring the degree of resilience. This paper considers the debate on this theoretical concept was adopting by Brunetta et al. (2020) definition, which focuses on applying an empirical model to measure the degree of vulnerability.

The paradigm shift brought about by the emergence of resilience as a "new way of thinking" (Folke, 2006) gave a new perspective to planning, surpassing the aim of a "final state of equilibrium" typical of 20th-century planning. This shift favoured a dynamic approach focused on the capacity of systems to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner (IPCC, 2012). Public institutions have also promoted a resilient approach to planning from the international to the local level, such as the 2030 Agenda for Sustainable Development (United Nations, 2015). Other experiences come from non-profits, also spreading thanks to the adaptation support efforts of some Transnational Municipal Networks (TMNs) as the 100 Resilience Cities Network (100RC), Local Governments for Sustainability (ICLEI), C40 or the Global Covenant of Mayors for Climate & Energy (GCOM) (Heikkinen et al., 2020). Despite its success in literature and field experiences, putting resilience into practice is a complex objective to pursue, and this is closely related to the nature of the concept itself: resilience, especially in its urban and territorial understanding, is a multidisciplinary and complex concept by definition (Jabareen, 2013), that frames a "conceptual umbrella" fascinating but slippery and ambiguous (Brunetta & Salata, 2019).

While there is agreement on some essential characteristics of urban resilience, which, if understood in its most recent co-evolutionary sense, is characterized by co-evolution, self-adaptiveness, and learning capacity (Brunetta & Salata, 2019), difficulties in measuring resilience persist. The literature is rich in attempts and methodologies, but comprehensive approaches are still lacking.

This paper assumes that the first step in operationalizing resilience and allowing its normative application in planning is to know and assess territorial vulnerabilities through a multi-risk semi-quantitative methodology based on the calculation of indicators representative of a series of variables characteristic of the territory. Vulnerability, often considered as the counter position to resilience, is to be understood as the predisposition of the elements of the system to be damaged by hazard events, punctuality, or by continuous pressures over time (IPCC, 2012), while resilience is, in fact, the coping capacity of the elements of the system. Consequently, the measurement of vulnerability lends itself to using quantitative methodologies based on multivariate analysis of representative indicators.

This paper aims to illustrate the methodology and initial experimentation of the Territorial Vulnerability Matrix developed by the Risk Resilience Centre (R3C) of Polytechnic of Turin. The Vulnerability Matrix is an assessment tool that makes it possible to identify in a spatially explicit manner the quadrants of the territory that are most vulnerable to a given set of disturbances, divided into punctual and continuous events, concerning the elements of territorial sensitivity. The aim of this matrix developed and tested within the municipality of Moncalieri (northern Italy) is to provide a scalable tool that can be applied in different contexts in order to allow measurement of vulnerability proper to identify strategies and actions for increasing territorial resilience, according to a co-evolutionary and transformative resilience concept.

The measure of vulnerability was obtained from the interaction of selected indicators of sensitivity, pressure, and hazards. The calculation operations were carried out with the help of Geographic Information System (GIS) tools (ESRI ArcGIS 10.7) and spreadsheets. The information was spatialized on a grid of 200x200 meters, making it possible to read the overlapping of the different thematic layers, showing simply the most vulnerable areas in line with the proposed by Pilone et al. (2016). On the other hand, the research group prepared a participatory weighing procedure and an interactive matrix. The results of the first assessment in Moncalieri are hereinafter presented, which, in line with expectations, made it possible to validate the methodology that is replicable to other territories due to its characteristics.

The main findings of this study are a comprehensive assessment of the various vulnerability components of a territorial system to increase vulnerability awareness, support the decision-making process and develop a resilient knowledge of the various vulnerable components of territorial systems. This knowledge can then support urban planners in policy design and land use plans that can adapt to uncertainties and disruptions.

The paper is structured in the following sections: First, a context description is offered. Second, the methodology applied is described, including a detailed mathematical procedure used to evaluate the indicators. Subsequently, the local vulnerability maps produced are presented. Finally, the conclusions about the tool's effectiveness and the possibility of extending the methodology to other territories are discussed.

1.1 State of the art

The issue that Land Use Planning policies in Italy do not deal with the possible consequences of the interaction between technological and natural hazards was a problem introduced by Galderisi et al. (2008). Moreover, it has also been recognized that different typologies of risks are generally handled separately and are analyzed with specific Plans. In addition, there remain some criticalities in the definition of a standard metric for the combined assessment and the weighting of the different categories of exposed elements and to produce results in a form that could be useful to planners. For example, although superordinate and sectorial plans provide prescriptions and recommendations on reducing and containing related risks; however, they cannot directly impose critical areas on the territory or cases of incompatibilities between combined risks and existing urban functions (Pilone et al., 2016). Although the junction point where all risks can be analyzed together is at the local scale, the lack of regulations and methodologies for multi-hazard assessment and the scarcity of technical and scientific knowledge leads to maintaining tools such as the land use plan as a mere sum of prescriptions without analyzing or correlating them in a systemic way (Pilone et al., 2017).

Few referenced methodologies at the Municipal scale are available (Bixler et al., 2021; Galderisi & Limongi, 2021). Moreover, the approaches used at a larger scale for the vulnerability and risk analysis may not be adequate at a minor scale. Likewise, some cases do not reflect the local situation due to the rapidly changing over time, which could negatively affect the vulnerability assessment significance. Consequently, the main hazards that threaten the territory can be identified based on a spatial filter. For example, data collection must be developed based on existing sectoral and emergency plans (Galderisi et al., 2021), and an in-depth direct on-site investigation should be addressed considering stressors associated with climate change (Francini et al., 2021). For this purpose, a helpful checklist could be found in the project ARMONIA (Applied multi–Risk Mapping of Natural Hazards for Impact Assessment) research project funded by the European Community (Menoni et al., 2006), which points out the following natural risks: flood, earthquake, forest fire, volcanoes, and landslide.

Some multi-risk projects have tried to define a framework for vulnerability assessment, defining analytical or qualitative methodologies. As it concerns quantitative methods, there is a general agreement on using vulnerability functions (fragility curves) to express physical vulnerability. In these methods, the input is a single hazard analyzed (e.g. intensity, magnitude, category), and the output is the average loss of a given vulnerable element. However, reliable vulnerability or fragility curves are not available for all risks. In addition, the fragility

curves do not express the vulnerability assessment for social and environmental factors, so it can be challenging to integrate them within a multi-risk framework. In other cases, vulnerability is also defined through semi-quantitative or qualitative methods. Therefore, the elements are described through indicators, which can be weighted and summed up to establish an integrated vulnerability index. One of the guiding principles for the selection of these indicators was the availability and reliability of the data in order to be able to provide brief elaborations and quick responses (Pilone, 2018).

This review aims to analyze the literature on vulnerability measurement in the multi-risk context. It found that the most common approach is preventive assessment, but it has limitations due to the complexity of the study and the multi-hazard analysis.

Although quantitative methods can measure vulnerability, they do not capture intangible elements such as power relations, social capital, and self-sufficiency that distinguish urban resilience. In the vast majority of cases, the indicators are not spatial but purely statistical and thus useful for comparative analysis between different urban areas, but of little use in building a spatial support system to guide the urban agenda of local institutions.

The literature review thus shows that semi-quantitative approaches offer a systematic and reliable way to measure different dimensions of resilience. In this line, the methodology implemented aims to address a gap in the existing planning and risk instruments, increasing the awareness of the local planners about the unexpected effects of multiple risks and providing an essential indication of the priority areas to address technical studies and financial resources.

2. Material and Methods

2.1 Methodology

This work is designed to provide a replicable methodology of the vulnerability matrix, a tool developed by the Responsible Risk Resilience Centre (R3C) from Polytechnic of Turin, to respond to the first objective of the project Measuring Resilience (Brunetta et al., 2019), which consist in the assessment and spatial representation of the systemic vulnerability of a territory.

A vulnerability matrix is a tool analysis that, through a series of recursive calculations, enables to introduce of several input variables projected on a grid that was determined based on specific research needs, to which the calculated systemic vulnerability values were attributed to each cell of the territory (Fig.1).

Conceptually, vulnerability was interpreted as the sum of the interactions between sensitivities, pressures, and hazards. The following steps concern the calculation of the "weighted" relationships between the indicators which define the index. The weighing phase is carried out through a participatory procedure with the research team's involvement.

The R3C Matrix develops a mathematical framework capable of quantifying the vulnerability in a territory, switching not only different stressors and hazards according to the location but also the necessities of the stakeholders. In this case, the territorial vulnerability index was determined by the relation of pressure and hazard index, both affected by a coefficient of interest.

The hazards index was conceptualized to determine how elements of sensitivity are affected by potential natural and anthropic hazards, including a factor that considers the impact of climate change, which was assigned to a fixed value for the present research. Similarly, for the pressure index, the sensitivity elements were affected by persistent chronic stressors in the territory, including a factor that introduces the temporal character of the pressures.

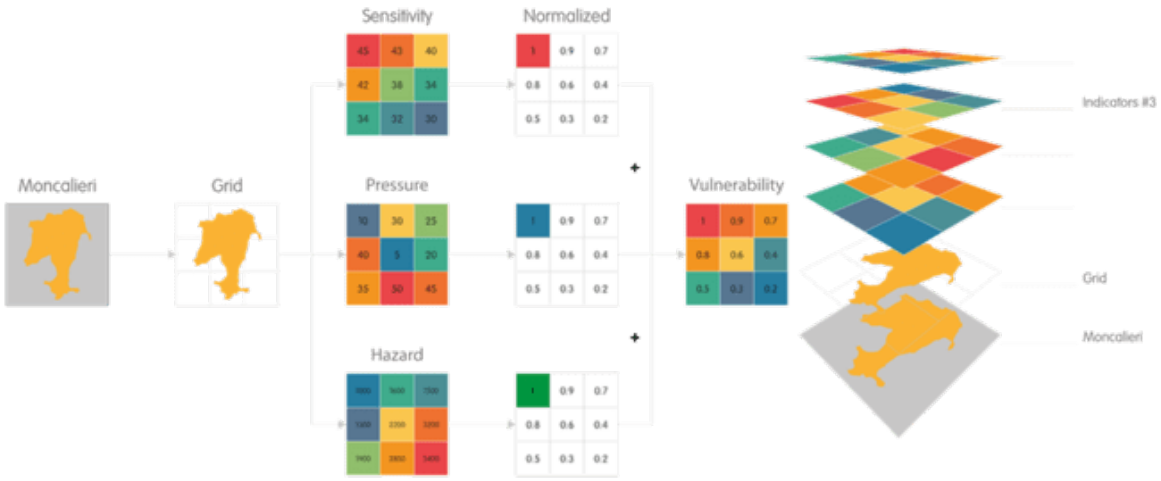


Fig.1 Schematic representation of the methodology

The starting point for the creation of the tool is the selection of a set of sensitivity, pressure, and hazard indicators and their calculation using GIS tools. Space-dependent analyses using GIS were developed from multiple nested indicators of sensitivity, pressures, and hazards, projecting the vulnerability index on a homogeneous grid in the territory of interest. This chapter presents the application of the methodology in the Municipality of Moncalieri, which can be used as a model for future applications in other case studies.

The sensitivity, pressure, and hazard indicators were selected following a discussion with stakeholders from the area under study and a review of the principal spatial government plans and territorial instruments, highlighting Moncalieri Municipality's specificities.

The matrix structure has a specific function in applying the methodology for the participatory weighing of the relationships between the indicators. In particular, the matrix structure is divided into three system components for the sensitivity indicators (rows of the R3C matrix), which in turn are made up of various indicators: Environment and Ecosystem Services (3 indicators); Construction, Infrastructure, Cultural Heritage and Landscape (5 indicators); Economy and Population (4 indicators). Fig.2 better illustrate the before description. Then, these three components intersected with three pressure indicators and six hazards (columns) (Fig.3). The way the indicators are related inside the methodology can be observed in Fig.4.

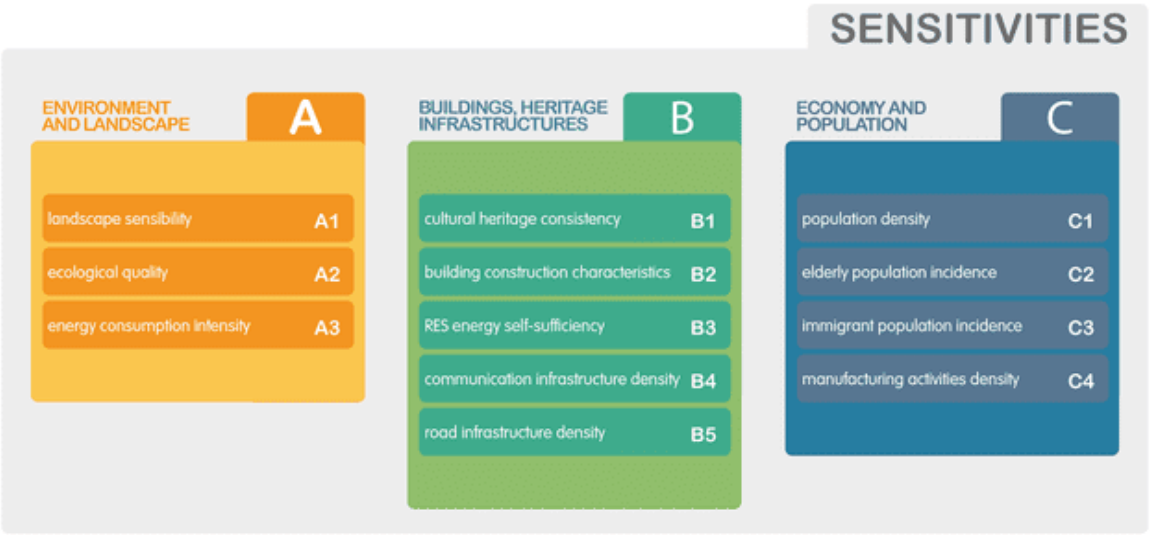


Fig.2 R3C matrix sensitivity indicators for the case study in Moncalieri

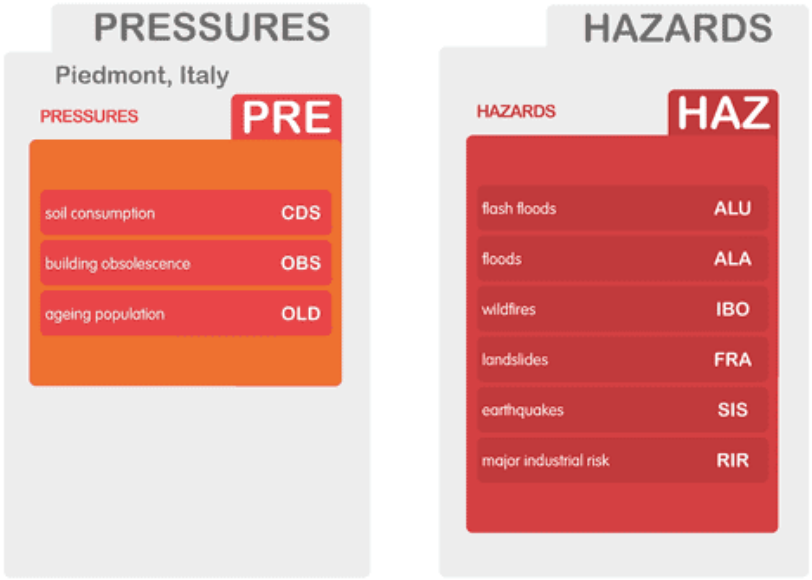


Fig.3 R3C matrix pressure and hazard indicators for the case study in Moncalieri

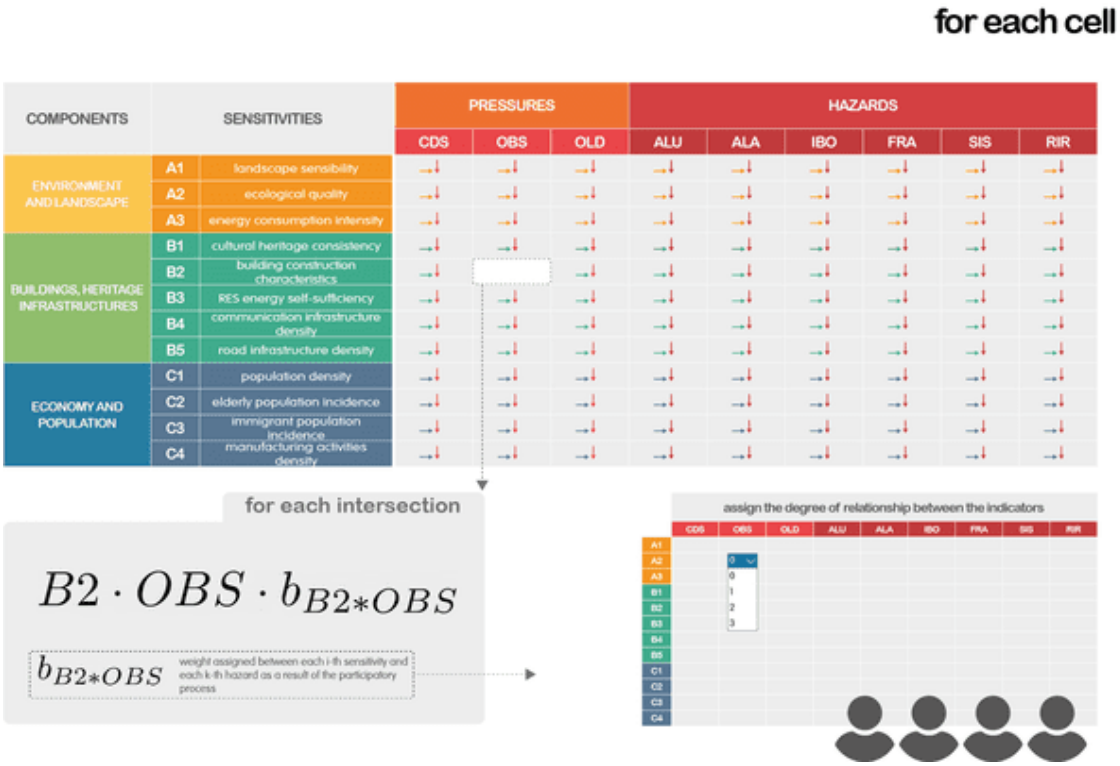


Fig.4 R3C matrix general structure

The definition and calculation of the indicators is the most consistent and time-consuming phase of this work. Each of the 21 indicators has followed a process of data collection, calculation, and attribution to the grid in a GIS environment with spatial join operations through a specific field identifier (FID) assigned to each cell. For a detailed description of each indicator and its calculation procedure see the following sections (Tabb. 1-5). Depending on the geometry of the input data - point, line, polygon - the attribution of the values obtained for each indicator to the grid was carried out according to five criteria: (i) point count (B1, ALA), (ii) sum of the point values (A3, B3, SIS), (iii) weighted sum of linear (B5) or areal elements (A1, A2, B2, B4, C4, CDS, OBS, IBO, FRA), (iv) average value of areas within the cell (C1, C2, C3, OLD) and (v) intersection between input polygons and each cell (ALU, RIR). The values assigned to the cells of the matrix were normalized to obtain a

standard metric that allows the integration among the indicators and the following operations. Partial results were displayed in a 2550-row table – one for each 200x200 m cell that subdivides the territory - with 21 columns corresponding to each indicator (Figg. 2 and 3). The following operationalization of the systemic vulnerability of the territory is described in section "Mathematical framework".

Sensitivity

Susceptibility/fragility in disaster risk management, or sensitivity in climate change adaptation, is considered as the physical predisposition of human beings, infrastructure, and the environment to be affected by a dangerous phenomenon. These affections are associated with a lack of resistance and predisposition of society and ecosystems to suffer harm due to intrinsic and context conditions, making it plausible that such systems, once impacted, will collapse or experience significant harm and damage due to the influence of a hazard event. (Cardona, 1999b; Cardona, 2001; Cardona, 2011; Cardona & Barbat, 2000; Cardona & Hurtado, 2000a,b; McCarthy et al., 2001; Gallopin, 2006; Manyena, 2006; Carreño et al., 2007a; IPCC, 2007; Carreño et al., 2009; ICSU-LAC, 2010; IPCC, 2012; Birkmann et al., 2013; IPCC, 2021). The sensitivity indicators analyzed for each system component, shown in Fig.2 now, are detailed in Tab.1, Tab.2, and Tab.3, respectively.

Sensitivity indicator	**Description**	**Databases and references**
Landscape sensibility (A1)	The indicator identifies areas of higher landscape sensitivity, meaning they have the potential to have a more significant impact on the landscape if changes are made to them. Once a set of significant "viewpoints" for the area under analysis has been defined according to bibliographic, normative, or direct survey criteria, the procedure for calculating the viewshed analysis for each viewpoint is used. The viewsheds identified for each viewpoint are then added together to obtain the area "most visible" from each.	Data: DTM (Digital Terrain Model) Recognized viewpoints/observers at a large scale (regional and national scale) Visual landmarks of the built and natural environment at a large scale (regional and national scale) Visual landmarks identified by the site survey References: Voghera & La Riccia, 2015; Voghera & La Riccia, 2016; Voghera et. al., 2017; Voghera & La Riccia, 2019
Ecological quality (A2)	The indicator uses an ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development) methodology. Based on the land use data, quality scores provided by the agency are assigned. The integrity of its components determines the ecological quality of the territory. The whole non-artificial territory contributes proportionally to the level of ecological quality, to the overall connectivity in terms of an ecological network. The score is given by the sum of the values of Naturalness (1-5), Conservation (1-4), Relevance (1-4), Fragility (1-4), Extroversion (1-5), Irreversibility (1-3). The degree of sensitivity has an absolute score of 5-21 (in 6 classes): Class 1: Poor ecological functionality; Class 6: Optimal ecological quality.	Data: Corine Land Cover for soil coverage References: Voghera & La Riccia, 2015
Energy consumption intensity (A3)	The energy consumption intensity indicator was calculated by geo-referencing the database of electrical energy consumption (point of withdrawal of electricity) in the municipality of Moncalieri. The geocoding of the addresses, obtained from the database (SIATEL), was carried out with the ESRI online service, transforming the addresses into points with precise geographical coordinates. The indicator represents the distribution of the intensity of electricity consumption and related emissions on the municipal territory.	Data: SIATEL database (point of withdrawal of electricity) of the Moncalieri users References: Mutani et al., 2020 a; Mutani et al., 2020b; Brunetta et al., 2021; Mutani et al., 2021

Tab.1 Environment and ecosystem services

Sensitivity indicator	Description	Databases and references
Cultural heritage consistency (B1)	The indicator consists of the spatialization of the presence of cultural assets, whose value and interest are recognized by institutional documents produced by the Ministry of Culture (bound under the Cultural Heritage and Landscape Code), or by the current instruments of territorial government (whose prerogatives include the recognition of cultural heritage), or by other bodies with authority over the protection and management of cultural heritage (WHL UNESCO, ecclesiastical bodies). Landscape assets within the meaning of the Code are excluded. The different databases are partly overlapping, and a systematization of the data is proposed here.	Data: Constraints on the Web, a portal of the MIBAC (Ministry of Culture) allowing the download of files SIGECWeb, by ICCD BeWeb, a portal for ecclesiastical cultural assets Territorial Coordination Plan of the Metropolitan City of Turin References: Mondino, 2020
Building construction characteristics (B2)	The indicator assigns a score to each building based on its construction characteristics, according to the literature classification: 0.1: (1991-present) Reinforced concrete buildings, adapted to building regulations, insulation 0.33: (1918-1944) Residential frame structures of concrete or mixed brick/concrete materials 0.5: (1880-1918) Buildings constructed mainly of brick; improved structural characteristics due to production in Hoffman kilns 0.66: (Formerly 1860 in historical centers) buildings made of solid brick, usually from kilns 0.83: (Former 1860 in rural areas) Locally available building materials, i.e. unfired bricks, plaster, among others. 1: (1950-1991) Reinforced concrete buildings, inadequate architectural, structural, and construction features.	Data: The age of the building used is derived from an analysis of the variation of the building analyzed through historical maps References: Barreca et al., 2018; De Lucia, 2019
RES energy self-sufficiency (B3)	The indicator represents the ratio between self-consumed energy from renewable sources (SC) and consumed energy (C). The geo-referencing of the databases on electricity consumption (electricity withdrawal point) and current energy production from Renewable Energy Sources (RES) was done through the ESRI online service. Self-sufficiency from renewable energies (SC/C) is represented by the ratio between self-consumption (SC) and consumption (C), calculated on GIS software by reporting the information on the grid. The indicator indicates the share of energy consumption covered by locally produced RES and thus the energy self-sufficiency of the territory from the national grid.	Data: SIATEL database for the (electricity withdrawal point) of the Moncalieri users Atlaimpianti for installed kWp GSE (Gestore Servizi Energetici) report for hours of use of the RES plants References: Mutani et al., 2020; Mutani et al., 2021; Mutani & Todeschi, 2021; Todeschi et al., 2021
Communication infrastructure density (B4)	The indicator calculates the density - expressed in square meters - of communication infrastructures. The following values are assigned for each facility: 1: Fiber routes 0.8: Radio Base Stations for telephony 0.8: TV 0.8: Radio	Data: ARPA Piemonte
Road infrastructure density (B5)	The indicator describes the density of road space occupied in the territory under consideration, assigning the following scores based on the type of road infrastructure: 1: Motorways and railways 0.7: Suburban road 0.5: Local road 0.3: Urban road	Data: Piedmont road network map (BDTRE 2021, official Piedmont cartography)

Tab.2 Construction, Infrastructure, Cultural Heritage, and Landscape

Sensitivity indicator	Description	Databases and references
Population density (C1)	The indicator is obtained from ISTAT (National Institute of Statistics) territorial bases, which give the resident population (P1) per census section that has been divided by the area of the census section.	Data: ISTAT for spatial bases and information on the 2011 censuses
Elderly component (C2)	The indicator is obtained from ISTAT territorial bases. The indicator considers the composition of the population aged ≥ 70 years and is obtained by a procedure like C1.	Data: ISTAT for spatial bases and information on the 2011 censuses
Immigrant component (C3)	The indicator is obtained from ISTAT territorial bases. The indicator considers the density in census sections of the immigrant component (ST15) and is calculated using a procedure like C2.	Data: ISTAT for spatial bases and information on the 2011 censuses
Density of productive activities (C4)	The indicator considers the density of productive activities obtained through the built footprint of the industrial and production activity.	Data: Industrial and production building use obtained from BDTRE 2021

Tab.3 Economy, Population

Pressures

Pressures are linear and predictable trends that affect the system gradually altering its condition (IPCC, 2012). The pressures affecting the components of the system progressively increase their sensitivity, making them more vulnerable to more significant events represented by Hazards. In addition, they follow specific temporal behaviors, in some cases described by literature (i.e., soil consumption and population aging), in other cases more difficult to understand (i.e., obsolescence of buildings). Moreover, pressures enable the construction of future vulnerability scenarios at a given time. A description of the pressure indicators is given in Tab. 4.

Pressure indicator	Description	Databases and references
Soil consumption (CDS)	The indicator was developed from a diachronic analysis of the built environment in which the concentrations of buildings constructed between 1990 and 2021 were measured.	Data: 2021 BDTRE buildings The age of the building used is derived from an analysis of the variation of the building analyzed through historical maps
Building obsolescence (OBS)	The obsolescence of buildings is related to the ageing of their constituent materials. The indicator takes into account the construction age of buildings by assigning a score to each of them: older buildings have a higher pressure value.	Data: 2021 BDTRE buildings The age of the building used is derived from an analysis of the variation of the building analyzed through historical maps
Aging population (OLD)	The indicator was calculated using the ageing rate for the 2001 and 2011 ISTAT censuses, comparing the resident population aged ≥ 65 years for each census section and the population aged 0-14 years, intersecting the two rates obtained to analyze the variation over the period considered. The ageing rate is calculated as the population over 65 divided by the under 14 population sum. The ageing of the population is (the ageing rate in 2011 – the ageing rate in 2001)/ageing rate at 2001.	Data: ISTAT for spatial bases and information on 2001, and 2011 censuses

Tab.4 Pressure indicators

Hazards

Shocks are unpredictable and dangerous events that threaten the system occasionally with a high impact on the environment, settlements, and populations (IPCC, 2021). They are intended as catastrophic events that the system should absorb in case of adverse conditions. Since the occurrence of shocks is viewed over a long-time period, their effects are often unpredictable. The hazards selected for the case study in Moncalieri illustrated in Fig.3 are described in Tab. 5.

Hazard Indicator	Description	Databases and references
Flash floods (ALU)	The indicator is derived from the hazard maps of the flood risk management plans (PAI), which define hazard bands (high, medium, low). The following hazard values have been assigned: 1, high; 0.75, medium; 0.5, low.	Data: Risk maps and Hydrogeological Risk Management Plan (PAI)
Floods (ALA)	Point data referring to the history of flooding incidents were considered. Each incident reported has a value of 1.	Data: Events database from 1800 to present (BDTRE)
Wildfires (IBO)	The indicator was calculated as a modified version of the Specific Hazardousness Index in the Interface Area (IPSI). The calculation classifies the territory into three slope classes, evaluates presence and fuel quality, and crosses these data with the presence of buildings and the percentage of buildings in each cell of the matrix in contact with the combustible material. Compared to IPSI, it does not consider the data relating to the construction characteristics of the roofs.	References: (Bovio et al., 2001) Data: Forest map and land use (Piedmont Geoportal) DTM (Digital Terrain Model) Buildings 2021 (BDTRE)
Lands slides (FRA)	The indicator assigns a score to landslide areas considering the classification made by Del Prete et al. (1992), which distinguishes between active, quiescent, and stabilized landslides based on recurrence, return time, and the last survey, assigning the first maximum score (1) and the last minimum score (0).	References: (Del Prete et al., 1993) Data: Database SIFRAP
Earthquakes (SIS)	Quantify the earthquake, EQE_k, based on peak ground acceleration (PGA-Peak ground Acceleration) expected on the site for a certain probability of exceeding, PGA_k, where the building is located and normalizes its value to the maximum expected value for a probability of exceeding the 5%, $r_k = max: \left\{PGA_{k\,|\,k}\right\}$ in a territorial area of reference. 0 = theoretical minimum PGA in the reference area, 1 = maximum PGA in the reference area. The index $\{EQE_k = \frac{PGA_k}{r_k}\ PGA_k = PGA_{0,k} \cdot S_{s,k} \cdot S_{t,k}\ r_k = max: \left\{PGA_{k\,|\,k}\right\}$ Quantity of input. $PGA_{0,k}$ [m/s^2]: Interpolation in the construction site (indexed by point k), of points with predefined PGA, the function of the probability of exceeding in the reference period of the seismic action (SLO=81%, SLD=63%, SLV=10%, SLC=5%), according to NTC18. It can be estimated from European and Italian regulations and websites, for example, INGV, USGS, CSEM / EMSC, AHEAD, JMA, NIED / BOSAI. Note: Operational Limit State (SLO), Damage Limit State (SLD), Life Limit State (SLV), Collapse Limit State (SLC). $S_{s,k}$ [-]: stratigraphic amplification factor at the site. NTC18. $S_{t,k}$ [-]: topographic amplification factor at the site. NTC18, QGIS.	References: National Technical Construction Regulations 2018 (NTC18) Piedmont Region, List of municipalities seismic classification 2019
Major Industrial Risk (RIR)	The indicator is a classification of industrial activities at major accident risk (Seveso activity) as indicated by the provisions derived from Legislative Decree 26 June 2015, no. 105 and identifies the areas of exclusion and observation considering (Castro et al., 2022).	References: Piedmont Region, Guidelines for the assessment of industrial risk in the context of territorial planning, 2010 Data: The data on the exclusion and observation areas was provided by the Municipal Administration

Tab.5 Hazard indicators

Relative weight among sensitivity, pressures, and hazards

At this stage, the intensity of the relationships between the sensitivity, pressure, and hazard indicators in the matrix was established. In particular, the relationship between each sensitivity indicator and pressure and hazard indicator was weighted using a crossing matrix procedure (row by column). In this phase, a participatory methodology was used, involving a team of 13 researchers participating in the project. Researchers were asked to compile an interactive version of the matrix, evaluating the degree of relationship between each indicator using an ordinal Likert scale, where: 0, no relationship; 1, weak relationship; 2, strong relationship; 3, very close relationship, according to the criteria defined by Hernández (2006) and used in a similar multi-risk context (Pilone, 2018).

After collecting all the contributions, the average of the evaluations was calculated, normalized, and reported interactively on the matrix (see the bottom of the previous Fig.4).
The weighted matrix has been prioritized, and the cells were coloured according to their correlation. A value of close to 0 indicates no relationship between the indicators compared; conversely, the closer the weight is to 1, the more related the indicators are. Consequently, a semaphoric combination of colours was used to establish the priority (green for low, yellow for medium, red for high) according to the dependence index defined using the above procedure. Although not necessary for the calculation, this operation makes it possible to evaluate the choice of indicators.

Mathematical framework

The spatial indicators were discretized into homogeneous cells of 200 by 200 meters to guarantee a homogeneous distribution of the values referring to the different components of the system. The value of systemic vulnerability for each cell has been calculated as described in this section.
First, for each component (A, B or C) of the sensitivities, the indicator of vulnerability due to pressures is calculated as a weighted sum of the products between any specific indicator of pressure on the cell with any specific indicator of sensitivity on the same cell (for all considered pressures and sensitivities). To take in account how strong any pressure reflects on any sensitivity, each of these products (whose value increases as the corresponding pressure or sensitivity in the cell increases) is further multiplied (weighted) by the indicator obtained through the procedure mentioned in Section "Relative weight among sensitivity, pressures, and hazards", which describes how strong is the relationship between such pressure and such sensitivity. Thus, the value of each product is appropriately weighted in the sum, assuming higher values for strong relationships, or lower (possibly null) values when the relationship is weak (or null). The sum of all these terms (concerning all pressures and all sensitivities, thus a double sum) is finally divided by the number of total pairs of pressures/sensitivities (to obtain a normalized value in [0,1]), obtaining the final index of vulnerability due to pressures on the cell. The same procedure is then applied to compute the index of vulnerability due to hazards on the cell. Note that, doing these calculations, one can also consider the temporal nature or the impact of climate change on the effect of each pressure/hazard on each sensitivity. For that, all the products mentioned above can be additionally multiplied by a specific factor that depends on such a temporal nature.
In detail, let us denote with b_{ij} the components of the matrix appearing in Fig.4 and obtained through participatory weighing, i.e., let b_{ij} be the indicator describing the relationship between the sensitivity *i* and the pressure *j*. Similarly, let b_{ik} be the indicator describing the relationship between the sensitivity *i* and the hazard *k*.

Then for each component of the sensitivities (say component A, for example), one can compute the normalized index of pressures $I_{PR(A)}$ on a single cell as a weighted sum of the effects of each pressure, and each sensitivity in component A, using the following formula:

$$I_{PR(A)} = \frac{1}{m_A n} \cdot \sum_{i=1}^{m_A} \sum_{j=1}^{n} K_{ij}(t) \cdot S_i \cdot b_{ij} \cdot PR_j \qquad (1)$$

where:

n= number of pressures.

m_A = number of sensitivities in component A.

$K_{ij}(t)$= a factor that depends on the temporal nature of the pressure *j* on sensitivity *i* (at the initial time, t_0=2020 one can fix $K_{ij}(t_0)$= 1).

S_i= indicator of sensitivity *i* in the specific cell.

PR_j = indicator of pressure *j* in the specific cell.

It should be noted that the sum is divided by $m_A\ n$ to normalize the index, i.e., to obtain a quantity assuming values in [0,1] (being a total of $m_A\ n$ summands). Furthermore, observe that each pressure affecting each sensitivity is multiplied by the indicator b_{ij} describing the relationship between each sensitivity and pressure.

Similarly, it is possible to compute the normalized index of hazard $I_{HZ(A)}$ on a single cell as a weighted sum of the effects of each hazard on each sensitivity of component A as follows.

$$I_{HZ(A)} = \frac{1}{m_A p} \cdot \sum_{i=1}^{m_A} \sum_{=k1}^{p} CC(t)_k \cdot S_i \cdot b_{ik} \cdot HZ_k \tag{2}$$

where:

p= number of hazards.

m_A = number of sensitivities in component A.

$CC(t)_k$= a factor that expresses the impact of climate change (for the present case study was considered $CC(t)_k$=1) related to hazard *k.*

S_i= indicator of sensitivity *i* in the specific cell.

HZ_k = indicator of hazard *k* in the specific cell.

For the rest of the sensitivity components (B and C for our study case, but it can be more), the procedure to calculate the index of pressures and the index of hazard is analogous to the one described previously in equations (1) and (2).

Subsequently, one can compute the overall pressure index, for each cell, by summing the indexes referring to every component of the sensitivities (A, B, and C). This sum can be a weighted sum in case one wants to attribute different importance to the different components. Similarly for the overall hazard index.

In detail, the overall pressure index I_{PR} is calculated as described in equation (3).

$$I_{PR} = \sum_{w=1}^{W} \beta_w \cdot I_{PR(w)} \tag{3}$$

where:

W = number of components of sensitivity (in the present case study W = 3; A, B, C).

β_w= weights assigned to every single component of sensitivity. ($\beta_w \in$ [0,1] in the present case study the three components of the sensitivity were weighted with the same value, then β_A; β_B; β_C = 1/3).

The overall hazard index I_{HZ} is calculated as stated in equation (4).

$$I_{HZ} = \sum_{w=1}^{W} \beta_w \cdot I_{HZ(w)} \tag{4}$$

In summary, the equations above can be combined and generalized into equations (5) and (6), respectively, which allows weighing both indexes independently (I_{PR} , I_{HZ}), for every single cell.

$$I_{PR} = \sum_{w=1}^{W} \frac{\beta_w}{m_w n} \cdot \sum_{i=1}^{m_w} \sum_{j=1}^{n} K_{ij}(t) \cdot S_i \cdot b_{ij} \cdot PR_j \tag{5}$$

and,

$$I_{HZ} = \sum_{w=1}^{W} \frac{\beta_w}{m_w p} \cdot \sum_{i=1}^{m_w} \sum_{k=1}^{p} CC(t)_k \cdot S_i \cdot b_{ik} \cdot HZ_k \tag{6}$$

where:

m_w= number of sensitivities in component *W.* The rest of the terms remain as defined before.

Finally, an overall vulnerability index for each cell is obtained by summing the two overall indexes defined in equations (5) and (6) (one for the pressures and one for the hazards). Again, this sum is a weighted sum, to

allow for the case one wants to attribute different importance to pressures and hazards, and assumes values in [0,1]. This can be done by using the formula (7), which enables the measurement of the systemic vulnerability in each territory cell.

$$I_V = \alpha \cdot I_{PR} + (1 - \alpha) \cdot I_{HZ} \quad (7)$$

where:

α = coefficient of "interest" in pressures/hazards; ($\alpha \in [0,1]$: if α=0; then "the index considers only the hazards", while if α=1; then "the index considers only the pressures"). For the present case study α=1/2 (the same weight for pressures and hazards was assigned).

2.2 Case study

The case study of this work is the municipality of Moncalieri. The municipality belongs to the Piedmont Region, in the North-West of Italy, and is part of the metropolitan area of Turin (Fig.5). The municipality has a population of 56,319 inhabitants (ISTAT, 2020) and is the fifth-largest city in the Piedmont region. The territory presents a mixed orography, partly flat in the southern and western areas of the municipality and the Po basin. At the same time, the northern part is characterized by a hilly dorsal that continues in the municipality of Turin. Moncalieri is a medieval town (1230), placed to protect the river Po passage. Controlled by the Savoy dynasty for the following decades, it became a vital court seat: the castle was transformed into a baroque residence and, since 1997, has been on the UNESCO World Heritage List. The city's role in the Savoy Duchy and its proximity to the capital encouraged the work of prestigious patrons who generated a cultural heritage of great value. The settlement system has developed transversally to the north-south axis of the river behind the hill. The settlements are distributed along the main roads in the hilly northern part. The municipality is characterized by a high level of accessibility and infrastructure: the city is located at the entrance to the motorway system of northern Italy. It is directly connected to Turin's ring road network. For this reason, the city has historically seen the development of large industrial areas. Nevertheless, on the other hand, the river Po has historically represented a limit to the development of settlements. The characteristics described making this municipality subject to vulnerabilities of different nature and extent.

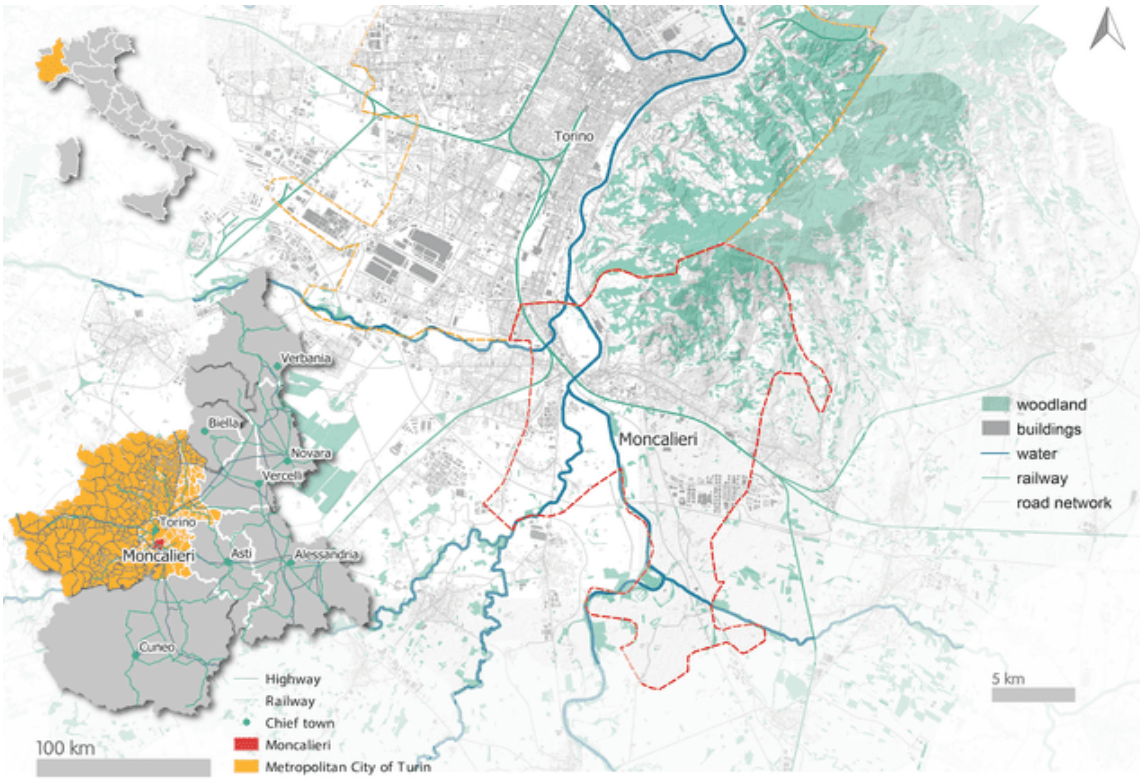


Fig.5 Localization of the Municipality of Moncalieri

3. Results

This section shows the results of the matrix implementation applied to the case study of Moncalieri. The weighted matrix, vulnerability indices by sensitivity components, and the systemic vulnerability index will be presented. Fig.6 shows the weighted matrix following the questionnaire with a participatory methodology, including the team of 13 researchers involved in the project. The result is a matrix representing the intensity of the relationships between the sensitivity, pressure, and hazard indicators. The matrix, with the coloured cells according to their correlation, prioritizes the intensity between indicators from 0 (no relationship) to 1 (intense relationship).

COMPONENTS	SENSITIVITIES		PRESSURES			HAZARDS					
			CDS	OBS	OLD	ALU	ALA	IBO	FRA	SIS	RIR
ENVIRONMENT AND LANDSCAPE	A1	landscape sensibility	0.70	0.21	0.00	0.67	0.61	0.79	0.76	0.48	0.58
	A2	ecological quality	0.79	0.00	0.00	0.73	0.67	0.94	0.76	0.36	0.85
	A3	energy consumption intensity	0.64	0.61	0.21	0.27	0.24	0.18	0.18	0.09	0.21
BUILDINGS, HERITAGE INFRASTRUCTURES	B1	cultural heritage consistency	0.27	0.58	0.06	0.82	0.76	0.61	0.73	0.94	0.52
	B2	building construction characteristics	0.30	0.94	0.00	0.55	0.61	0.39	0.45	0.82	0.33
	B3	RES energy self-sufficiency	0.45	0.79	0.15	0.06	0.09	0.03	0.00	0.12	0.09
	B4	communication infrastructure density	0.61	0.27	0.18	0.61	0.55	0.64	0.64	0.70	0.64
	B5	road infrastructure density	0.73	0.18	0.15	0.85	0.85	0.70	0.73	0.88	0.79
ECONOMY AND POPULATION	C1	population density	0.45	0.18	0.61	0.73	0.70	0.52	0.58	0.91	0.83
	C2	elderly population incidence	0.09	0.09	0.91	0.64	0.64	0.52	0.48	0.70	0.67
	C3	immigrant population incidence	0.21	0.06	0.30	0.27	0.27	0.21	0.21	0.27	0.24
	C4	manufacturing activities density	0.42	0.09	0.12	0.73	0.67	0.58	0.55	0.70	0.82

0.70 - 1 strong | 0.50 - 0.69 medium | 0.00 - 0.49 low

Fig.6 R3C matrix weighing

The outputs of the Vulnerability Matrix, deriving from the application with GIS tools and the formula described above, are the vulnerability index by component and the systemic vulnerability index, which assume a value in each grid cell. In the case study of Moncalieri, they are as follows:

- Vulnerability Index I_{VA} = Overall Vulnerability Index of Component A. Environment and Ecosystem Services (Fig.7a);
- Vulnerability Index I_{VB} = Overall Vulnerability Index of Component B. Construction, Infrastructure, Cultural Heritage and Landscape (Fig.7b);
- Vulnerability Index I_{VC} = Overall Vulnerability Index of Component C. Economy and Population (Fig.7c).
- The sum of the three indices gives I_V = Systemic Vulnerability Index at the municipal scale (Fig.8).

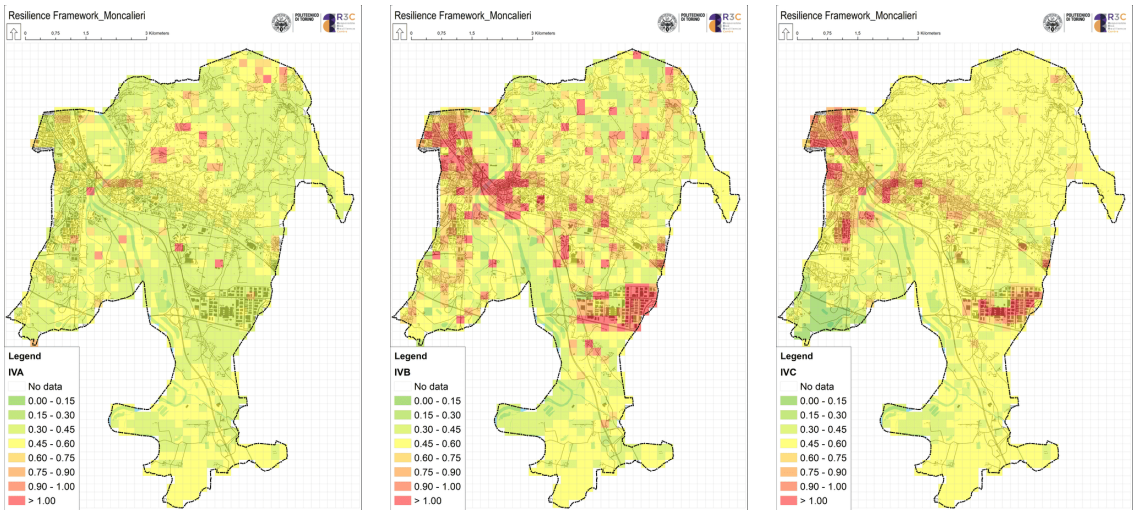
The values obtained, represented in the three maps, show the values of the vulnerability index divided according to the components I_{VA}, I_{VB}, and I_{VC}.

The results have been verified in a retroactive procedure that confirmed consistency concerning the presence of elements and factors determining territorial vulnerability.

The vulnerability index referring to component A shows a concentration of high vulnerability areas (I_{VA}, I_{VB}, I_{VC}>0.75) in the north-northeast region of the study area. This area, characterized by the wooded hills, is notably correlated to the phenomena of land consumption, wildfires, and landslides, especially for the A1 (landscape sensitivity) and A2 (ecological quality) sensitivities.

In component B, the most vulnerable areas are those with the highest density of built-up areas, road infrastructures, and the presence of cultural heritage buildings, with a substantial impact on the pressure indicator OBS (obsolete buildings) and the seismic hazard indicator (SIS). In component C, the most relevant sensitivity in the determination of vulnerability values is constituted by indicator C4 (density of productive activities) concerning the phenomena of the flood (ALU), earthquake (SIS), and risk of major industrial

accidents (RIR). Flood and earthquakes also significantly impact indicators C1 and C2 of population density and elderly population.



(a) (b) (c)

Fig.7 Systemic vulnerability maps (a) IVA: vulnerability index component A, (b) IVB: vulnerability index component B, (c) IVC: vulnerability index component C

The result of the work is a map that brings together all the interactions between sensitivities, pressures, and hazards. This synthesis map represented both on a numerical scale (8a) and a qualitative scale (8b), proper to facilitate reading by non-experts, shows the present situation of the municipality and identifies the territorial vulnerability that combines the most relevant aspects, characteristics, and criticalities for the case under study. The systemic vulnerability indicator combines all the relationships and elements examined and allows an overall reading of the critical territorial aspects.

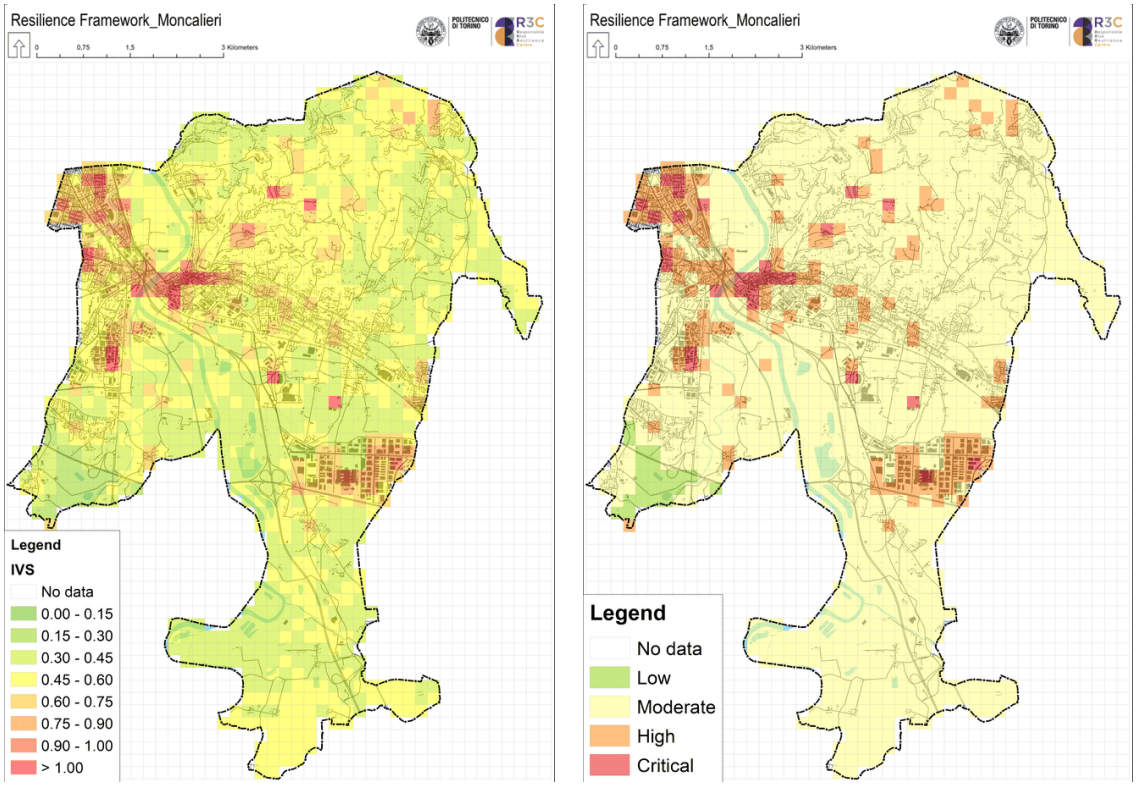


Fig.8 Final systemic vulnerability map (a) numerical scale (b) qualitative scale

The three most vulnerable areas correspond to the historical centre, the industrial areas, and the most anthropized area in the north-north-west. Other scattered areas identify situations characteristic of punctual elements of the territory. Indeed, after the first methodology test, some of these areas were verified by random sampling, confirming the model's results.

4. Discussion

The comparison with the literature and the case studies analyzed (Angiello et al., 2018; Bixler et al., 2021; Galderisi & Limongi, 2022) offers various discussion points. First, it highlights that this work is part of the attempt to define, calculate and spatialize an overall vulnerability index on a territory. Second, it reveals innovative points and possible extensions: the most innovative elements concern the choice of spatial scale, the weighting and calculation process, and the selection of indicators.

A peculiarity of the tool tested in Moncalieri is the use of the spatial grid, which allows the indicators to be reported at a more detailed level than in other cases that rely on - for example - census sections.

Unlike other case studies, the construction of the formula and the matrix allows for overcoming specific difficulties typical of the multivariate approach. In particular, the need to keep groups of indicators separate until an advanced stage of the calculation: the work here presented makes it possible to overtake this problem by clustering the groups of indicators.

Furthermore, the formula is characterized by the possibility of being independent regarding the indicators used and the ability to consider the degree of interaction between the indicators themselves, which are considered by ad hoc coefficients resulting from participatory weighting procedures.

From the earliest stages, the indicator selection process focuses on an analysis of the peculiarities of the specific case study, which make the matrix a tool sensitive to the characteristics of the area of application. The results obtained are encouraging, but it is necessary to emphasize that the matrix results are strictly dependent on the data's quality and level of updating. For instance, in the case study of Moncalieri, the methodology was tested using the current government demographical data provided by the Italian official statistical database, dated 2011. For other indicators, some specific authorizations or local datasets were required. On the other hand, the methodology replicability and the availability of up-to-date data enable the possibility to obtain a contemporary representation of systemic vulnerability.

This site-specific approach, also found in other works, may make it necessary to adjust the indicators selected in the event of other applications: however, the structure of the matrix is designed to make it adaptable to the territory to which it is applied and, therefore, to the indicators that best describe it.

Despite the importance of resilient approaches, they can still not provide practical solutions to the spatial planning process. For example, the lack of information about the system's various components can prevent the strategy's effective implementation.

The spatial measure of vulnerability aims to provide a tool that can help identify areas of vulnerability that are not adequately addressed by current analytical methods. This method should be used in local analysis to implement resilient strategies. In addition to identifying areas of vulnerability, this measure should also help develop effective strategies and implement resilient infrastructures. This work shows that using the map is key to reducing system vulnerability because spatializing interventions in urban areas allows the most appropriate measures to be defined according to the type of vulnerability and degree of priority.

In the case of Moncalieri, the analysis makes it possible to prioritize actions on the areas identified as having the highest vulnerability and needing more attention. Once the areas to intervene are identified, it is necessary to do a backward process to identify the causes, triggers, and measures following superordinate strategies. The primary reference at the national level is the national guidelines for defining Climate Change Adaptation- according to the National Climate Change Adaptation Plan (NCCP, 2016). The Plan includes different types of adaptation measures: "grey or structural measures" that include technical and engineering solutions; "green

or ecosystem-based measures" that involve ecosystem-based approaches; and "soft or light measures" that involve management, legal, and policy approaches. Green and grey measures range from mitigative to long-term adaptive solutions that transform the system to achieve a measurable resilient condition.
This study's main findings aim to develop a resilient knowledge of the various vulnerable components of territorial systems. In future work, this knowledge can be used to design land use plans that can adapt to climate change and identify the appropriate urban planning measures.

5. Conclusions

The tool allows for measuring territorial vulnerability by identifying a set of indicators relevant in the context of the case study for the factors that compose systemic vulnerability. In addition, the tool integrates indicators from different fields of territorial study with a holistic approach, enabling a composite reading of territorial vulnerabilities according to a multi-risk concept.
The territorial vulnerability index methodology sets the relevance between the pressures and hazards relationship and the territory's sensitivity elements. On the other hand, it considers the territorial peculiarities and the stakeholders' interests. These characteristics ensure the scalability and replicability of the matrix on different territories.
Moreover, the tool contributes to increasing territorial vulnerability awareness based on spatial analysis. Specifically, applying the matrix in the Moncalieri case study enables the validation of the calculation model. At the same time, the choosing indicators process allows a spatially explicit measurement. Hence, it is not configured as a statistical index on a municipal basis to compare territories but ensures the visualization of variations in the index within the territory itself.
On the other hand, it is aimed at supporting the elaboration of policies at a detailed scale, configuring itself as a decision support tool for local planning.
Further research needs to be developed on the temporal factors of the formula related to the variations of both the climate change-driven hazards (CC(t)k) and the pressure trends (Kij). Therefore, a deeper analysis should be carried out to evaluate model uncertainties. Likewise, the tool can be applied in the spatial vulnerability assessment of additional case studies.

Acknowledgments

This manuscript is a final results of the interdisciplinary research project “Measuring Urban Resilience” of the Responsible Risk Resilience Interdepartmental Centre (R3C) of Politecnico di Torino (see http://www.r3c.polito.it/), started in 2018. The collaboration with the Municipality of Moncalieri is part of the ongoing research experimentation aimed to promote a new planning approach towards the resilient city.

References

Angiello, G., Carpentieri, G., Morosini, R., Tremiterra, M. R., & Tulisi, A. (2018). Review Pages: The Resilience City/The Fragile City. Methods, Tools and Best Practices 3 (2018). *TeMA - Journal of Land Use, Mobility and Environment, 11*(3), 361-382. https://doi.org/10.6092/1970-9870/5957

Barreca, A., Curto R., & Rolando, D. (2018). Housing Vulnerability and Property Prices: Spatial Analyses in the Turin Real Estate Market. *Sustainability, 10*(91):3068, 1-20. https://doi.org/10.3390/su10093068

Birkmann, J., Cardona, O.D., Carreño, M.L., Barbat, A., Pelling, M., Schneiderbauer, S., Kienberger, S., Keiler, M. Alexander, D., Zeil P., & Welle, T. (2013). Framing vulnerability, risk and societal responses: the MOVE framework. *Nat Hazards 67*, 193–211. https://doi-org.ezproxy.biblio.polito.it/10.1007/s11069-013-0558-5

Bixler, R.P., Yang, E., Richter, S.M., & Coudert, C. (2021). Boundary crossing for urban community resilience: A social vulnerability and multi-hazard approach in Austin, Texas, USA*, International Journal of Disaster Risk Reduction*, 66, 102613, ISSN 2212-4209, https://doi.org/10.1016/j.ijdrr.2021.102613

Bovio, G., Camia, A., Marzano, R., & Pignocchino, D. (2001). Manuale operativo per la valutazione della pericolosità specifica e per le attività AIB in area di interfaccia. Dipartimento Agroselviter, Università di Torino, Torino.

Brunetta, G., & Caldarice, O. (2020). Spatial Resilience in Planning: Meanings, Challenges, and Perspectives for Urban Transition. In: Leal Filho, W., Marisa Azul, A., Brandli, L., Gökçin Özuyar, P., & Wall, T. (Eds) Sustainable Cities and Communities*. Encyclopedia of the UN Sustainable Development Goals.* Springer, Cham. https://doi.org/10.1007/978-3-319-95717-3_28

Brunetta, G., Mutani, G., & Santantonio, S. (2021). Pianificare per la resilienza dei territori. L'esperienza delle comunità energetiche. *Archivio di Studi Urbani e Regionali*, LII, 131(supl.), 44-70. https://doi.org/10.3280/ASUR2021-131-S1003

Brunetta, G., & Baglione, V. (2013). Resilience in the Transition Towns Movement. Towards a new Urban Governance. *TeMA - Journal of Land Use, Mobility and Environment, 6*(2), 251-264. https://doi.org/10.6092/1970-9870/1524

Brunetta, G., Caldarice, O., Tollin, N., Rosas-Casals, M., & Morató, J. (2020). Urban resilience for Risk and Adaptation Governance. The Resilient Cities book.

Brunetta, G., Ceravolo, R., Barbieri, C.A., Borghini, A., De Carlo, F., Mela, A., Beltramo, S., Longhi, A., De Lucia, G., Ferraris, S., Pezzoli, A., Quagliolo, C., Salata, S., & Voghera, A., (2019). *Territorial Resilience: Toward a Proactive Meaning for Spatial Planning. Sustainability, 11*(8), 2286. https://doi.org/10.3390/su11082286

Brunetta, G., & Salata, S. (2019). Mapping Urban Resilience for Spatial Planning—A First Attempt to Measure the Vulnerability of the System. *Sustainability, 11*(8), 2331. https://doi.org/10.3390/su11082331

Cardona, O. D. (1999). Environmental management and disaster prevention: Two related topics: A Holistic risk assessment and management approach. In J. Ingleton (Eds.) *Natural Disaster Management*, 151-153. Tudor Rose, London.

Cardona, O. D. (2001). Estimación holística del riesgo sísmico utilizando sistemas dinámicos complejos. PhD Thesis, la Universitat Politècnica de Catalunya (UPC). Retrieved from: https://dialnet.unirioja.es/servlet/tesis?codigo=6549

Cardona, O. D. (2011). Disaster Risk and Vulnerability: Notions and Measurement of Human and Environmental Insecurity. In: Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks, (Eds.). Brauch, H. G., Oswald, Ú., Mesjasz, S. C., Grin, J., Kameri-Mbote, P., Chourou, B., Dunay, P., Birkmann, J. Springer Verlag, Berlin Heidelberg. https://doi.org/10.1007/978-3-642-17776-7

Cardona, O.D., & Barbat, A.H. (2000). El riesgo sísmico y su prevención. In El riesgo sísmico y su prevención, 190.

Cardona, O.D., & Hurtado, J.E. (2000). Holistic seismic risk estimation of a metropolitan center. In *Proceedings of 12th world conference of earthquake engineering*. Auckland.

Cardona, O.D., & Hurtado, J.E. (2000). Modelación numérica para la estimación holística del riesgo sísmico urbano, considerando variables técnicas, sociales y económicas. Métodos Numéricos en Ciencias Sociales (MENCIS 2000).

Carreño, M. L., Cardona, O. D., & Barbat, A. H. (2007). Urban Seismic Risk Evaluation: A Holistic Approach*. Natural Hazards, 40* (2007), 137-172. https://doi.org/10.1007/s11069-006-0008-8

Carreño, M. L., Cardona, O. D., Marulanda, M. C., & Barbat, A. H. (2009). Holistic Urban Seismic Risk Evaluation of Megacities: Application and Robustness. In: The 1755 Lisbon Earthquake: Revisited. *Geotechnical, Geological, and Earthquake Engineering*, vol 7. Springer, Dordrecht. https://doi-org.ezproxy.biblio.polito.it/10.1007/978-1-4020-8609-0_10

Castro Rodriguez, D. J., Beltramino, S., Scalas, M., Pilone, E., & Demichela, M. (2022). Territorial Representation of a vulnerability associated with the Seveso installations in a Nord Italian case study. *Proceedings of the 32nd European Safety and Reliability Conference* (ESREL 2022). Published by Research Publishing, Singapore. https://doi.org/10.3850/978-981-18-5183-4_R25-02-574-cd

De Lucia, G. (2019). La conoscenza storica per la valutazione delle vulnerabilità del patrimonio culturale ecclesiastico: un approccio sistemico per strategie di valorizzazione e rigenerazione. BDC. *Bollettino Del Centro Calza Bini 19*(1):75–88. https://doi.org/10.6092/2284-4732/7061

Del Prete, M. (1993). Rischio da frane intermittenti a cinematica lenta nelle aree montuose e collinari urbanizzate della Basilicata: rapporto 1992-U.O. 2.37 / Mario del Prete, Emanuele Giaccari, Giuliana Trisorio-Liuzzi. (Eds.). [S.l : s.n.] (Potenza: Pisani & Iannielli), 1-84.

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change, 16*(3), 253-267. https://doi.org/10.1016/j.gloenvcha.2006.04.002

Francini, M., Chieffallo, L., & Gaudio, S. (2021). Climate change as stressor in rural areas. *TeMA - Journal of Land Use, Mobility and Environment*, 53-71. https://doi.org/10.6093/1970-9870/7422

Galderisi, A., Ceudech, A., & Pistucci, M. (2008). A method for na-tech risk assessment as supporting tool for land use planning mitigation strategies. *Nat Hazards 46*, 221–241. https://doi-org.ezproxy.biblio.polito.it/10.1007/s11069-008-9224-8

Galderisi, A., & Ferrara, F. F. (2012). Enhancing urban resilience in face of climate change: a methodological approach. *TeMA-Journal of Land Use, Mobility and Environment, 5*(2), 69-88. https://doi.org/10.6092/1970-9870/936

Galderisi, A., Guida, G., & Limongi, G. (2021). Emergency and spatial planning towards cooperative approaches. *TeMA - Journal of Land Use, Mobility and Environment*, 73-92. https://doi.org/10.6093/1970-9870/7417

Galderisi, A., & Limongi, G. (2021). A comprehensive assessment of exposure and vulnerabilities in multi-hazard urban environments: A key tool for risk-informed planning strategies. *Sustainability (Basel, Switzerland), 13*(16), 9055.

Gallopín, G.C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change*, 16 (3), 293-303. https://doi.org/10.1016/j.gloenvcha.2006.02.004

Gazzetta Ufficiale (2015). Attuazione Della Direttiva 2012/18/UE Relativa al Controllo Del Pericolo Di Incidenti Rilevanti Connessi Con Sostanze Pericolose. GU "Gazzetta Ufficiale." Serie Generale n.161 del 14-07-2015 - Suppl. Ordinario n. 38) Retrieved from: https://www.gazzettaufficiale.it/eli/id/2015/07/14/15G00121/sg

Heikkinen, M., Karimo, A., Klein, J., Juhola, S., & Ylä-Anttila, T. (2020). Transnational municipal networks and climate change adaptation: A study of 377 cities, *Journal of Cleaner Production, 257*(120474). ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2020.120474

Hernández-Sampieri, H., Fernández-Collado, C., & Baptista-Lucio, P. (2006). Research Methodology, 8ª ed., McGraw Hill, Madrid, 2006. ISBN: 970-10-1899-0 (in Spanish).

Huseyin, G. O., Szabolcs V., Huseyin G., & Arif H. (2021). Numerical simulation and parametric study of various operational factors affecting a PV-battery-air conditioner system under prevailing European weather conditions. *Sustainable Cities and Society, 67* (2021), 1-15. https://doi.org/10.1016/j.scs.2021.102754

ICSU - LAC (2010). Science for a Better Life: Developing Regional Scientific Programs in Priority Areas for Latin America and the Caribbean. Volume 1. Kalin T. Arroyo, M., Dirzo, R., Castillas, J.C., Cejas, F., and Joly, C.A. Biodiversity in Latin America and the Caribbean: An Assessment of Knowledge, Research Scope and Priority Areas ICSU - LAC / CONACYT, Rio de Janeiro and Mexico City, 332 pp. ISBN 978-0-930357-74-0

IPCC (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (Eds.)]. IPCC, Geneva, Switzerland, 104 pp. Retrieved from: https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report

IPCC (2012). Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.-K., Allen, S.K., Tignor, M., & Midgley P.M. (Eds.) Retrieved from Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 8RU ENGLAND, 582 pp.

IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelekçi, O., Yu, R., & Zhou, B. (Eds.). Cambridge University Press.

Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk, *Cities*, 31, 220-229, ISSN 0264-2751, https://doi.org/10.1016/j.cities.2012.05.004

Manyena, S. B. (2006). The concept of resilience revisited. *Disasters, 30*(4), 434-450. https://doi.org/10.1111/j.0361-3666.2006.00331.x

Mccarthy, J., Canziani, O., Neil, A., Dokken, D., & White, K. (2001). "Climate Change 2001: Impacts, Adaptation, and Vulnerability." Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change 19. Retrieved from: https://www.ipcc.ch/site/assets/uploads/2018/03/WGII_TAR_full_report-2.pdf

Menoni, S., Galderisi, A., Ceudech, A., Delmonaco, G., & Spizzichino, D. (2006). ARMONIA Deliverable 5.1., Harmonised hazard, vulnerability and risk assessment methods informing mitigation strategies addressing land-use planning and management.

Ministero delle Infrastrutture e dei Trasporti. Aggiornamento Delle «Norme Tecniche per Le Costruzioni». Retrieved from: https://www.gazzettaufficiale.it/eli/gu/2018/02/20/42/so/8/sg/pdf.

Mondino, L. (2020). Beni culturali e territorio per un approccio territorialista allo studio dei beni culturali di interesse religioso (Master Thesis, Politecnico di Torino, Torino). Retrieved from: https://webthesis.biblio.polito.it/16601/1/tesi.pdf.

Mutani G., & Todeschi V. (2021). Optimization of Costs and Self-Sufficiency for Roof Integrated Photovoltaic Technologies on Residential Buildings. *Energies, 14* (13): 4018, 1-25. https://doi.org/10.3390/en14134018

Mutani G., Beltramino S., & Schiavone, M. (2020a). Place-based Atlas for Energy Communities using Energy Performance Certificates Database. IEEE 3rd International Conference and Workshop in Óbuda on Electrical and Power Engineering (CANDO-EPE), 000179-000184. https://doi.org/10.1109/CANDO-EPE51100.2020.9337766

Mutani, G., Santantonio, S., & Goulias, D. (2020b). Environmental protocol for Energy Communities. IEEE 3rd International Conference and Workshop in Óbuda on Electrical and Power Engineering (CANDO-EPE), 000191-000196. https://doi.org/10.1109/CANDO-EPE51100.2020.9337784

Mutani, G., Santantonio, S., Brunetta, G., Caldarice, O., & Demichela, M. (2021). An energy community for territorial resilience: Measurement of the risk of an energy supply blackout. Energy and Buildings, 240 (2021) 110906, 1-28. https://doi.org/10.1016/j.enbuild.2021.110906

Mutani, G., Beltramino, S., & Forte, A. (2020). A clean energy atlas for energy communities in Piedmont Region (Italy). *International Journal of Design & Nature and Ecodynamics 15* (3), 343-353. https://doi.org/10.18280/ijdne.150308

Mutani, G., Santantonio, S., & Beltramino, S. (2021). Indicators and representation tools to measure the technical-economic feasibility of a renewable energy community. The case study of Villar Pellice (Italy). *International Journal of Sustainable Development and Planning, 16* (1), 1-11. https://doi.org/10.18280/ijsdp.160101

Pilone, E., Demichela, M., & Baldissone, G. (2019). The Multi-Risk Assessment Approach as a Basis for the Territorial Resilience. Sustainability, 11 (9):2612, 94-102. https://doi.org/10.3390/su11092612

Pilone, E., Demichela, M., & Camuncoli, G. (2017). Seveso Directives and LUP: The mutual influence of natural and anthropic impacts. Journal of Loss Prevention in the Process Industries, 49 Part A (2017), 94-102. https://doi.org/10.1016/j.jlp.2017.02.027

Pilone, E., Mussini, P., Demichela, M., & Camuncoli, G. (2016). Municipal Emergency Plans in Italy: Requirements and drawbacks. Safety Science, 85 (2016):2612, 163-170. https://doi.org/10.1016/j.ssci.2015.12.029.

Pilone, E. (2018). Risk Management and Land Use Planning for Environmental and Asset Protection Purposes (Doctoral dissertation, Politecnico di Torino).

Todeschi, V., Marocco, P., Mutani, G., Lanzini, A., & Santarelli, M. (2021). Towards energy self-consumption and self-sufficiency in urban energy communities. *International Journal of Heat and Technology, 39* (1), 1-11. https://doi.org/10.18280/ijht.390101

UN General Assembly (2015). Transforming our world: the 2030 Agenda for Sustainable Development, 21 October 2015, A/RES/70/1, Retrieved from: https://www.refworld.org/docid/57b6e3e44.html

Voghera, A., & La Riccia, L. (2015). Urbanistica e reti ecologiche per lo sviluppo urbano e territoriale. In: *Urbanistica Informazioni*, 263, 131-135.

Voghera, A., & La Riccia, L. (2016). Landscape and Ecological Networks: Towards a New Vision of Sustainable Urban and Regional Development. Laborest, 12, 89-93. https://doi.org/10.19254/LaborEst.12.15

Voghera, A., La Riccia, L. (2019). Ecological Networks in Urban Planning: Between Theoretical Approaches and Operational Measures. Chapter. In Calabrò F., Della Spina L., Bevilacqua C. (Eds). New Metropolitan Perspectives. Local Knowledge and Innovation Dynamics Towards Territory Attractiveness Through the Implementation of Horizon/E2020/Agenda 2030 (672-680). Cham, Springer.

Voghera, A., Negrini, G., La Riccia, L., & Guarini, S. (2017). Reti ecologiche nella Pianificazione Locale: Esperienze nella Regione Piemonte. Reticula, 14, 1-9. Retrieved from: https://www.isprambiente.gov.it/it/pubblicazioni/periodici-tecnici/reticula/Reticula_14_2017.pdf

Authors' profile

Simone Beltramino

Ph.D. student in Urban and Regional Development at the Interuniversity Department of Regional and Urban Studies and Planning (DIST) of Politecnico di Torino. His research concerns the topic of energy resilience planning.

e-mail: simone.beltramino@polito.it
ORCID: https://orcid.org/0000-0003-0872-951X

Mattia Scalas

Ph.D. student in Urban and Regional Development at the Interuniversity Department of Regional and Urban Studies and Planning (DIST) of Politecnico di Torino. His research deals with urban resilience planning.

e-mail: mattia.scalas@polito.it
ORCID: https://orcid.org/0000-0002-6912-1287

David Javier Castro Rodriguez

Ph.D. student in Chemical Engineering at the Department of Applied Science and Technology (DISAT) of Politecnico di Torino. His research is about industrial risk within territorial resilience.

e-mail: david.castro@polito.it
ORCID: https://orcid.org/0000-0002-7609-3229

Grazia Brunetta

Full Professor in Urban and Regional Planning at the Interuniversity Department of Regional and Urban Studies and Planning (DIST), and Coordinator of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. Her main research activities are in the field of town and regional planning, with a particular focus on the innovation in the theories, methodologies and approaches for spatial planning in both research and academic teaching activity.

e-mail: grazia.brunetta@polito.it
ORCID: https://orcid.org/0000-0003-1868-2700

Franco Pellerey

Full Professor in Probability and Statistics at the Department of Mathematical Sciences "Giuseppe Luigi Lagrange" (DISMA), and member of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. His research activity concerns the application of mathematics in industry and society.

e-mail: franco.pellerey@polito.it
ORCID: https://orcid.org/0000-0002-8983-855X

Micaela Demichela

Associate Professor in Theory of the Development of Chemical Processes at the Department of Applied Science and Technology (DISAT), and member of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. She is interested in risk assessment, process safety and environmental protection.

e-mail: micaela.demichela@polito.it
ORCID: https://orcid.org/0000-0001-5247-7634

Angioletta Voghera

Full Professor in Urban and Regional Planning at the Interuniversity Department of Regional and Urban Studies and Planning (DIST), and member of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. Her main research activities are in the field of Regional and Landscape and Protected Areas Planning, and Urban Design with reference to European contexts.

e-mail: angioletta.voghera@polito.it
ORCID: https://orcid.org/0000-0002-0166-3303

Andrea Longhi

Associate Professor in History of Architecture at the Interuniversity Department of Regional and Urban Studies and Planning (DIST), and member of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. He is interested in history of the territory and landscape, deepening the relationships between history and knowledge of regional systems of cultural heritage.

e-mail: andrea.longhi@polito.it
ORCID: https://orcid.org/0000-0001-7101-4168

Guglielmina Mutani

Associate Professor in Environmental Technical Physics at the Department of Energy "Galileo Ferraris" (DENERG), and member of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. Her research activities include models of energy consumption for heating buildings at a district and urban scale.

e-mail: guglielmina.mutani@polito.it
ORCID: https://orcid.org/0000-0001-6822-8624

Ombretta Caldarice

Adjunct Professor at the Interuniversity Department of Regional and Urban Studies and Planning (DIST), and member of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. His research activity focuses on the interaction between planning and urban resilience through the lens of urban regulation.

e-mail: ombretta.caldarice@polito.it
ORCID: https://orcid.org/0000-0001-6172-908X

Gaetano Miraglia

Research Assistant at the Department of Structural, Geotechnical and Building Engineering (DISEG) at Politecnico di Torino. He is interested in seismic monitoring and evaluation of the architectural heritage and dynamic structural identification.

e-mail: gaetano.miraglia@polito.it
ORCID: https://orcid.org/0000-0002-3611-0215

Erica Lenticchia

Assistant Professor at the Department of Structural, Geotechnical and Building Engineering (DISEG) and member of the Responsible Risk Resilience Centre (R3C) at Politecnico di Torino. Her research concerns the topic of seismic and structural analysis of existing RC and masonry structures, focusing on structural health monitoring, dynamic identification, and assessment and diagnosis of the structural condition of ancient and modern historic buildings.

e-mail: erica.lenticchia@polito.it
ORCID: https://orcid.org/0000-0002-3746-2933

Luigi La Riccia

Member of the SDG11LAB at the Interuniversity Department of Regional and Urban Studies and Planning at Politecnico di Torino. His research interests include landscape and local planning, Geographic Information Systems (GIS), remote sensing and participatory GIS.

e-mail: luigi.lariccia@polito.it
ORCID: https://orcid.org/0000-0002-4800-2641

TeMA Journal of Land Use, Mobility and Environment

Call for papers 2023

TeMA vol.16 (2023)

The climatic, social, economic, health and resources changes, that are increasingly challenging our cities, require the identification and implementation of strategies to increase the liveability, competitiveness and sustainable performance of urban systems and adaptation actions aimed at improving their resilience. Humanity's success in addressing such phenomena will be largely determined by what happens in cities. At the same time, the challenge that the complexity of the transformations and transitions in progress imposes on cities requires scholars, researchers, technicians and decision makers to rapidly commit to transforming cities into resilient, competitive urban systems and promoting sustainable communities. New technologies can support the innovation process towards multidisciplinary solutions to the above-mentioned challenges. For instance, big data, remote sensing offer unprecedented opportunities to know and interpret urban systems and their complexity. Thus, it is of primary importance to rethink the theories and methodologies underlying urban planning practice.

With these premises, TeMA Journal welcomes interdisciplinary work, with theoretical, methodological and empirical approaches concerning the following topics:

- Accessibility to urban services and places;
- Multidimensional resilience of cities to limit the impacts of climate change;
- Transitions to renewable resources and energy saving in cities;
- Definitions of planning tools, methods and techniques aimed at promoting city adaptation to current and foreseeable social, economic, innovation and energy transitions;
- Requalification of urban environments;
- Increasing urban competitiveness through sustainable and resilient solutions;
- Adaptation of urban systems to external (temporary and permanent) agents.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 377-396
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9031
Received 14th March 2022, Accepted 15th November 2022, Available online 30th December 2022

www.tema.unina.it

Resilient marginal cities by encouraging intermodality strategies

Analysis of the Campanian marginal cities with criteria for intermodal business model

Irina Di Ruocco

University of Insubria/Department of Economics
Varese, Italy
e-mail: idiruocco@uninsubria.it
ORCID: https://orcid.org/0000-0003-0829-0754

Abstract
While metropolitan areas are evolving, funds and investments are investing in megacities, an overwhelming part of the population lives in peripheral and decentralized areas. Starting from an international view, the paper intends to offer a spatial cluster analysis on the main business models that can be reproduced in marginal areas. The literature points out that there is much study of inland areas but no spatial analysis of transportation for a particular band of areas, which includes marginal cities. A focus will be made on the marginal cities of Campania, starting from the strategies of internal areas. Encouraging intermodality with alternative and ICT-connected transport systems is a way to provide a mode of transport to cities in crisis. After an analysis of the territory, we will proceed with the identification of models of business for the decentralized areas of Campania. The main objective is to provide a set of criteria to identify the most suitable mobility services in main territorial contexts, from the point of view of population density, travel time from the nearest hub and use of ICT. This study should be seen as an initial approach to identifying strategies to develop the inland territories for first and last mile connection.

Keywords
Marginal cities; Intermodality; Sustainable mobility; Urban space; Business model.

How to cite item in APA format
Di Ruocco, I. (2022). Resilient marginal cities by encouraging intermodality strategies. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 377-396. http://dx.doi.org/10.6092/1970-9870/9031

1. Introduction

The changes we are now experiencing in recent years, highlighted mainly by two major events such as climate change and the pandemic are likely to have a permanent status. Above all, these events have shown the weaknesses in our lives, which have become marked during the recent decades. In detail, starting from emerging trends aforementioned, this paper is intended to analyse the physical limit of the cities in which we live that are less suitable to offer sufficient levels of quality of life, pursuing cities more fitted for human scale. The methodological proposal is made to encourage marginal areas that are in danger of being pushed further away (Hoggart & Buller, 2016; Gallent et al., 2015). The outcome of this research is to build a cluster analysis, starting from the identification of marginal cities in Campania, based on similar cities analysing the existing business models of mobility services deriving from best practices of European projects and real cases of successful peripheral and remote mobility applied in Italy. Marginality is still the source of interpretations and perceptions, so defining it with a single concept is still the focus of discussion. The scientific literature offers valuable support, despite this, there is no clear consensus that has emerged on its single meaning (Bradley & Pretes, 2000). Thus, the objective of the article is a cross-sectional analysis of the main case studies in the literature and in the international context concerning transportation networks and sprawl cities, reinforcing the concept of social revolution as 'new contemporary humanism', with a shift in the perspective of communities from the city to urban hinge contexts (Beauregard, 2018). The proposed study is an approach that looks at both the territorial side, taking into account the urban aspects of the city, and the transport side, increasing the efficiency of the transport network. With regard to mobility, it is a matter of operating both on supply models and on the use of digitalization, so as to involve aspects such as frequency, regulation, safety, accessibility and system integration in a single vision. There has been a significant capitalization of metropolitan areas in terms of financial and planning commitment, although these opportunities have not affected the decentralized areas of the suburbs. The lack of strategic and intermodal alignment between mobility and urban planning is straightforward in many cities, and is most affected in marginal areas that are 'hinge cities' between medium-sized cities and metropolitan areas (Borrelli, 2007; Leimgruber & Chang, 2019). The pursuing of resilient cities can also be extended to decentralized areas, to encourage their connection with the territory. Frequently, a form of inequality lies behind marginal cities, resulting in a lack of accessibility to services, often caused between low-income neighborhoods and employment opportunities (Blumenberg & Manville, 2004).

The impossibility of moving easily has been an effect of both inadequate planning that today does not seek to create the physical spaces necessary to optimize transportation infrastructure and connections, and to pursue the minimum accessibility goals promoted by national and European regulations. While metropolitan areas are seeing an increase in mobility services, including electric services, marginal areas, being excluded from innovation and major economic and social processes, are unable to increase Local Public Transport as road and rail (Déry et al., 2012; Pelc, 2006). Along these lines, it is necessary to act by identifying concrete actions for sustainable mobility along the hinge between highly populated areas and decentralized cities, overcoming the concept of the classic city to imagine a territorial and functional connection between areas with different characteristics of urban density. Reinforcing the point about a change in urban design is the experience of the pandemic, which caused a massive shift of users from metropolitan cities to urban centres. A city is a set of functions, located in several points of the territory (Mela, 2020), remarkably complex, such as to drive the necessity to rethink a new concept of city itself (Amin, 2002). In its continuous nature, the urban texture exhibits the weakness of a network that has not distributed the required functions in each of its nodes of network. Concerning the medium-sized cities and regional metropolises emerges the awareness (Mascarucci, 2020) of how the traditional city has now transformed itself into a "continuous city", moving from a system of 'compact city' to a system of 'diffuse city', with a series of scattered parts throughout the territory.

During the pandemic was observed a return to the suburbs for work purposes. The practice of smart working has already highlighted the potential of suburban areas, but it is essential to provide adequate mobility with

high level of intermodality in the first, middle and last mile. Cities are still the focus of studies and researches (D'Ascanio et al., 2016) as attractors and enablers of resources, powers and knowledge (Barbera & De Rossi, 2021). The patchwork of urban functions is constantly composing and decomposing, interrupting that pattern of continuity in growth that has been the characteristic of the twentieth century. The complexity of the research lies in the difficulty of perceiving these new mechanisms, strongly influenced by unpredictable external factors, highlighting that urban planning projects have the task of looking at local resources, being able to offer a concrete response. In the last 30 years, the population has begun to settle close to cities, giving rise to suburbs defined as places "diffuse", "exploded", causing the loss of three important indicators proposed by Archibugi (Archibugi, 1995), such as human "sociality", sense of "identity", and environmental "sustainability". In the search for new solutions and mitigation modes for the new city, a mixed approach is required on the new identity of territories (Di Ruocco et al., 2019; Sicignano et al., 2019) and on the legitimate nature of mobility, which occurs in the relationship between space and accessibility. New experiments become opportunities to rethink needs and necessities between demand and supply based on economic developments, with the possibility of transport revitalization inspired by MaaS systems and the strengthening of ICTs (EU Smart Cities Information System, 2017; EU, 2020). Thus, the transition between metropolitan and marginal cities is a complex of interactions between governance and value creation with stakeholder participation (Cocchia, 2014). Thinking about the resilient city also means studying marginal cities that can become and promote themselves as smart cities. In the city of tomorrow, the focus should be shifted from the metropolitan city, whose challenge is to try to maintain a high quality of life, to the medium city and inner areas, and its connection with the big city. The current research focuses on spatial marginality analysed according to socio-financial indicators, mobility, territorial geography, ICTs, identifying the potential of accessibility as one of key factors to overcome marginality. Marginal cities gravitate to the medium cities but without benefiting from the investments that are attracted by the metropolitan areas, are unable to capture capital and losing competitiveness, becoming increasingly weak to propose high value-added activities. The definition provided by the Ministry of Social Cohesion covers only one aspect of marginality, understood spatially, but does not take into account other factors (Vendemmia et al., 2022).

Funds	**€**		**Topic**	**Key Actor**
Recovery Fund	300 M	2021-2026	Inland areas for the improvement of accessibility and safety of roads	UPI (unions of Italian districts)
Fund to support economic activities in internal areas Prime Ministerial Decree on internal areas (FSC)	210 M	2020- 2022	Economic activities, crafts and trade	Agency for Territorial Cohesion - ANCI, UPI
Development and Cohesion Fund	50 B	2021-2027	Italian government funding for underutilized areas of the country	European Structural Funds
European Funds (ESF-ERDF)	373 B	2021-2027	Investments in areas lagging behind in development	European Structural Funds
Recovery Plan – M3C1/C2	28.30 + 3.68 B	2021-2026	Innovation, digitalisation, road/infrastructure/intermodality	Recovery Fund, Supplementary Fund

Tab.1 Funds for inner areas in Italy

A preliminary analysis starts from understanding the resources financed for the development of inner areas, in which marginal areas are included. Inland areas, identified in a study by the Minister for the South and Social Cohesion known as SNAI strategy (Inner areas national strategy) is supported both by European funds (Agency for Cohesion, 2014), for the co-financing of local development projects, and by national resources, allocated by the Stability Laws 2014, 2015, 2016 and the Budget Law for 2018 (Regione Campania, 2020).
In addition to Tab.1 are the funds made available by the Recovery Plan "PNRR" for infrastructure and mobility and intermodality, which can be identified in the objectives of Mission 3 – "Infrastructure for sustainable

mobility" e M3C2 – "Intermodality and integrated logistics". In detail, in M3C1, whose policy area of interest is "National rail and road mobility" promotes the goal of increasing territorial connectivity and cohesion by reducing travel times; the digitalization of transport networks (Ministero delle infrastrutture e della mobilità sostenibili – Recovery Plan, 2019). The three actions aim to achieve cities more connected, safe and environmentally sustainable, increasing the national rail and road transport network, as well as the competitiveness of businesses, territories and cities (Recovery Plan, 2019). The total investment concerning the mission M3C1 is € 28.30 B, resources allocated to "Railway works for the mobility and the fast connection in the country, whose € 0.7 B are addressed to the railways of the South Italy[1].It is clear and obvious that, in the practical context, many marginal cities are unconnected and remote from medium city or urban centre, both for the scarcity of resources and policies. As will be highlighted in the next chapters, it is required to focus on lack of mobility for basic needs (mobility to work, to school, health purposes). A study that connects spatial marginality with accessibility, making an integrated analysis between socio-demographic marginality conditions and mobility practices at the national scale is provided by Vendemmia et al. (2022).

Overcoming isolation is at the heart of the issue of intermodality, which must be pursued by acting primarily on two indicators: cost of travel and type of vehicle. The home-work travel must be strengthened, especially for cities that are more than an hour away from work or from the first infrastructural node such as stations or health centres, etc. One of the goals of the 'city of tomorrow' is the total decrease of cars, by reinforcing the system of offer-demand in transportation on both medium and long distances of travel. First and foremost, it is necessary to act both on the decline of decentralized areas and on the regaining of the safe perception in travelling by using Local Public Transport "LPT", dropped by -45% during the pandemic, while the pedestrian mode only decrease of -5%, as observed in "Survey of Citizens' Mobility and Gentle Push Actions" from Transport Regulatory Authority (A.R.T., 2021). The reduction in the rate of LPT is marked for the regions of Central Italy (-56% against the national average of -48%) according to Isfort "Audimob" Observatory on the mobility behaviours of Italians (Isfort, 2020). On one side, the perception of travel between pre and post covid-19 conditions (Beck & Hensher, 2020; Politis et al., 2021) highlights a growth for some modes of transport such as bicycles (92%), car-sharing (300%), rented motor scooters (250%), high speed trains (170%) (A.R.T., 2021). On the other side, results on the use of regional train (17%) and LPT and metro dropped (23% for LPT and 24% for metro). The new mobility preferences suggest that the new way of seeing the city is characterized by a continuous connection, not fragmented (Mascarucci, 2020). Marginal cities lack infrastructure for movement, such as bus stops, bike or micro-mobility lanes, hub interchanges, bike parking, lack of "zones 30". The role of urban architecture must be exercised for the more peripheral and less concentrated forms of settlement, aiming to make them usable and habitable again. The relaunch strategies lies in the analysis of past decisions process proposed for the revitalization of the marginal territories. Recognizing the limited role of redevelopment planning, the crisis of the city is the occasion for the reconfiguration of settlements by creating new relationships between centres and margins zones. The actions suggested concern the digital, management and physical sector, in order to allow cities autonomy and meeting the needs of users. Thus, making smart cities means proposing an inclusive model of participation in mobility. Several adaptive solutions are proposed as measures for the built environment aiming at developing infrastructure and enable strategic mobility. These solutions exposed below are suggested at governmental level are identified with the following list:

- rehabilitation and revaluation of existing infrastructure assets (regeneration of soft and hard infrastructure);
- network of intermodal connections (including first and last mile);
- parking lots, interchange nodes (close to user collection areas);

[1] https://www.mit.gov.it

- strategic fares planning to increase competitiveness with private mobility system;
- incentives to intermodal collective systems (DRT sharing, Door2Door) for different age groups;
- application of MaaS (Mobility-as-a-systems) for smart use of transport (i.e. e-ticketing).

The difficulties for mobility and infrastructure lies in rigid built environment often characterised by important heritage of historical center. The current model of development is not balanced and is very fragile: the Italian geography has certainly focused attention on medium-sized cities but the main problem of urban space still remains (Corrado, 2021). The demand for mobility is implemented with the recognition of the new services necessary for the design of the new city (De Luca et al., 2020; De Luca & Lanzani, 2020). The environmental crisis and then pandemic have highlighted that the definition of the new city goes towards the search for development as a "word-value" (Pearce et al., 1989) that refers precisely to the quality of life, the health of the population, social welfare. Thinking about resilient cities and revitalizing marginal areas is not only a purely urban issue but an economic question, since many economic activities are located in cities, where infrastructure must be reconsidered in terms of value inclusion. Inclusion is one of the goals of sustainable mobility (Hidayati et al., 2021), which seeks to counter transport disadvantage (Denmark, 1998; Delbosc & Currie, 2011a; 2011c), other transport-related social exclusion weaknesses (Church et al., 2000; Kenyon et al., 2002), increase transport justice (Martens, 2012, 2017; Hidayati et al., 2021), redesign of distribution of resources (Verlinghieri & Schwanen, 2020). An analysis of the development of intermodality in marginal areas is to understand its potential in terms of technology and accessibility. Starting from ISTAT surveys, a first territorial analysis is proposed, whose focus for this case study is the Campania Region and marginal areas in relation to the metropolitan area of Naples. The proposed survey methodology proceeds first with spatial study, selecting some indicators to describe the state of marginal cities in relation to density, territorial attraction, intermodal impedance, propensity to use ICTs, travel time. Subsequently, the areas will be analysed according to territorial characteristics and cross-referenced with a set of national and international best practices selected by cluster approach (land similarity, population density, etc.) and compared by the mobility services of selected case studies (best practices, ongoing projects, existing mobility services. As suggested in Campisi et al. (2021), it is possible to locate 25 DRT flexible services in Italy (counted to 2021). The objective is to identify a set of criteria to build a 'Business Model' system appropriate to the areas of marginality analysed and to propose criteria for areas with higher risk of marginality.

2. Methodology

The paper focused on first a descriptive analysis of the characteristics of average cities, analysing their aspect of mobility and use of digital services (degree and level of connection to a mobile network), in detail:

- first identification of the baseline characteristics (socio-economic characteristics, travel time, infrastructure geomorphological features, etc.) of the areas analysed;
- assessment of the type of services;
- functional assessment of services and definition of Business Model.

In the first identification, socio-economic characteristics, travel time, transportation infrastructure (station or bus stop), and geomorphological characteristics (Campisi et al., 2021) of the areas analysed (Park & Goldberg, 2021; Vendemmia et al., 2022) in relation to the definition of SNAI and inland areas (Ministry for the South and Social Cohesion) are taken into account in order to classify services according to settlement-housing type, to assess which mobility pattern is more developed in some territorial contexts rather than others.

The transition between metropolitan and marginal areas takes up the concept of harmonization provided by the OECD (OECD, 2012), considering them as 'Larger Urban Zones' (LUZ), as delimit areas characterized by high rates of commuting to and from the city. According to this classification, the Larger Urban Zone provides a classification of urban areas (including metropolitan areas) in relation to the urbanization processes (Eea,

2016). The classification of municipalities also takes place according to three degrees of high, medium and low urbanization, using tools such as population density and number of inhabitants (Eurostat, 2011). Turning to the Italian and Campania case study, marginal areas are a category of inner areas, being fragile territories, far from major centres, occupying 60% of the Italian surface and 57% of the Campania territory (Campania Region, 2020). The internal areas identified by SNAI are 72, involving 1,077 municipalities and about 2,072,718 inhabitants (SNAI, 2014; ISTAT, 2021). The main categories proposed by the SNAI strategy (Minister for the South and Social Cohesion), highlighted by the new mapping, carried out by the Department for Cohesion Policies and ISTAT, based on distance (expressed in minute to reach the nearest hub) are: A - Hubs, B - Inter-municipal hubs, C- Belt areas (t<28'), D - Intermediate areas (28'<t<41'), E - Peripheral areas (41'<t<67'), F - Ultra-peripheral areas (t>67'). (SNAI, 2014). Based on the SNAI (Social Cohesion Agency, 2014), the study concerns on areas characterised by the average about 50 minutes away from the nearest pole (i.e. medium city), a distance that reaches, in some cases, even 60 minutes (from Naples city). Focusing on the typology of cities reworked on SNAI, in the definition of smart cities and big cities, it is necessary to redefine the travel time, chosen as a variable of infrastructure accessibility (Park & Goldber, 2021). Beyond the boundaries of the metropolitan city, the poles at a distance greater than 60 minutes were considered "edge cities". The tab.2 shows the two times evaluated for the case study.

City	Travel time (min)
Suburbs	40<t<65.9
Remote	t>65.9

Tab.2 Selection areas on SNAI strategies

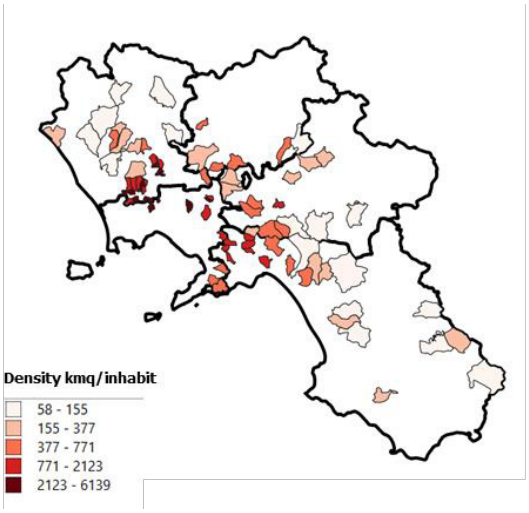


Fig.1 Density kmq/inhabit.

The marginal areas in Campania are selected on the basis of geographical criteria: 1. distance from the hub (hub as metropolitan city), 2. Absence or lack of LPT rail offer, 3. city with population between 5,000-20,000 inhabitants, 4. travel time t>60 minutes. In the following figure is exposed the result of criteria 3 (Fig.1).
Territorial density also affects the type of activity, in fact it is not unknown that low density is linked to few productive resources, encouraging distance from the metropolitan city that holds more capital wealth (Pearce et al., 1989), while the peripheral city loses social and economic wealth. Looking for an intersection between these two qualities in both fields should be the incentive to radically rethink the concept of the city, in the two extremes of its declination. Improving environmental quality is an improvement for development (Pearce et al., 1989). The disconnection is also caused by the new form of globalization of relationships and habits, emphasizing a declination of the city of proximity.

The form of mobility on the territory is reconfirmed as a necessity of the metropolitan area (Borja & Castells, 2002; Bauman, 2001) and the resulting lifestyles have shown the fragility of the different socio-territorial urban and metropolitan systems, losing connections with adjacent areas, causing an impoverishing of the social and urban texture of the neighbourhood (Amin & Thrift, 2005). A new declination of proximity and integrated mobility, particularly related to service delivery and lifestyles, is a recovery of the "15-minute city" (Moreno, 2020), in which the aim is to promote intermodality and the last mile for the marginal city.

The connection between marginal city and metropolitan area is a multiple system of the 15-minute city that aims to reactivate sustainable transport measures, addressing the issue of living in proximity that, in the declination of 15 minutes, aims to better reorganize the location of services, facilities for active mobility (Tesauro et al., 2017).

From the inner areas identified by the SNAI are 345 cities with resident population between 5,000 and 20,000 inhabitants (cities and towns with a population of less than 5,000 inhabitants were excluded). Among these, proximity cities close to metropolitan areas and medium-sized cities (classified as belt cities) were discarded, forming a final sample of 88 cities. Only 10 cities out of 88 have rail transportation (presence of a station or proximity to a train station as state railway RFI or EAV railway). From the 88 cities analysed, it appears that more than 80% are in non-flat areas (Fig. 2).

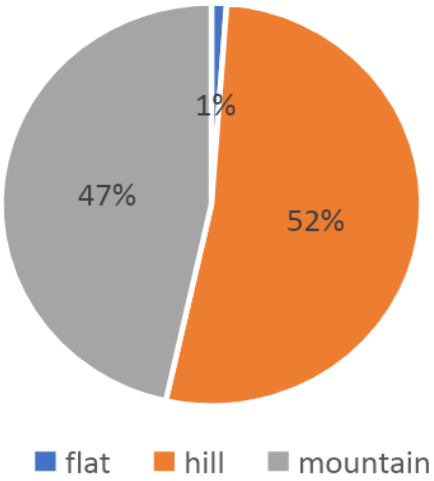


Fig.2. Kind of settlement

According to the Inner Areas strategies, a sub-sample has been created based on time of travel time toward Naples city as the metropolitan area of Campania Region. Cities from inner areas has been selected based on the criterion of distance from the hub in terms of rail transportation (Tab.3), since travel time by car is not of interest of this research, for the reduction of car use, and by wanting to focus on encouraging rail or LPT travel.

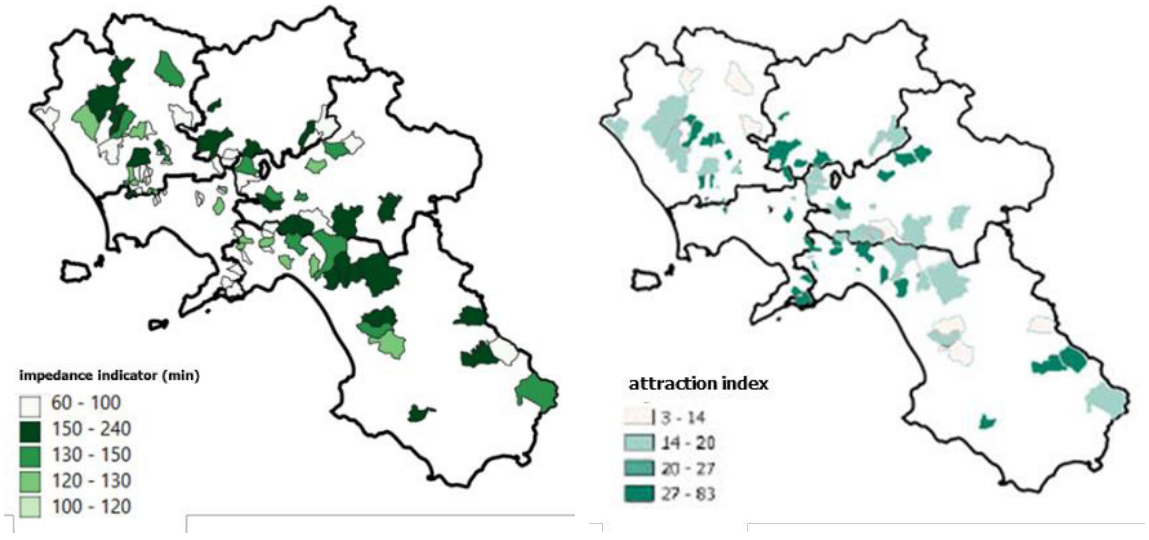
The analysis here only reports travel times for the metropolitan area. Travel times to the nearest average city (Salerno, Benevento, Caserta, Avellino) have been considered during the study in parallel with travel times towards metropolitan area of Naples. The first result of the travel time calculation (average travel time on a weekday during soft hours) shows that many cities have a travel time within 100 minutes, about 50 cities have a time above 100 minutes (Tab.3) , moreover it has been observed that for the same distance (invariant distance), the travel time between car and train is about double.

Cities with travel times greater than 200 minutes are located in mountainous areas of Campania or do not have a direct connection to Naples, being forced to make changes at other minor stations. Whether on the 100-minute or 200-minute trip, the lack of intermodality is evident. Moreover, not all users have access to the station as it is far from the center or located in a different city.

N. of cities	Travel time (min)
8	t<60
30	60<t<100
29	100<t<200
15	200<t<400
6	t>400

Tab.3 Travel time in marginal cities

In detail, low or insufficient intermodality is evidenced in many cities with the same distance from the metropolitan area have two different travel times showing that when *time travel car* is <30' for the car mode, *time travel railway* is 60'; when time travel car is t>60, time travel railway is about 120<t<200. Only in few case time trave railway is major than 200 minute (15 up to 400 minutes and only 6 cities over 400'). The value of the trip discourages the use of the LPT and increases the use of the car for short distances, while for long distances it seems impossible to use the train. In addition, the travel time does not allow commuting to home-school/work, to which must be added the movement from/to the station from the station to users' home. Thus, the study propose and evaluation of 'impedance indicator', as shown in the following figures, used for the calculation of potential accessibility, based on the travel time from the centre of the municipality considered to the centre of the metropolitan area (Fig.3a). Therefore, a general observation of the attraction on the basis of employees, population, income is essential (Statistical Atlas of Municipalities, 2019), highlighting the phenomena of mobility of the territory (Fig.3b).



(a) (b)

Fig.3 (a) Impedance indicator and (b) attraction index

3. Applications

The preceding results highlight an aspect of the Campania Region that is still far from offering adequate services to its citizens. The 57% of the cities analysed have a fairly low population density but are located in an area that is not flat and are characterized by severe transportation constraints towards medium-sized cities, except when considering the medium cities (Benevento, Salerno, Avellino), but there is still no balanced cross-selection between travel times between marginal cities in inner areas. Numerous negative aspects are also observed for cities close to the metropolitan city of Naples, where the comparison between car and train is still weak, with prevailing gains for the car. Thus, accessibility must aim to offer sustainable and safe mobility to all users, and to connect the city. Intermodality is no longer just a function of the possibility of changing

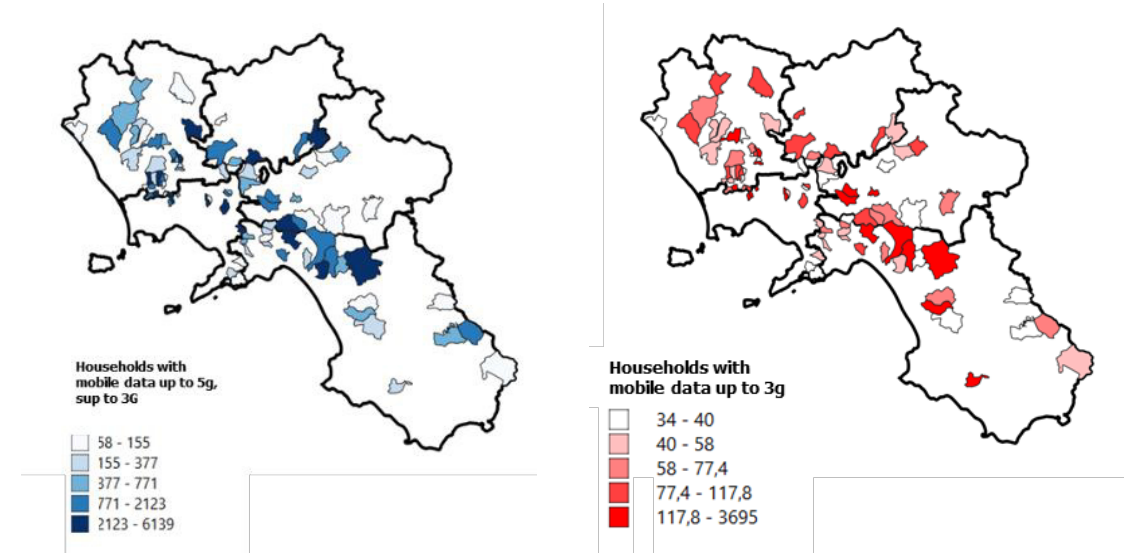
means of transport but is also in the adaptation of the urban form to shared forms of mobility. Increasing intermodality is a first contribution towards improving air quality by reducing congestion and increasing travel quality. Responding to the European needs to incentivize transport and railways provided by the funds provided by MIMS (Ministry of infrastructure and sustainable mobility, 2022) is declined both in the encouragement of existing railways, but especially in the items of developing transport between suburbs and promoting green vehicles. The transformation of marginal cities into smart cities requires a major challenge in finding resources and concrete actions. One of the points to build smart cities is the encouragement of ICTs in transport as a point of union between mobility and the city. In this perspective, similar to the concepts of the 'city-15-minute-walk', we proceed to develop a functional city in which transport connects the internal territory and maintains extra-zonal movements. What is clear from aforementioned results is that many cities still have poor technology available (26% of the cities in Campania analysed in mountains and hills settlement do not have a fast connection, of which 13 cities in mountain areas have less of 50% of connection percentage).At glance, national and international practices[2] Campisi et al. (2021) highlight strong aspects of integration between urban space and mobility such as the function of accessibility of the territories. 68 best practices, whose 45 from Central Europe, Ireland, UK have been considered relevant, 25 are Italian cases, related to flexible system (most of them DRT) services (mostly located in the North of Italy (64%), then in the central regions (32%) and finally only 4% in the regions of Southern Italy as reported in Campisi et al. (2021), and ongoing projects[3] with the objective of developing mobility in remote and marginal areas, promoting active citizenship and the introduction of ICTs systems to perform the mobility service[4]. The mobility services analysed have as main objective the intermodal development through green services with three different functions:

i) full mobility system;
ii) integration mobility system;
iii) additional mobility system.

(i) is a launch of a total mobility service in the total absence of LPT (rail, road) meeting the whole demand; (ii) is an integration of services especially for first/middle/last mile junction, often supplementing the same route, with a new schedule or different pathway; (iii) is a hybrid service that comes into play when the service is absent in some areas or trips becoming supplementary for that service offered. Both (2) and (3) include mobility services that are significantly different from existing LPT. The services indicated (1), (2), (3) can turn out to be either flexible services (FTS) (Brake et al., 2004) or rigid services. Flexible services turned out to be suitable for weak or economically disadvantaged areas, or used for a certain category of weak and vulnerable users (as best practices analysed in the UK will show (Campisi et al. 2021; Cervero, 1997; Maltintiet al. 2020). Based on this reflection, it is understood that the mobility system for a resilient city is composed of both the strengthening of intermodality and the improvement of accessibility. From European experiences (Horizon 2020, Horizon 2021-2027, INTERREG CE) it is now recognized that increasing mobility does not always result in increased accessibility. On the one hand, diversification in urban shapes and cause-effect of pandemic have witnessed unprecedented changes in metropolitan/regional accessibility, mainly based on increasing use of car instead of green mobility solutions. On the other hand, it is also clear the disappearance of local activities (public and private) and continued urban sprawl and consequently the loss of neighbourhood level accessibility. All the international practices fall in very disadvantaged areas, as sprawled villages, mountainous, hilly, where the use of the car is strong preferred to LPT (80% private car). Some of these services offer mobility service type (1) in marginal areas close to cities with remarkable results for transport (Switzerland, Germany, Italy, Ireland, UK, France, Spain).

[2] www.cordis.eu
[3] https://trimis.ec.europa.eu
[4] https://projects2014-2020.interregeurope.eu, https://www.interregeurope.eu

The marginal areas analysed from SNAI above were cross-referenced with the 43 mobility services of decentralized, peripheral areas of national and international projects. In identifying strategies to reshape activities in the new urban space, it is necessary to think of different mobility geographies in which it is possible to insert in the shorter distances the activities that require more congestion and thus reduce pollution, so as to recalibrate the attractiveness of the areas or to increase their connectivity. Processes of synergies between stakeholders and co-creating solutions for smart cities is based on the extension of governance by cities (Pereira et al., 2017). Stakeholder involvement already proven decisive in the decision of works and infrastructures (Pagliara & Di Ruocco, 2018), while it is also becoming so in the implementation of ICTs in transport systems. It is interesting to note that cases in Germany, Switzerland, Ireland, UK are based on strong synergies of stakeholders to which it is possible to consider replication in the Campania areas to start launching inclusive mobility services (e.g. Carpooling) that can cover the gap of the last mile. Thinking about mobility to encourage intermodality and thinking about medium-sized cities means re-adapting transportation services to new user needs, urban conditions, and economic conditions. Previous transportation services have been criticized for high operating and maintenance costs, and lack of flexibility in travel service (route planning, schedules) (Campisi et al., 2021). Service characteristics have been changed based on demand, and have changed demand, especially for medium-sized cities, it is about affecting user preferences, and the mobility service is not purely the launch of a service but the adaptation of the service with the behavioral preferences of demand. The potential of the flexible system is still evident today (Campisi et al., 2021), which through the additional use of technologies, can be used to overcome the limitations of the previous planning mode (Campisi et al., 2021; Mageean & Nelson, 2003). The paper offers an analysis of the ICTs initiatives for smart cities in order to make more collaborative the relationship between governance and citizens' engagement, empowering the new concept of smart collaboration between Public Actors and smart cities (Meijer & Bolívar, 2016). The integration of transport systems is based on the reduction of travel time, in which it is necessary to act on both the supply and the ICT propensity of households in marginal areas, both as a capacity of use of internet connection, use of 5G data and use of data at least 3G (Fig.4a, Fig.4b).



(a) (b)

Fig.4 (a) Households with mobile data up to 5g and (b) Households with mobile data up to 3g

With the analysis of 45 relevant Italian and European best practices in the field of mobility offering services for a group of 2,000 to 20,000 inhabitants, with the same territorial classification and for population density, low local public transport use or lack of LPT offer, we follow a simultaneous profiling of common characteristics.

These are pilot cases[5] or transport services launched in areas with the same orography and population density as marginal cities (mountainous, hilly, flat orography) gravitating around large cities, offering supplementary or full intermodal services, for an O-D pair (with D bus station, train, work centres, etc.). From the survey of the state of the art of mobility projects launched in Europe and in Italy, here are listed the main characteristics that emerged from the Best practices analysis:

- low use of digitization;
- absence of infrastructure connections;
- absence of commuter connections;
- existing DRT offer in small areas (for O-D connection) to service hubs (train stations, buses, medical centres);
- flexible fare;
- transition to digital systems, reservation via APP to be implemented, few experiments.

Similarly, the analysis of Campania's cities shows us that:

- transportation offers are absent in area of study;
- 30% of the cities have no rail offer of transport system;
- only 10 out of 86 cities have a railway station in the nearest town;
- only 10 out of 86 have a LPT line;
- 8 cities have poor connections with the nearest station, forcing people to travel the last mile by private car;
- high use of private car for all journeys (short and long distances).

The process is a methodological proposal applied in the Campania territories, to be extended to the marginal areas analysed, excluding from this type of analysis the ultra-peripheral areas for different structural components (revitalization funds, population, density, activities, etc.). The analysis of the LPT offer for the marginal areas of Campania was carried out on the current offer and on the potential offer, taking into consideration the main business models by type of timetable/route, passing from fixed services (LPT, rail) to flexible services (carpooling, carsharing, e-van, etc.).

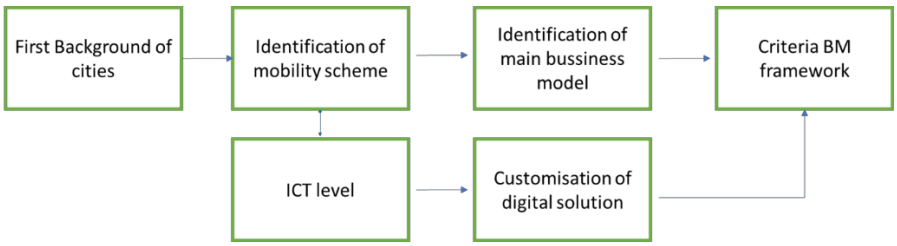


Fig.5 Workflow process

This study reviewed business model development frameworks and developed a practical tool to help remote/sprawled cities assess business models by adapting components of Business Model "BM" for cities and adding new ones that operationalize the smart city dimensions. Remembering that making a smart and resilient do not concern integrating new infrastructure, but instead involves enhancing ones existing with new technology in support. From the BMs developed for cities, criteria are identified for the analysed cities and a selection criterion is proposed to provide integrative support to rural areas. The intermodal integration between marginal cities and metropolitan areas investigated is in the adoption of Business Models that are adapted to the characteristics of marginal cities. Central to the argument of BM identification is the different trend between metropolitan cities and marginal areas (UN DESA, 2018).There is a necessity to move further from the idea of

[5] www.cordi.europa.eu

burdening metropolitan cities with too much pressure, but to start focusing on a part of the territory left behind by progress. In response to these trends, cities are aiming to offer high-quality services with the use of ICT. The proposed study starts with a question about the components that a smart city should have and what criteria it should apply, before making a feasibility study the resources should be included. The first step was a literature search on city trends and best practices in offering mobility solutions to identify the most suitable business model for decentralized cities. The construction of the BM for the identified cities, was performed by identifying the graph "*Service models*" (Fig.6) that collects the service models (y-axis time schedule in rigid and flexible, x-axis type of service) according the main characteristics of the service as suggested in Campisi et al. (2021) such as the characterisation of users, the definition of the service (timetable, route planning, type of stops). The timetable and route are placed on an incremental scale of flexibility, moving from rigid and fixed services (TPL as bus, metro line) to increasingly flexible services (DRT, On-demand). Having analysed suburban areas, the medium-sized cities focused on do not have metro systems, but only railway stations (belonging to the same operator RFI or EAV "Ente Autonomo Volturno" for some cities). Although in the literature the flexible system includes DRT, on-demand service or individual systems (i.e. taxis) (Torrisi et al., 2021; Campisi et al., 2020; Caggiani et al., 2018) the taxi mode was not considered as a separate service. Finally, the graph (Fig.6) is compared with both population and landscape features resulting in a diagram to indicate suitable services for marginal cities toward smart and resilient cities (Fig.8).

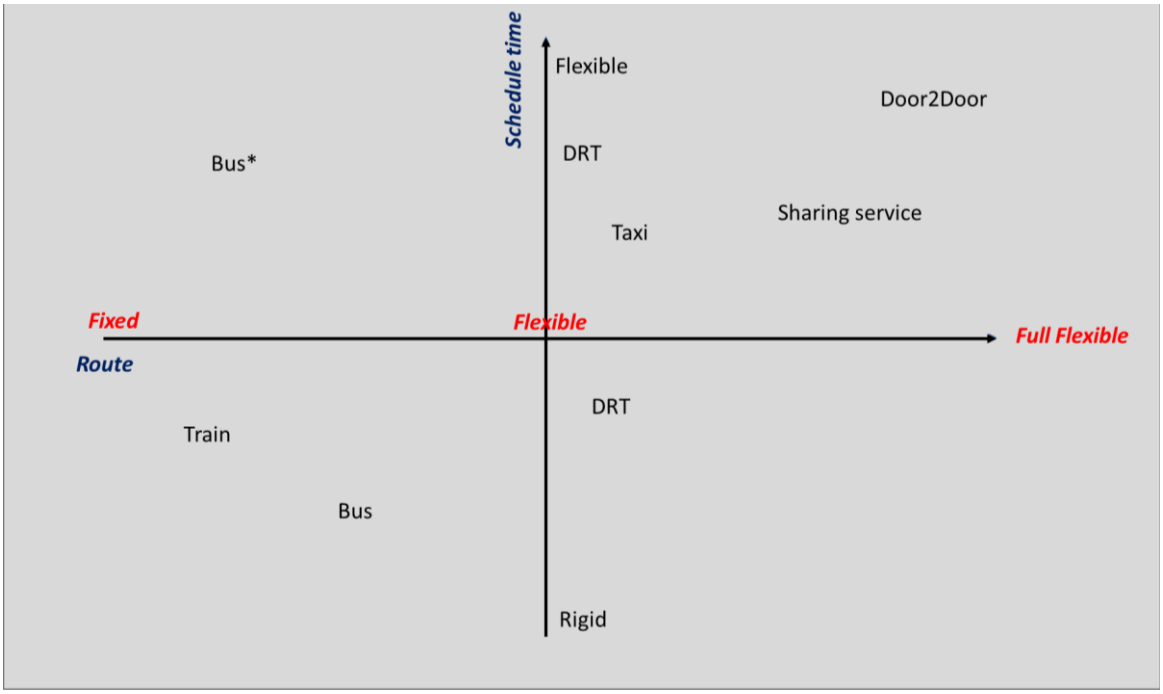


Fig.6 Graph of mobility system

Based on population and land settlement, 22 cities belong to full flexible services,19 for fixed schemes, and the rest of 45 for flexible (Fig.7), despite the 25 recent best practices (Campisi et al., 2021) none is related to Southern Italy, or in detail Campania. The 86 cities, by territorial characteristics, correspond to three mobility schemes such as Full-Flexible (on-demand service such as door2door), rigid services (rail, bus) and flexible (Carsharing, DRT, ridesharing, Blablacar). Fig.8 shows a greater adaptation result with the semi-flexible system, as the DRT service is characterised by a specific or modifiable point collection, compared to the fixed system, and a more elastic time window (Campisi et al., 2021).

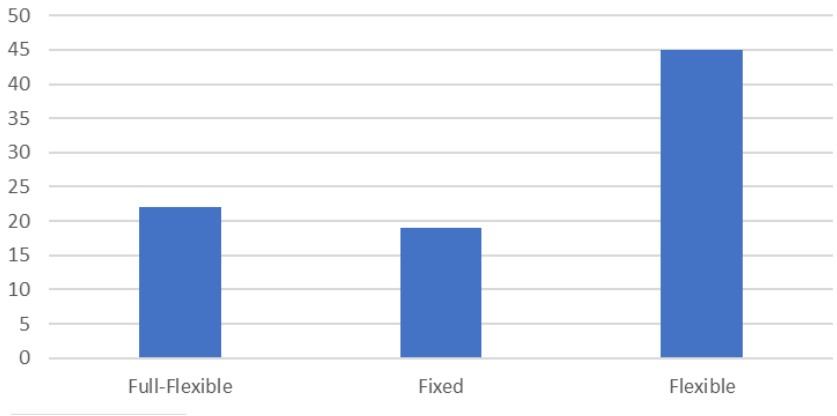


Fig.7 Business model for marginal cities

Fig.8 summarises the optimal configuration of services by type of city and territory. Services located in remote/sprawled settlements have a low use of ICTs, as fixed scheme do not offer on-board ticketing (not e-ticketing), furthermore, the collection points are represented by the standard stops. The groups of flexible services are present for types of territories such as suburbs and hilly areas, while for flat cities, the spread of flexible (on-demand) services is more extensive. The on-demand services are the most flexible in terms of booking and travel, with the possibility of choosing pick-up points near one's home and booking within a couple of hours before the trip. As result of the comparison, it can be concluded that for the same population density, for mountainous areas a transportation service with flexible service model is suggested, also confirmed by the introduction of MaaS mobility literature.

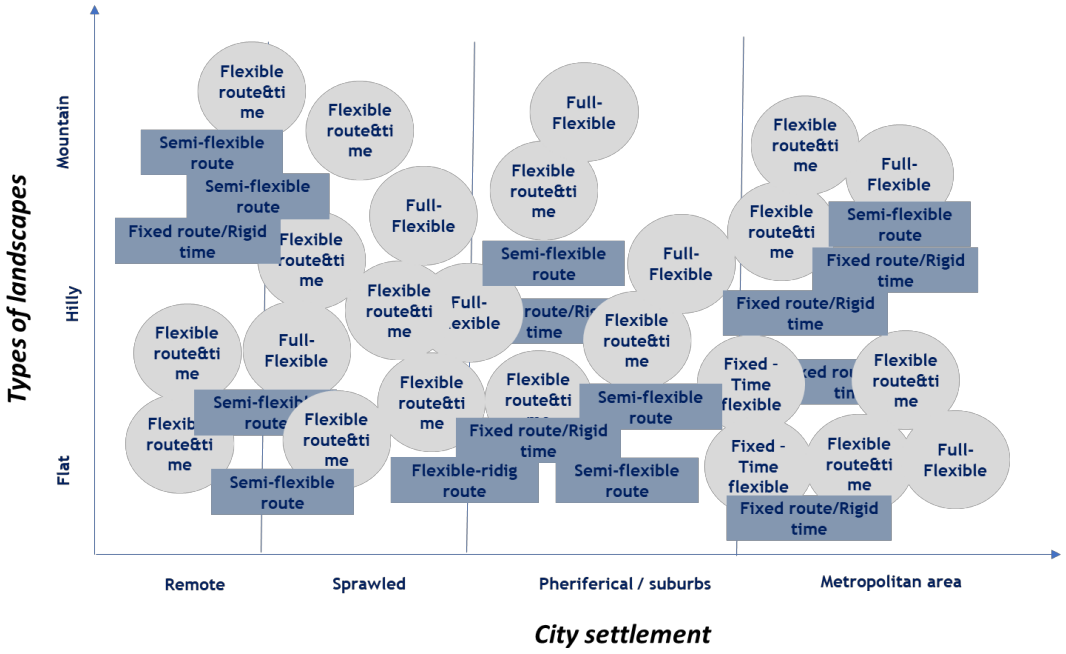


Fig.8 Matching of Business Model

In all cases analysed, the proposed BMs were developed on local characteristics. The main BMs proposed take into account operating costs, financial aspects for maintaining the service in complex areas, and the involvement of stakeholders and citizens. Therefore, three macro-guidelines emerge for the identification of BMs to promote intermodality:

- high stakeholder involvement, through volunteer-promoted mobility services;
- ICT use for ride trip management;
- semi-flexible services (change of flexibility in days, times depending on demand).

Therefore, the implementation of smart city solutions depends on what kind of BM can be adopted on them. The lack of literature collection and practical cases still makes it difficult to understand how to manage the study of sustainable mobility forms.

Hilly and mountainous areas show a majority of "B1" BM characterized by semi-flexible scheme service with:

- user collection at pre-determined pick-up-customer points but variable route and flexible schedules, or fixed route and flexible schedules;
- flexible service at particular times of day (not peak hour) or for certain days.

In the transition between the metropolitan area and the marginal area (Sprawled), the fixed scheme is left in favour of a flexible service based on trip booking.

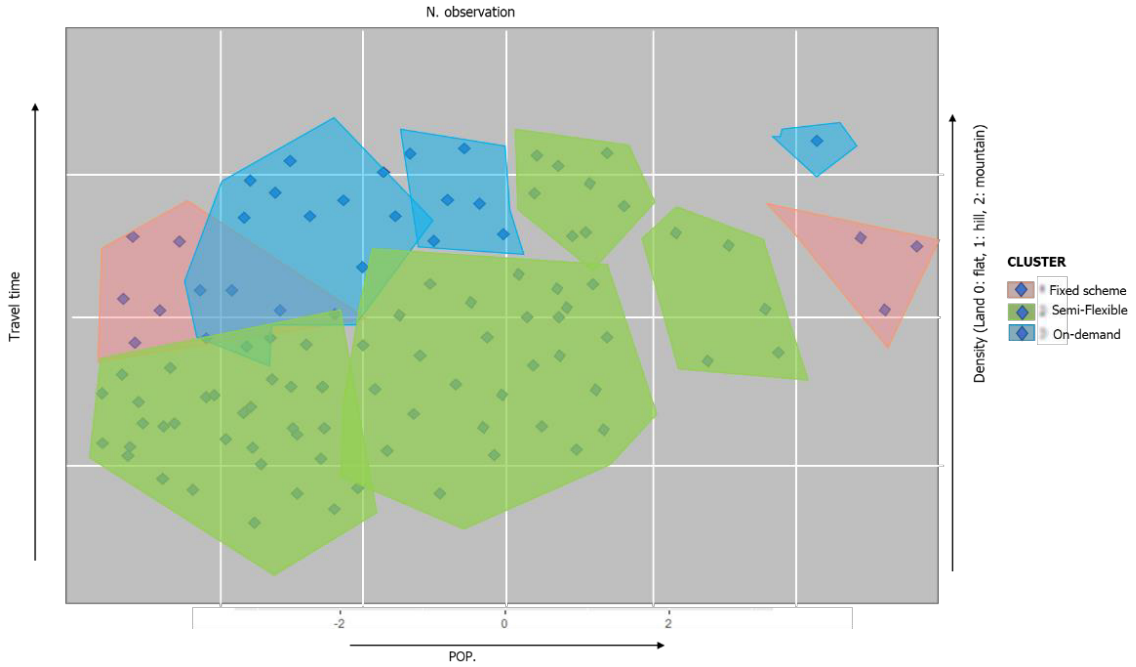


Fig.9 Cluster analysis of Business Model "BM"

Although it seems intuitive that for longer distances and travel times the door2door service seems the most appropriate, the distribution of the data connection index shows that many marginal cities are served by semi-flexible services.

The cluster analysis proposed create three classes of clusters of service scheme by grouping together different cities with similar input data (i.e. socio-economic characteristics, ICTs use, land settlement) (Fig.9). Fig.9 shows that for the two variables (time travel and density), flexible services are more prevalent at the territorial level, making them a recommendable solution for the areas analysed. This result, it is interesting to compare it with economic criteria (not covered in this work).

Variable	Obs	Mean	Std. Dev.	Min	Max
POP	86	9108.581	3292.005	5065	19305
TravelTime~n	57	100.7719	63.5343	30	480
Traveltime~r	84	58.79762	25.76155	25	140
Typeofsett~t	86	1.465116	.5017071	1	2
Typeofserv~e	86	2.034884	.6936294	1	3
Households~s	55	5163.079	933.4553	3712.645	7186.332
Fixedormob~e	55	112.7002	20.37556	81.04	156.864
Fixedbroad~g	55	3676.845	664.7526	2643.93	5117.688
Mobilebroa~a	55	2303.311	416.4255	1656.255	3205.908
Fixedbroad~r	55	5085.597	919.4471	3656.93	7078.488
Numberoftr~e	86	7.837209	8.301468	0	30

(a)

Variable	Obs	Mean	Std. Dev.	Min	Max
TravelTime	68	11.67647	5.053272	3	20
Density0fl~t	68	.9705882	.8972693	0	3
Service1Fi~3	68	1.75	.7604987	1	3

(b)

Fig.10 Descriptive statistics Medium city – intermodality and (b) descriptive statistics – Best Practices

Fig.10 shows descriptive statistics for the part of the cities analysed for the study on intermodality in Campania. Fig.10, on the other hand, similarly gathers travel time, type of service, and territory, for the case studies cited in the paper (68 examples, including the 25 brought by Campisi et al. (2021).
Thus, many hilly cities with small populations are similar to cities with high populations in mountainous areas (door2door or on-demand class), while for hilly type and travel time t>100' semi-flexible services are the most appropriate to implement. Few are the cases of fixed-scheme, in that case, it is a matter of strengthening the existing TPL.

4. Conclusion

The proposed research considers a multi-sectoral approach. Focusing on the urban form, cities are changing and the new challenges is to convert the existing urban layout and encouraging intermodality. Metropolitan cities are undergoing a major explosion, so rethinking marginal territories is a key step in creating resilient cities. This work, in line with recent themes on sustainable (environmental and economic) solutions for mobility (Angiello, 2022; Franco, 2022), although many evidences focuses on urban mobility regarding the accessibility of urban areas and few on inner areas (Passarelli et al., 2016; Pirlone et al., 2016), aims to enrich the mobility analysis also for marginal areas by studying the relation between intermodality and inner areas.
Inner territories have their own identity, but they need capital and immaterial investments to change the capitalist paradigm of the metropolitan city as a place of relationships and production of things. Intermodal connectivity, which has been of European interest for years, is at the heart of achieving sustainable mobility in marginal areas. As a first analysis, the paper has shown strong potential for investment of mobility services in the selected marginal cities, based on funds from the Agency for Cohesion, Recovery Plan and MIMS (Sustainable Infrastructure and Mobility Ministry), there is the right attention to marginal areas and their revitalization, reconnecting with the need to discuss the access-oriented network investment of suburban areas (Lahoorpoor et al., 2022) and interest in analysing the investments offered by Recovery Plan the for urban areas (Sgambati, 2022). Inner areas, being a very complex system, have territorial and accessibility peculiarities for which the development is composed on two levels: physical measures rethinking the urban space of the cities from sidewalks, stations, shelters, etc. or implementing the offer of mobility. Identifying the fundamental intermodal characteristics is the first action required to identify the mobility services needed to relaunch the marginal areas. The analysis of accessibility proposed in the manuscript, starting with a GIS-based approach, relates to the importance of accessibility for reaching stations, as highlighted in recent literature (D'Orso & Migliore, 2018; Shinoda, 2019; Levinson & Wu, 2020) but focuses on the role of intermodality and the competitiveness of means of transport (car and rail), however the proposed topic intends to extend the analysis by bringing last-mile accessibility focused on soft mobility. The matching to evaluate the business models has also opened interesting reflections that lead us consider that sustainable mobility is not only based only on the offer of the service, but is close to the orography, includes a share of digitalization to reduce operating costs, and has a large component of governance process. The proposed methodological approach is based on main social and transport characteristics, which offers a first insight to the problem of marginal cities and their connection in transportation system, reinforcing last-mile and involving social mobility inclusion. Based on the cities analysed, a predominance of semi-flexible services are evident, characterized by fixed stops (may coincide with existing LPT stops), which can add a route to/from the station or stop. The slow mobile connection present in many cities still makes difficult the complete digital transformation of mobility booking by phone, so more innovative services like door2door are to be thought in a next step. Transport accessibility is to be sought by offering basic services to citizens. The cluster analysis proposed, in

line with further evidence from the literature as proposed by Padon & Iamtrakul (2021), is the final result resulting from the service matrix methodology. The cluster analysis can be resumed and reproposed for other territorial realities in Campania and elsewhere, based on the similarity of social and territorial differences. About the case study, it was preferred to put as constraints the territorial and connection characteristics, thinking in a MaaS perspective of real-time connection of transport, reinforcing the importance of ICT in urban areas, as a means of reducing externalities, and supporting economic and technological dynamics, increasing competitiveness between territorial locations (Delponte, 2021). Intermodality consists in providing both a transport interchange, which can implement semi-flexible services, and technologies (ICTs), making it possible to book the journey in absence of infrastructure in cities, at stations, reducing cost of services. In addition, some business models offer last-mile reduction, which is one of the main challenges of intermodality, as semi-flexibile or D2D service. Precisely, the last-mile connection is a constraint that still causes the use of the car. The criteria outlined in this manuscript and the proposal to improve the connection between the medium and marginal cities, is not implementable in the short term but in the long-term. The experiences analysed show us a great participation between private and public (e.g. bus companies, cabs, volunteers) to encourage the movement and make up for the lack of infrastructure (e.g. bus lines or rail). The flexible system can be supported by the costs of company and public, being realized also with electric vehicles impacting less on the environment, and offering movement for the last mile (home-station journey). It is equally interesting to see how the analysis of the territory and habits, as well as technological characteristics can lead to evaluate which is the best mobility service to be launched in the territory. It seems intuitive to use a door2door service, but based on the criteria outlined, it is more appropriate to implement a different service for mountain and hill areas. The proposed methodology, based on territorial criteria, digital technologies, travel time, present connections (rail, bus) offers a vision of how to build a model of mobility service more suitable according to the present characteristics of the territory. Clustering brings together cities with different characteristics that can use the same mobility service. Remote cities (population less than 5,000 inhab.) were excluded as the origin of different processes and habits. Therefore, this study is not intended to be limited and binding, but it is referred to further stages of analysis for these more remote realities.

The result is consistent with the existing literature. The flexible service is still the most widely used means for small and medium-sized cities, analysing what was reported in Campisi et al. (2020, 2021), the coverage of the DRT detected is only 28% for small and metropolitan cities, while a majority is present for large cities (100,001-200,000 inhabitants) not analysed in this case study. Concerning the use of DRT, a greater extension can be supported by the implementation of mobility system technologies. Findings suggest that marginality is still existing but underrated in social science. Future research could be aimed at improving the analysis of accessibility in term of last and middle mile, both under the intermodaility point of view, both under the users' perceptions. Further fundings will focus on support measures for planning at regional level, strengthen with the implementation of decision support tools.

Acknowledgement

I thank the reviewers for their valuable suggestions to enrich the work. This work is not funded by any grant, but comes from an in-depth analysis of case studies (EU projects) on mobility in Europe, America, Australia, Italy. There are no conflicts of interest with other studies.

References

Agenzia per la coesione territoriale. (2014). Strategia Nazionale per le Aree Interne (SNAI). Retrieved from: https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne

Angiello, G. (2022). Planning for sustainable urban mobility in Southern Europe: insights from Rome and Madrid. *TeMA - Journal of Land Use, Mobility and Environment, 15*(2), 335-340 https://doi.org/10.6093/1970-9870/9321

Amin A., Thrift N. (2005). *Città. Ripensare la dimensione urbana*. Il Mulino.

Archibugi, F. (1995). La centralità ottimale, come idea guida della strategia urbana. In Urban Utopias. *New Tools for the Renaissance of the City in Europe, European Conference*.

Amin, A. (2002). Spatialities of globalisation. In *Environment and Planning* A, 34, 385-399.

Barbera, F., De Rossi, A. (edited by). (2020). *Metromontagna. Un progetto per riabitare l'Italia*. Donzelli editore.

Bauman, Z. (2001). *Dentro la globalizzazione. Le conseguenze per le persone*. Roma-Bari: Laterza.

Beauregard, R. A. (2018). *Cities in the Urban Age: A Dissent*. The University of Chicago Press Chicago and London.

Beck, M. J., Hensher, D. A. (2022). Insights into the impact of COVID-19 on household travel and activities in Australia-The early days under restrictions. *Transp. Policy* 96, 76–93.

Blumenberg, E., Manville, M. (2004). Beyond the Spatial Mismatch: Welfare Recipients and Transportation Policy. *Journal of Planning Literature*, 19, 182-205.

Brake, J., Nelson, J.D., Wright, S. (2004). Demand responsive transport: towards the emergence of a new market segment. *J. Transp. Geogr.* 12, 323–337.

Borja, J., Castells M. (2002). *La città globale.* Milano: De Agostini.

Borrelli, G. (2007). Capitali del Nord-Ovest la politica economica delle città italiane. Franco Angeli.

Caggiani, L., Camporeale, R., Ottomanelli, M., Szeto, W.Y. (2018). A modeling framework for the dynamic management of free-floating bike-sharing systems. Transp. Res. Part C: *Emerg. Technol*. 87, 159–182.

Campisi, T., Ignaccolo, M., Inturri, G., Tesoriere, G., Torrisi, V. (2020). The growing urban accessibility: a model to measure the car sharing effectiveness based on parking distances. In: Gervasi, O., et al. (eds.) *Computational Science and Its Applications – ICCSA 2020*, pp. 629–644. Springer, Cham.

Campisi, T., Torrisi, V., Ignaccolo, M., Inturri, G., Tesoriere, G. (2020). University propensity assessment to car sharing services using mixed survey data: the Italian case study of Enna city. *Transp. Res. Procedia* 47, 433–440.

Campisi, T., Canale, A., Ticali, D., Tesoriere, G. (2021). Innovative solutions for sustainable mobility in areas of weak demand. Some factors influencing the implementation of the DRT system in Enna (Italy). In: *AIP Conference Proceedings, vol. 2343*, no. 1, p. 090005. AIP Publishing LLC.

Cervero, R. (1997). *Paratransit in America Praeger Westport*, Connecticut.

Church, A., M. Frost, and K. Sullivan. (2000). "Transport and Social Exclusion in London." *Transport Policy 7* (3): 195–205.

Cocchia, A. (2014). *Smart and Digital City: A Systematic Literature Review*. Springer.

Corrado, F. (2021). *Urbano Montano. Verso Nuove Configurazioni E Progetti Di Territorio*. Franco Angeli.

Cullen, B. T., & Pretes, M. (2000).The meaning of marginality: Interpretations and perceptions in social science. *The Social Science Journal*, 37:2, 215-229, https://doi.org/10.1016/S0362-3319(00)00056-2

D'Ascanio F, Di Ludovico D., Di Lodovico L. (2016) – Design and urban shape for a resilient city, 2nd international symposium "new metropolitan perspectives" – Strategic planning, spatial planning, economic programs and decision support tools, through the implementation of Horizon/Europe2020, Reggio Calabria (Italy) 18-20 Maggio 2016

D'Orso, G., Migliore, M. (2018). A GIS-based method to assess the pedestrian accessibility to the railway stations. *International Conference on Computational Science and Its Applications*, 19–30

De Luca, S., Di Dio, D., Mochi Sismondi, C. (edited by). (2020). Se la Pa non è pronta. Forum Disuguaglianze Diversità, Forum Pa, Movimenta

De Luca, S. Lanzani, A. (edited by). (2000). Liberiamo il potenziale di tutti i territori. Forum Disuguaglianze Diversità, luglio

Delbosc, A., G. Currie. (2011a). Exploring the Relative Influences of Transport Disadvantage and Social Exclusion on Well-being. *Transport Policy* 18:555–62

Delbosc, A., G. Currie. (2011c). Transport Problems that Matter— Social and Psychological Links to Transport Disadvantage. Journal of Transport Geography 19:170–78

Delponte I. (2021). Trasporti, ICT e la città. Perché alla città interessano le ICT?. *TeMA - Journal of Land Use, Mobility and Environment, 5*(3), 33-45. https://doi.org/10.6092/1970-9870/1215

Denmark, D. (1998). The Outsiders: Planning and Transport Disadvantage. *Journal of Planning Education and Research* 17: 231–45

Déry, S., Leimgruber, W., Zsilincsar W., (2012). Understanding Marginality: Recent Insights from a Geographical Perspective. In Hrvatski geografski glasnik. Vol. 74. No. 1

Di Ruocco, G., Grimaldi, C., Di Ruocco, I., Passannanti, M. (2019). Le greenways come opportunità per il turismo a bassa emissione di carbonio: la Via Silente nel Parco Nazionale del Cilento, il Vallo di Diano e i Monti Alburni. In Conference: STC 2019 - *International Conference University of Salerno*, 19-20 September 2019

Eea. (2016). Urban sprawl in Europe Joint EEA-FOEN report. Retrieved from: https://www.eea.europa.eu

Eurostat. (2011). Degree of urbanisation classification - 2011 revision. Retrieved from: https://ec.europa.eu/

EU Smart Cities Information System. (2017). The making of a smart city: replication and scale-up of innovation in Europe. Retrieved from: https://smartcities-infosystem.eu

Franco S. (2022). Sustainable cities and communities: the road towards SDG 11. *TeMA - Journal of Land Use, Mobility and Environment, 15*(2), 341-344. https://doi.org/10.6093/1970-9870/9316

Gallent, N., Juntti, M., Kidd, S., Shaw, D. (2015). Introduction to Rural Planning. Taylor & Francis.

Hidayati, I., Tan, W., Yamu, C. (2021). Conceptualizing mobility inequality: Mobility and accessibility for the marginalized. *Journal of Planning Literature, 36*(4), 492-507

Hoggart, K., Buller, H. (2016). *Rural Development: A Geographical Perspective*. New York: Routledge

Isfort, Observatory "Audimob". (2020). The impact of lockdown on the mobility behaviors of Italians. Retrieved from: https://www.isfort.it

Kenyon, S., G. Lyons, and J. Rafferty. (2002). Transport and Social Exclusion: Investigating the Possibility of Promoting Inclusion through Virtual Mobility. *Journal of Transport Geography* 10: 207–19

Lahoorpoor B., Wu H., Rayaprolu H., Levinson D. (2022). Prioritizing active transport network investment using locational accessibility. *TeMA - Journal of Land Use, Mobility and Environment, 15*(2), 179-192 https://doi.org/10.6093/1970-9870/9174

Leimgruber, W., Chang, C. D. (2019). *Rural Areas Between Regional Needs and Global Challenges: Transformation in Rural Space.* Switerzland: Springer Nature Switzerland AG 2019

Mageean, J., Nelson, J.D. (2003). The evaluation of demand responsive transport services in *Europe. J. Transp. Geogr. 11*(4), 255–270

Maltinti F., et al. (2020). Vulnerable users and public transport service: analysis on expected and perceived quality data. In: Gervasi, O., et al. (eds.) *Computational Science and Its Applications – ICCSA 2020*, pp. 673–689. Springer, Cham

Martens, K. (2012). "Justice in Transport as Justice in Accessibility: Applying Walzer's 'Spheres of Justice' to the Transport Sector. *Transportation 39* (6): 1035–53

Martens, K. (2017). Transport Justice: Designing Fair Transportation Systems. Oxon, UK: Routledge.

Mascarucci, R. (2020). *Città medie e metropoli regionali*. Roma: INU Edizioni

Meijer, A., Pedro, M., Bolívar., R. (2016). Governing the smart city: a review of the literature on smart urban governance. In *Big data, public policy & public administration*, Volume: 82 issue: 2, page(s): 392-408. https://doi.org/10.1177/0020852314564308

Mela, A. (2020). *Le città contemporanee. Prospettive sociologiche.* Roma: Carocci editore.

MIMS. (2021). Ministry of infrastructure and sustainable mobility - Investments in infrastructure and sustainable mobility for the South in the National Recovery and Resilience Plan and the Complementary National Plan

Moreno, C. (2020). *Vita urbana e prossimità ai tempi del Covid-19*. Editions de l'Observatoire

OECD. (2012). Redefining "urban": A new way to measure metropolitan areas. OECD Publishing 2012

Padon, A., Iamtrakul, P. (2021). Land Use and Transport Integration to Promote Pedestrian Accessibility in the Proximity of Mass Transit Stations. In *Urban Rail Transit* (185–206). Springer

Pelc, S. (2006). Geographical marginality in Slovenia from the point of demographical indicators. In Revija za geografijo, letnik 1, številka 2, str. 121-131

Park, J., Goldberg, D. W. (2021). A review of recent spatial accessibility studies that benefitted from advanced geospatial information: multimodal transportation and spatiotemporal disaggregation. ISPRS *International Journal of Geo-Information, 10*(8), 532

Pearce, D. W., Markandya, A., Barbier E., Cardani, M. (1989). *Progetto per un'economia verde*. Il Mulino

Pereira, G. V., Cunha, M. A., Lampoltshammer, T. J., Parycek, P., Testa M. G. (2017). Increasing collaboration and participation in smart city governance: a cross-case analysis of smart city initiatives. In *Information Technology for Development*, 23:3, 526-553, DOI: 10.1080/02681102.2017.1353946

Pagliara, F., Di Ruocco, I. (2018). How public participation could improve public decisions on rail investments? *Regional Science Policy and Practice, 10* (4), 383–403. https://doi.org/10.1111/rsp3.12143

Politis, I., Georgiadis, G., Nikolaidou, A. et al. (2021). Mapping travel behavior changes during the COVID-19 lock-down: a socioeconomic analysis in Greece. *Eur. Transp. Res. Rev.* 13, 21. https://doi.org/10.1186/s12544-021-00481-7

Regione Campania. (2020). La Strategia Nazionale delle Aree Interne in Campania. Retrieved from: http://www.regione.campania.it/

Sgambati, S. (2022). The interventions of the Italian Recovery and Resilience Plan: Energy efficiency in urban areas. *TeMA - Journal of Land Use, Mobility and Environment, 15*(2), 345-351. https://doi.org/10.6093/1970-9870/9322

Sicignano, E., Di Ruocco, G., Di Ruocco, I. (2019). Itinerari pluritematici: dai siti archeologici di Pompei ed Ercolano ai presidi protoindustriali del Ducato Amalfitano In Conference: STC 2019 - International Conference University of Salerno. 19-20 September 2019

Shinoda, B. (2019). Pedestrian Activity Model for prioritizing investment–A case study of sidewalk snow clearing in the City of Waterloo [Master's Thesis]. University of Waterloo

Tesauro, C., Iacobucci, D., Ferlaino, F. (2017). *Quali confini? Territori tra identità e integrazione internazionale*. Franco Angeli

Torrisi, V., Ignaccolo, M., Inturri, G., Tesoriere, G., Campisi, T. (2021). Exploring the factors affecting bike-sharing demand: evidence from student perceptions, usage patterns and adoption barriers. *Transp. Res. Procedia* 52, 573–580

Transport Regulatory Authority "A.R.T". (2021). Survey of Citizens' Mobility and Gentle Push Actions. Retrieved from: https://www.autorita-trasporti.it

Vendemmia, B., Pucci, P., Beria, P. (2022). Per una geografia delle aree marginali in Italia. Una riflessione critica sulla classificazione delle aree interne. *Archivio di Studi Urbani e Regionali*, 133, 29-55

Verlinghieri, E., Schwanen, T. (2020). Transport and Mobility Justice: Evolving Discussions. Journal of Transport Geography 87:102798. https://doi.org/10.1016/j.jtrangeo.2020.102798

United Nations. (2015). Make cities and human settlements inclusive, safe, resilient and sustainable. Retrieved from: https://sdgs.un.org /goals/goal11

UN DESA. (2018). Revision of World Urbanization Prospects produced by the Population Division of the UN Department of Economic and Social Affairs. Retrieved from: https://www.un.org

Sitography

Istat- Istituto Nazionale di Statistica. Retrieved from: www.istat.it

Ministro per il Sud e la Coesione sociale. Retrieved from: https://www.ministroperilsud.gov.it/it/approfondimenti/aree-interne/cosa-sono/, visited on 24/06/2022

Ministro per il Sud e la Coesione sociale. Available on https://www.ministroperilsud.gov.it/it/approfondimenti/aree-interne/strategia-nazionale-aree-interne/, visited on 24/06/2022.

Ministero delle infrastrutture e della mobilità sostenibili. Retrieved from: www.mit.gov.it, visited on 24/06/2022.

PNRR, Ministero delle infrastrutture e della mobilità sostenibili. Retrieved from:

- https://www.assolombarda.it/pnrr/missioni/infrastrutture-per-una-mobilita-sostenibile
- https://www.ice.it/en/sites/default/files/banner_files/italian-recovery-and-resilience-plan.pdf
- https://www.unicatt.it/amministrazione-M3%20-%20Infrastrutture%20per%20una%20mobilit%C3%A0%20sostenibile.pdf, visited on 24/06/2022

PNRR NEXT Generation Italia. Retrieved from: https://www.mef.gov.it/en/focus/documents/PNRR-NEXT-GENERATION-ITALIA_ENG_09022021.pdf, visited on 24/06/2022

INTERREG EUROPE. Retrieved from: https://projects2014-2020.interregeurope.eu, visited on 24/06/2022

INTERREG EUROPE. Retrieved from: https://www.interregeurope.eu/good-practices/local-link-rural-transport-programme, visited on 24/06/2022

Image Sources

Fig.1-10: all images have been elaborated by the author.

Author's profile

Irina Di Ruocco

Irina Di Ruocco, transport engineer graduated at Federico II of Naples in transport engineering and hydraulic systems, is PhD student in Methods and Models for Economic Decisions (MMED) at University of Insubria. She deals with transport and sustainable mobility, evaluation and assessment analysis of infrastructure projects, economic analysis and European planning (EU projects) in the field of transportation and mobility. Her professional background includes the mobility and transportation projects, urban planning (PUMS, PUC, etc.) and relative sustainable projects on waterfront and ports regeneration, cycleways, carsharing. The work experience is in transportation and infrastructure field, she is the author of several scientific contributions and speaker in many conferences.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 397-413
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9056
Received 31st March 2022, Accepted 31st August 2022, Available online 30th December 2022

www.tema.unina.it

How urban food gardening fits into city planning

Evidences from Italy

Anna Forte [a], Enrico Gottero [b*], Claudia Cassatella [c]

[a] Politecnico di Torino, Turin, Italy
e-mail: a.anna.forte@gmail.com

[b] Interuniversity Department of Regional and Urban Studies and Planning
Politecnico di Torino, Turin, Italy
e-mail: enrico.gottero@polito.it
ORCID: https://orcid.org/0000-0002-0245-4319
* Corresponding author

[c] Faculty of Planning and Design DIST
Politecnico di Torino, Turin, Italy
e-mail: cassatella@polito.it
ORCID: https://orcid.org/0000-0002-0461-0274

Abstract
The international planning agenda is opening its attention to the integration of food systems in urban planning and, consequently, to Urban Agriculture (UA). However, what UA and, particularly, Urban Food Gardening (UFG) mean in terms of city planning and urban space management have been less explored by the academic point of view. Here we propose a frame to analyse UFG practices in relation with land use and zoning, land property, management and urban regulations. By an empirical analysis of a thirty case studies in Italian metropolitan cities, we show that the Italian panorama of UA practices is wide and varied, and that the recent policies aimed at promoting UFG adopt different tools, according to path-dependencies and different actors involved in defining urban agendas. However, the Italian planning system has not yet integrated UA within its planning tools in a structured way. Current trends regard to the adoption of UA-related policies, strategies, plans and regulations has been highlighted, in order to identify possible points of attention for the development of UA in the European context.

Keywords
Urban agriculture; Urban Food Gardening; City planning; Urban planning; Governance.

How to cite item in APA format
Forte, A., Gottero, E., Cassatella, C. (2022) How urban food gardening fits into city planning. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 397-413.
http://dx.doi.org/10.6092/1970-9870/9056

1. Integrating Food Production into City Planning: key issues

Urban Agriculture (UA) is experiencing a strong revival out of its ability to coping with diverse development challenges. It can represent a policy in achieving planning goals related to sustainable city form and function, urban environmental management, and community development. It is being promoted to meet the objectives of numerous policy fields, such as urban development, green space development, poverty alleviation, economic growth, improved health outcomes, environmental management, social interaction and community strengthening (Contesse et al., 2018; Horst et al., 2017; Mougeot, 2000; Prové, 2018). Moreover, UA represents an entry point for integrating also food system planning into the planning agenda of cities (Cabannes & Marocchino, 2018).

However, the current state demonstrates that often Urban Agriculture goes unregulated in many contexts, creating policy vacuums that could lead to conflicts between practitioners, regulators and politicians, limiting the potential of implementing these practices in urban environments (Meenar et al., 2017). Cities require an enabling policy framework to guide the implementation and enhancement of Urban Agriculture. Institutionally, this framework should acknowledge that UA can fall under the jurisdiction of several different levels and types of authorities, according to the policy realm in which it is integrated and with what kind of intent (Mubvami et al., 2006). Integration of Urban Agriculture in land-use planning has been rarely considered in top-down urban planning systems (as we will show with reference to the Italian context). Often Urban Agriculture practices are implemented and spread spontaneously from the bottom-up. Where Urban Planning is characterised by long-range comprehensive planning, which adopt a blue-print approach, this has negatively affected the integration of Urban Agriculture (*ibid.*). As a result, in most cities UA is ignored, not addressed by urban policies and, even when regulation on UA exists, this is often not under an overall policy. In addition, another key issue is that usually UA is simply not recognized as a land-use activity and not acknowledged as a valid urban land use (Quon, 1999). Generally, UA suffers from a combination of political restraints, that can include restrictive urban policy, law and regulation. The lack of formal recognition of UA in planning policies could lead to land use issues, specifically availability, access and usability of land. Land speculation, infrastructures and facilities availability, or political and social constraints, could also influence UA (*ibid.*). In addition UA can take place in all urban contexts, from the built-up downtown areas to the open space of peri-urban areas. For these reasons, UA requires different knowledge and planning approaches, since the two contexts differ in their setting, development perspectives and therefore regulation needs.They request different strategies, for example: while in more urban areas land allocation is the main issue, in peri-urban contexts the focus is more on land protection through fore-front appropriate zoning measure and policies, since land conflicts due to urban sprawl and the conversion of agricultural land to urban uses is a particular concern (Drescher, 2001).

The purpose of this research is to explore the current state of Urban Agriculture practices in the Italian context, in order to investigate possible links or interactions between Urban Agriculture and City Planning. This research was carried out through the comparative analysis of case studies primarily focus on Urban Gardens initiatives, which represent the most popular In Italian Cities and in their policies, in order to answer the research question on what Urban Food Gardening means and represents from the perspective of urban planning and management of urban spaces.

A first section illustrates the methodology applied in this research, based on the analysis of multiple case studies of Urban Food Gardening (UFG) in the cities of Bologna, Milan, Rome and Turin. The results will then follow, highlighting the status of UFG policies and path-dependencies in each context and the integration of UA into local City Planning tools, focusing on the emerging trends and solutions adopted, distinguishing between UFG on public or private land. The conclusions section will highlight limits and opportunities of this research and new perspectives in order to integrate Urban Food Gardening into city planning in Italy and in the European context.

2. Method. An empirical analysis of practices in Italian cities

2.1 Selection of case studies at city level

In order to deepen the Italian panorama relating to Urban Agriculture and explore its interaction with the urban planning systems and the management of urban spaces, this research is based on the selection and comparative reading of case studies of Urban Food Gardening (UFG) practices. According to Lohrberg et al. (2016), UFG mainly refers to non professional agricultural activities (production of food for other goals), while UF refers to farm enterprises. Four of the main Italian cities that in recent years have shown particular propensity to the issue of Urban Agriculture were selected: Bologna, Milan, Rome and Turin (Fig.1). These four Metropolitan Cities1 have experiences related to Food Gardening in urban and peri-urban areas rooted in time and in local communities, very active and involved in the formulation and implementation of specific policies on this issue. The case studies identified as relevant for this study are 27 practices.

- Bologna: *1-Villa Bernaroli; 2-Greenhousing; 3-Orti Salgari; 4-Orti di Via Orfeo; 5-Ortocircuito Spazio Battirame; 6-Orti Condivisi Peppino Impastato*
- Milan: *1-Il Giardino degli Aromi; 2-Orti Spiné Boscoincittà; 3-Orti Fioriti CityLife; 4-Coltiviamo Insieme; 5-CasciNet; 6-Orti di Via Chiodi; 7-Orti Parco Alessandrini*
- Rome: *1-Orti di Veio; 2-American Academy in Rome; 3-Hortus Urbis; 4-Orti Garbatella; 5-Orti Tre Fontane; 6-Ortolino; 7-Parco Ort9 Casal Brunori*
- Turin: *1-Orti Laghetti di Falchera; 2-Orto Fai Da Noi Leroy Merlin; 3-OrtoAlto Ozanam; 4-Orti Al Centro Parco Dora; 5-Orto Urbano Lidl; 6-Or-To Eataly Lingotto; 7-Orti Generali*

Fig.1 Location of UA Practicesexamined

[1] The Metropolitan City is a local administrative body, with special legislative power and competences compared to Provinces.

2.2 Data collection and policy review

Being based on the case studies methodology, the research combined multiple sources in order to identify the urban policy framework in each selected city, the state of the art and trends related to UFG. This phase includes the collection and consultation of formal and informal documents, mainly urban planning tools (Tab.1) and policy documents (Tab.2), reports and annexes of territorial and urban planning tools, survey and mapping initiatives, research reports, documents produced in the context of research networks and projects, newspaper items, social media, websites and newsletters.

City	Level	Document title	Type	Producer, year	Source (available from)
Bologna	Municipal	Municipal Structural Plan (*PSC*)	Strategic Masterplan	City of Bologna, 2009	http://dru.iperbole.bologna.it/categorie-pianificazione/piano-strutturalecomunale-psc(last access 15th May 2021)
		Regulation on public and private greenery (Urban Building Regulation)	Regulation	City of Bologna, 2020	http://sit.comune.bologna.it/alfresco/d/d/workspace/SpacesStore/b25b3048-a733-4c02-9563-abfa6151005d/RE_AllegatoRegolamentoVerdePubblicoPrivato.pdf (last access 15th May 2021)
Milan	Municipal	Territorial Governance Plan (*PGT*) – Milan 2030	Strategic Masterplan	City of Milan, 2019	http://allegati.comune.milano.it/territorio/PGT_BURL/1_DP/1_DP_Relazione_generale.pdf (last access 21st April 2021)
		Public Facilities Plan (*PdS*)	Sectorial Plan	City of Milan, 2019	https://www.pgt.comune.milano.it/piano-dei-servizi (last access 21st April 2021)
Rome	Municipal	Comprehensive Masterplan (*PRG*)	Based on non-functional zoning	City of Rome, 2008	http://www.urbanistica.comune.roma.it/images/uo_urban/prg_adottato/D1.pdf (last access 28th April 2021)
		Regulation on public and private greenery	Regulation	City of Rome, 2021	https://www.carteinregola.it/wp-content/uploads/2021/01/REGOLAM.-VERDE-testo-coordinato-12-01-21.pdf (last access 28th April 2021)
Turin	Metropolitan	Comprehensive Masterplan (*PRG*)	Based on functional zoning	City of Turin, 1995	http://geoportale.comune.torino.it/web/governo-del-territorio/piano-regolatore-generale (last access 18th May 2021).
		Preliminary Project	*PRG* Revision	City of Turin, 2020	http://www-portale-coto.territorio.csi.it/web/relazioneillustrativa-generale-e-scheda-quantitativa-dei-dati-urbani (last access 25th May 2021)

Tab.1 Urban Planning tools

City	Level	Document title	Type	Producer, year	Source (available from)
Bologna	Metropolitan	Metropolian Strategic Plan: Metropolitan Agriculture	Strategy	Bologna Metropolitan Authority, 2013	https://psm.bologna.it/Engine/RAServeFile.php/f/Progetti/4.16_AGRICOLTURA-METROPOLITANA.pdf (last access 15th April 2021)
		Città-Campagna Agricultural Park	Strategy & Agreement	Bologna Metropolitan Authority, 2010	https://www.cittametropolitana.bo.it/pianificazione/Pianificazione_del_territorio/Progetti_Metropolitani/Parco_Citta_Campagna(last access20th April 2021)
	Municipal	Bologna city of urban gardens	Strategy	City of Bologna, 2014	http://www.comune.bologna.it/media/files/relazione_orti_urbani_a_bologna.pdf(last access 10th June 2021)
		Ortpertutti	Report	Urban Center Bologna	https://www.fondazioneinnovazioneurbana.it/images/ORTIPERTUTTI/ortipertutti_digitale.pdf(last access6th April 2021)
		Urban Gardens Regulation	Regulation	City of Bologna, 2009	http://www.comune.bologna.it/media/files/regolamento_per_la_conduzione_e_la_gestione_dei_terreni_adibiti_ad_aree_ortive_1.pdf(last access 15th May 2021)
		Regulation on Urban Commons	Regulation	City of Bologna, 2014	http://partecipa.comune.bologna.it/sites/comunita/files/allegati_blog/odg_172_reg.beni_comuni_urbani_pgn_45010_2014.pdf(last access 15th May 2021)
Milan	Regional	*Milano Metropoli Rurale*	Agreement	Milan Metropolitan authority, 2015	https://www.milanometropolirurale.regione.lombardia.it/wps/portal/site/milanometropolirurale(last access 29th April 2021)
	Metropolitan	Milan Agricultural Park	Agreement	Milan Metropolitan Authority, 2016	https://www.cittametropolitana.mi.it/parco_agricolo_sud_milano/territorio_e_pianificazione/il_territorio_in_cifre.html (last access 29th April 2021)
	Municipal	Milan Food Policy	Policy	City of Milan, 2015	https://foodpolicymilano.org/(last access12th May 2021)
		Regulation on Urban Commons	Regulation	City of Milan, 2019	https://www.comune.milano.it/documents/20126/200092257/Regolamento+Disciplina+Beni+Comuni.pdf/e429814f-20bd-b311-a542-02979673b66?t=1565365393504(last access 30th April 2021)
	Municipal district	Urban Gardens Regulation	Regulation	City of Milan, 2012	https://www.comune.milano.it/documents/77612408/182330086/Regolamento_Orti_def_timbrato.pdf/af02bf0a-b724-28b5-f021-db32517a3a93?t=1633964595534 (last access 30th April 2021)
Rome	Metropolitan	Strategies and policies on *Agro Romano Antico*	Strategy	Rome Metropolitan Authority, 2015	https://www.cittametropolitanaroma.it/homepage/aree-tematiche/ambiente/aree-protette-tutela-della-floradella-biodiversita/i-progetti/tutela-valorizzazione-dellagro-romano-antico/(last access 24th April 2021)
	Municipal	Report on Environment and Agriculture	Report	City of Rome, 2011	https://pdfslide.net/documents/relazione-sullo-statodellambiente-agricoltura-cibo-per-la-citta-13-le-aziende.html (last access 5th May 2021)

		Report on Urban Gardens	Report	City of Rome, 2020	http://www.hortusurbis.it/wp-content/uploads/2020/03/Bilancio-Roma-Orti-2020__.pdf (last access2nd April 2021)
		Food Policy Proposal	Policy	City of Rome, 2019	http://www.terraonlus.it/wpcontent/uploads/2017/03/Food-Policy-Roma.pdf (last access28th April 2021)
		Urban Gardens Regulation	Regulation	City of Rome, 2015	https://www.comune.roma.it/web-resources/cms/documents/Delib_N_38_17.07.2015.pdf(last access 28th April 2021)
Turin	Metropolitan	Food Atlas	Atlas	public partnership, 2017	https://atlantedelcibo.it/2017/05/27/i-molteplici-volti-dellorticoltura-a-torino/#_ftnref2(last access 2nd April 2021)
		Food Policy	Policy	Turin Metropolitan Authority, 2015	http://www.cittametropolitana.torino.it/cms/agri-mont/politiche-alimentari/nutrire-to-metro(last access 15th April 2021)
	Municipal	Green Infrastructure Strategic Plan	Strategy	City of Turin, 2020	http://www.comune.torino.it/verdepubblico/2020/altrenews20/piano-strategico-infrastruttura-verde.shtml(last access 5th April 2021)
		Urban Gardens Regulation	Regulation	City of Turin, 2013	http://www.comune.torino.it/regolamenti/363/363.htm(last access5th April 2021)
		Regulation on Urban Commons	Regulation	City of Turin, 2020	http://www.comune.torino.it/benicomuni/co-city/index.shtm(last access 5th April 2021)l

Tab.2 Main policy documents relating to UA

2.3 A framework to interpret and classify Urban Food Gardening practices

In each city five different typologies of Urban Gardens has been identified and classified on the basis of three main dimensions (Fig.2; see also Appendix 1 - Case Studies Summary Tables): first, Site Description (UA type, location, land cover and ownership) (i); second,Management (users, intent, mantainance) (ii); third, Regulation (land use designation, space management tools, regulatory instruments in force) (iii). The management section investigates aspects related to the main users to whom the case study is addressed, the maintenance methods in terms of economic sustainability, and any use of contract or concession instruments between public and private actors. The regulation sectionfocuses on the regulatory instruments in force, in order to understand the solutions adopted, such as urban planning tools, building regulations, green regulations and plans, instruments concerning urban commons management orspecifically addressed to urban vegetable gardens ruling.

The typologies of Urban Gardens were classified according to Lohrberg et al. (2016): Allotment Gardens, Family Gardens, Community Gardens, Educational Gardens, Therapeutic Gardens. The case studies fall into the category of UFG, which generally includes those UA practices not aimed at an economic profit and where food production is an opportunity to achieve social objectives. Following Opitz et al. (2016), the research also take in account spatial factors such aslocation and land use/cover category, land use texture, patterns and functions, based on the data provided by the CORINE Land Cover (2018) inventory[2]. In addition land use designation by the urban planning tools in force in each city were analysed, in order to identify if and

[2] CLC service is coordinated by the European Environment Agency (EEA). It provides consistent and thematically detailed information on land cover changes across Europe. Source: https://land.copernicus.eu/pan-european/corine-land-cover - visited on 8th June 2021.For the purpose of this research and given the availability of data, the third level of CLC class has been considered.

how the function of UA has been explicitly foreseen by the planning system. The research also analysed possible relationships of the UFG initiatives with urban regeneration policies, the system of green spaces and infrastructures,the public facilities and any other sector of urban policies. Considering the above criteria, five main categories of relationships between UFG and land use designation (UFG-UP) (Fig.3) have been identified, that allows to classify the case studies: Urban Food Gardening in Agricultural Area; in Green Urban Area; in Public Facility Area (excluding public green); in Mixed-use built-up Area; and in Specialized built-up Area (intended for commercial or industrial use).

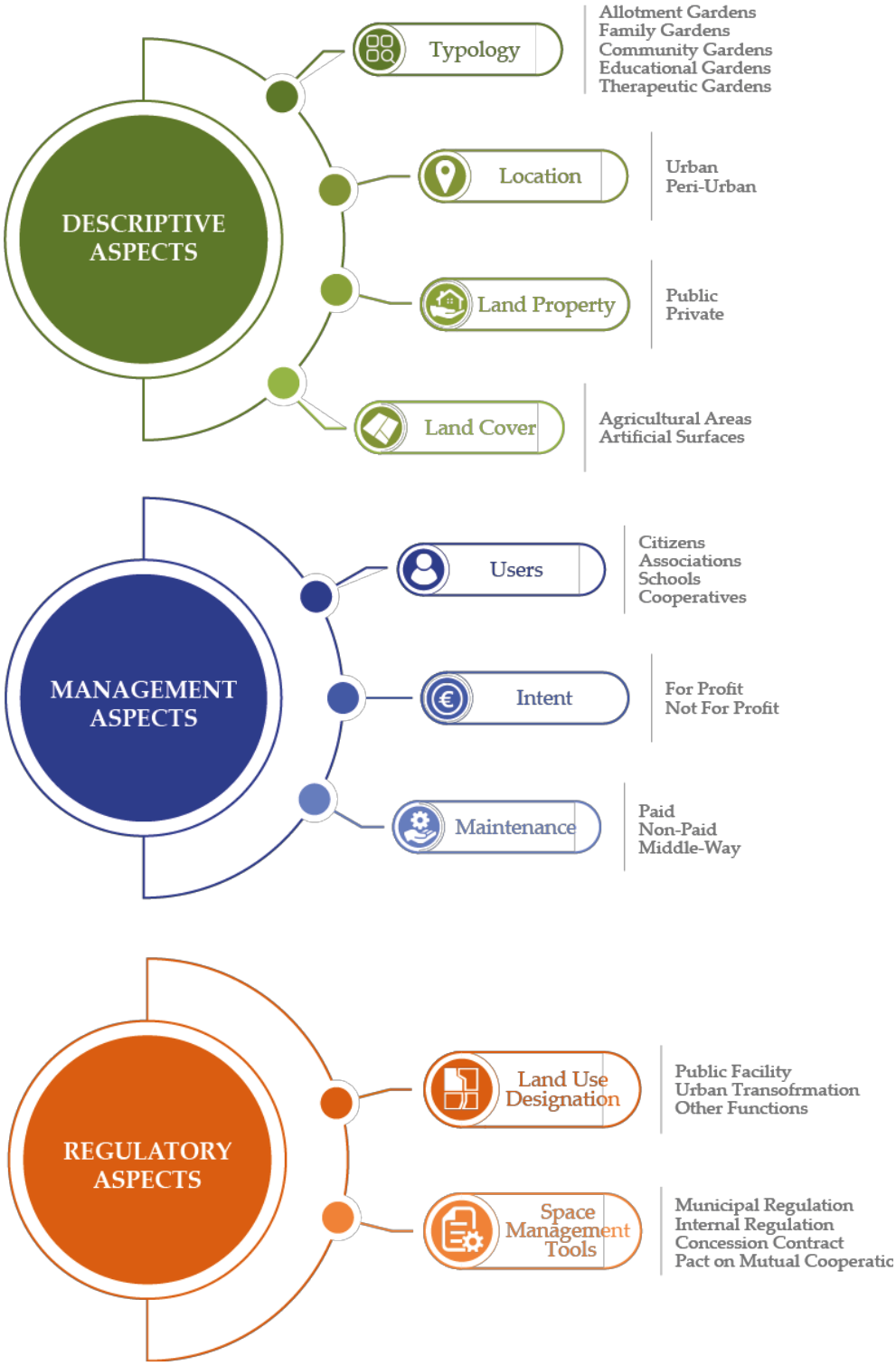


Fig.2 The interpretative framework of UFG practices: Site, Management, Regulation

Fig.3 Categories of relationships between UFG and land use designation (UFG-UP)

3. Results: Urban Food Gardening and Urban Planning in Italian cities

Out of a total of 27 case studies analyzed (see Appendix 1), two are the main recurring typologies of urban gardens (Fig.4a): Community Gardens (CG, about 67%) and Allotment Gardens (AG, about 19%). Both are often associated with Therapeutic and Educational initiatives. Most of the cases (about 33%) falls into Green Urban Areas, while fewer cases are Public Facility and Specialized Built-up Areas (almost 7%) (Fig.4b). The majority (about 19 out of 27 cases) are on public land, showing that private initiative is still rather scarce. Urban horticulture projects promoted by private companies are appearing, especially in the cities of Milan and Turin, but for the most part not for profit. Business models, when the offer of Family Gardens becomes a private service offered to individual citizens, remain sporadic and recent.

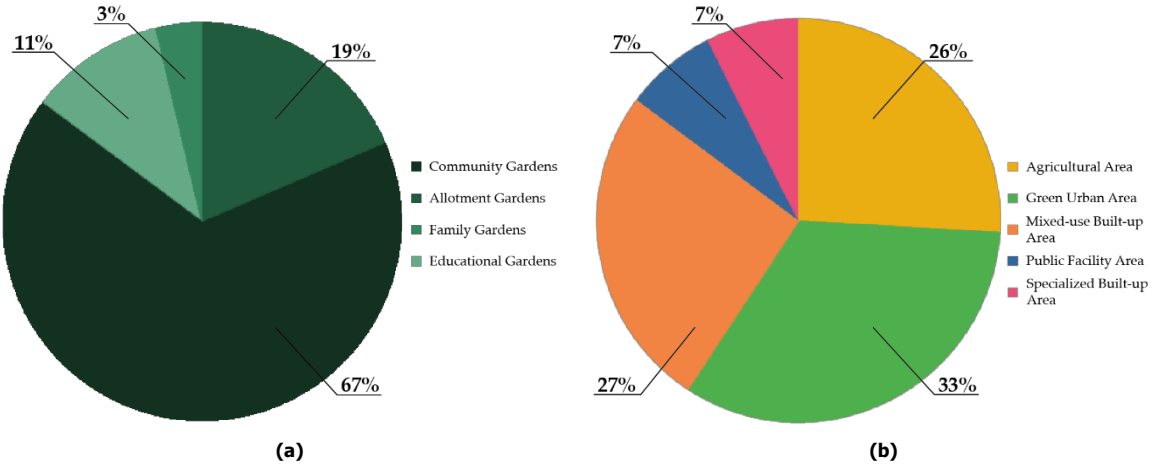


Fig.4 (a) UFG Typologies: results. (*Therapeuitc Garden is a cross category); (b) UFG-UP TypifiedCategories: results

3.1 Urban Food Gardening policies and path-dependencies

The city of Bologna is a peculiar case when it comes to UA. The public administration made UA a political issue, thus the city has been a frontrunner in Italy regarding UA and its integration in urban policies. UA has been adopted as a tool to physically and culturally regenerate urban spaces, integrating UFG to enrich and qualify the green heritage of the city. The public administration has undertaken a survey on existing practices to further plan UA development, experimenting new forms of management of public spaces.

Bologna is active in the international contexts and through the ResCUE-AB, the Centre for Studies and Research in Urban Agriculture and Biodiversity of the University of Bologna, the lively panorama of Bolognese initiatives is also very much supported by the academic realm.

In the case of Milan, the debate about the integration of UA in City Policies can be traced back to the pioneering experiences of UFG promoted in the 80s by *Italia Nostra*, a NGO which promoted the creation of Allotment Gardens inside the *Boscoincitta*Park,and still plays a role in promoting UA also at a national level. In the driving public initiative, active on policies and strategies aimed at integrating in City Planning especially after EXPO 2015, the Milanese context is also interested by the initiatives of other institutions, such as universities, hospitals, penitentiaries or local health services. Moreover, private developers have also entered the realm of UA practices, inserting urban gardens as component of the greenery on the occasion of urban renewal initiatives. Initiatives which sometimes are contested because of the risks of privatization of public spaces, without activating synergies in local communities. The Milanese context is also dotted with a lot of bottom-up initiatives, asking for the concession of abandoned public areas for agricultural purposes. In order to give them formal recognition, the municipality provided for *Giardini Condivisi*, a successful tool for collaboration between civil society and administration. The *Bando Cascine* is a tender aimed to enhance the rural heritage of publicly owned farmhouses. It has to be mentioned that the Milanese context gave birth to the paradigma of the peri-urban agricultural park (Fanfani, 2019) thanks to the well-known *Parco Agricolo Sud Milano* [South-Milan Agricultural Park], a protected area established by the Province to preserve agricultural landscape and activities combating urban speculation.

In the city of Rome Urban Food Gardening activities are a lively reality of formal and informal associations dedicated to the care of green areas, which undertake a bottom-up re-appropriation of urban spaces, to combat urban pressure and building speculation. The municipality of Rome has late understood the potentials represented by Urban Food Gardening, which for years has developed with an informal character. Consequently, the political debate focused on regularizing existing informal experiences and on the creation of new horticultural areas on publicly owned land, leading to the progressive integration of UA in City Planning, translated into the integration of urban gardens as greenery provision for recovering land in degraded conditions. Nowadays, Rome is lead partner in the RU:RBAN project for the transfer of good practices related to UA, which focuses on the role of the third sector and citizens' associations in implementing Urban Food Gardening. The Roman context is also active in the debate on the Agricultural Park paradigm, thanks to the *Agro Romano*, a protected area where heritage preservation and nature conservation are strongly linked with agriculture.

Urban Agriculture in Turin has changed over time, especially since the Nineties, when the city began a process of post-industrial regeneration. Turin has witnessed a progressive mushrooming of UA initiatives, rooted in rural origin of many workers of the industry, progressively promoted both by citizens' groups and public institutions. A peculiar aspect of the Turin case is the activism of the urban green sector.

The recently adopted Green Infrastructure Strategic Plan (2021) defines explicit policies in the field of Urban Food Gardening, intended for providing a range of ecosystem services. The European project ProGIreg[3], aimed at introducing productive green infrastructure for post-industrial urban regeneration, proposed UA as a Nature Based Solutions. At the supra-level scale, the Metropolitan City has also played a fundamental role in fostering green infrastructure projects, such as the *Corona Verde*[4] [The Green Crown], which value peri-urban agriculture for its multifunctionality. The city of Turin has stated its future prospects on UA, expressing its intent to enhance existing horticultural areas, mainly for addressing ecological-environmental and socio-cultural benefits, as testified by the project FOOD ATLAS[5] aimed at creating a space for participation about

[3] See: https://www.torinocitylab.it/it/progireg - visited on 8th April 2021.
[4] See: https://www.coronaverde.it/wp/ - visited on 10th April 2021.
[5] See: https://atlantedelcibo.it/ - visited on 2nd January 2022.

food systems. In this regard, Turin is also involved in the European Forum on Urban Agriculture EU H2020 research project[6].

3.2 The integration of UA into City Planning

In the city of Bologna, UA is declined in a rather sectorial manner, in relation to the green sector and to environmental policies. The Urban Building Regulations allows for recognizing urban vegetable gardens as public green spaces. The plan provides specific indications for their implementation and design, identifying the performance requirements to be respected for their construction, but it does not identify spaces for the construction of urban gardens. The local planning system is not based on functional zoning but it's strategic in its nature. The Municipal Structural Plan approach could implicitly have offered numerous opportunities for UA, being oriented to regeneration in suburbs, which could constitute attractive context for implementing UFG. In particular, the recognition of UGF as urban standards to be provided in urban transformation intervention would be potentially possible, but it's not explicitly mentioned, leaving UFG to the sole initiative of the environmental sector.

In the City of Milan, the sector in charge of the Urban Planning Policies for the Suburbs has been proved to be the body committed in identifying areas for implementing urban vegetable gardens, pursuing objectives of both environmental and social quality. In addition, each decentralized administrative district has a specific office for the management of instances concerning UFG activities, which is part of the unit relating to public services offered to citizens. UA is dealt with in an inter-sectorial manner: in terms of urban regeneration policies and in relation to the supply of public facilities. As for the integration into planning tools, the Public Facilities Plan recognizes urban gardens among the types of urban green spaces, addressing to this function part of the newly planned green areas of the city.

With regard to the city of Rome, at the beginning of the 2000s the municipality established the Urban Garden Service, within the Department of the Environment, which is responsible for the implementation procedures of new projects according to the city's Urban Food Gardening regulation. Rome is the only case in which the regulation on urban gardens explicitly refers to the provisions of the Comprehensive Masterplan, asserting that the gardens can only be created in accordance with the zoning identified by the plan. Its Technical Implementation Rules also mention the "recreational-social urban vegetable gardens" as one of the possible functions that can be established, integrated as a typology of green space and local public facility.

In the city of Turin, UA is mainly addressed in a sectorial way by the Green Infrastructure Strategic Plan. The city promotes the expansion of urban horticulture in the name of its multiple benefits, but with particular attention to ecological functions. With regard to urban planning tools, the Comprehensive Masterplan is based on a strictly functional zoning, which originally did not included UA nor agriculture among its intended land use. Due to the growing interest in the field, agriculture was reintroduced as a possible land use designation in 2013. Moreover, the recent Proposal for the general variance of the Plan (2021) has introduced a new land use designation, defined as "Ecological Agricultural Areas" (*ZAE*). This land-use designation is addressed to cultivated areas that today are fragmented by urban pressure, and can be referred not strictly to UFG but more in general to UA. Another proposed innovation is the possibility of activating Temporary Use projects, useful also for implementing possible new UA. Although the current urban planning tools is still a rigid functional zoning, the new interest on UA is contributing to a progressive adaptation of the planning instruments. In this regard, the municipality has recently decided to modify its Building Regulation in order to facilitate the creation of rooftop gardens.

[6] See: https://efua.eu/about-efua/efua-partners - visited on 8th June 2021.

3.3 Urban Food Gardening on Public Land

In Italy UFG on public land mainly refer to Allotment Gardens, declined with different solution in terms of management according to each city (Fig.5). The cities of Bologna and Milan are characterized by experiences particularly rooted in time, while the promotion of UA by the public administration in Rome and Turin has been delayed. In addition, bottom-up projects coordinated by associations, or third parties were developed on public land.

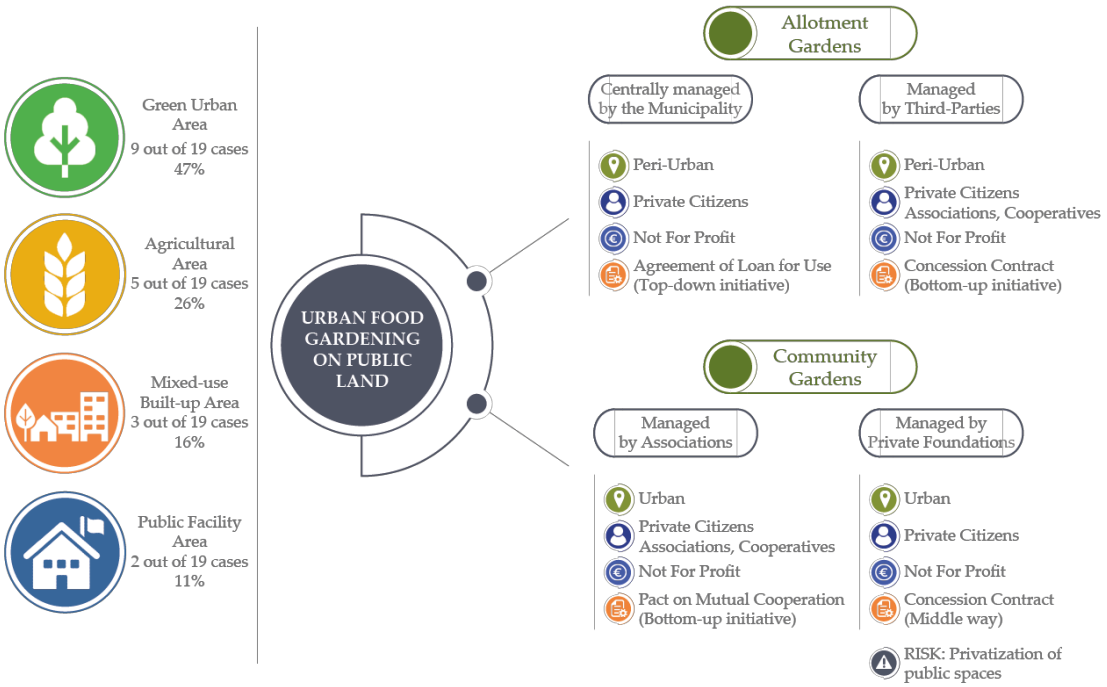


Fig.5 UFG on Public Land

Bologna stands out for cases of Allotment Gardens and Community Gardens in areas intended for social housing, such as the *Orti Salgari*, peri-urban environments and public green spaces. Usually these are multi-functional gardens, hosting therapeutic and rehabilitative activities, which join the offer of vegetable plots for self-production of private citizens. In other cases, such as *Villa Bernaroli*, the Allotment Gardens are also supported by complementary Urban Farming activities such as Community-Supported Agriculture business models. The municipal Allotment Gardens in the city of Bologna are distributed in each decentralized district. The Bolognese municipal regulation (2009) assigned the municipal Allotment Gardens to associations or other local authorities rather than directly to private citizens. Moreover, it establishes that the concession takes place without costs. The plots are assigned to private citizens for free, thus their maintenance is usually managed by group of citizens in a non-paid way. They are self-managed by the associations that play an intermediary role between the public administration and private citizens, through public tenders for land assignment on free loan for use in horticulture.

As regards the experiences of horticulture on public land that cannot be classified as Allotment Gardens, the Bolognese case is characterized by experiences of UA usually integrated in wide-ranging project and social intentions. These are addressed to associations and cooperatives, but also to the residents themselves not for profit purposes, whose maintenance is often assigned to groups of volunteers who take care of the space, or supported by profitable Urban Farming activities. Bologna has been the first city in Italy to equip itself with a tool for the shared management of urban commons in 2014, applied especially with regard to the dissemination of UFG activities. From the point of view of land use designations, the urban gardens on public land in Bologna are classified as public facilities, part of the planned system of public green areas.

In Milan the Allotment Gardens are mainly located in the large suburban parks of *Parco Boscoincittà* and *Parco Nord*. Instead, the municipal vegetable gardens are mainly located in the urban context and aimed almost exclusively at cultivation by private citizens for self-consumption. Nevertheless, they remain a niche category. The number of gardens promoted by bottom-up initiatives on marginal public places is relevant, as well as the experiences developed in public farmhouses owned by the municipality and through the *Bando Cascine*. In the city of Milan, the Allotment Gardens are assigned with public tenders for land assignment and they are coordinated by the decentralized administrative districts or by park authorities (the *Centro Forestazione Urbana* for the gardens in *Parco Boscoincittà*; the Park Authority of *Parco Nord*). The assignment takes place through an agreement of loan for use contact between individual citizens and the managing body, after a public tender. The gardens are given in concession with a variable annual fee to private citizens. In Milan urban gardens on public land are characterized by long-standing bottom-up initiatives, spontaneously born as re-appropriation of green spaces, which have obtained official recognition only after their implementation. In these contexts, a grant of land for rent was reached between the association promoting the project and the public body that owned the area. However, when the management body is a private actor, the evidence demonstrates that in some cases the managerial approach of the area is not oriented to the needs of the local community, being more intended to attract external users in singular events and reaching other targets. In addition, the public gardens in the case of Milan are part of the public facilities provision. The urban gardens on public land part of the AgriculturalPark, they are subject to specific territorial development policies and excluded from urban development. Regarding the space management, Allotment Gardens are subject to municipal regulation, with exception of Milan city, where they are subject to different regulation according to the different management bodies. In the case of *The Parco Nord,* the regulation established that the gardens can be directly assigned to private citizens and in part opened to agreement solutions with institutions for educational or rehabilitative courses. Instead, the regulation of *Parco Boscoincittà* includes both individual and collective horticultural areas, also for educational activities.

In the city of Rome, the identification of Allotment Gardens appears controversial and difficult. Most of the experiences developed as spontaneous initiatives on vacant spaces, often characterized by improper uses to counter building speculation. Examples of how activist groups have re-appropriated these spaces are the *Orti Tre Fontane* and the *Orti Garbatella*, playing a role of territorial control in peripheral neighbourhoods. Following the institutionalization of these kind of experiences, the current regulation on Allotment Gardens provides that their implementation must take place on the initiative of associations. The management of gardens on public land of Rome takes place through the definition of an agreement for free loan for use between the association promoting the project and the decentralized district. The model adopted in Rome is based on the initiative of associations or citizens who respond to public tender upon project presentation. These gardens on public land are provided and maintained as public facilities, requiring the urban gardeners to pay an annual fee to cover management costs. The allotment gardens of Rome are developed in accordance with the zoning provisions, so they can be implemented in areas identified for public green, also as components of the ecological network at municipal level. The regulation of horticultural areas on public land is the result of a quite recent political debate. Until 2015 the Urban Food Gardening activities in the Capital were not regulated at all. The current regulation specifies that the construction of allotment gardens must be preceded by the presentation of a project designed by associations or groups of citizens. Each allotment garden is subjected to an internal regulation, defined by associations that take care of the management of the garden area.

The Turin case is characterized by a rather recent experience of official municipal allotment gardens, which developed following the formal recognition of pre-existing spontaneous urban horticulture sites, often located in peripheral contexts.

In the case of Turin, gardens on public land stand out for their social and inclusive purposes, managed directly by the decentralized administrative districts, by associations or even private entities (such in the case of *Eataly* which has implemented an urban garden on a public square). The gardens managed by associations are located in urban environment, even within municipally owned buildings intended to host public facilities for citizens, as in the case of the *Ortoalto Ozanam*. In Turin the municipal allotment gardens are intended as public facilities for the residents' community.

They are assigned directly to private citizens, through public tender by the decentralized administrative districts. However, after the successful example of *Orti Generali*, the city of Turin is considering to assign the management of the municipal horticultural areas to third parties or association, as a more efficient management model. An annual fee is requested which differs in case they are social gardens, at controlled prices. The gardens on public land in Turin are also managed as not-for-profit experiences, through public concession notices by the municipality.

They are often supported through direct funding from private companies promoting the project, or based on models of co-maintenance and co-governance through the voluntary work of groups of citizens. In Turin too, the recourse to the shared management of horticultural areas is becoming a widespread practice. The gardens on public land implemented in the city of Turin are located in areas classified as urban standards, even if within Urban Transformation Zones. Regarding the regulation, in the case of Turin it is applicable only to gardens centrally managed by the municipality. For the remainder the regulatory framework remains milder, as their management often relies on voluntary activities, without resorting to adoption of particular tools. The city of Turin is also the only one to have recently adopted the Guidelines for the first Urban Gardens Operational Plan, which however is only an instrument addressed to the protection of public health linked to the risks of urban gardens.

3.4 Urban Food Gardening on Private Land

As regards Urban Food Gardening on private land, Milan and Turin present a diversity of case studies (Fig.6). The private sphere in the Bolognese context of UA is therefore almost completely absent. The existing cultivated private gardens, belonging to foundations or institutions, are mostly of historical values, no longer accessible or used and also poorly managed, as in the case of the *Orti di Via Orfeo*. However, this absence of private initiative could be justified by the strong presence of the public actor on the other side, whose policies on UA have given Bologna the largest and most long-lived heritage of horticultural projects in Italy.

In Milan the third sector usually tends to turn to private actors to implement UA projects, to reduce time and bureaucratic needs with respect to the public institutions. The same initiative could come directly from the private sector, as for the *Orti di Via Chiodi*, where the private substitutes the public offer of urban gardens with a proper business model. In other cases, the gardens on private land are included in urban renewal interventions, as for the *Orti Fioriti* in the *CityLife* district, where the investor wanted the creation of gardens at the service of the resident community. Regarding the typology, they are usually Community Gardens mixed with Family Gardens. The maintenance of horticultural areas on private land can be paid by individual users, or financed by the private company which commissioned the project. Regarding the management aspects, the case of the *Orti Fioriti* of *CityLife* appears controversial and interesting, since its management resembles that of a Botanical Garden: its maintenance is entrusted to professional gardeners, while remaining accessible for the community. From the point of view of land use designations, the gardens in Milan on private land can be part of a urban transformation project, so it is possible that they were created to meet the obligation on urban standards provision. On the other hand, the *Orti di Via Chiodi* are part of the Agricultural Park, thus excluded from urban development, which is the reason that led the owner to implement his own business model based on Urban Food Gardening.

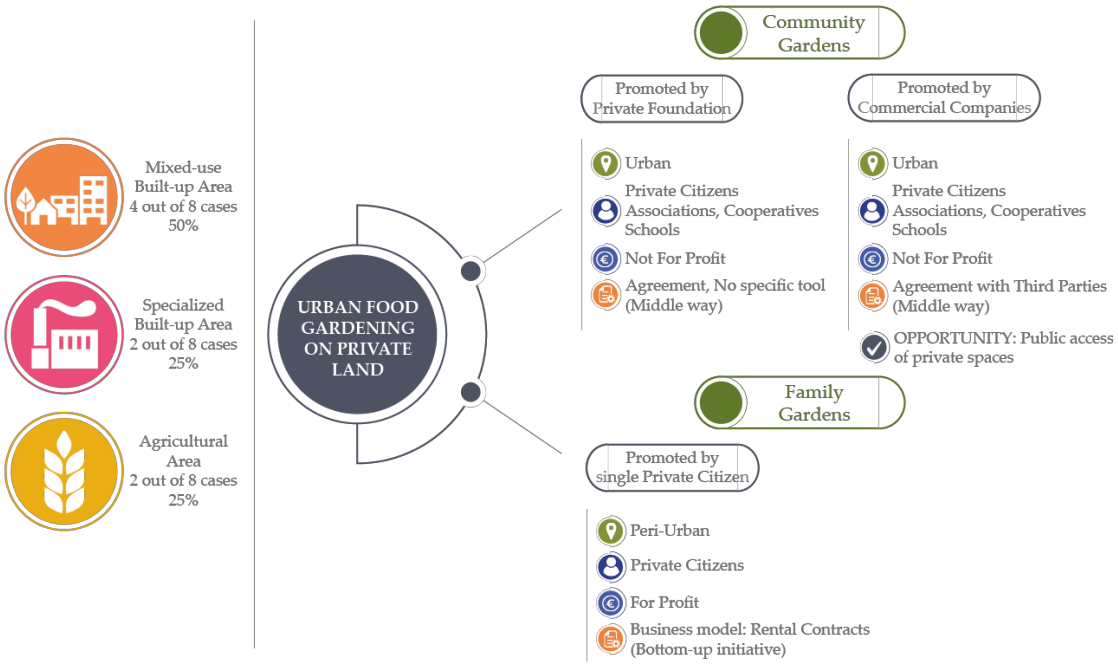


Fig.6 UFG on Private Land

The Roman urban landscape is instead dotted with squatter gardens on private land, often regulated by rental contracts. In peri-urban contexts, they usually develops integrated to multi-functional Urban Farming, where agriculture business models are emerging as private offer of UFG, as in the case of the *Orti di Veio*. There is no shortage of urban gardens promoted by private institutions, particularly sensitive to the theme of food policies and urban sustainability, such as the urban gardens of the American Academy. Generally the experiences related to private foundations are made to be lived by the members of the institution, and financed by the private owner as for the American Academy. Different is the case of the *Orti di Veio*, which represents a business model where a single private citizen rent his land for horticultural activities. In both cases it is not even possible to identify a specific space management tool. In addition the gardens of the American Academy are part of the historic city centre, within a private green areas of historical-environmental value. As for the *Orti di Veio*, their case history is similar to that of the *Orti di Via Chiodi* in Milan, since they are within a Regional Park, subject to restrictions for urban development.

In the case of Turin, gardens on private land are often implemented by private companies of commercial nature (large-scale retail trade), located in specialized or mixed-use built-up areas. These are private gardens adjacent to commercial outlets, as in the case of *Leroy Merlin* or *Dora* Commercial Park. These experiences on private land, however, retain a social nature. They can be considered Community Gardens, proving to be initiatives aimed at serving the needs of the resident communities. In Turin, the maintenance of private urban gardens takes place through funding from the same commercial company that built the garden, or thanks to the commitment of volunteers. These private gardens are usually assigned to associations that deal with their management through public tenders or agreements of loan for use, to make the area available for private citizens. However, these are still fenced areas, as in the case of *Leroy Merlin*'s gardens, being accessible only during the opening hours of the shop. In Turin the gardens on private land are all created in Urban Transformation Zones, to be destined for commercial or mixed use. In general the horticultural areas remain on private land and not fully accessible. In the case of Turin, all the case examined on private land have their internal regulation, which does not interact with the municipal one, concerning also relations with any external third-party associations involved in the management.

4. Discussion and conclusions

This research has highlighted the existence of different tools and approaches for the integration of UA in urban planning: urban gardens are part of green infrastructures, as well as urban green development and management strategies of cities, although there is no real integration of UA in urban plans in any of the contexts analysed. Existing UA is acknowledged as main component of green zoning systems, and future plans for urban and peri-urban agricultural areas are included in city development plans as part of green belts and corridors. UA can be effective in terms of city ecology (Deelstra & Girardet, 2000) and for the implementation of nature based solutions (Artmann & Sartison, 2018; Budau & Papina, 2021), especially where UA is expressly integrated into green infrastructure strategies, as the Turin case has shown.

Should UA be integrated as a legitimated land use designation? In the Italian conformative planning system, this option could represent a winning choice to reduce urbanization pressures and limit further land consumption. However, the research shows that the use of rigid functional zoning, which is not adaptive to the needs of contemporary urban contexts, might not be the best solution. In this regard, another point of reflection could concern the possibility of integrating UA as a temporary use in urban planning tools, to make these adaptable to the ever-changing needs of urban development (Ursić et al., 2018; Van Veenhuizen, 2011; Wekerle & Classens, 2015). This is a solution that appears little practiced in the Italian context, especially in the case studies analyzed. However, the promotion of tools and space management instruments which go behind formal ownership or permanent user rights could play a role, promoting short or medium-term occupancy licences which could foster urban farmers and citizens interested in such initiatives to implement UA activities (de Zeeuw et al., 2000).

Some cities, such as Almere in the Netherlands (Jansma & Wertheim-Heck, 2021), have also demonstrated that UA sites can be combined with other urban functions promoting multi-functional land use. Horticultural spaces can be included within new housing development which envisage forms of communal space for agricultural activities (de Zeeuw et al., 2000). Even with regard to new private residential districts, recent urban redevelopment projects have also seen the proliferation of Community Gardens, usually promoted by the same private investors as an alternative to other types of neighbourhood green spaces, as in the case of Milan.

Finally, regarding to space management tools, the preferred formula in the Italian context is that of new tools for the shared management of urban commons. Resorting to the direct involvement of citizens, the public administration is relieved from commitments relating to the management and maintenance of public spaces, which weighs on often troubled municipal budgets. In fact, the financial aspect represents one of the main difficulties encountered in the implementation and maintenance of UA projects by public actors. As a consequence, the solutions for the implementation of various UFG experiences are no longer limited to public administration or voluntary institutions but increasingly involve otherprivate actors. In this line, Italian and European cities may look at recent experiences of American cities (Sacramento, Seattle, New York, etc.) which have developed financial tools to facilitate the development of UA such as Urban Agriculture Incentive Zones, property tax reductions to landowners (Napawan & Townsend, 2016) and bonds of taxpayers (Horst et al., 2017).

During this research, a lack of information on UA practices and their diffusion emerged. Despite some scholars (Cavallo et al., 2016; Delgado, 2017; Lupia & Pulighe, 2015; Taylor & Lovell, 2012) have tried to collect and systematize data, most of the attempts undertaken at city level, especially in Italy, have remained incomplete. Therefore, a first starting point for further deepening the scenario of Urban Agriculture, not only in the Italian context, should start from an effective systematization and collection of georeferenced data, with the help of practitioners and farmers, also through community and participatory mapping (as also suggested by Brown et al., 2022; García-Nietoet al., 2015). Moreover, the difficulties related to the lack of a clear terminology to identify UFG experiences in a univocal way and allow a more

precise comparison of the multiple experiences in progress, must also be overcome. In this regard, the method applied in this research with the definition of typified categories to analyse UFG in relation to land use designation, and thus urban planning (UFG-UP), represents a possible starting point.

References

Artmann, M., & Sartison, K. (2018). The role of urban agriculture as a nature-based solution: A review for developing a systemic assessment framework. *Sustainability, 10*(6), 1937. https://doi.org/10.3390/su10061937

Brown, G., Kyttä, M., & Reed, P. (2022) Using community surveys with participatory mapping to monitor comprehensive plan implementation. *Landscape and Urban Planning*, 218. https://doi.org/10.1016/j.landurbplan.2021.104306

Budau, O.E., Papina, C. (2021) *Roadmap towards urban planning in follower cities*, D2.6, proGIreg. Horizon 2020 Grant Agreement No 776528, European Commission, 68 pp.

Cabannes, Y., & Marocchino, C. (2018) *Food and urban planning: The missing link*. In Cabannes, Y., &Marocchino, C. (Eds.), Integrating Food into Urban Planning (pp. 18–59). London and Rome: UCL Press and FAO.

Cavallo, A., Di Donato, B., & Marino, D. (2016) Mapping and Assessing Urban Agriculture in Rome. *Agriculture and Agricultural Science Procedia*, 8, 774–783. https://doi.org/10.1016/j.aaspro.2016.02.066

Cinà, G., & Di Iacovo, F. (2015). Integrating top down policies and bottom up practices in Urban and Periurban Agriculture: An Italian dilemma. Future of Food: *Journal on Food, Agriculture and Society*, 3(1), 9-20.

Contesse, M., Van Vliet, B. J., & Lenhart, J. (2018) Is urban agriculture urban green space? A comparison of policy arrangements for urban green space and urban agriculture in Santiago de Chile. Land Use Policy, 71, 566-577. https://doi.org/10.1016/j.landusepol.2017.11.006

Deelstra, T., &Girardet, H. (2000). *Urban agriculture and sustainable cities*. In Bakker N., Dubbeling M., Gündel S., Sabel-Koshella U., de Zeeuw H. Growingcities, growing food. Urban agriculture on thepolicyagenda. Feldafing, Germany: Zentralstelle für Ernährung und Landwirtschaft (ZEL), 43-66.

Delgado, C. (2017) Mapping urban agriculture in Portugal: Lessons from practice and their relevance for European post-crisis contexts. *Moravian Geographical Reports*, 25(3), 139–153. http://hdl.handle.net/10362/41866

De Zeeuw, H., Guendel, S., & Waibel, H. (2000) The integration of agriculture in urban policies. Growing cities, growing food. *Urban agriculture on the policy agenda*, 161-180.

Drescher, A. (2001) The integration of urban agriculture into urban planning–An analysis of the current status and constraints. Annotated Bibliography on Urban Agriculture; ETC-RUAF/CTA: Wageningen, The Netherlands.

Fanfani, D. (2019) *Spatial Agricultural Park in Europe as Tool for Agri-Urban Policies andDesign: A Critical Overview*. In Gottero, E. (Ed.), *Agrourbanism. Tools for governance and planning of agrarian landscape*, Springer, Cham. 149-169.

Gabellini, P. (2008) Profiles of Italian Urban Planning. Planum – *The European Journal of Planning* on-line, 1-15.

García-Nieto, A. P., Quintas-Soriano, C., García-Llorente, M., Palomo, I., Montes, C., & Martín-López, B. (2015) Collaborative mapping of ecosystem services: The role of stakeholders' profiles. *Ecosystem Services*, 13, 141–152.

Horst, M., McClintock, N., & Hoey, L. (2017) The Intersection of Planning, Urban Agriculture, and Food Justice: A Review of the Literature. *Journal of the American Planning Association*, 83(3), 277-295. https://doi.org/10.1080/01944363.2017.1322914

Jansma, J. E., & Wertheim-Heck, S. C. O. (2021) Thoughts for urban food: A social practice perspective on urban planning for agriculture in Almere, the Netherlands. *Landscape and Urban Planning*, 206. https://doi.org/10.1016/j.landurbplan.2020.103976

Lohrberg, F., Licka L., Scazzosi L., Timpe, A. (Eds.) (2016). *Urban Agriculture Europe*. Berlin, Jovis.

Lupia, F., & Pulighe, G. (2015). *La nuova mappatura spaziale dell'agricoltura urbana realizzata dal CREA* [The new map of urbanagriculturecreated by CREA]In Giarè, F. & Vanni, F. (Eds.), *Agricoltura e città* [Agriculture and city]. Milano, Edagricole, 82-104.

Meenar, M., Morales, A., &Bonarek, L. (2017) Regulatory practices of urban agriculture: a connection to planning and policy. *Journal of the American Planning Association*, 83(4), 389-403. https://doi.org/10.1080/01944363.2017.1369359

Mougeot, L. J. (2000) Urban agriculture: definition, presence, potentials and risks. *Growing cities, growing food: Urban agriculture on the policy agenda*, 1, 42.

Mubvami, T., Mushamba, S., & De Zeeuw, H. (2006). *Integration of agriculture in urban land use planning. Cities Farming for the Future: Urban Agriculture for Green and Productive Cities.* RUAF, IIRR and IDRC, Silang, the Philippines, 54-74.

Napawan, N. C., & Townsend, S. A. (2016) The landscape of urban agriculture in California's capital. *Landscape Research, 41*(7), 780–794. https://doi.org/10.1080/01426397.2016.1151484

Opitz, I., Berges, R., Piorr, A., &Krikser, T. (2016) Contributing to food security in urban areas: differences between urban agriculture and peri-urban agriculture in the Global North. *Agriculture and Human Values*, *33*(2), 341-358. https://doi.org/10.1007/s10460-015-9610-2

Pareglio, S. (2009) *L'insufficienza del piano. Ovvero: governare il territorio agricolo tra forza e limiti del piano urbanistico* [The insufficiency of the plan. Governing agricultural land between strengths and limits of urban planning]. In Bocchi, S., Corsi, S., Feretto M., & Mazzocchi, C. (Eds.), *Per un'altra campagna. Riflessioni e proposte sull'agricoltura periurbana* [For anothercountryside. Reflections and proposals on peri-urbanagriculture], Bologna, Maggioli editore, pp. 87-94.

Prové, C. (2018) *The Politics of Urban Agriculture : An International Exploration of Governance, Food Systems, and Environmental Justice*. Doctoral dissertation, Ghent University, Faculty of Bioscience Engineering.

Quon, S. (1999) *Planning for urban agriculture: A review of tools and strategies for urban planners*. Cities feeding people series; rept. 28.

Taylor, J. R., & Lovell, S. T. (2012) Mapping public and private spaces of urban agriculture in Chicago through the analysis of high-resolution aerial images in Google Earth. *Landscape and Urban Planning*, 108(1), 57–70. https://doi.org/10.1016/j.landurbplan.2012.08.001

Ursić, S., Krnić, R., &Mišetić, A. (2018) "Pop-up" urban allotment gardens - How temporary urbanism embraces the garden concept. *SociologijaiProstor*, 56(1), 53–69. https://doi.or/10.5673/sip.56.1.3

Van Veenhuizen, R. (2011) Inclusive, greenand productive cities. The role of urban agriculture. *Journal of Environmental Protection and Ecology*, *12*(3 A), 1470–1483.

Wekerle, G. R., & Classens, M. (2015). Food production in the city: (re)negotiating land, food and property. *Local Environment*, 20(10), 1175–1193. https://doi.org/10.1080/13549839.2015.1007121

Images source

All figures have been elaborated by authors.

Author's profile

Anna Forte

She is an Urban Planner, Master's Degree in Territorial, Urban and Landscape- Environmental Planning at the Politecnico di Torino, Curriculum "Planning for the Global Urban Agenda". The Thesis Research field focused on the interactions between Urban Agriculture and City Planning, deepening potential rising solutions for integrating Urban Food Gardening practices into Spatial Planning policies, tools and regulations at urban level in Italy.

Enrico Gottero

He is an Architect, PhD in Spatial Planning and Local Development, research assistant and lecturer in the field of Landscape and Regional Planning at the Interuniversity Department of Regional and Urban Studies and Planning (Politecnico di Torino). His research focuses on the interaction between agriculture and rural landscapes, urban and peri-urban agriculture, urban-rural linkages, farmland preservation, agrarian urbanism, as well as food planning. He is also the author and editor of several publications, including at the international level.

Claudia Cassatella

She is an Architect, PhD in Landscape Design, Associate Professor in Urban and Landscape Planning and Chair of the Faculty of Planning and Design,at Politecnico di Torino DIST. Her theoretical and applied research mainly deals with landscape planning, landscape heritage, green and blue infrastructures, rural development. Partner of the H2020 Project EFUA European Forum for Urban Agriculture. She lectured internationally in Europe and Japan, visiting scholar at The University of Tokyo, Nagoya University, University of Copenhagen. ICOMOS Expert, past-Member of the Executive Boards of UNISCAPE and of the Italian Society of Urban Planners (SIU).

TeMA Journal of
Land Use, Mobility and Environment

Call for papers – Special Issues 2023

BURN OR SINK.
THE PLANNING AND MANAGEMENT OF THE LAND

Throughout the summer of 2022, several alarming episodes related to the growing climate and energy crises have exposed vulnerabilities in the social and economic organization of the territories. While the appropriate regenerative, adaptative, and mitigative actions must be carried out for cities, other approaches should be pursued simultaneously regarding the natural resources present in the territory. In particular, water, food (hence, soil), and energy, which are often exchanged with other territories. Natural resources are one of the bases of the economy of a territory and can come to represent its identity, especially when they can be used to obtain high value-added goods which are recognized outside their place of origin. Furthermore, they represent an indicator of the equilibrium between environment and man in a territory. Natural resources are the focus of global attention, as indicated in the UN Sustainable Development Goals and the environmental action programs of the European Community.
For this reason, natural resources must be protected from climate change and from excessive use that causes destructive and dispersive effects. Furthermore, they must be considered as strategic resources to be fully included in the processes of territorial planning.

This Special Issue wants to deepen the topic through articles that investigate the following points:

- The first is scientific. The research in progress (see, for example, that on ecosystem services, on natural capital and on FEW Nexus) should be further deepened and addressed towards the identification of theoretical principles deepening the relationships between resources and territory, to be developed through models and quantitative or qualitative/quantitative techniques (scenario techniques, and others).
- The second point is related to the research effects. Theoretical results must be the building blocks of real action systems that can enhance the broader planning actions. Deepening case studies is relevant for this second point.
- The third point is social. The papers should explore what changes in individual and collective behaviour are required to steer society towards the greater collective well-being. This point could be investigated using case studies centred on particularly problematic areas, such as, for example, inland areas or urban and metropolitan peripheries. Case studies, in parallel with the regeneration actions, can be the starting point to build new social relationships and behaviours.
- The fourth point concerns the decision-making systems and the evolution of the legislation. The research and applications could significantly contribute to the process of simplifying and updating the legislation, becoming an authoritative source for the new rules regarding the management and sustainable regulation of land use processes.

The Special Issue of TeMA is mainly addressed to urban and planning scholars interested in deepening the topic's evolutionary aspects which the processes of climate change have made necessary. In consideration of the aforementioned points, the call is open to contributions of scholars of other research sectors too, with the objective of cultivating a healthy exchange of knowledge with the urban planning field.
Papers must deepen the analysis of ongoing processes and workable solutions, focusing on the development and utilization of quantitative and/or qualitative techniques and models highlighting the acceleration of the processes occurring in recent decades and building scenarios for the future.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 415-429
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9314
Received 9th July 2022, Accepted 11th December 2022, Available online 30th December 2022

www.tema.unina.it

Landscape and the city

A new vision for enhancing sustainability issues

Donatella Cialdea [a*], Antonio Leone [b], Vito Muscio [c]

[a] L.a.co.s.t.a. Laboratory
Università degli Studi del Molise, Campobasso, Italy
e-mail: cialdea@unimol.it
ORCID: https://orcid.org/0000-0001-9310-2732
* Corresponding author

[b] School of Civil Engineering
Università del Salento, Lecce, Italy
e-mail: antonio.leone@unisalento.it
ORCID: https://orcid.org/0000-0002-7893-4650

[c] L.a.co.s.t.a. Laboratory
Università degli Studi del Molise, Campobasso, Italy
e-mail: lab.lacosta@unimol.it

Abstract
In recent times, there has been an increasing number of initiatives for developing green and agricultural areas connected to urban ones. This is certainly very positive, from many points of view, both social as well as environmental. This work presents a study regarding an Agricultural Park proposal. It is located in an urban context, which involves a populous district of the Bari Municipality (Apulia Region, Southern Italy). The role of Nature Based Solutions was further considered: they are inspired and supported by nature and could help to build land robustness increasing soil permeability and, as a result, decreasing the risk of hydraulic hazards. For this purpose, the Digital Terrain Model was utilised: obtained by the LIDAR survey, it was employed in order to create the hydrographic micro-network, giving us details of runoff paths. Consequently, agricultural activity, by increasing soil permeability, will contribute to reducing hazards. This methodology has allowed for the creation of different areas to be allocated to agricultural activity; this process started with the localisation of hydraulic micro-network and became part of the "new" landscape. Landscape management, through Agricultural Park creation, therefore turns into a catalyst for local development, due to its agriculture relevance and its ability to absorb anthropic pressures.

Keywords
Urban agriculture; Ecosystem services; Urban regeneration.

How to cite item in APA format
Cialdea, D., Leone, A. & Muscio, V. (2022). Landscape and the city. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 415-429. http://dx.doi.org/10.6092/1970-9870/9314

1. Introduction

1.1 Background

This paper investigates the evolution of the relationship between urbanised and agricultural areas in the contemporary city, from the perspective of the urban planner who, today more than ever, is entrusted with the task of evaluating landscape and environmental implications.

Nowadays, increasing research is being carried out into planning activities linked to the creation of agricultural parks in urban areas, above all for reducing urban pressure on the surrounding context.

Especially in European countries, many investigations have concerned the urban demand for rural goods and services, with a view to restructuring agricultural activities in a multifunctional way, adapting them to socio-economic changes and development opportunities.

Secondly, the well-being deriving from increasing the sustainability of open spaces is often analysed. In fact, there are a growing number of scientific papers on urban open green space and many of them try to answer the question of what the main environmental benefits produced by urban open green spaces are. (Mehdi Rakhshandehroo, et al., 2017; Gaviglio et al., 2021)

Many applications have been made in recent years, in various countries which also have different urban conditions. (Jong-Il & Jin-Wook, 2017; Zasada et al., 2017, 2018; Pölling & Mergenthaler, 2017).

They investigate multiple aspects, often very different from each other: much attention is paid to the positive aspects that derive from them, especially as regards the cultural "value" of the landscape (linked to its historical value). In this field, methodologies related to spatial and perceptual analyses are studied, with specific in-depth analysis of their application to agricultural parks (Tóth & Supuka, 2013; Lange et al., 2015).

According to current scientific evidence, the parts of the city linked to the tradition of land cultivation create a specific type of urban-agricultural landscape and at the same time constitute a strong historical memory of past activities.

The underlying problem is the need for reconnecting urban-rural relationships. The studies in the landscape planning field have demonstrated the opportunity of using more complex approaches by stating the integration of different aspects (Zasada, 2011; Beichler et al., 2014; Cooke et al., 2015; García-Martín et al., 2016; McCracken et al., 2015; Fanfani, 2018; Zasada et al., 2019).

The issue is certainly complex. The innovativeness of this work, which is consequent to a wide range of other applications carried out by the authors in recent years (Leone, 2019a, 2019b; Leone et al., 2020; Pelorosso et al., 2018a, 2018b; Cervelli et al. , 2017; Cialdea, 2020a,b), consists in having developed a methodology useful for the precise localisation of potential agricultural areas according to the nature of the land and the presence of water, which can be used to proper management of green areas (urban green and agricultural green).

1.2 Current approaches analysis

The study of mechanisms connecting agri-environmental and landscape policies involves territorial management aspects that can feed the socio-economic development of rural areas, even when they are close to or inside urban areas.

Agriculture is therefore a focus element for the achievement of sustainable development goals, but also a harbinger of a new relationship with the city. In recent years, the so-called "agro-urban" project has found ample space in research, combining the efforts of the planning disciplines and the disciplines that most closely deal with environmental and agricultural policies.

The interdependence of agriculture, development and the environment for the purposes of global sustainability is widely reflected in the system of "Sustainable Development Goals" (SDGs).

The 2030 Agenda for Sustainable Development (United Nations, 2015a) states these goals, to be achieved by 2030. They pursue aims of the previous "Millennium Development Goals" (MDGs) (United Nations, 2015b),

and represent common objectives on a set of important issues such as fighting poverty or climate change. The definition of "common objectives" means the total involvement of all countries on a global scale, in order to bring the planet onto a sustainability path. In June 1992, in the *Summit* in Rio de Janeiro, Brazil, over 178 countries adopted the "Agenda 21", a plan to build a global *partnership* for sustainable development to improve human life and to protect the environment. In June 2012, Member States adopted the final document "The future we want" (United Nations, 2012) in which they decided to start a development process; a series of sustainable development objectives to be added to the MDGs and to establish the United Nations Political Forum on sustainable development. In January 2015, the General Assembly started the negotiation process on the post 2015 development agenda. The process culminated in the subsequent adoption of the 2030 agenda for sustainable development, with 17 SDGs. The Division for Sustainable Development Goals at the United Nations Department of Economic and Social Affairs (UNDESA) currently offers substantial support and capacity building for the SDGs and related thematic issues, including water, energy, climate, oceans, urbanisation, transport, science and technology, as defined in the "Global Sustainable Development Report" (GSDR) (United Nations, 2019).

Among these 17 SDGs, number 11 aims at "Making cities and human settlements inclusive, safe, resilient and sustainable". Many cities around the world are facing demanding challenges in managing rapid urbanisation from ensuring adequate housing and infrastructure to support population growth, coping with the environmental impact of widespread urban sprawl, to reducing vulnerability to natural disasters.

Over the past few decades, the world has experienced unprecedented urban growth. In 2015, approximately 4 billion people - around 54% of the world population - lived in cities and that number is expected to increase to around 5 billion people by 2030. Urbanisation has brought enormous challenges, including an increasing number of slum dwellers, increased air pollution, inadequate basic infrastructure and services and unplanned urban sprawl. As stated in the Goal 11 Report, already in May 2017, 149 countries were developing urban policies. From 2000 to 2015, in all countries, the expansion of urban areas outstripped the growth of urban populations. As a result, cities are becoming less dense as they grow, with unplanned urban sprawl challenging the more sustainable urban development models. Goal No. 11 deals with the issue of urban sustainability. Cities play an essential role in achieving the Sustainable Development Goals: half of the world's population and three-quarters of the European population live in urban areas.

The presence of green and public spaces, the protection of cultural and natural heritage, the redevelopment of degraded areas, the relation with peri-urban and rural areas are all essential elements for the whole community.

The extent and complexity of the topic of urban sustainability needs integrated planning and management capacity. The orientation of some targets to the consequences of climate change and the urgent need to mitigate their consequences, especially those related to water, is absolutely vital. Last but certainly not least, is the desire to strengthen the positive economic, social and environmental ties between the city and the countryside, two worlds that in many Italian cities never appear as a dense and compact core, since the only the outermost belt tends to decline to rurality, being the one which does not remain involved in the planning processes. In fact, there are numerous cases in which it is possible to discover a strong mixture between these two worlds that elevates the city itself to a status of agricultural city, just think of the case of Rome considered the largest agricultural municipality in Europe or the "Parco Sud di Milano", an Agricultural Park that appears to be the main green attraction of Milan (Migliorini & Scaltriti, 2012; Sorace, 2001; Bechini & Castoldi, 2009).

The issue of the relationship between urbanised and agricultural areas has been addressed for a long time in various countries which present - albeit in different forms - the duality of this relationship. To overcome this dualism, it is necessary for the two worlds to interact with each other and, given that they are territorial systems, this is realised through the flows of mass and energy. It is therefore necessary for the city and the countryside to establish a mutual exchange of ecological services.

This is the fundamental role of the Agricultural Park connected to the city: directing and managing these interactions.
Regarding to what was outlined by the AGRI Committee - Urban and Peri-urban Agriculture of the European Parliament (Piorr et al., 2018), which analyses some interesting cases in Europe, the agricultural park can be considered the vector of connections between different systems, physical and economic, of the city and the agricultural land that surrounds it.
The primary objective is to ensure the liveability of urban areas, especially when they include disused areas and attention must also be focused on the need to recover abandoned landscapes (Fayet et al., 2022). Also in Italy, the aforementioned experiments have paved the way for multiple applications also in urban areas (Castoldi & Bechini, 2006; Pacini et al., 2009; La Rosa et. al, 2014).

1.3 Aim of the study

The literature - with texts and articles relating to principles and samples - constitutes the backbone of the article and is constantly examined during drafting.
This paper undertakes a research path by combining considerations related to theoretical issues and to practical interventions, carried out on areas devoted to agricultural uses. The main goal is to point out the empirical approach, based on hydraulic asset verification, in order to give agricultural activities a role in reducing the hydraulic hazard.
The relationship between countryside and the city has been addressed, by proposing the application of a methodology for green space design in a seaside city. The research aimed at developing a methodology able to combine the development of agricultural areas and the protection of the territory. The first step was the collection of land use data (analysed in the most recent transformations). The investigation then focused on the aspects of soil defence and hydrogeological issues, and this is reported in this paper.
The traditional solution is the creation of an urban drainage network. This is a type of "a posteriori" solution, which takes place when the damage connected to the risk of floods has already occurred. It therefore acts on the effects and not on the causes. The present work aims to demonstrate that it is much more profitable to intervene "a priori" on the hydrological pressure, reducing the soil sealing.
Nature Based Solutions (NBS) express this need well. The EU Commission defines NBS as "Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions" (EEA, 2021).
The use of NBS is constantly increasing due to their high efficacy; for example, Pelorosso et al. (2018a) showed how a few green structures can significantly reduce the hydrological load on the urban drainage network of Bari. These are green-based techniques, which contribute to creating positive effects, for example for extreme temperature regulation and for the increase in biodiversity.
A particular category of NBS are the SuDs (Sustainable Drainage Systems), green arrangements designed to reduce the potential impact of new and existing urbanisation related to rainwater surface runoff (Woods Ballard et al., 2015). The SuDs outlook is to replicate the drainage models of natural systems, using cost-effective solutions with low environmental impact to drain water and release it slowly into the environment (Recanatesi et al., 2017). In addition, runoff absorption allows water filtering and purification and, therefore, improves its quality, as well as enriching groundwater storage.
The purpose of the research, ultimately, was oriented to the localization of different areas to be allocated to agricultural activities, starting from a technical definition of water collection and providing new varied agricultural activities.

The article is organised as follows: the introduction (Section 1) describes the main issues of the paper, including the literature review; the next section (Section 2) introduces the methodology steps adopted to assess the study area context; the empirical findings are presented in "Results" and "Discussion" (Section 3 and Section 4); and, finally, concluding remarks are summarised in the "Conclusion" section (Section 5), geared towards stimulating future research.

2. Material and Methods

2.1 Study area

The case-study is located in the Apulia Region, South of Italy (Fig.1).

The proposed methodology involves the South-East coastal area of its capital, Bari, called "Bari South Coast" (BSC). This territory is therefore significant with respect to the study aims: it is an important part of the city, destined for a strong urban development, but, at the same time, there are many semi-natural spaces, a consistent agricultural activity and various rural buildings, which can contribute to creating a complex and resilient landscape. These are the prerequisites to support sustainability enhancement.

Fig.1 part a) illustrates the localization in the national context and the Apulia Region, through an image of its Landscape Plan: it reports the analysis of rural morphologies. In particular, the area in question (circled in red) shows a highly heterogeneous agriculture in an area defined as a "transition landscape" with "landlocked sections" of houses with characteristics of dispersed settlements. It is important to underline that the Apulia Region is equipped with recent generation vast area planning tools. In 2015 Region approved the first Landscape Plan in Italy, following the requirements of the Code of Cultural Heritage and Landscape (Repubblica Italiana, 2004; Regione Puglia, 2015). Among other things, the Landscape Plan provides for the realization of Agricultural Parks, intended not as yet another entity, but as an informal meeting place and common growth of local citizens and farmers.

The following image refers to the Bari Masterplan. There appears the clear desire to enhance this part of the coastal strip - which is the only "not occluded" part - as an environmental and landscape resource: "The particular condition of isolation, separateness and poor accessibility, due to the breakdown of the Adriatic railway line, has preserved this territory from settlement pressure, at the same time gradually confining its spaces to residual agricultural uses and, more often, to abandonment and degradation"(Comune di Bari, 2010).

As the recent research on Italian metropolitan cities highlights, this tool has also produced a propulsive effect, evidenced by the proliferation of the ability of municipalities to create territorial development by putting public and private resources into the system and activating a broad partnership, especially for projects that invested degraded areas of cities. It states that the "Terra di Bari" Metropolis has more souls within it, that of the tertiary sector, that of the food and manufacturing industry and that traditionally linked to agriculture": consequently, development tools must necessarily understand the permanence of the agricultural matrix, especially in areas where there is a risk of losing it (PCM, 2017).

Moreover, the recent national report on land consumption (SNPA, 2020) highlights how the city of Bari records a significant growth in artificial surfaces, with values among the highest for regional capitals: in particular, in the analysis of the increases between 2018 and 2019 the city has the highest density of consumption (it is 32.8 hectares consumed, corresponding to 28.19 m^2 of new land consumed per hectare). The value of marginal land use (as the ratio between net land consumption and new residents between one year and the next) also denotes an alarming situation, with values clearly higher than the national average.

In relation to the spread of still alive phenomena of soil aggression, is important to resort to operations on the regional territory to recover areas with an "uncertain definition", combining aspects of environmental protection.

The historical shortages of urban green spaces are also constantly recorded by national surveys: "Among the large municipalities, even in the presence of consistent absolute values (in Rome the m^2 of urban green areas are over 45.6 million, in Milan 22.8 million, Turin 19.5, Bologna and Naples 11.1 million) per capita endowments are compressed by the high demographic size: on average 19.3 m^2 per inhabitant are available compared to 47.1 m^2 in medium and small-sized capitals; among the other large cities, the cities of Genoa, Bari and Taranto are below the national average, with less than 9 m^2 of urban green space each (ISTAT, 2016; ISPRA, 2020).

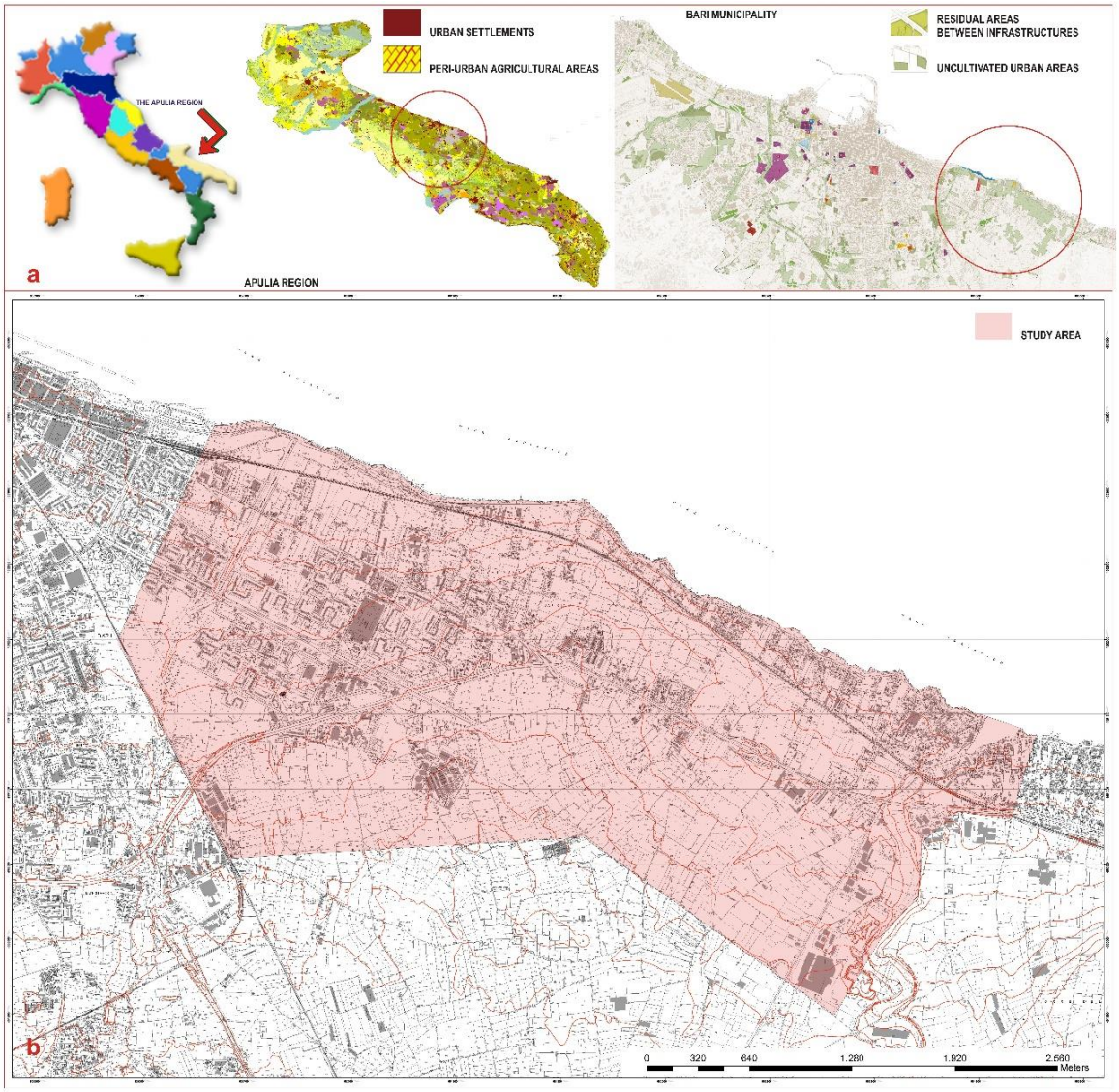


Fig.1 Location of the sample area. *Part a:* Italy, Apulia Region and the Bari South Coast area; *Part b:* The sample area survey vision (Source: *Part a:* Landscape Plan Rural Areas Typologies, 2015; Bari Masterplan Rural Land Map, 2010. *Part b*: Technical Map Bari Municipality, Authors' own elaboration, 2021)

Fig.1 in part b. shows the case-study area, defined for the research aims. Given this context, the creation of new green spaces is particularly relevant, especially making all green spaces functional, from urban interstices to the agriculture surrounding the city. This is the main aim of the Agricultural Park envisaged by the Landscape Plan, which is expressed through the City-Countryside Pact: the physical and cultural place where the urban and rural environment contribute to the single goal of sustainable development.

2.2 Theoretical Methodology Approach

The green standard is vital to increasing urban living standards, providing the operational tool for green design. Nowadays, innovating urban projects with environmental issues, through green networks, is essential (Santamouris, 2013; Matzarakis, 2021; Cialdea, 2018, 2020a). Giving value (in terms of environmental processes) to green areas means the standard dimensions currently used need to be rethought.

In Italy, the "green areas' standard" was introduced in 1968, following intense politically-charged debate. After more than 50 years, there is a need to review the bases of this regulation because society's needs have changed. The general topic of the environment must be treated in dynamic and proactive, not conservative, terms and above all from a landscape viewpoint (Cialdea, 2020b, 2021). Hence the importance of ecosystem services, in order to pursue environmental sustainability through the use of soil and its resources (Leone, 2019a, 2019b; Pelorosso et al., 2018a, 2018b).

Landscape derives from the interaction between nature and culture, not just aesthetics and perception (Council of Europe, 2000a, 2000b; Repubblica Italiana, 2004). At the same time, the city is considered a complex and dynamic system, whose continuous evolution is defined by the inhabitants' needs, interacting with places and generating landscapes. The traditional urban plan shows its limits, emphasising the physical role of its different zones and is not always able to involve the landscape aspects and promote the increase of environmental value.

This paper tries to reverse course, starting from landscape resources and citizens' needs. This approach follows the new procedure advocated by numerous researchers (Rothwell et al., 2015; Sharma et al., 2016; Cervelli et al., 2017): the "flexible plan" is able to adapt to needs as they arise.

Elements involved in the Multifunctional Agricultural Park (MAP) proposal, outlined in this paper, are:

1. *Urban and peri-urban green areas*. Agricultural systems and urban greenery are not just amenities and leisure places, but vital organs (city's heart and lungs) whose functionality must be rediscovered. They should become a climatic extreme mitigation factor, both limiting flooding due to greater urban permeability and addressing the urban heat island (Leone et al., 2020).
2. *Green and agricultural production*. The main Agricultural Park's aim is to prevent agricultural production from being dispersed in "anonymous" markets. The concept of the agricultural product in its own right must be overcome; it is necessary to think about the food product as a supply chain result, in a process that is not only productive but with the right governance has the added value to create a quality landscape. More than solutions as vertical woods - elitist systems greatly dependent on external resources, such as water or energy - a complex network of multifunctional, adaptive and integrated activities could be a right solution.
3. *Rural buildings*. Their recovery is functional to this new socio-ecological model. They can be considered a resource for the new agricultural development and contribute to the park's multifunctionality.

2.3 General framework and its application

Territorial resource ecosystem services, useful for our research aims, have been analysed.

The sample area is a complex territory, characterised by large agricultural spaces, in a very well-defined urban context, because - both west and south of the BSC area - there are large and densely populated neighbourhoods and the historic city centre is not more than a couple of kilometres away.

The strategic vision assumes adaptation and autopoiesis. They are the "beautiful" landscape keywords, to provide environmental protection and sustainable resource use. Tactical tools are also necessary to give concrete life to this strategic vision. The main local problem is the hydraulic risk. Agriculture could play a key role, as a connective tissue absorbing anthropic pressures. Active agriculture is necessary, attractive to citizens, with the now widespread practice of urban gardens, but, above all, with traditional crops, such as olive and almond. This production offers added value through its transformation and marketing on site.

Nature (green areas, waterways and the sea) is closely linked to the hinterland (the so-called "deep country") and connects ecological networks and agricultural systems.
In this context, the MAP can be interpreted as the connective tissue of the entire surrounding area, as magma in dialogue with the built environment. Moreover, it satisfies the aforementioned City-Countryside Pact envisaged by the Regional Landscape Plan, developing all the possible synergies that can create a complex and stratified landscape, in which city and countryside develop territorial identities in symbiosis.
Analysing land uses, the Municipal Agricultural System has been divided into three landscape systems, with different vocation, integrating each other: a) tree crops; b) arable land, which needs new paradigms; c) marginal lands, primarily those with the highest hydraulic risk, with a greater vocation for greening, which simultaneously contribute to the local ecological network and, furthermore, to soft mobility.
Land uses define the compositional characteristics of the rural landscape of the Bari territory, together with the various types of rural buildings, such as small "haystacks" as temporary shelters, but also large farms and numerous abandoned buildings. The planning strategy proposes agricultural revitalization, like the cultivation of olive trees and almond trees, the "historical" fruit of the Bari agriculture, which has important new markets because of its significant increase in consumption.
In both cases, the tool to be used is the supply chain agreement between production and marketing and, when possible, also processing phases and direct sales, involving all the existing structures that may be functional to this goal. The strategy consists in transforming these structures into functional resources for agricultural "short chain" development. Following the census, therefore, some of these buildings can be selected for reuse aimed at processing phases and direct sales of the MAP products. In this sense, the Landscape Plan prevision is very worthwhile; it provides the Landscape and Ecologically Equipped Areas (LEEA), for which the MAP proposal defines areas useful for agricultural products making and marketing, becoming meeting points for producers and consumers.
Another strategy is one of the municipality's two sewage treatment plants, located near the sample area. This plant treats wastewater of about 500,000 inhabitants per day, meaning 200 l per person per day and, therefore, the daily flow of 100,000 m3.
For several reasons, oriented to the circular economy, it can become a strategic resource:

1. the agriculture receives great benefits, both in terms of water irrigation use in summer, and for the possibility of reusing the purification sludge (another product of the depuration process) as a soil improver;
2. during the non-irrigation season, this water flow can be conveyed to the nearby Lama San Giorgio stream, in order to increase biodiversity and ecological network;
3. it is possible to recover the biogas from the anaerobic fermentation of the sludge. It can start a pole of biomass energy exploitation, such as the agricultural residues of the MAP, the algae beached on the coast and the organic fraction of domestic waste. Consequently, a LEEA can be created, a Biomass Centre, the collection of waste (neighbourhood organic waste, agricultural waste biomass and sewage sludge).

In this context, the relevant hydraulic hazard could be faced with traditional infrastructures (drainage network) but it could be increased with other integrated solutions, as will be proposed later.
In this paper, the role of Nature Based Solutions was further considered: they are inspired and supported by nature and could help to build land robustness increasing soil permeability and, thus, decreasing the hydraulic hazard posed.
For this purpose, the Digital Terrain Model (DTM, raster to 1 m) was utilised: the LiDAR is an active remote sensing system and uses medium power lasers from which it is possible to generate the digital elevation model. The hydrographic micro-network was carried out by the LIDAR survey. In consequence, it has been possible to have the detail of the runoff paths and, therefore, be able to identify where the hydraulic hazard originates (Fig.2).

3. Results

NBS are the green infrastructure useful to the mitigation of climatic extremes by increasing territory permeability through reservoirs and infiltration of rainwater runoff.

For this reason, they have been located where there is an accumulation of water flow, indicated in the Fig.2 map, in the spaces suitable for greening, considering the area's morphology and availability.

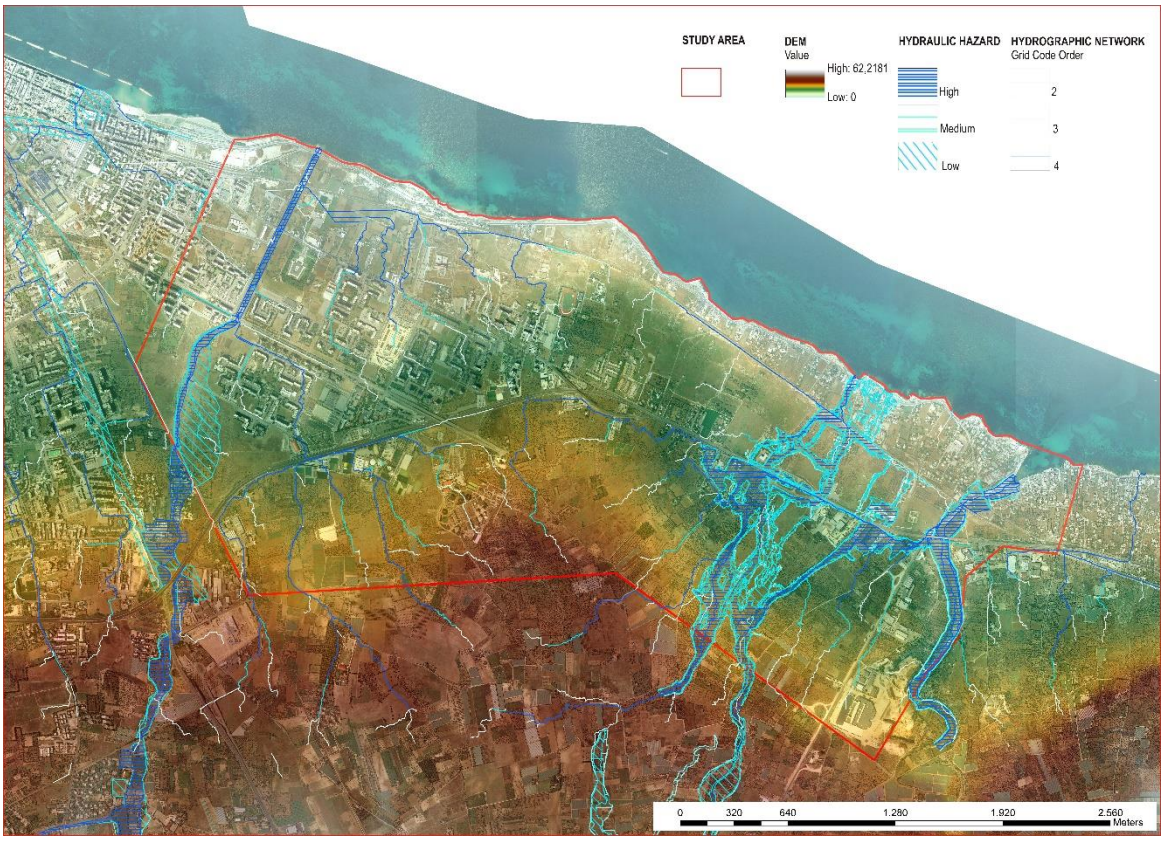


Fig.2 Sample area Analysis: Hydraulic hazard and risk (Sources: Apulia Region LIDAR Project, Hydraulic Management Plan, Comune di Bari, 2007. Authors' own elaboration, 2021)

As a result of flow characteristics analysis, two types of NBS emerge (Fig.3): the linear (especially large and grassy road bumps) and the areal (infiltration areas of the runoff).

Even rural land itself could contribute to the strategy. Two different agricultural area typologies have been identified:

1. The first one involves agricultural patches along the coastal strip, where the main vocation is horticultural cultivation: it will be oriented to social purposes - like leisure time, which has to be spread throughout the South Coast - and also to agricultural activities, already sufficiently developed.
2. The second one involves the innermost agricultural area, which can be considered as "deep countryside", as it has all the agro-environmental characteristics of the Bari countryside ("Conca di Bari"), despite being in the heart of the city. It is characterised by the cultivation of olive trees, in some cases even intensive, which often is associated or alternated with almond trees and is interspersed with fig and carob.

4. Discussion

The MAP, including the LEEA proposal, could contribute to landscape enhancing. The purpose of these initiatives is to ameliorate quality and BSC's short chain production. At the same time, LEEA will be a full circle operation, carrying out water reuse and the recovery of biomass (sludge) produced in the wastewater treatment plant, aiming at improving soil quality and producing renewable energy.

Suggested NBS could be considered an endogenous solution to the territory difficulties, like a form of recycling: defending soil through soil use.

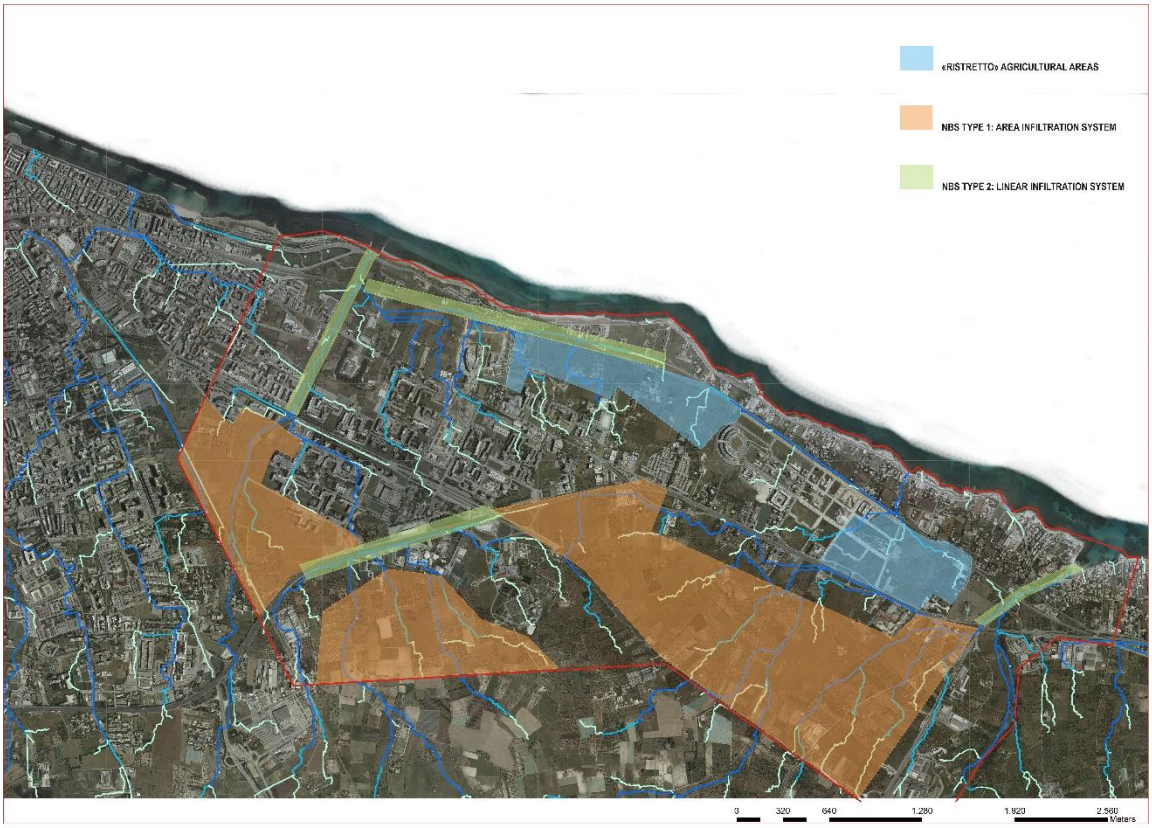


Fig.3 Sample area Project: The "Bari South Coast" Agricultural Park Proposal. (Source: Authors' own elaboration, 2021)

The proposed approach, in summary, found the following results:

1) The green system

The green area management guidelines, both in urban and agricultural contexts, have been defined in order to optimise ecosystem services. Beyond the traditional function of urban quality enhancement, greening is designed to increase land permeability and, therefore, reduce runoff and hydraulic hazard.

This strategy is implemented on two levels (Fig3):

- upstream, through conservative agriculture and large runoff accumulation areas, increasing land's capacity to store and infiltrate rainwater;
- downstream, in the more urbanised area, the greenery necessary for urban planning standards, also including NBS, for the control of residual runoff.

The Italian law - regulating public green spaces and parks - requires 9 m2 for each inhabitant. It dates back to 1968, when environmental issues had not yet emerged. Moreover, at that time, useful techniques to encourage ecosystem services didn't exist.

Now, fifty years later, this standard must be revised, adapting it to contemporary needs, in a sustainability way, and relating it to development mitigation processes.

The relationship between standard and hydraulic hazard is relevant: for example, Pelorosso, Gobattoni & Leone (2017, 2018a, 2018b) have defined greenery potential in quantitative terms, through NBS design.

These studies show that NBS are able to gain 2 to 40 m². It means that 1 m² of greening through NBS could generate a 2-40 m² sustainable area. Nevertheless, these green areas have many other functions: they mitigate the urban heat island, increase biodiversity, and assure socially valuable public spaces.

2) The agricultural system

As conceived, the MAP is an incubator and catalyst for agricultural development. The close integration with the city is a guarantee of economical sustainability. Citizens, in fact, are direct purchasers of the park's products and, therefore, they exercise control over product quality and marketing.

3) The rural system.

Some rural buildings can be equipped for agricultural products processing and marketing. Moreover, the East Bari large wastewater treatment plant is functional to agriculture. The domestic water utilised by every citizen - and related nutrients, together with the solids produced in the purification process - are a very important resource for agriculture, today "wasted" and discharged into the sea. Its importance is easily demonstrated. The water supply of Bari city is 200 l/per capita per day: considering an average irrigation requirement of 4 mm/day (corresponding to 4 l/m2/day), it follows that the supply of each citizen allows the irrigation of 50 m2, which satisfies the vegetable growing needs of about 2 citizens. The East Bari plant treats 500,000 inhabitants, so the relevance of the available resource is evident.

In conclusion, the MAP, the regional ecological network and the LEEA produce sustainability and stimulate endogenous resources. Furthermore, these steps can considerably improve urban planning tools from several points of view: they allow them to rationalise strategic environmental assessment, following the critical analysis of the present urban plan, in view of the greater sustainability.This strategy needs "light" governance, not a new authority: the existing administration (the management authority of Metropolitan City or one of its Municipalities) could start a Planning Office as an incubator for initiatives involving all other authorities.

It could set up agreements for the park and LEEA creation, for the wastewater treatment plant management and assist food supply chains. Tab.1 shows the "Bari South Coast" (BSC) area Framework: in Column 1 the general objectives of the Bari Municipality Planning Office are indicated. This study led us to define new main features and to identify related suggested tools, as they are respectively in Column 2 and Column 3 of the table.

5. Conclusions

Results demonstrate how to overturn the usual planning perspective: context is organised not belonging to urban settlements but to its landscape, following its endogenous features. This is a great novelty compared to planning activities over the last decades. Green is the main strategic factor of the whole socio-ecosystem: it is the heart, lungs and backbone of the new structure of Bari South Coast. Each landscape element has its own function, often multiple, which contributes to building a single, strong entity. Strategies - but also techniques - are necessary allowing both to optimise and improve rules and customs. This work is an example of mitigation and optimization techniques: it is possible to predict how and how much public spaces reduce soil sealing. Introducing this innovation in planning tools could guarantee management of the landscape, as envisaged by the European Landscape Convention. In conclusion, the main product of this research phase is the introduction of the technical approach useful for defining Agricultural Park localization, which can be an innovative contribution to investigations. The extension of this methodology to the entire urban area will constitute a benchmark for local authorities, who have a duty to safeguard the landscape and at the same time provide for agricultural economic maintenance and development. Landscape management, through the Agricultural Park creation, becomes a protagonist for local development, due to its agriculture relevance and also its ability to absorb anthropic pressures.

In this sense, the proposed method can also find application in other regional contexts as it proposes an active tool for the protection of the landscape that can be inserted within the individual municipal urban planning instruments. Future research efforts will be oriented to landscape policy design, with the aim of highlighting local peculiarities and simultaneously strengthening the interactions between agriculture and the city.

Topics and strategies	General Aims	Suggested Tools
Environment & Landscape The BSC, placed in the urban context, could be representative of many other Italian contexts. it is crossed by the national railway along the coast, as in every Italian region along the Adriatic Sea. Thanks to its relocation further from the coast, a large agricultural area has been gained.	- Strict integration. - Reuse. - Recycle.	- Agreements with private operators (agricultural entrepreneurs, beach managers, tour operators) for the multifunctional enhancement of the coast. - Green Design oriented to ecosystem services, first of all the mitigation of hydraulic hazard through Nature Based Solutions. - Tool oriented to the hydraulic invariance maintenance, at the building settlements scale. - Tool oriented to wastewater and sludge recycle.
Agriculture & Multifunctional Agricultural Park (MAP) It is a connective tissue integrated into the city. In this way it expresses the City-Countryside Pact envisaged by the Apulia Region Landscape Plan. The MAP interprets the guidelines of the regional landscape plan through ecosystem services. The Ecological Network and the LEEA, developed through all territorial synergies are able to create a unicum, an identity-making landscape.	- Agricultural products enhancement, based on the food short chain. - Ecosystem services supply.	- The short supply chain creation, through technologies (Websites, APPs, etc.) able to set up purchasing groups, purchase reservations, visits to cultivated fields. - The food supply chain creation: "farm to fork" for all agricultural activities. - Outlets integrated network creation: in supermarkets, in open-air markets and in present abandoned buildings. - Improving the school role, in particular for the Agricultural Technical Institute in the neighbourhood. It could become: a) reference point for MAP activities; b) experience at some sample farms, as an example of the overall activity. - Managing the planned NBS aimed to reduce the hydraulic hazard. - Managing the Biomass Centre aimed at biogas and digestate production in the LEEA.
Urban & Rural Settlements BSC is to all intents and purposes a city, with a significant residential vocation, of great quality and economic value. There are also large green spaces, quality agriculture, sea and streams. The main issue is to address the problem of abandoned rural and industrial buildings.	- Mixitè (multiple urban and rural functions). - Focus on environmental sustainability and related techniques.	- Executive Urban Plans in compliance with the BSC's environmental vocation. - ITACA Protocol (established by the Apulia Region) aimed at the environmental quality in residential buildings and the climate change adaptation. - New building fabrics integrating residence, offices, retail trade, crafts. - Reuse scenarios for abandoned buildings, related to crafts, catering and processing of agricultural products. Consequent creation of the BSC's brand. - Connection to local consumers also through technologies (Internet Of Things for example) to promote activities and commerce, also thanks to the 5G network already available in Bari.
Infrastructures & Viability At present, a strongly integrated communication network exists, both in the East-West (city centre and S. Giorgio) and in the North-South area (sea and Japigia district).	- Increase the public transport offer, integrated with private automobile mobility. - Promote soft mobility for the coastal fruition, connecting the city and suburbs to the sea.	- Tramway on the present railway site. - Vehicle traffic axes, even if already adequate. - Road network enhancement along the South-North direction, both pedestrian and cycle path. - Bike paths: coastal and transversal network.

Tab.1 The "Bari South Coast" (BSC) area Framework

References

Bechini, L. & Castoldi, N. (2009). On-farm monitoring of economic and environmental performances of cropping systems: Results of a 2-year study at the field scale in northern Italy. *Ecological Indicators* 9:1096-1113. https://doi.org/10.1016/j.ecolind.2008.12.008

Beichler, S.A., Hasibovic, S., Davidse, B.J. & Deppisch, S. (2014). The role played by socialecological resilience as a method of integration in interdisciplinary research. *Ecol. Soc*. *19* (3). http://www.jstor.org/stable/26269629

Castoldi, N. & Bechini, L. (2006). Agro-ecological indicators of field-farming systems sustainability. I. Energy, landscape and soil management. *Ital. J. of Agrometeorology* 1, 19-31.

Cervelli, E., Pindozzi, S., Sacchia, M. Capolupo, A., Cialdea, D., Rigillo, M. & Boccia, L. (2017). Supporting land use change assessment through Ecosystem Services and Wildlife Indexes. *Land Use Policy* 65 249–265. http://dx.doi.org/10.1016/j.landusepol.2017.04.011

Cialdea, D. (2018). Smart Land: Regeneration and Sustainability in Lost Scenarios and New Performances. In: Rocco P. et al. Smart Planning: Sustainability and Mobility in the Age of Change. vol. chapter 2, p. 1-25, Springer Editor. http://dx.doi.org/10.1007/978-3-319-77682-8

Cialdea, D. (2020a). Landscape Features of Costal Waterfronts: Historical Aspects and Planning Issues, *Sustainability* 2020, 12, 2378; http://dx.doi.org/10.3390/su12062378

Cialdea, D. (2020b). The city and natural resources. Pandemic disaster can be a driving force for new perspective. *TEMA Journal of Land Use, Mobility and Environment*, vol. Special Issue | Covid-19 vs City-20, p. 67-79, http://dx.doi.org/10.6092/1970-9870/6861

Cialdea, D. (2021). Evaluation vs landscape planning in the Italian framework. Is risk prevention a utopia?. *Tema Journal of Land Use, Mobility and Environment*, vol. Special Issue 1, p. 25-38, http://dx.doi.org/10.6092/1970-9870/7423

Comune di Bari (2007). *Piano di bacino. Agg. 09.05.2007 - Piano di assetto idrogeologico.* Retrieved from https://www.comune.bari.it/web/edilizia-e-territorio/piano-di-assetto-idrogeologico (accessed May 2021)

Comune di Bari (2010). *Documento Programmatico Preliminare per il Piano Urbanistico Generale*. Bari Municipality, IT.

Cooke, B. & Lane, R. (2015). Re-thinking rural-amenity ecologies for environmental management in the Anthropocene. *Geoforum* 65, 232–242.

Council of Europe (2000a). *European Landscape Convention*. (CETS No. 176). Dordrecht: CoE Publ.

Council of Europe (2000b). *European Landscape Convention: Florence Explanatory Report* (CETS No. 176). Strasbourg: CoE Publ.

EEA European Environmental Agency (2021). *Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction*. Retrieved from https://op.europa.eu/ (accessed July 2021)

Fayet, C.M.J., Reilly, K,H., Van Ham, C. & Verburg, P.H. (2022). What is the future of abandoned agricultural lands? A systematic review of alternative trajectories in Europe. *Land Use Policy* 112 105833. https://doi.org/10.1016/j.landusepol.2021.105833

Fanfani, D. (2018), Agricultural Park in Europe as Tool for Agri-Urban Policies and Design: A Critical Overview, *GeoJournal Librarybook series* (GEJL, volume 124). https://link.springer.com/chapter/10.1007/978-3-319-95576-6_10

García-Martín, M., Bieling, C., Hart, A. & Plieninger, T. (2016). Integrated landscape initiatives in Europe: multi-sector collaboration in multi-functional landscapes. *Land Use Policy* 58, 43–53. https://doi.org/10.1016/j.landusepol.2016.07.001

Gaviglio, A., Filippini, R., Albino Madau, F., Marescotti, M.E. & Demartini, E. (2021). Technical efficiency and productivity of farms: a periurban case study analysis. *Agricultural and Food Economics* (2021) 9:11. https://doi.org/10.1186/s40100-021-00181-9

ISPRA Istituto superiore per la protezione e la ricerca ambientale (2020). *Consumo di suolo, dinamiche territoriali e servizi ecosistemici.* Report SNPA 15/20. Report SNPA, 15/20.

ISTAT Istituto Nazionale di Statistica (2016), Istat, verde urbano in Italia. Retrieved from http//www.istat.it (accessed July 2021).

Jong-Il, L. & Jin-Wook. K. (2017). Strategy and Basic Planning for Creating an Urban Agricultural Park. *Journal of the Korean Institute of Landscape Architecture* 45, 4: 23-34. https://doi.org/10.9715/KILA.2017.45.4.023

La Rosa, D., Barbarossa, L., Privitera, R. & Martinico, F. (2014). Agriculture and the city: A method for sustainable planning of new forms of agriculture in urban contexts. *Land Use Policy* 41, 290–303. https://doi.org/10.1016/j.landusepol.2014.06.014

Lange, A., Siebert, R. & Barkmann, T. (2015). Sustainability in land management: an analysis of stakeholder perceptions in rural Northern Germany. *Sustainability* 7 (1), 683. https://doi.org/10.3390/su7010683

Leone, A. (2019a). *Ambiente e pianificazione. Uso del suolo e processi di sostenibilità*. Collana Urbanistica Territorio governance sostenibilità. Milano, Franco Angeli Editore.

Leone, A. (2019b). Il Patto Città Campagna generatore di paesaggio. *Rassegna di Architettura e Urbanistica*, 157:98-101.

Leone, A., Balena, P. & Pelorosso, R. (2020), Take advantage of the black swan to improve the urban environment, *TeMA–Journal of Land Use, Mobility and Environment*, vol. Special Issue | Covid-19 vs City-20, p. 247-259. https://doi.org/10.6092/1970-9870/6851

Matzarakis, A. (2021), Comments about Urban Bioclimate Aspects for Consideration in Urban Climate and Planning Issues in the Era of Climate Change. *Atmosphere*, 12, 546. https://doi.org/10.3390/atmos12050546

McCracken, M.E., Woodcock, B.A., Lobley, M., Pywell, R.F., Saratsi, E., Swetnam, R.D., Mortimer, S.R., Harris, S.J., Winter, M., Hinsley, S., & Bullock, J.M. (2015). Social and ecological drivers of success in agri-environment schemes: the roles of farmers and environmental context. *J. Appl. Ecol.* 52 (3), 696–705.

Mehdi Rakhshandehroo, M, Mohd Yusof, MJ, Arabi, R., Parva, M. & Nochian, A. (2017). The Environmental Benefits of Urban Open Green Spaces. *Alam Cipta 10* (1) 10-16.

Migliorini, P. & Scaltriti, B. (2012). Evaluation of sustainability of the farms in the Agricultural Park of South Milan and their production chain. *New Medit* Special Issue 4, 53-56.

Pacini, C., Lazzerini, G., Migliorini, P. & Vazzana, C. (2009). An indicator-based framework to evaluate sustainability of farming systems: review of applications in Tuscany. *Italian Journal of Agronomy,* 4(1): 23-40, ISSN: 1125-4718. https://doi.org/10.4081/ija.2009.1.23

PCM Presidenza Consiglio dei Ministri (2017), I *dossier delle Città Metropolitane: Città metropolitana di Bari*, ISTAT, Invitalia & Consorzio MIPA.

Pelorosso, R., Gobattoni, F. & Leone, A. (2017), The low-entropy city: A thermodynamic approach to reconnect urban systems with nature, *Landscape and Urban Planning*, 168: 22–30.

Pelorosso, R., Gobattoni, F., Leone, A. (2018a). Increasing Hydrological Resilience Employing Nature-Based Solutions: A Modelling Approach to Support Spatial Planning, in: R Papa, R Fistola (Eds.) *Smart Planning: Sustainability and Mobility in the Age of Change*, Springer International Publishing AG, part of Springer Nature 2018. Page: 71-82, https://doi.org/10.1007/978-3-319-77682-8_5

Pelorosso R, Gobattoni F, Leone A. (2018b). Reducing Urban Entropy Employing Nature-Based Solutions: The Case of Urban StormWater Management, in: R Papa, R Fistola (Eds.) *Smart Planning: Sustainability and Mobility in the Age of Change*, Springer International Publishing AG, part of Springer Nature 2018. Page: 37-48. https://doi.org/10.1007/978-3-319-77682-8_3

Piorr, A, Zasada, I, Doernberg, A, Zoll, F & Ramme, W. (2018). *Research for AGRI Committee – Urban and Peri-urban Agriculture in the EU,* European Parliament, Policy Department for Structural and Cohesion Policies, Brussels.

Pölling, B. & Mergenthaler, M. (2017). The location matters: determinants for "deepening" and "broadening" diversification strategies in Ruhr metropolis' urban farming. *Sustainability* 9.

Recanatesi, F., Petroselli, A., Ripa, MN. & Leone, A. (2017). Assessment of Stormwater Runoff Management Practices and BMPs Under Soil Sealing: A Study Case in a Peri-Urban Watershed of The Metropolitan Area Of Rome (Italy), *Journal of Environmental Management*, 201: 6-18. https://doi.org/10.1016/j.jenvman.2017.06.024

Regione Puglia (2015). *Il Piano Paesaggistico Territoriale Regionale della Puglia*. Piano approvato dalla Giunta Regionale con Delibera n. 176 del 16 febbraio 2015, pubblicata sul BURP n. 39 del 23.03.2015.

Repubblica Italiana (2004), *Decreto Legislativo 22 gennaio 2004 n. 42 recante il "Codice dei beni culturali e del paesaggio" ai sensi dell'articolo 10 della legge 6 luglio 2002, n. 137*. G.U. 24.2.2004 e successive modifiche e integrazioni.

Rothwell, A., Ridoutt, B., Page, G. & Bellotti, W. (2015). Feeding and housing the urban population: Environmental impacts at the peri-urban interface under different land-use scenarios. *Land Use Policy* 48 377–388. http://dx.doi.org/10.1016/j.landusepol.2015.06.017

Santamouris, M. ed. (2013), *Energy and Climate in the Urban Built Environment*, London, Routledge.

Sharma, D., Holmes, I., Vergara-Asenjo, G., Millerc Mitzy Cunampio, WN., Cunampio, RB., Cunampio, MB. & Potvin, C. (2016). A comparison of influences on the landscape of two social-ecological systems. *Land Use Policy* 57 499–513. http://dx.doi.org/10.1016/j.landusepol.2016.06.018

SNPA Sistema Nazionale per Protezione dell'Ambiente (2020), *Consumo di Suolo, Dinamiche Territoriali e Servizi Ecosistemici.* Report di Sistema SNPA, 15, 2020.

Sorace, A. (2001). Value to Wildlife of Urban-Agricultural Parks: A Case Study from Rome Urban Area. *Environmental Management* 28**,** 547–560 https://doi.org/10.1007/s002670010243

Tóth, A. & Supuka, J. (2013). Agricultural Parks: Historic Agrarian Structures in Urban Environments (Barcelona Metropolitan Area, Spain). *Acta Environmentalica Universitatis Comenianae (Bratislava)* 21, 2: 60-66.

United Nations (2012). *Outcome document of the United Nations Conference on Sustainable Development*, Rio de Janeiro, Brazil, 20–22 June 2012. Retrieved from www.Sustainabledevelopment.un.org (accessed February 2021)

United Nations (2015a). *The Millennium Development Goals Report.* Retrieved from: https://www.un.org/millenniumgoals/ (accessed February 2021).

United Nations (2015b). *Transforming our world: the 2030 Agenda for Sustainable Development A/RES/70/1*. Retrieved from www.Sustainabledevelopment.un.org (accessed February 2021).

United Nations Independent Group of Scientists appointed by the Secretary-General (2019). *Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development*. Retrieved from www.Sustainabledevelopment.un.org (accessed Avril 2021).

Woods Ballard, B., Wilson, S., Udale-Clarke, H., Illman S, Scott, T., Ashley, R. & Kellagher, R. (2015). *The SuDS Manual*, The Environmental Protection Group, Imperial College, London, CIRIA 753, 968

Zasada, I. (2011), Multifunctional peri-urban agriculture—A review of societal demands and the provision of goods and services by farming, *Land Use Policy*, 28,4: 639-648.

Zasada, I, Häfner, K., Schaller, L., van Zanten, BT., Lefebvre, M., Malak-Rawlikowska, A., Nikolov, D., Rodríguez-Entrena, M., Manrique, R., Ungaro, F.,Zavalloni, M., Delattre, L., Piorr, A., Kantelhardt, J., Verburg, PH. & Viaggi,D. (2017). A conceptual model to integrate the regional context in landscape policy, management and contribution to rural development: Literature review and European case study evidence, *Geoforum,* 82: 1-12. https://doi.org/10.1016/j.geoforum.2017.03.012

Zasada, I. Weltina, M., Reuttera, M., Verburgb, P.H. & Piorra, A. (2018). EU's rural development policy at the regional level—Are expenditures for natural capital linked with territorial needs? *Land Use Policy* 77 344–353. https://doi.org/10.1016/j.landusepol.2018.05.053

Zasada, I, Schmutz, U, Kneafsey, M., & Boyce, P. (2019). Food beyond the city–analysing foodsheds and self-sufficiency for different food system scenarios in European metropolitan regions. *City, Culture and Society*, 16, 25–35. https://doi.org/10.1016/j.ccs.2017.06.002

Author's profile

Donatella Cialdea

Full Professor (Urban Planning) at the University of Molise since 1988. She is the Director of the Laboratory L.A.Co.S.T.A. (Laboratory for activities relating to Territorial and Environmental Development) at the University of Molise in order to prepare students and operators in the Geographical Information Systems field. Dean of the Faculty of Engineering from 2009 to 2012 and the Coordinator of the PhD Course in "Landscape Analysis and Valorisation". At present she is a Vice-President of the National Landscape Committee of the Italian Ministry of Cultural Heritage. She is also a Member of the Italian Steering Committee for River Contracts and a Member of the National Commission for the National Prize for River Contracts. She has been designed as the University of Molise Deputy for the UNISCAPE European Network of Universities (from 2015). She took part, as referee, for the publications of the ECLAS / UNISCAPE conference 2019. Professor Cialdea has been the Head and Principal Investigator of several International Scientific Projects funded by Competitive Calls at European and International levels, financed by the NPPA INTERREG/CARDSPHARE; by the INTERREG III A; by the Cooperlink International Project; by the National Council of Research C.N.R.) and of several National Scientific Projects funded by Competitive Calls at National level, financed by the National University Ministry and by the Molise Region, Italy. In leading up to these lines of research, Professor Cialdea has written extensively and critically about planning tools, management of spatial data, creation of metadata, creation and management of Geographical Information Systems, Web GIS of urban and extra-urban territory. Professor Cialdea has published 19 books and over two hundred refereed research papers about these and related topics.

Antonio Leone

Degree in Civil Engineering. Full professor of Planning and Environmental Evaluation at the University of Salento, School of Civil Engineering. Participant and responsible in several projects financed by the European Union within 5th and 7th Framework Programme, Interreg Research Program, COST-actions, LIFE programme and applied research programs (e.g. plans of Parks and Nature 2000 Sites). Member of Scientific International Committee for Metropolitan Strategic Master Plan "Terra di Bari" and AI SMART Project Interreg Greece-Italy. Author of over 180 papers and scientific articles on the main international journals related to the environment and landscape management and planning, for the most part of which he also carries out the activity of an anonymous reviewer.

Vito Muscio

Graduated in Geological Sciences. He has gained experience both in the field of applied geology and in the field of topographic and three-dimensional surveys. His professional and research production is oriented to the management of data in the GIS environment and to the creation of digital platforms concerning the enhancement of historic centres and the landscape. At present, he is Research Fellow in "Molise Region Landscape Analysis: Territorial data update" at University of Molise.

TeMA Journal of
Land Use, Mobility and Environment

Call for papers – Special Issues 2023

URBAN INEQUALITIES

The unavoidable current and near-future challenges, which require defining strategies and actions that can effectively support the evolution of urban and territorial systems, also contribute to widening the historically existing inequalities between different countries and, at the same time, generate additional ones even within the same state or city. At the urban level, these disparities are due also to the diversity of access to services, infrastructure and urban places, as well as the origin from a specific territorial area (center vs. periphery) and could be furtherly accentuated by unforeseen and uncontrolled global pandemics. The reduction of socio-spatial inequalities constitutes the tenth Sustainable Development Goal (SDG) "Reduce inequality within and among countries" within the United Nations 2030 Agenda, to ensure that adequate levels of quality of life for all populations are achieved. The pursuit of this goal requires rethinking and redesigning territories and cities through transformative actions and interventions predicted by urban and spatial planning tools too. In this perspective, TeMA Journal aims at fostering the international scientific debate by welcoming interdisciplinary works about the following three declinations of the topic of social inequalities:

- *social inequalities and climate change*
  How can adaptation to climate change help reduce social inequalities?
  To what extent do the effects of climate change contribute to widening inequalities in already fragile territories?
- *social inequalities and urban /accessibility*
  How can urban mobility/accessibility contribute to reducing social inequalities by improving the use of places and services?
- *social inequalities and urban governance*
  How to define new governance approaches and processes that can reduce social inequalities?

This TeMA Special Issue is oriented to collect papers aimed at answering to these questions by providing new approaches, methods, tools, techniques and innovative practices to support policy- makers in preventing and reducing socio-spatial inequalities.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 431-445
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9062
Received 7th April 2022, Accepted 1st October 2022, Available online 30th December 2022

www.tema.unina.it

Travel mode choice and its responsiveness to the needs of commuters with disability in the Accra Metropolitan Assembly

Odame Prince Kwame

Department of Geography Education
University of Education, Winneba, Ghana
pkwameodame@uew.edu.gh
https://orcid.org/0000-0002-4118-1042

Abstract

The need for out-of-door trips is informed by the fact that many life-enhancing opportunities are found outside one's home. Here, access to public transport becomes critical in enjoying facilities like schools and hospitals due to the low ownership of private cars among the low and middle-income bracket. Unfortunately, the conditions of the physical environment (including transport services) do not reflect the needs of minority travellers, making way to ascertain the responsiveness of public transport services to Ghana's disability population. This study engaged 50 PWDs' from the Accra Metropolitan Assembly (AMA) and adopted a semi-structured interview guide in eliciting PWDs' experience in using public transport in Accra. Beyond this, an auditing instrument was also engaged to ascertain the current conditions of public transport buses using the Ghana Disability Act as the basis for measurement. The study found that none of the buses examined met the conditions of Ghana's Disability Act, leaving PWDs to rely on transport operators for basic services. This situation did not only project transport operators' poor knowledge of the needs of the disability population but also reduced PWDs' travel options. The study recommends rigorous enforcement of Ghana's Disability Act, beginning with an educational outreach program for transport operators.

Keywords

Public transport; Disability; Qualitative; Accra; Trotro.

How to cite item in APA format

Odame, P.K. (2022). Travel mode choice and its responsiveness to the needs of commuters with disability in the Accra Metropolitan Assembly. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 431-445. http://dx.doi.org/10.6092/1970-9870/9062

1. Introduction

The need for out-of-door trips is informed by the fact that many life-enhancing opportunities like schools, nightclubs and hospitals are found outside one's home (Brussel et al., 2019). This situation highlights the importance of transport services in connecting people to opportunities and demonstrates how the absence or poor delivery of transport services may hinder life's progress (Delatte et al., 2018; Kett et al., 2020). Regardless of the purposes that inform one's decision to undertake an out-of-door trip, not everyone in the general population enjoys the same ease when engaging transport services. A common phrase for people who encounter such challenges is transport disadvantaged (Hernandez & Titheridge, 2016).

In a cross-country study to identify the composition of the transport disadvantaged group while using an online Delphi survey, 33 transport expects unanimously identified persons with disability (PWD) as the most represented (Yigitcanlar et al., 2019). This is because PWDs' challenges in using transport services were considered permanent when compared to other groups like pregnant women, children and the aged. Also, PWDs constitute about 15% of the globe's population making them the world's largest minority group (Ipingbemi, 2015; World Health Organization, 2011). By this proportion, attention to the travel needs of PWDs' may go a long way to address the needs of other transport disadvantaged given observed similarities between the disability community and other minority groups.

Having established the need for transport services, the road transport sector dominates the movement of the transport disadvantaged group, particularly in developing countries given their lower fares, extensive coverage and flexibility in schedules (Agyemang et al., 2020; Yobo, 2013). Precisely, the road transport sector is estimated to be responsible for the movements of about 96% of passengers and freights in Ghana (Atubiga, 2016). Aside from the state that exclusively provides the road infrastructure, the provision of vehicular services is heavily dominated by the Ghana Private Road Transport Union (GPRTU) which controls about 80% of all human and freight movement in Ghana (Ojo et al., 2014). For PWDs, the potential of public transport services to create an inclusive and participatory environment accounts for various calls to address issues relating to the use of boarding facilities in Stockholm (Stjernborg, 2019), modification of the physical environment in Turkey (Meshur, 2016) and use of assistive aids in Chile (Peña Cepeda et al., 2018).

While the above examples depict activities in the Global South, Frye (2013) indicates that developing countries fall behind in providing barrier-free transport services for commuters with disability. Key reasons include society's poor appreciation of the travel needs of persons with disabilities, which results in the pursuit of transport development schemes that reflect the general population's needs (Ferreira et al., 2012). This situation raises concerns about the need to appreciate the heterogeneous characteristics of the travel population, understand each travel population's experiences, and develop responsive approaches to address all gaps. Doing this will project the disability community as valuable members of society and also attain Goal 11 of the Sustainable Development Goals (SDG), which seeks to provide access to safe, accessible and sustainable transport systems while prioritising the needs of vulnerable commuters like those with disability (Niglio & Comitale, 2015)

Unfortunately, academic attention to PWDs' use of the physical environment (including public transport services) in Ghana has primarily centred on PWDs' use of other facets of the built environment. These include the focus on the PWD's use of educational facilities (Tudzi et al., 2017), shopping centres (Danso & Tudzi, 2016), hotels (Adam, 2019) and other monumental buildings in Ghana (Danso et al., 2011). Despite the relevance of these studies in exploring the living conditions of Ghana's disability community, the paucity of literature on the extent of ease in using transport services does not offer a holistic picture of PWDs' daily living situation, given the role of public transport services in connecting PWDs' to the facilities mentioned above. Against this backdrop, this study was undertaken to explore the responsiveness of public transport services to the needs of persons with disability in the Accra Metropolitan Assembly.

2. Literature review

2.1. Disability in Ghana

Disability in Ghana is a complex socio-cultural phenomenon that differs in various settings and contexts (Baffoe 2013). With varied definitions and perspectives, the Ghana Statistical Service (2014) defines disability using three main approaches namely; impairment, activity limitation and restriction in one's ability to participate in any activity. By this definition, Ghana is said to align with the tenets of the Social Model of disability which considers disability as the outcome of one's interaction with their society and not necessarily as an attribute of oneself (Ghana Statistical Service, 2014; Meshur, 2016).

At present, Ghana's disability population ranges from all persons who have lost body parts to those who have lost functional ability of any part of their body due to health complications like mental disorders, old age, multiple sclerosis, and congenital disabilities. By this, 3% of Ghana's population is estimated to be in the disability bracket but Slikker (2009) and Voice of People with Disability Ghana (2014) have estimated this number to be higher given some observed challenges in the enumeration efforts by the Ghana Statistical services. Gregorius (2014) also noted that poor training given to census enumerators and the stigma attached to having a disability also accounted for the low output in the disability population during the 2010 population and housing census. To this effect, Ghana's disability population is estimated to be between 7 and 10 percent (Voice of People with Disability Ghana 2014).

With no universally accepted approach to measure the prevalence of disability, the commonest approach adopted by most statistical organisations across the globe is the use of impairment types. In the case of Ghana, popular impairment types include visual, emotional, physical, hearing, speech, and intellectual (Ghana Statistical Service 2014). Comprising about 40% of Ghana's disability population, the visually impaired are known to be the largest disability group in Ghana (Ghana Statistical Service, 2014). Visual impairment, in this case, relates to people whose vision is 20/200 or worse. Specifically, this refers to people who fall within the category of low vision to those who cannot see. 20/200 means that a person should at least see an object at 20 feet just as a 'normally' sighted person would see the same object at 200 feet. By this standard, if an individual fails to see a said object at 20 feet, that person is technically regarded as visually impaired.

Having taken the lead, persons with physical impairment constitute the most visible form of disability and represent about 25.4% of Ghana's disability population, making them the second-largest disability group (Ghana Statistical Service, 2014). This group includes persons who have lost an arm or limb or even endured a poor functioning of these organs even if such organs are present. This group primarily comprises amputees, wheelchair/skate/crutches users, and persons using various assistive technology. Finally, persons considered to have a hearing impairment are those who require about five to ten times the loudness of sound to hear what a 'normal' person would need. Specifically, the hearing impaired requires at least 90 decibels of sound to interact with others and constitute about 15% of Ghana's disability population (Ghana Statistical Service, 2014).

Following the United Nations Convention on the Rights of Person with Disability (CRPD), various national disability groups and civil service organisations in Ghana pushed for the enactment of Ghana's Disability Act since this was crucial in removing all barriers to PWDs' life in Ghana (Adam, 2019). Principal among such groups was the Ghana Federation of Disability Organisations (GFD) which acts as the umbrella unit for all disability groups and also serves as a reference point to other individuals who wish to engage any disability community.

The various units of the GFD include the Ghana Society of the Physically Disabled (GSPD), the Ghana National Association of the Deaf (GNAD), the Ghana Association of Persons with Albinism (GAPA) and the Ghana Blind Union (GBU). It must be noted that membership in these groups is voluntary and does not come with any special privileges.

2.2. Public Transport Services in Ghana

Regardless of the ownership, public transport is primarily defined as a shared passenger travel mode available to the public under specific terms (Buehler & Pucher, 2012). This travel mode could be a taxi, commuter bus, train or ferry and may be available to the public at a fee as determined by transport operators or the state. From the definition, two fundamental concepts that differentiate public transport from privately-owned transport modes are 'access' and 'sharing' which portray public transport as a "public good" rather than a "private good".

While the ownership of public transport differs across societies, arguments in support of a state-sponsored public transport service range from the need to prevent market failures to consideration of mobility as a fundamental right that ought to be protected at all cost. It is in this light that numerous state-sponsored public transport services in Ghana like the Omini Bus Authority (OSA), City Express Services (CES) and State Transport Company (STC) have existed from 1909 to date (Agyemang, 2015). To Hotor (2016), a significant reduction in the market share of these state-sponsored public transport services can be attributed to rising financial loss, mismanagement, political unrest/overthrow of governments, and the growing popularity of privately owned transport services loosely referenced as 'trotro'.

The word 'Trotro is a local Ghanaian word that translates to "three pence" and this was the fee charged for trips undertaken in mummy trucks in the late 1950s to 60s (Abane, 2011). At present, the word 'trotro' generally refers to vehicles engaged in commercial transport, including but not limited to Toyota Hiace minibuses, Nissan Urvans, and the Mercedes-Benz 207 series buses (Agyemang, 2015). By association, trotro operators have metamorphosed into a popular union that lies under the banner of the Ghana Private Road Transport Union (GPRTU). This supposed popularity of the GPRTU is witnessed in the ready availability of its services, wide scope of coverage and cheaper fares charged (Agyemang, 2015).

Unlike the Metro Mass Transit (MMT) and State Transport Company Limited (STC), the use of vehicles with low carrying capacity (12 to 15 passengers) by trotro operators usually eliminates long queues at various terminals making it easier for commuters to reduce travel time. Indeed, the cumulative effect of these factors has resulted in making GPRTU a dominant market player as they control about 80% of all trips executed in Ghana (Abane, 2011).

Despite this remarkable accomplishment of the GPRTU in filling the gap in service delivery, non-availability of services at peak times, mechanical breakdowns and delays of services ranks among the factors that have witnessed a growing dissatisfaction with trotro services among them low and middle-income earners (Hotor, 2016).

Additionally, low entry requirements into the trotro space have also been credited with the use vehicles in poor conditions that have subsequently increased the need for more reliable and adaptive travel options (Agyemang, 2013).

With the hope of offering responsive public transport services, the Metro Mass Transit (MMT) services was established in 2003 by the government of Ghana. As a welfare incentive to vulnerable populations (persons with disability, aged, etc), the MMT charges 20% below the market rate and excludes uniformed school children from paying fares (Birago et al., 2017).

For the disability community, the MMT is the first urban transport service to offer disability-friendly buses as seen in the acquisition of buses with priority seats, ramps, assistive communication technology and contrasting colours (Yobo, 2013). Unfortunately, the MMTs' decision to charge below the current market rate has also heightened its challenges in maintaining their vehicular fleets and other overhead costs of operation (Yobo, 2013).

This situation has shifted its focus from delivering intra-city services (that benefited vulnerable populations) to inter-city services since it was easier to stay in business with this business direction.

3. Method and Setting

The Accra Metropolitan Assembly (AMA) was selected for the study. Aside from harbouring Ghana's national capital city of Accra, the AMA also has the highest urban disability population and vehicular fleets both in terms of public and privately operated vehicles (Ghana Statistical Service, 2014). Participants for the study comprised the physically and visually impaired since both groups constitute about 65% of Ghana's disability space, are the most visible or clearly observable form of disability, and also reflect the mobility needs of other disability groups (Odame, 2022; Reynolds, 2010; Yigitcanlar et al., 2019). Drawing on the findings of the National Household Survey (Ghana Statistical Service, 2013), trips to school or work constitutes frequent trips that require public transport. By this, selection criteria also included PWDs who work or go to school and have used public transport (trotro) at least once a month in 2020.

In all, 50 PWDs comprising 22 physically and 28 visually impaired were engaged through the Ghana Federation of Disability Association (umbrella union of all disability Associations in Ghana) as well as the Ghana Society for the Socially Disadvantage (NGO). Overall, participant's age ranged from 18 to 64 years with males and females comprising 67 and 33 percent respectively.

With an emphasis on participants' lived experience in trotro, the study adopted a qualitative research design since it affords the researchers to to understand complex behaviors, needs and cultures (Rabino, 2014). Here, a semi-structured interview was employed to offer flexibility in the data collection process that extended to probing unsatisfied responses.

The instrument used was categorised into three sections; the first focused on basic demographics, intended to facilitate a smooth transition to other sections. The second and third sections covered PWDs' account of physical and intangible support services enjoyed at various terminals in Accra. To validate PWDs' claim of some physical support services, an auditing scheme was adopted to examine the physical conditions of buses at the selected transport terminals. Sections 23 to 30 of Ghana's Disability were adopted to contextualise this instrument since it clearly outlines key disability-friendly facilities required by transport operators. Variables of interest at this level included the presence, conditions and dimensions of selected facilities like a ramp, dedicated seats or space and audio or visual gadgets. Pre-testing of the interview guide was executed between 11th to 13th February 2020 where visually and physically impaired students at the University of Cape Coast were engaged as research participants. The outcome of the interview sessions gave grounds for the researcher to appreciate the duration of the interviews and help develop strategies to promote shorter but effective interview sessions. The auditing scheme was also tested using the campus shuttle as the test subjects within the same period.

The Institutional Review Board of the University of Cape Coast approved the study's final research instruments prior to data collection. Further approval was obtained from the Ghana Blind Union (GBU) and Ghana Association for the Physically Challenged (GAPC) in reaching prospective members who met the selection criteria for this study. Upon confirmation of their willingness to join the study, participants were given different schedules to meet at the Accra Rehabilitation Centre for interviews and interactions. The interview sessions (face-to-face interactions) was expected to last from February to April of 2020 but the outbreak of COVID-19 and the designation of Accra as a hotspot only restricted such face-to-face interaction to 12th March. The rest of the interview sessions were held via phone calls. Interviews were conducted by the author and lasted between 35 to 80 minutes. At all times, the researcher sought permission before recording each interview session. The auditing scheme on the other hand was executed at four popular and busy transport terminals within the Accra Metropolitan Assembly. These include the Kaneshie lorry station, Kwame Nkrumah Circle, Tema Station and 37 Military Station.

At each of these stations, 15 buses were audited to ascertain their compliance with the dictates of sections 23 to 30 of Ghana's disability Act.

Audiotapes from interviews were transcribed using Otranscribe, a free online transcription tool. The transcripts were later exported and edited with MaxQDA for coding. The qualitative data analysis entailed thematic analysis that primarily focused on identifying and reporting common ideas like boarding platform, priority seat and access to information. This was done after a thorough reading of transcripts and subsequent development of a coding framework. The analysis was iterative as the study sought to illustrate a wide range of key views and concerns relating to PWD's travel issues. At all times, anonymous quotations were employed to highlight the perspectives of PWDs and also support the interpretation of themes. Regarding the auditing scheme, pictures and annotations from the field augmented the outcome of the interviews, which offered a detailed description of the facilities found in vehicles and transport terminals.

4. Results and discussions

4.1 Mode Choice

Among various public transport options, participants were vocal about the use of mini-vans which are loosely referred to as trotro. As seen in the narratives, the relatively cheaper cost of engaging trotro services was found to be the prime reason that attracted them to use this service and this revelation does not come as a surprise since Ghana's disability population has been identified to be well represented in the poverty bracket (Ghana Statistical Service, 2014).

> *"…If I am going by trotro, economical reason will be the factor..."* [26-year-old male *visually* impaired National Service Person].

> *'It is really fun to be in a trotro. You get to hear things that can make you laugh since there may be arguments, misunderstandings and other interesting events. In such a case, being in a trotro really makes your day"* [32-year-old visually impaired female administrator]

> *'Trotro comes with all sort of characters and it is also a bit safer because you are many. But in a taxi, the driver can decide to team up with others to rob you."*[43-year-old male visually impaired Public Servant]

In perusing the data, the choice for trotro was seen to be popular among the unemployed participants and those with little or no formal education.

When asked to rate their weekly frequency of engaging trotro services, participants cited 80% to 90% of all trips except in cases where they travelled in groups for religious/other functions or when PWD's were offered lifts. On the other hand, the economically active participants rated their weekly frequency of using trotro services between 70% to 80%. This usually excludes weekends and some occasions when trotro services were either unavailable or when access became a challenge. In such situations, participants resort to other transport options like taxis, Uber or walking (if possible).

Another variable that informed participants' choice for trotro service was the sense of community and social engagement that comes with this travel mode. To participants, the trotro environment offered an opportunity to witness the daily living situations of the low and middle-income class which would otherwise be eluded in other travel modes like taxi or e-hailing services like Uber. Just as Amoako-Sakyi (2017) cited in her study on school children's walkability in Cape Coast, the communal atmosphere in group trip fuels interactions since

trip makers are free to pick on issues that meet their interests. For participants, topics discussed in trotro include complaints about a driver or conductor's attitude, sermons from on-board preachers as well as arguments on politics, sports and other social issues.

The final variable that informed participants' mode choice was the perceived sense of personal safety or security that comes with trotro services. Participants' safety concerns emanated from reported cases of robbery and/or ritual killings of some factions of the disability community namely persons with albinism and mentally retarded. As exclaimed by Bayat (2015), these killings are usually motivated by the belief in the potency of PWDs' body parts in the preparation of potions believed to bring good fortunes and wealth to people. Indeed, fewer incidences of kidnapping and ritual murder have been reported in the media space but participants still expressed their fear of being victims of such crimes despite no history of such cases.

4.2 Support Services Received at The Transport Terminal

Access to Information and Identifying the Right Bus

For most participants, the use of transport terminals as the first reference point for trips appeared to be an ideal thought since they perceived transport terminals to offer some level of security especially when it comes to tracing missing items or seeking redress from transport operators who misconduct themselves in their line of duty. While at a terminal, the location of the right vehicle to join, time of movement and changes in the fare system are critical to the visually impaired group though the physically challenged also benefit from such provision. When asked how participants identify the right vehicles to join, the following are some participants' responses:

> *"At Madina station, the arrangement of trotro's is based on their destination but you will hear the mate (conductors) calling out such places. Because the cars are not properly arranged, I always and ask for help to locate such cars especially when I travel alone…."* [35-year-old male visually impaired radio presenter]

> *"In most cases, you hear shouts from the conductors, which are usually an indication of the moving vehicle at the station. Sometimes, when I get to the station, I am quizzed by drivers and others. I think only 2 out of 5 drivers do such things."* [48-year-old male Unemployed Male Wheelchair user]

The remarks above highlight PWDs' dependence on transport operators as a way to find the right vehicles to join.

Though Frye (2013) identifies knowledge from previous trips as a key tool in identifying a bus, this approach was deemed inadequate for visually impaired participants since the haphazard arrangement of vehicles makes it difficult to assign a dedicated loading bay (as seen in Fig.1) that would have offered an indication of the right bus to join. In the face of an absence of any information portal or assistive technology, the primary indicator in locating the right vehicle was the reliance on callouts from various conductors. Unfortunately, the study identified this approach as confusing for the visually impaired who travelled alone. This is because, the proximity of different conductors made it difficult for participants to hear and follow in the direction of the right vehicle.

The outcome of wheelchair users' attempts to seek directions was different since their quest to find the right vehicle was sometimes interpreted as an attempt to ask for alms or beg for money.

The study found participants' remarks to confirm Munyi (2012) and Nyame & Hague (2013) revelation on how society's position in equating disability to burden culminates in poor services and treatment meted out to PWDs. It must be noted that most participants with higher education did not cite such ill-treatment and attributed this to their conscious effort to look and dress smartly at all times. This need to dress to look apart further confirmed Sawadsri (2010) position on how biased social standard induces 'misfits' like PWDs to assume different personalities if they wish to be accepted.

Fig.1 Kaneshie Lorry Station (A) and Kwame Nkrumah Lorry Station (B)

On getting to the right vehicle, the vehicle's conditions also play a critical role in limiting PWDs' ability to join public transport. While Mitchell & Rickert (2010) recommends a minimum floor height of about 250 millimetres for PWDs', observed height among vehicles ranged from 320 to 520 Millimetres since Toyota Haice, Nissan Urvan, Hyundai Grace and the Mercedes Benz Sprinter 207 were the most commonly used buses among trotro drivers in Accra (see Fig.2).

Fig.2 Toyota Hiace (A) and Mercedes Benz 207 Sprinter (B)

In the face of high-floor vehicles, visually impaired participants did not consider this situation a challenge given their years of experience using such high-floor buses.

This remark also confirms Odame et al.'s (2020) study on how visually impaired students in the University of Cape Coast relied on muscle memory and experience in using campus shuttles with high floor height.
Though the visually impaired participants seemed to have no challenge with the height of the vehicles, the wheelchair users had a different story. When asked how they find their way into the vehicles, the following responses were made:

> "*I have one problem with the Benz buses. Yes, if I'm in a wheelchair and I want to join the bus, I have to get down and crawl on it. The height of the step leading into the car is too high for my wheelchair'* [42-year-old male wheelchair user, Teacher]

> "*Sometimes the height is too much. So, while climbing, you have to put in too much energy to join a bus especially the Mercedes Benz 207 buses."* [32-year-old physically impaired unemployed male].

For wheelchair users in particular, the absence of a ramp in joining public transport buses induced participants to resort to crude techniques like propelling or crawling from the ground into the buses. Though crawling was found to be a primary tool for users of the Mercedes Benz 207 Sprinter buses, concerns raised by participants centred on the tendency of soiling their dress with dirt since the first level of entry and the floor of most trotro buses were always dirty. In some cases, participants even revealed how they resorted to commonly shared taxis when they wore their best dresses or attended important occasions. Amid the high-floor buses and the absence of ramps, calls on transport owners to resort to simple tools like wooden ramps or pallets did not yield any positive feedback. Here, casual conversation with transport operators revealed their objection to this recommendation since they consider it an extra cost to their operations.
To reduce their stress in joining trotro services, participants cited some strategies adopted by trotro operators in facilitating their entry into these buses. Unfortunately, these strategies take the form of physically lifting participants into buses and though transport operators' intentions seem to be good, participants branded such efforts as embarrassing and dehumanising. To participants, the public display and unnecessary attention that accompanies such assistance creates a feeling of shyness and even perpetuates the negative stereotype of PWDs as incapable of undertaking simple activities like boarding buses. Such embarrassing moments have been identified by Nyaupane & Andereck, (2008) to demoralise self-confidence and even make it difficult for PWDs to enjoy public services.
During the interview, an elderly female wheelchair user who seemed to have gained considerable weight shared her frustrations on how the absence of ramps made her unattractive to transport operators due to her constant request for assistance in getting into or disembarking from trotro buses. In this regard, this participant had no option but to reduce her dependency on trotro since she was spared the embarrassment of being lifted while joining or disembarking from the trotro.

Priority Seats and Designated Space

In ensuring easy access, offering dedicated services like priority seats for the visually impaired or dedicated spots for wheelchair users is crucial. To ascertain the presence and utilisation of such facilities, participants were asked to identify where they sit when they join trotro buses and the following are some of the responses gathered:

> *"Anywhere! Where there is an available seat, I sit there. But it's good you don't sit at a place where they will ask you to adjust yourself anytime other passengers join or alight."* [52-year-old-visually impaired male craftsman].

> *"I sit in front, just by the driver but when the front seats are occupied, I just move to other seats. This could be at the back or any other seats in the car."* [38-year-old-female wheelchair user, Tailor]

The responses from participants indicate the clear absence of a prescribed seating area for both wheelchair users and the visually impaired though participants identified their preferred seating area. Preferred seating positions include the seat directly behind the driver and the ones adjacent the driver's seat, as seen in Fig.3. The choice of these seats was informed by the fact that, these preferred seats spared participants the trouble of intermittently alighting anytime other passengers decided to descend or join the bus.

Fig.3 Front seat (A) and the seat behind the driver (B)

In as much as participants expressed their desire to avoid the discomfort associated with other seats, the '*first come - first served'* approach (a situation where passengers who arrive first at the bus terminal occupy comfortable seats) at various terminals made it difficult to escape this reality.

The only time participants were assured of getting their preferred seats was when they arrived early at the bus terminal.

At one time, a participant narrated how this desire to get the front seat induced him to get to the terminal as early as 4:00 AM since such preferred seats may not be available during 6:00 AM peak time.

While not in a hurry, other participants also indicated their decision to skip vehicles until they found a preferred seat of their choice. Other identified method of getting participants preferred seats was the reliance on the discretion or goodwill of transport operators but these were seldomly experienced except for participants who had long-standing relationships with specific transport operators.

In cases where transport operators allowed PWDs to utilise their preferred seats, competition from other passengers hindered PWDs from occupying such seats though this does not happen at all times. To participants, the relatively comfortable and ideal position of these seats also made it a target for other passengers who wished to escape the trouble of alighting intermittently for other passengers to join or alight.

In fact, this absence of priority seats was found to contradict the dictates of Ghana's Disability Act which categorically enjoins transport operators to reserve two seats for PWDs at all times (Government of Ghana, 2006).

These two seats were only permitted to be given to the general population if no PWD boarded the bus before leaving the terminal.

4.3 Wayfinding Aids on Public Transport

Ensuring independence in using transport facilities does not only lie with identifying the right vehicle but also extends to making travel decisions while a vehicle is en route. For PWDs, such independence may be exhibited by utilising wayfinding platforms or assistive technology that allow PWDs' to relay their travel decisions to transport operators. Though these issues were pertinent to all participants, wayfinding aids were more crucial to the visually impaired since other disability groups could easily identify their location.

As a measure of the presence of wayfinding aids, the study enquired about how participants ascertain their location while journeying from one point to the other. The following are some of the responses:

> *"I just know where I have gotten to base on the call out from the conductors..."* [24-year-old visually impaired male, National Service Person]

> *"I've been on this road since 1992 and I am quite observant. So, if I sit in the car, I always make sure I observe the curves, the roughness of the road, the slope. Sometimes I count the speed rumps."* [39-year-old-male visually impaired local craftsman]

While focusing on the assertion of only the visually impaired, the leading tool employed in ascertaining participants' location was their reliance on callouts from conductors. This approach was not only new to Accra since Frye (2013) identified such a method in other African countries like Uganda, Tanzania and Papua New Guinea.

To participants, the frequency of callouts was higher if the moving bus had many vacant seats since this was also a strategy to get prospective passengers to fill such vacant seats. On the other hand, callouts from conductors were seldomly heard if the moving vehicle was full though doing this would have aided strangers and other passengers who were not familiar with the route.

In as much the dependency on callouts appeared to be a regular routine in the operations of trotro, participants identified some potential risks associated with this approach. To some participants, forgetfulness on the part of conductors resulted in missing one's destinations even though advanced notices had been given to this effect. This finding is in tandem with Odame (2017) who attributed the forgetfulness of campus shuttles operators to missing one's destination at the University of Cape Coast. To ensure compliance with their travel needs, participants resort to issuing constant reminders since this reduces the tendency of forgetfulness on the part of the conductors.

Aside from participants' reliance on conductors, reliance on their lived experiences or local knowledge of the route also emerged as a valuable source of expertise in ascertaining one's location. Here, visually impaired participants cited known landmarks and personal intuition as key in ascertaining their location on familiar routes.

Some of these landmarks include the presence or number of roundabouts, speed rumps, slope or roughness of road, as well as twists and turns along a route.

Beyond the reference to physical structures, participants also revealed how they rely on the voices of vendors, unique stench and busy setting of places like the Kwame Nkrumah Circle as a measure to determine their location. In the face of its usefulness, Murty et al. (2020) and Kowialiewski & Majerus (2020) reveal how a disruption to one's attention may impair a person's ability to make on the spot decision, hence the need for assistive support services that complement human capabilities.

5. Conclusion

Public transport like 'trotro' increases the mobility options of vulnerable populations as it is cheaper and readily available than other transport services. Unfortunately, this transport service does not promote the creation of an inclusive space since many of its features do not conform to the dictates of Ghana's Disability Act. This was evident in the absence of key features like priority seats, assistive devices and ramps on all buses audited for this study. To both the visually and physically impaired, this situation did not only amplify society's poor recognition of the needs of the disability community but also heightened their dependency on the general population when it comes to simple activities like locating or joining bus.

6. Policy Implication

The study calls for urgent measures to overhaul the entire public transport space (trotro), beginning with a rigours educational outreach program for transport operators.

This will enlighten transport operators on the need to create an inclusive environment and given the contributory role of road accidents in causing disability. While this education program is underway, the Ministry of Transport, Ghana Private Road Transport Union and other agencies should put in measures to ensure total compliance with the dictates of the Ghana disability Act, which has existed for nearly 15 years. This could range from the issuance of an ultimatum for the moderation or acquisition of new buses as well as the prosecution of all operators who flout this directive.

Beyond this, establishing a dedicated operational guideline that outlines basic entry requirements for transport operators will be needed. This will empower the Drivers and Vehicles Licence Authority (DVLA) to include disability-specific parameters as key requirements for attaining a roadworthy certificate. Finally, the Government of Ghana can also support trotro operators to acquire modern and disability-friendly through soft loans and other concessions. Doing this will reduce the economic burden of acquiring new buses or modifying existing ones.

7. Limitations and areas for further research

The findings presented in this study should be interpreted with caution, given a few limitations. Being qualitative inclined, the study cannot be used to represent the views of all visually and physically impaired in the Accra Metropolitan Assembly and those who use trotro.

Secondly, there is the probability of sampling bias due to how participants were engaged. The study heavily relied on the recommendations and references from leaders of the various disability groups which may indicate some biasness on their part. However, data collection and compliance with research ethics were upheld to the latter.

This ensured that the results and discussion presented in this manuscript reflected participants' views and opinions. Finally, the outbreak of COVID-19 and the designation of Accra as a hotspot reduced in-person interaction with participants, which may have denied the study of valuable data relating to non-verbal responses and gestures.

Acknowledgments

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request. This manuscript was extracted from an ongoing PhD study on transport-related social exclusion among persons with disability in the Accra Metropolitan Assembly, Ghana.

References

Abane, A. (2011). Travel behaviour in Ghana: Empirical observations from four metropolitan areas. *Journal of Transport Geography*, *19*(2), 313–322. https://doi.org/10.1016/j.jtrangeo.2010.03.002

Adam, I. (2019). Drivers of physical accessibility among hotels. *Anatolia*, *30*(4), 560–571. https://doi.org/10.1080/13032917.2019.1651356

Agyemang, E. (2015). The bus rapid transit system in the Greater Accra Metropolitan Area, Ghana: Looking back to look forward. *Norsk Geografisk Tidsskrift*, *69*(1), 28–37. https://doi.org/10.1080/00291951.2014.992808

Agyemang, K. K., Amoako-sakyi, R., Antwi, K. B., & Mensah, C. A. (2020). Transit oriented development: theory and implementation challenges in Ghana. *TeMA. Journal of Land Use, Mobility and Environment*, *13*(3), 409–425. https://doi.org/http://dx.doi.org/10.6092/1970-9870/6981

Agyemang, W. (2013). Measurement of Service Quality of " Trotro " As Public Transportation in Ghana : a Case Study of the City of Kumasi. *32nd Southern African Transport Conference*, *July*, 283–291.

Amoako-Sakyi, R. O. (2017). *School path walkability and pedestrian crashes in the Cape Coast Metropolitan Area* [University of Cape Coast]. https://doi.org/10.1017/CBO9781107415324.004

Atubiga, E. (2016). *An effective and efficient road transport system requires regular road maintenance - Government of Ghana*. Retrieved from: http://www.ghana.gov.gh/index.php/media-center/features/2505-an-effective-and-efficient-road-transport-system-requires-regular-road-maintenance

Baffoe, M. (2013). Stigma, Discrimination & Marginalization: Gateways to Oppression of Persons with Disabilities in Ghana, West Africa. *Journal of Educational and Social Research*, *3*(1), 187–198. https://doi.org/10.5901/jesr.2013.v3n1p187

Bayat, M. (2015). The stories of "snake children": Killing and abuse of children with developmental disabilities in West Africa. *Journal of Intellectual Disability Research*, *59*(1), 1–10. https://doi.org/10.1111/jir.12118

Birago, D., Opoku Mensah, S., & Sharma, S. (2017). Level of service delivery of public transport and mode choice in Accra, Ghana. *Transportation Research Part F: Traffic Psychology and Behaviour*, *46*, 284–300. https://doi.org/10.1016/j.trf.2016.09.033

Brussel, M., Zuidgeest, M., Pfeffer, K., & van Maarseveen, M. (2019). Access or accessibility? A critique of the urban transport SDG indicator. *International Journal of Geo-Information*, *8*(2), 67. https://doi.org/10.3390/ijgi8020067

Buehler, R., & Pucher, J. (2012). Demand for Public Transport in Germany and the USA: An Analysis of Rider Characteristics. *Transport Reviews*, *32*(5), 541–567. https://doi.org/10.1080/01441647.2012.707695

Danso, A. K., Ayarkwa, J., & Dansoh, A. (2011). State of accessibility for the disabled in selected monumental public buildings in Accra, Ghana. *The Ghana Surveyor*, *2*(3), 23–32.

Danso, A. K., & Tudzi, E. P. (2016). *Inclusive Access to Accra Shopping Malls*. *August 2015*.

Delatte, A., Baouni, T., Belwal, R., Daou, L., Gourram, D., Imam, R., Zitoun, M. S., & Smadi, A. (2018). Understanding the needs of MENA public transport customers: Culture of service and gender-responsive recommendations 1. *TeMA. Journal of Land Use, Mobility and Environment*, 7–30. https://doi.org/10.6092/1970-9870/5458

Ferreira, A., Beukers, E., & Brömmelstroet, M. Te. (2012). Accessibility is gold, mobility is not: A proposal for the improvement of Dutch transport-related cost-benefit analysis. *Environment and Planning B: Planning and Design*, *39*(4), 683–697. https://doi.org/10.1068/b38073

Frye, A. (2013). *Disabled and older persons and sustainable urban mobility*. Retrieved from: http://unhabitat.org/wp-content/uploads/2013/06/GRHS.2013.Thematic.Disabled.and_.Older_.Persons.pdf

Ghana Statistical Service. (2013). *Second National Household Transport Survey Report 2012*. http://www.statsghana .gov.gh/docfiles/publications/Second National Household Transport Survey Report 2012.pdf

Ghana Statistical Service. (2014). *Population and Housing census report - Disability in Ghana*.

Government of Ghana. (2006). *Persons With Disability Act , 2006 Act 715: Vol. ACT 715*.

Gregorius, S. (2014). *Transitions to adulthood: the experience of youth with disability in Accra, Ghana.* Loughborough University.

Hotor, D. E. (2016). *The use of Public Transport Services by Residents in the Accra Metropolitan Area* [University of Ghana]. http://ugspace.ug.edu.gh

Ipingbemi, O. (2015). Mobility challenges and transport safety of people with disabilities in Ibadan, Nigeria. *African Journal for the Psychological Study of Social Issues*, *18* (3), 15–28.

Kett, M., Cole, E., & Turner, J. (2020). Disability, mobility and transport in low- and middle-income countries: A thematic review. *Sustainability (Switzerland)*, *12* (2), 1–18. https://doi.org/10.3390/su12020589

Kowialiewski, B., & Majerus, S. (2020). The varying nature of semantic effects in working memory. *Cognition*, *202*(4), 104–118. https://doi.org/10.1016/j.cognition.2020.104278

Meshur, H. F. A. (2016). Evaluation of Urban Spaces from the Perspective of Universal Design Principles: The Case of Konya/Turkey. *TeMA. Journal of Land Use, Mobility and Environment. Journal of Land Use, Mobility and Environment*, *9*(2), 191–208. https://doi.org/10.6092/1970-9870/3786

Mitchell, C., & Rickert, T. (2010). *A review of international best practice in accessible public transportation for persons with disabilities*. http://www.my.undp.org/content/malaysia/en/home/library/poverty/PubPovRed_PublicTransportation.html

Munyi, C. W. (2012). Past and Present Perceptions Towards Disability: A Historical Perspective. *Disability Studies Quarterly*, *32*(2). https://doi.org/10.18061/dsq.v32i2.3197

Murty, V. P., Fain, M. R., Hlutkowsky, C., & Perlman, S. B. (2020). Memory for social interactions throughout early childhood. *Cognition*, *202*(3), 1–17. https://doi.org/10.1016/j.cognition.2020.104324

Niglio, R., & Comitale, P. P. (2015). Sustainable Urban Mobility Towards Smart Mobility: the Case Study of Bari Area, Italy 1. *TeMA - Journal of Land Use, Mobility and Environment*, *8*(2), 219–243. https://doi.org/http://dx.doi.org/10.6092/1970-9870/3009

Nyame, J., & Hague, T. (2013). *'Are we men enough?' An intersectional analysis of lived experiences of men with physical disability in Accra-Ghana*.

Nyaupane, G. P., & Andereck, K. L. (2008). Understanding travel constraints: Application and extension of a leisure constraints model. *Journal of Travel Research*, *46*(4), 433–439. https://doi.org/10.1177/0047287507308325

Odame, P. K. (2017). *Road transport infrastructure and mobility: Views of students with physical disability in the University of Cape Coast* [University of Cape Coast]. Retrieved from: https://erl.ucc.edu.gh/jspui/handle/123456789/3211

Odame, P. K. (2022). Recounting the Blessings and Curses of Living with a Disability: The Experiences of Persons with Visual and Physical Impairment in Accra. *Global Social Welfare*. https://doi.org/10.1007/s40609-022-00244-9

Odame, P. K., Abane, A., & Amenumey, E. K. (2020). Campus shuttle experience and mobility concerns among students with disability in the University of Cape Coast, Ghana. *Geo: Geography and Environment*, *7*(2). https://doi.org/10.1002/geo2.93

Ojo, T. K., Amoako-Sakyi, R. O., & Abane, A. (2014). Bus passenger movement in Ghana: A case of Intercity State Transport Corporation (ISTC) Coaches Ltd. *Research on Humanities and Social Sciences*, *4*(22), 106–111. Retrieved from: http://www.iiste.org/Journals/index.php/RHSS/article/view/16814

Oviedo Hernandez, D., & Titheridge, H. (2016). Mobilities of the periphery: Informality, access and social exclusion in the urban fringe in Colombia. *Journal of Transport Geography*, *55*, 152–164. https://doi.org/10.1016/j.jtrangeo.2015.12.004

Peña Cepeda, E., Galilea, P., & Raveau, S. (2018). How much do we value improvements on the accessibility to public transport for people with reduced mobility or disability? *Research in Transportation Economics*, *69*(4), 445–452. https://doi.org/10.1016/j.retrec.2018.08.009

Rabino, G. (2014). Ontologies and Methods of Qualitative Research in Urban Planning. *TeMA - Journal of Land Use, Mobility and Environment*. https://doi.org/10.6092/1970-9870/2549

Reynolds, S. (2010). Disability culture in West Africa: Qualitative research indicating barriers and progress in the greater Accra region of Ghana. *Occupational Therapy International*, *17*(4), 198–207. https://doi.org/10.1002/oti.303

Sawadsri, A. (2010). *Accessibility and disability in the built environment : Negotiating the public realm in Thailand* [Newcastle University]. http://theses.ncl.ac.uk/jspui/handle/10443/1656

Slikker, J. (2009). Attitudes Towards Persons With Disability In Ghana. *VSO Ghana*, *May*, 82.

Stjernborg, V. (2019). Accessibility for all in public transport and the overlooked (social) dimension-A case study of Stockholm. *Sustainability (Switzerland)*, *11*(18). https://doi.org/10.3390/su11184902

Tudzi, E. P., Bugri, J., & Danso, A. K. (2017). Towards accessible built environments in Universities in Ghana: An approach to inclusiveness assessment. *Disability, CBR & Inclusive Development*, *28*(1), 189–206. https://doi.org/10.5463/dcid.v1i1.592

Voice of People with Disability Ghana. (2014). *Political governance for persons with disability*. https://doi.org/10.1287/orsc.1090.0428

World Health Organization. (2011). Understanding disability. *WHO. World Report on Disability. Malta: WHO*, 1–17.

Yigitcanlar, T., Mohamed, A., Kamruzzaman, M., & Piracha, A. (2019). Understanding Transport-Related Social Exclusion: A Multidimensional Approach. *Urban Policy and Research*, *37*(1), 97–110. https://doi.org/10.1080/08111146.2018.1533461

Yobo, E. (2013). *The politics of public transportation in Ghana: The case of Metro Mass Transit Limited* [University of Ghana]. http://ugspace.ug.edu.gh/bitstream/handle/123456789/5284/Eric Yobo_Politics of Public Transportation in Ghana. The Case of Metro Mass Transit Limited_2013.pdf?sequence=1

Image Sources

Fig.1: Author (2021);

Fig.2: Author (2021);

Fig.3: Author (2021).

Author's profile

Odame Kwame Prince

He is a transport geographer and lecturer at the Department of Geography Education at the University of Education, Winneba. His research interest focuses on transport and exclusion, non-motorised transportation modes, urban transport issues and disability research.

TeMA Journal of
Land Use, Mobility and Environment

Call for papers – Special Issues 2023

WHAT TRANSITIONS? SCIENTIFIC DEBATE, RESEARCH, APPROACHES AND GOOD PRACTICES

The current challenges (climate change, pandemic, social divide, lack of resources, economic crisis, population ageing, depopulation of inland areas) affecting cities require a global renewal of methodologies, approaches, tools, policies and behaviours, calling into action all urban actors (planners, decision-makers, investors, city-users, citizens). The convergence point identified as a possible solution, both in the academic and political spheres, refers to the "transition" towards more sustainable, resilient and compatible management, governance and use of cities. With this input being accepted, TeMA Journal aims to investigate possible scenarios of urban transition inviting scholars, professionals, technicians, and urban actors to present contributions that address the following topics:

- *transitions in methods and approaches particularly concerning*
  transport-territory integration
  roles of planners and experimental governance
  assessment of impacts on the organization of urban and regional systems
  15 minutes-city
  urban accessibility to goods and services
  ageing of the population
  research scenarios for resilience and sustainability appliance synergies between urban infrastructures
- *transitions related to digital technological innovations particularly concerning*
  urban digital twin
  smart city
  augmented reality applications for urban planning
  participation and Big Data
- *environmental* transition with particularly concerning
  best practices in applying the principles of resilience and sustainability
  mitigation and adaptation to climate change in the urban environment
  requirements and challenges for the creation of sustainable green cities
  optimization of energy consumption in urban areas
  sustainable and responsible cities and ways of use
  overtourism
  post Covid-19 city
  healthy cities
  optimization of energy consumption

The call for contributions for this Special Issue, also in a critical/provocative key, aims to delve into the state of art regarding a goal/challenge (the transition) that risks being a new "label" hard to define and implement.

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 3 (2022) 447-469
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9068
Received 31st March 2022, Accepted 31st August 2022, Available online 30th December 2022

www.tema.unina.it

Circular living. A resilient housing proposal

Emanuela Braì [a], Giovanna Mangialardi [b], Domenico Scarpelli [c*]

[a] Department of Innovation Engineering (DII)
Unisalento, Lecce, Italy
e-mail: emanuela.brai@unisalento.it
ORCID: https://orcid.org/0000-0002-1503-4233

[b] Department of Science in Civil Engineering and Architecture (DICAR)
Polytechnic University of Bari, Bari, Italy
e-mail: giovanna.mangialardi@poliba.it
ORCID: https://orcid.org/0000-0003-3256-5367

[c] Department of Science in Civil Engineering and Architecture (DICAR)
Polytechnic University of Bari, Bari, Italy
e-mail: domenico.scarpelli@gmail.com
ORCID: https://orcid.org/0000-0002-4214-4649
* Corresponding author

Abstract
The current climate change consequences, the migration phenomena, the pandemic, and the war affect the already unstable housing system situation. Implementing resilience is as necessary as ever to solve the existing housing crisis. In particular, a little number of housing units, lack of maintenance, the inadequacy of the heritage to the new housing needs, and weak attention to social aspects, characterize the Italian social housing system. Considering the possible powerful relationships between resilience, circular economy, and housing, this paper is aimed at determining whether and how CE principles can be applied in the social housing system to make it more resilient, adopting a qualitative research method. To this end, a model for Circular Living (CL) is proposed: it includes strategies at the building, neighbourhood/city, and territorial scales. It is extrapolated from the existing bibliography on housing system, resilience and circular economy; the analysis of the case study of south Salento together with its critical housing system and some emerging best practices. The use case of a 70s public building in Lecce is also presented. Although the CL Model is for the resilience of the social housing system in peripheral territories, future research could implement and validate the model in different contexts and systems.

Keywords
Resilience; Circular economy; Social housing; Flexibility; Housing distress.

How to cite item in APA format
Braì, E., Mangialardi, G. & Scarpelli, D. (2022). Circular living. A resilient housing proposal. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 447-469. http://dx.doi.org/10.6092/1970-9870/9068

1. Introduction

Strategies to implement resilience are an increasingly urgent demand. This nowadays is crucial, considering the constant and new natural catastrophes and climate change consequences – which are expected to worsen in the following years (Micalella, 2014) – migration phenomena, the effects of the pandemic, and the more unstable economic and social situation. All these aspects have a great impact on housing issues.

In detail, the Italian housing system is characterized by several inefficient aspects: these include the numerical lack of housing units, the inadequacy of heritage (Mielis, 2011), and the weak attention to social aspects (Guarino, 2010). The need of modifying the actual housing system to fight the housing access problem has already been pointed out (Federcasa, 2020). Moreover, a lack of strategic view in management choices characterizes the system, which has rarely been reinterpreted in a resilient way.

Some definitional clarifications are necessary. The European interpretation of the term "social housing" refers to the set of services and housing, actions and tools needed to allocate suitable units to families who, due to financial or other problems, have difficulty in finding housing at the market conditions (Czjschke & Pittini, 2007). In this sense, "social housing" includes all other forms and models of housing (public housing, cooperative, affordable private housing, etc.). Social housing is not only a provision of houses but also a complex system (Kraatz, 219) that interferes with and can change many layers and systems making up a city (Porter et al., 2018).

In some studies, housing and resilience are closely related. All UN-Making cities resilient[1], City Resilience Profiling Program[2], and 100 Resilient Cities[3] consider social housing as a system in which resilience can and must be implemented, representing an occasion for multiple levels. It is worth mentioning the reference contained in the Sustainable Development Goals of the Agenda 2030, where housing is one of the strategies to obtain Goal 11 "Sustainable cities and communities"[4]. Indeed, some achievements are not a novelty in public housing history. Social housing was conceived in the immediate post-war period through a strong centralist intervention plan. During the INA Casa[5] period, it achieved social cohesion and led to the construction of new and more sustainable buildings, new relationships between the city and the user, new public spaces, and new urban fabrics connected to the rest of the city (Di Biagi, 2001). Moreover, nowadays, social housing has allowed starting urban regeneration processes (Guarino, 2010), as it has modified the social infrastructure, empowering people, and giving them the tools to operate to become active citizens and workers (Holz, 2016). Experimentations on social housing sites can be a strategy to regenerate cities and provide them with quality and efficiency, in addition to a way to recover from the pandemic crisis. In this way, social housing can also become a tool to experiment and set new standards, as done in the past. So, social housing experimentations can define a new paradigm of spaces, in adaption to economic, social, and environmental external agents.

Instruments to obtain a resilient housing system could be various. Among them, one of the most significant could be the application of the circular economy (CE) approach, as it allows operating on both physical and human dimensions. According to the European Parliament (2022), CE is defined as "a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended". Although the approach has been deeply studied because of the huge resource consumption caused by the construction sector, the interaction between social housing and circular economy is an emerging theme. A few studies, such as the ones by Marchesi & Tweed (2021), Cetin et al. (2021) and Bolici et al. (2020), apply circular and

1 Available at: www.unisdr.org/campaign/resilientcities/

2 Available at: unhabitat.org/programme/city-resilience-profiling-programme

3 Available at: resilientcitiesnetwork.org/

4 Available at: ec.europa.eu/international-partnerships/sustainable-development-goals_en

5 INA Casa was an intervention plan by the Italian government. The plan was in effect between 1949 and 1963, implemented Italian public housing, and generated work. It was managed by a specific branch of INA (Istituto Nazionale per le Assicurazioni), the national authority for insurance.

collaborative economy principles either to urban planning or to some aspects of the buildings. Nevertheless, even though it may represent a significant part of the built environment to be implemented, no study yet has applied CE to the whole housing system.

To overcome this gap, the authors intend to further explore the relationships and opportunities arising from the application of the circular economy approach to achieve a resilient housing system, proposing an innovative model useful to generate improved conditions within the social housing system, reaching a new state of balance. In detail, the analysis will use the circular economy pillars to formulate a Circular Living Model as a new tool for supporting the development of resilient urban social housing solutions, boosting the housing crisis response, and generating urban and territorial regeneration and flexibility.

After the introduction, the paper deals with an overview of the national housing system's criticality. Then, the research method is presented. Later, the paper deals with a literature review of resilience and circular economy strategies, analysing the existing correlation with the social housing system, extrapolating the literature gaps, and the theoretical matrix useful for addressing the research. In detail, using and analysing the case study method of the South Salento housing system in Apulia Region, a Circular Living Model is extrapolated. The last sections outline discussions and conclusions, current limits, and future research suggestions.

2. Difficulties and values of the national housing system

Public housing in Italy has a long history and a strong value in constructing cities. The Italian experience started in 1903, when Law n. 254 of the 31st of May 1903[6], better known as Luzzati Law, introduced affordable housing for the working class and institutions, tasking Municipalities with the construction and management of the houses . In 1908, instead, the central State started funding these operations. During Mussolini's government, thanks to Royal Decree of Law 1944/1924[7], the management institutions started working on a provincial level and added the possibility for users to buy their homes. An important turning point was in 1949, with the introduction of Piano Fanfani (INA Casa). This operation was unprecedently aimed at poor people, to create a big stock of apartments with high-quality buildings and public spaces, usually leading to the formation of autonomous quartiers (Di Biagi, 2013). Most of these buildings have nowadays been sold. Another important turning point was the GESCAL[8] period, from 1963 to 1978, during which a lot of housing was built. These constructions were usually characterized by a worse quality level, a bad relationship with public space, excessive size, and a great distance from city centres (Mielis, 2011). The houses of this period represent an important part of public housing and an important field to operate on. Until 1992, public housing followed a similar logic, but a halt occurred in the construction process, together with a rise of the sold public apartments to solve a chronicle absence of resources in housing.

In the last years, this shortage of public resources led to the need of involving the private sector, using new models and stakeholders. In addition, a new group of vulnerable people emerged, the "grey" target, defined as the group whose income is too high to enter the public housing sector yet too low income to access the free market[9] (Lodi Rizzini, 2013).

In 2008, an important instrument to fight housing exclusion has been introduced by the Ministerial Decree of 22 April 2008: *Edilizia Residenziale Sociale* (ERS), complementary to the previously existing *Edilizia*

6 Full text available at: https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzeL

7 Full text available at: https://www.gazzettaufficiale.it/eli/gu/1944/01/15/2/sg/pdf

8 GEStione CAse per i Lavoratori (Institution for worker's houses) was a fund, established with Italian Law 60/1963, which helped to build several public apartments within the considered period.

9 The "Grey" target is composed of people whose annual income is between the highest income to access Edilizia Residenziale Pubblica and twice that value. It is mainly composed of the so-called "impoverished middle class", which consists of young people with precarious jobs, foreigners, single-parent families, elder people, and university students.

Residenziale Pubblica (ERP)[10]. Some of the aspects, which make ERS an innovative model, compared to the ERP system, are the partnership between the public and private sector, the strong attention to social actions and services, and, as mentioned, the presence of different targets. At the same time, working on ERS is a great opportunity to operate on the communitarian level of the system. Anyway, ERS experimentations are not so frequent and are mainly located in Northern Italy. It should also be noted that the reuse of existing buildings in a state of neglect as a means of responding to housing problems is not a common practice. ERS interventions have often implied the construction of new buildings; this has led to more soil consumption, the absence of new value, and new territorial resources to trigger urban regeneration processes (Martinelli et al., 2020).

Despite the presented tools for fighting housing exclusion, as previously stated, the Italian social housing system is characterized by a defective offer – just 3% of the total housing units are social (Pittini, 2019) – lack of maintenance of the heritage and weak attention to the social aspect. The rising in poverty and extension of the "grey target" has produced a high, unfulfilled housing demand (Palvarini, 2006). Consequently, 9% of Italian families are in a condition of housing poverty (Palvarini, 2010), hence leading to the current housing crisis.

These critical conditions lead to the need for specific interventions and funding, not as spot actions, but instead organized in a complex and organic frame, to properly modify and improve the housing system.

3. Research method

Considering the possible powerful relationships between resilience, circular economy, and housing, this paper is aimed at determining whether and how CE principles can be applied in the social housing system to make it more resilient, adopting a qualitative research method (Creswell & Creswell, 2017). The research aims at exploring possible new governance solutions to overcome the current limits in the management of housing supply, functionally and typologically adapting the existing public heritage to the new needs. The goal is to protect and extend the lifetime of the public heritage, modifying uses and shapes and responding to growing housing needs, using resources circularity. To this end, the research consists of three consequential main phases, hereafter briefly recalled and represented in Fig.1: Phase 1) Literature review; Phase 2) Case study exploration; Phase 3) Model definition.

In the first phase, the literature review about CE, resilience, and social housing has been explored to create a common knowledge base on a previously unexplored topic useful to guide the entire study. So, by adopting a snowball sampling technique, the explorative literature review process stopped when qualitative information collected was considered complete and clear (saturation) (Bell et al., 2018). From the review, the theoretical matrix based on resilience adjectives and CE pillars has been extrapolated, and literature gaps have been underlined. The main contents emerging from this first phase were proposed in section 4.

In the second phase "Case study exploration", South Salento is chosen as the area of investigation. The South Salento housing system is selected as a case study (Yin, 1994) because of its territorial peculiarities, unexplored social housing issues, and suitability for wide-area strategies. It is peripheral, characterized by medium-small strongly interconnected municipalities, housing distress, and landscape values, together with social phenomena, such as aging of the population and internal area depopulation (Puglia, 2015). Therefore, the selected case study involves a case that is somehow unique and specific, as well as unexplored. Two main data collection methods are adopted, namely the analysis of existing documentation and data (secondary data) and field observation.

[10] Within the document, ERS is defined as the system of "real estate units with residential and general interest function that safeguard social cohesion and reduce the housing problems of disadvantaged individuals and families, who are unable to access the rental of housing in the free market. It is accompanied by the set of housing services aimed at satisfying primary needs".

As to documentation, the plans at the regional (PPTR[11]), provincial (PTCP[12]) and municipal levels (e.g. Lecce PRG[13]), and sectorial studies (South Salento Internal Area[14]) were studied. In addition, all data found online and at the relevant administrations related to housing needs and public assets were collected. Data collected were integrated with those collected by direct observations of the work carried out within the public administrations (Apulia Region, ARCA Sud Salento). Direct observation was particularly useful to better understand the recurrent problems, ongoing projects, and emerging strategies. This phase of the South Salento scenario corresponds to paragraph 5.

The last step, as reported in paragraph 6, has been the definition of the CL Model, an innovative tool for improving the resilience of the social housing system in peripheral territories, operating on different scales and dimensions.

The model consists of a frame that derives from the overlapping of the concepts of CE, social housing, and resilience, and a set of strategies that are specific for the analysed territorial context. Its infrastructure is, in fact, the direct consequence of the first phase whereas the specific actions that are presented in the model are the consequence of the second phase. Finally, a use case assessment (Kart & Spece, 2003) is provided. The selected use case is a '70s building located in Piazzale Cuneo (Lecce) because it represents one of the most frequent conditions of South Salento's public housing heritage. The example also represents a way to show a possible and real application of the model.

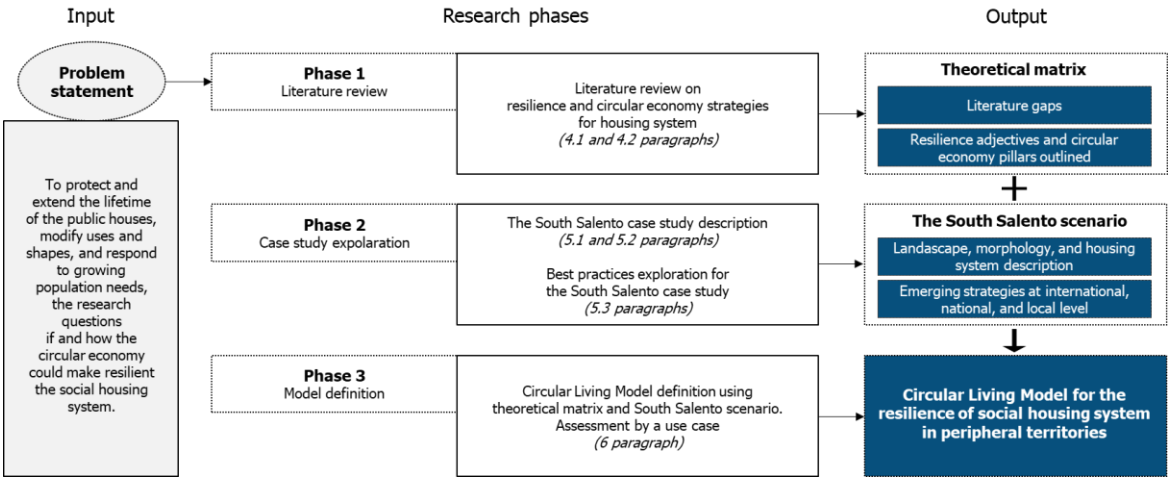


Fig.1 Research design

11 Regional Territorial Landscape Plan is a landscape plan which has been introduced in Apulia in 2015. The plan is supposed to give a deep knowledge of Apulian territory, to protect and enhance landscape values and to give directions for a sustainable and harmonic territorial development. Further information is available at: http://www.sit.puglia.it/portal/portale_pianificazione_regionale/Piano%20Paesaggistico%20Territoriale

12 Provincial Territorial Coordinament Plan is a territorial plan which has been introduced with Law 1150/42. The plan gives instructions for more detailed local plans. The PTCP for Lecce Province has been approved in 2008 and is available at http://www3.provincia.le.it/ptcp/ptcp/index.htm

13 General Regulator Plan, introduced with Law 1150/1942, is a municipal plan which established the territorial development of the area. In Apulia Region this planning tool has been replaced by the more innovative General Urbanistic Plan with Regional Law 20/2001. Anyway, many Municipalities, such as Lecce, still use their ancient PRG. Lecce PRG, which was approved in 1983, is available at: https://www.comune.lecce.it/amministrazione/settori/pianificazione-e-sviluppo-del-territorio/progetti/p.r.g.-vigente-tavole-centro-storico---1-2000---1-5000

14 More information and studies over the area can be found at https://politichecoesione.governo.it/it/strategie-tematiche-e-territoriali/strategie-territoriali/strategia-nazionale-aree-interne-snai/strategie-darea/regioni-del-sud/regione-puglia/sud-salento/

4. Background

4.1 Housing resilience

Resilience is the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions (UNISDR & WMO, 2012).

Since 2008, resilience is one of the main themes of urban studies (Jong et al., 2015). The concept comes from biological studies, where it refers to the idea of a system that recovers from shocks (Talia, 2021) and comes back to the past or a new condition (Mehaffy & Salìngaros, 2014). When referring to urban studies (Esopi, 2018), it would be more appropriate to consider resilience as the ability to reach a new state of equilibrium. This idea comes from the consideration that urban systems are not stable but change constantly (Porter et al., 2018).

Although resilience from natural catastrophes is well defined and quantifiable (Khazai, et al., 2015), the term, especially when referring to social and economic events, is quite vague. This has sometimes led to different interpretations and political uses of the term (Porter et al., 2018). Commonly, when talking about resilience, the focus is not only to the shock action, but also to the response to continuous stresses in urban systems (Micalella, 2014).

Resilience has become more relevant in the post-pandemic urban scenario. According to the *City Resilience Framework* (Silva, 2015) the adjectives of a resilient city (Tab.1) are reflective, robust, redundant, flexible, resourceful, inclusive, and integrated, and they refer to the interaction of physical and human dimensions (Micalella, 2014). All these adjectives and their definitions are significant to the scientific community for various reasons. They allow better defining resilience and widening the scope of this term; they are qualitative elements of resilient systems evaluation; they represent the input of actions to implement resilience and define urban planning strategies.

Adjective	**Definition**
Reflective	Reflective systems accept ever-increasing uncertainty and change, have mechanisms to continuously evolve, and will modify based on emerging evidence; they systematically learn from their past experiences to inform future decision-making.
Robust	Robust systems include well-conceived, constructed, and managed physical assets so that they can withstand the impacts of hazard events without significant damage or loss of function. Robust design anticipates potential failures in systems and ensures failure is predictable.
Redundant	Redundancy refers to spare capacity purposely created within systems so that they can accommodate disruption, extreme pressures, or surges in demand. It implies the presence of multiple ways to achieve a given need or fulfill a particular function. Redundancies should be intentional, cost-effective, and prioritized at a city-wide scale.
Flexible	A flexible system can change, evolve and adapt in response to changing circumstances. This may favour decentralized and modular approaches and can be achieved through the introduction of new knowledge and technologies.
Resourceful	Resourceful systems can rapidly find different ways to achieve their goals or meet their needs during a shock or when under stress, so they can anticipate future conditions, set priorities, and respond, for example, by mobilizing and coordinating wider human, financial and physical resources.
Inclusive	Inclusion emphasises the need for broad consultation and engagement of communities, including the most vulnerable groups. Inclusive systems can address both shocks and stress through the diminution of the isolation of sectors, locations, and communities. An inclusive approach contributes to a sense of shared ownership or a joint vision to build city resilience.
Integrated	Integration between city systems promotes consistency in decision-making. Integration should be evident within and between resilient systems, and across different scales. Exchange of information between systems enables them to function collectively and respond rapidly through shorter feedback loops throughout the city.

Tab.1 Qualities of resilient city system and definitions

The relationship between social housing and resilience has been mostly explored in the last few years. The first works in this field mainly consider the environmental aspect of both housing and resilience. For instance, one study monitors the overheating of social housing units to implement its resilience (Marvogianni et al., 2015) and others consider the building aspects of the housing system and the reduction of its vulnerability (Garrefa et al., 2021). Another study describes how to improve resilience through the implementation of a management system (Blackwell & Bengtsson, 2021). Some of them specifically analyze risk management of the housing system as a way to improve resilience (Gibb et al., 2016). One of the most complex and complete articles is the one by Kraatz (2019): considering housing as a complex system, he uses both its physical and socio-economic aspects to improve its flexibility and resilience. However, no one investigates the resilience strategies for the social housing system on a multi-scalar basis, and even less adopting circular visions of house reuse, as discussed more specifically in the next section. This paper, instead, tries to fill this literature gap.

4.2 Circular strategies

A possible solution to generate housing resilience, modernize housing heritage, and resolve the chronicle under-sizing of the public housing system could be the adoption of a circular economy approach. The European Union classifies CE as a core strategy. It can inspire restorative and regenerative design, and creates environmental and social benefits, contributing to building long-term resilience (Marchesi et al., 2020). When applying this approach to buildings, CE is defined as "a lifecycle approach that optimizes the buildings' useful lifetime, integrating the end-of-life phase in the design and uses new ownership models where materials are only temporarily stored in the building that acts as a material bank" (Leising et al., 2018). For buildings, circularity includes design for flexibility (Geraedts, 2016), adaptability (Mofatt & Russel, 2001), disassembly (Ciarimboli & Guy, 2007, Cottafava & Ritzen, 2021; Durmisevic et al., 2007), and the evaluation of embodied energy/carbon (Hammond et al., 2008). The construction sector is identified as a priority area to transform the current linear economy into a circular one. The need for regeneration of the European building stock represents a challenge, but also an important opportunity to apply a circular economy to the built environment (Giorgi et al., 2020), and a tool to reuse materials and reduce land consumption. A better use of the existing housing stock and the extension of its life cycle can reduce the construction of new buildings and urban sprawl phenomena, and the consequent use of new soil. (Mirzahossein, 2022) This problem is particularly evident in national contexts that are often invaded by construction, with loss of natural spaces, and degradation of soil, landscape, and ecosystem services (Torre et al., 2017).

On a larger scale, CE can improve the management of resources in cities to enhance efficiency and thereby reduce demand, enhance accessibility and support local economic growth, job creation, and innovation (Marchesi & Tweed, 2021). Few studies are documenting how CE can be an alternative space of urban policy and praxis (Bassens et al.2020). It has been noticed that "circular cities" and, consequently, circular territories, offer improved access to housing, goods, and services and better liveability (Marchesi et al., 2020). A circular city is defined as a city that practices CE principles to close resource loops, in partnership with the city's stakeholders, to realize its vision of a future-proof city. Amsterdam, Glasgow, and Barcelona are some of the cities trying to apply CE to their management strategies (Predenville et al., 2017). Specifically, Predenville et al. (2017) use a CE framework called ReSOLVE, applying it to urban studies. ReSOLVE (Tab. 2) is the most widespread framework among several CE models and has been developed for business models based on other sectors. Even though the framework comes from a different discipline, its definition and characteristics, as shown in the table, can be easily applied, with little variations, to urban studies. The method is particularly important because it is both descriptive and practical and focuses on CE activity on a macro-level (Predenville et al., 2017). At the same time, its value is related to the possibility of working on various dimensions: governmental, economic, environmental behavioural, societal, and technological (Marchesi & Tweed, 2021).

Consequently, the framework well adapts to complex systems such as the housing one. The ReSOLVE framework works on the six pillars of circular economy: regenerate, share, optimize, loop, virtualize, and exchange (Murphy & Rosenfield, 2016). These actions all increase the utilization of physical assets, prolong their life, and shift the use of resources from finite to renewable sources. Each action reinforces and accelerates the performance of the other actions, creating a strong compounding effect (McKinsey, 2015).

Circular Economy pillars	Main actions and strategies
Regenerate	Shift to renewable energy and materials Reclaim, retain, and restore health of ecosystems Return recovered biological resources to the biosphere
Share	Share assets Reuse/secondhand Prolong life through maintenance, design for durability, upgradability etc.
Optimise	Increase performance/efficiency of product Remove waste in production and supply chain Leverage big data, automation, remote sensing and steering
Loop	Remanufacture products or components Recycle materials Digest anaerobically Extract biochemicals from organic waste
Virtualise	Dematerialise directly Dematerialise indirectly
Exchange	Replace old with advanced non-renewable materials Apply new technologies Choose new product/service

Tab.2 The ReSOLVE Framework

The interaction between social housing and circular economy is an emerging theme. Marchesi & Tweed (2021) deal with its dimensions exploring the good effect of technological implementation on the building scale. Some recent studies, instead, propose to implement the circular economy within social housing thought operating on the behavioural and societal dimensions of the community, to promote more sustainable consumption practices (Cetin et al., 2021). At the same time, some studies on social housing focus on its relationship with the collaborative economy which does not propose a new consumption model but also an alternative way to move, lend, work, travel, be together, and therefore live (Bolici et al., 2020). Improving the system within a shared logic can improve services, reduce waste, and increase both sustainability and resilience. Whereas these few studies apply circular and collaborative economy principles either to urban planning or to some aspects of the housing system, no study has applied these strategies to the housing system as a whole yet. This dimension is part of the exploration of this paper.

5. The South Salento case study

5.1 Landscape morphology and inter-urban synergies

The South Salento is a strategic territorial area in several respects. It is a peninsula that can be considered a sub-region: it is the province with the highest number of municipalities in the Region, as well as being the second most populous in Puglia after the Metropolitan City of Bari. The province of Lecce is administratively organized into 96 municipalities and has a total population of over 782,000 inhabitants. With a surface area of almost 2,800 km2, it has a density of about 280 inhabitants per km2, due to the local morpho-typological characteristics of the area.

The Regional Territorial Landscape Plan (PPTR) identifies two main landscape areas in the South Salento: "Tavoliere Salentino" and "Salento delle Serre". Both are characterized by the widespread presence on the

territory of small and medium-sized urban centres, interconnected by a dense provincial road network and fast-flowing roads, which allow continuous dynamic flow and socio-economic correlations between several towns. In particular, Tavoliere Salentino has a more consolidated urban network, which is denser until merging near the provincial capital Lecce, where the suburban fabric develops almost uninterruptedly along the main arterial routes. The existing road network and the morpho-typological characteristics of the South Salento have thus allowed, over time, the creation of an articulated urban system consisting of a series of interconnected and complementary urban centres, which are characterized by consolidated or ongoing conurbation phenomena and strong synergic socio-economic relations.

A shared identity factor between both landscape areas is the existence of synergic socio-economic and cultural inter-urban relations and dynamics that transcend municipal administrative boundaries. These synergies make up the image of a "widespread Salento city" in the territory, which takes the form of a territorial archipelago of several urban conglomerates; for each inter-municipal archipelago, common identity features and internal flows of exchange and dynamic actions can be identified.

This theory is proven by the current system of local autonomies in Salento. The Unions of Municipalities in the province of Lecce provide for the administrative grouping of 74 municipalities into 15 groups, a significant number if we consider that they are 22 in the whole Puglia Region. Besides, the conurbation of the municipalities of Acquarica del Capo and Presicce has been approved, and the *Area Interna Sud Salento* (South Salento Internal Area) has been established. The latter is a group of 13 municipalities in the Capo di Leuca area to implement strategies to improve the quality of the area to counteract the abandonment of urban centres.

This trend offers the opportunity to experiment with new planning and regeneration strategies in the housing sector to counter the risk of impoverishment and abandonment of smaller urban centres, while responding to the growing housing needs exacerbated by the pandemic.

5.2 Housing trends

Public housing in South Salento is characterized by an excessively small number of large apartments, principally built in the GESCAL period, with a scarce maintenance level. The housing heritage is represented by 9,044 public apartments, which is too little considering that the resident population of the area is 797,000 persons; this is also the lowest number of housing units among Apulian provinces (Fig. 2). Total demand data are not available, but as a reference, in Lecce, only 5% of the requesting people have been provided a housing unit (Miglietta et al., 2021). Moreover, on a Provincial level, from the side of supply, just considering ARCA Sud Salento[15] properties, out of the owned apartments almost 50% is for families of 5 or more components (more than 85 square meters according to Apulian regional law) which instead only represent 6.7% of the local population. The apartments for 1 or 2 persons, which represent almost 63% of the population, are instead just 8.8% (Fig.2 and Fig.3). Similar data can be seen when focusing on Lecce, the provincial capital. These data are quite homogenous over the whole analysed area. It is also worth noting that a big problem of the provincial housing system is that no system for collecting data is well working. It is also conceivable that data on the demand side could not be appropriate because many people do not ask for an apartment, as they already know their request will not be fulfilled. These data are also managed on a Municipal level and at different times and so are very difficult to collect and interpret.

No ERS initiatives have yet been started, except for La Casa and Galateo in Lecce, which are still under construction. Moreover, there are no data on the "grey" target, which is supposed to be a large amount of the population considering that South Salento is one of the poorest areas in Italy. Consequently, no useful urban

15 ARCA (Regional Agency for Housing and Living policies) is a Provincial authority in charge of the management and implementation of the local public housing system. ARCA Sud Salento works in the area of the current study, whose website is: arcasudsalento.it

policies can be properly defined and hence there is a high risk of making private interests prevail over public ones. Instead, ARCA has collected data on the users of public housing units thanks to a 2018 survey. Anyway, these data have never been elaborated on.

The analysis of ARCA properties – that is, improperly excluding municipal properties – shows a capillary distribution of the apartments; anyway, this distribution is unequal between different Municipalities. Indeed, over 96 Municipalities 89 are provided public housing and the major concentration of public apartments is in the biggest centres such as Maglie and Lecce (Fig. 3). Concerning all said, generating greater cooperation among Municipalities. This is because, according to the Regional Law 10/2014[16] over "Allocation and lease determination of public housing units", Municipalities do own a smaller part of public housing and at the same time they are in charge of matching houses and inhabitants. Consequently, ARCA is unable to have a complex outlook of the housing system of its territory of action. Also, concerning territorial relations and the abovementioned shrinkage problems of the smaller centres of South Salento, inter-institutional and territorial cooperation could be a wide-area response strategy against housing distress.

Fig.2 Public Housing distribution in south Salento

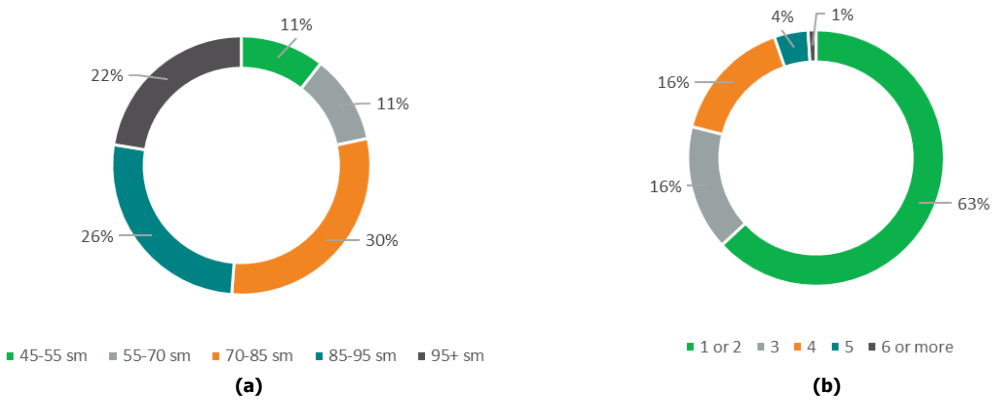


Fig. 3 (a) Housing units dimensions and (b) Number of families depending on the number of components

16 This law is the most important one for managing the public housing system. It establishes the dimensions of housing units depending on the family dimension, the way to calculate the rent of the users, who can enter the public system and who should exit it, how to make the mobility tool work.

5.3 Best practices suitable for the local housing system

After examining the abovementioned characteristics and criticalities of South Salento, and studying them through the analysis of its landscape morphology and inter-urban synergies, and its housing system, different possible strategies emerged. In detail, thanks to a desk analysis of international, national best practices in the housing field and the efforts of the local managing authorities and academic researchers, strategies are extrapolated and generalized to apply them to the "peripheral territories" (with similarities to the case study), as a filter.

A relevant best practice that implements the number of housing units is the reuse of an existing and abandoned building to obtain new housing units. In this category, relevant examples are the reuse of Torino Porta Palazzo (Spadafina & Scarpelli, 2022) and Caserne de Reuilly (Habitat, 2020). Another variation of this strategy is to loop and exchange soils by demolition and reconstruction. This alternative possibility has emerged in the latest studies and is based on the consideration of the underuse of the heritage, its weak maintenance status, and its low architectural and constructive qualities can lead to demolition that is now acquiring a new value (Merlini, 2019).

In other best practices, such as Grand Parc Bordeaux and Rooftop Housing (Paris & Bianchi, 2019), new housing units are obtained through a different action, that is the addition of new parts to the existing building. Grand Parc Bordeaux is also significant because it focuses on the energy retrofit and extraordinary maintenance of the existing building (Paris & Bianchi, 2019).

The huge investments for ecologic transition together with the necessity of maintenance of the housing heritage underline the importance of this strategy.

As stated, the application of collaborative economy and co-housing strategies can realize housing resilience. This has been done in La Borda in Barcelona, where private spaces are reduced to create common services and spaces (La Borda, 2022), and in *Cenni di Cambiamento* in Milan, where a common space "for working mothers" has been built; in this space, mothers can help each other to educate and look after children (FHS, 2022).

A significant best practice is the social mix: despite being an emerging strategy in Italy, it has been widely tested in the Netherlands. It means creating a specific mix of people to promote integration. In Italy, *Ospitalità Solidale and Casa dell'Accoglienza* (Castelli et al., 2019) are some of the most relevant examples.

Closely in touch with the creation of the social mix, it is to be stated the possibility to match spaces, targets, and services for its specific necessities and services. This strategy, studied by the "Service-oriented Urbanism" (Izza et al., 2007), also responds to the emerging need of a 15-minutes city (Abdelfattah et al., 2020).

When thinking of urban regeneration and social cohesion processes, another significant experience is represented by DAR Casa Milano, a program where residents pay a minor rent in exchange for hours of social activities to obtain more social cohesion (Spadafina & Scarpelli, 2022).

This objective has also been reached in *Cenni di Cambiamento* by FHS Milano[17] where a specific non-profit organization has been founded: *Associazione Officina Gabetti 15*.

In this specific context, actions to better environmental awareness are developed, through events and associations (FHS, 2022).

Another successful action is to establish a mandatory percentage of ERP and ERS units in big private operations. This possibility is supposed to have great success in Milan, in the area where it is planned by PGT[18] (2019).

[17] Fondazione Housing Sociale is a no-profit found involved in providing a house to "grey targets". Nowadays, it represents one of the most important and best-working bodies in the housing field

[18] Piano di Governo del Territorio (Territorial Management Plan) is a planning document where the main strategies to obtain the vision of Milan 2030 are listed.

Strategy	Best practice	Source
Recovery and Reuse of the existing heritage	Torino Porta Palazzo and Caserne de Reuilly	https://www.officina-artec.com/project/officina-36/ https://www.parishabitat.fr/nos-programmes/caserne-de-reuilly/
Extraordinary maintenance and energy efficiency	Grand Parc Bordeaux and Rooftop Housing	Paris, S., & Bianchi, R. (2019). Ri-abitare il moderno. Macerata: Quodlibet.
Reuse of soils	Demolition as a territorial reform (2019) by Merlini	Merlini, C. (2019). Demolition as a Territorial Reform Project. In S. Della Torre, C. Cattaneo, C. Lenzi, & A. Zanelli, Regeneration of the Built Environment drom a Circular Economy Perspective. Milano: Springer Open.
Common and shared spaces	La Borda and Cenni di Cambiamento	http://www.laborda.coop/ca/ http://www.cennidicambiamento.it/
Operation over Social Mix	Ospitalità Solidale and Casa dell'Accoglienza	http://www.darcasa.org/portfolio/ospitalita-solidale-2/ http://www.casadellaccoglienza.org/
Users with specific tasks	DAR Casa Milano	http://www.darcasa.org/
Activities to create sense of community and environmental awareness	Cenni di Cambiamento	http://www.cennidicambiamento.it/
Applying sharing economy and co-housing tools	La Borda and Cenni di Cambiamento	http://www.laborda.coop/ca/ http://www.cennidicambiamento.it/
Definition of a relationship between target and service	Service-oriented Urbanism	Izza, S., Vincent, L., & Burlat, P. (2007). An Approach for Service-Oriented Urbanism. In R. Gonçalves, J. Müller, K. Mertins, & M. Zelm, Enterprise Interoperability II (p. 879-890). Londra: Springer.
Mandatory percentage of social and public housing in new interventions	PGT Milan	https://www.pgt.comune.milano.it/
Territorial management of services	ALER Milan	https://aler.mi.it/
Agency to match demand and supply	Milano Abitare	https://milanoabitare.org/
Reuse of touristic apartments during no-touristic periods	UK and Irealand	

Tab.3 Best practices and strategies coming from bibliographical research and suitable for bettering the local housing system

Another important experience has been led by ALER Milano[19], which is now managing the apartments owned by Milan Municipality. This improves efficiency by creating unique management of data and apartments.
Milan Municipality also developed Agenzia Abitare Milano, in cooperation with Fondazione Welfare Ambrosiano, which enriches the low-cost rent market and helps the "grey target" to access an apartment. This agency works to create a contact between offer and demand inside of the private sector and helps the "grey target" by either bestowing them facilitation or giving the owners the assurances the private cannot guarantee

[19] Agenzia Lombarda Edilizia Regionale of Milan is the responsible housing association for the Province of Milan. It is the local equivalent of ARCA.

(Spadafina & Scarpelli, 2022). This strategy is particularly important because in Italy around 12% of the private housing units are unused (Agenzia delle Entrate, 2019).
Colleges in the UK represent the last reported significant best practice. In summer, they are used for tourists and, in the other periods of the year, they are used to respond to student housing needs.
Tab.3 summarizes the presented actions and references.

5.4 Emerging strategies within the local housing system

Many positive strategies are emerging within the case study area. It is worth mentioning the valorisation of public and open space and mobility systems, already proposed by PPTR, with particular reference to peri-urban areas and slow mobility. Considering the interurban synergies of South Salento, the implementation of these systems and the connection of the housing system with the other layers of the urban structure are key aspects to improve system integration.
One more interesting experience is the research work "*Città Pubblica nel Mezzogiorno*"[20], developed in a degree thesis at the Polytechnic University of Bari, whose reflection starts from the oversizing of the housing units, and proposes fragmentation policies for the built environment. The study proves the adaptability of some best practices that have been developed in Northern Europe and Italy, within the city of Lecce and hence within South Salento. The main examples presented by the work are the fragmentation of the existing units in De Flat Kleiburg (Paris & Bianchi, 2019) and Ausbauhaus Neukolln (Richter Praeger, 2014) and the case study of Piazzale Cuneo in Lecce.
Within the same thesis, housing strategies have been proposed considering Regional Law 10/2014[21] and the abovementioned incoherence between housing unit dimensions and users. Housing mobility is scarcely practiced in South Salento but should be implemented, making mobility compulsory or voluntary depending on the situation (e.g. mandatory within the same building and the same small municipality). This framework of housing mobility could help disabled and elder persons to stay on the ground floors, while voluntary mobility between different cities should be possible. Another important innovation for housing mobility strategies can be the accompaniment of people who are no more suitable for public housing but still stay within the "grey target" and should be helped to find a new house.
Apulia Region is considering the construction of a continuously updated online system to match user and housing units, and to manage the mobility system on a territorial scale, as it has been done in Lombardy. This is supposed to be helpful because Municipalities take years to assign housing units, resulting in incompatibility with rapidly changing housing needs. Concerning data collection, Apulia has already developed the PUSH[22] platform to collect data on the "grey targets" and the ORCA platform to collect data over Regional Law 431/98[23]. At the same time, in the framework of the regional research project B@ARCA – BIM at ARCA[24], ARCA Sud Salento virtualized data on maintenance status through BIM and GIS technology and collected information from users through a specific app, improving the citizens' engagement. Both strategies are in effect – yet partially – but require implementation and use on a larger scale.

---

20 The thesis, entitled "Città pubblica nel Mezzogiorno Bisogni emergenti e politiche urbane per i luoghi dell'abitare contemporaneo", includes design studies on housing system within the city of Lecce and develops two possible intervention projects on the heritage. The first one reuses Manifattura Tabacchi, a historical building by Pierluigi Nervi. The second one splits the housing units of a '70s building to obtain smaller units. The thesis has been made by Pio Emanuele Longo, Sabrina Mellacqua, Francesca Palmieri, Rossella Pellicani, Domenico Scarpelli, and Lorenzo Susca, under the guide of Professors Nicola Martinelli and Giovanna Mangialardi.

21 Ibidem 16.

22 Puglia Social Housing is an information system of the Puglia Region for collecting and digitization of the main information over the public and social system. It is part of the ORCA (Regional Observatory over Housing) system.

23 "National fund for supporting the access to rented dwellings". This law establishes a fund for reducing the pricing of rented dwelling and is addressed to the same target of public housing.

24 The experimental project called BIM at ARCA "B@ARCA" has been made by the cooperation between ARCA Sud Salento and University of Salento, and Gravili, N&C, and Altea firms. The specific website is: www.bimatarca.it

Although the local emerging strategies in South Salento demonstrate both the academic and public interest in improving the local housing system, some significant strategies are not completely efficient because they have not been fully applied, implemented, or systematised.
Tab.4 synthesises the strategies, in relation to the existing criticalities.

Existing criticality (para. 4.2)	**Emerging strategy**	**Existing action**	**Source**
Inefficiency of the mobility system. No integration with the housing system	Implementation of the mobility and slow mobility system	PPTR	https://pugliacon.regione.puglia.it/web/sit-puglia-paesaggio/tutti-gli-elaborati-del-pptr
Low quality of the urban space, especially near public housing building	Implementation of public and open space	PPTR	https://pugliacon.regione.puglia.it/web/sit-puglia-paesaggio/tutti-gli-elaborati-del-pptr
Insufficient number of housing units of too big dimension	Fragmentation of the existing housing heritage	"Città pubblica nel Mezzogiorno" thesis	-
Absence of correspondence between housing units and users	Mobility tool	"Città pubblica nel Mezzogiorno" thesis	-
No ERS experiences	ERS implementation	National law 3904/2008 Galateo in Lecce	https://www.leccesocialhousing.it
Too slow assignation system. Only on municipal level	On-line territorial system for housing units assignation	Regione Lombardia law 16/2016	-
No data over "grey target"	Collection of data over "grey target"	PUSH Platform	https://push.regione.puglia.it/
Incomplete data over public housing potential users	ORCA implementation	ORCA Platform	http://old.regione.puglia.it/web/orca
Absence of information over maintenance status	B@ARCA implementation	B@ARCA Project	https://www.arcasudsalento.it/

Tab.4 Relationship between the existing criticalities, the emerging strategies and their references

6. Circular Living Model definition

This paper has analysed the existing literature, and its deficiencies concerning CE, resilience, and their relationship with the housing system. The following phase has been the collection of some significant strategies and best practices at the international, national, and local levels, through bibliographic research and case study analyses. Putting them into relation, this contribution has defined a Circular Living Model.
The *CL Model* proposes a set of strategies that can define a complex and organic set of actions to partially solve the described criticalities of the housing system of the South Salento, and/or similar contexts.
The different actions, as already stated, are supposed to work according to the various pillars of CE and at the same time implement the resilience of the system.
The achieved resilience is evaluated qualitatively through the adjectives defined by the City Resilience Framework (Silva, 2015). Consequently, each strategy is related to one (or more) pillar of CE and one (or more) adjective of resilience.

In the selected actions, both material (e.g. the reuse of existing buildings) and immaterial strategies (e.g. the agency matching demand and supply of housing units) appear; they are divided into 3 different categories depending on the scale of the intervention: that is, building, urban, or territorial. When referring to the building scale, the model focuses on a single building and its immediate adjacent areas, seen both in their physical and social dimensions. Instead, the urban scale focuses either on a neighbourhood or, in the case of the small village, on the whole Municipality.

This is because, concerning both the dimension and number of inhabitants, the majority of South Salento centres are more similar to urban districts. The widest scale is the territorial one; in this case, the whole South Salento area.

The possibility to consider a wide territory as an area of intervention for housing is due to its specific characteristics (par. 4.1) that allow interactions and synergies among close Municipalities. The CL Model process and dimensions are shown in Fig. 4; instead, Fig. 5 outlines the CL Model, highlighting the different strategies, their scale, and relations to the CE pillars and resilience.

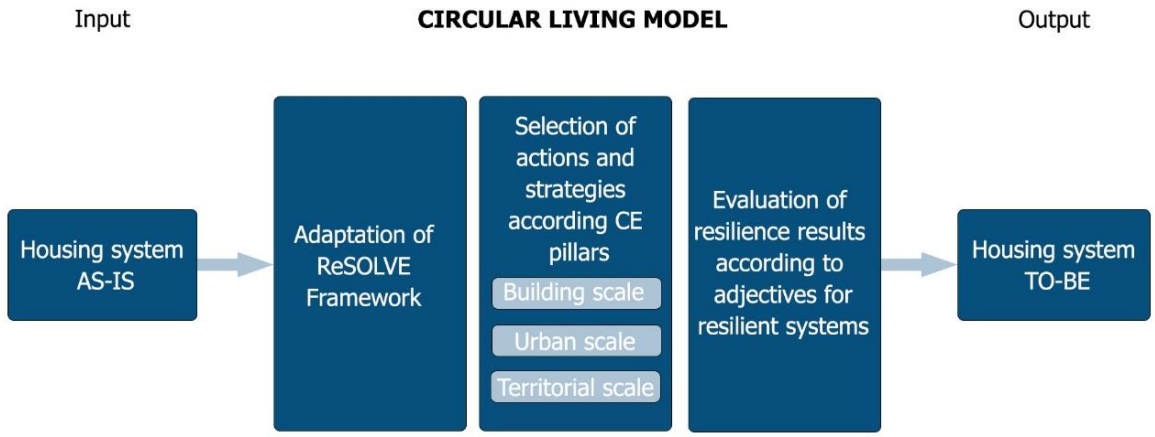


Fig.4 The process from input to output through the Circular Living Model

A possible application of the *CL Model* is represented by the use case of a '70s ERP building, located in Piazzale Cuneo, that is one of the most frequent conditions of South Salento's public housing heritage. The use case is meant to clarify the actors, aims, and use modality of the Model, to show its possible practical application. In detail, the main objective of the application is to solve typological, functional, and social criticalities thanks to a collaboration between institutional actors (Apulia Region, Lecce Municipality, and ARCA Sud Salento) and the users/inhabitants of the building. The Model is not applied as a whole; instead, according to the specific characteristics of the building, the most significant strategies are selected and placed in chronological order to ease its application.

All the actions still work on different scales and both on material and immaterial aspects.

Starting from a good knowledge of the situation and the application of the mobility strategy, the main physical actions consist of the addition of two winter gardens on both sides of the building, to obtain more space and to improve energy efficiency, and into the fulfilling of the ground floor with housing units, common spaces, and services.

The material actions also insist on the public spaces of the neighbourhood. At the same time, a set of immaterial actions over the community, which are typical of urban regeneration, are applied. The process is graphically shown in Fig.7.

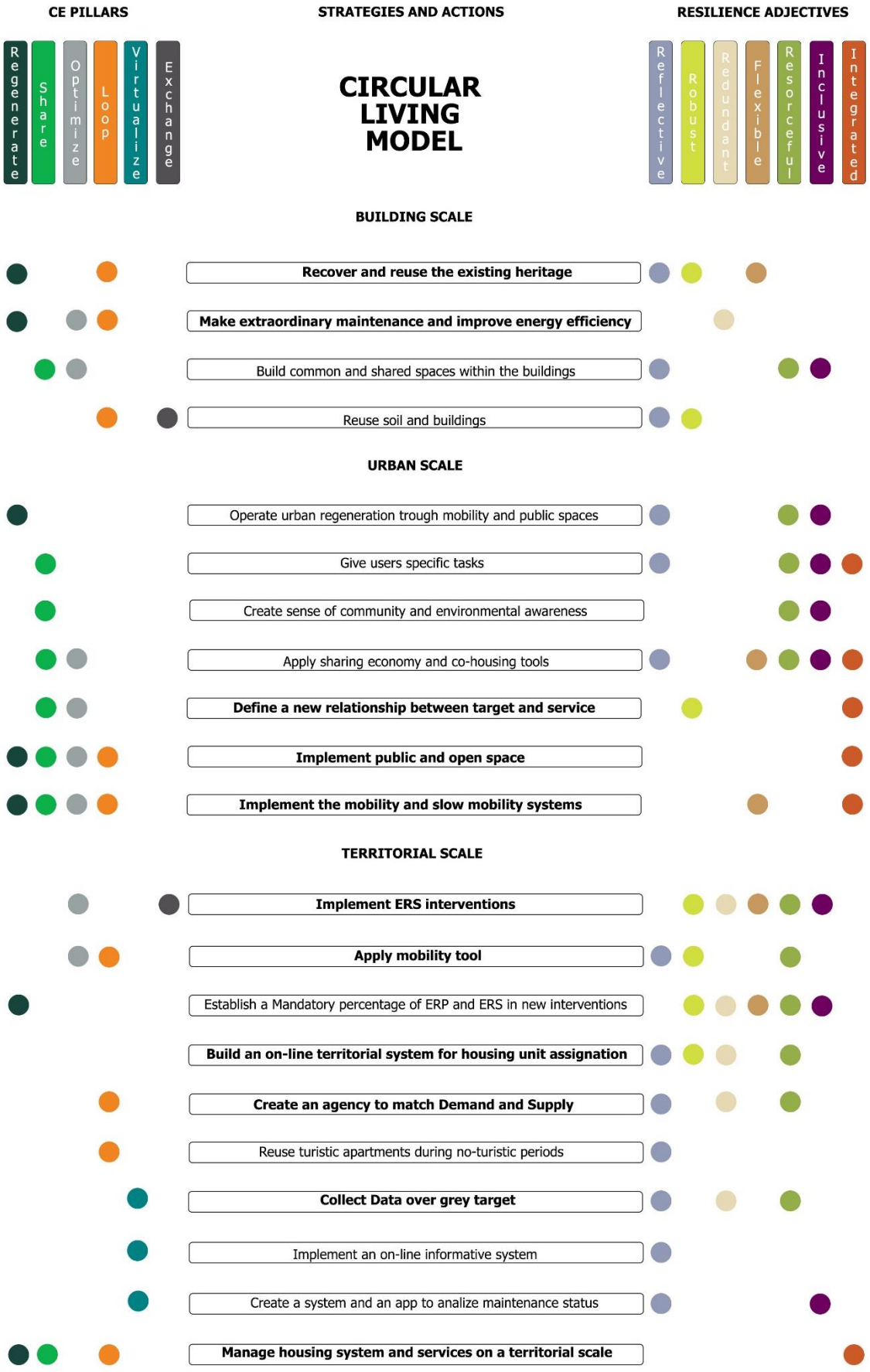


Fig.5 Circular Living Model. The figure reports the different actions that are supposed to better South Salento housing system. They are grouped according to the scale of the intervention. For each action it is stated the CE pillars (left side) and the resilience adjectives (right side) it is related to

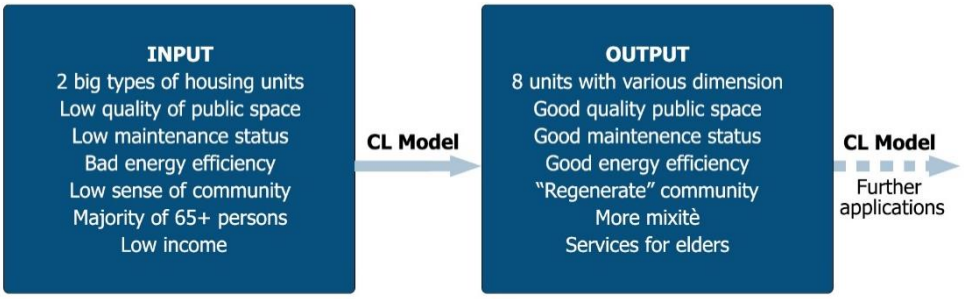


Fig.6 Input and expected output of the application of CL Model to the case use of Piazzale Cuneo public building

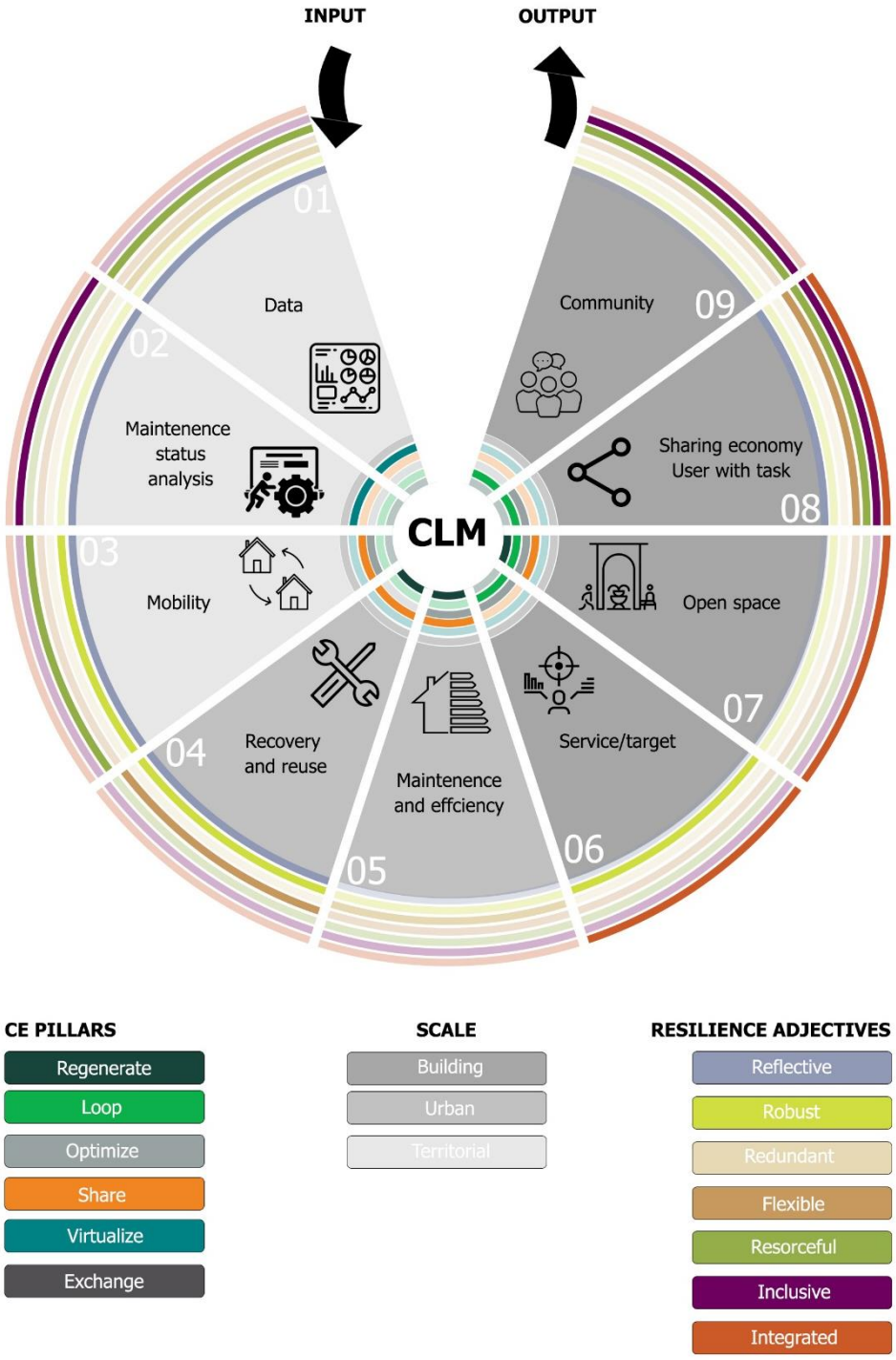


Fig.7 Application of the CL Model to the case use of Piazzale Cuneo public building

The input building of the application of the CL Model (Fig.6) is characterized by most of the described criticalities of the housing system (paragraph 5.2); the expected output (Fig.6) is better responding condition to both housing and resilience needs, in a circular way. Consequently, ARCA Sud Salento has considered the output to be highly interesting. It is worth specifying that the application of the CL Model on a use case is not supposed to be applied once but also to be done in a loop, with different strategies, to constantly implement the life quality and resilience of the housing system. At this point, monitoring actions have great importance.

7. Discussion

The proposed Circular Living Model defines a set of different scale strategies to be applied both in the case study and in comparable contexts and relates actions both to the ReSOLVE Framework (McKinsey, 2015) and to resilience adjectives (Silva, 2015).

The proposed Model has practical and theoretical implications, as described below.

On the theoretical side, the article innovatively declines CE to the housing system by recycling and reusing the existing heritage, by redistributing resources within the whole area and by adapting integrated solutions. Moreover, the article tries to overcome the literature gaps related to the absence of studies that address in an integrated way the application of circular economy to make social housing stock resilient at different scales (urban, neighbourhood, building). The research fits into an innovative field of study because the relationship between housing and resilience is a scarcely explored field and has been mainly investigated from an environmental (Marvogianni et al., 2015) and management-related (Gibb et al., 2016) standpoint. This paper, like the one by Kraatz (2019), is one of the few that point out both the physical and socio-economic dimensions in relation to resilience, while considering housing as a complex system. Anyway, no study yet had adopted the adjectives of resilience, described by the City Resilience Framework, to qualitatively evaluate resilience in housing systems and, consequently, to support the orientation of future strategies. At the same time, the correlation between CE and housing is particularly innovative because it has mainly been studied only either at the building scale, as by Marchesi & Tweed (2021) and Giorgi (2020), or in its social dimension, as done by Cetin, Vincent & Straub (2021). Instead, this study also addresses it in a complex way at the neighbourhood, urban and intercity scales. The provincial management of the apartments, using for example the mobility strategy, can be a positive opportunity to create a deeper interconnection between the owned and public heritage that can work as a complex system, generating a territorial circular social housing economy. In the Model, it is necessary to consider the public housing of cities of peripheral territories as a whole system. These connections represent a new vision of system interaction. At the same time, the innovation brought about by the model is related to its interdisciplinarity, and its multiple foundations coming from international, national, and local best practices. Even though the proposed strategies are not new but come from verified studies and experimentations, the association of the actions and their organization are innovative.

Another important theoretical contribution of this article is represented by the developed method (Gregor & Jones, 2007). The classification of strategies according to the CE pillars had indeed been used only once by Predenville et al. (2017), where it was done after the strategies were practically applied; this paper instead takes advantage of the CE pillars while defining strategies, therefore, it defines a method not only to classify but also to develop them. The confirmation of the impact of the actions in terms of resilience, at the design stage, is also an important method to be applied in territorial governance definition moments.

The Model could be an important starting point for the scientific community because further studies can use it, not only for classifying and reorganizing actions, but also for developing new ones, based on the theoretical matrix. This can be done both for the housing system of different territorial contexts and, also, for different systems, even from different fields of study, which need circular strategies for improving resilience

On the practical side, the model's importance stands in the adaption to specific contexts, because it defines strategies and actions that can be applied by its territorial administrations, overcoming the lack of strategic

view in management choices that characterize the housing system. Through its application, the CL Model is supposed to implement resilience and to reduce the housing crisis by "regenerating, sharing, optimizing, looping, virtualizing, and exchanging" the existing public and private heritage. After application, actions could be monitored by comparing their real effect with the expected one to better evaluate and constantly modify the model. Moreover, the set of strategies can be implemented by adding actions that have not been considered in this paper. The practical importance of the study also stands in its application to similar contexts. As said, South Salento has specific characteristics, such as an inefficient housing system, a total population of 800,000 persons, and a network of middle and small centres, which are interconnected and complementary, defining a "widespread Salento city". Consequently, the CL Model could be applied to similar territories, without relevant modifications. It is to be pointed out that the model can, not only, respond to the housing crisis and needs but also become an important planning tool for defining urban policies and visions.

8. Conclusions

In this current unstable situation, the implementation of the resilience of complex systems is as necessary as ever. At the same time, the above described inefficiencies of the housing system require a new strategic view to solve the existing housing crisis. This paper has great relevance within this recent situation, characterized by environmental, social, economic, and health problems because it is aimed at reducing the effects of these phenomena and transforming the housing system into a resilient and competitive part of the urban system. This is even truer when considering that the paper suggests a possible use of the great number of economic resources that are going to be invested for post-pandemic recovery.

The importance of operating on social housing in a circular way, that is sustainably using existing tangible and intangible resources to meet a strong housing need, is powered by the presence by the huge financing given by the Italian PNRR[25] (NextGeneration EU , 2021) (Gargiulo, 2022). This amount of money will be a great opportunity to innovate and implement the housing system and shows how social housing are relevant to the main aims of Next Generation EU: inclusive recovery and green transition.

The proposal tries to create a basis to improve social heritage management and face housing access problems, operating with complex actions of urban regeneration, exploiting the built heritage by reusing buildings, and avoiding the sale of housing units and land consumption. In this research, circular economy stands as a tool to achieve resilience in the social housing system, including strategies at the building, neighbourhood/city, and territorial scales. This is achieved by proposing a Circular Living Model, which adopts the circularity strategies of resources at all levels. In detail, the article aims at creating a model to be applied to housing contexts in critical situations, but with evident opportunities for intervention, and to improve its resilience through the application of CE approaches and strategies.

In light of the existing gap in the literature, the emerging environmental necessities, and the chronic problems in accessing an accommodation, this study interprets housing as a complex system and as one of the most important layers of urban planning and operates on public and social housing on a territorial level. The case study method helps to analyse how the approach to housing welfare and social housing management must take on innovative features to overcome the limits of administrative boundaries and be based on the planning and programming of interventions that recognise the existing inter-municipal synergies to respond to housing needs with quality. The CL model is developed on the South Salento peripheral territory case study, but the variety of its strategies allow application to similar contexts. The South Salento case study aims at building initial understandings of a situation and are not particularly concerned about generalizing. The explorative literature review, the single case study and the lack of model validation by expert represent the limits of the research. Therefore, future research will be oriented to validate the model through key actors involved in

[25] *Piano Nazionale di Ripresa e Resilienza*, Italy's recovery and resilience plan

urban transformation processes. Moreover, further research will verify the applicability of the model to different contexts such as metropolitan ones.

References

Abdelfattah, L., Deponte, D., & Fossa, G. (2022). The 15-minute city: interpreting the model to bring out urban resiliencies. *Transportation Research Procedia*, 330-337. https://doi.org/10.1016/j.trpro.2021.12.043

Agenzia delle Entrate. (2019). Lo stock immobiliare in Italia: analisi degli utilizzi. In G. Guerrieri, & M. T. Monteduro, In Gli immobili in Italia. Retrieved from: https://www1.finanze.gov.it/finanze/immobili/public/contenuti/immobili_2019.pdf

Bassens, D., Keblowski, W., & Lambert, D. (2020). Placing cities in the circular economy: neoliberal urbanism or spaces of socio-ecological transition? *Urban Geography*. https://doi.org/10.1080/02723638.2020.1788312

Bell, E., Bryman, A., & Harley, B., (2018). *Business research methods*. Oxford university press. ISBN: 9780198869443

Blackwell, T., & Bengtsson, B. (2021). The resilience of social rental housing in the United Kingdom, Sweden and Denmark. How institutions matter. *Housing Studies*. https://doi.org/10.1080/02673037.2021.1879996

Bolici, R., Leali, G., & Mirandola, S. (2020). Reusing built heritage. Desing for the sharing economy. In S. Della Torre, S. Cattaneo, C. Lenzi, & A. Zanelli, *Regeneration of the built environment from a circular economy prospective*, 311-320. Milano: Springer Open. https://doi.org/10.1007/978-3-030-33256-3

Castelli, I., Kleinhans, R., & Mugnano, S. (2019). Reframing social mix in affordable housing initiatives in Italy and in the Netherlands. Closing the gap between discourses and practices? *Cities*, 131-140. https://doi.org/10.1016/j.cities.2019.01.03 3

Cetin, S., Vincent, G., & Straub, A. (2021). Towards circular social housing: an exploration of practices, barriers and enablers. *Sustainability*. https://doi.org/10.3390/su13042100

Ciarimboli, Nicholas and Brad Guy (2007). *Design for Disassembly in the built environment: a guide to cloosed-loop design and building*. In: Pennsylvania State University https://www.lifecyclebuilding.org/docs/DfDseattle.pdf

Comune di Milano (2020). Piano di Governo del Territorio (PGT). Milano. Retrtieved from: https://www.pgt.comune.milano.it/

Cottafava, Dario, and Michiel Ritzen. (2021) Circularity indicator for residential buildings: Addressing the gap between embodied impacts and design aspects. *Resources, Conservation and Recycling* 164 (2021): 105120.

Czjschke, D., & Pittini, A. (2007). Housing Europe, Review of Social, Co-operative and Public Housing in the 27 EU Member States. Brusselles: CECODHAS European Social Housing Observatory. ISBN 978-92-95063-04-4

Di Biagi, P. (2001). Introduzione. In P. di Biagi, *La grande ricostruzione: il piano INA casa e l'Italia degli anni Cinquanta* (p. XXIII-XXVI). Roma: Donzelli Editore. EAN: 9788860365347

Di Biagi, P. (2013). Il piano INA-Casa: 1949-1963. Retrieved from: https://www.treccani.it/enciclopedia/il-piano-ina-casa-1949-1963_%28Il-Contributo-italiano-alla-storia-del-Pensiero:-Tecnica%29/

Durmisevic, E, Ö Ciftcioglu, and CJ Anumba (2006). *Knowledge Model for Assessing Disassembly Potential of structures*. Delft University of Technology, Faculty of Architecture, Department of Building Technology ISBN-13: 978-90-9020341-6

Esopi, G. (2018). Urban commons: social resilence experiences to increase the quality of urban system. *Tema. Journal of Land Use, Mobility and Environment, 11*(2), 173-194. doi: http://dx.doi.org/10.6092/1970-9870/5532

European Parliament (2022) Circular economy: definition, importance and benefits. Retrieved from: https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits

Federcasa. (2020). Dimensione del disagio abitativo pre e post emergenza Covid-19. Nomisma Federcasa. http://cms.federcasa.it/download.aspx?id=9fe957dd-f413-476f-ba81-4c05cf30149e

FHS, M. (2022). Cenni di Cambiamento. Retrieved from: Fondazione Housing Sociale https://www.fhs.it/progetti/residenze/cenni-di-cambiamento/

Garrefa, F., Barbosa Villa, S., Carrer Ruman de Bortoli, K., Stevenson, F., & Barcelos Vasconcellos, P. (2021). Resilience in social housing developments through post-occupancy evaluation and co-production. *Ambiente Costruìdo*, 151-175. https://doi.org/10.1590/s1678-86212021000200519

Geraedts, Rob (2016). FLEX 4.0, a practical instrument to assess the adaptive capacity of buildings. In: *Energy Procedia* 96, pages 568–579 https://doi.org/10.1016/j.egypro.2016.09.102

Gargiulo, C., Guida, N., & Sgambati S. (2022). NextGenerationEU in major Italian cities. *Tema. Journal of Land Use, Mobility and Environment, 15*(2), 287-305. https://doi.org/10.6093/1970-9870/9260

Gibb, K., McNulty, D., & McLaughlin, T. (2016). Risk and resilience in the Scottish social housing sector: 'We're all risk managers'. *International Journal of Housing Policy*, 435-457. https://doi.org/10.1080/14616718.2016.1198085

Giorgi, S., Lavagna, M., & Campioli, A. (2020). Circular economy and regeneration of building stock: policy improvements, stakeholder networking and life cycle tools. In S. Della Torre, S. Cattaneo, C. Lenzi, & A. Zanelli, *Regeneration of the build environment from a circular economy perspective* (p. 288-297). Milano: Springer Open. https://doi.org/10.1007/978-3-030-33256-3_27

Guarino, M. (2010). Verso una nuova qualità dell'abitare: la riqualificazione dell'edilizia residenziale pubblica. Salerno: Università degli Studi di Salerno. http://elea.unisa.it/jspui/bitstream/10556/156/1/tesi%20M.%20Guarino.pdf

Habitat, P. (2020). La Caserne de Reuilly. Retrieved from Paris Habitat: fr.calameo.com/read/00426177420a9d0ac1c4a

Hammond, Geoffrey P and Craig I Jones (2008). "Embodied energy and carbon in construction materials". In *Proceedings of the Institution of Civil Engineers-Energy* 161.2, pages 87–98. https://doi.org/10.1680/ener.2008.161.2.87

Holz, E. D. (2016). Towards Self-Managed (Urban) Resilience. Berlino: Technische Universität Berlin. https://www.urbanmanagement.tu-berlin.de/fileadmin/f6_urbanmanagement/Study_Course/student_work/2016_Masterthesis_Evandro_Holz.pdf

Izza, S., Vincent, L., & Burlat, P. (2007). An Approach for Service-Oriented Urbanism. In R. Gonçalves, J. Müller, K. Mertins, & M. Zelm, *Enterprise Interoperability* II (p. 879-890). Londra: Springer. https://doi.org/10.1007/978-1-84628-858-6_94

Jong, d., Joss, Schraven, Zhan, & Weijnen. (2015). Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2015.02.004

Kurt, B & Spence, I. (2003) Use case modeling. Addison-Wesley Professional ISBN-13: 978-0201709131

Kraatz, J. (219). Innovative approaches to building housing system resilience: a focus on the Australian social and affordable housing system. Australian Planner Vol 55 No 3-4, 174-185. https://doi.org/10.1080/07293682.2019.1632361

La Borda, C. (2022). Arquitectura. Retrieved from Coperativa La Borda: http://www.laborda.coop/ca/projecte/arquitectura/

Leising, E., Quist, J., and Bocken, N.M.P., 2018. Circular economy in the building sector: three cases and a collaboration tool. *Journal of Cleaner Production*, 176, 976–989. https://doi.org/10.1016/j.jclepro.2017.12.010

Lodi Rizzini, C. (2013). Il social housing e i nuovi bisogni abitativi. In F. Maino, & M. Ferrara, *Primo rapporto sul Welfare in Italia* (p. capitolo 8). Torino: Centro di Ricerca e Documentazione Luigi Einaudi. ISBN13: 9788890941740

Mangialardi, G., Palmieri, F., Pellicani, R., & Zappatore, S. (2021). Innovazioni nelle politiche abitative. Le esperienze dell'ARCA Sud Salento. *Urbanistica Informazioni*, 42-44. https://www.aisre.it/wp-content/uploads/aisre/60fb06e737ed09.95122457/Zappatore.pdf

Marchesi, M., & Tweed, C. (2021). Social innovation for a circular economy in social housing. *Sustainable Cities and Society*. https://doi.org/10.1016/j.scs.2021.102925

Marchesi, Tweed, & Gerber. (2020). Applying circular economy principles to urban housing. *World sustainabe build environment conference.* https://doi.org/10.1088/1755-1315/588/5/052065

Martinelli, N., Mangialardi, G., & Spadafina, G. (2020). Abitare la Puglia. Criticità e sfide per nuovi modelli abitativi nel Mezzogiorno. QuAD. ISSN 2611-4437

Marvogianni, A., Tailor, M., Davies, C., & Kolm-Murray, J. (2015). Urban social housing resilience to excess summer heat. *Building Research & Information* Vol.43, 316-333. https://doi.org/10.1080/09613218.2015.991515

McKinsey, C. f. (2015). Growth within: a circular vision economy for a competitive Europe. Ellen Macarthur Foundation. https://emf.thirdlight.com/link/8izw1qhml4ga-404tsz/@/preview/1?o

Mehaffy, M., & Salìngaros, N. (2014). *Verso un'architettura resiliente*. Il Covile. ISSN2279–6924

Merlini, C. (2019). Demolition as a Territorial Reform Project. In S. Della Torre, C. Cattaneo, C. Lenzi, & A. Zanelli, *Regeneration of the Built Environment drom a Circular Economy Perspective*. Milano: Springer Open. https://doi.org/10.1007/978-3-030-33256-3

Micalella, M. L. (2014). New Orleans Lezione di città resiliente. Roma: Sapienza-Università di Roma. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiLj9OE9dX6AhVwXvEDHW7gBR8QFnoECAsQAQ&url=https%3A%2F%2Firis.uniroma1.it%2Fretrieve%2Fhandle%2F11573%2F918288%2F329003%2FMicalella_New%2520Orleans_2014.pdf&usg=AOvVaw2eCZ02iStTgkIvRWahCjDA

Mielis, P. (2011). La valutazione della qualità globale degli edifici residenziali nella programmazione degli interventi di riqualificazione alla scala del patrimonio edilizio. Cagliari: Università degli Studi di Cagliari. https://core.ac.uk/download/pdf/35315415.pdf

Miglietta, R., Scarpelli, D., Spadafina, G., & Susca, L. (2021). Pensare alle forme dell'abitare per i nuovi bisogni abitativi. AISRe. Lecce. https://www.aisre.it/wp-content/uploads/aisre/60fbd82982b7d4.29846176/Spadafina.pdf

Mirzahossein, H., Noferesti, V., Jin, X. (2022). Residential development simulation based on learning by agent-based model. *Tema. Journal of Land Use, Mobility and Environment, 15* (2), 193-207. http://dx.doi.org/10.6092/1970-9870/8980

Moffatt, Sebastian and Peter Russell (2001). Assessing the adaptability of buildings. In: IEA Annex 31 https://doi.org/10.1088/1755-1315/225/1/012012

Murphy, C., & Rosenfield, J. (2016). The circular economy: moving from theory to practice. McKinsey & Company. https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/The%20circular%20economy%20Moving%20from%20theory%20to%20practice/The%20circular%20economy%20Moving%20from%20theory%20to%20practice.ashx

NextGeneration EU. (2021). Retrieved from Unione Europea : https://europa.eu/next-generation-eu/index_it

Palvarini, P. (2006). Il concetto di povertà abitativa: rassegna in tre definizioni. Working paper del Dottorato in Studi europei urbani e locali. Università di Milano Bicocca. https://boa.unimib.it/bitstream/10281/7615/3/phd_unimib_R00763.pdf

Palvarini, P. (2010). Cara dolce casa. Come cambia la povertà in Italia dopo le spese abitative. Terza Conferenza annuale ESPAnet Italia.

Paris, S., & Bianchi, R. (2019). *Ri-abitare il moderno*. Macerata: Quodlibet. ISBN 9788822901927

Pittini, A. (2019). The State of housing in the EU. Bruxelles: Housing Europe. https://www.housingeurope.eu/resource-1323/the-state-of-housing-in-the-eu-2019

Porter, L., Steele, W., & Stone, W. (2018). Housing and resilience - When, for Whom and for What? A Critical Agenda. *Housing Theory and Society* vol 35, 387-393. https://doi.org/10.1080/14036096.2018.1492964

Predenville, S., Cherim, E., & Bocken, N. (2017). Circular cities: mapping six cities in transition. *Environmental Innovation and Societal Transition*, 171-194. https://doi.org/10.1016/j.eist.2017.03.002

Regione Puglia (2015). PPTR- Schede d'ambito. Retrieved from: https://pugliacon.regione.puglia.it/web/sit-puglia-paesaggio/le-schede-degli-ambiti-paesaggistici

Richter Praeger, A. (2014). Ausbauhaus Neukolln. Retrieved from Praeger Richter Architekten: praegerrichter.de/AUSBAUHAUS-NEUKOLLN-1

Shirley, G. & Jones D. (2007) The anatomy of a design theory. *Association for Information Systems*. https://doi.org/10.17705/1jais.00129

Silva, J. d. (2015). City Resilience Framework. New York: The Rockefeller Foundation. https://www.rockefellerfoundation.org/wp-content/uploads/City-Resilience-Framework-2015.pdf

Spadafina, G., & Scarpelli, D. (2022). L'alloggio in affitto come opportunità. Officina, p. 78-81. ISSN 2532-1218

Talia, M. (2021). The time profile of transformations in territorial governance *Tema. Journal of Land Use, Mobility and Environment*, 182-189. http://dx.doi.org/10.6092/1970-9870/7746

Torre, C. M., Morano, P., & Tajani, F. (2017). Saving Soil for Sustainable Land Use. *Sustainability*. https://doi.org/10.3390/su9030350

UNISDR, & WMO. (2012). Disaster risk and resilience. UN. https://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/3_disaster_risk_resilience.pdf

Yin, R. K., (1994). Case Study Research Design and Methods: Applied Social Research and Methods Series. *Thousand Oaks, Sage Publications*. ISBN-13: 978-1412960991

Table sources

Tab.1: Revised by authors. Source: The Rockfeller Foundation (2014) City Resilience Framework;

Tab.2: Revised by authors. Source: McKinsey (2015) Growth within: a circular economy vision for a competitive Europe. Report commissioned by Ellen MacArthur Foundation;

Tab.3: By authors;

Tab.4: By authors.

Image sources

Fig. 1: By authors;

Fig.2 Source: The figure is part of the inedited thesis "Città Pubblica nel Mezzoggiorno. Bisogni emergent e politiche urbane per i luoghi dell'abitare contemporaneo by Nicola Martinelli, Giovanna Mangialardi, Sabrina Mellacqua, Pio Emanuele Longo,

Francesca Palmieri, Rossella Pellicani, Domenico Scarpelli and Lorenzo Susca. The figure is based on ARCA Sud Salento data;

Fig.3: By authors. Figure based on ARCA Sud Salento and ISTAT 2011 data;

Fig. 4: By authors;

Fig. 5: By authors;

Fig. 6: By authors;

Fig. 7: By authors.

Author's profile

Emanuela Braì

Graduated cum laude in Architecture at University of Chieti-Pescara, she is Research Fellow at the Department of Innovation Engineering with expertise in Building Information Modeling, Geographic Information System and urban and territorial sustainable Planning and Management. Her research focuses on multi-scalar and interdisciplinary management of complex spatial systems and sustainable urban design. She is a consultant for several Public Administrations and Private Organizations in urban planning and sustainable mobility networks, and she is responsible for writing and managing regional, national and European research projects.

Giovanna Mangialardi

Graduated in Building Engineer and Architect, and Ph.D. in Complex System, she is an Adjunct Professor in Urban Planner at the Polytechnic University of Bari and in Landscape BIM at the University of Basilicata. She participates in the research activities of the national "Urban@it - Centro Nazionale di Studi per le Politiche Urbane", of PRIN 2013 "Re-cycle Italy" and PRIN 2009 "Rehabilitation of peri-urban areas". Since 2015, she has been a research fellow at the University of Salento where she was the technical manager of the regional Innolabs project "B@ARCA - BIM at ARCA" and is responsible for writing and managing regional, national and European research projects. She is Associate Editor of the International Journal of Urban Planning and Smart City and author of several articles exploring urban planning and its sustainable, resilient, and inclusive management in an interdisciplinary way.

Domenico Scarpelli

Graduated, cum laude, in Architecture at Polytechnic University of Bari. He now works as a freelance architect. During his studies, he acquired knowledge of economics and social sciences; he made a traineeship at Lecce Municipality, where he studied the local need for housing and he joined Erasmus+ program at University of Sevilla, where he focused his studies on constructive aspects of architecture. Currently, he is studying Urban Regeneration and Social Innovation (U-RISE course) at IUAV University of Venice. His research interests mainly focus on both public and social housing, on the Apulian territory and on urban regeneration processes.

We are online!

TeMA Lab

Follow us on LinkedIn

TeMA Lab

TeMA Laboratory of Land Use, Mobility and Environment

Editoria · Napoli, Napoli

TeMA Lab and our Journal are finally on LinkedIn! TeMA Lab is the Laboratory of Land Use, Mobility and Environment of the Department of Civil, Building and Environmental Engineering, at Università degli Studi di Napoli Federico II. Our field of expertise relates to urban systems, their complexity and the challenges that they will face in near future: adaptation to climate change, ageing population, energy consumptions, development of sustainable mobility and so on. Follow us to be constanly updated!.

www.linkedin.com/company/tema-journal/

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 471-486
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9151
Received 5th May 2022, Accepted 15th October 2022, Available online 30th December 2022

www.tema.unina.it

Landscape and urban planning approach within regional spatial planning system. Case study of Moscow oblast'

Elina Krasilnikova [a], Alesya Goncharik [b*]

[a] Institute of Urban Development
Department of Architecture and Design
Sevastopol State University, Russia
e-mail: eekrasilnikova@sevsu.ru
ORCID: https://orcid.org/0000-0002-9845-5374

[b] Institute of Urban Development
Department of Architecture Design,
Sevastopol State University, Russia
e-mail: alessia26@yandex.ru
ORCID: https://orcid.org/0000-0002-3456-677X
* Corresponding author

Abstract
This article is devoted to the landscape and urban planning system formation issues of the Moscow region, based on the integration of landscape and urban planning approaches. The current proposal considers the landscape both as a system and as an active part of the completely urban planning process. The article aims to present landscape and urban planning as systemic tools for transforming the spatial and planning structure of the macro-region - the Moscow region, offering opportunities for the physical and spatial restructuring of regional landscapes into a single green infrastructure of the region. The relevance of the study is related to the lack of documents in the Town Planning Code of Russia substantiating the need for the development of landscape planning projects, which are necessary for the landscape and urban planning system formation of cities, agglomerations, provinces, regions. In creating the landscape and urban planning system of the Moscow region, it is necessary to rely on the theory and practice of landscape urbanism, which shows the possibilities of its active use in the modern process of urban planning development. Furthermore, this article specifies modern research in the landscape and urban planning transformation field of spatial planning structures at the macro-regional level (macro-regional scale). The article will be useful for training researchers and specialists who could improve planning methodology and, consequently, existing landscape and urban planning practices.

Keywords
Moscow region; Landscape-urban planning system; Natural-ecological framework; Landscape urbanism; Green infrastructure.

How to cite item in APA format
Krasilnikova, E., Goncharik, A. (2022). Landscape and urban planning approach within regional spatial planning system. Case study of Moscow oblast'. *Tema. Journal of Land Use, Mobility and Environment*, *15*(3), 471-486. http://dx.doi.org/10.6092/1970-9870/9151

1. Introduction

Garrett Eckbo (1950) said that in any landscape we look for two features: one is an expression of landscape nature specifics; the other is the development of maximum landscape opportunities for adjustment to the human being's needs (Eckbo, 1950; Treib, & Imbert, 1997). Therefore, the purpose of this study is to substantiate the need for the integration of landscape and urban planning approaches, which is the main mechanism for creating the landscape and urban planning system of the Moscow region.

1.2 The path of transformation of the landscape and urban planning structure

One of the areas of landscape and urban planning transformation of the spatial and planning structure of the Moscow region is the creation of green infrastructure. Green infrastructure is a definition that originates from the Western scientific tradition. Green infrastructure is a unified system of facilities that ensures the preservation of the natural environment along with a system of measures for the construction and reconstruction of facilities (Gushchin, 2015).

In the Russian scientific tradition, Reĭmers (1990) gives the concept of ecological infrastructure: "a complex of structures, enterprises, institutions and technological systems that provides the conditions of the human life environment (the environment surrounding a person)" (Dushkova & Kirillov, 2016). This infrastructure should ensure the sustainable development of the urban planning system. Green infrastructure is a single continuous system of interacting and interconnected urban development objects, united by green spaces and green areas for special purposes.

The emergence of the priority project "Formation of a comfortable urban environment" in Russia (Pravitel'stvo Rossii, n.d.), focused on taking into account the interests and needs of citizens and individual urban residents, gave impetus to a new round of development of green infrastructure concept. Green infrastructure is currently being considered from the position of socio-ecological orientation for solving social, economic and environmental problems in modern society and its environment (Podoĭnit͡syna, 2016).

The process of forming a green infrastructure will inevitably require its assessment, corresponding to modern ideas and qualities. Experts suggest using indicators and indices of biological and environmental sustainability to assess the quality of the infrastructure itself. Experts note that only the system interconnection can ensure its sustainable development (Divakova & Krasilnikova, 2019).

Green infrastructures of cities, which in the 90s in Russia, were destroyed by chaotic buildings, of various functional purposes, are becoming the main criterion for balanced urban development and the main element of the spatial planning structure of cities and regions. The understanding of the importance of creating green infrastructure for the adaptation of cities, villages, and settlements to climate change (Marić, Crnčević & Cvetić, 2015), especially in the context of COVID-19, is obvious. An urgent question is: "How to form an effective, environmentally safe, socially-oriented, healthy, and comfortable city environment?" the environment created by the green infrastructure of the city.

The answer to this question defines a new approach to managing the environmental qualities of the urbanized environment, reflected in the UN document "New Urban Development Program. Habitat III" which emphasizes of the importance of creating attractive and livable cities and towns, urban landscapes based on "evenly distributed networks of multipurpose, safe, open to all, accessible, environmentally friendly and quality public places" (New Urban Agenda, 2017; Krasilnikova et al., 2020).

A number of Russian scientists and architects (Vladimirov, 1982, 1986, and 1999; Zalesskaya & Mikulina, 1979; Yargina, 1986; Sosnovskiy, 1988; Vergunov, 1991; Kolbovsky, 2008; Krasilnikova, 2015; Reĭmers, 1994; Kavalyauskas, 1985, 1987 and 1988; Rodoman, 1974 and 2002; Sokhina, 1991; Zarkhina, 1978; Luntz, 1974; Nefëdov, 2002 and 2012) were engaged in the problem of formation of the green infrastructure of the cities and complex scientific and practical approach to urban landscaping.

2. Case study

2.1 Influence of features of urban planning development: historical context

The Moscow Region is the largest region of Russia, a constituent entity of the Russian Federation with an area of about 46,000 km2. The population of the region is approximately 8 million people. According to the administrative-territorial structure, the Moscow region is divided into districts, cities, and urban-type settlements of regional subordination and closed administrative-territorial units.

Due to the administrative division peculiarities and the presence of the federal capital in its composition, the Moscow region is deprived of its own center, which forms the specifics of the landscape and urban planning system development. In the course of its development, the Moscow region was an advanced region, in which many production processes were introduced earlier than in other regions of the country, as a result of which at the moment there are a significant number of degrading territories in the region formed in the process of urbanization. The process of forming a green infrastructure with the introduction of innovative technologies in the Moscow region will allow solving many existing environmental problems of the region under consideration. Methods that at this stage of the theoretical level of research include an existing structure analysis of the Moscow region, which is formed from the consideration of the historical component of the formation of this agglomeration, then the transport infrastructure is studied as one of the main influences on development. Based on the synthesis of the obtained data and taking into account the state of recreational and investment resources, proposals are formed for generating a landscape and urban planning system with the introduction of innovative technologies into its structure.

The landscape and urban planning system formation of the cities of the Moscow region were influenced by the historical development processes of the cities of the Moscow region, as a result of which the region boundaries were gradually formed and consolidated.

The settlement system of the Moscow region was formed under the influence of the Moscow transport infrastructure, which originated in ancient times. From the moment of its existence, the main Moscow territory and region routes were rivers, since most of the territory was occupied by impenetrable forests (Pravitel'stvo Moskovskoi oblasti, 2016).

The first land acquisitions of the Moscow princes are the Mozhaisk principality (1303, west, inheritance from Smolensk), now the Mozhaisky district of the Moscow region, Kolomensk land (1300, south, inheritance from Ryazan), now Kolomensk, Voskresensk, Stupinsk districts of the Moscow region, " Lopastensky places "(1300, south, volosts from Ryazan, located on the river of the same name), now the Yasnogorsk district of the Tula region, Chekhovsk, Stupinsk, Serpukhov districts of the Moscow region and" another Ryazan places "(between 1353 and 1359, west, volosts from Ryazan), now Naro-Istoricheskie Fominsk district of the Moscow region. Purchased by Moscow in the principalities of North-Eastern Russia - Rostov, Yuryevsk, Dmitrov, Pereyaslavsk, etc. The rest of the Moscow territory in the scientific literature is usually called "Moscow land", which entered a qualitatively new stage in its territorial development, affecting the scale of entire North-Eastern Russia.

2.2 Spatial planning context

In the process of urban development of the Moscow region, the integration of transport infrastructure and the construction industry expanded, namely, drivable dirt roads, highways, railways, and subsequently, airfields, highways were built at a rapid pace (between 2015 and today).

Subsequently, such elements of transport infrastructure as the Moscow Canal, airports, the Moscow ring road, the Big Moscow ring road, the main routes of the head radial sections, and the ring oil product pipeline were actively developing in the Moscow region.

At present, for the sustainable spatial development of the Moscow Region, further development of the existing transport system of the Moscow Region is envisaged on the basis of its integration into the backbone network of highways of the Russian Federation and improving the quality of transport services for the population and economy of the Moscow Region (Pravitel'stvo Moskovskoi oblasti, 2016).

One of the largest megacities in the world, Moscow, plays a vital role in the settlement system of the Moscow region. The Moscow agglomeration is constantly developing and transforming, at present, it is a monocentric agglomeration. The Moscow agglomeration includes Moscow with all its suburbs; is the largest macroeconomic region in Russia (territorial production unit) and an interregional center of socio-economic development and attraction of the central part and all of Russia; one of the largest urban agglomerations in the world. Moscow is the center of gravity of all world agglomerations, which is 10 times larger than the number of inhabitants of other cities included in the agglomeration (with an average distance between neighboring cities and towns not exceeding 10 km). The Moscow agglomeration ranks 15 in the world (Rosstat, 2022).

A feature of the spatial planning structure of the Moscow region at the moment of development is the functional and typological diversity of cities that form its urban planning structure (Fig.1):

- *historical cities* (Sergiev Posad, Kolomna, Dmitrov, Zaraysk, Volokolamsk, Serpukhov, Zvenigorod, Mozhaisk, Noginsk, etc.) that contain historical value, with a history of several centuries.
- *closed cities* (Krasnoznamensk, Vlasikha, Voskhod, Zvezdny City, Molodezhny) for which a special regime has been established for the safe functioning and protection of state secrets, including special living conditions for citizens.

The cities of the Moscow region can be classified according to the territorial distance from a large metropolis, which directly depends on the existing transport links "center-region", and, accordingly, on the development of the transport infrastructure of the agglomeration.

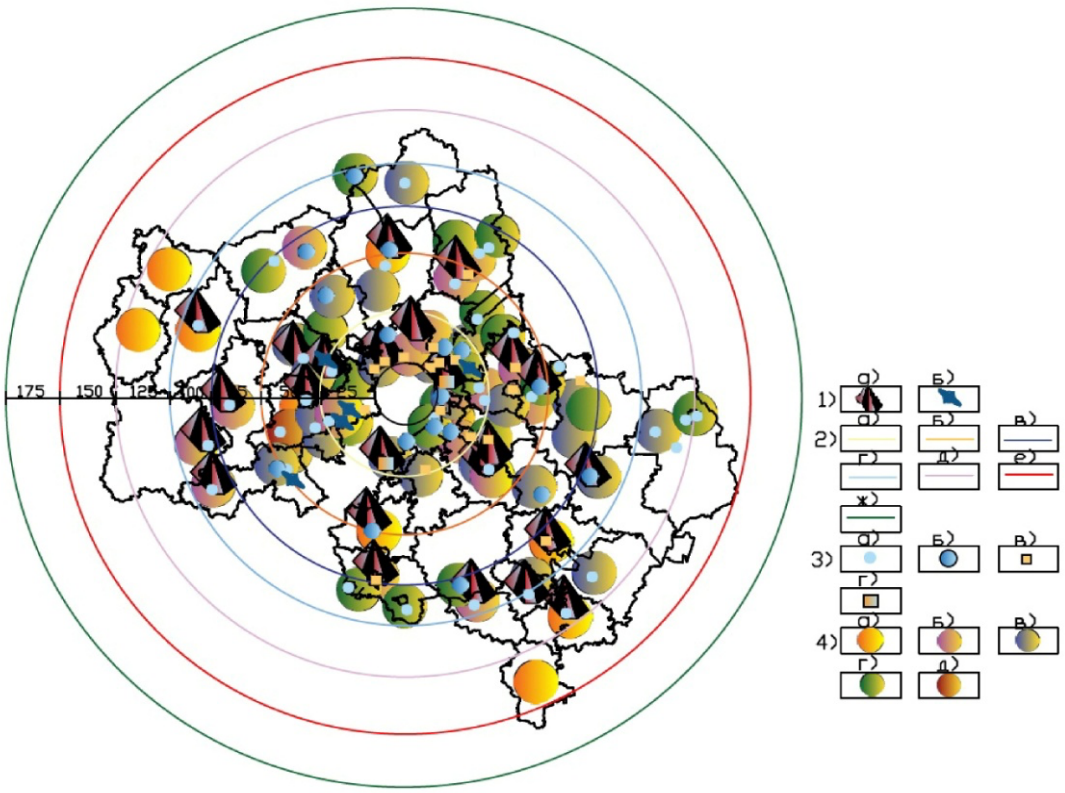


Fig.1 City features: 1) based on functional and typological features: a) historical, b) closed; 2) based on distance to metropolis: a) 25 km; b) 50 km; c) 75 km; d) 100 km; e) 125 km; f) 150 km; g) 175 km; 3) based on human geography: a) with a population of 50,000- small; b) from 50,000 to 100,000 - medium; c) from 100,000 to 250,000 - big; d) from 250,000 to 1,000 000 - massive; 4) based on periods of formation: a) during X-XII centuries; b) during XII-XV centuries; c) during XV-XIX centuries; d) during XIX-XX centuries; e) during XXI century (Goncharik A., (2017).

The Moscow region has a variety of recreational resources for the inhabitants of the region: physical, biological, energy-informational resources form a single network of territorial-recreational complexes with individual, unique features and types with characteristics of a particular territory (direct, indirect, active, historical, evolutionary, ecological, therapeutic, etc.).

At present, in the cities of the Moscow region, in order to create a favorable investment climate, a decision has been made (Pravitel'stvo Moskovskoi oblasti, 2016) to improve the architectural and artistic appearance, to form a comfortable urban environment (Moskovskaya oblastnaya Duma, 2014), to create a comfortable, environmentally sustainable and socially-oriented urban environment, including on the Moscow region territory, which is to ensure safety and create favorable conditions for human life.

Thanks to the improvement of the architectural and artistic appearance of the Moscow region cities, the negative impact of economic and other activities on the environment will be limited, and the protection and rational use of natural resources in the interests of present and future generations will be ensured. An important aspect in the formation of a comfortable and safe environment in the Moscow region cities is the rebranding of cities. Each of the Moscow region cities is unique, as it has independent cultural and historical development, landscape, and planning features of the spatial and planning structure formation of cities in conjunction with the natural frame. Thus, each of the Moscow region cities has its own "urban legend" and its own unique, memorable image of the city.

The residents' perceptions of the city are formed by the surrounding reality - the urban environment nature. Over time, individual elements of visual and mental perception of the city are strengthened, passed on to future generations, become the accumulated collective memory, traditions, ideas, city essence (Vizgalov, 2011). At present, measures to shape the individual appearance of the Moscow region cities are carried out on the basis of the strategy of the Government of the Moscow Region "New Image of the Moscow Region Cities" (Glavnoe upravlenie arkhitektury i gradostroitelstva Moskovskoi oblasti, 2015). This strategy is aimed at creating a modern and comfortable urban environment, developing territories, creating recreational zones in the structure of Moscow region cities.

Consequently, it can be predicted that the Moscow region cities can be vectors for the development of an interconnected system of recreational territories of various functional purposes, which, when integrated with the regional transport infrastructure, form the landscape and urban planning system of the Moscow region.

In almost every country, enterprise and city, the approach to gardening is unique. At the same time, the problems of landscaping have a rich historical aspect and a powerful legal structure - the development of taste. In France, they follow the path of adaptation to the specific features of the territories (climate, regulatory framework, building practices, process organization system). Improvement projects are accepted by the City Hall and are aimed at recreating a unique environment both on the square and on the small street of the quarter (Haute Qualité Environnementale, HQE, 1992).

The principles demonstrate their relevance and success, then a decision is made to use it in other cities. In the United States of America, design codes and new principles for planting urban trees, restoring soil and vegetation are being developed (Time-Saver Standards for Landscape Architecture, 1997; Landscape architectural graphic standards, 2007; Street Design Manual, 2013). In Canada, the approach to greening is staged by thematic area and area-specific, detailing the results (Toronto Official Plan, 2006; Urban Design Guidelines, 2006).

2.3. Landscape and ecological context

Currently, for the further urban development of the Moscow region, the issues of the natural potential development of its cities are topical.

The natural potential of the Moscow region cities is represented by a wide range of landscape, recreational and natural areas, these are natural and national parks, large recreational complexes, historical and cultural

sites inscribed in picturesque natural landscapes, state nature reserves, natural monuments, specially protected water bodies, coastal recreational zones, natural-historical complexes, specially protected natural areas, ski resorts, old museum-estates, temples, kremlins, hunting grounds, lakes, caves, equestrian complexes, reserves, reservoirs.

These objects of the spatial and planning structure of the Moscow region create a unique image of the Moscow region and are the main structure-forming elements of the landscape and urban planning system.

The intensive growth of new construction in the cities of the Moscow Region contains risks that lead to environmental imbalances (changes in ecosystem connections, disruption of the ecological sustainability of the city). The reduction of natural areas is compensated for on the basis of disorderly (not defined by the project for the reconstruction of green spaces) compensatory landscaping.

It is also important for the Moscow region to pursue a policy of constraining the growth of urban sprawl, in which there are three types of urban containment policy – green belts, boundaries of urban growth, and boundaries of urban services (Vladimirov, 1982).

However, considering the containment process solely at the expense of the green belt, on the one hand, forms environmental sustainability, and on the other hand, creates economic difficulties in varying degrees of manifestation.

Therefore, in this situation, it is more correct to focus on a comprehensive solution to the planning of the region, cities, and individual districts based on the creation of a green infrastructure, which forms an evenly distributed space of the landscape and urban planning system at each territorial level, avoiding the creation of territories strictly delimited by a specific function.

At the moment, there is no such complex solution for the territory of the Moscow region, which forms the ecological degradation of the region.

Based on a consistent assessment of the ecological state of the Moscow region (see Figg.1-2) it is necessary to form the basic principles of ecological optimization of urban areas in the Moscow region (Goncharik, 2016).

The ecological problems of the Moscow region are in the contradiction between the intensive processes of urbanization, the combination of various heterogeneous urban planning objects, and the preservation of the natural environment. Urbanized territories need the preservation, reclamation of natural, inartificial landscapes, their protection through legal and urban planning regulation and strategic planning of the development of territories.

To improve the ecological situation of the region's territory in order to create an effective landscape and urban planning system based on the green infrastructure of the Moscow region (including green infrastructures and blue-green infrastructures of cities, urbanized and natural areas), an important element necessary for implementation into this system is innovative technologies.

Innovative technologies that are possible for implementation in the structure of the landscape and urban planning system can be divided into several levels:

- pre-design and design technologies, which include at the stage of analysis of the use of GIS-technologies, at the design stage - the use of BIM technologies;
- socio-ecological, which make it possible to form a friendly and conscious attitude to the landscape and urban planning system, due to the restoration of the ecosystem, the formation of a new structure, and its further maintenance;
- technological, within the framework of which it is possible to use different methods and elements - energy obtained from renewable sources, biological treatment of the environment, preservation and restoration of existing wetland ecosystems, a qualitative approach to processing and utilization.

When using this scenario, it is possible to clearly control the development of sustainable development of the landscape and urban planning system, and not just the maintenance of the existing natural resources of the Moscow Region.

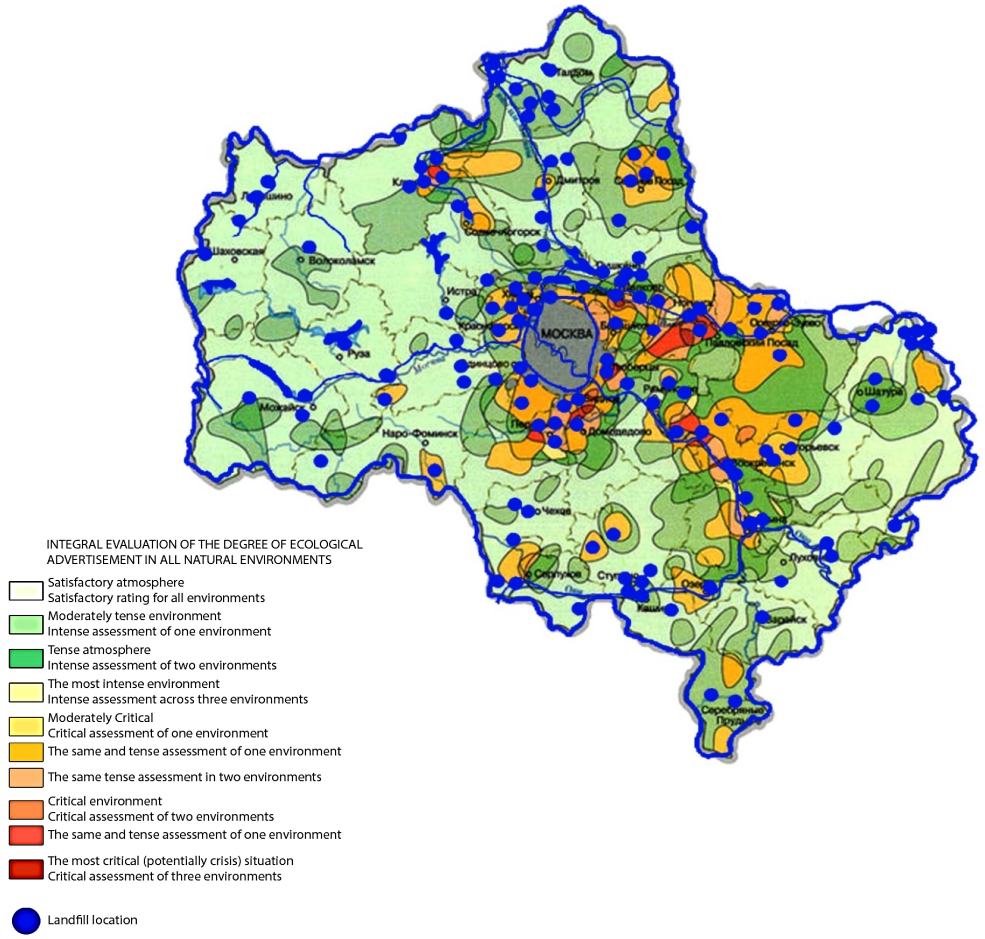


Fig.2 Explication to the scheme of the ecological situation on the Moscow region territory (Source: Authors)

3. Materials and methods

The relevance of the study is associated with the absence of legally approved landscape plans of cities and regions in the territorial planning documents in the Town Planning Code of Russia, and the insufficient number of scientific studies justifying the need to introduce the landscape and urban planning approach in the of regions spatial development strategy.

The aforementioned Russian scientists have considered various aspects of the formation of an interconnected system of landscape and urbanized territories, but research on the creation of a unified landscape and urban planning system of the Moscow region has not yet been carried out. Therefore, an important aspect for substantiating the research results is the study of the world experience of landscape and urban planning, in the context of its interdisciplinary focus. A modern direction in the scientific and practical concept development for the formation of green infrastructure of cities is the creation of a landscape and urban planning framework (Vargas-Hernández & Zdunek-Wielgołaska, 2021). This approach has been applied to the creation of the green infrastructure of Northwest England (Horwood, 2020). The green infrastructure of North West England interconnects the natural ecosystems of suburban areas between cities in the region and permeates the urban fabric of cities: Carlisle, Lancaster, Barrow-in-Furness, Preston, Blackpool, Manchester (Mell et al., 2013), Liverpool и Chester, through its integration with transport infrastructure in the landscape - urban development framework (Krasilnikova, 2018).

Based on the fact that at the territorial level of regions and large agglomerations, the landscape and urban planning framework is part of the landscape and urban planning system, it can be concluded that its creation is a necessary condition for ensuring stability of the spatial planning structure of the regions. In spatial

planning, the natural and urban landscape properties are determined on the basis of cartographic, functional, historical-genetic, morphotype, geoecological, visual methods, and GIS research methods (Kochurov et al., 2018). Such an integrated approach based on the above research methods is revealed in the definition of landscape urbanism, which is an ecologically oriented direction in modern urban planning theory and practice, based on an interdisciplinary approach, in which the landscape plays one of the dominant roles in determining the main vectors of territorial development (Krasil'nikova, 2015). When compiling figures 3 and 4, historical data on the development of the territory, the existing transport infrastructure, historical references of cities were used. All these data are aimed at developing objective, system-organized and substantiated knowledge about nature, man and society.

3.1 Landscape urbanism in the formation of landscape and urban planning system

The introduction of new ecologically and socially oriented directions and theoretical concepts of modern urbanism is relevant for the formation of the landscape and urban planning system of the Moscow region. In our opinion, it is advisable to dwell on the application of the scientific and practical foundations of the theoretical concept of landscape urbanism in the creation of the landscape and urban planning system of the Moscow region.

The theory and practice of landscape urbanism reveal the real possibilities of its active application in the modern process of development of urbanized territories. Landscape urbanism is focused on the creation of ecologically sustainable territories with a unique and identical spatial planning structure.

Landscape urbanism, according to Weller (2008), allows one to move away from critical regionalism due to the absence of dogmatism in its theory, offering a broader view of urban spatial planning and design. According to Waldheim (2006), new urbanism is a serious drawback of modern urban planning, since the coding of territories proposed by this direction leads not only to a lack of variability in the possibilities for the development of a territory, but also to leveling and diminishing the importance of the creativity of architects, designers, and artists in shaping its individual image.

Examples of the creation of small cities in America, similar to one another, built based on space coding of new urbanism, leads to the depersonalization of cities, the loss of an individual architectural and artistic image. Therefore, for the landscape and urban planning transformation of regional systems, such as the Moscow region, theoretical and practical methods and approaches of landscape urbanism are the most effective. The rationale for the choice of the scientific basis for this study is the expansion of the scale of urban planning application of landscape urbanism at various territorial levels.

An example of the transition of the application of landscape urbanism from the regional level to the level of development of mega-territorial structures is the project of the West Coast Region in Australia, developed by Weller (2008), Ahern (1999). R. Weller's concept is based on the creation of a mega-region, the structure of which is formed in such a way as to improve difficult environmental conditions and conditions for socio-economic development. From the point of view of R. Weller, mega-regional planning presupposes a new concept of integration between landscape systems and urbanized structures, which will ensure the sustainable development of this territory in the future. The symbiosis of landscape, cities, and humans in the 21st century is one of the main directions of economic optimization based on the ecological vision of mega-regional development. Landscape urbanism was born at the University of Pennsylvania in the early 1980s.

This was obvious because the founder of the Department of Landscape Architecture at the University of Pennsylvania was Ian McHarg (1957), who first proposed the concept of ecological land planning in 1969 in his book «Design with Nature». The ideas of McHarg (1963, 1969) on the integration of man and the natural environment, as well as his scientific research on the interaction of urbanized and natural territories in the process of their evolution, became the scientific and theoretical basis of landscape urbanism and are still relevant for the development and transformation of urbanized territories (Krasilnikova, 2015).

The followers of McHarg, who study the issues of effective integration of landscape and urban planning in the context of preserving and increasing natural components in urbanized areas, are currently well-known scientists: Corner J. (2014), Mostafavi M. (2010), Waldheim C. (2002), Weller R. (2008), Spirn A.W. (1984), Burns K. (2008), Forman R. (2008), Allen S. (1999), Kahn E. (2008), Ahern J.F. (2002).

Understanding the space from the perspective of "landscape as an ecosystem" in landscape urbanism is the priority of the ecosystem approach in building a sustainable, flexible model for the development and transformation of territory capable of self-healing. Each of the theorists of landscape urbanism in their own way interprets the role, place, and range of applications of landscape urbanism in the modern practice of urban development. Analyzing the theoretical works Corner (2014), Mostafavi (2010), Waldheim (2003, 2006), Weller (2008), Allen (2008) and other theorists of landscape urbanism, it is possible to formulate more specific definitions of the principles of landscape urbanism, the application of which can be traced in practice and shows the possibilities of applying this direction in a wider territorial range.

Openness, democracy, flexibility, and the ability to temporarily transform landscape urbanism make it possible to creatively develop and substantiate its theoretical principles for specific territorial levels. In this regard, it should be noted the importance of scientific methods and approaches to the formation of strategic landscape plans at the regional level, based on the integration of landscape ecology and landscape planning in the studies of Ahern (2002) and Forman (2008). The infrastructure approach, according to Allen (1999), can be defined as the basis or foundation for any concept that determines the direction of aesthetic and symbolic nature development. Allen's definition is important for understanding current trends in the infrastructural development of cities and agglomerations. The scenario approach of Ahern (2002), Weller (2008), Burns (2008) and the concept of "scenario city" (Kahn, Thomsen, & Golan, 2008) is currently one of the modern approaches to the selection of the most effective concepts for the development of landscape and urban planning systems at various territorial levels from a small town to an agglomeration. The priority of preserving the cultural and historical environment, based on its integration into the landscape-planning framework of urban areas, is considered in the studies of Spirn (1984), Burns (1991). Thus, the study of modern research related to the transformation of the spatial and planning structure of cities and regions in order to form the landscape and urban planning systems, allows us to determine foregrounded approaches for their creation: landscape and urban planning approach, infrastructure approach, ecosystem, scenario approach. The methodology of the above-mentioned approaches should be based on the identification of regional features of territorial development: landscape, spatial planning, natural-ecological, socio-cultural, socio-economic, and demographic, and others (Krasilnikova, 2014) (Fig.3).

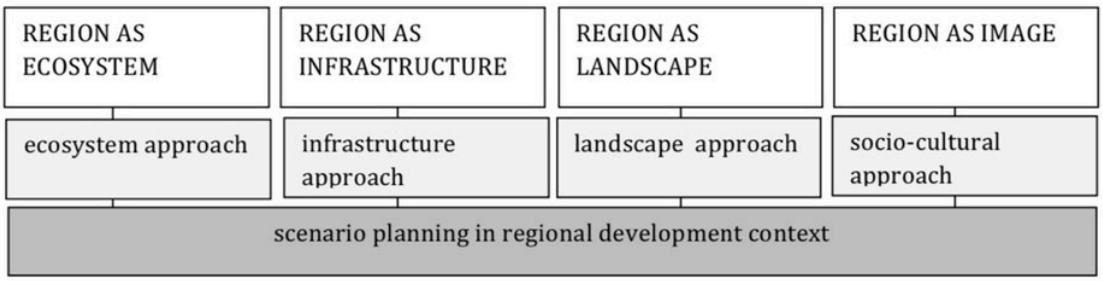


Fig.3 Landscape and urban planning transformation (Krasilnikova E., 2014)

Based on the foregoing, it is possible to propose the main directions of the formation of a conceptual model of the landscape and urban planning system (on the example of the Moscow region), based on the theory and practice of landscape urbanism. Namely, the landscape and urban planning system will determine the development of the region as a balanced ecosystem, as a multifunctional infrastructure, as a single landscape system, and as a region, that has an identity, a territorial brand, and a memorable visual and mental image of the territory (Fig. 4).

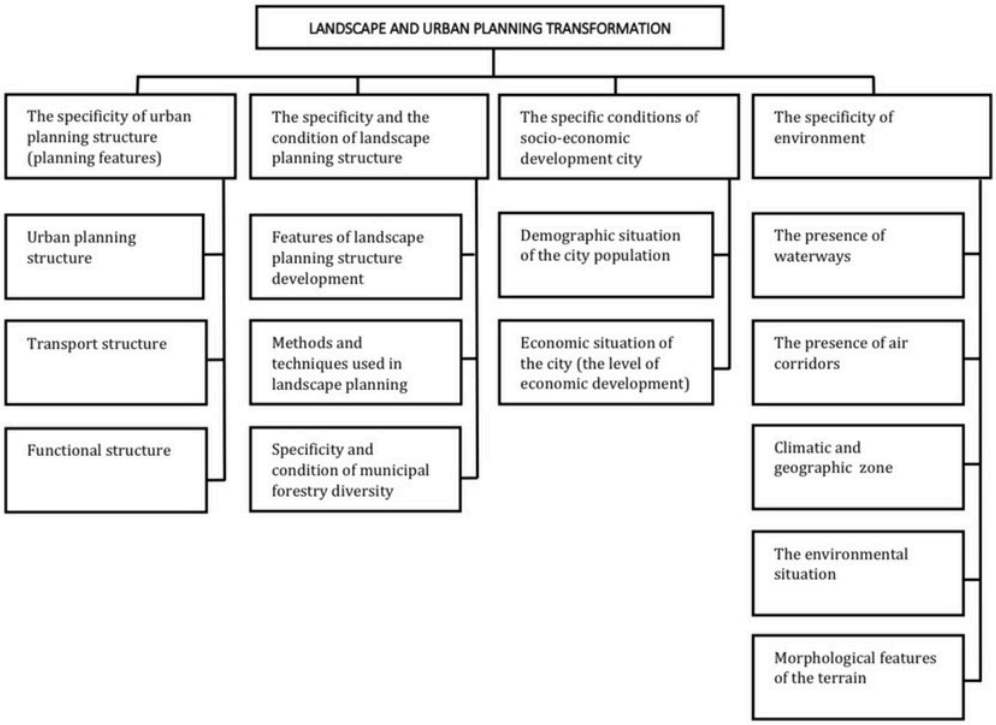


Fig. 4 The concept of the spatial planning structure transformation in the context of landscape urbanism at the regional level

The landscape and urban planning transformation of the Moscow region territory is one of the most ecologically oriented directions for the further development of the spatial planning structure of the region.

The symbiosis of urban planning transformations and the formation of a sustainable landscape system will create a viable, flexible, and sustainable landscape and urban planning infrastructure of the region (infrastructural approach).

The interrelationship between the landscape and urbanized Moscow region territories should be at each hierarchical level of the spatial planning structure. Globally, the urban space transformation is aimed at creating an urban-ecological balance of the urban environment. These transformations are based on the multifunctional use of the ecological capabilities of the existing landscape-planning framework and its diffusion into the spatial-planning framework of the Moscow region at each hierarchical level. Thus, we can create a dispersed multifunctional and socially oriented infrastructure that permeates all elements of the spatial planning framework of the Moscow region and affects the development of border areas (Tab.1).

Region	Development of a regional system of recreational spaces of natural areas, such as river valleys, sea areas, mountain forests, historical landscapes in the zone of agglomerations and metropolises influence
City	Formation of the landscape and urban planning scenario of the city on the basis of its integration with the natural frame of the city and adjacent territories for the effective territorial development of the city. Priority in the creation of contact zones between the elements of the natural framework of the city and territories with a high degree of urbanization. Formation of an interconnected system of embankments as a vector for the development of adjacent territories
District	Creation of multifunctional socially oriented public and recreational spaces that provide environmental, visual comfort, and accessibility for all categories of residents. Formation of the landscape and urban planning scenario of the district.
City Centre	Urban regeneration of central public and recreational spaces based on the formation of an interconnected system of green public pedestrian spaces (green routs) and multifunctional objects in the context of the surrounding socio-cultural environment
Post-industrial violations of the territory	Comprehensive landscape and urban planning regeneration of industrial, post-industrial, and disturbing territories, based on an urban-ecological approach to the restoration of a comfortable and safe socially oriented environment. Formation of new markers of city public spaces in conjunction with the development of adjacent territories

Tab. 1 Landscape urbanism in the development of urbanized territories (proposed use)

The formation of a comfortable, balanced, "open nature" urbanized environment in the context of landscape urbanism is considered at the level of a) region, b) city, c) district, d) city center, and e) post-industrial disturbed territories (Krasilnikova, 2015).

3.2 Proposed approach

The proposed case s experimental trials in Berlin and Seoul, which demonstrate that the cities are similar in size but with vast differences in landscape. As a method, maps are parsed according to types, each of which represents a template. Overlapping patterns indicate systematic relationships between different disciplines. The arts and humanities approach can be linked to the natural sciences approach by overlaying historical layers on geoscience layers. This provides the key to planning for sustainability in a social and environmental sense.

The geo-historical map overlay is a platform that can bring practitioners from different disciplines together to work in an urban environment. For the analysis and mapping of the European countryside, the landscape is defined as a functional, hierarchical layer of abiotic, biotic and anthropogenic processes (Mücher 2003; Mücher, Klijn, Wascher & Schaminée 2010). Landscape architecture holds this favorable position between nature - sciences and sciences of the humanities, between engineering and admin. Landscape architects offer design solutions to manage urban form more in line with topography (Condon, 1996; Mostafavi & Doherty, 2010; Waldheim, 2006, Journal of Landscape Architecture / spring 2013).

4. Results

For the purpose of defining the main directions for the formation of the landscape and urban planning system of the Moscow region, it is necessary at the level of strategic territorial planning to develop several scenarios for the development of the landscape and urban planning system of the Moscow region, taking into account a number of urban planning problems that currently require new approaches to solve them:

Ecosystem approach (Moscow region as a single ecosystem):

- creation of a unified ecosystem of the Moscow region based on the preservation of existing and new natural recreational facilities and the re-functionalization of landscaping facilities;
- development of a strategy for urban development of natural areas of the Moscow region.

Infrastructure approach (Moscow region as a sustainable landscape and urban planning infrastructure):

- development of a model of legal regulation of the landscape and urban planning system of the Moscow region in conditions of intensive urbanization;
- development of a clear functional purpose of each landscaping object and the mode of its use;
- development of a unified greening system for the Moscow region (region - city - adjacent territories);
- green infrastructure - green infrastructure - blue-green infrastructure;
- creation of a unified system of landscaping and water resources - blue-green infrastructure;
- formation of a set of measures for the introduction of innovative technologies into the structure of the landscape and urban planning system of the Moscow region.

Landscape approach (Moscow region - Russian landscape):

- preservation of unique landscape parks, nature reserves, forest resources, which form the "postcard view of the territory" and the landscape identity of the Moscow region;
- creation of the landscape code of the Moscow region at the legislative level;
- an increase in bio-diversion in the Moscow region cities;
- an increase in urban forests in the structure of the Moscow region cities;

- development of the Urban Forest Program.

Sociocultural approach (visual and mental image of the Moscow region, delirium of the territory):

- cultural and historical development, landscape and planning features of the spatial and planning structure formation of cities in conjunction with the natural frame;
- involvement of residents in the process of creating the landscape and urban planning system of the Moscow region;
- integration of tourist routes into the green infrastructure of the Moscow region.

Currently, the most favorable conditions for the formation of the landscape and urban planning system arise in the Moscow region cities as a result of their constant development. The current trend in the development of land planning projects in the Moscow region cities is to increase the living space and the formation of an affordable and favorable life for the population. In this regard, the migration of people from areas with a low level of landscaping to another area with a more favorable and comfortable living environment is possible. Therefore, in connection with the possible migration of the population in the Moscow region and the increase as a result of this process the area of disappeared from the city-forming elements of the planning structure of cities and villages. Thus, there is an ineffective and unbalanced use of natural territories, the unity of nature with man disappears, and the number of green areas decreases, the ecological situation in the region deteriorates.

In the structure of the Moscow region, at present, the processes of development of territories for housing, civil and industrial construction are actively taking place. As a result of such an intensive investment development of territories, the resource of natural landscapes was practically not used in the urban planning concept for the development of these territories, i.e. inclusion of natural landscapes in the building structure. Thus, as a result of this, the existing urban planning composition of plans for historical cities can change, collapse, deform.

The next aspect justifying the creation of the landscape and urban planning system of the Moscow region is the need for strengthening state control over the state and use of natural areas, excluding unplanned (chaotic or unsystematic) urban land development.

Municipalities establish individual requirements and land planning restrictions on their territory. As a result, the risk of social and environmental tension in the Moscow region may increase. Consequently, the relevance of this study is due, on the one hand, to the current absence in Russia of a legal basis in the field of landscape and urban planning, on the other hand, to the need to create an ecologically sustainable and socially-oriented landscape and urban planning system of the Moscow region and other regional systems of Russia.

Thus, the landscape and urban planning organization of territories, which combines urban planning and nature conservation functions, is aimed at creating an urban ecological framework for the Moscow region, focused on ensuring the bio-diversion of the natural environment for further sustainable development. In the Moscow region, there are favorable conditions for the formation of an integrated system for the preservation of existing and creation of new natural objects and on its basis.

The landscape and urban planning organization of territories, which combines urban planning and environmental functions of architectural objects, is aimed at creating an urban ecological framework of spatial elements of the Moscow region, focused on ensuring the natural environment viability for their further sustainable development.

5. Conclusion and discussion

As a result of the study, it can be concluded that at different stages of the historical development of urban planning structures of the Moscow region cities, natural factors have always been the most stable elements of their spatial and planning structure, which have great potential and opportunities for transformation and

evolution, since they obey more dynamic infrastructural elements such as the transportation system, social, industrial and recreational connections.

Based on the fact that the landscape and urban planning system is based on the system integration of green areas of limited and special purposes, specially protected natural areas, urban forests, urban green public spaces with transport infrastructure, public spaces, residential and industrial areas of the region, it is necessary to clearly define the main directions ("Roadmap") of its spatial and planning transformation.

This approach to the future continuation of this study, namely, the transition from a theoretical to a practical level, will be a scientific and practical justification for the creation of a landscape and urban planning system of the Moscow region.

Therefore, as part of the next stage of these studies, it is necessary:

- to assess the current state of the landscape and urban planning system at all territorial levels;
- to reveal the regularity in the formation of the landscape and urban planning framework of the Moscow region cities;
- determine the strategy for the region development of the landscape and urban planning system based on green infrastructure;
- to determine the most optimal ways of sustainable urban development of the territories of the Moscow region cities, in the context of the theory and practice of landscape urbanism and considering the introduction of innovative technologies.

Thus, the research results presented in the article and promising proposals for further research, related to the formation of the landscape and urban planning system of the Moscow region, show the relevance, prospects, and the need for its creation. The article presents a hypothetical theoretical model of the concept of transformation of the spatial planning structure in the context of landscape urbanism (Figg.3, 4), which substantiates the landscape and urban planning approach integration to the formation of the landscape and urban planning system of the Moscow region and will be focused on creating a safe, environmentally stable and socio-oriented living environment of people in the Moscow region cities (Goncharik, 2018).

In conclusion, our study notes that a landscape-urban system, coupled with an efficient administrative system, is critical to the conservation of the natural environment. The analysis for each municipality can provide more accurate data, especially if data at the neighborhood level are provided. This is a complex and labor-intensive task. For this reason, the main contribution of the article lies in the preservation of existing ties and the development of new territories. To the best of our knowledge, our study is the first attempt to form a landscape infrastructure at the subject level.

References

Ahern, J. F. (1999). Spatial Concepts, Planning Strategies, and Future Scenarios - A Framework Method for Integrating Landscape Ecology and Landscape Planning. In J.M. Klopatek, & R.H. Gardner (Eds.), *Landscape Ecological Analysis* (175-201). New York - Springer.

Ahern, J. F. (2002). G*reenways as Strategic Landscape Planning - Theory and Application*. (Doctoral dissertation). Wageningen - Wageningen university. Retrieved September 18, 2021, from: https://library.wur.nl/WebQuery/wurpubs/318380

Allen, S. (1999). *Pointes+lines - Diagrams and project for the city.* New York - Princeton architectural press.

Allen, S. (2008). Infrastructural urbanism. In D. Allmy (Ed.), *On Landscape Urbanism. Center. A Journal for Architecture in Americ*a, 14 (pp. 174-181). Austin, TX - The Univerity of Texas at Austin school of architecture.

Azmoodeh, M., Haghighi, F. & Motieyan, H. (2022). Combining resources and conversion factors. *Tema. Journal of Land Use, Mobility and Environment, 15(2),* 227-248. http://dx.doi.org/10.6092/1970-9870/8906

Bengston, D. N., & Youn Y.-C. (2006). Urban containment policies and the protection of natural areas - The case of Seoul's greenbelt. *Ecology and Society*, 11(1). Retrieved from - http://www.ecologyandsociety.org/vol11/iss1/art3/

Corner, J. (2006). Terra Fluxus. Waldheim, C. (Ed.) *The Landscape Urbanism Reader* (pp. 28-33). New York - Princeton architectural press.

Corner, J., & Hirsch A. B. (2014). *The landscape imagination. Collected Essays of James Corner 1990-2010.* New York - Princeton architectural press.

Burns, K. (2008). On site. In D. Allmy (Ed.), *On Landscape Urbanism. Center. A Journal for Architecture in Americ*a, 14 (pp. 122-123). Austin, TX - The Univerity of Texas at Austin school of architecture.

Condon, P.M. (1996). *Sustainable urban landscapes: The surrey design charrette, University of British Columbia.* Vancouver - University of British Columbia press.

Divakova, M. N., & Krasilnikova E. E. (2019). The main directions of the formation of green infrastructure in large industrial cities. Sustainable development of regions in terms of improving the quality of live of citizens. *Collection of materials of the IV All-Russian Congress of industrial ecology of regions*. (pp. 107-111). Yekaterinburg.

Dushkova, D. O., & Kirillov, S. N. (2016). Green infrastructure of the city. German experience, Bulletin of Volgograd state university, 2, 189.

Eckbo, G. (1950). *Landscape for Living.* New York - F.W. Dodge.

Forman, R. (2008). Ecologically sustainable landscapes - The role of spatial configuration. In D. Allmy (Ed.), *On Landscape Urbanism. Center. A Journal for Architecture in Americ*a, 14 (pp. 56-69). Austin, TX - The University of Texas at Austin school of architecture.

Glavnoe upravlenie arkhitektury i gradostroitelstva Moskovskoi oblasti (2015). *Novyi oblik gorodov Moskovskoi oblasti.* Moskva - Glavnoe upravlenie arkhitektury i gradostroitelstva Moskovskoi oblasti. Retrieved August 18, 2021 from https://standartgost.ru/g/pkey-14293759592

Goncharik, A. A. (2016). Formation of the landscape and urban planning system of cities and villages when considering issues of legal support for urban planning activities in the Moscow region, Technologies and equipment for landscape gardening and landscape *construction. Collection of articles of the All-Russian scientific-practical conference ekhnologii* (pp. 58-62). Krasnoyarsk - SibGAU.

Goncharik, A. A. (2017). Formation of the landscape and urban planning system of cities and villages when considering issues of legal support for urban planning activities in the Moscow region, Modern city - *Power, management, economy,* 1, 210-217.

Goncharik, A. A. (2018). Natural potential in continuous communication of ecological balance (on the example of the Moscow region), *Urban sociology*, 4, 67-75.

Government of the Moscow region (2016). The State program of the Moscow region *«Architecture and urban planning of the Moscow region for 2014-2018», approved by the decree of the government of the Moscow region 23.08.2013 №661/37 August 23, 2013 (as amended No. 453/19 June 14, 2016).* Moscow - Government of thr Moscow region.

Government of the Moscow region. (2016). *Scheme of territorial planning of transport services in the Moscow region, approved by the decree of the Govenment of the Moscow region №230/8 dated March 25, 2016.* Moscow - Government of the Moscow region.

Guida C., & Natale F. (2021). Ecological transition: which transactions?. *TeMA - Journal of Land Use, Mobility and Environment, 14*(1), 93-98. https://doi.org/10.6092/1970-9870/7878

Gushchin, A. N. (2015). *Teoriia ustoĭchivogo razvitiia goro*da. Moskva-Berlin - Direct-Media.

Horwood, K. (2020). The development of green infrastructure policy in the Northwest Region of the UK 2005–2010, *Planning Practice & Research*, *35* (1), 1-17.

Kahn, E., Thomsen, R., Golan, R., & Christensen, J. (2008). Scenario city. In D. Allmy (Ed.), *On Landscape Urbanism. Center. A Journal for Architecture in Americ*a, 14 (pp. 196-203). Austin, TX - The Univerity of Texas at Austin school of architecture.

Kavalyauskas, P. (1985). System design of a network of a specially procted *area. Geoecological approaches to the design of natural and technical geosystems. Moscow* - IG AN SSSR.

Kavalyauskas, P., Lekavichyus, A. (1987). Formation of a network of protected areas. Ecological optimization of the agricultural landscape. Moscow - The science.

Kavalyauskas, P. (1988). Geosystemic concept of planning natural framework. Theoretical and applied problems of landscape sciense. *Theses VIII All-Union conference on landscape science* (pp. 102-104). Moscow - GO AN SSSR.

Kolbovsky, E. Yu. (2008). *Landscape planning*. Moscow - Akademy.

Kochurov, B. I., Khaziakhmetova Yu. A., Ivashkina I. V., & Sukmanova E. A. (2018). Landscape approach in urban planning. *Yug Rossii: ecology, development.* 13 (3), 71-82.

Krasilnikova, E. E. (2000) The role of the urban-ecological approach in the development of strategy for the sustainable development if cities. In V.I. Atopov (Ed.), International scientific and practical conference *"Large cities on the threshold of*

the XX century: problems, prospects" (pp. 76-94). Volgograd - Volgograd state university of architecture and civil engineering.

Krasilnikova, E. (2014). Landscape and urban planning transformation of space-planning structure. *The Hybrid Link Vol. 03, Hybridization Between Form and Energy. Urban Hybridization.* Retrieved from - http://www.urbanhybridization.net

Krasilnikova, E. E. (2015). *Landscape urbanism - Theory and practica. Scientific monograph.* Moscow-Volgograd - OOO «IAA «Regional news».

Krasilnikova, E. E., & Goncharik, A. A. (2017) Topical issues of the formation of landscape and urban macrosystems (on the example of the Moscow aglomeration). *Sociology of the city*, 2, 53-61.

Krasilnikova, E. (2018). Phenomenom Manchester. Urban hybridization in the context of landscape urbanism. *Urban planning,* 1, 40-50.

Krasilnikova, E. E., & Petrova, Yu. A. (2018). The role of green infrastructure in the formation of an actual socially oriented urban space. International scientific and practical conference *"Science education and experimental design at MARKHI".* Collection of abstracts of reports of the international scientific-practical conference (pp. 353-355). Moscow - MARKHI.

Krasilnikova, E., & Popova, L. (2018) Modern trends of sustainable housing design using landscape urbanism principles. In V. I. Vasenev, E. Dovletyarova, Z, Chen, & R. Valentini (Eds.), *Megacities 2050: Environmental consequences of urbanization. Proceedings of the VI International conference on landscape architecture to support city sustainable development,* 172-182. Cham - Springer.

Krasilnikova, E. E., Divakova, M. N., Zhuravleva, I. V., & Kuzmin, A. V. (2019). Features of the formation of the green frame of Sevastopol. Integration of agricultural landscapes into the green frame of the city. International and scientific conference *"Green infrastructure of the urban environment: current state of development prospects". Collection of articles of the international scientific conference.* 173-177. Voronezh-Moscow - OOO «The envelope».

Krasilnikova, E. E., Kusov, I. S, Zuravlëva, T. A., Goncharik, A. A. (2020). Integration of therapeutic landscapes in the green infrastructure of the city. International conference *"Comfortable environment - healthy Creation of therapeutic gardens in the structure of the city environment". Materials of the international scientific conference.* (pp. 13-19). Sevastopol - Sevastopol state university.

Lappo, G. M. (2007). Urban agglomeration of the U*SSR-Rossia - Features and dynamics in XX century. Russian Expert Review, 4-5, 3-10.*

Lester, S. E., Dubel, A. K., Hernán, G., McHenry, J., & Rassweiler, A. (2020). Spatial planning Principles for marine ecosystem restoration. *Frontiers in marine science, 7,* 328. https://doi.org/10.3389/fmars.2020.00328

Luntz, L. B. (1974). Urban green *building*. Moscow - Stroyizdat.

McHarg, I. L. (1967). Ecological method for landscape architecture. *Landscape Architecture,* 57 (2), 105–107.

McHarg, I. L. (1969). *Design with Nature*. New York - Natural History.

Marić, I., Crnčević T., Cvetić, J. (2015). Green infrastructure planning for cooling urban communities - Overview of the contemporary approaches with special reference to Serbian experiences, *Spatium,* 33, 55-61.

Mell, I. C., Henneberry, J., Hehl-Lange, S., & Keskin, B. (2013). Promoting urban greening: Valuing the development of green infrastructure investments in the urban core of Manchester, UK. *Urban Forestry & Urban Greening*, 12 (3), 296-306.

Miralles i Garcia, J. L., & Grau V. J. A. (2016). Updated method of aptitude to sustainable urban development for including green infrastructure. *International Journal of Sustainable Development and Planning,* 11 (6), 970-979.

Moskovskaya oblastnaya Duma (2014). *Zakon Moskovskoj oblasti o blagoustrojstve v Moskovskoj oblasti ot 30.12 2014 goda N 191/2014-OZ.* Moscow - Moskovskaya oblastnaya Duma.

Mostafavi, M., & Doherty G. (2010). *Ecological Urbanism.* Zürich - Lars Muller Publishers.

Nefëdov V. A. (2002). *Landscape design and sustainability of the environment..* Sankt-Petersburg - Poligrafist.

Nefëdov, V. A. (2012). *Gorodskol landscape design.* Sankt-Petersburg - Lyubavich.

Podoĭnîtsyna, D. S. (2016). Critical analyss of the concept of "Green infrastructure".

Architecture and modern information technologies, 1, 10-13.

Reĭmers, N. F. (1990). Nature management. Moscow - Thought.

Reĭmers, N. F. (1994). *Ecology.* Moscow - Roussia Is young.

Rodoman, B. B. (1974). *Polyarizaciya landshafta kak sredstvo sohraneniya biosfery i rekreacionnyh resursov*. Moskva - Resursy, sreda, rasselenie.

Rodoman, B. B. (2002). *Polarized biosphera.* Smolensk - Oikumen.

Russian Government (n.d.). *Priority project "Formation of a comfortable urban environment*". Retrieved 18 August, 2021 from http://government.ru/projects/selection/649/

Pirlone, F., Spadaro, I., De Nicola, M., Sabattini, M. (2022). Sustainable urban regeneration in port-cities. A participatory project for the Genoa waterfront. *Tema. Journal of Land Use, Mobility and Environment*, *15* (1), 89-110. http://dx.doi.org/10.6093/1970-9870/8322

Salata, K. D., & Yiannakou, A. (2016). Green Infrastructure and climate change adaptation. *Tema - Journal of Land Use, Mobility and Environment, 9(1),* 7-24. https://doi.org/10.6092/1970-9870/3723

Sokhina, E. N. (1991). The ecological frame of the territory as the basis for the system regulation of nature management. *Problems of formation of formation of strategy of nature management.(pp. 194-200)*. Vladivostok-Khabarovsk - Izdatelstvo DVO AN USSR.

Sosnovskiy, V. A. (1998). Urban planning. Moscow - Graduate school.

Spirn, A. W. (1984) *The granite garden - Urban nature and human.* New York - Basic Books.

Temes, R. I., Moya, A. (2016). Typology of the transformations occurred in the peri-urban space of huerta de Valencia. Evidence from north arch of Valencia (Spain). *International Journal of Sustainable Development and Planning*, 11 (6), 996-1003, https://doi.org/10.2495/SDP-V11-N6-996-1003

Treib, M., & Imber, D. (1997). *Garrett Eckbo: Modern landscapes for living*. Berkeley - University of California Press.

United Nations (2016). *New Urban Agenda.* Retrieved from - https://habitat3.org/wp-content/uploads/NUA-English.pdf

Vargas-Hernández, J. G., & Zdunek-Wielgołaska, J. (2021). Urban green infrastructure as a tool for controlling the resilience of urban sprawl. *Environment, Development and Sustainability,* 23, 1335–1354.

Vergunov, A. P., Denisov, M.F., & Ozhegov, S.S. (1991). *Landscape design.* Moscow - Architecture-S.

Vizgalov, D. V. (2011). City branding. Moscow - Fond « Institute of urban economics».

Vladimirov, V. V. (1999). *Urbanecology*. Moscow - MNEPU.

Vladimirov, V. V. (1982). Settlement and *environment.* Moscow - Stroyizdat.

Vladimirov, V. V. (1986). City and landscape - *Problems, constructive tasks and solutions*. Moscow - Thought.

Waldheim, C. (Ed.) (2006). *The Landscape urbanism reader.* New York - Princeton architectural press.

Waldheim, C. (2016). Landscape as urbanism - A general theory. *Environment and Planning B Planning and Design, 44* (3), 10–17, https://doi.10.1177/0265813516677112

Weller, R. (2008). Landscape (sub) urbanism in theory and practice? Board of regents of the university of Wisconsin system. *Landscape journal,* 27 (2), 255–278.

Yargina, Z. N. (1986). Basic theories of urban planning. Moscow - Stroyizdat.

Zalesskaya, L. S., & Mikulina, E. M. (1979). *Landscape architecture*. Moscow - Strojizdat.

Zarkhina, E. S. (1978). Forest cover as the main tool for optimizing the landscape balance. Rational use of natural resources and environmental protection *on BAMe* (pp. 105-111). Irkutsk - SO AN USSR.

Image Sources

All figures from 1 to 4 have been elaborated by authors.

Author's profile

Elina Krasilnikova

Full professor, Head of Department of Architecture and Design at the Institute of Urban Development of Sevastopol State University. She is interested inn urban design and planning from the position of sustainable cooperation between anthropogenic and natural aspect, eco-city reconstruction on the basis of sustainable development, Landscape urbanism and Landscape and urban planning approach within regional spatial planning system.

Alesya Goncharik

Engineer of landscape gardening and landscape construction, Associate Professor of Department of Architecture and Design at the Institute of Urban Development of Sevastopol State University. Her research concerns historical, environmental, social, and economic actions in order to define regional models for sustainable territorial regeneration based on a landscape and urban planning approach.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 487-500
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9232
Received 16th June 2022, Accepted 25th November 2022, Available online 30th December 2022

www.tema.unina.it

Buffer areas for sustainable logistics. Assessing their added value towards port community

Ilaria Delponte[a*], Valentina Costa[b], Ennio Cascetta[c], Armando Cartenì[d], Flavia Scisciot[e]

[a] Department of Civil, Chemical and Environmental Engineering
University of Genoa, Genoa, Italy
e-mail: ilaria.delponte@unige.it
ORCID: https://orcid.org/0000-0002-6876-4053
* Corresponding author

[b] Italian Excellence Centre for Logistics, Transport and Infrastructures
University of Genoa, Genoa, Italy
e-mail: valentina.costa@edu.unige.it
ORCID: https://orcid.org/ 0000-0002-8841-6187

[c] Department of Civil, Building and Environmental Engineering
University of Naples Federico II, Naples, Italy
e-mail: ennio.cascetta@unina.it
ORCID: https://orcid.org/0000-0001-7471-3562

[d] Department of Engineering
University of Campania "Luigi Vanvitelli", Caserta, Italy
e-mail: armando.carteni@unicampania.it
ORCID: https://orcid.org/0000-0003-4181-6631

[e] Autostrade Per l'Italia
e-mail: flavia.scisciot@autostrade.it

Abstract
Port-City interface is becoming increasingly pivotal in both urban and infrastructural sustainable development. Urban centers tend to regain their overlook on the sea, while "gigantic" ships require ports to become bigger and bigger. These convergent processes frequently lead to conflicts and unsolved issues. This is the reason why solutions are often searched in defining specifical and dedicated areas and routes to reduce interferences. Buffer Areas for logistics-related operations and procedures are often mentioned. The present work concerns the stakeholders' engagement process conducted in order to evaluate most suitable areas and relevant features to host these activities before freight vehicles reach the proper port area, thus reducing externalities on ordinary traffic flows. In particular, in-depth interviews to several stakeholders of Genoese Port community were conducted and their results were later mainstreamed into a multi-criteria analysis. Despite not being a structured participatory process, the present methodology could help defining intervention priorities and identifying the added value of this kind of facilities for different members of local port community.

Keywords
Sustainable logistics; Buffer Areas; Port-City interface.

How to cite item in APA format
Delponte, I., Costa, V., Cascetta, E., Cartenì, A., Marzano, V. & Scisciot, F. (2022). Buffer areas for sustainable logistics. Assessing their added value towards port community. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 487-500. http://dx.doi.org/10.6092/1970-9870/9232

1. Introduction

The maritime sector constitutes an important segment of the overall transport system, both for the quantitative importance of the goods handled and for the economic and employment dimension.

As far as Italy is concerned, the port cluster as a whole (freight and passengers) generates – considering direct and indirect effects – about 2.6% of the national GDP, registering over 11,000 companies in the sector and 93,000 employees. The multiplicative factor appears to be among the highest and more increasing in comparison with other sectors (from the CENSIS Reports, equal to 2.3 for profit and 1.7 for number of employees in 2009 and respectively equal to 2.9 and 2.4 in 2011) (Censis, 2011; 2019). These levels are also confirmed from the National Strategic Plan of Logistics of 2015 (Ministero Italiano delle Infrastrutture e dei Trasporti, 2015) and the latest IPSOS (2021) research, in recalling that Italian logistics as a whole is now worth 9% of national GDP, second only to manufacturing (18.8%).

However, the congestion levels of the motorway network, with the consequent diseconomies in terms of transport times and costs, contribute to make the entire supply chain less efficient and stimulate research to investigate alternative modes more competitive for the transfer of goods. As known, the whole process is structured in three phases, each of which corresponding to the sections in which the transport service is divided into:

- the overland route from origin to the port of origin;
- the sea route, commonly referred to as short sea transport radius;
- the overland route from the port of destination to the final destination of the goods.

To support this complexity, in the main traffic routes, the focus was often on the construction of "freight platforms" (with rail-road interconnection); another possibility is to set up platforms intended only for the parking of road vehicles which do not perform any load breaking.

The concept of Ro - Ro has undergone a great evolution over the years, both in terms of materials used and in terms of organization of the service.

Moreover, as twenty years of studies confirmed, even the creation of new terminals in minor ports must not be neglected because what makes them competitive is the creation of remote platforms that allow a more effective management of port gates (especially in access), particularly when the logistics yards are quite close to the terminals themselves (Foschi, 2006). In literature, they were called "buffer areas BA": according to the definition made by Musso & Sciomachen (2020) "Buffers are all the zones of the terminal where parts wait to be serviced, such as road and yard". Several BAs already exist and assessed their actual performance and how the new options helped reducing congestion and implementing transport efficiency; one of the best case in Italy is that of Venice.

In scientific literature, they are often related to a choice problem in their location: namely, the increase of container traffic and land acquisition issue for terminal expansion leads to usage of external yard in a port buffer area and scholars investigated requisites and method for a optimized positioning in city-port surroundings (Casaca, 2005; Beretta et al., 2009; Rusgiyarto et al., 2017).

In particular, this paper intends to address the case study of the port buffer areas of Genoa and reflect on the acceptability by the logistic community of these new areas identified.

The relationship between the city and the port has been cyclically conflicting and collaborative in coastal areas (Vallega & Augustinus, 1998; Hoyle et al., 1994; Hall & Jacobs, 2012; Xiao & Lam, 2017). In fact, numerous studies in relationship between city and port have been carried on by universities and research groups from all the world (Hoyle, Pinder and Husain, 1994; Musso & Ghiara, 2007; Haezendonck & Verbeke, 2018). The choices made by Port Authorities or other actors of the port clusters often affected the city scale development more than the Municipality which legitimately governed within the urban boundaries (Garcia, 2008). Moreover, the providers of transport connected services and network operators have a big relevance in all strategical issues concerning urban mobility in the metropolitan areas. On the contrary, port productivity can be heavily

constrained by bottle necks represented by urban node which prefers not to be so accessible and open to traffic of international goods (Rodrigue, 2004; Merk & Notteboom, 2014).

Traditionally, the efficiency and effectiveness have the main place in transport policies and research (Sanchez et al. 2003; Valentine & Gray, 2001; Clark, Dollar & Micco, 2002; Blonigen & Wilson, 2008; Merk & Dang, 2013); but, after the big shift occurred about thirty years ago in EU with the innovative conceptions of the White Papers (1992, 2001, 2011, 2021), the issue of sustainability started to enter strongly in the decision process regarding port infrastructures, and in particular in the latest version of the Papers with its holistic definition (considering also the quality of life, the containment of air emissions) (Alberini, 2021; Chang et al., 2018; Casazza et al., 2019; Lam & Yap, 2019; Gonzalez-Aregall & Bergqvist, 2020; Waterbone, 2021).

At the same time, ports systems cannot stop their rush to productivity and traffic increase, because the confirmed trend towards "ship giantism" selects gradually performative ports which are able to update and enlarge their facilities (Randrianarisoa & Zhang, 2019; Randrianarisoa, Wang & Zhang, 2020; Becker et al.; 2021). In particular, shipping emits approximately 1 billion of CO2 emissions and they are projected to increase by 20-50% between 2008-2050 (nowadays, ships in EU ports emit 13% of the total EU transport emissions). The European waterborne transport sector welcomes the European Green Deal (European Commission, 2019) and is committed to reaching its objectives. In particular, the European maritime technology sector annually invests 8-9% of its turnover in RD&I and is fully committed to develop the solutions needed and to invest accordingly. Moreover, the PNRR (Piano Nazionale di Ripresa e Resilienza) provides in section 3.2 "Intermodality and Integrated Logistics" three reforms of specific interest for the digitalization of logistics. In fact, TTS says in its latest report (2021) that a priority for the country are interventions aimed at improving the efficiency and safety of urban logistics, through the adoption of Information Technology Systems in the various areas of activity and optimization tools (travel planning; booking of loading / unloading areas; tracking and tracing of vehicles and loads).

By literature, a strong connection with SUMP, Sustainable Urban Mobility Plan, is also wished. But, above all, the need is related to logistics studies which are focused on city impacts (positive or negative) as Cerreta et al. already did (2020); very often, the urban asset is in fact considered only as a "theater" of the evolution of port development dynamics. Furthermore, the participatory aspects are sometimes neglected about port development decisions, partly because of the absence of devoted mandatory planning tools concerning the topic within the national and local regulations, partly because of a lack of mature mentality by population, that is urgently needed.

This paper tries to help bridge this gap by presenting the process of engagement and acceptability assessment that was carried out with the stakeholders of the port cluster of Genoa. Being Genova city the sixth municipality in Italy (approximately 560 000 inhabitants) and one of the biggest Italian ports (in terms of variety of typologies of handled goods), its metropolitan area plays a pivotal role in terms of investments and, at the same time, it represents a particularly interesting case-study speaking of relations between urban asset and logistics hub (De Ciutiis, 2010). The geomorphological constraints make the expansion of Genoa's port traffic critical and the latest construction sites planned for the entire Liguria Region on the major roads and motorways have made it urgent to reflect on remote areas, such as buffer areas, for efficiency of the arrival and departure of trucks at the gates. Precisely because spaces for port and spaces for civil use are very narrow and interconnected in the Genoese area and a chaotic and uncontrolled situation is often created, the case study appears particularly interesting from the point of view of how to consider the different opinions around the buffer areas by the actors the community (that are the first interested in solving the problem); once more, participatory processes become essential in order to make logistics more sustainable and consistent with other urban activities (Gonzalez-Feliu & Morana, 2010).

This paper will analyze several methodologies that could be implemented in order to engage and involve local stakeholders in participatory steps to define a shared framework of urban logistics territorial asset (section 2),

focus in the following section 3 will be concentrated on the case-study of Genoa Logistics Hub and the specifical interviews and stakeholders' engagement procedures that have been carried on to investigate buffer areas location and functional layout. In section 4 some evidence and conclusions on the main results of the present study will be carried out.

2. Available Methodologies and Analysis' Objectives

As previously mentioned, speaking of relations between urban asset and logistics activities, stakeholders' engagement and involvement procedures, though rarely implemented, could represent a precious tool to find a point of contact (Debrie & Raimbault, 2016), between the need to make logistics chain more effective and efficient on one hand and to respect time and spaces of the city and its inhabitants. A way to see in the integrations of these two components not only a source of conflicts (Van den Berghe et al., 2022) but a fundamental resource (Raimbault, 2019).

In order to foster and support a stakeholders' engagement process, thus mainstreaming in the assessment and selection of the areas' phase further considerations by the local port community, it was decided to drive a specifical analysis on the areas pre-requisites and features.

The initial and crucial step was represented by the choice of an appropriate assessment methodology that could help facilitating management process, legitimizing and strengthening the credibility of the project, motivating the participants, and which is able to convey potential benefits. To achieve these goals, it could be preferable to:

- outline it in the initial phase of the project;
- structure the process around methodologies that can be objectively controlled and organized in consideration of the crucial moments of the project in order to guarantee their supervision;
- ensure the participation of actors involved.

Starting from these essential pre-requites, most appropriate methodology can be chosen among several techniques applied in the present research field:

- SWOT analysis: highlighting strengths, weaknesses, opportunities and threats related to each of the considered alternatives;
- Benchmarking: providing direct comparisons with similar successful international experiences;
- Cost Benefits and Cost Effectiveness Analysis: comparing positive and negative cashflows;
- Multicriteria Analysis: confronting alternatives considering several evaluations criteria;
- Participatory Social Research (Delphi): following several steps of social interaction and interview to relevant stakeholders and experts.

In particular, in this specific case it was decided to carry out some in-depth interviews, according to the Delphi Research approach, targeting stakeholders belonging to the logistics community of the Genoese hub and, subsequently, to place them in support of a multi-criteria analysis.

The proposed methodology derives from the intersection of the Delphi Intuitive Forecasting Method with Multicriteria Analysis. This methodologies' interaction on one hand provides a statistical technique for obtaining individual weighting of the alternatives thus allowing to mainstream individual considerations and evaluations coming from relevant stakeholders; but on the other hand, it enables to standardize them and attribute a global value to the results obtained as well, thus supporting a final synthesis step.

From a theoretical point of view, the combination of mathematical procedures and forecasting techniques suits well to define non-exclusive scenarios to support the development processes of industrial and experimental research, both in terms of forecasting and defining levels of reliability of the results. These, in aggregate form, can contribute to scientifically validate two steps: starting from the data collection phase where research group

have prepared materials to be showed to interviewees, to that of the choices to be made from policymakers, and from the realization of the project to its ex-post evaluation.

According to this coupled methodology, it would be possible to mainstream stakeholders considerations and evaluations in the process of buffer areas' assessment and selection, thus granting simultaneously a more effective and efficient functioning of logistics chain and a higher level of acceptance and integration within the port ecosystem and community as well.

In particular, in this case, following a preliminary discussion about the state of the art of local logistics, through the presentation of area localisation and possible range of services to be inserted in each Buffer Area to interviewees, after literature and case-studies recognition was conducted, issues were subjected to the attribution of weights by the community, which selected the most useful and appropriate ones with the value assigned to it.

At this point the problem shifts to the determination of the necessary activities and / or initiatives to obtain the results expected by the community itself (planning process).

As far as this matter is concerned, it must be highlighted that this step is particularly critical speaking of city/port interface areas' land use. Being respective values sometimes not-shared and intervention rationales driven by law requirements or market instances (Lami & Beccuti, 2010).

This methodology enables researchers to approach the topic focusing on two aspects: on the one hand, the qualitative, behavioural, intentional one; and on the other hand, the more purely quantitative, statistical, operational (Fig.1).

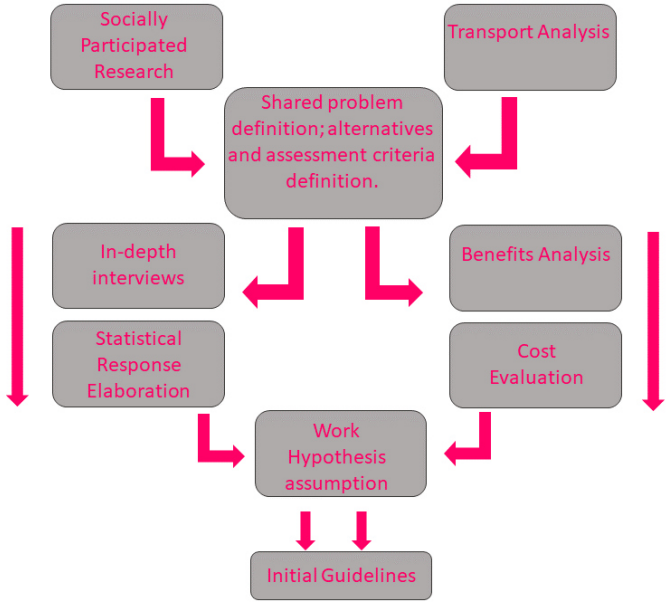


Fig.1 Methodology Flow Chart

In addition, in-depth interviews allow to grasp and highlight the decision-making aspect of the choices, elements that determine individual behaviours. In this way, different interests, sensitivities and needs that influence the work of the subjects who in various ways make up the Genoese logistics community can emerge. However, a subsequent phase of quantification, of attribution of the weights relating to the various alternatives, to the possible scenarios, their hierarchization, according to the method of multi-criteria analysis, allows to operationally estimate the demand (for services, transport, parking) expressed by these stakeholders. The choice to combine participatory social research approach with quantitative assessment methodologies, such as that deriving from multi-criteria analysis, not only aims at reaching greater levels of comprehensiveness, but it represents a precise operational choice.

The quantitative analysis, in fact, intuitively more immediate for the identification of a reference scenario between different alternatives, however falls within the range of the statistical-descriptive models often used for the estimation of demand in the transport sector, and as such allows the elaboration of a model starting from the interpretation of experimental data.

This therefore prevents the replicability of these considerations, binding them to the considered context. A higher, more general degree of knowledge of the dynamics can only be achieved with the analysis of the social, economic and behavioural aspects that characterize the reference community. In fact, this makes it possible to trace the causes of the behaviours implemented and to establish exportable relationships, with appropriate corrections, also in other similar contexts. Despite not being a real participatory process itself, this initial step could represent an important moment to face local port community needs and instances, thus integrating them into the decisional procedures.

The questionnaire includes the request for expressions of the will in part referring to entirely technical aspects, in part to more aspects of vision and future propensity. Despite having detailed questions, it was decided to address varied categories of the urban logistics sector, in order to collect an opinion on issues perhaps not relating to the category itself, but which could still be interesting to understand how this topic it is perceived. This aspect is particularly relevant, also from a scientific point of view, as it allows to safeguard the general intention of the Delphi-Method: the fact that, even on objective questions, the interviewee provides incorrect answers is not decisive. On the other hand, it is interesting for those who have to plan and / or technically support the process to record the sensitivity of the employees in some fields, as well as the more or less structured knowledge at the time of questioning on more technical issues.

In details, major issues addressed by the present survey have been the following:

- definition of the general appeal of a buffer area network of spaces located along the main access routes to Genoa's port in every direction, in terms of location and provision of services, considering the necessary tools and infrastructures, technical, technological, orographic constraints, etc., and verifying the stakeholders and partners to be involved;
- evaluation of a project implementation priority, which may result in a progressive implementation process along the time axis, or as a pricing policy with repercussions on revenue and therefore economic - financial considerations.

Considering targeted stakeholders, two points of view have been mainly deepened:

- transport stakeholders, who pursues the goal of minimizing travel times and, secondly, increasing the quality of the journey given the economic constraints;
- Port Community, that aims to make logistic flows and operations faster, more efficient and cost-effective.

A third relevant point of view is represented by urban local community, which pursues the objective of maximizing the quality of life at the urban level, of preserving the balance and urban, landscape and environmental assets of the area subject to interventions (Pirlone et al., 2022). In this work, this segment's viewpoint won't be particularly deepened, being the attention focused mainly on the areas requisites and features according to the sector's stakeholders perspective.

In this sense, a multi-criteria approach must necessarily make a synthesis of the different "souls" and interests, identifying basic tools and data that make it possible to interpret local dynamics from different points of view. Starting from the previously introduced issues and targeted stakeholders, main objectives of the analyses have been defined:

- to collect preferences, relating to the various services that can potentially be placed in the buffer - survey areas under development;
- to register qualitative and quantitative information on the attractiveness of the system as a whole and knowledge of the phenomenon, based on face-to-face surveys to relevant stakeholders;

- to assess priorities/values of the various services potentially to be offered, based on the technical considerations of the survey and interviews with stakeholders;
- to define "weights" to be attributed to the various criteria, also on the basis of interlocutions with the reference stakeholders.

3. Stakeholders and Interviews

Focusing on the interviews that have been conducted, first step has been represented by stakeholders mapping procedures.

In particular, the specifical need was to identify several relevant stakeholders within Genoese port community in order to reach a comprehensive framework representing different interests, points of view, roles and necessities. Being a quite technical matter, in this initial phase relevant sector's stakeholders were involved in order to obtain more evaluation elements about the pros and cons of each of the alternative considered. Citizens weren't engaged in this first step, being a preliminary assessment of the added value of building a similar network supporting logistics' flows.

As previously mentioned, in fact, it is particularly important to include various perspective and vision, which are not relevant only in an absolute way, but above all as one of many pieces building a more extensive and complex picture.

Following this idea, seven stakeholders have been identified representing several sectors of local port ecosystem:

- Logistical Regional Federation;
- freight transport operators;
- Port Authority;
- carriers trade association;
- Craft and Industry trade associations;
- shipowners.

This initial cluster clearly represents an incomplete one, and many other subjects, as well as infrastructure, dry logistic platforms or maritime services providers, could be involved. Nevertheless, this network was mapped according to literature review and evaluating the most relevant stakeholders referring to Genoa local ecosystem. Each of these seven stakeholders have been addressed with an in-depth interview and many interesting hints and reflections emerged. In details, interviews have been structured into two parts: state of the art analysis and new services to be inserted into buffer areas project definition.

When asked about the state of the art of port operations and logistics procedures, interviewees have highlighted some criticalities mainly concerning digitalisation and space availability.

Looking at digitalisation and access procedures, mentioned main issues are:

- poor data-sharing;
- non-digitalised documents and procedures;
- scarcely integrated and fragmented digital platforms;

Focusing on infrastructures and traffic flows, stakeholders registered:

- absence of parking areas dedicated to carriers, adequately provided with basic services facilities;
- motorway network congestion and consequent problems related to travel time planning;
- limited access areas in port terminals.

Concerning new buffer areas (later B.A.) design and services to be introduced, several ideas emerged:

- B.A. could turn particularly useful in case of traffic congestion;
- B.A. should include service facilities addressing carriers and their vehicles for longer stops;
- B.A. could act as pre-gates or remote operational spaces.

Looking at new buffer areas design, from a previous recognition of urban plan previsions and suitable areas for similar projects implementation along local motorway axes (through the interaction with the local highway infrastructural provider) five lots have been identified around Genoa logistics hub and interviewees were asked to assess their potential strengths and weaknesses (Fig.2).
In particular:

- two areas are located approximately 30 km from Western part of Genoa Port area along motorway network-Savona, West direction and AdS Stura, North direction;
- two areas are located approximately 30 km from Central part of Genoa Port area along motorway network-Chiavari, East direction and Serravalle Scrivia, North direction;
- one closer area -Ex-Fondega- located between Western and Central Genoa Port Area (distances are approximately 5 km).

Fig.2 Buffer Area localisation

To assess alternatives in terms of their suitability as pre-gate areas, for night stops and freight storage, as well as services range to be provided in buffer areas a multi-criteria analysis was conducted on the basis of stakeholders' interviews results. In particular, they were showed empty matrix where only expected impacts' categories and areas' names were present.
Main aim was to identify stakeholders' priorities and preferences through the evaluation and weighting of several features that B.A. should assure in general (namely Usability, Availability, Services Supply, Environment, Road Safety, Urban Environment Quality) and a specifical criterium for pre-gate functions (Social Impact) and night stops and storage usage (Transport needs) (Tabb. 1-2). A similar process concerned services to be provided in buffer areas, where a wide range of functionalities were presented to interviewees to point out which could be considered as most useful and essential (Tab. 3). The research outputs have been three matrix that are showed in the following figures, where options related to different areas and stakeholders' categories were hierarchically classified through colour gradients in order to highlight most required and preferred ones.

As pre-gate area, the closest to port hub – Ex-Fondega – was preferred in terms of usability, availability, quality, environment and social impact; the Eastern one – Chiavari – was well evaluated though, in terms of quality, environment, social impact and safety, even though being nearly 40 km away from Genoa Logistics Hub. Looking at night stops and storage areas, three were selected: Ex-Fondega, being the closest and being considered positively in terms of quality of the environment, usability and safety; AdS Stura adding a strategical position on the way to/from Northern Italy and Savona combining space availability and favourable location for export and import travel with French Border.
In terms of services availability, preferences have been directed towards personal care facilities for drivers, safe parking facilities (responding to EU standards) and fuel stations.

Assessing B.A. alternatives: Pre-Gate Areas					
Criteria/ Expected Impact	1. Ex-Fondega	2. AdS Stura	3. Serravalle Scrivia	4. Chiavari	5. Savona
Usability					
Availability					
Services Supply					
Environment					
Road Safety					
Urban Environment Quality					
Social Impact (Emissions, Fuel…)					

Tab.1 Buffer Areas assessment as Pre-Gates-Interviews results synthesis

Assessing B.A. alternatives: Night Stops and Storage Areas					
Criteria/ Expected Impact	1. Ex-Fondega	2. AdS Stura	3. Serravalle Scrivia	4. Chiavari	5. Savona
Usability					
Availability					
Services Supply					
Environment					
Road Safety					
Urban Environment Quality					
Transport Needs					

Tab.2 Buffer Areas assessment for night stops and freight storage-Interviews results synthesis

Service availability in B.A.								
Function/ Expected Impact	Drivers	Trade Association	Terminal Operators	Industry and Enterprises Association	Carriers	Transport Operators Association	Port Autority	TOTAL
Toilets/ Restaurant								
Hotel								
Safe&Secure EURO Park								
Traditional Fuel Station								
Alternative Fuel Station (LNG, electricity..)								
Hydrogen Station								
Vehicles Repair and Maintenance								
Charging System for Refrigerated Trucks								
ADR Areas								
Weighting System								
PT links								
Car-sharing services								
Remote Port Services								
Trip Planner App								

Tab.3 Buffer Areas service facilities assessment- Interviews results synthesis

4. Conclusions

As previously introduced, port and logistics activities represent extremely relevant resources to urban centers as Genoa.

Nevertheless, conflicts between city and port communities frequently emerge in terms of land use definition and overlapping traffic flows; and this becomes more and more evident in urban contexts where infrastructural asset is not adequate (as motorway network in Genoese Area) and dedicated routes and areas are absent.

As SUMP strategy suggests for urban mobility, traffic components should be separated using dedicated infrastructure and assets in order to enhance safety, livability and sustainability.

When speaking of freight transport this need to reduce shared spaces in common with private mobility, translates into two different strategies: motorway and rail infrastructure enlargement, thus enabling faster and more efficient connections and definition of specific areas (the so-called Buffer Areas) for bureaucratic procedures, vehicles maintenance and repair, drivers personal care and stops.

These areas have to be found outside port borders thus interfering with urban space, this requires necessarily to identify adequate methodologies and solutions to engage and involve port and urban stakeholders to find and assess possible locations and services facilities.

For the present case-study it was decided to carry out some in-depth interviews, according to the Delphi approach, targeting stakeholders belonging to the logistics community of the Genoese hub at different levels and, subsequently, to place them in support of a multi-criteria analysis. This integrated methodology allows firstly to investigate progressively which are local stakeholders' preferences and needs, and secondly to identify a hierarchy within them, to translate quantitively qualitative considerations. Even though absolute values are not assigned relative comparison enables further decisional steps.

Stakeholders' involvement led to identify several functions to be assigned to five areas belonging to the central part of Liguria Region, located within a radius of approximately 30 km from Genoese Logistics Hub in order to improve accessibility and working conditions for drivers and port stakeholders.

The definition of a participated and shared approach allows to include different perspective and points of view and to build a more comprehensive framework that goes beyond technical and operational issues, thus enabling researchers to assess social, environmental, and economic aspects, too. Nevertheless, this initial step need to be further supported by citizens engagement and involvement (Franco & Cappa, 2021) in order to acquire a larger view of urban/port spaces interrelations, while the first part of the process that has been presented in the previous lines mainly concerned the mainstreaming of technical considerations by port community stakeholders.

Sustainability enters therefore the debate on local infrastructure, as recently has been suggested and promoted by the Italian Ministry of Infrastructure and Sustainable Mobility that developed a specifical scoring methodology (the so-called SIMS) to support social and environmental considerations to be mainstreamed in infrastructure design and project process. It is desirable, though, to extend this kind of reasoning and rationale from urban infrastructures to port and logistics ones.

As Covid-19 pandemic outbreak outlined dramatically freight transport and logistics will become more and more relevant in our society, thus requiring larger spaces within urban borders (Stufano Melone & Borgo, 2020), : main hubs growing outside cities need to have some arrival points to manage last-mile component to reach railways, port, businesses and consumers. These new spaces, as Gonzalez-Feliu & Morana (2010) highlight, need to be thought as urban spaces, integrated to urban fabric, and interacting sustainably with local community and environment: they don't have to be designed as simply functional areas serving port activities, but as a *trait-d'union* linking city and port, especially in urban realities where space is missing, Genoa above all.

For this reason, the application of a multi-criteria analysis reveals extremely pivotal to assess alternatives relatively and to define intervention priorities, thus contributing to subsequent decisional moments. Contribution indeed not only in terms of pre-elaborated analysis but also in terms of dissemination and communication of projects intention to the local community. The possibility to include a wider range of considerations compared to Cost-Benefit Analysis and to involve directly local stakeholders represents a unique opportunity to re-think relation between city and port and to overcome traditional barriers that, though invisibly, still separate Genoa from the sea.

References

Alberini, C. (2021). A holistic approach towards a more sustainable urban and port planning in tourist cities. *International Journal of Tourism Cities*. *7* (4), 1076-1089. https://doi.org/10.1108/IJTC-02-2021-0028

Becker, A., Ng, A. K., McEvoy, D., & Mullett, J. (2018). Implications of climate change for shipping: Ports and supply chains. *Wiley Interdisciplinary Reviews: Climate Change*, *9* (2), e508. https://doi.org/10.1002/wcc.507

Beretta, E., Dalle Vacche, A., Migliardi, A. (2009). Il sistema portuale italiano: un'indagine sui fattori di competitività e di sviluppo. *Economia dei servizi*, 4(2), 177-194. Retrieved from: https://www.bancaditalia.it/pubblicazioni/qef/2009-0039/QEF_39.pdf

Blonigen, B. A. & Wilson, W.W. (2008). Port efficiency and trade flows. *Review of international Economics*, *16*(1), 21-36. https://doi.org/10.1111/j.1467-9396.2007.00723.x

Casaca, A.C.P. (2005). Simulation and the lean port environment. *Maritime Economics Logistics*, 7(3), 262-280. https://doi.org/10.1007/s10696-016-9239-5

Casazza, M., Lega, M., Jannelli, E., Minutillo, M., Jaffe, D., Severino, V., & Ulgiati, S. (2019). 3D monitoring and modelling of air quality for sustainable urban port planning: Review and perspectives. *Journal of cleaner production*, *231*, 1342-1352. https://doi.org/10.1016/j.jclepro.2019.05.257

Censis (2011). *IV Rapporto sull'economia del mare. Cluster marittimo e sviluppo in Italia e nelle regioni*. FrancoAngeli, Milano. Retrieved from: https://federazionedelmare.it/wp-content/uploads/2015/04/IV_Rapporto_sull_economia_del_mare_2011_Sintesi.pdf

Censis (2019). *V Rapporto sull'economia del mare. Cluster marittimo e sviluppo in Italia e nelle regioni*. Retrieved from: https://federazionedelmare.it/wp-content/uploads/2020/07/VI_Rapporto_su_Economia_del_Mare_FedMARE_2019.pdf

Cerreta, M., Giovene di Girasole, E., Poli, G., & Regalbuto, S. (2020). Operationalizing the circular city model for Naples' city-port: A hybrid development strategy. *Sustainability*, *12*(7), 2927. https://doi.org/10.3390/su12072927

Chang, Y. T., Park, H. K., Lee, S., & Kim, E. (2018). Have emission control areas (ECAs) harmed port efficiency in Europe?. *Transportation Research Part D: Transport and Environment*, *58*, 39-53. https://doi.org/10.1016/j.trd.2017.10.018

Clark, X., Dollar, D., & Micco, A. (2002). *Maritime transport costs and port efficiency*. Policy Research Working Paper; N. 2781, Washington, DC: World Bank. Retrieved from: http://documents.worldbank.org/curated/en/2002/02/1703257/maritime-transport-costs-port-efficiency

Debrie, J., & Raimbault, N. (2016). The port–city relationships in two European inland ports: A geographical perspective on urban governance. *Cities*, *50*, 180-187. https://doi.org/10.1016/j.cities.2015.10.004

De Ciutiis F. (2010). Planning Practices: Planning Experiences of Urban Logistics. *TeMA - Journal of Land Use, Mobility and Environment*, *3*(2). https://doi.org/10.6092/1970-9870/173

European Commission (2019). *European Green Deal*. Retrieved from: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_it

Foschi, A. D. (2006). La concentrazione industriale per i sistemi di trasporto sostenibile: un caso di successo nel Mediterraneo orientale (No. 2006/63). Retrieved from: https://www.ec.unipi.it/documents/Ricerca/papers/2006-63.pdf

Franco, S. & Cappa, F. (2021). Citizen science: involving citizens in research projects and urban planning. *TeMA - Journal of Land Use, Mobility and Environment*, *14* (1), 114-118. https://doi.org/10.6092/1970-9870/7892

Garcia, P.R. (2008). The role of the port authority and the municipality in port transformation: Barcelona, San Francisco and Lisbon. *Planning Perspectives*, *23*(1), 49-79. https://doi.org/10.1080/02665430701738032

Gonzalez-Aregall, M., & Bergqvist, R. (2020). Green port initiatives for a more sustainable port-city interaction: The case study of Barcelona. In A.K.Y. Ng, J. Monios & C. Jiang (Eds.), *Maritime transport and regional sustainability*, 109-132. Elsevier. https://doi.org/10.1016/B978-0-12-819134-7.00007-1

Gonzalez-Feliu J., & Morana J. (2011). Are city logistics solutions sustainable? The Cityporto case. *TeMA - Journal of Land Use, Mobility and Environment*, *3*. https://doi.org/10.6092/1970-9870/496

Haezendonck E. & Verbeke A. (2018) (eds.), *Sustainable Port Clusters and Economic Development Building Competitiveness through Clustering of Spatially Dispersed Supply Chains*, Springer Nature. https://doi.org/10.1007/978-3-319-96658-8, 978-3-319-96657-1

Hall, P. V., & Jacobs, W. (2012). Why are maritime ports (still) urban, and why should policy-makers care?. *Maritime Policy & Management*, *39*(2), 189-206. https://doi.org/10.1080/03088839.2011.650721

Hoyle B.S., Pinder D.A. & Husain M.S. (1994). *Aree portuali e trasformazioni urbane*. Mursia, Milano.

IPSOS (2021). Global Trends 2021. A changing world. Retrieved from: https://www.ipsos.com/sites/default/files/ct/publication/documents/2021-10/global-trends-2021-report.pdf

Lam, J.S.L., & Yap, W.Y. (2019). A stakeholder perspective of port city sustainable development. *Sustainability*, *11*(2), 447. https://doi.org/10.3390/su11020447

Lami, I.M. & Beccuti, B. (2010), "Evaluation of a project for the radical transformation of the Port of Genoa-Italy: According to community impact evaluation (CIE)", Management of Environmental Quality, Vol. 21 No. 1, pp. 58-77. https://doi.org/10.1108/14777831011010865

Merk, O., & Dang, T. T. (2013). The effectiveness of port-city policies: A comparative approach. OECD Regional Development, Working Papers, 2013/25. Retrieved from:

Merk, O., & Notteboom, T. (2015). Port hinterland connectivity. Discussion Paper No. 2015-13. Retrieved from: https://www.internationaltransportforum.org/jtrc/DiscussionPapers/DP201513.pdf

Ministero Italiano delle Infrastrutture e dei Trasporti (2015). *Piano Strategico Nazionale della Portualità e della Logistica*, 2015, Retrieved from: https://www.mit.gov.it/sites/default/files/media/notizia/201604/Piano_Porti_PPT___3_luglio_-2015_2015_DEF_h_14_pdf.pdf

Musso, E., & Ghiara, H. (2007). *Ancorare i porti al territorio-Dai traffici alla marittimizzazione*. Milano, McGraw-Hill.

Musso, E. & Sciomachen, A. (2020). Impact of megaships on the performance of port container terminals. *Maritime Economics Logistics*, 22(3), 432-445. https://doi.org/10.1057/s41278-019-00120-y

Pirlone, F., Spadaro, I., Sabattini, M. & De Nicola, M. (2022). Sustainable urban regeneration in port-cities. A participatory project for Genoa waterfront. *TeMA - Journal of Land Use, Mobility and Environment*, 15(1), 89-110. https://doi.org/10.6093/1970-9870/8322

Raimbault, N. (2019). From regional planning to port regionalization and urban logistics. The inland port and the governance of logistics development in the Paris region. *Journal of Transport Geography*, *78*, 205-213. https://doi.org/10.1016/j.jtrangeo.2019.06.005

Randrianarisoa, L. M., & Zhang, A. (2019). Adaptation to climate change effects and competition between ports: Invest now or later?. *Transportation Research Part B: Methodological*, *123*, 279-322. https://doi.org/10.1016/j.trb.2019.03.016

Randrianarisoa, L. M., Wang, K., & Zhang, A. (2020). Insights from recent economic modeling on port adaptation to climate change effects. In A.K.Y. Ng, J. Monios & C. Jiang (Eds.), *Maritime transport and regional sustainability*, 45-71. https://doi.org/10.1016/B978-0-12-819134-7.00004-6

Rodrigue, J. P. (2004). Freight, Gateways And Mega-Urban Regions: The Logistical Integration Of The Bostwash Corridor1. *Tijdschrift voor economische en sociale geografie*, *95* (2), 147-161. https://doi.org/10.1111/j.0040-747X.2004.t01-1-00297.x

Rusgiyarto, F., Sjafruddin, A., Frazila, R. B. et al. (2017). Discrete event simulation model for external yard choice of import container terminal in a port buffer area. *AIP Conference Proceedings*, 1855(1), 040014. AIP Publishing LLC.. https://doi.org/10.1063/1.4985510

Sanchez, R. J., Hoffmann, J., Micco, A., Pizzolitto, G. V., Sgut, M., & Wilmsmeier, G. (2003). Port efficiency and international trade: port efficiency as a determinant of maritime transport costs. *Maritime economics & logistics*, *5*(2), 199-218. https://doi.org/10.1057/palgrave.mel.9100073

Stufano Melone, M.R. & Borgo, S. (2020). Rethinking rules and social practices. The design of urban spaces in the post-Covid-19 lockdown. *TeMA - Journal of Land Use, Mobility and Environment*, 333-341. https://doi.org/10.6092/1970-9870/6923

TTS (2021). *TTS Italia Report 2021*. Retrieved from: https://www.ttsitalia.it/wp-content/uploads/2021/03/Le-applicazioni-ITS-per-lefficientamento-della-logistica_Marzo21.pdf

Valentine, V. F., & Gray, R. (2001). The measurement of port efficiency using data envelopment analysis. In *Proceedings of the 9th world conference on transport research*, 22, p. 27. South Korea: Seoul.

Vallega A., Augustinus Pieter G.E.F. & Smith H.D. (eds) (1998) *Geography, oceans and coasts towards sustainable development*, Ocean change publications. Milan: Franco Angeli.

Van den Berghe, K., Louw, E., Pliakis, F. & Daamen, T. (2022). When "port-out – city-in" becomes a strategy: is the port–city interface conflict in Amsterdam an observation or a self-fulfilling prophecy? *Maritime Economics & Logistics* https://doi.org/10.1057/s41278-022-00236-8

Waterbone TP (2021). Strategic research and innovation agenda for the partnership on zero-emission waterborne transport. Retrieved from: https://www.waterborne.eu/images/210601_SRIA_Zero_Emission_Waterborne_Transport_1.2_final_web_low.pdf

Xiao, Z., & Lam, J.S.L. (2017). A systems framework for the sustainable development of a Port City: A case study of Singapore's policies. *Research in Transportation Business & Management*, *22*, 255-262. https://doi.org/10.1016/j.rtbm.2016.10.003

Image Sources

Fig.1: Authors' elaboration;

Fig.2: Authors' elaboration;

Tab.1: Authors' elaboration;

Tab.2: Authors' elaboration;

Tab.3: Authors' elaboration.

Author's profile

Ilaria Delponte

Engineer and PhD in "Places and Times of City and Territory" at the University of Brescia (IT), is Associate Professor in Town Planning at the University of Genoa, where she has been carrying on her research on urban and territorial governance since 2004. Her studies are particularly focused on transport, logistics and port management and planning. She is also author of several papers, both didactic and scientific, related to the field. She led projects at the regional, national, EU and Mediterranean level and she took part into conferences and meetings as speaker and moderator. She is member of the Italian Center of Excellence on Logistics, Transport and Infrastructures and Scientific Responsible for the National Association of Italian Municipalities.

Valentina Costa

She is an engineer, PhD Student in "Logistics and Transport" at the Italian Center of Excellence on Logistics, Transport and Infrastructure of University of Genoa (IT), and previously research fellow for SavingScapes Project for Civil, Chemical and

Environmental Engineering Department of the above mentioned university. Her studies are particularly focused on transport, sustainable mobility and urban planning.

Ennio Cascetta

Engineer and full professor at Federico II University and Massachusetts Institute of Technology, as well. His research activity has mainly regarded transportation planning, High Speed Railways and regional metro systems planning, analysis, modelling and estimation of transport demand, static and dynamic models for traffic assignment, multimodal network planning, supply design models for transit and traffic systems, traffic theory and circulation on motorways, analysis and control of traffic congestion in urban areas. He has been the scientific responsible of research units in the context of several UE research programs in DGXIII and DGVII such as DYNA, AIUTO and TRACE. Took part as on expert to the international committee for the design of the EURET 2 Project and 4th Framework program appointed by DGVII. He is currently member of the Scientific Advisory Board of the Future Mobility project in the MIT and Singapore SMART program and president of the scientific committee of Italian Motorist Association (ACI) and of NETLab, r&d unit of the multinational group NET. He is an appointed member of the Transport Research Board of National Research Council (USA).

Armando Cartenì

Professor in Transportation Planning at the University of Campania "L. Vanvitelli" (Italy); he got a PhD degree on Transportation Engineering at the Department of Transportation Engineering, University of Naples. His research activity has mainly regarded: transportation planning; transportation decision-making process and public engagement; sustainable mobility; public transport; discrete choice models for transport user behavior; freight transport and container terminal simulation modelling; transportation environmental impacts. He has been participated in many research projects and has author of more than 100 papers published in journals, book series and conferences proceedings.

Flavia Scisciot

She is an engineer and currently Technical Director of Transport Systems and Sustainable Mobility for "Autostrade per l'Italia" company. Former Head of Transport and Feasibility Studies. Her professional expertise mainly deals with Infrastructures and Transportation Planning.

TeMA
Journal of
Land Use, Mobility and Environment

TeMA 3 (2022) 501-516
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9265
Received 27th June 2022, Accepted 7th November 2022, Available online 30th December 2022

Climate variation in metropolitan cities

Spatial self-containment, contiguity and space-time relations in Cagliari urban area (Sardinia, Italy)

Ginevra Balletto [a*], Martina Sinatra [b], Roberto Mura [c], Giuseppe Borruso [d]

[a] Department of Civil and Environmental Engineering and Architecture, University of Cagliari, Cagliari, Italy;
e-mail: balletto@unica.it
ORCID: https://orcid.org/0000-0003-0876-0605

[b] Department of Civil and Environmental Engineering and Architecture, University of Cagliari, Cagliari, Italy;
e-mail: m.sinatra@studenti.unica.it
ORCID: https://orcid.org/0000-0002-5989-7305

[c] IUAV University of Venice - Department of Culture of the Ca' Tron Project - Santa Croce 1957- 30135 Venice
e-mail: rmura@iuav.it
ORCID: https://orcid.org/0000-0002-4022-4442

[d] Department of Economics, Business, Mathematics and Statistics, University of Trieste, Trieste, Italy;
e-mail: giuseppe.borruso@deams.units.it
ORCID: https://orcid.org/0000-0002-0933-5208

Abstract
Climate has always been studied in cities, where strong relations can be found with urban form and spatial patterns. Temperature variations, heat islands and floods are among the main factors to represent climatic phenomena and related changes over time. The same urban location choices come out from the need to resist adverse events. In general, the urban form can be related to climatic conditions, both to benefit from positive externalities - healthiness, sun exposure, ventilation, water supply - and to reduce negative externalities - thermal stress, heavy rainfall and heat islands. Furthermore, urban development, particularly attributable to land take, put in evidence how the European, and particularly the Italian, urban system presents 56% of population settled in urban areas with a high value of sealed surfaces and limited green areas, so that urban centres are more and more characterizing as climate change hotspots. In this framework the hereby presented research is developed, focused on the observation of the temperature variations in urban areas in time, aimed at capturing the changes occurring also considering the spatial extent and form of the cities more vulnerable to such phenomenon. The research in particular was aimed at exploring possible different ways of aggregating areas to a proper urban dimension: in particular Metropolitan Cities (MC) and Labor Market Area (LMA) in order to identify the most suitable geographical dimension both for the observation of the phenomenon and for the policy targets of climate neutrality. This is done analysing the spatial autocorrelation of climate-related variations in space and time.

Keywords
Climate variation; Metropolitan city; Labour Market Areas; LISA; Spatial Autocorrelation.

How to cite item in APA format
Balletto, G., Sinatra, M., Mura, R., Borruso, G. (2022). Climate variation in metropolitan cities. *Tema. Journal of Land Use, Mobility and Environment, 15* (3), 501-516. http://dx.doi.org/10.6092/1970-9870/9265

1. Introduction

Climate has always been a phenomenon observed and studied in cities, in which there are deep correlations with the relative shape and spatial distribution (Kellogg & Schwarz, 2019). Temperature increase, heat islands and hydraulic floods are the main factors of representativeness of the climatic phenomena and its change over time. The urban localization, shape and spatial distribution are strongly related to climate, on the one hand to derive greater benefits and positive externalities: healthiness, sun exposure, ventilation, water and on the other to minimize the negative externalities: thermal stress, intense precipitation, and heat islands (Koop & van Leeuwen, 2017; Papa et al., 2014). In particular, the urban location choices arise from the important need to resist adverse events such as hydraulic floods, while the high temperatures have been addressed by means of a dense urban system able to shade and create thermal currents of air to dissipate heat (Salvati et al., 2019). Urban forms developed in the past, even in hot and arid climates, were organized to mitigate the temperature. An important example is the city of Yazd in Iran, where the use of towers about 30 meters tall performed the function of generating air currents able to counteract the heat, removing hot air from inside the building during the day and letting in fresh air from outside during the night. Underground water tanks further cooled the air. Furthermore, since ancient Greece, the urban form has been compact, so as to avoid direct solar radiation as well as the ability to reflect sunlight, rejecting the sun rays in the streets and at the same time thus reducing the formation of heat in the urban spatial organization. In other periods, in the cities of the Renaissance, pools of water and fountains were proposed with a double function, aesthetics and as a heat exchanger for cooling. While climate has driven the obstruction of the city, the latest climate change has become one of the most significant threats to world heritage properties, potentially impacting their Outstanding Universal Value, including their integrity and authenticity, and their potential for economic and social development at the local level [1]. Nonetheless, compared to pre-industrial levels, the average temperature of the planet has increased by 0.98° C and the trend observed since 2000 suggests that, in the absence of interventions, it could reach +1.5° C between 2030 and 2050 [2]. Indeed, despite the progressive international commitments (Kinley et al., 2021; UNFCCC, 2015; UNFCCC, 2020) aimed at reducing the emission of greenhouse gases, overall CO_2 emissions have increased, while in Italy a decline has begun on the occasion of the 'double dip', global financial and internal debt crisis (Accetturo et al 2022). In Italy, the trend in the intensity of carbon dioxide emissions over the course of almost 20 years has declined and is partly attributable to the production of energy from renewable sources (hydroelectric, wind and solar) and to the increase in energy efficiency in the residential, tertiary and industrial sectors (Andreoni & Galmarini, 2012) (Fig.1).

In particular, 56% of the population is concentrated in European and Italian urban systems; in urban contexts with high impermeable surfaces, limited green areas and a gradual increase in temperatures (Cobbinah, 2021; Fan et al., 2021). In this synthetic framework, the present work aims to observe the climate and temperatures' patterns in two geographic dimensions: the Italian metropolitan cities (MC) and the Labour Market Area local (LMAs, "Local Labour Systems – SLL" in Italy).

In particular: i) the MC, as defined by law (Law 7 April 2014), includes a large core city and the smaller surrounding municipalities belonging to a same wide interconnected area, with regards to economic activities and essential public services, as well as to cultural relations and to territorial features - in Italy in most of the cases MC are evolution of provinces, therefore based on an administrative rather than a functional principle. In the case of the MC of Cagliari, its set up as a set of interconnected municipalities is mainly based on functional principles; ii) system of municipalities are grouped on the basis of commuting movements, therefore representing a 'homogeneous' system of relationships among living and working places. The concept of LMA wants to bring light to the effects of commuting on the labour market centres and their hinterlands. This should assist further in the urban planning policies, while being based on relevant statistical evidence. The LMAs represent a geographical dimension to observe and to address new perspectives in terms of analyzes

and studies and therefore also a powerful policy tool. From the functional point of view this represents an interesting aggregation to study phenomena considering the metropolitan connections.

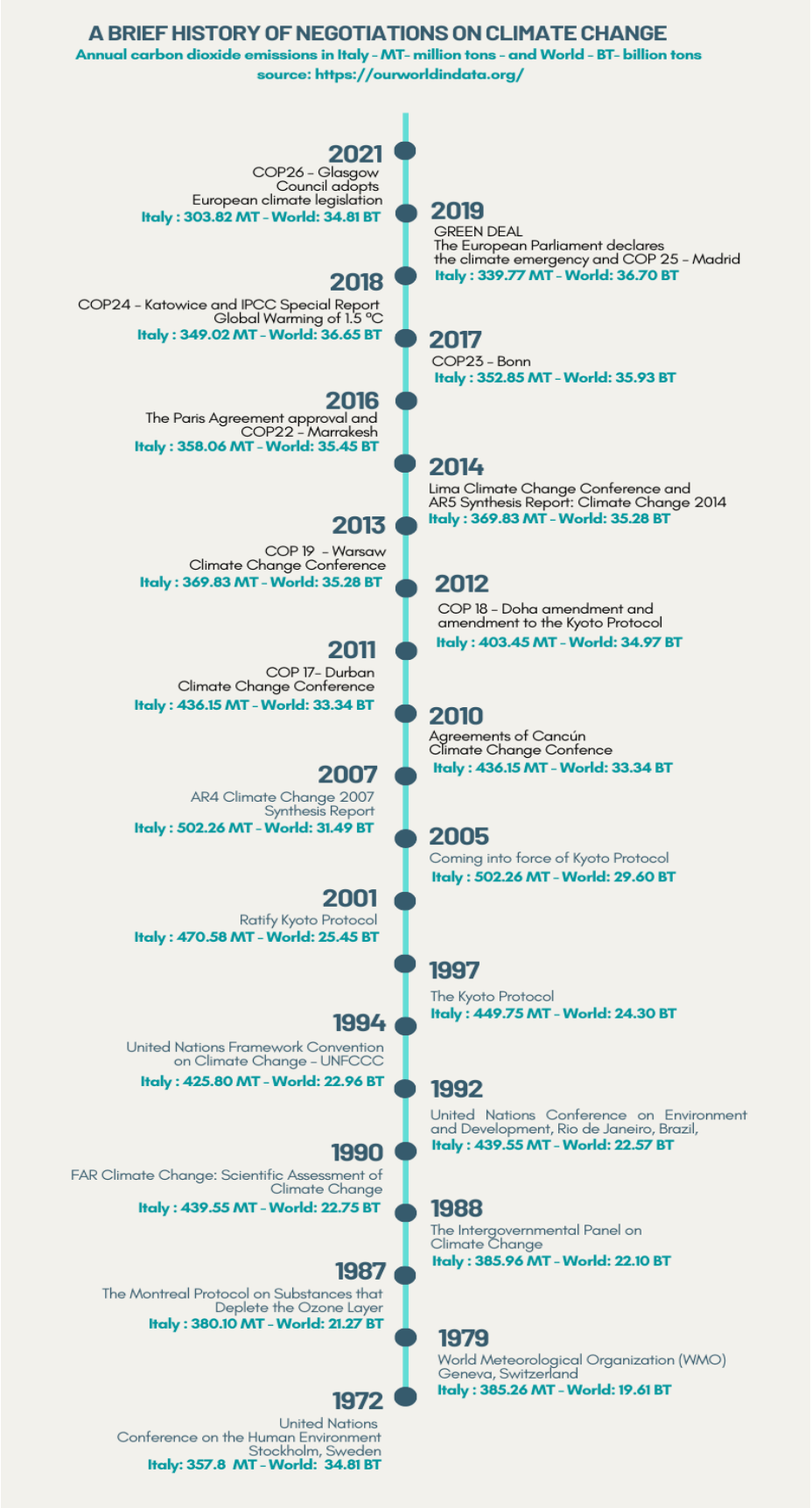


Fig.1 Major conferences and events on environmental and climate issues (Italy and Word)

The observation of the phenomenon was concentrated in the MC and LMA of Cagliari (case study) considered a representative Italian case (Ferguson, 2022; Palumbo et al., 2020) (Fig.2).

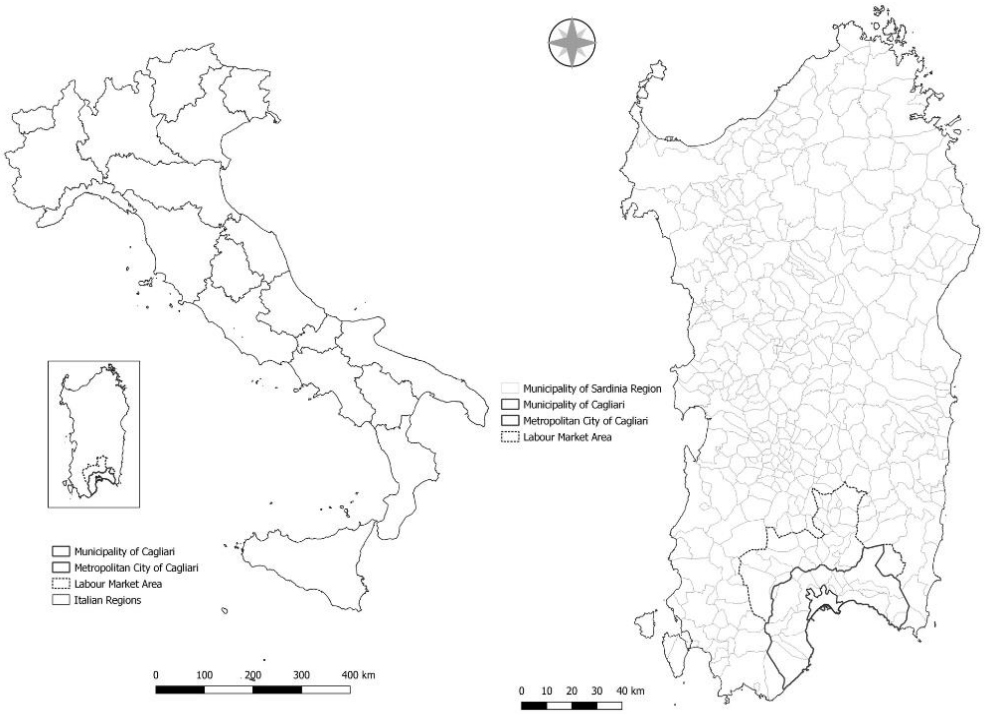


Fig.2 Geographical focus. Sardina Region in Italy and the units of analysis (Cagliari Metropolitan City and Labour Market Area)

The contribution is not intended to be exhaustive, rather to draw attention to possible interpretations of the phenomenon 'Climate variation analyzed through the territorial dimension of spatial self-containment, contiguity' and commuting (LMA).

The paper is organized as it follows:

Paragraph 2 Materials and Methods; 2.1 Temperature increase and human factors, which anticipates the relationship between temperature increase and vulnerability of some segments of the population; 2.2 Metropolitan City (MC) and Labour Market Area (LMA), which describes the territorial dimensions (CM and LMA) on which the observation of the thermal phenomenon is based; 2.3 Methodology: Spatial dimension (MLA and MC) and Spatial representation; paragraph 3: Case study of Cagliari: Metropolitan City (MC) and the Labour Market Area (LMA), Sardinia, Italy; paragraph 4 and 5: Results and Discussion and paragraph 6: Conclusions and future development.

2. Materials and methods

2.1 Temperature increase and human factors

The 21st century presents new urban challenges, in Italy in particular, which combine local and global issues. Complex challenges arise, such as the need for renewed economic growth, contextual to the gradual aging of the population, environmental degradation and the consumption of resources: energy, water, land take (Dameri et al., 2019; Di Febbraro et al., 2019).

Furthermore, the city, as a spatial organization with a high anthropogenic concentration – residence, production / services and mobility – is also a vulnerable place for thermal variations such as the Urban Heat Island - UHI which depends on the characteristics of the building materials, bituminous roads and greenhouse gas emissions (Susca, 2020).

Furthermore, UHIs ranking in size – from hundreds of square meters to hundreds of square kilometers – often persist in contexts characterized by widespread demographic aging processes that make large sections of the population vulnerable (Gonzalez-Trevizo et al., 2021). Necessarily, the Human Factor constitutes a problem to which it is essential to find an immediate solution to mitigate these effects – Human Solution (Dwivedi et al., 2022). In fact, the forecasts suggest worrying scenarios such as the increase in global temperature from 2 to 4° C over a period of about forty years, with greater increases in urban contexts, which would require systematic monitoring aimed at mitigation (Balletto et al., 2018; Marando et al., 2022; Morabito, et al., 2021). This increase is worrying both for sensitive communities (over 65) and for the progressive vulnerability extended: buildings, roads, monuments and water and food distribution networks (Phelps, 2021).

2.2 Metropolitan City (MC) and Labour Market Area (LMA)

In consideration of future scenarios, analyzing and evaluating thermal variations represents one of the most complex challenges for the preparation of climate adaptation policies.

An important consideration needs to be carried on before addressing the topics at stake in the present paper, such as the arrangement of the metropolitan areas, and its interpretation from the different points of view. Although metropolitan cities were created to ensure better management of the territory and urban phenomena with a supra-municipal dimension, nevertheless they represent vulnerable contexts due to the increase in temperatures partly attributable to land consumption which in the 14 metropolitan cities have shown an overall increase since 2016 21.4% of land consumed (about 5,000 km^2 compared to about 23,000 km^2 on the entire national territory) (Romano, 2017). In this synthetic framework, the Metropolitan City of Cagliari represents an important case of methodological experimentation, other than representing a nearly unique case in the Italian intermediate administrative framework, of a metropolitan city designed more on a functional basis than on an administrative one. In fact, for this target area of Cagliari, the climate projections show a significant increase of the temperature minimum, maximum and average temperature increase (from +1.3° C to +3.6° C). This confirms the strong increase in hot extremes such as tropical nights and summer days (+ 22-40 days) and a slight general reduction in total rainfall. The significant increase of the temperature (min - max) and the strong increase of the hot extremes of Cagliari represents the most significant case of all the Italian metropolitan capital cities, also in terms of exposed population. The temperatures are extracted from the open database (https://climatechange.europeandatajournalism.eu/) built by OBC Trans Europa for EDJNet, that takes into consideration the temperature data of over 100,000 municipalities in 35 European countries. The average values of the 1960s were compared with those of the period 2009-2018, in order to detect the extent of global warming in each local community. Data is taken from Copernicus and the European Center for Medium-Range Weather Forecasts (ECMWF).

The data provide estimates of the temperature two meters above the ground and refer to a grid of cells measuring 5.5x5.5 km. The raw data were processed to obtain for each cell the values of the average annual temperature estimated in the two decades taken into consideration (1961-1970 and 2009-2018), in order to calculate the variation that took place. Each European municipality was then associated with one of the cells of the grid, also considering the urban density and the conformation of the coastline.

The land temperature observation scale was municipal aggregated by metropolitan cities (MC) and by the Labour Market Area (LMA). According to ISTAT (Italian National Institute of Statistics), LMA means a territorial area whose boundaries, regardless of the administrative articulation of the territory, are defined using the flows of daily home/work trips (commuting). In the LMA the population resides and works and exercises most of the social and economic relationships, home / work trips are used as a proxy of the relationships existing in the territory. From that point of view, an LMA can be considered as the catchment areas or the hinterland of the central place of the unit itself.

The evaluation of temperature proposal therefore refers both to an administrative dimension (that of governance of the metropolitan city - MC) and to a non-administrative dimension, representative for describing the phenomenon (LMA). In other words, the observation of the phenomenon of increasing temperatures on the LMC scale allows it to represent the phenomenon in its complexity, unlike the MC scale: this, nevertheless, represents the territorial dimension of the governance of complex urban phenomena.
The temperatures, on the other hand, were analyzed by spatial autocorrelation, applying the local Moran's I, using the open GEODA software, in line with the territorial dimensions (LMA and MC) respectively representative of the proxy of the relationships existing in the territory (self-containment, urban contiguity, and governance).
The population vulnerable to climate change (over 65), on the other hand, it was extrapolated from Climate Change 2022: Impacts, Adaptation and Vulnerability [1], which highlights how in Italy the population aged 65 and over compared to the total population is 23.8%, which also represents the highest percentage among European Nations, which in 2042 according to ISTAT will be 34% of the population.

2.3 Methodology: Spatial dimension (MLA and MC) and Spatial representation

The proposed method consists in the observation of the phenomenon of temperature variation (space - time) through two geographical dimensions LMA, representative of urban dynamics and the urban administrative dimension MC, less representative for observation, but central in achieving the political objectives of climate neutrality (Hurlimann et al., 2021). The representation of the phenomenon is based on spatial autocorrelation by virtue of the nature of the observed phenomenon of being continuous in space (Majumdar & Biswas, 2016) (Fig. 3), while the administrative divisions represent, obviously, a discrete partitioning. The flow diagram of the proposed methodology highlights the framework and main references.

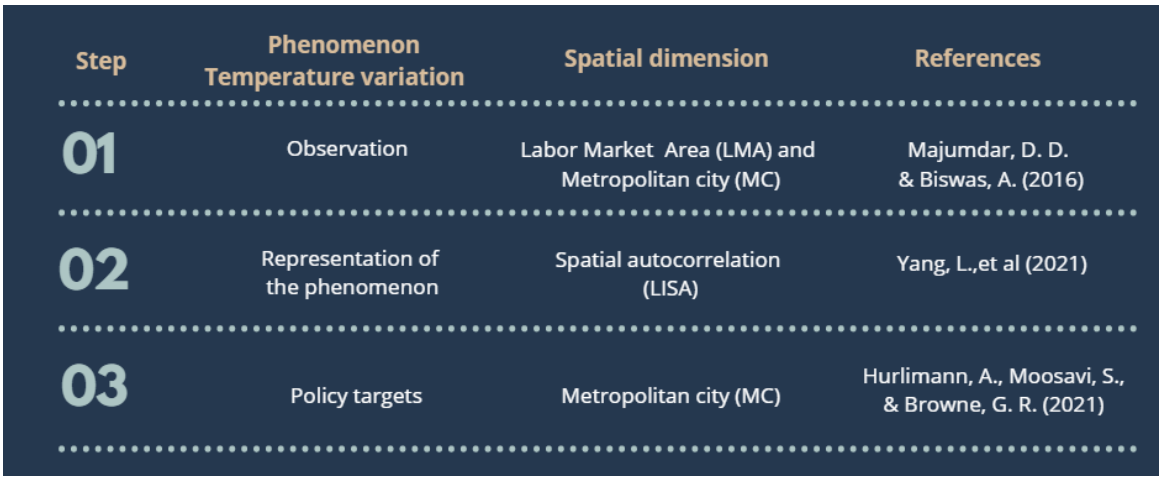


Fig.3 The flow diagram of the proposed methodology

The temperature, referring to spatial units that are generally contiguous in geographical terms, can benefit from a vast set of spatial analytical techniques to evaluate their local and proximity effects. In such a sense, evaluating the so-called spatial autocorrelation of data or indicator to a set of contiguous geographical units, can be useful for evaluating local effects and clusters in terms of attribute and geographical data. Area units in fact can mutually influence themselves in geographical terms and in terms of the data referred to such units. In geographic analytical terms, Tobler has highlighted (Tobler, 1970) as "nearby things are more related than distant things", apparently an intuitive approach (Tobler, 2004), although only recently rediscovered (Sui, 2004). Spatial autocorrelation is a tool that allows you to observe the behavior of a variable with respect to its

[1] https://www.ipcc.ch/report/ar6/wg2/

position in space and with respect to what occurs in its proximity. Through two categories of information such as location and related properties it is possible to describe geographic objects. In particular, in analytical terms, spatial autocorrelation can be defined as follows (Lee et al., 2000):

$$SAC = \frac{\sum_{i=1}^{N} \quad \sum_{j=1}^{N} \quad c_{ij} w_{ij}}{\sum_{i=1}^{N} \quad \sum_{j=1}^{N} \quad w_{ij}} \tag{1}$$

Where:

- i and j are two objects or events in space;
- N is the number of objects or events;
- c_{ij} is a degree of similarity of attributes i and j;
- w_{ij} is a degree of similarity of location i and j; From the general formula two indices derive as the Geary C Ratio (Geary, 1954) and the Moran Index I (Moran, 1948).

Defining x_i as the value of object i attribute; if $c_{ij} = (x_i - x_j)^2$, Geary C Ratio can be defined as follows:

$$c = \frac{(N-1)(\sum_i \quad \sum_j \quad w_{ij}(x_i - x_j)^2)}{2(\sum_i \quad \sum_j \quad w_{ii}) \sum_i \quad (x_i - \underline{x})^2} \tag{2}$$

If $c_{ij} = (x_i - \underline{x})(x_j - \underline{x})$, Moran Index I can be defined as follows:

$$I = \frac{N \sum_i \quad \sum_j \quad w_{ij}(x_i - \underline{x})(x_j - \underline{x})}{\sum_i \quad \sum_j \quad w_{ij}(x_i - \underline{x})^2} \tag{3}$$

As recalled and applied recently in several Italian contexts (Murgante et al., 2012), these indices are quite similar, differing by the cross-product term in the numerator, calculated using the deviations from the mean in Moran, while directly computed in Geary. The main message coming from the indices is highlighting the presence - or absence - of spatial autocorrelation at a global level in the overall distribution, while the local presence of autocorrelation can be highlighted by the LISA (Local Indicators of Spatial Association), or, as after Anselin (Anselin, 1988; Anselin,1995), a local Moran index, as the sum of all local indices is proportional to the value of the Moran one:

$$\sum_i \quad I_i = \gamma * I \tag{4}$$

The index is calculated as follows:

$$I_i = \frac{(X_i - \underline{X})}{S_X^2} \sum_{j=1}^{N} \quad (w_{ij}(X_j - \underline{X})) \tag{5}$$

The index allows assessing for each location assess the similarity of each observation with its neighbors, and five combinations can be obtained from its application:

- hot spots: areas with high values of the phenomenon and a high level of similarity with its surroundings (high-high H-H);
- cold spots, as areas with low values of the phenomenon and a low level of similarity with its surroundings (low-low L-L);
- potentially spatial outliers, with high values of the phenomenon and a low level of similarity with its surroundings (high-low H-L);
- potentially spatial outliers, with low values of the phenomenon and a high level of similarity with its surroundings (low-high L-H);

- lack of significant autocorrelation. The interesting characteristic of LISA is in providing an effective measure of the degree of relative spatial association between each territorial unit and its neighboring elements, thereby highlighting the type of spatial concentration and clustering.

An important element to be considered in the above-mentioned equations, related. The neighborhood property is analyzed by means of the parameter weight, w_{ij}, whose values indicate the presence, or absence, of neighboring spatial units to a given one. A spatial weight matrix is realized, with w_{ij} assuming values of 0 in cases in which i and j are not neighbors, or 1 when i and j are neighbors. Neighborhood is computed in terms of contiguity such as, in the case of areal units, sharing a common border of non-zero length (O'Sullivan & Unwin, 2010).

3. Case study of Cagliari: Metropolitan City (MC) and Labour Market Area (LMA), Sardinia, Italy

As a study area, the metropolitan city of Cagliari was chosen to test the methodology and as a testbed for another, wider study to be extended to the national territory, other than to an international context. Such a choice was justified, from the Italian administrative subdivisions point of view, by the presence of a Metropolitan City in Sardinia region built more on functional terms rather than on administrative ones, which generally happens in most of the other Italian Metropolitan City. In the Italian case, the recent laws re-defining the intermediate administrative levels - as those lying between Regions and Municipalities, has led to defining Metropolitan Cities, together with Provinces and other inter-municipal aggregations, starting generally from the previous organization of Municipalities in provinces, or in any case following more an administrative aggregation rather than focusing on a functional or systemic aggregation of lower-level administrative units. The study area is therefore represented by the metropolitan city of Cagliari, both in its administrative (MC) and statistical functional meanings as represented by the LMA as identified by Italian National Institute of Statistics (ISTAT). It is known that defining urban and metropolitan areas is not an easy task and simulations and proposals were done at national and international level (i.e., see the EU proposals for the Functional Urban Areas - FUA). However, LMA can be used for a functional exam of the working / studying - related movements to and from a major pole in a given area. Their extension can therefore be considered as the gravitation area of a city. In the case of Cagliari, we can recall it as the major city of Sardinia Region. The city of Cagliari is the capital of the Sardinia Region and Metropolitan City since 2016, and is the most important cultural, economic, political and administrative center of Sardinia. It is a new administrative structure of 17 municipalities. The Municipality of Cagliari hosts over 150,000 inhabitants, while the Metropolitan City spans nearly 420,000 inhabitants (ISTAT, 2022). Cagliari is the most important cultural, economic, political and administrative center of Sardinia. It plays a role as the major urban area in the Island (Table 1).

Cagliari	Population (2022)	Mr. of Municipalities
Municipality	148,881	1
Metropolitan City – MC	419,770	17
Labour Market Area – LMA	500,398	42
Cagliari + South Sardegna	754,878	124

Tab.1 Cagliari, summary demographic statistics. Source: our elaboration on data from ISTAT (2022)

The idea of addressing the topic considering two different aggregations of municipalities gravitating around a major, capital one, is that of putting together the administrative level where appropriate environmental policies can be put in action, and a wider area where such actions could be effective, given the continuity in space of

climate-related phenomenon aimed at climate neutrality. We considered the MC as the administrative and political context in which policies and actions and also the broader belt of municipalities surrounding the Metropolitan city, an extended buffer zone whose area can be considered as that of LMA. On one side, in fact, there was the need to limit the edge effect when performing the LISA – Local Moran compilation. As the algorithm considers neighboring area units, limiting the analysis to the sole municipalities belonging to the MC would have caused the information to be distorted at extreme edges of its external border. Therefore, a second belt of Municipalities around the major one – the municipality of Cagliari – would be an option to consider, in order to smooth and limit the edge effect. Another motivation lies in the functional aggregation of municipalities of the area related to the functional aggregations of the area in terms of commuting. The above-mentioned LMA are in fact based on self-containment in terms of such set of movements and therefore can provide a flavor of the gravitation powers in given municipalities, in particular if they host a MC.

4. Results

The analysis was performed considering the average yearly temperature registered over a wide timeframe, from 1960 to 2018, attributed to each Municipality (MC and LMA of Cagliari, Sardinia, Italy). Such data were used as the input for the computation of LISA and in particular the local Moran's I. The analysis was performed on the temperature data in 1960 and 2018. Also, the computation was run onto the temperature difference between the initial and final periods. The results are displayed in figures 4, 5, 6 and 7 (LISA Significance Map and Moran's I Scatterplot). As mentioned above, Moran's I is aimed at clustering areas in terms of similarity in a selected attribute together with a spatial contiguity.

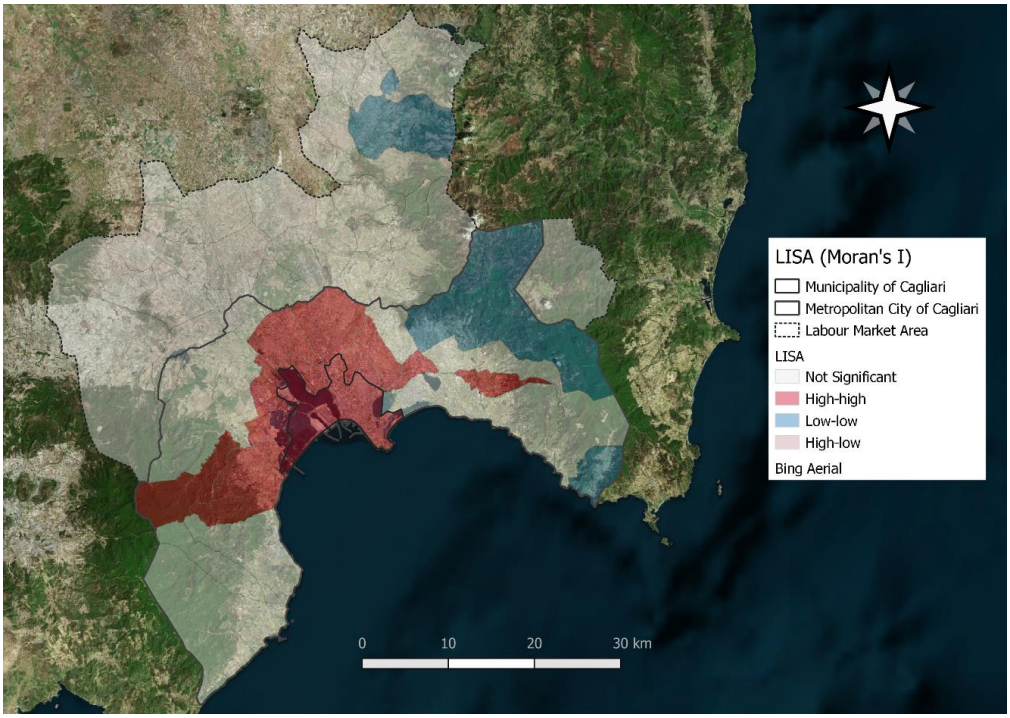


Fig.4 Lisa Map: Temperature 1960. Cagliari: MC and LMA

The analysis performed on 1960 data presents a situation of clustering – hi-hi autocorrelation – of the municipalities in the first belt around the municipality of Cagliari - with the exception of the Municipality of Quartu Sant'Elena, East from Cagliari.
The other municipalities of both the to-date LMA and MC are not significant in terms of spatial autocorrelation, or assume low-low autocorrelation - Municipality of Sinnai, Eastern limit of to-date MC.

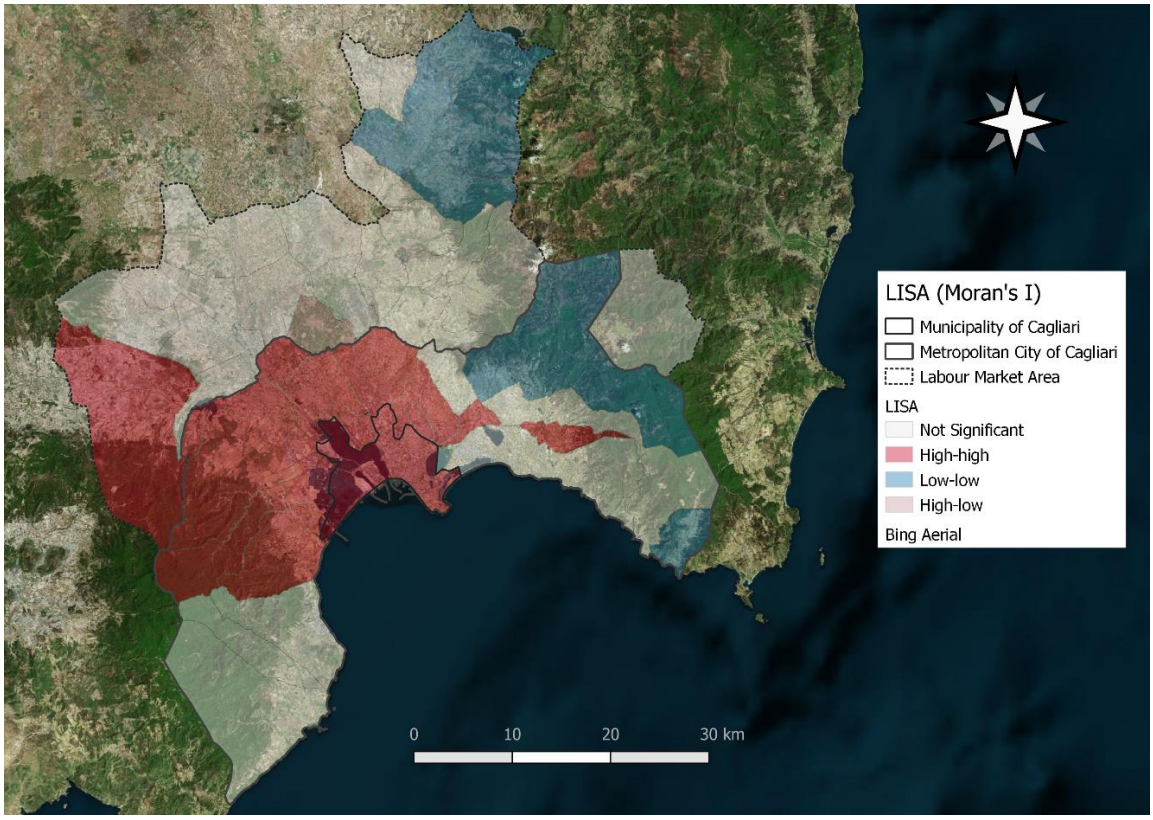


Fig.5 Lisa Map: Temperature 2018, Cagliari: MC and LMA

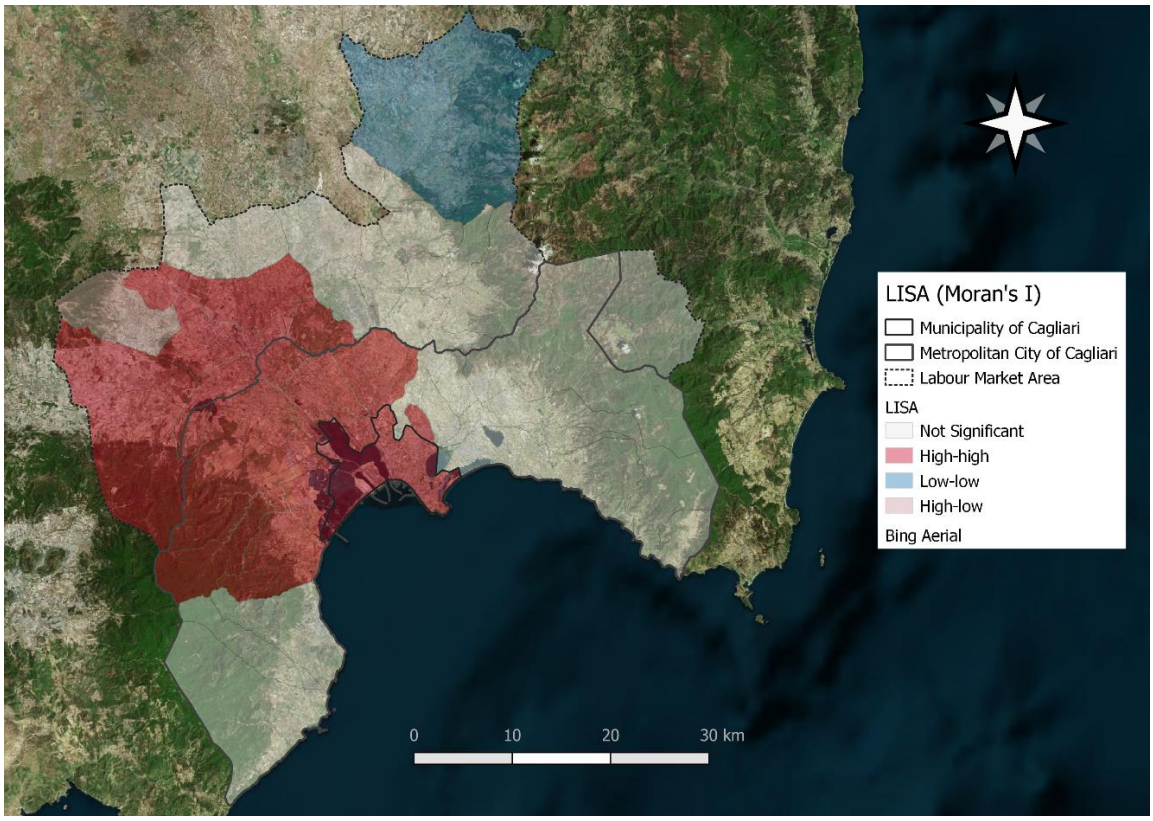


Fig.6 Lisa Map: Temperature delta (1960-2018) Cagliari: MC and LMA

The analysis on 2018 data shows an average increase of 2.7 Celsius degrees in the MC of Cagliari – 2.8 if we consider the average value of the municipalities belonging to Cagliari LMA – and high values of spatial autocorrelation as explored by the Moran's I can be found in the same municipalities as observed in 1960,

extended to include those belonging to the second belt around the city of Cagliari and oriented towards the Northwestern part of the area considered. A further analysis was performed considering the absolute variations in temperature as registered from 1960 to 2018. It is worth noting that the major changes occurred particularly from the end of the '90s of the past century and the first two decades of the XXI century, however an analysis on the overall changes was performed as well using local Moran's I. The analysis on the overall changes occurred confirms the pattern as drawn in the 2018 exam, with a wide set of Municipalities belonging to the MC and the LMA of Cagliari clustered, following particularly a South-East – North-West orientation, centered on the Capital Municipality of Cagliari.

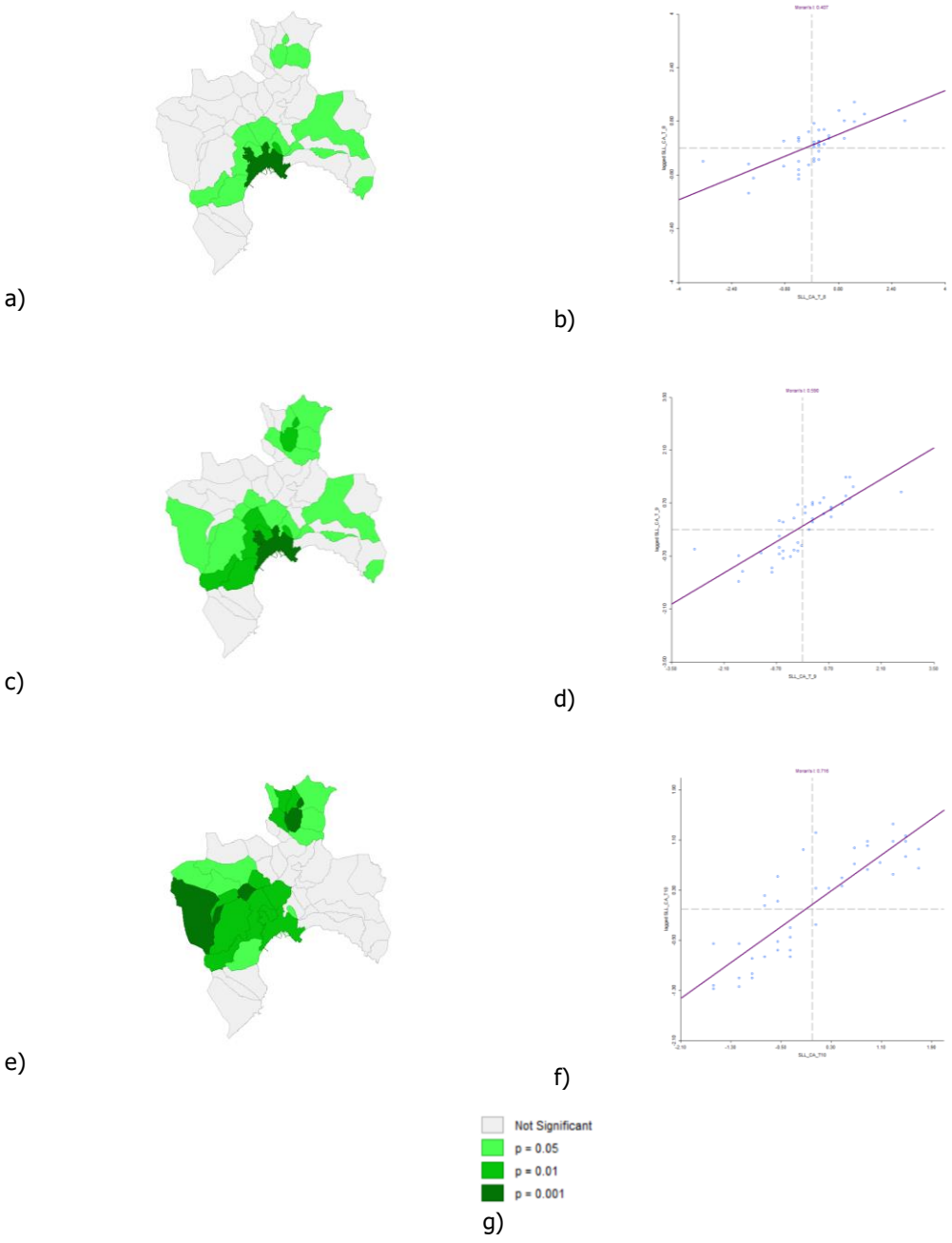


Fig.7 LISA Significance Map and Moran's I Scatterplot. Significance maps years 1960 (a), 2018 (c), difference 2018 - 1960 (e); Legend of Significance Maps (g). Moran's I scatterplots 1960 (b), 2018 (f), difference 2018 - 1960 (f)

From this first methodological application makes evident, once more, the existing mismatch, at least in the Italian administrative system, among the functional and administrative dimension. Italy for statistical purposes has identified the Labor market area (LMA) as aggregations of municipalities clustered in terms of their gravitation around certain locations presenting an attractive power to other external settlements. Such an instrument is of particular use for determining areas of gravitation for industrial and service activities, and, as a peculiarity of the Italian industrial system, for determining the areas where industrial districts could be detected. Their shape and extension is constantly monitored and updated as soon as commuting flows and population data are updated. However, they are not used from an administrative point of view but as statistical reference. Italy passed through several redesign and shaping of the intermediate administrative level, those lying between that of the Municipalities, and the Regions, these latter holding a particular authority in policies on spatial planning, transport and health, just to mention a few. Italian Provinces were reformed in 2015, and that led to the institution of the Metropolitan Cities (MC), as originally foreseen already during the Nineties of the past century. Their design, however, followed particularly an administrative path, not necessarily related to functional and/or systemic approaches in designing service areas around nodal cities. The administrative concept of 'Metropolitan City' in the Italian system is therefore different to that of a proper 'Metropolitan Area' or, as in the European nomenclature, Functional Urban Area.

5. Discussion

In the present manuscript, the combination of the two different spatial concepts (LMA and MC) related to the city of Cagliari allowed on one side to observe a phenomenon, that related to the temperature as representative of climate changes, in a context of proximity of relation – as the Labour Market Area (LMA) ones, in terms of industry, service, agricultural production, transport infrastructure, etc. – spanning out from administrative borders and therefore capable of maintaining a robust analysis of the variability of the phenomenon; on the other side, it allowed to understand to what extent the current administrative pattern is both non completely valid to detect phenomena that have consequences on its territory, although generated outside it, and, from another point of view, the MC is necessarily involved and asked to intervene for proposing climate neutrality policies. The cluster characterized by the increase in temperature, are those characterized by a more flat morphology – built and / or used for production activities, traditionally oriented towards the northwest from Cagliari (towards the main road transport infrastructure of Sardinia).

The results of this first methodological application show how the administrative territorial dimension of the metropolitan city is not representative for the observation of the phenomenon related to the change in temperatures. Furthermore, this methodology allows to highlight the municipalities and therefore the potentially vulnerable community deriving from thermal change. Some summary statistics derived from the analysis carried on, show as the cluster of municipalities where the major temperature increase occurred in the most recent period host a percentage close to 20 of the vulnerable resident population (over 65 years), counting around 77 thousand people in the Metropolitan City (touching 420 thousand people in 2022), what involves taking a series of urgent actions within the Metropolitan Urban Planning Plan, with the aim of mitigating and adapting the climatic effects. Actions are no longer negligible as, in fact, the increase in temperature in metropolitan city of Cagliari, but also in all Italian metropolitan cities is accompanied by the progressive aging of the population and therefore by the progressive increase in the vulnerability of the urban communities.

The research carried on and presented in the current manuscript represents a local demonstration of the need to consider the different spatial units of analysis and policy related to a country - or, considering a wider, international scenario, a set of countries as the European ones could be. As it often happens, the phenomena needing to be addressed are continuous in space - such as a rise in temperature and/or, more in general, the issues related to climate change. However, the decision making process is generally tackled considering

discrete partitioning of space, often non-optimal in their pattern and extension, and little flexible in terms of adaptability of changes. The recent restructuring of the Italian intermediate set of administrative units - that including Provinces and Metropolitan Cities - confirmed in most of the cases shapes and extensions of areas conformed to a well rooted system, with little changes occurring. An exception, as mentioned, is that of the Metropolitan City of Cagliari, whose extension is different from any other administrative partition adopted in the past. Nonetheless, given the increase in the importance of the city at regional level, its catchment area or hinterland is wider and needs to be addressed at a wider spatial scale, at least from the analytical point of view. Italian Labour Market Areas are such that they are updated regularly, according to the changes intervening in the commuting and residential habits of people and, particularly in the past, were fundamental in highlighting Industrial Districts, as the backbone of Italian Small and Medium Enterprise system that characterized particularly the last decades of the past century. The occasion, therefore, was that of reflecting on the need to consider different spatial units and analytical tools to couple analysis and policy proposals at spatial level.

6. Conclusions and future development

During the twentieth century, the world has increased tenfold both the use of fossil fuels and the extraction of natural resources. This seemingly rich era of abundant and cheap resources is drawing to a close. Raw materials, water, air, biodiversity and marine, terrestrial and aquatic ecosystems are all under pressure from thermal change. There is a need to monitor the variations occurring in temperature in the different contexts, particularly those characterized as urban and periurban, where industrial, services and residential activities developed with particular evidence in the latest years. Also, there is the need to overcome the administrative organization of territories for studying phenomena, coordinating actions in order to allow administrations to intervene on their own territories, without forgetting the effects actions and policies can have on neighboring areas. In the particular case, the analysis portrayed the situation of the temperature increase in two major aggregations, as the Metropolitan City and the Local Market Area of Cagliari. Clustering of municipalities with increased temperature in the years popped up, allowing also to estimate figures of population at risk due to the changes intervened.

Such an analysis allowed, other than to observe the changes occurred in time and space in terms of the phenomenon observed, to highlight the need to focus on different levels of spatial aggregations when dealing with the political action's level of one side - the more rigid administrative level of the official spatial units - and the effect on the true territorial extension of the phenomenon on one side, and of the metropolitan context on the other one.

Future research direction will involve considering the Italian Metropolitan Cities and their related Local Market Areas, therefore extending the analysis to the entire country, to observe the behavior of the phenomenon in time and space, not just limited to a single case or part of a region. The idea is also that of considering other 'shapes' and extensions of the metropolitan areas, as those proposed at European level of the FUA – Functional Urban Areas, realized by a composite indicator of commuting, residential density and availability of services. This will allow considering a third level of aggregation, in continuous update based on Earth's observation technology (Copernicus project, based on remotely sensed satellite data). Particular attention will be paid to the vulnerability analysis of the population (age and spatial distribution). Finally, the climate mitigation policies of metropolitan cities will be assessed to determine coherence with the recorded climate changes.

Acknowledgements

The author Ginevra Balletto took part in the following research activities: i) Strategic Plan of the Metropolitan City of Cagliari, commissioned to the Temporary Business Association (ATI), constituted by Lattanzio Advisory and Lattanzio Communication in 2019: Luigi Mundula (PI) University of Cagliari, ii) "Investigating in the

relationships between knowledge-building and design and decision-making in spatial planning with geodesign – CUP F74I19001040007 – financed by Sardinia Foundation, Annuity 2018'. Professor Michele Campagna (PI).
This paper is the result of the joint work of the authors. In particular: paragraph 1, 2.1, 2.2, 4 and have been written by G. Balletto; paragraph 3 has been written by G. Borruso; paragraphs 2.3, 6 and Database collection have been jointly written by M. Sinatra and R. Mura.

References

Accetturo, A., Albanese, G., Ballatore, R.M., Ropele, T. & Sestito, P. (2022). *Regional inequality in Italy in the face of economic crises, recovery, and the health emergency*. Occasional Papers, 685. Roma: Bank of Italy, Economic Research and International Relations Area

Andreoni, V., & Galmarini, S. (2012). Decoupling economic growth from carbon dioxide emissions: A decomposition analysis of Italian energy consumption. *Energy*, *44*(1), 682-691. https://doi.org/10.1016/j.energy.2012.05.024

Anselin, L. (1988). *Spatial Econometrics: Methods and Models*. Dordrecht: Springer. https:// doi.org/10.1007/978-94-015-7799-1

Anselin, L. (1995). Local indicators of spatial association – LISA. *Geographical analysis, 27*(2), 93-115. https://doi.org/10.1111/j.1538-4632.1995.tb00338.x

Balletto, G., Borruso, G., & Donato, C. (2018). City dashboards and the Achilles' heel of smart cities: putting governance in action and in space. *International Conference on Computational Science and Its Applications*. 654-668. Cham: Springer. https://doi.org/10.1007/978-3-319-95168-3_44

Cobbinah, P.B. (2021). Urban resilience in climate change hotspot. *Land use policy*, *100*, 104948. https://doi.org/10.1016/j.landusepol.2020.104948

Dameri, R.P., Benevolo, C., Veglianti, E., & Li, Y. (2019). Understanding smart cities as a glocal strategy: A comparison between Italy and China. *Technological Forecasting and Social Change*, *142*(C), 26-41. https://doi.org/10.1016/j.techfore.2018.07.025

Di Febbraro, M., Menchetti, M., Russo, D., Ancillotto, L., Aloise, G., Roscioni, F., ..., & Mori, E. (2019). Integrating climate and land-use change scenarios in modelling the future spread of invasive squirrels in Italy. *Diversity and Distributions, 25*(4), 644-659. https://doi.org/10.1111/ddi.12890

Dwivedi, Y.K., Hughes, L., Kar, A.K., Baabdullah, A.M., Grover, P., Abbas, R., ..., & Wade, M. (2022). Climate change and COP26: Are digital technologies and information management part of the problem or the solution? An editorial reflection and call to action. *International Journal of Information Management, 63*, 102456. https://doi.org/10.1016/j.ijinfomgt.2021.102456

Fan, X., Miao, C., Duan, Q., Shen, C., & Wu, Y. (2021). Future climate change hotspots under different 21st century warming scenarios. *Earth's Future, 9*(6), e2021EF002027. https://doi.org/10.1029/2021EF002027

Ferguson, R.J. (2022). The Political Challenge of Linking Climate Change and Sustainable Development Policies: Risks and Prospects. In P.S. Low (Eds.), *Sustainable Development: Asia-Pacific Perspectives*, 298-314. Cambridge:Cambridge University Press. https://doi.org/10.1017/9780511977961.028

Geary, R.C. (1954). The contiguity ratio and statistical mapping. *The Incorporated Statistician, 5*(3), 115-146.

Gonzalez-Trevizo, M.E., Martinez-Torres, K.E., Armendariz-Lopez, J.F., Santamouris, M., Bojorquez-Morales, G., & Luna-Leon, A. (2021). Research trends on environmental, energy and vulnerability impacts of Urban Heat Islands: An overview. *Energy and Buildings, 246*, 111051. https://doi.org/10.1016/j.enbuild.2021.111051

Hurlimann, A., Moosavi, S., & Browne, G.R. (2021). Urban planning policy must do more to integrate climate change adaptation and mitigation actions. *Land Use Policy, 101*, 105188. https://doi.org/10.1016/j.landusepol.2020.105188

Kellogg, W.W., & Schware, R. (2019). *Climate change and society: consequences of increasing atmospheric carbon dioxide*. New York: Routledge. https://doi.org/10.4324/9780429048739

Kinley, R., Cutajar, M.Z., de Boer, Y., & Figueres, C. (2021). Beyond good intentions, to urgent action: Former UNFCCC leaders take stock of thirty years of international climate change negotiations. *Climate Policy, 21*(5), 593-603. https://doi.org/10.1080/14693062.2020.1860567

Koop, S.H., & van Leeuwen, C.J. (2017). The challenges of water, waste and climate change in cities. *Environment, development and sustainability, 19*(2), 385-418. https://doi.org/10.1007/s10668-016-9760-4

Lee, J., Wong, D.W.S., & David, W.S. (2000). *GIS and Statistical Analysis with ArcView*. Hoboken: Wiley.

Majumdar, D.D., & Biswas, A. (2016). Quantifying land surface temperature change from LISA clusters: An alternative approach to identifying urban land use transformation. *Landscape and Urban Planning, 153*, 51-65. https://doi.org/10.1016/J.LANDURBPLAN.2016.05.001

Marando, F., Heris, M.P., Zulian, G., Udías, A., Mentaschi, L., Chrysoulakis, N., ... & Maes, J. (2022). Urban heat island mitigation by green infrastructure in European Functional Urban Areas. *Sustainable Cities and Society, 77*, 103564. https://dx.doi.org/10.1016/j.scs.2021.103564

Morabito, M., Crisci, A., Guerri, G., Messeri, A., Congedo, L., & Munafò, M. (2021). Surface urban heat islands in Italian metropolitan cities: Tree cover and impervious surface influences. *Science of the Total Environment, 751*, 142334. https://doi.org/10.1016/j.scitotenv.2020.142334

Moran, P.A.P. (1948). The interpretation of statistical maps. *Journal of the Royal Statistical Society: Series B, 10*(2), 243-251. https://doi.org/10.1111/j.2517-6161.1948.tb00012.x

Murgante, B., Borruso, G. (2012). Analyzing migration phenomena with spatial autocorrelation techniques. In: B. Murgante et al. (Eds.) *ICCSA 2012. LNCS*, 7334, 670-685. Heidelberg: Springer. https://doi.org/10.1007/978-3-642-31075-1_50

O'Sullivan, D., Unwin, D.J. (2010). *Geographic Information Analysis: Second Edition*. Hoboken: Wiley.

Palumbo, M.E., Mundula, L., Balletto, G., Bazzato, E., & Marignani, M. (2020). Environmental dimension into strategic planning. The case of metropolitan city of Cagliari. In *International Conference on Computational Science and Its Applications*. 456-471. Cham: Springer. https://doi.org/10.1007/978-3-030-58820-5_34

Papa, R., Gargiulo, C., & Zucaro, F. (2014). Climate Change and Energy Sustainability. Which Innovations in European Strategies and Plans. *TeMA, Journal of Land Use, Mobility and Environment*. https://doi.org/10.6092/1970-9870/2554

Phelps, N.A. (2021). *The Urban Planning Imagination: A Critical International Introduction*. John Wiley & Sons.

Romano, B., Zullo, F., Fiorini, L., Marucci, A., & Ciabò, S. (2017). Land transformation of Italy due to half a century of urbanization. *Land use policy, 67*, 387-400. https://doi.org/10.1016/j.landusepol.2017.06.006

Salvati, A., Monti, P., Roura, H.C., & Cecere, C. (2019). Climatic performance of urban textures: Analysis tools for a Mediterranean urban context. *Energy and Buildings, 185*, 162-179. https://doi.org/10.1016/j.enbuild.2018.12.024

Sui, D.Z. (2004). Tobler's first law of geography: a big idea for a small world? *Annals of the Association of American Geographers. 94*(2), 269-277. https://doi.org/10.1111/j.1467-8306.2004.09402003.x

Susca, T. (2020). Climate Change and European Cities. *European Journal of Climate Change, 2*(1), 1-2. https://doi.org/10.34154/2020-ejcc-0201-01-02/euraass.

Tobler, W.R. (1970). A computer movie simulating urban growth in the Detroit Region. Economic Geography. 46, 234-240.

Tobler, W. (2004). On the first law of geography: a reply. *Annals of the Association of American Geographers, 94*(2), 304-310. https://doi.org/10.1111/j.1467-8306.2004.09402009.x

Yang, L., Yu, K., Ai, J., Liu, Y., Lin, L., Lin, L., & Liu, J. (2021). The influence of green space patterns on land surface temperature in different seasons: a case study of Fuzhou City, China. *Remote Sensing, 13*(24), 5114. https://doi.org/10.3390/rs13245114

UNFCCC (2015). *The Paris Agreement*, Retrieved from: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

UNFCCC (2020). *Decision 2/CMA.2 - Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts and its 2019 review*. Madrid: Spain.

Web References

- Retrieved from (last access June 20, 2022)

[1] https://whc.unesco.org/en/climatechange/

[2] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf

[3] https://www.meteoblue.com/en/weather/archive/export/italy-cross_canada_5984755

[4] https://www.istat.it/en/labour-market-areas

[5] https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FinalDraft_FullReport.pdf

Image Sources

Fig.1: Ginevra Balletto, 2022;

Fig.2: Authors' elaboration from ISTAT base data, 2022;

Fig.3: Ginevra Balletto, 2022;

Fig.4: Giuseppe Borruso, 2022;

Fig.5: Giuseppe Borruso, 2022;

Fig.6: Giuseppe Borruso, 2022;

Fig.7: Giuseppe Borruso, 2022.

Author's profile

Ginevra Balletto

(Roma, IT - 1971) Associate Professor of Urban and Territorial Planning, DICAAR, University of Cagliari. Her actual interests are related to geospatial planning in the multiple transitions (energetic, ecological, and digital).

Martina Sinatra

(Cagliari, IT - 1995) is an environmental engineer who works in the renewable energies and environmental impact assessment fields.

Roberto Mura

(Oristano, IT - 1989) is an environmental engineer who has a research scholarship at the Department of Culture of the Project "Ca' Tron" at University IUAV of Venice.

Giuseppe Borruso

(Trieste, IT - 1972) is an Associate Professor of Economic and Political Geography at the DEAMS - Department of Economics, Business, Mathematics and Statistics "Bruno De Finetti, University of Trieste. His actual research interests are related to economic geography, with particular reference to urban geography, transport and population.

TeMA

Journal of
Land Use, Mobility and Environment

TeMA 3 (2022) 517-531
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9549
Received 3rd December 2022, Accepted 16th December 2022, Available online 30th December 2022

www.tema.unina.it

Energy saving and efficiency in urban environments: integration strategies and best practices

Carmen Guida

Department of Civil, Building and Environmental Engineering
University of Naples Federico II, Naples, Italy
e-mail: carmen.guida@unina.it
ORCID: https://orcid.org/ 0000-0002-8379-7793

Abstract
As engines of growth and socio-economic development, cities are responsible for 66% of global energy consumption and 70% of emissions. The current energy crisis makes it more imperative than ever to integrate energy saving and energy efficiency into the governance of urban and territorial transformations, from strategies to tools, at all scales of the city: from the building to the neighbourhood, from large urban areas to the territory as a whole. With a bottom-up approach, this contribution identifies, starting from a review of best practices, strategies and solutions for energy saving and efficiency for the different urban fabrics, as an integral part of the tools for the governance of urban and territorial transformations. The contribution concludes with an analysis of the energy consumption of a case study and the identification of possible interventions. The application highlights the strong interactions of the city's energy performance containment with other urban dynamics, including vulnerability to natural phenomena.
The article is the first step of a wider research aimed at developing an expert system to support decision-making by identifying energy-consuming areas and proposing potential transformation scenarios due to urban characteristics.

Keywords
Energy consumption; Energy crisis; Urban environments.

How to cite item in APA format
Guida, C. (2022). Energy saving and efficiency in urban environments: integration strategies and best practices. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 517-531. http://dx.doi.org/10.6092/1970-9870/9549

1. Introduction

In recent years, the reduction of energy consumption and the improvement of its efficiency have assumed a more strategic role than ever before. On the one hand, the impacts of climate change-related phenomena on cities and communities around the world urgently call for the implementation of concrete, scalable and workable solutions (approaches, methods, procedures and policies) to mitigate and adapt urban environments to extreme events (Fasolino et al., 2020). On the other, the current energy crisis is delivering a shock of unprecedented breadth and complexity to the industrialised West, making the energy issue more urgent than ever, as a consequence (Chu, 2022).

Regardless of the source, energy is a major factor in urban development. Hence, urban areas substantially influence global energy demand and energy-related emissions. Cities consume about 75% of global primary energy and emit between 50% and 60% of total greenhouse gases (UN-Habitat, 2022). This trend peaks at approximately 80% when the indirect emissions generated by urban inhabitants are included (Su et al., 2022). As far as the European scenario, cities take up only 4% of the EU land area yet are home to 75% of citizens, and this number is expected to rise to approximately 83.7% by 2050 (Steurer & Bayr, 2020). The energy footprint of cities is due to many sectors. Buildings, for instance, consume vast amounts of energy at all stages of their existence (Gargiulo & Russo, 2017): energy is needed for the raw materials, construction process, maintenance, and daily operational needs such as lighting, air conditioning, and cleaning (Xie et al., 2018; Sharma et al., 2022). In addition, urban sprawl, increasing distances between destinations, and inefficient public transport systems prompt overall reliance on private motorised transport, such as cars, which have a high energy consumption, mostly of petroleum products (Gargiulo et al., 2012; François et al., 2021).

The IPCC's Sixth Assessment Report (2022) highlights the close linkage between the energy performance of urban environments and their resilience when climatic events (floods, water bombs, heat waves and droughts) occur. The report also shows that the risk people and assets face from climate change hazards has increased significantly. Hence, investments to accelerate the transition to renewable resources and withdrawal from fossil fuels are needed to mitigate GHG emissions but may also increase the overall resilience of the energy system. Due to climatic or meteorological events, power or fuel supply disruption impacts all other infrastructure sectors and affects businesses, industry, healthcare and other critical services (Groundstroem & Juhola, 2019). The economic impacts of climate change risks are significant. For example, in the EU, the expected annual damages to energy infrastructure, currently €0.5 billion per year, are projected to increase by 1,612% by the 2080s (Forzieri et al., 2018). In China, 33.9% of the population is vulnerable to electricity supply disruptions from a flood or drought (Hu et al., 2016), whilst in the USA, higher temperatures are projected to increase power system costs by about USD 50 billion by the year 2050 (Jaglom et al., 2014). Recent studies from Stockholm, Sweden, show that future heating demand will decrease while cooling demand will increase (Nik & Sasic Kalagasidis, 2013). A study from the USA showed that climate change would impact buildings by affecting peak and annual building energy consumption (Fri and Savitz, 2014). Finally, climate change can, for example, influence energy consumption patterns by changing how household and industrial consumers respond to short-term weather shocks and how they adapt to long-term changes (Auffhammer and Mansur, 2014).

Therefore, cities should shift from the current unsustainable fossil fuel energy dependency towards using renewable energy sources, not only because of the dynamics of the energy crisis, but also curb negative externalities such as pollution, greenhouse gas emissions and potential damages due to climate change-related events.

In addition to the scramble to comply with the Paris Agreement (United Nations, 2015) and limit the global temperature increase to 1.5°C by 2050, the ongoing energy crisis is a further impetus for change. Even if it shares some parallels with the oil shocks of the 1970s, there are important differences (Sturm, 2022). Today's crisis involves all fossil fuels, while the 1970s price shocks were largely limited to oil at a time when the global

economy was much more dependent on such energy resource. Moreover, the entire word economy is much more interlinked than it was 50 years ago, magnifying the impact. That is why it can be claimed as the first global energy crisis (Zakeri, 2022), mainly caused by the increase in energy prices since 2021 because of the rapid economic recovery, maintenance work that the pandemic and adverse weather conditions had delayed, and earlier decisions by oil and gas companies and exporting countries to reduce investments. All that led to already tight supplies, exacerbated by Russia's attack on Ukraine. Another significant difference to the gas crisis of 1970 is that, nowadays, urban areas account for the greatest shares of both the global population and world economic activity, two key drivers of energy use (Fig.1).

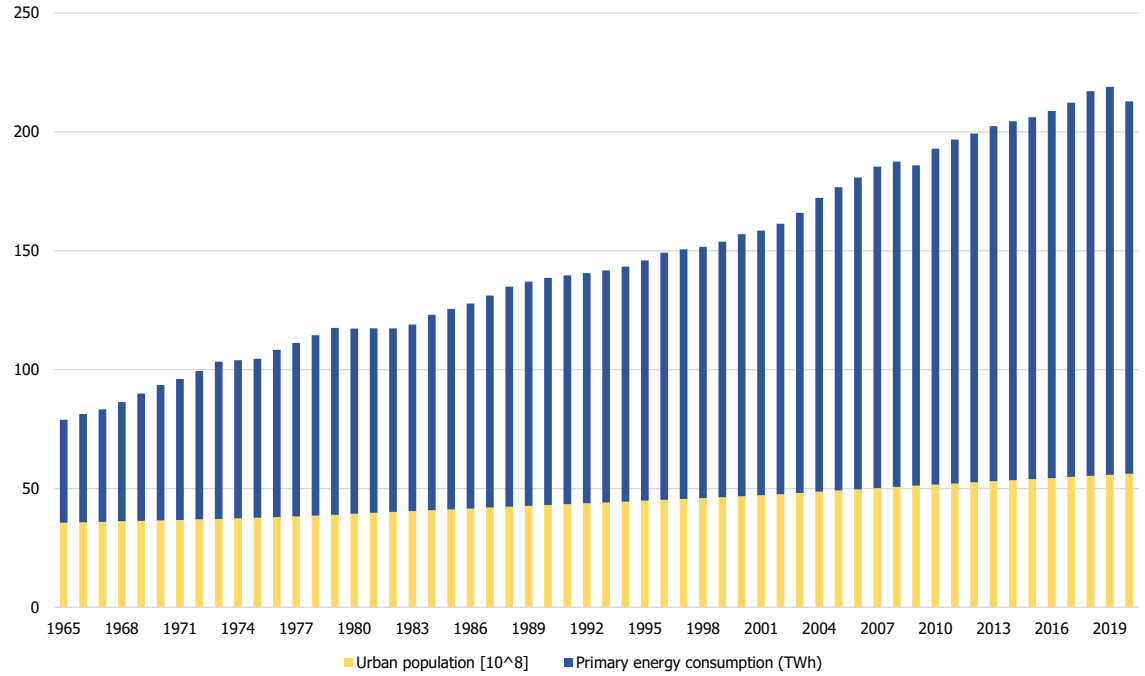


Fig.1 Urban population and energy consumption trend, 1965-2020 (OurWorldinData)

The overview, albeit brief and certainly not exhaustive, of the challenges that cities face and will face during the 21st century, described in this paragraph, gives a glimpse of the extent to which energy saving and efficiency in cities may influence urban resilience to climate change impacts and fossil fuel dependency. In order to effectively face (the combination of) these challenges, urban planning, building regulations, and other plans and policies should be integrated to enable deep and cost-effective decarbonisation of each urban activity.

The current energy crisis may represent a historical turning point for urban planners, stakeholders and citizens to integrate the energy issue into urban and town planning tools. Under the impetus of recovery plans developed in response to the economic crisis resulting from the Covid-19 pandemic, both the aims and contents of urban planning tools are increasingly characterised by a marked orientation towards finding answers for the new and urgent demands of environmental sustainability and energy saving.

With regard to the Italian context, the government has allocated substantial funds to incentivise energy efficiency and the improvement of building quality (Ecobonus). This practice has been widely used but does not reward community-based activities aimed at improving the quality of larger urban areas. Given the close linkage of the energy challenge to climate resilience, an urban approach would be preferable.

Hence, the innovative feature of this research would be the extension of investigation scale from building to urban environment. However, it is still unclear how to proceed with more appropriate planning forms in this sense, integrating energy models and scenarios into the procedures and methodologies of urban and territorial transformation governance.

This contribution is the first step of wider research which tries to answer this question by developing an expert system to support decision-making in identifying energy-consuming areas and proposing potential transformation scenarios according to existing urban characteristics. To this end, the paper analyses best practices, strategies and solutions for energy saving and efficiency for the different urban fabrics, which have been integrated into tools for the governance of urban and territorial transformations. Following this introduction, the reduction of energy consumption will be delved into to highlight its connection to urban and territorial planning governance. The third paragraph will summarise the review-based evidence from best practices, analysing possible solutions for different urban textures. The fourth section is dedicated to the lessons learned by the best practices, highlighting the most common sectors of interventions and their eventual integration into urban planning tools. Before the conclusion, a case study is analysed: energy consumption of a small residential area has been related to other urban features, and a set of possible solutions have been identified.

2. The reduction of energy consumption and new possibilities/opportunities for the governance of urban transformation

Although in the last few decades, many efforts have focused on defining measures to reduce consumption at the building scale, there has been increased awareness of the need to undertake measures at the urban scale (Papa et al., 2016; Bellezoni, 2021). Thus successful, isolated episodes of energy savings in buildings have proved insufficient to respond concretely to the problem. In fact, cities are naturally positioned to undertake energy-saving and efficiency processes: the density of human, economic and intellectual capital in cities can be a driving force for the acceleration of clean energy development and deployment and, more effectively, promoting and developing energy-saving strategies and interventions (Butters et al., 2020; Fasolino et al., 2020; Thellufsen et al., 2020; Nastjuk et al., 2022). As more and more cities take the opportunity to act as innovation hubs and test beds for sustainable urban energy technology, the closer the whole world will be to providing secure, sustainable and affordable energy for all (Sancino et al., 2022). Hence, a growing *momentum* is being recorded behind the city's role in taking action on energy saving and efficiency (Breetz et al., 2022; Fraser et al., 2022). The focus on cities and their role in the ecological transition are certainly due to large urban areas being complex organisms with a high degree of entropy (Gargiulo & Papa, 2021) and, therefore, among the largest contributors to energy demand and climate-changing gas emissions (Qian et al., 2022).

This scenario calls for a more conscious approach to urban and territorial governance issues (Oktay, 2022). It implies a multidisciplinary working method, with particular attention to the achievement of energy efficiency at all levels: from the building to the neighbourhood, from urban areas to the territory, from citizens' behaviour to the good practices of the public administration, introducing a monitoring routine practice of the implementation phase and the activity when fully operational, also with feedback value concerning plans and programmes (Papa et al., 2016).

The current energy crisis and the need to keep financial and security threats at bay may lead the way for urban planners to integrate territorial planning instruments with energy contents, typically dealt with by specialist tools. It is no coincidence that a transition state characterises the current phase of spatial governance and urban planning, accelerated and prioritised by fiscal *stimuli* such as Green Deal, Next Generation EU, and RePower EU, to boost and recover the European economy (Lambert et al., 2022; Sgambati, 2022). In fact, from the point of view of purpose and content, the evolution of urban planning instruments is increasingly characterised by a marked orientation towards finding answers to the new and urgent questions of sustainability and energy saving. However, it still does not appear clear how to proceed with more appropriate planning forms in this sense, if not by integrating traditional urban planning tools with the more recently established sector ones, such as energy performance forecasting models. The development of legislation and sector regulations gives an account of the need to remedy the shortcomings of traditional planning techniques

and how this need stems from a new sensitivity and awareness of the limits of natural energy resources and the problems associated with the energy and climate crises. In recent years, the introduction into territorial governance procedures of technical tools designed for this purpose has, in its way, provided the revision and updating of urban planning instrumentation from an environmental perspective. It is not, therefore, the result of an organic reform of the instruments for governing urban and territorial transformations but rather the attempt, at least on the part of the legislator, to progressively bring closer together and make an effort to integrate two spheres of undoubted influence, the urbanised territory and energy consumption, which are as distinct as they are complementary. In particular, the energy-saving issue is the foundation of the social and economic model of transformation for the near future and the turning point for sustainable, smart and energy-resilient urbanisation (Papa et al., 2015). Thus, good practices capable of a new and decisive integration between the two fields of influence are not always traceable in practice. More often, the outcome of planning strategies and interventions and programming activities is the juxtaposition of technical documents conceived as products of specialised and non-converging sectors without necessarily precluding the possibility of finding a synthesis between the two fields of influence.

In an interpretation that hopefully is not juxtaposed but rather complementary to urban planning, the sphere of planning for energy consumption and transition to renewable resources can provide an innovative contribution to the vision of urban and territorial governance and integration, in the sign of environmental sustainability and urban planning technique, by making the issue of energy requirements part of an urban accounting work to be contextualised in the broader municipal budget. It is a matter of establishing a close dialogue between often inhomogeneous territorial government tools, conceived with different purposes in different historical moments, which, however, has the possibility of finding in the good practices of policy-makers that unity is given by the uniqueness of the territory and the limits of its development.

Many experiences from real-world practice revealed that energy efficiency and saving simulation models focus on individual buildings rather than whole urban areas (Papa et al., 2014). The lack of a holistic approach makes it difficult for urban planners to consider energy efficiency and supplies when designing and planning refurbishment actions or new city developments. Moreover, the lack of quantitative information to seriously evaluate energy savings, or the cost and impact of retrofitting, renewable energy options, cogeneration or district heating extensions, is the gap that this research, starting from analysing some interesting best practices, aims at filling.

3. Lessons from some best practices

In order to define suitable strategies and interventions to reduce energy consumption in urban areas, different real-world planning practices have been analysed. The case studies were selected to collect as large a sample as possible, not only in terms of the proposed interventions but also concerning the characteristics of the urban areas in which they were implemented. Furthermore, the selection of best practices was carried out according to two eligibility criteria. The first concerns the scale of the intervention, so those limited to the building scale were excluded; the latter relates to the integration of transformation choices in the tools of urban and territorial governance, so only those for which an update/revision or the drafting of an *ad hoc* urban plan were selected as best practices. Even if not exhaustively, the sample collects the following best practices:

- Solar-City Linz-Pichling (Austria), 1996;
- Beddington Zero Energy Development, London (United Kingdom), 2000-2002;
- Ecociudad Valdespartera, Zaragoza (Spain), 2001;
- Urbes Project Barcelona (Spain), 2018;
- Izmir (Turkey) Sustainable Energy Climate Action Plan and the Façade Rehabilitation Project of its historical centre, 2020;
- UrbanGaia project in Coimbra (Portugal), 2020;

- North Walsham (United Kingdom) Heritage Action Zone Projects, 2021;
- Nordhavn, Copenhagen (Denmark), ongoig;
- Social Housing programme for Torri Madonna Bianca, Trento (Italy), ongoing.

The sample of best planning practices was selected by consulting several international databases (weADAPT, C40, ESMPA) and scientific papers (Zanon & Verones, 2013; Amado & Poggi, 2016; Cajot et al., 2017; Scorza & Santopietro, 2021; Stober et al., 2021; Ruggiero et al., 2021). What emerges is a very mixed picture of cities: from those in northern Europe, whose interest in environmental, climate and energy issues has its roots in the 1970s and led the research and development of alternative energy sources to fossil fuels, to cities where only more recently have these issues found a place in the governance of urban and territorial transformations. The choice of case studies to be analysed also took into account the type of urban fabric to which the energy efficiency and saving measures were implemented. The following table summarises interesting features of the selected planning practices (Tab.1).

Case study	Country	N. citizens	Area extension [ha]	Actors involved
Solar City, Linz-Pichling	Austria	4,000	60	Municipal administration
Beddington, London	United Kingdom	21,044	161	Borough Council, private companies
Valdespartera, Zaragoza	Spain	20,000	600	Ministry of Defence, Municipal administration, University, private companies, banks
Barcelona	Spain	1,620,343	1,014,000	Metropolitan administration, University, private companies
Izmir	Turkey	2,965,900	9,190,000	Municipal administration, citizens associations, private companies
Coimbra	Portugal	134,463	3,190,000	Municipal administration, citizens associations
North Walsham	United Kingdom	11,998	172,700	Municipal administration, private companies, citizens associations
Nordhavn, Copenhagen	Denmark	2,144	20,000	Municipal administratio, private companies, research institutes, University
Torri Madonna Bianca, Trento	Italy	1,400	40	Municipal administration, private companies, citizens associations

Tab.1 Overview of selected best planning practices

Some of the best practices gather experiences of urban transformation governance in newly built contexts. That is the case of the Solar City in Linz (Austria), where a radio-centric urban layout has been implemented, symmetrical to two main axes, which corresponds to a model of ideal sustainability and energy efficiency, surrounded by a green belt. In this case, the energy saving and efficiency of the district are due to the orientation of the buildings and their building quality, which compensates for the not-always-optimal location, and to the high concentration of open spaces: private gardens, semi-public green areas owned by companies but in public use, pedestrian paths and parks. In addition, the city of Linz relies on its energy park, which can meet the average energy demand of approximately 21-28 kWh/sqm per year per building, contained through active and passive energy-saving technologies. Similar examples can be observed in the Valdespartera district in Zaragoza (Spain) and Beddington in London (UK). The Spanish district is a recently built urban neighbourhood where the governance of urban transformations played a key role in building an energy-efficient urban environment and responding to social and economic issues. In an area of former military assets, the Ecociudad de Valdespartera converted an area of approximately 240 hectares into 9,500 social residences. Several features were considered to have the lowest footprint possible: the strategic placement of trees for

cooling, the orientation of buildings to maximise shaded areas, and the use of solar heating and natural ventilation.

(a) (b) (c)

Fig.2 View from (a) Solar City in Linz, (b) Ecociudad of Valdespartena in Zaragoza and (c) Beddington

The small London borough has instead invested in functional *mixité*, and in offering sustainable mobility services to limit the use of private cars and encourage walking or public transport (Guida et al., 2022). A similar approach was also chosen for the social housing complex in Torri Madonna Bianca, Trento (Italy). It is an ongoing process of constructing a new residential area through implementing retrofitting techniques and energy-efficient systems that heavily rely on ICT. Moreover, new renewable energy resources and novel combined heating, and cooling systems will be installed in selected sites to boost the efficiency of the city's district heating network. The Municipality also wants to push for their Urban Mobility plan, which aims to promote car-sharing of electric vehicles and limit the usage of fuel-based cars. Also in this plan are a set of ICT tools, which will be implemented to optimise the transport system within the city. Implementing new technology products to limit energy consumption in urban areas is one of the key elements for the Danish district.

Nordhavn is being converted from an industrial harbour area into an energy-efficient and high-architectural-quality neighbourhood. As a full-scale smart city energy lab, the district demonstrates how electricity and heating, energy-efficient buildings and electric transport can be integrated into an intelligent, flexible and optimised energy system.

The energy retrofit projects for the former Ottoman town of Izmir (Turkey) and North Walsham (UK) are different. For these territorial contexts, the dynamics related to energy saving and energy efficiency are strongly linked to other challenges: for instance, the protection of resources of historical, artistic and architectural value against extreme climatic and meteorological phenomena, the competitiveness and tourist attractiveness of places. For these places, the range of compatible transformations narrows considerably. Given the overall artistic value, it is not always possible to work on more energy-efficient building materials or a different orientation of existing buildings concerning the heliothermic axis. The focus of the interventions foreseen for the historical centres of Izmir and North Walsham concerns the improvement of open and public spaces to enhance active sustainable mobility.

(a) (b) (c)

Fig.3 View from (a) Torri Madonna Bianca in Trento, (b) Nordhavn in Copenhagen and (c) Izmir

The best planning practices from Barcelona (Spain) and Coimbra (Portugal) differ for the area extension and nature of interventions. They promote nature-based solutions in city-belt areas to limit energy consumption

within the city boundary and damage due to climate-change-related phenomena, particularly sea-level rise and storm surges.

This comparative review has made it possible to highlight not only the range of potential interventions on an urban scale, respecting the starting urban conditions, but also the combination of challenges that different portions of the same cities are facing and that the government of urban transformations oriented towards the reduction of energy consumption can potentially control, from increasing the response of cities to climate change to limiting urban sprawl, from providing green infrastructure to ensuring the provision of essential In the next section, a comparative reading of the case studies is proposed with respect to the fabric in which they were implemented.

(a) (b) (c)

Fig.4 View from (a) North Walsham, (b) nature-based solutions in Barcelona and (c) Coimbra

4. Possible solutions for different urban fabrics

4.1 The historical city

The built historic environment has a vital role in the journey towards a more efficient energy-saving future. For historical centres, at least for those urban areas of which Master Plans provide for their protection and preservation, the relationship with the tools of energy planning may concern the possibility of modifications for increasing the energy efficiency of buildings. Such possibility may also be extended to the real estate unit coinciding with the single apartment, the entire building or an aggregate of several buildings. The possibility of interventions in the historic centre, even if diffuse or dimensionally limited, could, in any case, give rise to forms of energy micro-efficiency of the whole historic building fabric, with experimentation of techniques and materials for thermal insulation in buildings with stone or brick bearing structure. In such cases, intervention in historical centres may be called energy retrofit of existing buildings, examples of which are not lacking, especially in Europe, of which the Izmir and North Walsham planning cases are examples, too. This choice is far from trivial since the materials and technologies available are mainly directed at new buildings with reinforced concrete structures.

Urban planning tools, in this regard, should contain a performance specification to achieve efficiency standards for the containment of consumption, with particular reference to residential and historic buildings compatible with architectural and building characteristics. Municipal building regulations are a key lever for promoting and implementing innovative environmental and energy policies. According to a survey carried out by Cresme and Legambiente (2014) on a sample of Italian 1,000 municipalities, 188 building regulations, through obligation (104) or only incentives (85), promote a different way of building that looks towards energy independence. The main guideline that emerges from the analysis of the 188 building regulations is the obligation to design and install thermal energy production systems in order to cover with renewable sources at least 50% of the annual energy requirements for the production of hot water, and to provide for the installation of photovoltaic panels for the production of electricity not less than quantities defined with different values per housing unit by the various regulations.

Other energy efficiency and saving option may imply a changing scale, from the building unit to territorial areas whose forecasts are pursued through urban implementation planning. These actions aim at achieving

substantial protection of the historic centre. They could be included in a strategy whose objective is the recovery or even partial transformation of the historic centre, for example, with targeted replacements aimed at improving urban conditions in some well-identified and motivating situations (collapsed buildings, ruins, buildings to be demolished as they are in poor static condition and of no historical testimonial value), using insertions of new energy-efficient construction.

The presence of any voids within the historic fabric could be taken in a systemic key as a form of soil protection to increase the possibility of air, light and ventilation for the historic fabric and to improve soil permeability with the planting of trees for heat island mitigation.

Urban planning tools may also intervene by focusing on roofing in order to:

- collect and store rainwater for a functional secondary water network for condominium needs (for instance, cleaning and irrigation of green spaces);
- recover terrace and roof surfaces for the installation of photovoltaic panels;
- establish garden roofs to improve the insulation of roof slabs and mitigate the heat island effect;
- create passive solar systems as an accessory residential surface for the sole purpose of energy saving.

In more general terms, redevelopment interventions in the historic centre with recovery plans or even transformation/replacement found in the energy retrofit of the buildings, and more generally of the existing fabric, an adequate response to the new standards for the containment of energy consumption and the improvement of housing quality in areas characterised by a strong building degradation. This is a common case in those cities that have taken advantage of those large urban renewal programs (often, unfortunately, due to sanitary issues) that have especially characterised the urban planning culture between the nineteenth and twentieth centuries. Those transformations usually had complementary effects exacerbating the degradation of the historic centre for the parts that survived the implementation of the new interventions.

In conclusion, as far as the historic city is concerned, the review of best practices revealed that the relationships between urban and energy planning guidelines and tools are mainly found with the following guidelines: improvement of the building envelope and use of renewable energy sources.

4.2 The consolidated city

The consolidated areas within a city include largely urbanised areas, often coinciding with the consolidated suburbs that begin where the historical centre ends. They can be areas of completion and potential transformation or consolidated areas. These areas of the city can be further classified by operating within the more overall category and detailed according to certain criteria, including building quality, with particular reference to energy characteristics; the bioclimatic qualities of the urban layout (e.g. orientation and exposure); the potential of land utilisation for greater densification of the building fabric, including for the realisation of activities supplementary to residence (parking, commerce, public facilities, services); sufficient road access to the area also for public transport; green spaces for the formation of urban environments with microclimate, capable of counteracting the heat island effect; public assets such as public housing districts to be preserved and to undergo a process of energy retrofit.

According to the building stock usually characterising newly developed city areas, energy saving and efficiency interventions may include the adaptation of existing buildings to new energy efficiency standards, with particular reference to the building envelope, the installation of systems for the production of renewable energy, and the use of roofs, including roof gardens.

Moreover, energy plans may encourage transformation or completion interventions with new construction, preferably with high density and high energy efficiency, with particular reference to the bioclimatic quality of the building system.

The possibility of providing for new building interventions in open urban areas in consolidated city could be directed especially to the experimentation of sustainable housing programs such as self-building, co-housing,

and social housing, of which there are beginning to be some particularly interesting experiences in Italy as well. These are opportunities put in place to respond to the long-standing housing emergency of those social groups that do not qualify for public housing but are also unable to afford the market prices of housing. Specifically, regarding co-housing, a project usually includes 20 to 40 families living together as a neighbourhood community and managing common spaces collectively with economic, social and environmental benefits. This practice, together with the participatory design approach, promotes energy savings and mitigates the community's environmental impact through actions such as establishing solidarity purchasing groups, car sharing or the location of various shared services.
As highlighted by the case study analysis of Beddington and Trento, the relationships between urban and energy planning tools mainly concern the following domains: soil protection, heat island reduction, bioclimatic quality of urban design, improvement of the building envelope, and use of renewable energy sources.

4.3 The transforming city

The transforming city concerns urban areas destinated for new residential and non-residential developments. It can also be defined as a building expansion zone identifiable as urban suburbs with neighbourhoods characterised by the almost absolute presence of residences, lack of services and facilities, dependence and insufficient connection with the city centre. On the other hand, these urban areas are those where the range of potential urban interventions is wider than elsewhere.
The possibility of further expansion of our cities, to the detriment of the preservation of the still existing soil, should be limited to these areas, upon the demonstration of the need for new residential developments and lack of usable areas for this purpose in much-urbanised areas. In this case, however, the need for new residential developments could not be met without further land consumption. The model of reference should be sought in eco-sustainable neighbourhoods, some important examples of which have been included in the case studies (the Ecociudad of Zaragoza and the Solar City in Linz). The review of some interesting best practices highlights that developing inner cities should consider the following guidelines: soil protection, heat island reduction, bioclimatic quality of urban design, improvement of the building envelope, and use of renewable energy sources.

4.4 The ecosystem city: natural, seminatural and agricultural environments

The endowment of green areas at the urban and territorial scale implies finding conspicuous areas within the municipal territory to fulfil this standard. In addition to the quantitative aspects of green and blue infrastructures, it is interesting to define its systemic aspects that connote its strategic role in the overall energy saving and efficiency performance, to be understood in this case as extended to the entire city context, in the relationship between urbanised and non-urbanised areas (parks, green belt, countryside). Soil conservation involves the preservation of open and un-urbanised spaces with natural features (scrub or forest), seminatural (countryside still present in the city, new crops for urban gardens and urban farms), abandoned and dispersed fallow to be reconnected, through the creation of ecological corridors, in a system including larger areas (natural or cultivated) as well as smaller ones thus giving substance to the city of ecosystems.
Concerning the city of ecosystems, the relationships between strategies and urban and energy planning tools can be found with the following addresses: soil protection, reduction of urban heat islands, and bioclimatic quality of urban design.
The case studies of Barcelona and Coimbra highlighted the almost exclusive interest of the government of urban and territorial transformations in this aspect. At the same time, other examples, such as the Austrian Solar City, integrated these green solutions outside the urban space in combination with solutions of a different nature.

5. A baseline case study

To support local policy makers' decisions and foster the transition towards a low-carbon future, a growing body of international researchers has been studying the complex and multidimensional relationship between cities and energy consumption. Previous researches were developed following the approaches summarised in this contribution on the relationship between the urban form and energy consumption, between urban form and climate change and, further, on the relationship between city and vulnerability to climatic and natural risks. Some of them proposed intervention classification of urban settlements to reduce energy consumption and climate-change-related risks, which, at the same time, take account of aspects related to the microclimatic welfare of dwellings, urban quality and the creation of economic value of the existing building stock (Gargiulo & Lombardi, 2016; Guida et al., 2022). In particular, a neighbourhood in a densely residential area was studied, with high vulnerability levels in terms of supplies and location. It is a district in the city of Naples, one of the most densely inhabited metropolitan areas in Europe, within which an urban environment with homogeneous constructional, settlement and morphological characteristics was identified, namely Rione Gemito in the Arenella neighbourhood, a complex of 29 buildings, developed between 1946 and 1948, social building, from a project by Marcello Canino and Alfredo Sbriziolo. Conceived to house the homeless from the Second World War, the complex is designed in a cross-shape where the buildings are arranged lengthwise along two rows either side of a broad tree-lined avenue (via Altamura), according to a late 19th-century pattern of an ordered residential neighbourhood (La Gala, 2006).

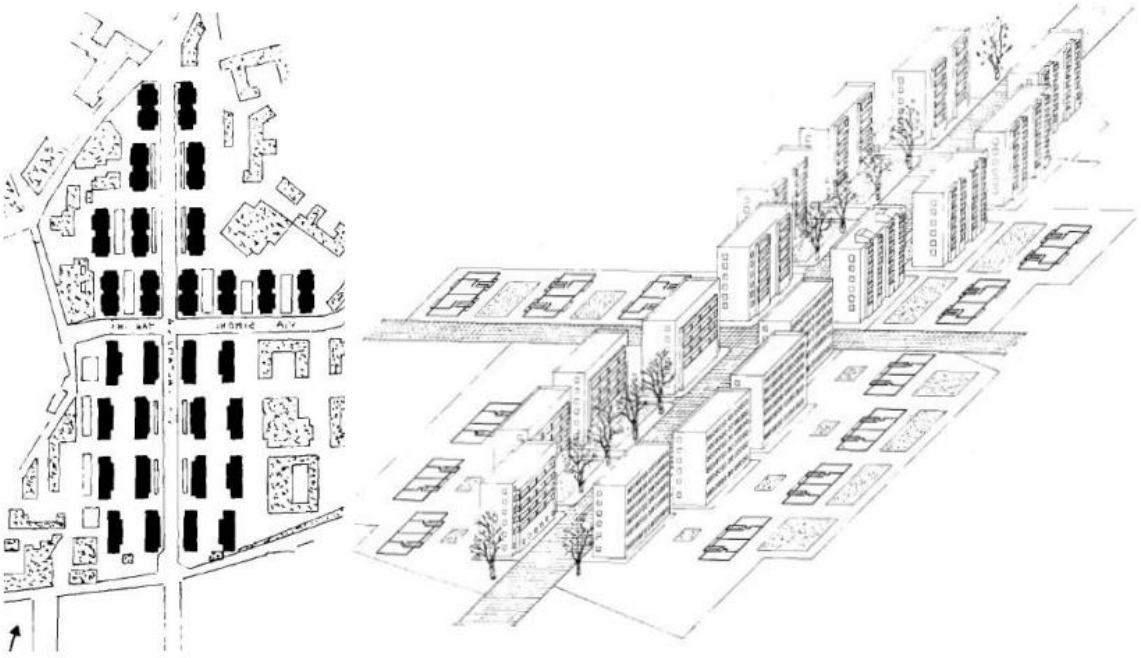


Fig.5 Rione Gemito plan and prospect

The research of Gemito sought to highlight the possibility of identifying integrated strategies to optimize the ever- diminishing supply of resources at the disposal of municipal authorities in order to maximize benefits in terms of reducing energy consumption, reducing urban vulnerability, and improving the quality of the building stock whilst enhancing its value. The intervention proposals were formulated to be grafted onto a theoretical context consisting of the set of recent scientific research developments in very disparate disciplines. The outcomes of the research may support the set up a masterplan of concrete interventions, within which the times, costs and suitable technologies are established.

The attention paid in the research to the importance of tackling the complexity of the issues within a holistic framework represents a significative starting point for the current research. In this sense, although the calculations yielded some significant results, a more rigorous methodology would be designed. Indeed, the

research procedure was carried out through two kinds of analysis: the ACP and Clustering, which provide such valid results in terms of correlations between physical parameters and energy consumption. The interesting datum emerging from the comparison of the two elaborations is that the homogeneity of constructive characteristics of buildings plays a determinant role in the correlations of variables and consumptions: actually, it emerged that the more the buildings are similar in terms of physical parameters, the more the correlations are evident.

In this context, it would be worth applying an improved analytical procedure to a less homogeneous area in terms of construction, settlement type and land area than the neighbourhood in question. Such an extension would help enhance the proposed methodology. In this context, selecting a sampling area characterized by dishomogeneous buildings, preferably threatened by different risks or of different intensity than those identified in Rione Gemito, may provide interesting insights for a different selection of measures to combine each other.

6. Conclusions

Given the relevance of energy saving and efficiency in facing the current urban challenges, this contribution is a first step of wider research aimed at developing an expert system to support decision-making in identifying energy-consuming areas and proposing potential transformation scenarios according to existing urban characteristics. In particular, the paper analyses best planning practices, strategies and solutions for energy saving and efficiency for the different urban fabrics, which have been integrated into tools for the governance of urban and territorial transformations. The bottom-up review of interesting case studies revealed that interventions' effectiveness in reducing energy consumption depends on their adaptation and suitability to compatible physical and functional transformations given by state-of-art conditions. One of the more significant findings to emerge from this study is that the energy issue is intrinsically linked to the challenges facing the city in the 21st century. The transition to the use of renewable and more sustainable energy resources and city models with a reduced carbon footprint, made more urgent by the current crisis, is urgently needed to mitigate global warming and adapt cities to the impacts of natural phenomena, including those triggered by rising temperatures. Another aspect highlighted by the review concerns the necessary integration in urban and spatial planning tools of the knowledge, methods and models proper to the energy performance of the components of the urban environment.

Although the study has successfully demonstrated the linkage between energy consumption and urban planning practices, it has certain limitations in terms of in terms of sample size of case studies. Moreover, the bottom-up review lacks quantitative analyses that would be useful to compare before-and-after scenarios. The collection of energy consumption data would be helpful to establish a greater degree of accuracy on this matter. Furthermore, with a small sample size, caution must be applied, as the findings might not be transferable to other territorial contexts. While choosing the case studies this aspect has been taken into account.

The picture defined in this contribution, thus inexhaustive in terms of quantitative assessments, represents the starting point of a wider research, whose aim is to evaluate the extent to which urban characteristics influence energy consumption on a city scale. Based on this framework, the next steps will delve into the developing of a methodology for identifying energy-consuming urban areas and given their inner features, intervention scenarios in order to enable urban planning policies to effectively improve energy saving in cities and reduce urban emissions.

References

Amado, M., Poggi, F. (2016). Energy efficient city: A model for urban planning. *Sustainable Cities and Society*, 26, 476-485. https://doi.org/10.1016/j.egypro.2014.02.174

Auffhammer, M. & E.T. Mansur (2014). Measuring climatic impacts on energy consumption: A review of the empirical literature. Energy Econ., 46, 522–530. Aune, K.T., D. Gesch and G.S. Smith, 2020: A spatial analysis of climate gentrification in Orleans Parish, Louisiana post-Hurricane Katrina. *Environmental Research*, 185, 109384. https://doi.org/10.1016 /j.eneco.2014 .04.017

Bellezoni, R. A., Meng, F., He, P., & Seto, K. C. (2021). Understanding and conceptualising how urban green and blue infrastructure affects the food, water, and energy nexus: A synthesis of the literature. *Journal of cleaner production*, 289, 125825. https://doi.org/10.1016/j.jclepro.2021.125825

Butters, C., Cheshmehzangi, A., & Sassi, P. (2020). Cities, energy and climate: Seven reasons to question the dense high-rise city. *Journal of Green Building*, *15*(3), 197-214. https://doi.org/10.3992/jgb.15.3.197

Breetz, H. L., Kunkel, L. C., Vallury, S., & Cuiffo, K. V. (2022). Small towns with big plans: Municipal adoption of 100% renewable electricity policies. *Energy Research & Social Science*, 90, 102664. https://doi.org/10.1016/j.erss.2022.102664

Cajot, S., Peter, M., Bahu, J. M., Guignet, F., Koch, A., & Maréchal, F. (2017). Obstacles in energy planning at the urban scale. *Sustainable cities and society*, 30, 223-236. https://doi.org/10.1016/j.scs.2017.02.003

Chu, K., Le, N.T.M. Environmental quality and the role of economic policy uncertainty, economic complexity, renewable energy, and energy intensity: the case of G7 countries. *Environmental Science and Pollution Research* 29, 2866–2882 (2022). https://doi.org/10.1007/s11356-021-15666-9

Fasolino, I., Grimaldi, M., & Coppola, F. (2020). The paradigms of urban planning to emergency-proof. *TeMA - Journal of Land Use, Mobility and Environment*, 165-178. https://doi.org/10.6092/1970-9870/6912

Forzieri, G., Bianchi, A., Silva, F. B. E., Marin Herrera, M. A., Leblois, A., Lavalle, C., Aerts, J. C. J. H., & Feyen, L. (2018). Escalating impacts of climate extremes on critical infrastructures in Europe. *Global environmental change: human and policy dimensions*, 48, 97–107. https://doi.org/10.1016/j.gloenvcha.2017.11.007

François, C., Gondran, N., & Nicolas, J. P. (2021). Spatial and territorial developments for life cycle assessment applied to urban mobility—case study on Lyon area in France. *The International Journal of Life Cycle Assessment*, *26*(3), 543-560. https://doi.org/ 10.1007/s11367-020-01861-2

Fraser, T., Bancroft, M., Small, A., & Cunningham, L. (2022). Leaders or networkers? the role of mayors in renewable energy transition. *Environmental Innovation and Societal Transitions*, 42, 301-316. https://doi.org/10.1016/j.eist.2022.01.003

Fri, R. W., & Savitz, M. L. (2014). Rethinking energy innovation and social science. *Energy Research & Social Science*, 1, 183-187. https://doi.org/10.1016/j.erss.2014.03.010

Gargiulo, C., & Lombardi, C. (2016). Urban Retrofit and Resilience: the Challenge of Energy Efficiency and Vulnerability. *TeMA - Journal of Land Use, Mobility and Environment*, 9(2), 137-162. https://doi.org/10.6092/1970-9870/3922

Gargiulo, C., & Papa, R. (2021). Chaos and chaos: the city as a complex phenomenon. *TeMA - Journal of Land Use, Mobility and Environment*, 14(2), 261-270. https://doi.org/10.6093/1970-9870/8273

Gargiulo, C., Pinto, V., & Zucaro, F. (2012). City and mobility: towards an integrated approach to resolve energy problems. *TeMA - Journal of Land Use, Mobility and Environment*, 5(2), 23-54. https://doi.org/10.6092/1970-9870/920

Gargiulo, C., & Russo, L. (2017). Cities and Energy Consumption: a Critical Review. *TeMA - Journal of Land Use, Mobility and Environment*, *10*(3), 259-278. https://doi.org/10.6092/1970-9870/5182

Groundstroem, F. & Juhola, S. (2019). A framework for identifying cross-border impacts of climate change on the energy sector. *Environment Systems and Decisions*. 39. 10.1007/s10669-018-9697-2.

Guida, C., Carpentieri, G. & Masoumi, H. (2022). Measuring spatial accessibility to urban services for older adults: an application to healthcare facilities in Milan. *European Transport Research Review* 14, 23. https://doi.org/10.1186/s12544-022-00544-3

Guida C., Gargiulo C., Papa R., Carpentieri G. (2022). Vulnerability and Exposure of Mediterranean Coastal Cities to Climate Change-Related Phenomena. *Environmental Sciences Proceedings*, 21(1), 79. https://doi.org/10.3390/environsciproc 2022021079

Jaglom, W., McFarland, J., Colley, M., Mack, C., Venkatesh, B., Miller, R., Haydel, J. & Schultz, P., Perkins, B., Casola, J., Martinich, J., Cross, P., Kolian, M. & Kayin, S. (2014). Assessment of projected temperature impacts from climate change on the US electric power sector using the Integrated Planning Model (R). *Energy Policy*. 73. 524-539. https://doi.org/10.1016 /j.enpol.2014.04.032.

La Gala, A. (2006). Le strade del Vomero. Napoli, edizione Guida. ISBN: 9788860422552.

Lambert L.A., Tayah J., Lee-Schmid C., Abdalla M., Abdallah I., Ali A.H., Esmail S., Ahmed W. The EU's natural gas cold war and diversification challenges. *Energy Strategy Review,* 2211-467X, 43 (2022), Article 100934. https://doi.org/10.1016/j.esr.2022.101006

Nastjuk, I., Trang, S., & Papageorgiou, E. I. (2022). Smart cities and smart governance models for future cities. *Electronic Markets*, 1-8. https://doi.org/10.1007/s12525-022-00609-0

Nik, V. & Sasic Kalagasidis, A. (2013). Impact study of the climate change on the energy performance of the building stock in Stockholm considering four climate uncertainties. *Building and Environment*. *60*. 291–304. https://doi.org10.1016/ j.buildenv.2012. 11.005.

Oktay, D. (2022). Promoting Energy-Efficient Neighbourhoods: Learning from BedZED. In Sustainable Energy Development and Innovation,841-847. *Springer, Cham*. https://doi.org/10.1007/978-3-030-76221-6_93

Papa, R., Gargiulo, C., & Zucaro, F. (2014). Climate Change and Energy Sustainability. Which Innovations in European Strategies and Plans. *TeMA - Journal of Land Use, Mobility and Environment*. https://doi.org/10.6092/1970-9870/2554

Papa, R., Galderisi, A., Vigo Majello, M. C., & Saretta, E. (2015). European Cities Dealing with Climate Issues: Ideas and Tools for a Better Framing of Current Practices. *TeMA - Journal of Land Use, Mobility and Environment*, 63-80. https://doi.org/10.6092/1970-9870/3658

Papa, R., Gargiulo, C., Zucaro, F. (2016). Towards the Definition of the Urban Saving Energy Model (UrbanSEM). In: Papa, R., Fistola, R. (eds) Smart Energy in the Smart City. Green Energy and Technology. *Springer, Cham*. https://doi.org/ 10.1007/978-3-319-31157-9_9

Papa, R., Gargiulo, C., Zucaro, F., Cristiano M., Angiello G., Carpentieri G. (2016). Energy and Climate Change Policies in Europe: Overview and Selected Examples from a Spatial Planning Perspective. Smart Energy in the Smart City. *Green Energy and Technology.* https://10.007/978-3-319-31157-9_13

Qian, Y., Zheng, H., Meng, J., Shan, Y., Zhou, Y., & Guan, D. (2022). Large inter-city inequality in consumption-based CO2 emissions for China's pearl river basin cities. *Resources, Conservation and Recycling*, *176*, 105923. https://doi.org/10.1016/j. resconrec.2021.105923

S. Ruggiero, H. Busch, T. Hansen, A. Isakovic (2021). Context and agency in urban community energy initiatives: An analysis of six case studies from the Baltic Sea Region. *Energy Policy*, Volume 148, Part A, 111956, ISSN 0301-4215. https://doi.org/10.1016/j.enpol.2020.111956.

Sancino, A., Stafford, M., Braga, A., & Budd, L. (2022). What can city leaders do for climate change? Insights from the C40 Cities Climate Leadership Group network. *Regional Studies*, *56* (7), 1224-1233. https://doi.org/10.1080/00343404 2021.2005244

Scorza, F., & Santopietro, L. (2021). A systemic perspective for the Sustainable Energy and Climate Action Plan (SECAP). *European Planning Studies*, 1-21. https://doi.org/10.1080/09654313.2021.1954603

Sgambati S. (2022). The interventions of the Italian Recovery and Resilience Plan: Energy efficiency in urban areas. *TeMA - Journal of Land Use, Mobility and Environment, 15* (2), 345-351. https://doi.org/10.6093/1970-9870/9322

Sharma, S., Saini, G., Kumar, K., & Saini, K. (2022). Futuristic Approach to Energy in Smart Cities. In Smart Cities (pp. 293-309). *CRC Press*. ISBN: 9781003287186

Steurer, M., & Bayr, C. (2020). Measuring urban sprawl using land use data. *Land Use Policy*, 97, 104799. https://doi.org/10.1016/j.landusepol.2020.104799

Stober, D., Suškevičs, M., Eiter, S., Müller, S., Martinát, S., & Buchecker, M. (2021). What is the quality of participatory renewable energy planning in Europe? A comparative analysis of innovative practices in 25 projects. *Energy Research & Social Science*, 71, 101804. https://doi.org/10.1016/j.erss.2020.101804

Sturm, C. (2022). Between a rock and a hard place: European energy policy and complexity in the wake of the Ukraine war. *Journal of Industrial and Business Economics*, 1-44. https://doi.org/10.1007/s40812-022-00233-1

Su, B., Goh, T., Ang, B. W., & Ng, T. S. (2022). Energy consumption and energy efficiency trends in Singapore: The case of a meticulously planned city. *Energy Policy*, 161, 112732. https://doi.org/10.1016/j.enpol.2021.112732

Thellufsen, J.Z., Lund, H., Sorknæs, P., Østergaard, P.A., Chang, M., Drysdale, D., Nielsen, S., Djørup, S.R., Sperling, K. (2020). Smart energy cities in a 100% renewable energy context. *Renewable and Sustainable Energy Reviews*, Volume 129, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2020.109922.

United Nations, FCCC – Framework Convention on Climate Change (2015). Adoption of the Paris agreement.

United Nations Habitat for a better future (2022). World Cities Report 2022: Envisaging the Future of Cities. Available at: https://unhabitat.org/world-cities-report-2022-envisaging-the-future-of-cities

Xie, L., Yan, H., Zhang, S., & Wei, C. (2020). Does urbanisation increase residential energy use? Evidence from the Chinese residential energy consumption survey 2012. *China Economic Review, 59*, 101374. https://doi.org/10.1016 /j.chieco.2019.101374

Zakeri, B., Paulavets, K., Barreto-Gomez, L., Echeverri, L. G., Pachauri, S., Boza-Kiss, B., Zimm, C., Rogelj, J., Creutzig, F., Ürge-Vorsatz, D., Victor, D. G., Bazilian, M. D., Fritz, S., Gielen, D., McCollum, D. L., Srivastava, L., Hunt, J. D., & Pouya, S. (2022). *Pandemic, War, and Global Energy Transitions. Energies, 15* (17), 6114. https://doi.org/10.3390/en15176114

Zanon, B., & Verones, S. (2013). Climate change, urban energy and planning practices: Italian experiences of innovation in land management tools. *Land use policy*, *32*, 343-355. https://doi.org/10.1016/j.landusepol.2012.11.009

Web Sources

weADAPT - https://www.weadapt.org/
C40 Cities - https://www.c40.org/
ESMAP Energy System Management Assistance Programme - https://www.esmap.org/node/231

Image Sources

Fig.1: Author's elaboration from https://ourworldindata.org/;

Fig.2: (a) https://www.urbangreenbluegrids.com/projects/solar-city-linz-austria/; (b) https://arainfo.org/113532-2/; (c) https://www.rinnovabili.it/bozze/bedzed-complesso-eco-compatibile-877/;

Fig.3: (a) https://www.rainews.it/tgr/trento/video/2018/08/tnt-Trento-Edifici-Torri-Economia-Lavoro-Edilizia-Look-Ambiente-59a7f0b6-4c25-41c1-ace6-871c6a90f251.html; (b) https://www.ilsole24ore.com/art/nordhavn-citta-ideale-danese-sull-acqua-sostenibilita-e-suite-luxury-sospese-porto-ADWvKQg; (c) https://www.novo-monde.com/en/things-to-do-izmir-turkey/;

Fig.4: (a) https://www.northwalshamguide.co.uk/north-walsham-directory; (b) https://nrcsolutions.org/beaches-and-dunes/; (c) https://networknature.eu/casestudy/18418;

Fig.5: Sergio Stenti, Napoli moderna, città e case popolari 1868-1980, CLEAN edizioni, 1993.

Author's profile

Carmen Guida

She is an engineer, PhD in Civil Systems Engineering and Postdoctoral Researcher at the Department of Civil, Architectural and Environmental Engineering of the University of Naples Federico II. Her research activities concern adapting the urban environment to climate change-related hazards and accessibility to urban services for older adults to minimise social exclusion and inequalities within urban areas.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 533-542
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/8886
Received 5th January 2022, Accepted 28th September 2022, Available online 30th December 2022

www.tema.unina.it

The weapons of the city against pandemic assaults

Maria Angela Bedini [a]*, Fabio Bronzini [b]

[a] Department of Materials, Environmental Sciences and Urban Planning (SIMAU)
Polytechnic University of Marche, Ancona, Italy
e-mail: m.a.bedini@staff.univpm.it
ORCID: https://orcid.org/0000-0002-2657-8703
* Corresponding author

[b] Department of Materials, Environmental Sciences and Urban Planning (SIMAU)
Polytechnic University of Marche, Ancona, Italy
e-mail: lutacurb@gmail.com
ORCID: https://orcid.org/0000-0002-4593-1912

Abstract
The cyclical spread of the pandemic requires a modification of the urban and territorial planning tools and a national anti-pandemic urban and territorial plan. The objective of the paper is to present some proposals for the protection from Covid risk, with a flexible reorganization of the times, spaces of the city and the territory. The working methodology consists in the revision of procedures for the protection from seismic risks and their expansion and complexification for the protection from pandemic risk. Some summary results of the study concern suggestions for the search for a symbiosis between the city of concentration, peripheralization and diffusion with the introduction of flexible, temporary and variable uses. But the possibility of reducing socio-spatial inequalities in cities, regions and the Country can be pursued not only in the context of European Recovery Plan funding, but also with a thorough review of the tools for protecting against global risk. The conclusions show that, with the recurrence of "mutant" pandemics, the city abandons the certainty of a continuity, in alternating phases, of development, the stability of uses and times of use of the urban space, favored by the permanence of habits and forms of consolidated life, and it will become a transforming city, a two-faced city.

Keywords
Seismic risk and pandemic risk; Flexible, unstable, insecure cities; Symbiosis between centralized and widespread settlements.

How to cite item in APA format
Bedini, M.A. & Bronzini, F. (2022). The weapons of the city against pandemic assaults. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 533-542. http://dx.doi.org/10.6092/1970-9870/8886

1. The ongoing disciplinary debate: urban planning to rethink the times of the pandemic

The context of the study is the scenario of the cyclical spread of pandemic events that require a rethinking of the organization of the city and the regional territory in terms of flexibility of use of spaces, change in the times of use of the city, diffusion of equipment and economic activities on the territory, proximity services.
In the absence, in most of the current town planning tools, of elements concerning the prevention from seismic risk, it is useful to recall the disciplinary bases set in the last thirty years on the relationship between territorial systems and seismic vulnerability (Caldaretti et al., 1987), between future city and seismic protection (Fera, 1991), between vulnerability and urban space (Fabietti, 1999).
In the last two decades, some studies have been carried out on social resilience to national disasters (Pelling, 2003) and on vulnerability and adaptability to risks (Adger et al., 2004).
In a more recent disciplinary context, new investments and disciplinary attention to risk prevention and mitigation are required (Paleari, 2018).
In recent years, studies have been launched to address interactions between Covid-19 and environmental contexts (Paez et al., 2020) and to evaluate planning and geographical aspects related to the pandemic in Italy (Murgante et al., 2020) and to situations of aggravation of the spread of the virus caused by the presence of settlement densities (Hamidi et al., 2020). Different approaches to the health of the post-Covid city (Florida et al., 2021) have been used, even proposing methodologies to deepen the risk scenarios in Italy (Murgante et al., 2022) and to define actions and plan strategies (Capolongo et al., 2018). It also comes to the application of simulation tools to outline possible post-Covid scenarios in cities (Batty, 2022; Batty, 2021; Batty, 2020).
Of particular interest on the subject is what is presented in the special issue *Covid-19 vs City-20* of TeMA Journal, where an extensive editorial (Gargiulo, 2020) illustrates the contents of the volume, in which the effects of the pandemic Covid-19 in rural areas are described (De Luca et al., 2020). Flexible forms of planning are also investigated, adaptable to the spaces to be governed in the post Covid (Pontrandolfi, 2020).
Finally, health risk monitoring (Tiboni et al., 2020) and sustainable urban development solutions are proposed as a response to a dramatically urgent need (Tira, 2020a).
Ultimately, it is acknowledged that the spread of the pandemic is favored by high urban density, poverty and marginalization (Borjas, 2020; Balducci, 2020a). Hence the need to rethink dwelling in overall terms (Tarpino & Marson, 2020) and to combat social inequalities.
In the ongoing debate on the future dynamics of settlement choices, various instances invite us to seriously consider the negative impacts generated by the pandemic on the urban form and its relations with the territory (Sbetti, 2019) and to strongly re-propose the productive model of urban and rural space (Tarpino & Marson, 2020).
Consequently, while some opinions consider a flight from cities to the nuclei of inland areas to be foreseeable (Fuksas, 2020), other interpretations evaluate possible more moderate settlement reallocation solutions (Boeri, 2020; Spada, 2020). Furthermore, the city's ability to overcome disasters is acknowledged by resorting to forms of social solidarity (Indovina, 2020).
Therefore, on the one hand, the transformation of the villages spread over the territory into places of welcome for the population that temporarily moves away from urban centers and for the emigrants must be encouraged and, on the other hand, it must be avoided that they become *élite* environments (Barca, 2020).
Territorial planning must therefore seek new hierarchical relationships between polarizing areas, peripheral areas and internal areas, rejecting bad policies capable of accentuating, rather than reducing, inequalities (Barca, 2020).
In other words, it is essential to restore, in a fair way, social relations between densely populated and sparsely inhabited areas, between public and private areas (Pasqui, 2019), obtaining the important result of favoring

the supply of services to local communities (Clemente, 2020) and encouraging interpersonal relationships in the neighborhoods (Balducci, 2020a).

2. The objectives of the paper in line with the objectives of the European Union

The European Union has established some guiding objectives, which can be summarized in supporting an ecological transition, planned in time and space, which involves the enhancement and protection of the environment, the diffusion of green cities and the development of the green economy.
It is also recommended to mitigate the imbalances between centralized settlements and widespread settlements, decrease environmental risk, reform public administration with extensive reduction of bureaucracy and disseminate health services throughout the regional territory.
The paper pursues these objectives with specific reference to some unsolved issues of Urban Planning and Territorial Planning for the protection of pandemic risk.
Strategic lines are identified for a model of life different from the past, with an integration between centralized settlement systems and widespread systems related by efficient infrastructural networks.
An operational objective is the updating of some contents of the urban and territorial planning tools, made able to respond to the changing needs of securing from global risks.
The objectives pursued and the related programmatic proposals are obviously realistic only if supported by the Next Generation EU plan for relevant projects of international interest.

3. The methodology: from seismic to pandemic risks

The applied methodology starts from the consideration of the seismic risk structure (Fig.1) and introduces a conceptual extension related to the pandemic risk structure.

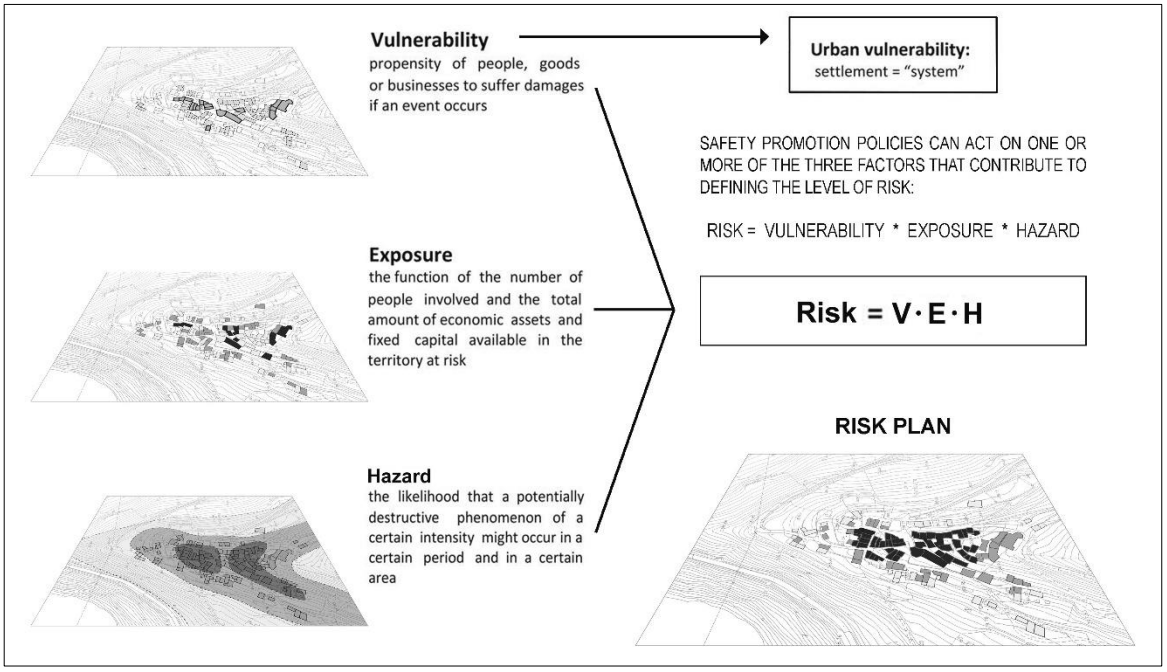


Fig.1 Structure of seismic risk (Tira, 2017). The risk measurement can be obtained as a sum of the contribution of the components of Vulnerability, Exposure, Hazard

Following the methodological path introduced here, the components of the seismic risk structure shown in the diagram of Fig. 1 can find a correspondence in the pandemic risk structure proposed in this work, where:

- vulnerability concerns the propensity (potentiality, territorial diffusion and level of the health structure at the service of the population, accessibility and social and economic organization) of the population of certain territorial and urban contexts to suffer greater or lesser damage in the event of a pandemic;
- the Exposition identifies the areas with greater or lesser densification of the population and of its productive activities and the strategic value of centralized or isolated settlements;
- The Danger is the probability of viruses to affect in certain periods and in certain different environmental and social contexts (for statistical, economic, technological reasons) such as the cities, the suburbs, the countryside.

The methodology introduced is developed by examining, first of all, some positive and negative results, found by authors in the prevention, emergency, and post-earthquake phases, that highlight the opportunity to plan the post-earthquake phase in advance, considering it a priority over the emergency phase (Bedini & Marinelli, 2021). This approach then introduces new and peculiar programmatic suggestions for preventive defense against pandemic risks (Bedini & Bronzini, 2019; Bedini & Bronzini, 2018).

If an earthquake breaks the fragile existing equilibrium of the territory and makes it necessary to rethink the model of life in centralized and widespread settlements, a pandemic instead overwhelms the pre-existing models and requires a radical transformation of the ways of life and work.

In any case, it must be considered that the awareness and acceptability of the impending dangers must be addressed from the perspective of the new hierarchy of risks: health, environmental, socio-economic.

The methodology of this study therefore firstly implements the shared disciplinary assumptions on the subject of seismic risks, suggesting then some contents to also plan a possible "coexistence" with pandemic risks and support social and economic recovery.

In this logic, an emergency plan, even a pandemic one, should not be launched in the absence of a preventive plan, life-saving defense tools and a contextual planning-management of the rebirth. In other words, each phase (preventive, emergency and post-crisis) must be planned in advance, consistently with the previous and subsequent phases. In any case, the management protocols should require the simultaneous implementation of emergency health plans and socio-economic regeneration plans.

To expand the concept of protection from seismic risk to pandemic risk, a method of comparing seismic risk with pandemic risk is prepared in relation to some strategic aspects (Plans for minimum urban structures, flexibility of urban spaces and times; mitigation of territorial imbalances, integration between city and country), able to highlight how the shared design elements of seismic protection can be integrated with pandemic protection elements. The specification of the related project suggestions, highlighted in the results achieved, is a further element of originality of the research.

4. Some early results

A first innovative result of this work can be summarized in the proposal to integrate the contents of the Minimum Urban Structure (SUM) (Bedini & Bronzini, 2021; Bedini et al., 2019), planned for protection from seismic risk, and to define a Minimum Urban Pandemic Structure (SUMP), at urban level and at territorial level, which prepares the minimum elements for protection from global risk.

In particular, in the SUMP proposed here at the urban level shall be identified: elements characterizing the areas of flexible zoning in normal conditions or in a state of pandemic emergency; structures to be used for widespread healthcare activities, including with the reactivation of deactivated hospitals, first aid and local clinics, school complexes with variable uses; squares and pedestrian paths with limited flows, with delimitation only of the usable areas in case of restrictions; widespread hotels to accommodate quarantined population; neighborhood health centers for the supply of tampons and vaccines; outdoor public areas for temporary use for catering, trade, etc.; urban containers of considerable size, to accommodate the population in conditions of protection and confidentiality.

In the SUMP at territorial level, proposed here, shall be identified and localized: equipped centers will be located to serve large areas, always easily accessible, in all weather conditions, to emergency vehicles; centers equipped with autonomous electric generators, telematic services, areas for the provision of health services, with places of isolation, etc.; platforms for air ambulances; disused school buildings and sports venues, deconsecrated churches, urban containers that can be used for mass vaccination; adequate rural buildings suitable for quarantine sites; private buildings that can be used as occasional residences; Covid free "islands" to safely accommodate teams of doctors and nurses.

In order to specify the advanced design suggestions for protection against pandemic risks, the shared positive results achieved for the mitigation of seismic risks are reviewed, as already anticipated in the methodology. Their usefulness and applicability is also verified in situations of viral spread.

a. Among the interventions for the mitigation of Vulnerability should be considered: a progressive adaptation of the times and the functional rhythms of the city (Zaoli, 2020; Bonfiglioli, 2013; Colarossi & Latini, 2008) to the changing needs for isolation of the population as a function of monitoring the evolution of the virus; the repositioning of public transport stops, the variation in their frequency and the change in the timetables of shops and public offices (Tira, 2020b), which allow a greater distancing of users in public transport in the event of an increase in the speed of contagion (Tira, 2020b); the planning of post-covid public mobility in big cities (Ravagnan, Cerasoli & Amato, 2022); the reconsideration of the relationships between mobility, urban space and health, paying particular attention to walking as a reference for sustainable mobility (Cirianni, Comi & Luongo, 2022); the organization of the city into human-sized neighborhoods (Balducci, 2020b), which also favors home health and social assistance and food supplies to the elderly and vulnerable people, their monitoring and their transport to medical facilities in the emergency situations, in case of contagion; the enhancement of slow mobility and the planning of flexible use (Monti, 2020) of urban areas, depending on the evolution of the emergency situation. In the event of pandemic, schools to be allocated to places of temporary isolation, or sports spaces to be used for the positioning of first aid, medical tents, vaccination hubs, etc., district plans with urban facilities that can be reached in 15 minutes (Abdelfattah et al., 2022; De Luca, 2020; Tira, 2020b), with particular attention, in the event of pandemic, to health and emergency services; identification of areas for epidemic prevention (Epidemic Prevention Area, EPA) (Wei, 2020); definitive overcoming of deterministic urban plans with the introduction of a flexible zoning, with variable uses, in situations of normality or in emergency conditions, at urban (Zaoli, 2020), municipal and vast area level, of particular interest in case of need to limit crowding to reduce infections; simplification of all urban planning bureaucratic procedures, of the modalities and times for drawing up plans (Tira, 2020b), in order to adapt to the speed of spread of pandemic events according to the monitoring of situations at risk; simplification of the approval process of urban planning and building practices to respond quickly to changing settlement needs, even temporary ones, with the drastic reduction of bureaucracy and the long waiting times of the public administration, with increased guarantees of efficiency, flexibility and equity.

   The choices to combat seismic damage clearly respond also to the needs of defense from viral spread, with the delimitation of "red zones", both within urban centers and vast areas, with different levels of protection and isolation / integration.

b. The protection against risks, both seismic and pandemic, related to the Exposure, due to residential and productive densification, involves a contrast to territorial imbalances. To this end, a timetable for an ecological and digital transition can be formalized, setting out the modalities, timing and funding for a substantial change in living, working and leisure conditions. A transition that connects centralized urban areas and widespread villages, with the implementation of broadband networks, energy control, the reorganization of the waste system and separate collection, the spread of slow mobility for the re-appropriation of historical and environmental values.

In situations of spread of contagion it is essential to define of a masterplan of vast area with identification of rural or urban-rural buildings for the quarantine of entire families, hotels with rooms for the isolation of individual members of family groups, small historical centers to be allocated to Covid free "islands", of maximum protection, equipped centers with high accessibility, places of irradiation and branching of the diffused services; local health and outpatient emergency services for home medical care, widespread school services.

Ultimately, modalities, times, financings, incentives must be codified for mitigating the imbalances between centralized settlements, peripheral areas and widespread settlements of the inland areas (Balducci, 2020a) at high environmental risk (Ventura & Tiboni, 2016) in order to transform the diffused settlements in attractive places in the periods of social distancing (Compagnucci, 2020) and of temporary migration from urban centers.

In pandemic emergency situations, thousands of rural buildings and small historic centers will be able to house the population, temporarily forced to move from centralized cities.

In this way it will be possible to create new forms of symbiosis between fragile areas and urban centers which will remain the engines of economic change.

c. In the context of seismic risk to counteract the Hazard is shared the need to give new new impetus to green production activities in internal areas (Bedini & Bronzini, 2021), such as the "Production Landscape" (Bedini & Marinelli, 2017; Abbasi, 2017), with a program of strategic incentives, the approach of Urban Agriculture (Torquati et al., 2015) and the agricultural park plans (Giacchè, 2014).

   Such a focus on the countryside as a place of life and work, to mitigate the potentiality and likelihood of the virus spreading, reinforces the urgency of implementing a new pact between city and countryside to relaunch the development and integration of resources, on the one hand widespread and underused, on the other centralized and consolidated (Bronzini & Bedini, 2015; Bedini & Bronzini, 2016). It is also a question of encouraging the dissemination of practices already tested for consultancy activities to local companies present in the places of diffusion, such as the "Itinerant University Chair of AgriCulture" (Giacchè, in press), services to credit assistance companies, home health professional activities for humans and animals. In this context there is support for quality production in the inland areas, for the provision of collective services to local businesses, for the promotion of highly qualified "itinerant" commercial services and activities.

   The same development of a "door to door" service system becomes indispensable in periods of lockdown. Of particular relevance are the home care by doctors and nurses in internal areas, the provision of basic necessities and assistance for carrying out medical and administrative procedures.

   With the repetition of pandemic cycles it is not possible to transcend the city-countryside pact and the strategy of the productive landscape considered here, since the dominant centralized social and productive model has shown all its limits and problems in situations of health risk.

5. Conclusions

Earthquakes and pandemics have profoundly changed the perception of security. Preventive risk protection must therefore be declined against both seismic instability and viruses that can affect body and mental health. In conclusion, this work comes to the following three innovative proposals:

a. The methodology for defining the seismic risk structure is implemented, expanding it with the elements of the pandemic risk structure related to Vulnerability, Exposure, Hazard.
b. New contents and design suggestions are specified, to be introduced for the protection and containment of the risk of pandemic spread, starting from some shared strategies related to the flexibility of the destinations of use, spaces and times of the city, to the enhancement of the human dimension of neighborhood, to the mitigation of territorial imbalances between centralized areas and scattered

settlements and between city and countryside, pursuing their symbiosis, indispensable in emergency situations.

c. A new type of operational plan "The minimum pandemic structure, SUMP" is introduced, at urban and territorial level, which integrates the SUM to pursue a protection from global risk. Reception systems are suggested in the thousands of villages scattered throughout the territory, for citizens fleeing from centralized areas in the event of a pandemic. Places where the cyclical need to avoid concentrations, both of people and of densely built spaces, can be conjugated with the precious environmental function performed by the areas of settlement spread.

In all cases of risk, unresolved endemic problems emerge: the rupture of the pre-existing space-time dimension, the anachronism between deterministic vision and dynamic conception of the rapidly evolving city, the planning of the future in conditions of uncertainty, the programming of flexible uses of spaces in urban plans as an alternative to static destinations of use.

Finally, it emerges that it is impossible to develop and apply risk protection instruments without overcoming territorial fragility and spatial-temporal inequalities, without revaluating the role of scattered settlements, in line with the driving function of the urban centres, placed in safe conditions.

This study started from the proposals of strategic lines for protection against seismic risk, suggested by the research itself and many other studies; it has developed with peculiar methodological and operational suggestions for the defence from pandemic risk, specifically presented in this paper; its future developments, already underway, concern theoretical and practical insights for the settlement protection from the danger of war, with the ultimate aim of defining an operational method of mitigation of global risk.

From the conclusive results it can be said that the pandemic will certainly leave an indelible mark on living conditions and will lead to the search for new tools to counter social, health and spatial inequalities and foster an indispensable symbiosis between settlements "protected", at high and low density, towards an uncertain, unstable, insecure future.

References

Abbasi, H.A. (2017). Productive Landscape. *Procedia Environmental Sciences*, *37*, 131-140. https://doi.org/10.1016/j.proenv.2017.03.029

Abdelfattah, L., Deponte, D. & Fossa, G. (2022). The 15-minute city as a hybrid model for Milan. *TeMA - Journal of Land Use, Mobility and Environment*, *special issue*, 71-86. http://dx.doi.org/10.6092/1970-9870/8653

Adger, W.N., Brooks, N., Kelly, M., Bentham, S. & Eriksen, S. (2004). New Indicators of Vulnerability and Adaptive Capacity. *Technical Report*, *7*, Tyndall Centre for Climate Change Research University of East Anglia, Norwich, UK.

Balducci, A. (2020a). I territori fragili di fronte al Covid. *Scienze del Territorio*, special issue Living the territories in the time of Covid, 169-176. https://doi.org/10.13128/sdt-12352

Balducci, A. (2020b). Come cambiano le città dopo la pandemia. In *28° Forum Scenari Immobiliari "Après le déluge"*, Santa Margherita Ligure, 11-12 September.

Barca, F. (2020). Ai territori serve progettualità, non sussidi e grandi opere. In: Pierro, L. & Scarpinato, M. (Eds.). *Intervista a tutto campo al coordinatore del Forum Disuguaglianze e Diversità: sviluppo locale, aree interne, redistribuzione di opportunità e accesso alla conoscenza, ruolo degli architetti e geopolitica mediterranea*. Retrieved from: https://ilgiornaledellarchitettura.com/2020/07/22/fabrizio-barca-ai-territori-serve-progettualita-non-sussidi-e-grandi-opere

Batty, M. (2022). The post-pandemic city: speculation through simulation. *Cities*, *124*, 1-18. https://doi.org/10.1016/j.cities.2022.103594

Batty, M. (2021). What Will The Post-Pandemic City Look Like? *Findings*, 1-6, June. https://doi.org/10.32866/001c.23581

Batty, M. (2020). The Coronavirus crisis: What will the post-pandemic city look like? *Environment and Planning B: Urban Analytics and City Science*, *47* (4), 547-552. https://doi.org/10.1177/2399808320926912

Bedini, M.A. & Bronzini, F. (2021). Priority in post-earthquake intervention. *Territorio*, *96*, 127-136. https://doi.org/10.3280/TR2021-096012

Bedini, M.A. & Marinelli, G. (2021). Project suggestions for post-earthquake interventions in Italy. From building reconstruction to the population resettlement. *TeMA - Journal of Land Use, Mobility and Environment*, *14*, 21-32. https://doi.org/10.6092/1970-9870/7568

Bedini, M.A. & Marinelli, G. (2017). The productive landscape as a driver for economic recovery. Diffused settlements and synergies between the agricultural-rural environment and the urban grid. In Aa. Vv. (Eds.). *Changes. Responsibility and tools for urban planning at the service of the Country*, 196-201, Rome-Milan: Planum Publisher.

Bedini, M.A. & Bronzini, F. (2019). Old and new paradigms in pre-earthquake prevention and post-earthquake regeneration of territories in crisis*. Archivio di Studi Urbani e Regionali*, *124*, 70-95. https://doi.org/10.3280/ASUR2019-124004

Bedini, M.A. & Bronzini, F. (2018). The post-earthquake experience in Italy. Difficulties and the possibility of planning the resurgence of the territories affected by earthquakes. *Land Use Policy*, *78*, 303-315. https://doi.org/10.1016/j.landusepol.2018.07.003

Bedini, M.A. & Bronzini, F. (2016). The New Territories of Urban Planning. The Issue of the Fringe Areas and Settlements. *Land Use Policy*, *57*, 130-138. https://doi.org/10.1016/j.landusepol.2016.05.020

Bronzini, F & Bedini, M.A. (2015). The City-countryside embrace. *Archivio di Studi Urbani e Regionali*, *112*, 60-76. https://doi.org/10.3280/ASUR2015-11200

Bedini, M.A., Bronzini, F. & Marinelli, G. (2019). Preservation and valorisation of small historical centres at risk. In C. Gargiulo, & C. Zoppi (Eds.). *Planning, Nature and Ecosystem Services*, 744-756, Napoli: FedOA Press. https://doi.org/10.6093/978-88-6887-054-6

Boeri, S. (2020). Coronavirus, Boeri: "Via dalle città, nei vecchi borghi c'è il nostro futuro". In B. Giovara (Ed.). *La Repubblica*, 20 April.

Bonfiglioli, S. (2013). Nuovi tempi e spazi di vita e nuovi desideri di libertà orientano il paradigma urbanistico per progettare la città contemporanea. In R. Sbetti, F. Rossi, M. Talia & C. Trillo (Eds.). *Il governo della città nella contemporaneità. La città come motore di sviluppo*, 359-361, Rome: Inu Publisher.

Borjas, G. J. (2020). Demographic determinants of testing incidence and Covid-19 infections in New York City Neighborhoods, *National Bureau of Economic Research*, Cambridge Mass Working Paper 26952. https://doi.org/10.3386/w26952. Retrieved from: http://www.nber.org/papers/w26952

Caldaretti, S., Fabietti, W. & Riggio, A. (1987). *La vulnerabilità sismica dei sistemi territoriali*. Rome: Dei Publisher.

Capolongo, S., Rebecchi, A., Dettori, M., Appolloni, L., Azara, A., Buffoli, M., Capasso, L., Casuccio, A., Oliveri Conti G., D'Amico, A., Ferrante, M., Moscato, U., Oberti, I., Paglione, L., Restivo, V. & D'Alessandro, D. (2018). Healthy Design and Urban Planning Strategies, Actions, and Policy to Achieve Salutogenic Cities. *International Journal of Environmental Research and Public Health*, *15* (2), 1-15. https://doi.org/10.3390/ijerph15122698

Cirianni, F.M.M., Comi, A. & Luongo, A.S. (2022). A sustainable approach for planning of urban pedestrian routes and footpaths in a pandemic scenario. Evidence from Italian cities. *Tema - Journal of Land Use, Mobility and Environment*, *15* (1), 125-140. http://dx.doi.org/10.6092/1970-9870/8629

Clemente, P. (2020). Piccoli paesi nell'ondata del virus. Resistenza, democrazia, comunità. *Scienze del Territorio*, special issue Living the territories in the time of Covid, 44-52. https://doi.org/10.13128/sdt-12331

Colarossi, P. & Latini, A.P. (2008) (Eds.)*. La progettazione urbana. Metodi e materiali*. Vol. 2. Milan: Il Sole 24 Ore.

Colarossi, P. & Lange, J. (1996) (Eds.). *Tutte le isole di pietra. Ritratti di città nella letteratura*. Rome: Gangemi Publisher.

Compagnucci, F. (2020). Covid-19, Aree Interne e Città. In F. Compagnucci, G. Urso & G. Morettini (Eds.). *Project Inner Areas.* https://doi.org/10.13140/RG.2.2.13545.52326

De Luca, G. (2020). Il ruolo dello spazio pubblico come risorsa antipandemica. In *Nuovi paradigmi urbani e abitativi per le città post pandemia*, Urbanpromo Green, Venice, 18 September.

De Luca, C., Tondelli, S. & Åberg, H.E. (2020). The Covid-19 pandemic effects in rural areas. Turning challenges into opportunities for rural regeneration. *TeMA - Journal of Land Use, Mobility and Environment*, special issue Covid-19 vs City-20, *1*, 119-132. https://doi.org/10.6092/1970-9870/6844

De Rossi, A. (2020). Viaggio nell'Italia dell'emergenza/13. Aree interne e montane, gli atouts da giocare. In *Il Mulino*, 21 April. Retrieved from: https://www.rivistailmulino.it/news/newsitem/index/Item/News:NEWS_ITEM:5169

Fabietti, W. (1999) (Ed.). *Vulnerabilità e trasformazione dello spazio urbano*. Firenze: Alinea Publisher.

Fera, G. (1991). *La città antisismica. Storia, strumenti e prospettive per la riduzione del rischio sismico*. Roma: Gangemi Publisher.

Florida, R., Rodríguez-Pose, A. & Storper, M. (2021). Cities in a post-COVID world. *Urban Studies*, 1-23. https://doi.org/10.1177/00420980211018072

Fuksas, M. (2020). Coronavirus, Fuksas: "Ridisegnare lo spazio vitale nella casa post Covid". In F. Merlo (Ed.). *La Repubblica*, 18 April.

Gargiulo, C. (2020). Editorial Preface. *TeMA - Journal of Land Use, Mobility and Environment*, special issue Covid-19 vs City-20, *1*, 5-8. https://doi.org/10.6092/1970-9870/6985

Giacchè, G. (2014). L'expérience des parcs agricoles en Italie et en Espagna: vers un outil de projet et de gouvernance de l'agriculture en zone périurbaine. In S. Lardon & S. Loudiyi (Eds.). *Agriculture urbaine et alimentation: entre politiques publiques et initiatives locales*. *Revue Géocarrefour*, *89* (1-2), 21-30. https://doi.org/10.4000/geocarrefour.9372

Giacchè, L. (in press). *Cattedra Ambulante di AgriCultura della Valnerina*, Norcia.

Hamidi, S., Sabouri, S. & Ewing, R. (2020). Does density aggravate the COVID-19 pandemic? Early findings and lessons for planners. *Journal of the American Planning Association*, *86* (4), 495-509. https://doi.org/10.1080/01944363.2020.1777891

Indovina, F. (2020). La città dopo il coronavirus. *Archivio di Studi Urbani e Regionali*, *128*, 5-10. https://doi.org/10.3280/ASUR2020-128001

Monti, C. (2020). Oltre la città razionalista: nuove prospettive e nuovi modelli urbani per il post pandemia. In *Ingenio. Informazione tecnica e progettuale*. Retrieved from: https://www.ingenio-web.it/29185-oltre-la-citta-razionalista-nuove-prospettive-e-nuovi-modelli-urbani-per-il-post-pandemia

Murgante, B., Balletto, G., Borruso G., Saganeiti, L., Pilogallo, A., Scorza, F., Castiglia, P., Arghittu, A. & Dettori, M. (2022). A methodological proposal to evaluate the health hazard scenario from COVID-19 in Italy. *Environmental Research*, *209*, 1-12. https://doi.org/10.1016/j.envres.2022.112873

Murgante, B., Borruso, G., Balletto, G., Castiglia, P. & Dettori, M. (2020). Why Italy First? Health, Geographical and Planning Aspects of the COVID-19 Outbreak. *Sustainability*, *12* (12), 1-44. https://doi.org/10.3390/su12125064

Paez, A., Lopez, F.A., Menezes, T., Cavalcanti, R. & Galdino Da Rocha Pitta M. (2020). A spatio-temporal analysis of the environmental correlates of COVID-19 incidence in Spain. *Geographical Analysis*, *53* (3), 397-421. https://doi.org/10.1111/gean.12241

Paleari, S. (2018). Natural disasters in Italy: do we invest enough in risk prevention and mitigation? *International Journal of Environment Studies*, *75* (4), 673-687. https://doi.org/10.1080/00207233.2017.1418995

Pasqui, G. (2019). Il territorio al centro. *Urbanistica Informazioni*, *287-288*, 10-11. Rome: Inu Publisher.

Pelling, M. (2003). *The Vulnerability of Cities: Natural Disasters and Social Resilience*. London: Earthscan Publications.

Pontrandolfi, P. (2020). Physical spacing and spatial planning. New territorial geographied and renewed urban regeneration policies. *TeMA - Journal of Land Use, Mobility and Environment*, special issue Covid-19 vs City-20, *1*, 315-326. https://doi.org/10.6092/1970-9870/6854.

Ravagnan, C., Cerasoli, M. & Amato, C. (2022). Post-Covid cities and mobility. *TeMA - Journal of Land Use, Mobility and Environment*, *15*, 87-100. http://doi.org/10.6093/1970-9870/8652

Sbetti, F. (2019). Spazio e tempo. *Urbanistica Informazioni*, *287-288*, 3-4. Rome: Inu Publisher.

Spada, M. (2020). I virus passano le città restano. Urbanistica *Informazioni*, *287-288*, 36-37. Rome: Inu Publisher.

Tarpino, A. & Marson, A. (2020). Dalla crisi pandemica il ritorno ai territori. *Scienze del Territorio*, special issue Living the territories in the time of Covid, 6-12. https://doi.org/10.13128/sdt-12369

Tiboni, M., Pezzagno, M., Vetturi, D., Alexander, C. & Botticini, F. (2020). Data analysis and mapping for monitoring health risk. What has the spread of the Covid-19 pandemic in northern Italy taught us? *TeMA - Journal of Land Use, Mobility and Environment*, special issue Covid-19 vs City-20, *1*, 343-360. https://doi.org/10.6092/1970-9870/6899

Tira, M. (2020a). About the Sustainability of Urban Settlements. A first reflection on the correlation between the spread of Covid-19 and the regional average population density in Italy. *TeMA - Journal of Land Use, Mobility and Environment*, special issue Covid-19 vs City-20, *1*, 361-371. https://doi.org/10.6092/1970-9870/6984.

Tira, M. (2020b). La pandemia come volano per il ripopolamento dei centri rurali? In C. Samorì (Ed.). *Ingenio. Informazione tecnica e progettuale*. Retrieved from: https://www.ingenio-web.it/28124-la-pandemia-come-volano-per-il ripopolamento-dei-centri-rurali

Tira, M. (2017). Pianificazione urbanistica e mitigazione del rischio. Lesson held at the *Master Città e Territorio. Strategie e Strumenti Innovativi per la Protezione dal Rischio dei Territori in Crisi*. Camerino, july.

Torquati, B., Giacchè, G. & Venanzi, S. (2015). Economic Analysis of the Traditional Cultural Vineyard Landscapes in Italy. *Journal of Rural Studies*, *39*, 122-132. https://doi.org/10.1016/j.jrurstud.2015.03.013

Ventura, P. & Tiboni, M. (2016). Politiche di sviluppo sostenibile per comunità urbane minori svantaggiate e conservazione del patrimonio naturale e culturale. In F. Rotondo, F. Selicato, V. Marin & J. López Galdeano (Eds.). *Cultural Territorial Systems. Paesaggio e patrimonio culturale come chiave per lo sviluppo sostenibile e locale nell'Europa orientale*, 29-49, Switzerland: Springer International Publishing, ISBN 978-3-319-20752-0. https://doi.org/10.1007/978-3-319-20753-7

Wei, D. (2020). Urban Function-Spatial Response Strategy for the Epidemic. A Concise Manual on Urban Emergency Management, 18 March. Retrieved from: https://www.ovpm.org/wp-content/uploads/2020/03/covid-19icomos-china.pdf

Zaoli, M. (2020). L'urbanistica oltre l'emergenza del Covid 19: una città resiliente condivisa responsabile inclusiva. In Blog Urbanistica Inu. Retrieved from: https://www.inu.it/assets/doc/urbanistica-e-covid-19-marco-zaoli.pdf

Author's profile

Maria Angela Bedini

Associate Professor of Urban and Territorial Planning at the Department Simau, Faculty of Engineering, Polytechnic University of Marche where she teaches Urban Planning Technique and Urban Recovery. She has published numerous studies on Italian Urban Plans, City, Pre-earthquake prevention and post-earthquake regeneration of territories in crisis, New Territories of Urban Planning.

Fabio Bronzini

Full Professor out of role of Urban and Territorial Planning, Faculty of Engineering, Polytechnic University of Marche. He has published numerous articles in international journals on Innovative strategies and tools for risk protection areas in crisis and volumes, in several languages, on the beauty of the city and the territory.

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 543-547
print ISSN 1970-9889, e-ISSN 1970-9870
10.6092/1970-9870/9410
Received 26th September 2022, Available online 30th December 2022

www.TeMA.unina.it

REVIEW NOTES – Urban planning literature review

Climate adaptation in the Mediterranean: storms and droughts

Carmen Guida [a*], Stella Pennino [b]

[a] Department of Civil, Architectural and Environmental Engineering
University of Naples Federico II, Naples, Italy
e-mail: carmen.guida@unina.it
ORCID: https://orcid.org/0000-0002-8379-7793
*Corresponding author

[b] Department of Civil, Architectural and Environmental Engineering
University of Naples Federico II, Naples, Italy
e-mail: ste.pennino@studenti.unina.it

Abstract

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always remaining in the groove of rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is the expression of a continuous updating of emerging topics concerning relationships between urban planning, mobility and environment, through a collection of short scientific papers written by young researchers. The Review Notes are made of four parts. Each section examines a specific aspect of the broader information storage within the main interests of TeMA Journal.
In particular, the Urban planning literature review section aims at presenting recent books and journals, within global scientific panorama, on selected topics and issues.
This contribution aims at delving into the most severe effects due to storms and droughts and presenting three interesting and significant scientific books and journal that present effective adaptation strategies to limit climate crisis and improve Mediterranean resilience towards more frequent and severe storm surges and droughts. The third contribution of the Review Notes for TeMA vo. 15 highlights the need for integrated action to address the climate crisis in the Mediterranean region, bringing together the strengths and weaknesses of its shores, despite social, economic and political differences. Moreover, the extreme weather events that are occurring throughout Europe, from the south to the north, show how the Mediterranean area is particularly sensitive to climate change-related events.

Keywords

Climate Change; Floods; Droughts; Mediterranean.

How to cite item in APA format

Guida, C., & Pennino, S. (2022). Climate adaptation in the Mediterranean: storms and droughts. *TeMA. Journal of Land Use, Mobility and Environment*, *15* (3), 543-547. http://dx.doi.org/10.6092/1970-9870/9410

1. Introduction

When it's time to sum up the achievements, facts and data for the end of the year, climate change and its dynamics must not be saved. The 2022 year seems to have collected several unfortunate records on that side. According to NASA, planet Earth just experienced one of its warmest years on record. Hot weather baked the globe, with Europe and China both recording their warmest meteorological summers and poorest rain seasons. In particular, no continent is experiencing hot weather (and related climatic and meteorological phenomena) as Europe. Although a significant reduction of greenhouse gases emission has been recorded, average temperatures increased at double pace than global average. After a slight increase during 2021, accomplice the post-pandemic economic recovery, equivalent CO_2 emissions decreased about 5%, on average, compared to the emissions of the previous year. This issue was definitely influenced by Ukraine-Russian war and consequent energy crisis that produced, as effects, a general decrease of carbon consumptions, domestic and industrial, and ongoing transitions to renewable energy sources.

The knowledge frame outlined so far about Mediterranean cities and their exposition and vulnerability to cope with climate change effects justify the recently published remarks of MedECC (Mediterranean Experts on Climate and Environmental Change) report, which states that, with more that 500 million inhabitants, Mediterranean cities are the second most affected region, after the Artic (Miranda et al., 2020). For what concerns the focus of this issue, different climatic scenarios agree that, by 2050, Mediterranean cities will experience a reduction of 10% of water sources, which will result in a more precarious food security. Predictive models compute an increase in intensity and frequency of climatic extreme events: droughts and floods are on the top of the list, as also shown by the unfortunate events recorded during 2022 (Gargiulo & Lombardi, 2016; Amponsah et al., 2020; World Meteorological Organization, 2022). Long-term projections are even more dramatic: by 2100, with an expected increase of temperature close to 6°C, increases of 20% reduction of rainfalls and 100% of land interested by wildfires are foreseen. Although the conclusions produced by different climatic models may differ a lot, nearly all of them agree that the Mediterranean region would suffer of an intense desertification process, due to a decrease of rainfall precipitations close to 40% in some areas, especially during winter seasons. Climate changes would generally produce a temperature increase but, unlike in other regions, where warming will result in more frequent storms, for Mediterranean coastal cities there will be an exception to the rule. But no exception seems to occur when it comes to recorded climatic data for cities that have already been experiencing water shortage for years (Bucchignani et al., 2018). In fact, the numbers summed up in this contribution will worsen the already critical water deficit, also due to pollution, poor management of resources and significant population increase. Water and related urban systems play a key role migrating impacts of climate change to local economies and societies. In fact, international scientific literature agrees that urban vulnerability to such phenomena is closely connected to socio-economic conditions of interested areas. Also floods, surges and storms, that would be more intense and frequent, will provoke further damages to water networks and storage infrastructures, unlike what has been commonly thought (Balaban & Şenol Balaban, 2015). The Urban Planning Literature Review section of Review Notes for TeMA Journal vol. 15 focuses on the effects of climate change-related phenomena for Mediterranean coastal cities, as hot-spot case studies in terms of exposure, vulnerability and resilience. The first two issues presented the main features, strengths and weaknesses of mare nostrum cities in their ability to cope with global warming and extreme natural events. In particular, the second contribution highlighted the impact of extreme heat waves on urban environments. As undeniable consequence of global warming, this current review note concerns the effect and storms and droughts for Mediterranean cities, through a review of the scientific literature and three interesting and recent books and reports.

For this issue, two books and a report, recently published, have been investigated. The first two books concern the development of adaptation strategies to floods and drought. Their approach to the matter is holistic and they both promote the integration of adaptation solutions from different points of view. The latter is a technical

report, developed and published by C40 to increase awareness among policy-makers and professionals and disseminate knowledge about potential solutions and interventions, according to 2050 scenarios.

2. Approaches to adapt cities to storms and droughts

Plans and strategies designed to improve water management and reduce flood and drought-related risks often focus on technological issues (hydraulic or grey engineering). Such approach ignores all environmental, ecological, socioeconomic and political features that significantly influence the impacts of extreme climatic events, as well as the vulnerability of threatened communities. Given that it is not possible to fully control the occurrence of these events, stakeholders, decision-makers, entrepreneurs and citizens should focus their resources on increasing the resilience of the cities where they live (Tulisi, 2017). The management of urban floods and drought events has directly and explicitly to do with the supply of drinkable water, with the disposal of sewage, controlling the quantity of rainfall and the effects of precipitations of water quality.

Given the complexity of urban systems and the multitude of physical and functional elements upon which these phenomena have effects, the design of integrated plans and strategies to mitigate and adapt cities sounds a necessary action. In this regard, the World Meteorological Organization (WMO) identified four possible approaches in order to design good practices of resilience and adaptation and to integrate them in urban planning tools (2012).

The first approach is hazard-based and focuses on the physical, infrastructure and technology features of urban environment in order to manage floods and eventual water shortage, in case of extended droughts. Climate adaptation of cities through this approach means matching the design features and the management and disposal capabilities to actual rainfall. Critical infrastructure may be reinforced or suitably sized in order to satisfy changing requisites. In case improving interventions are not possible or not economically convenient, adaptive non structural elements may be integrated, as a mean to reduce even residual risks.

A second approach, based on vulnerability, encourages to limit the vulnerability of exposed population, taking into account economic activities and development degree of urban areas (Papa et al., 2014).

The vulnerability-based approach involves limiting the vulnerabilities of the affected population by considering the economic activities and degree of development of the areas, the intensity and frequency of flooding or drought events, land consumption, and the expected impacts on the development of activities and community demand for essential resources.

Vulnerability conditions can be improved through economic development strategies that are generally outside the scope of flood management policies and plans.

The second, policy-based approach is structured around the following principles (WMO, 2009):

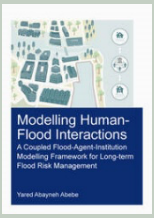
- adaptation to short-term climate change is a starting point for reducing long-term vulnerability to global warming;
- adaptation policies and measures are best evaluated in a development context;
- the adaptation strategy and the process through which it is implemented are equally important.

This approach focuses on long-term development at the national and regional scale, focusing on economic and financial planning, education, health, agriculture, food and environmental security, which are the basis for targeted action at the local (urban) level through the involvement of social groups, civil society, organisations and individuals.

The adaptive approach focuses on the overall capacity of communities to adapt to and be resilient to extreme and sudden weather events and longer-term adverse trends. This capacity is highly dependent on improving and sharing knowledge about climate change, its effects and the adaptation of human settlements to such phenomena, creating better forecasting and early warning capabilities, and generally improving the socio-economic level of the population.

Over the last decade, several cities around the world have been working to implement plans to integrate knowledge, technological and engineering innovations, economic and financial strategies to make their urban contexts more resilient, with the aim of mitigating the phenomena related to global warming, but above all to adapt their built and unbuilt spaces to its irreversible and inevitable impacts.

Modelling Human-Flood Interactions



Authors/Editors: Yared Abayneh Abebe
Publisher: Routledge
Publication year: 2021
ISBN code: 9780367748869

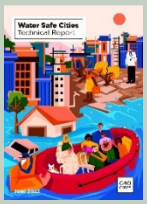
The negative impacts of floods are attributed to the extent and magnitude of a flood hazard, and the vulnerability and exposure of natural and human elements. In flood risk management (FRM) studies, it is crucial to model the interaction between human and flood subsystems across multiple spatial, temporal and organizational scales. Models should address the heterogeneity that exists within the human subsystem, and incorporate institutions that shape the behaviour of individuals. Hence, the main objectives of the dissertation are to develop a modelling framework and a methodology to build holistic models for FRM, and to assess how coupled human-flood interaction models support FRM policy analysis and decision-making.
To achieve the objectives, the study introduces the Coupled fLood-Agent-Institution Modelling framework (CLAIM). CLAIM integrates actors, institutions, the urban environment, hydrologic and hydrodynamic processes and external factors, which affect FRM activities. The framework draws on the complex system perspective and conceptualizes the interaction of floods, humans and their environment as drivers of flood hazard, vulnerability and exposure. The human and flood subsystems are modelled using agent-based models and hydrodynamic models, respectively. The two models are dynamically coupled to understand human-flood interactions and to investigate the effect of institutions on FRM policy analysis.

Investing in Disaster Risk Reduction for Resilience

Authors/Editors: A. Nuno Martins, Gonzalo Lizarralde, Temitope Egbelakin, Liliane Hobeica, Jose Mendes, Adib Hobeica
Publisher: Elsevier
Publication year: 2022
ISBN code: 9780128186398

Disaster prevention and the mitigation of climate change effects call for global action. Joint efforts are required among countries, economic sectors, and public and private stakeholders. Not surprisingly, international organizations, such as the United Nations agencies, propose policy frameworks aimed at worldwide influence. The 2015–2030 Sendai Framework seeks to create consensus about the need to act for disaster risk reduction and climate adaptation. A key goal is to promote investments in risk reduction and resilience. But how useful is this policy framework? What does it say, and what does it overlook? How can it be implemented among vulnerable communities, in historic sites, and in other sensitive locations affected by disasters?
In this book, prominent scholars and practitioners examine the successes and failures of the Sendai Framework. Their case studies show that, despite its good intentions, the Framework achieves very little. The main reason is that, while avoiding a political engagement, it fails to deal with disasters' root causes and guide the difficult path of effective implementation.The authors bring a fresh look to international policy and design practices, highlighting cross-disciplinary research avenues, and ideas and methods for low-income communities, cities and heritage sites in Portugal, Haiti, the United States, the Philippines, New Zealand, Sri Lanka, Nigeria, among other countries.Global action requires collaboration between heterogeneous stakeholders, but also the recognition of inequalities, power imbalances, and social and environmental injustices.

Water Safe City



Editors-in-Chief: C40
Publisher: C40 Knowledge Hub
Publication year: 2022
Website: https://www.c40knowledgehub.org/s/article/Water-Safe-Cities?language=en_US

This report from C40's Water Safe Cities programme shines a light on the likely impact of flooding and drought by 2050, focusing on the 97 cities in C40's membership. The research finds that, without urgent action, millions more people face grave risks from frequent and severe flooding and drought, as well as significant economic, health and social impacts. If global warming continues unabated, 7.4 million people in C40 member cities alone will be exposed to severe river flooding within the next three decades, with damages expected to cost $64 billion per year by 2050 – even with current levels of global flood protections in place. The results are indicative of likely climate change impacts for countless more cities around the globe.

References

Abebe, Y. A. (2021). *Modelling Human-Flood Interactions*. Routledge, London. ISBN code: 9780367748869

Amponsah, W., Marra, F., Marchi, L., Roux, H., Braud, I., & Borga, M. (2020). Objective analysis of envelope curves for peak floods of European and Mediterranean flash floods. In *Climate Change, Hazards and Adaptation Options* (pp. 267-276). Springer, Cham. https://doi.org/10.1007/978-3-030-37425-9_14

Balaban, O., & Şenol Balaban, M. (2015). Adaptation to Climate Change: Barriers in the Turkish Local Context. *TeMA - Journal of Land Use, Mobility and Environment*, 7-22. https://doi.org/10.6092/1970-9870/3650

Bucchignani, E., Mercogliano, P., Panitz, H. J., & Montesarchio, M. (2018). Climate change projections for the Middle East–North Africa domain with COSMO-CLM at different spatial resolutions. *Advances in Climate Change Research, 9*(1), 66-80. https://doi.org/10.1016/j.accre.2018.01.004

Errigo, M. F. (2018). The Adapting city. Resilience through water design in Rotterdam. *TeMA Journal of Land Use, Mobility and Environment, 11*(1), 51-64. https://doi.org/10.6092/1970-9870/5402

Gargiulo C., & Lombardi C. (2016). Urban Retrofit and Resilience: the Challenge of Energy Efficiency and Vulnerability. *TeMA - Journal of Land Use, Mobility and Environment, 9*(2), 137-162. https://doi.org/10.6092/1970-9870/3922

Miranda, A., Lara, A., Altamirano, A., Di Bella, C., González, M. E., & Camarero, J. J. (2020). Forest browning trends in response to drought in a highly threatened mediterranean landscape of South America. *Ecological Indicators*, 115, 106401. https://doi.org/10.1016/j.ecolind.2020.106401

Nuno, M. A., Lizarralde, G., Egbelakin, T., Hobeica, L., Mendes, J. M., Hobeica, A. (2022). (Edts) Investing in Disaster Risk Reduction for Resilience, Elsevier. ISBN 9780128186398. https://doi.org/10.1016/B978-0-12-818639-8.00002-8

Papa R., Gargiulo C., & Zucaro F. (2014). Urban Systems and Energy Consumptions: A Critical Approach. *TeMA - Journal of Land Use, Mobility and Environment.* https://doi.org/10.6092/1970-9870/2552

Tulisi, A. (2017). Urban Green Network Design: Defining green network from an urban planning perspective. *TeMA - Journal of Land Use, Mobility and Environment, 10*(2), 179-192. https://doi.org/10.6092/1970-9870/5156

World Meteorological Organization (2022). State of the Global Climate 2021.

World Meteorological Organization (2012). The Global Framework for Climate Services - *Innovation and Adaptation. Bulletin* 61 (2) – 2012. Retrieved from: https://public.wmo.int/en/resources/bulletin/

Author's profile

Carmen Guida

She is an engineer, Ph.D. in Civil Systems Engineering and Postdoctoral Researcher at Department of Civil, Architectural and Environmental Engineering of University of Naples Federico II. Her research activities concern adaptation of urban environment to climate change-relates hazards and accessibility to urban services for elderly people, with the aim of minimising social exclusion and inequalities within urban areas.

Stella Pennino

She is a master's degree student in Building Engineering – Architecture at the Department of Civil, Architectural and Environmental Engineering of the University of Naples Federico II.

We are online!

TeMA Lab

Follow us on Twitter

TeMA Lab and our Journal are finally on Twitter!
TeMA Lab is the Laboratory of Land Use, Mobility and Environment of the Department of Civil, Building and Environmental Engineering, at Università degli Studi di Napoli Federico II. Our field of expertise relates to urban systems, their complexity and the challenges that they will face in near future: adaptation to climate change, ageing population, energy consumptions, development of sustainable mobility and so on. Follow us to be constanly updated!.

www.twitter.com/TeMALab_unina

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 549-553
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9413
Received 28th September 2022, Available online 30th December 2022

www.tema.unina.it

REVIEW NOTES – Town planning international rules and legislation

Accelerate urban sustainability through policies and practices on the mobility system in Italy

Federica Gaglione [a]*, David Ania Ayiine-Etigo [b]

[a] Department Engineering
University Sannio, Benevento, Italy
e-mail: fgaglione@unisannio.it
ORCID: https://orcid.org/0000-0002-7067-7784
* Corresponding author

[b] Department of Geography and Environment, School of Geosciences, University of Aberdeen,
e-mail: d.ayiine-etigo@abdn.ac.uk
ORCID: https://orcid.org/0000-0003-3593-9889

Abstract

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always following a rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is a continuous update about emerging topics concerning relationships among urban planning, mobility, and environment, thanks to a collection of short scientific papers written by young researchers. The Review Notes are made up of five parts. Each section examines a specific aspect of the broader information storage within the main interests of the TeMA Journal. In particular: the Town Planning International Rules and Legislation. Section aims at presenting the latest updates in the territorial and urban legislative sphere. The current challenges that today's cities have to face, from climate change to environmental and social ones, have led to urban planning being accompanied by the mobility system from a sustainable point of view. In turn, sustainable mobility constitutes that important link in the chain of development of cities. In this direction, the contribution explores in the first part how the scientific community is addressing the issue of sustainable mobility and what the new paradigms are, however, in the second part it focuses on the urban policies issued by the Italian government.

Keywords

Urban sustainability; Sustainable mobility; European policy; Urban agenda; Sustainable Development Goals.

How to cite item in APA format

Gaglione, F., & Ayiine-Etigo, D. A. (2022). Accelerate urban sustainability through policies and practices on the mobility system in Italy. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 549-553. http://dx.doi.org/10.6092/1970-9870/9413

1. Towards urban sustainability mobility

Rapid urbanization in many cases unplanned combined with population growth and its relative aging are problems felt in much of the world (Cobbinah et al., 2022). In the latest reports issued by the United Nations, more than half of the world's people live in urban centers, with expectations of further growth in the future (Lu et al., 2021). This has led to spatio-temporal inequalities between travel needs and requirements and transport infrastructures which has had significant consequences on cities such as traffic congestion, road accidents, air and noise pollution, inefficient energy consumption and finally and most importantly, the impacts on people's general standard of living (Kiba-Janiak & Witkowski, 2019). At European level, urban traffic contributes around 40% of CO2 emissions and 70% of emissions of other pollutants from road transport. In detail, Italy emits about 23% of total greenhouse gas emissions from road transport (of which about 60% attributable to cars), nitrogen oxide emissions for about 50% and particulate emissions for about 13% (Ispra, 2017). These data highlight the need to plan and improve the urban mobility system from a strategic point of view in relation to the urban layout of cities in order to achieve sustainable development objectives. Transport-territory integration has undergone a strong evolution over the years (Wegener, 2021). In the early 1980s, in many urban communities, the most common primary mode of travel was the private car. Consequences also related to a lack of encouragement, coordination and alignment between transport planning and urban planning (Silva et al., 2017). The current challenges that cities are facing such as climate, environmental, social and economic change have overturned the paradigm of urban planning of the mobility system, accompanying it from a sustainable perspective. Just think of Agenda 2030, which has identified the important link in the chain of sustainable development of cities precisely in the sector of urban transport planning. The ever more overwhelming emergence in the scientific and political debate of a will to favor sustainable mobility combined with "intelligent mobility" has provided researchers and policymakers with new ways to understand and plan cities (Yigitcanlar & Kamruzzaman, 2020).Today, sustainable mobility is becoming a new theoretical paradigm that introduces an alternative approach to conventional transport planning. Following this new paradigm, people are at the center of the planning objective; therefore, integrated actions must be implemented to encourage modal shift in the transport system and to reduce the need to travel (Gehl, 2013). In recent years there has been an intense discussion in the literature on various issues related to future mobility and the future of public transport. Most of the studies focus on trying to promote sustainable mobility through the use of new technologies, while other similar research topics outline a completely fragmented picture of possible future perspectives and practices related to future urban mobility and public transport (Porru et al., 2020). Some studies like Sahu et al.2021; Langford et al., 2021, have tried to develop methodologies based on spatial analysis in a GIS environment to define the levels of accessibility to urban services through rail and road transport. Other studies, on the other hand, have focused on examining how to optimize the times needed to reach a given service based on the user's travel behavior inferred from sample surveys relating to current preferences, constraints and behaviors and the topological characteristics of the network and the quality of the service offered (Wong et al., 2017). Understanding these mobility patterns can help establish effective and appropriate public transport policy measures to improve user mobility. In turn, today the scientific debate is strongly focused on the study of "soft" mobility networks on an urban and neighborhood scale in relation to the built environment and the shape of urban fabrics (Gaglione et al., 2022). In particular, the studies investigate the physical characteristics related to geometry such as the width of sidewalks and road crossings, etc., environmental characteristics related to urban furniture elements, such as lighting and functional characteristics related to the location of urban services in order to understand the significance of each feature and understand how and where to improve and design "soft" mobility networks (Alattar et al., 2021). Last year's events related to the pandemic forcefully re-proposed the experimentation of a city model based on soft mobility networks enclosed under the 15-minute city model (Calafiore et al., 2022). The 15-minute city relies on traffic containment, the provision of safe and pleasant spaces for walking

and cycling, as well as the implementation of quality public transport at affordable prices, are the main lines of defense of the city. This has forced changes in the use of urban spaces and routes, to reach and use services as close to home as possible, requiring short distance travel only in the immediate area around the homes, and has helped to raise the "walking appeal", which has been the subject of study within the scientific community and political-institutional spheres for some years. The scientific progress made so far in trying to propose methods of analysis, scenarios and intervention solutions all converge in a single supply chain that can be enclosed in "smart mobility". The real criticality emerges in the fact that cutting-edge methods, models and technologies should coordinate to favour an integrated planning process. In turn, there is now a lack of political leadership support for meaningful decision-making on urban mobility. While on the one hand the scientific community is trying to make progress in the field of research, also political institutions such as the European Union are trying to propose locally decided and implemented solutions to shape a new culture of urban mobility. In particular, the European Commission has tried to strongly support local decision-makers especially in terms of resources in order to aim for a type of competitive and efficient urban mobility in terms of resources. Some valid examples can be found in the projects funded under the European Framework Program for Research and Innovation Horizon 2020 by the European Community such as CIVITAS aimed at bringing the latest innovations of European research on urban mobility into cities through coordination mechanisms and exchange between projects. In the meantime, numerous strategic documents have been adopted which also constitute a guide for local authorities for the definition of guidelines and strategies to be implemented in the field of urban mobility such as the White Paper: roadmap towards a single European transport area: towards a competitive and resource-efficient transport system; Green Paper: Towards a new culture for urban mobility; Action Plan on Urban Mobility; and a European strategy for low-emission mobility. These are just some proposed documents. Projects and strategic documents should encourage local governments to develop and implement a SUMP to decrease dependence on individual private transport. In turn, the theme of sustainable mobility is also one of the missions of the recovery and resilience plans after the pandemic crisis. In the light of these premises, the document focuses on the latest reports approved and issued by the Italian government or Urban Agenda of the Ministry of Infrastructure and Sustainable Mobility where cities are at the center of the action and on investments, programs and innovation of sustainable mobility in metropolitan cities.

National urban agenda for sustainable development

One of the latest documents issued in the field of urban policies, in turn approved in October 2022, aims to define a strategic framework to guide the policies under the responsibility of the Ministry of Infrastructure and Sustainable Mobility (Mims). The document puts cities at the center of attention. This is in turn demonstrated by the huge resources allocated to urban policies deriving from the National Recovery and Resilience Plan (Pnrr) and the Complementary National Plan (Pnc)". Above all, the document provides methods and devices to contribute to the definition of the national Urban Agenda for Sustainable Development, pursuant to the mandate of the Interministerial Committee for Urban Policies (CIPU). The drafting of the document took place through a pool of urban policy experts set up at the Mims, which proposed concrete actions and programs in line with the objectives of the 2030 Agenda. The Urban Agenda stands as a tool for dynamic policy guidance of the Ministry aimed at cities, a theme on which, with a view to complementarity, other documents on issues relating to urban policies have also recently been produced. In its first part, the Urban Agenda defines a methodology aimed at achieving the Sustainable Development Goals of the UN 2030 Agenda, however, in the second part, the operational and governance tools useful for sustainable urban development are examined. For each action envisaged in the Agenda, the 2022-2036 budget allocations and the resources of the PNRR and the Complementary National Plan have been identified. Linking them to the 17 objectives of the 2030 Agenda and to 27 quantitative objectives linked to European Union or national strategies and plans. The document sets several objectives related to public infrastructures and logistics that strategic planning of sector and road and highway systems in order to develop quality, reliable, sustainable and resilient infrastructures. In particular, among the various proposals, it aims at the territorial scale for the development and safety

of air transport through the modal integration between air, rail, motorway and port transport, determining on this basis the catchment areas and the airport accessibility of each airport. In turn, rail systems, development and safety of rail transport: by 2030 double and by 2050 triple high-speed rail traffic compared to 2015. Instead, at the urban scale it aims to provide access to safe, sustainable transport systems and convenient for all with a view to wanting to improve road safety especially for vulnerable groups of the population to women, children, people with disabilities and the elderly through the expansion of public transport by 2030. A further step must be carry forward in 2030 aimed at "soft" mobility aimed at doubling the extension of urban cycle paths compared to 2020, as indicated by the EU Commission by intervening directly in urban areas. Finally, with regard to housing policies, the goal is to double the annual rate of energy renovation of buildings (from the current 1% to 2%) and to stimulate the undertaking of deep energy renovations. Finally, the document describes the best practices developed in various territorial contexts and which can also serve as an example for territories that are not yet highly developed. The methodology and guidelines illustrated in the document may also be adopted, in the future, by other Ministries to accompany national, regional and local planning with a view to more resilient, inclusive and sustainable development.

Policies for sustainable urban mobility

This second document examined strongly shows how policies are moving towards a strengthening of new and increasingly sustainable forms of mobility. The development of new mobility paradigms is in fact changing the way of conceiving travel and is affecting individual behavior. To speed up these processes, the Italian government has favored investments in infrastructure and means of transport, also enhancing the tools for managing local mobility, with the aim of improving services for citizens and reducing pollution and congestion in metropolitan cities. The document is divided into five parts: (i) MIMS policies for urban and metropolitan areas; (ii) the demand and supply of passenger transport; (iii) tools to improve mobility in cities between mobility management and smart mobility policies; (iv) plans and programs for sustainable mobility in urban areas; (v) priority interventions and programs for the development of sustainable mobility in metropolitan cities. The document aims to define an exhaustive framework of the tools available to local administrations to improve mobility in urban and metropolitan areas, including those in which the Ministry has invested in the two-year period 2021-2022, and highlights the main plans and programs for metropolitan cities and urban areas.

An in-depth analysis is dedicated to the policies for sustainable local mobility on how the two-year period 2021-2022 aimed at upgrading the infrastructure and the local transport system. In particular, the major investments were made: (i) 3.6 billion for the commissioning of 216 km of new metros, tramways and bus ways; 3 billion for the purchase of 3,000 electric/hydrogen buses in urban areas and 1,500 natural gas buses for extra-urban transport; 200 million for the construction and commissioning of 565 km of urban cycle paths. The document places a further focus on the "Mobility as a Service (MaaS)" model, which provides for the integration of several public and private transport services that can be combined into a single service accessible digitally through platforms that offer different mobility options on the basis to the needs of the individual user. The leading cities of the Maas services were Milan, Naples, Rome, Bari, Florence and Turin, to which 57 million euros were allocated. In turn, the report mentions the initiatives concerning local public transport, highlighting that the Government has reserved 190 million euros for the "transport bonus", which can be used for the purchase of season tickets for public transport. Finally, attention is also paid to planning activities, with the establishment of the Mobility Management technical table and the strengthening of the functions of the national observatory for planning support and for monitoring sustainable local mobility. In summary, the entire work highlights how cities are the main players on which to intervene in order to respond to the sustainability targets to which we must strive.

The document focuses its attention on the theme of sustainable mobility and how today new mobility paradigms are increasingly consolidating in different territorial contexts and in the habits and behaviours of users. The organization and management of the various forms of mobility has always been a "hot" topic in the scientific and political debate since it constitutes that element of conjunction between users, activities and territory in urban areas. In the first part, the work examines how the scientific literature is addressing the issue and, in turn, how sustainable urban mobility is becoming a new theoretical paradigm which introduces an alternative approach to conventional transport planning and which can be enclosed within the large supply chain called "smart mobility". In the second part, the work underlines that cities are the main actors on which to intervene to respond to the sustainability targets to which the European Community and the recovery and resilience plans have called us to act and to move towards new ways of looking at the different territorial contexts. The review boxes of this work, in turn, underline that Italy is trying to produce dynamic and flexible guidance tools and a concrete example is the MIMS Urban Agenda, in turn supporting large investments in the various transport sectors. The real difficulties today arise in coordination aimed at promoting integrated planning within the significant decision-making processes of urban mobility.

References

Alattar, M. A., Cottrill, C., & Beecroft, M. (2021). Modelling cyclists' route choice using Strava and OSMnx: A case study of the City of Glasgow. *Transportation research interdisciplinary perspectives*, *9*, 100301. https://doi.org/10.1016/j.trip.2021.100301

Battarra, R., Zucaro, F., & Tremiterra, M. R. (2018). Smart mobility and elderly people. Can ICT make the city more accessible for everybody?. *TeMA-Journal of Land Use, Mobility and Environment*, 23-42. https://doi.org/10.6092/1970-9870/5768

Bianconi, F., Clemente, M., Filippucci, M., & Salvati, L. (2018). Regenerating Urban Spaces: A Brief Commentary on Green Infrastructures for Landscape Conservation. *TeMA-Journal of Land Use, Mobility and Environment, 11*(1), 107-118. https://doi.org/10.6092/1970-9870/5216

Calafiore, A., Dunning, R., Nurse, A., & Singleton, A. (2022). The 20-minute city: An equity analysis of Liverpool City Region. *Transportation Research Part D: Transport and Environment*, 102, 103111. https://doi.org/10.1016/j.trd.2021.103111

Cobbinah, P. B., Korah, P. I., Bardoe, J. B., Darkwah, R. M., & Nunbogu, A. M. (2022). Contested urban spaces in unplanned urbanization: Wetlands under siege. *Cities*, *121*, 103489.

Gaglione, F., Gargiulo, C., & Zucaro, F. (2022). Where can the elderly walk? A spatial multi-criteria method to increase urban pedestrian accessibility. *Cities*, 103724. https://doi.org/10.1016/j.cities.2022.103724

Gehl, J. (2013). *Cities for people*. ISBN: 9781597269841. Island: Press.

Kiba-Janiak, M., & Witkowski, J. (2019). Sustainable urban mobility plans: How do they work?. *Sustainability*, *11*(17), 4605. https://doi.org/10.3390/su11174605

l'Agenda Urbana del Ministero delle Infrastrutture e della Mobilità Sostenibili (2022). Retrivied from: https://www.mit.gov.it/nfsmitgov/files/media/notizia/2022-10/AGENDA%20URBANA%20MIMS.pdf

Langford, M., Higgs, G., & Jones, S. (2021). Understanding spatial variations in accessibility to banks using variable floating catchment area techniques. *Applied Spatial Analysis and Policy*, 14(3), 449-472. https://doi.org/10.1007/s12061-020-09347

Lu, J., Li, B., Li, H., & Al-Barakani, A. (2021). Expansion of city scale, traffic modes, traffic congestion, and air pollution. *Cities*, *108*, 102974. https://doi.org/10.1016/j.cities.2020.102974

Porru, S., Misso, F. E., Pani, F. E., & Repetto, C. (2020). Smart mobility and public transport: Opportunities and challenges in rural and urban areas. *Journal of traffic and transportation engineering, 7*(1), 88-97. https://doi.org/10.1016/j.jtte.2019.10.002

Rapporto investimenti, programmi e innovazioni per lo sviluppo della mobilità sostenibile nelle Città metropolitane (2022). Retrivied from: https://www.mit.gov.it/

Sahu, P. K., Mehran, B., Mahapatra, S. P., & Sharma, S. (2021). Spatial data analysis approach for network-wide consolidation of bus stop locations. Public Transport, 13(2), 375-394.

Silva, C., Bertolini, L., te Brömmelstroet, M., Milakis, D., & Papa, E. (2017). Accessibility instruments in planning practice: Bridging the implementation gap. *Transport Policy*, *53*, 135-145. https://doi.org/10.1016/j.tranpol.2016.09.006

Wegener, M. (2021). Land-Use Transport Interaction Models. In: Fischer, M.M., Nijkamp, P. (eds) Handbook of Regional Science. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-60723-7_41

Wong, R. C. P., Szeto, W. Y., Yang, L., Li, Y. C., & Wong, S. C. (2017). Elderly users' level of satisfaction with public transport services in a high-density and transit-oriented city. *Journal of Transport & Health*, *7*, 209-217. https://doi.org/10.1016/j.jth.2017.10.004

Yigitcanlar, T., & Kamruzzaman, M. (2020). Smart cities and mobility: Does the smartness of Australian cities lead to sustainable commuting patterns? In *Smart Cities and Innovative Urban Technologies* (pp. 21-46). Routledge.

Author's profile

Federica Gaglione

She is an engineer, PostDoc research fellow at Department of Engineering, University of Sannio, Benevento, Italy. She received her Ph.D. in Civil Systems Engineering at the University of Naples Federico II. The research topics addressed in recent years refer to accessibility to proximity services for vulnerable groups of the population. From August to December 2019, she served as a Visiting Researcher at the University of Aberdeen (UK) and from July to September 2022 Visiting Researcher at the University of Edinburgh (UK) carrying out research on urban accessibility in the context of climate change and sustainability, leveraging geographic big data through GIS and programming languages.

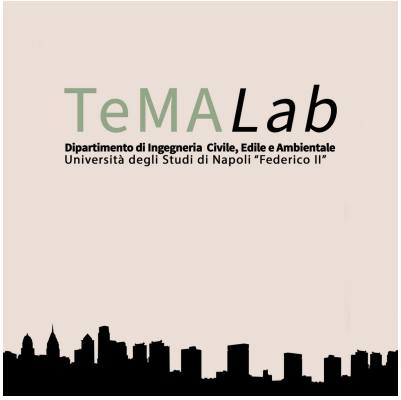
David Ania Ayiine-Etigo

Ayiine-Etigo David Ania is graduating doctoral student from the department of Geography and Environment, at the University of Aberdeen (UK). He has interest in the Political Economy of the Green Economy transition in Africa, with focus on tourism and energy transitions. David obtained a Bachelor's in Political Science and Classical history from the University of Ghana, Legon. Guest Editor at case studies on Transport Policy for Elsevier.

We are online!

TeMA Lab

Follow us on Instagram



TeMA Lab and our Journal are finally on Instagram! TeMA Lab is the Laboratory of Land Use, Mobility and Environment of the Department of Civil, Building and Environmental Engineering, at Università degli Studi di Napoli Federico II. Our field of expertise relates to urban systems, their complexity and the challenges that they will face in near future: adaptation to climate change, ageing population, energy consumptions, development of sustainable mobility and so on. Follow us to be constanly updated!.

www.instagram.com/temalab.unina/

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 555-559
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9438
Received 10th October 2022, Available online 30th December 2022

www.tema.unina.it

REVIEW NOTES – Urban practices

Planning for sustainable urban mobility in Italy. Insights from Palermo and Cagliari

Gennaro Angiello

Systemica, Bruxelles, Belgium
e-mail: gennaro.angiello@unina.it

Abstract

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always following a rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is the expression of a continuous updating of emerging topics concerning relationships among urban planning, mobility and environment, through a collection of short scientific papers. The Review Notes are made of four parts. Each section examines a specific aspect of the broader information storage within the main interests of TeMA Journal. In particular, the *Urban Practices* section aims at producing, analyzing and reporting data on recent and relevant policies in the urban domain.

The present note in particular reports on the recent initiatives undertaken by two major Southern Italian cities to foster sustainable mobility: Palermo and Cagliari. To this aim, the note briefly introduces the legal background and current developments of the Sustainable Urban Mobility Plan (SUMP), a framework developed by the European Commission to support local administrations in developing holistic urban mobility strategies. This is followed by (i) an overview of the mobility situations in Palermo and Cagliari and by (ii) an analysis of the objectives, the strategies and the measures set in their respective SUMPs.

Keywords

Sustainable Mobility; SUMP; Palermo; Cagliari.

How to cite item in APA format

Angiello G. (2022). Planning for Sustainable Mobility in Italy. Insight from Palermo and Cagliari. *Tema. Journal of Land Use, Mobility and Environment*, *15* (3), 555-559. http://dx.doi.org/10.6092/1970-9870/9438

1. Introduction

Urban mobility — the movement of people and goods in urban areas — has a significant impact on sustainability and quality of life in cities. Mobility indeed generates significant externalities such as air pollution, noise, congestion, occupation of public space, and increased morbidity and mortality caused by traffic accidents and pollution (Chatziioannou et al., 2021; Gargiulo & Russo 2017). Furthermore, mobility externalities are unequally distributed on society, since they particularly burden the most disadvantaged communities (Lucans & Jones, 2012). Additionally, the impacts of urban mobility — and in particular that of motorized mobility — extend far beyond the cities' boundaries where they are generated. Indeed, the use of fossil fuel combustion engines in urban areas greatly contribute to the global climate change crisis and to the human perturbation of the global environment (IPCC, 2014).

Due to these negatives externalities, promoting sustainable mobility in urban areas has become an issue of main concern for policy makers and, as such, one of the most widespread objectives in transportation planning worldwide: nowadays, no plan, project, or policy direction concerning the transport sector does not (at least) mention the concept of sustainable mobility (Gallo & Marinelli, 2020). Yet, sustainable mobility — as a complex socio-technical phenomenon — remains quite challenging to operationalize (Geels, 2012) while different frameworks have been proposed by researchers and practitioners to foster its implementation in planning practices (Gallo & Marinelli, 2020).

This short note focuses on one particular implementation framework: the "Sustainable Urban Mobility Plan" (SUMP), a concept/framework developed by the European Commission to support local level authorities in exploring new urban mobility strategies. Within this context, this note reports on the recent initiatives undertaken by two major Southern Italian cities to foster sustainable mobility: Palermo and Cagliari. To this aim, the note briefly introduces the legal background and current developments of the SUMP framework in Europe. This is followed by (i) an overview of the mobility situations in Palermo and Cagliari and by (ii) an analysis of the objectives, the strategies and the measures set in their respective SUMPs.

2. What is a Sustainable Urban Mobility Plan?

In recent years, the European Commission has been increasingly focused on the development of sustainable urban transport and has introduced legislation and formal directives in this domain. In its 2013 Communication on competitive and resource-efficient urban mobility, the Commission has acknowledged the importance of supporting local authorities "so that all cities across the Union can achieve a step-change in their efforts for more competitive and resource-efficient urban mobility" (EC, 2013a). Still, the impact assessment accompanying the 2013 Urban Mobility Directive (EC, 2013b) found that most European cities have not solved their urban mobility challenges, and that deficient planning practices on the local level endangered key European objectives, including a competitive and resource-efficient transport system, the EU's future prosperity and its international competitiveness. In an attempt to address these shortcomings, the Commission introduced the concept of Sustainable Urban Mobility Planning (SUMP) in Annex I of its 2013 Urban Mobility Package (EC, 2013c). The package advocates "a step-change in the approach to urban mobility" (…)"to ensure that Europe's urban areas develop along a more sustainable path and that EU goals for a competitive and resource-efficient European transport system are met.". It sketches out the guiding principles of the planning process and the topics to be addressed in a SUMP.

Within this legal background, a SUMP can be regarded as "a strategic and integrated approach for dealing effectively with the complexities of urban transport" (EC, 2013c). Its core goal is to improve accessibility and quality of life by achieving a shift towards sustainable mobility. SUMP advocates fact-based decision making guided by a long-term vision for sustainable mobility. As key components, this requires (i) a thorough assessment of the current mobility situation, (ii) a widely supported vision with strategic objectives, and (iii) an integrated set of infrastructure, regulatory and financial measures to deliver the objectives – whose

implementation should be accompanied by systematic monitoring and evaluation. In contrast to traditional planning approaches, SUMP places particular emphasis on the involvement of citizens and stakeholders, the coordination of policies between sectors and broad cooperation across different layers of government and with private actors. The concept also emphasises the need to cover all aspects of mobility (both people and goods), and all modes and services in an integrated manner, and to plan for the entire "functional urban area", as opposed to planning for a single municipality within its administrative boundaries.

Implementation of SUMPs across Europe has been supported by numerous and diverse EU initiatives aimed at funding SUMPs adoption, providing strategic guidance, and foster network opportunities for cities and functional areas. As result, more than 1,300 SUMP initiatives are reported on the Eltis City Database (Elstis, 2022), as of November 2022, while the SUMP — as a planning instrument— has taken over the role of the main strategic transportation planning document in most EU cities (Gallo & Marinelli, 2020). Italy is no exception: according to the Eltis City Database, 116 SUMP initiatives have occurred in Italian cities since the launching of the SUMP framework. This high number is possibly the result of innovative regulation in the transport sector. Indeed, in 2017, the Italian law D.M. 4 agosto 2017 was approved, which provides national guidelines for the development of SUMPs in Italian municipalities. The law establishes the approval of the SUMP as a compulsory step for local authorities to get State-level public funding for public transport projects. The two paragraphs below, reported on the case studies of Palermo (3.1) and Cagliari (3.2), two Southern Italian cities that have recently developed their respective Sustainable Urban Mobility Plans.

3.1 Palermo

Palermo and its metropolitan area

Palermo is the capital and the largest city of the autonomous region of Sicily, and it is considered its political, economic and cultural center. The population of Palermo is estimated to be 855,285 inhabitants, while its metropolitan area is the fifth most populated in Italy with around 1.2 million inhabitants. The Metropolitan Area of Palermo includes 82 municipalities, and its extension is approx. 5,000 km^2.

Mobility challenges

Most of the mobility challenges currently faced by the Metropolitan Area of Palermo are the results of decades of poorly regulated urban development and inadequate provision of public transport services and infrastructures, especially in peripheral areas. These circumstances have resulted in the dominance of car as the preferred mode of transport that accounts for more than 75% of daily trips (Osservatorio PUMS, 2021a). The excessive use of the private car is a problem in Palermo more than in other Italian cities. In particular, according to the most recent data from the Global Traffic Scorecard (IRIX, 2021), Palermo is the 9th most congested city of the world while its inhabitants spend approximately 110 hours a year in the traffic. The motorization rate, i.e., the number of cars circulating per 100 inhabitants, is also quite high: 58.2 cars per 100 inhabitants circulate. The public transport use (which does not exceed 9% overall) is low, but it is positively observed that cycling and walking are a quarter of the total commuter mobility. Urban buses and trams are little used in Palermo and its metropolitan area because the citizen associates to them a sense of distrust and insecurity, caused by a poor service regularity and by a transport supply not able to meet the mobility needs of the transport demand (Migliore et al., 2019). The shared-mobility ecosystem is also relatively underdeveloped if compared with other major Italian cities such as Milan or Rome. For instance, only in May 2022 the first free-floating bike sharing services was introduced in the Sicilian capital.

SUMP objectives

In order to cope with these challenges, the Metropolitan Council approved the SUMP of the Palermo Metropolitan City. The main aim of plan is to improve the quality of life of the citizen of the metropolitan area by developing a systemic vision of urban mobility that is well integrated with the urban planning initiatives and ongoing environmental restoration efforts.

The plan's main aim is further articulated in six objectives:

- Reduce the consumption of traditional fuels.
- Improve air quality and reduce noise pollution.
- Improve the attractiveness of public transport and biking.
- Improve the energy performances of the fleet of both public and private vehicles.
- Improves safety and security.
- Contribute to the attractiveness of the territory and the quality of the urban environment.

Measures

In order to support the modal shift from car to public transport and reduce the longstanding city's car dependency, the plan envisions the extension of the city's subway system toward the peripherical areas, the construction of new urban rail corridors and the introduction of a congestion charge zone in the city center. Beside building new lines and new stations, the plan also envisions the redevelopment of most of the existing stations to improve station access and create multimodal hubs with new parking and extended facilities. Furthermore, in order to reduce the high levels of morbidity and mortality caused by traffic accidents, the plan identifies a number of interventions on the city's most critical car axes. These measures are coupled with interventions aimed at promoting active mobility by (i) improving the safety condition of pedestrians, (ii) expanding the city's bike network with of additional bike lanes and (iii) establishing "car free islands" in several city's neighborhoods.

3.2 Cagliari

Cagliari and its metropolitan area

Cagliari is the capital and the largest city of the autonomous region of Sardinia, and it is considered the region main political, economic, tourist, and cultural centre. The population of Cagliari is estimated to be 154,460 inhabitants, while its metropolitan area is home to 418,353 inhabitants. The Metropolitan Area of Cagliari includes 12 municipalities, and its extension is of approx. 1,250 km^2.

Challenges

Most of the mobility challenges currently faced by the metropolitan area of Cagliari are strictly connected to its monocentric urban structure, to the spatial imbalance between home and workplaces, and to the lack of adequate provision of public transport services connecting the capital city with it surrounding municipalities. These circumstances have resulted in the dominance of car as the preferred mode of transport that accounts for more than 75% of daily trips (Osservatorio PUMS, 2021b). Transport policies implemented in recent years in Cagliari tried to curb the dominance of private cars with special efforts being devoted to expanding the public transport network to the outer municipalities. Despite these recent developments, public transport services remain fragmented: services are indeed provided by several companies that often operate in competition and overlap with each other and not in a system logic. Shared mobility services are also relatively limited and have been developed in an uncoordinated fashion. For instance, four different bike sharing systems have been introduced so far. However they are managed independently and cover only a small portion of the territory. Beside these issues, the metropolitan area of Cagliari faces also important logistic challenges connected with the Cagliari port activities and the flow of tourists, mainly coming to Cagliari by ferry, that determine seasonal peak in transportation demand.

SUMP objectives

The main aim of the SUMP of the Metropolitan Area of Cagliari is to is to promote accessibility for all and to better connect its capital city with the surrounding municipalities in a way to reduce the high reliance of private car. This high-level aim is further articulated in six general objectives:

- Provide all citizens with public transport options that enable them to access key destinations and services.
- Improve safety and security conditions.
- Reduce air and noise pollution, greenhouse gas emissions and energy consumption
- Improve the efficiency and cost-effectiveness of passenger and freight transport.
- Contribute to improving the attractiveness of the territory and the quality of the urban environment and the city in general to the benefit of citizens, the economy and society as a whole.

The plan furthermore recognizes the specific territorial characteristics of each municipality. For this reason, the above-mentioned objectives are further elaborated at the municipal level to meet specific needs of the territories involved.

Strategies

To meet the objectives listed above, the PUMS develops 22 integrated strategies addressing different aspect of urban mobilities. A selection of these strategies is reported below:

- Integration of the existing public transport services into a single physical network by building new links, new stations and new modal interchange facilities and integration and establishment of metropolitan-wide management of transport tickets and fares;
- Creation of Low Emission and Accessibility-controlled Zones with differentiated entry policies based on the mode of transportation and the emission class, also for urban freight logistics operations;
- Development of a metropolitan network of bicycle routes, by connecting and expanding existing routes in both urban and rural setting in order to connect the new 30 km/h urban areas with green areas and parks of the city, the rural areas and the riverbanks of the territory.
- Actions to improve the accessibility of the Port of Cagliari and better connect it with the rest of the city, by improving walking path and regenerate large portions of the territory that are in close proximity to the port area.
- Development of Mobility as a Service (MaaS) solutions to integrate existing shared mobility services and accommodate new private initiatives aimed at offering different modes/types of shared mobility services.

References

Chatziioannou, I., Alvarez-Icaza, L., Bakogiannis, E., Kyriakidis, C., & Chias-Becerril, L. (2020). A structural analysis for the categorization of the negative externalities of transport and the hierarchical organization of sustainable mobility's strategies. *Sustainability*, 12(15), 6011. https://doi.org/10.3390/su12156011

Eltis (2022). City Database. Retrieved from: https://www.eltis.org/mobility-plans/city-database. Last accessed: June 2022.

European Commission (2013a). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Together towards competitive and resource-efficient urban mobility. Retrieved from: https://eur-lex.europa.eu/resource.html?uri=cellar:82155e82-67ca-11 e3-a7e4-01aa75ed71a1.0011.02/DOC_3&format=PDF.Last accessed: June 2022.

European Commission (2013b). Commission staff working document accompanying the Communication Together towards competitive and resource-efficient urban Mobility. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0526&from=NL. Last accessed: June 2022.

European Commission (2013c). Commission staff working document accompanying the Communication Together towards competitive and resource-efficient urban Mobility. Annex I: A concept for sustainable urban mobility plans. Retrieved from: https://eur-lex.europa.eu/. Last accessed: June 2022.

Gallo, M., & Marinelli, M. (2020). Sustainable mobility: A review of possible actions and policies. *Sustainability*, *12* (18), 7499. https://doi.org/10.3390/su12187499.

Gargiulo, C., & Russo, L. (2017). Cities and energy consumption: a critical review. *TeMA-Journal of Land Use, Mobility and Environment*, *10*(3), 259-278. https://doi.org/10.6092/1970-9870/5182

Geels, F. W. (2012). A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. *Journal of transport geography*, *24*, 471-482. https://doi.org/10.1016/j.jtrangeo.2012.01.021.

Guida, C., & Caglioni, M. (2020). Urban accessibility: the paradox, the paradigms and the measures. A scientific review. *TeMA-Journal of Land Use, Mobility and Environment, 13*(2), 149-168. https://doi.org/10.6092/1970-9870/6743

Inrix (2021). Irix 2021 Global Traffic scorecard. Retrieved from: https://inrix.com/scorecard/. Last accessed: June 2022.

IPCC — Intergovernmental Panel on Climate Change (2014). Mitigation of climate change. Contribution of working group III to the fifth assessment report of the intergovernmental panel on climate change. Retrieved from: https://repository.uneca.org/handle/10855/22514.Last accessed: June 2022.

Lucas, K., & Jones, P. (2012). Social impacts and equity issues in transport: an introduction. *Journal of Transport Geography*, *21*, 1-3. https://doi.org/10.1016/j.jtrangeo.2012.01.032.

Migliore, M., D'Orso, G., & Caminiti, D. (2020). The environmental benefits of carsharing: the case study of Palermo. *Transportation Research Procedia, 48*, 2127-2139. https://doi.org/10.1016/j.trpro.2020.08.271

Metropolitan City of Cagliari (2022). Piano Urbano della Mobilita Sostenibile. Retrieved from: https://www.cittametropolitanacagliari.it/portale/it/focus_pums_01.page Last accessed: October 2022.

Municipality of Cagliari (2022). Piano Urbano della Mobilita Sostenibile. Retrieved from: http://www.cittametropolitana.pa.it/provpa/provincia_di_palermo/amministrazione_trasparente/00020470_P.U.M.S.__Pian o_Urbano_della_Mobilita_Sostenibile__della_Citta_Metropolitana_di_Palermo.html. Last accessed: October 2022.

Osservatorio PUMS (2022a). Palermo. Retrieved from: https://www.osservatoriopums.it/palermo. Last accessed: October 2022.

Osservatorio PUMS (2022a). Cagliari. Retrieved from: https://www.osservatoriopums.it/cagliari. Last accessed: October 2022.

Image Sources

All images are from wekipedia.org.

Author's profile

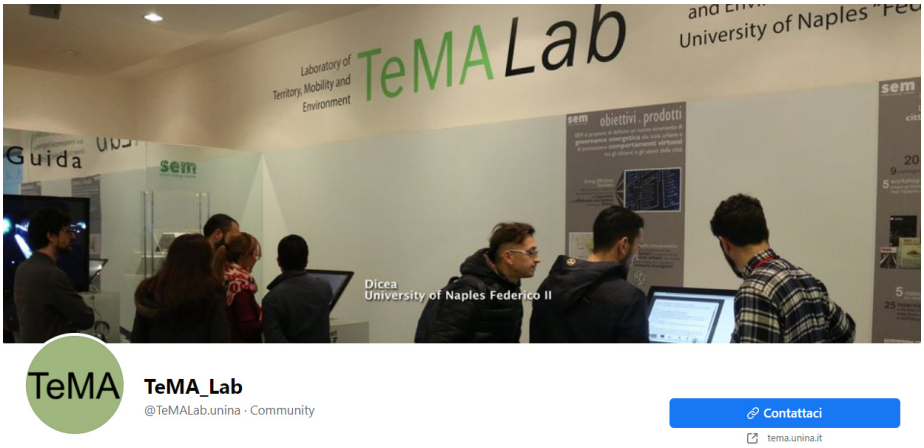
Gennaro Angiello

Gennaro Angiello is a Senior IT Consultant, currently auditing for the European Commission, where he leads the analysis and design of information technologies aimed at supporting data-driven policymaking in the domain of environment, public health and food safety. Prior to moving to the private sector, Gennaro has worked as researcher at the Department of Civil, Architectural and Environmental Engineering of the University of Naples Federico II and has been Visiting Fellow at the Department of Human Geography of the Complutense University of Madrid.

We are online!

TeMA_Lab

Follow us on Facebook



TeMA Lab and our Journal are on Facebook!
TeMA Lab is the Laboratory of Land Use, Mobility and Environment of the Department of Civil, Building and Environmental Engineering, at Università degli Studi di Napoli Federico II. Our field of expertise relates to urban systems, their complexity and the challenges that they will face in near future: adaptation to climate change, ageing population, energy consumptions, development of sustainable mobility and so on. Follow us to be constanly updated!.

www.facebook.com/TeMALab.unina

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 561-564
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9422
Received 2nd October 2022, Available online 30th December 2022

www.tema.unina.it

REVIEW NOTES – Economy, business and land use

Urban sustainable development: the cost of pursuing SDGs

Stefano Franco

Department of Business and Management
LUISS Guido Carli University, Rome, Italy
e-mail: sfranco@luiss.it
ORCID: https://orcid.org/0000-0001-7341-8318

Abstract
Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always following a rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is the expression of a continuous updating of emerging topics concerning relationships among urban planning, mobility and environment, through a collection of short scientific papers. The Review Notes are made of four parts. Each section examines a specific aspect of the broader information storage within the main interests of TeMA Journal. In particular, the Economy, business and land use section aims at presenting recent advancements on relevant topics that underlie socio-economic relationships between firms and territories. The present note aims at highlighting the costs associated to the UN Sustainable Development Goals. The hight investment costs and the gap that still divides cities from the achievement of the sustainable targets shed lights on the need to incentivize both public and private investments.

Keywords
Sustainable Development Goals; Cities; Costs; Investments.

How to cite item in APA format
Franco, S. (2022). Urban sustainable development: the cost of pursuing SDGs. *Tema. Journal of Land Use, Mobility and Environment, 15* (3), 561-564. http://dx.doi.org/10.6092/1970-9870/9422

1. Introduction

The pursuit of a sustainable development has become a priority for both public and private organizations that seek to foster social, environmental and economic development without compromising the possibility for future generations to do the same. Improving social inclusion, climate change mitigation and adaptation (Errigo, 2018; Molavi, 2018), reducing inequalities (Battarra et al., 2018; Guida & Caglioni, 2020), protecting cultural and natural heritage (Bianconi et al., 2018; Shirgir et al., 2019), are some of the critical challenges on which organizations should focus on, while generating wealth for communities that can thrive over time. The 17 Sustainable Development Goals (SDGs) developed by the United Nations trace the path bot for administration and companies to pursue sustainable development. These ambitious goals represent great opportunities that require large investments to be put into practice. To this aim it is worth investigating what are the costs associated to the achievement of SDGs, since most of the literature has mainly focused on the related benefits. Analyses from the World Bank have recently estimated that low and medium income countries need investments from $1.5 to $2.7 trillion per year between 2015 and 2030 to achieve SDGs (Vorisek & Yu, 2020). Although the relevance of this issue, very few attempts in literature have tried to address it, and yet it is worth the investigation, given that financial constraints may hinder the effective implementation of practices aimed at pursuing a sustainable development. A recent study (Filho et al., 2022) has highlighted that, financially, SDGs can be pursued through private investments, social and environmental bonds, and foreign direct investments. These financial instruments represent investments and not mere costs that suggest that sustainability makes sense, financially, only if it also generates desired returns. That is a critical point in the debate about sustainable-related costs. About this, Filho and colleagues (2022) also argue that there is a cost on non-being sustainable that probably overcome the cost of implementing sustainability-related measures. That said, it seems clear that sustainability-related investments can help communities in generating future benefits, but at the same time it is necessary to incentivize public and private investments that need also to guarantee short-term performance to be attractive for investors. Balancing short-term financial performance with long-term social and environmental value creation is thus one of the most challenging points for achieving SDGs. To this aim, ambitious public policies have been designed to create business opportunities for sustainability-related investments within a so-called sustainable transition. In the case of urban environments, the most significant areas of intervention about sustainable investments may regard among others transports, public housing, waste management, public space management, governance quality, inclusion and transparency. As far as these areas are concerned, in the next section some examples will be highlighted to show the composition of sustainability-related required investments in the cities of four developing countries.

2. The cost of pursuing SGDs in cities

Sustainable development in urban environments mainly refers to the specific SDG 11, sustainable cities and communities. However, also other SDGs may be oriented towards to development of sustainable urban environment. Developing transportations, housing and governance (Burlando & Cusano, 2018), for example, do not just allow cities to pursue SDG11 related targets but also other targets related for example to SDG1 (reduce poverty), SDG10 (reducing inequalities), or SDG16 (peace, justice and strong institutions) to name a few. In 2020, a study of the United Nations (UN Habitat, 2020) tried to assess the level of investments needed by 129 small, medium and large cities in Bolivia, Colombia, India and Malaysia. The study identifies five investment categories: housing, transports, solid waste, public space, and governance and planning. According to the analysis, the average annual costs of developing sustainable cities spans from an average of circa $18million for small cities (less than 100.000 inhabitants) in Malaysia to $5,28 billion for large cities (more than 1 million inhabitants) in Malaysia as well. In the country of Southeast Asia, the most consistent investments for small and medium (between 100.000 and 1 million inhabitants) cities regard transportations,

with expenses that would absorb about 80% of the total required resources. For large cities, instead, Malaysia's priority regards the management of public space with an estimated annual cost of $3,60 billion. Indian cities face a slightly different situation, as their priority is the management of public space both for small, medium, and large cities. In this case, however, the percentage of the investments absorbed by the different categories shows a pick for public space management with an average annual cost of about 50% on the total amount of resources needed to pursue SDGs. Small Indian cities need about $34 million, while the investments expected for medium and large cities are respectively $143 million and $2,02 billion.

South American countries show different priorities. Both in Bolivia and Colombia, cities allocate most of the investments on transports and housing. Bolivian cities require respectively $54 million, $190 million, and $644 million, for small, medium and large cities, while Colombian cities require an annual expense of $30 million, $340 million, and $3,10 billion.

These estimated costs give an idea of the huge amounts of investments required by cities if they want to achieve the targets identified in the SDGs scheme. At the same time, the four countries analyzed are not among the best performer in achieving SDGs. Although the situation may vary from country to country, however, the analysis carried out by the United Nation gives a clear idea of the investments needed by urban environments if they want to become sustainable. Moreover, in order to have a much clearer idea of the investments needed it is also important to understand what still needs to be done before cities achieve SDGs-related targets. A recent report analyzed how much Italian cities are close to achieving SDGs (Cavalli et al., 2020). According to this research, all the Italian provinces perform very well only in SDG13 (climate action) related targets. On the contrary, they are still quite far from achieving many other goals such as SDG5 (gender equality), SDG7 (affordable and clean energy), SDG10 (reduced inequalities), and even SDG11 (sustainable cities and communities). This suggests that still much needs to be invested for cities to achieve most of the expected results related to SDGs.

3. Discussion and conclusions

SDGs represent a great opportunity for cities to develop new investment plans aimed at achieving sustainability-related targets. Costs associated to the strategies and activities oriented towards the sustainable development maybe very high, as the related interventions may regard structural changes as the construction or renovation of infrastructures. This is the case, for example, of developing countries where transports, housing and public space management represent the most significant areas of interventions that require both public and private investments. Costs are also high for those cities that are still far from achieving SDGs target. As we have seen for Italian provinces, there is still much to do to reach the desired levels of SDGs, and in order to achieve these results by 2030, investments are still needed. To a certain extent, governmental actors are developing incentive plans to drive sustainable-related investments, but in order for them to be effective, long-term benefits should also encounter attractive short-medium financial returns. Sustainability-related expenses in fact should not be seen as mere costs, but they should rather be perceived as investments. To this extent, it is important to assess the convenience to invest in such activities considering that missing the opportunity of embracing sustainability may present more costs in the future for cities and other organizations.

References

Battarra, R., Zucaro, F., & Tremiterra, M. R. (2018). Smart mobility and elderly people. Can ICT make the city more accessible for everybody?. *TeMA-Journal of Land Use, Mobility and Environment*, 23-42. https://doi.org/10.6092/1970-9870/5768.

Bianconi, F., Clemente, M., Filippucci, M., & Salvati, L. (2018). Regenerating Urban Spaces: A Brief Commentary on Green Infrastructures for Landscape Conservation. *TeMA Journal of Land Use Mobility and Environment, 11*(1), 107–118. https://doi.org/10.6092/1970-9870/5216

Burlando, C., & Cusano, I. (2018). Growing Old and Keeping Mobile in Italy. Active Ageing and the Importance of Urban Mobility Planning Strategies. *Tema-Journal of Land Use Mobility and Environment*, Special Is, 43–52. https://doi.org/10.6092/1970-9870/5756

Cavalli, L., Eni, F., Mattei, E., Italia, S., Lizzi, G., & Toraldo, S. (2020). L'Agenda 2030 in Italia a cinque anni dalla sua adozione: una review quantitativa. *Reports*.

Errigo, M. F. (2018). The Adapting City: Resilience Through Water Design in Rotterdam. *TeMA, Journal of Land Use, Mobility and Environment, 11*(1), 51–64. https://doi.org/10.6092/1970-9870/5402

Filho, W. L., Dinis, M. A. P., Ruiz-de-Maya, S., Doni, F., Eustachio, J. H., Swart, J., & Paço, A. (2022). The economics of the UN Sustainable Development Goals: does sustainability make financial sense? *Discover Sustainability, 3*(1). https://doi.org/10.1007/s43621-022-00088-5

Guida, C., & Caglioni, M. (2020). Urban accessibility: the paradox, the paradigms and the measures. A scientific review. *TeMA Journal of Land Use Mobility and Environment, 13*(2), 149–168. https://doi.org/10.6092/1970-9870/6743

Molavi, M. (2018). Measuring Urban Resilience to Natural Hazards. *TeMA, Journal of Land Use, Mobility and Environment, 11*(2), 195–212. https://doi.org/10.6092/1970-9870/5485

Shirgir, E., Kheyroddin, R., & Behzadfar, M. (2019). Defining urban green infrastructure role in analysis of climate resilience in cities based on landscape ecology principles. *TeMA Journal of Land Use Mobility and Environment, 1*2(3), 227–247. https://doi.org/10.6092/1970-9870/6250

UN Habitat. (2020). The cost of making a city sustainable. Retrieved from: https://unhabitat.org/news/27-apr-2020/the-cost-of-making-a-city-sustainable-measuring-the-financial-cost-of-meeting-sdg

Vorisek, D., & Yu, S. (2020). Understanding the Cost of Achieving the Sustainable Development Goals. World Bank Working Paper, (February). https://doi.org/10.1596/1813-9450-9164

Authors' profile

Stefano Franco

PhD, is a Postdoctoral Researcher at LUISS Guido Carli University in Rome. He has been visiting researcher at Rey Juan Carlos University, Madrid. His main research interests are in the areas of sustainability and innovation. His papers have appeared in international refereed journals, among others *IEEE Transactions on Engineering Management, Business Strategy and the Environment, Journal of Cleaner Production.*

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2022) 565-570
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/9414
Received 28th September 2022, Available online 30th December 2022

www.tema.unina.it

REVIEW NOTES – NextGenerationEU and urban development

The interventions of the Italian Recovery and Resilience Plan: tourism for more competitive cities

Sabrina Sgambati

Department of Civil, Architectural and Environmental Engineering
University of Naples Federico II, Naples, Italy
e-mail: sabrina.sgambati@unina.it
ORCID: https://orcid.org/0000-0001-8900-278X

Abstract

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always following a rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is the expression of a continuous updating of emerging topics concerning relationships among urban planning, mobility and environment, through a collection of short scientific papers. The Review Notes are made of five parts. Each section examines a specific aspect of the broader information storage within the main interests of TeMA Journal.

This section of the Review Notes explores a specific topic, related to cities, within the framework of the European program NextGenerationEU.

This contribution deepens the topic of tourism in urban areas within the framework of the Italian National Recovery and Resilience Plan. It provides an overview of the proposed reforms, strategies and interventions to improve the digitalization of tourism services, the cultural development and the improvement of attractiveness and competitiveness of Italian cities.

Keywords

Italian Recovery and Resilience Plan; Tourism; Digitalization; Competitiveness; Cities.

How to cite item in APA format

Sgambati, S. (2022). The interventions of the Recovery and Resilience Plan in Italy and the future of the Italian cities: Energy efficiency in urban areas. *Tema. Journal of Land Use, Mobility and Environment*, *15 (3),* 565-570. http://dx.doi.org/10.6093/1970-9870/9414

1. Tourism in cities

The management of tourists flows in urban environment together with the supply of services and facilities for the tourism sector has gradually become fundamental in the governance of urban transformations, especially in relation to the sustainability and competitiveness of urban systems (Jiao et al., 2019). Globalization, the increasing affordability in travelling, and the spread of information - also throughout new means of communication such as social media – has substantially increased the tourists flows, particularly in countries with an invaluable landscape, artistic and cultural heritage and in consolidated tourists' destinations characterized by multidimensional attractiveness. It is the case of European cities, global leaders in international tourism, that account for roughly two-thirds of international tourist arrivals worldwide. In Europe, in 2017, urban tourism grew 7.7%, as a result of the acceleration in the growth rate of inbound tourism during the 2010s, reporting a peak of 745 million international visitors in 2019 (Statista, 2022). This makes tourism one of the major pools for economic growth in Europe (according to Statista in 2019 the total contribution of tourism to the GDP was 2,141.4$), thus, one of the foremost components to be boosted to enhance urban competitiveness and urban quality (La Rocca, 2014). Promoting the right form of tourism, according to the vocations of the city – e.g. artistic and cultural heritage, nature and landscape, multidimensional tourism – can lead to new occupations in the tourism sector, a dynamic labor market, and continuous economic inflows, as well as a renovated urban image. On the other hand, the increasing number of tourists raises issues regarding the impacts on the urban environment and the loss of identity of cities and historical centres, being often associated with the keywords "gentrification", "touristification", and "overtourism" (da Silva et al., 2019). Therefore, one of the challenges to be addressed by local administrators and stakeholders is how tourism can keep on being an economic resource while being managed in a sustainable way.

With the COVID-19 outbreak in 2020, the volume of inbound tourists fell unprecedently (see Fig.1) since the adopted emergency measures, such as lockdowns, dramatically restricted non-essential travel between territories (Corbisiero & La Rocca, 2020). According to ECM (2021) the average growth rate for tourism in 107 European cities accounted for -60.9% in 2020, an impressive rate if compared with the value of 2019 (e.i.: 4.3%).

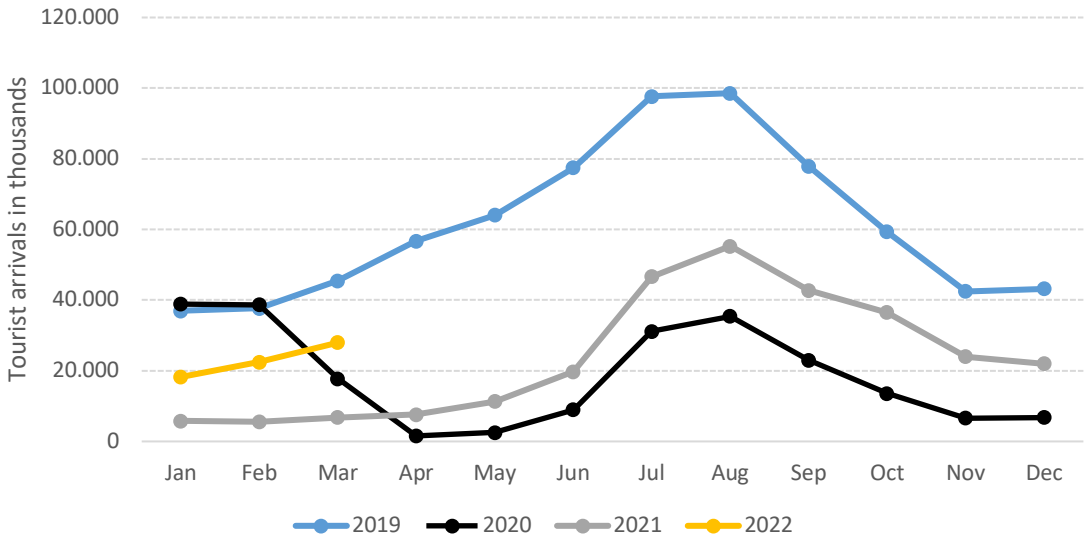


Fig.1 Change in international tourist arrivals in Europe from January 2019 to March 2022 (Source: Statista, elaborated by the author)

As a reaction to the pandemic crisis, the European Union approved in 2021 a new strategy, namely "re-Open EU" to make tourism safer and more sustainable and to facilitate its recovery in the post-pandemic period. In the context of NextGenerationEU (European Commission, 2021), Italy has proposed its own strategy, promulgating tourism as a mean of economic recovery in the National Recovery and Resilience Plan, NRRP

(Governo Italiano, 2021). Italy is, indeed, the third country in Europe by number of visitors (WorldBank, 2022), following France and Spain. The share of travel and tourism's total contribution to GDP was 10.6% in 2019, dropping to 6.1% in 2020 and becoming 9.1% in 2021. Thanks to their unique and heterogeneous cultural and historical heritage and the diffusion of cultural sites, Italian cities are among the most visited locations in the world. This makes tourism a fundamental sector for Italian cities competitiveness and a substantial source of income for local economies. Italian cities can be classified on the basis of their touristic vocation in different clusters: (i) Big cities with multidimensional tourism; (ii) Cities with cultural, historical, artistic and landscape vocation; (iii) Maritime destinations; (iv) Lake destinations; (v) Mountain destinations; (vi) Thermal tourism destinations; (vi) Cities with more than one vocation (ISPRA, 2020). That is why the Italian Government has included the tourism sector within the missions of the NRRP.

2. Tourism in the Italian NRRP

The tourism sector has been included among the fields of investment of the Italian NRRP, in the Mission 1-M1 "Digitalization, innovation, competitiveness, culture and tourism". The Mission M1 includes investments for a total budget of € 40.29 billion, distributed among 3 components which aim to relaunch the competitiveness of Italy by enhancing the connectivity, the digital performance, and the innovation of several economic sectors, including culture and tourism. Indeed, the third component M1C3 "Tourism and Culture 4.0" promotes interventions to renew the touristic and cultural sectors, focusing on the regeneration/valorization, digitalization, and safety/accessibility of cultural heritage and tourism destinations. This component embeds big cities, specifically cities with a metropolitan area, as well as small centers and towns, suburban and internal areas, providing € 6.08 billion that have been divided as follows:

- cultural heritage € 1.1 billion;
- cultural regeneration of small villages, rural and suburban areas € 2.42 billion;
- cultural and creative industry € 0.16 billion;
- tourism 4.0 € 2.40 billion.

€ 3.11 billion are dedicated to cities, with € 820 million reserved for the regeneration of small towns ("borghi") with a population lower than 5,000 inhabitants, and € 1.2 billion for other Municipalities and Metropolitan Cities. In particular, €0.6 billion have been allocated for new projects for the valorization and conservation of architectural heritage and landscape, whereas € 0.3 billion are for programs of valorization of places' identity and for the redevelopment of parks and historic gardens within urban contexts.

ID of the investment	Investment	Implementing bodies	Resources (€ billion)
M1C3.2.1	Attractiveness of small towns	Municipalities with less than 5k inhabitants	1.02
M1C3.2.2	Protection and enhancement of architecture and landscape	Regions and provinces	0.60
M2C3.2.3	Enhancing place's identity and participated regeneration of suburban areas	Public and private owners of parks and gardens of cultural interest	0.30
M2C3.4.2	Support for tourism politics	Different subjects (private and public)	1.80
M2C3.4.3	Caput Mundi. NextGenerationEU for great touristic events	Different public subject (see first table below)	0.50

Tab.1 the investments for urban regeneration in the National Plan for Recovery and Resilience (Source: Openpolis https://www.openpolis.it/i-nostri-open-data-per-il-monitoraggio-del-pnrr/)

The first investment in Tab.1 refers to the attractiveness of small towns, disseminated in the Italian territory. It is intended to promote small historic towns ("borghi") to face the overcrowding that characterizes the main tourists' destinations, creating an alternative sustainable tourism, thanks to the promotion of still not-known cultural sites, historical centres, arts, and traditions. On the other hand, this investment aims at revitalizing the small towns, that are suffering processes of abandonment, ageing and depopulation, and that need measures of economic revitalization. The second investment aims to enhance the historic building stock and protect the rural landscape so as to support local development processes. The main objectives of the investment are preserving the values of historic rural landscapes and promoting the creation of initiatives and activities linked to sustainable cultural tourism. The investment M2C3.2.3 aims to leverage cultural assets as driving factors for the socio-economic regeneration of neighbourhoods and peripheries. This investment aims to respond to the degradation of public areas and public services, parks and gardens, and the lack of places for social life – especially for young people. The investment M2C3.4.2 is divided into several sub-investments. It is linked to different categories of intervention such as the improvement of the accommodation infrastructure, the removing of architectural barriers, the improvement of energy efficiency and seismic performance of touristic areas, the sustainable development of the tourism sector, and the economic support for new enterprises. This investment allows tourism enterprises to benefit financial supports to leverage urban competitiveness, environmental sustainability, innovation and digitisation. The investment Caput Mundi, the last one in Tab.1, will be deepened in the following tables.

In conclusion, tourism is one of the main components of competitiveness for Italian cities and, at the same time, the development of sustainable forms of tourism is one of the main challenges that our cities are called upon to face in the coming years. The investments of NRRP in the tourism sector should be managed paying attention both to competitiveness and sustainable development, using a multidimensional approach. In this regard, the plan includes measures that deal with the management of tourists flows, sustainable mobility, the conservation and redevelopment of cultural heritage, the valorization of public spaces, gardens and parks, as well as the encouragement of private action to improve the touristic attractiveness. Measures at the building level will be accompanied by integrated actions at the urban and metropolitan levels in different sectors (economic, environmental, and so on) and considering both private and public initiatives. It is expected that the promoted measures will provide benefits in terms of economic performance, city image, urban attractiveness, and sustainable development.

In the following tables, there are two of the proposed projects within the framework of the NRRP.

Caput Mundi – NextGenerationEU for great touristic events

"Caput Mundi" aims to enhance the tourism and cultural heritage of Rome in order to revitalize existing tourist routes and enhance minor destinations, not yet involved in the great tourists tours, in order to promote sustainable tourism and at the same time increase the competitiveness of parts of the city that are still not-known. This project can be embedded within the NextGenerationEU investments for great touristic events since it has been promoted in the light of the great Jubilee of 2025. The role of great events in the increase of urban competitiveness is yet recognized as demonstrated by the example of cities that have taken substantial benefits from the organization of big events (e.g.: the Olympic Games for the city of Turin). The Jubilee is considered an unprecedented opportunity and, for this reason, requires a specific project to enhance the attractiveness of the City of Rome. The targets embed relaunching minor places/monuments, creating new tourist routes, and restoring cultural sites both in the city and its suburbs.

In particular, the resources will be allocated amongst 6 investments, involving 335 measures on 283 cultural sites. The first investment involves 52 measures and regards the regeneration and restoration of the cultural and urban heritage of the city along with the valorization of complexes having high historical and architectural value. The second investment provides 149 measures and concerns the religious architectural heritage ("From Pagan Rome to Christian Rome"), in particular safety, earthquake-proofing and restoration of public places and buildings of historical interest along the City's Jubilee routes. The third investment "#Lacittàcondivisa" (literally, "#thesharedcity"), which includes 61 measures and can responds to the necessity of enhancing not only traditional tourists destinations but also the one included in more marginal areas (this investment includes the redevelopment of the peripheral areas of the City and archeological sites located in the large peripheral areas outside the centre of Rome). #Mitingodiverde (55 measures) is the fourth investment: it regards the renovation and restoration of parks, historical gardens, fountains and villas. This investment is connected to the valorization of cultural sites and also to the valorization of green areas, which is something related

to the green transition of the city. The fifth investment #Roma4.0 (14 measures) is connected to the mission "Tourism 4.0" since it promotes the digitalization of cultural services in order to facilitate the usability of cultural heritage and the tourists flows within the city centre throughout the promotion of innovation within the tourism sector. The last investment #Amanotesa aims at fostering social inclusion in the suburban areas by increasing and improving the cultural supply, for a total of 4 measures. The implementing bodies of the project are the City of Rome, Soprintendenza Archeologica per i Beni Culturali, Ambientali e Paesaggistici di Roma (Archeological Superintendence of Cultural, Environmental and Landscape Heritage of Rome), the Archeologic Park of Colosseum, The Archeologic Park Appia Antica, Diocese of Roma, the Ministry of Toursim, the Lazio Region.
The general objectives of this project concern the regeneration and valorization of cultural and urban heritage. Sustainable tourism is also fundamental, that is why the measures try to increase the number of cultural alternatives to the most famous ones – also outside the historic centre of Rome - by, for example, improving the accessibility and quality of different complexes. The amount for the investment is €500 million.

The attractiveness of small villages and suburban areas

The tourists flows in Italy are characterized by the "magnetism" of great cultural attractors, specifically the cities of art such as Florence, Venice, Rome, but also the big cities characterized by multidimensional tourism (Milan and Naples). The consequences of this polarization of tourists flows regard the intensive use of some cultural destination which are, in this way, in danger of impoverishment because of the high intensity of unsustainable tourists flows. On the other hand, another important consequence should be considered: there are some cultural sites that stay out of the tourists flow, despite their inestimable historical and cultural value. For this reason, the component M1C3.2 is dedicated to the regeneration of small cultural sites and the enhancement of small villages (namely "borghi"). The investments allow for the promotion of the cultural heritage and history of places, but also the revitalization of the economic and social structure of these places (throughout the valorization of manufacturing, local products, and traditional jobs, with the added value of preserving landscape and traditions), limiting the depopulation processes that have characterized small villages in the last decades. The investments include the revitalization of 250 small villages (within the wider national program "Piano dei Borghi") sponsored by Regions, Provinces and Municipalities. The objective of this plan is to create sustainable and high-quality growth of these small realities, diffused on the whole Italian territory. 21 small towns have been selected by Regions to be financed with €20 million, for the artistic restoration and recovery of historical heritage. The first line of actions is aimed at the economic and social relaunch of villages uninhabited or characterized by an advanced process of decline and abandonment. Each Autonomous Region or Province has examined the applications proposed by the various territories and identified the pilot project. The resources will be used for the establishment of new functions, infrastructures, and services in the field of culture, tourism, social development, and research.
Among the selected projects "Rocca Calscio Luce d'Abruzzo" aims at the restoration and conservation of the archaeological sites and the realization of accommodation services, exploiting abandoned historical buildings. The project for Borgo Castello in Liguria Region is intended to recover and functionalize the historical and rural heritage, to promote sustainable and smart forms of tourism. The project proposed by the autonomous Province of Bolzano for Stelvio involves the realization of socio-cultural, ecological, and socio-economic measures, the empowerment of local manufacturing activities and the creation of new cultural spaces. The Puglia Region has presented the project "Future in the past" for the village Accadia: the project is intended to realize integrated actions on the cultural heritage, in order to relaunch the development of the village from an economic and demographic point of view.

(Image Source Ministero della Cultura. Retrieved from: https://cultura.gov.it/pnrr-borghi)

References

Corbisiero, F., & La Rocca, R. A. (2020). Tourism on demand. New form of urban and social demand of use after the pandemic event. *TeMA-Journal of Land Use, Mobility and Environment*, 91-104. https://doi.org/10.6092/1970-9870/6916

da Silva, F. P., Brandão, F., & Sousa, B. (2019). Towards socially sustainable tourism in cities: local community perceptions and development guidelines. Enlightening tourism. *A pathmaking journal, 9*(2), 168-198.

ECM (2021) European Cities Marketing Benchmarking Report 17th edition 2020-2021. Retrieved from: https://citydestinationsalliance.org/mpage/HomepageBR2021

European Commission (2021). NextGenerationEU. Retrieved from: https://ec.europa.eu/info/strategy/recovery-plan-europe

Fistola, R., & Rocca, R. A. L. (2018). Slow mobility and cultural tourism. Walking on historical paths. In *Smart planning: sustainability and mobility in the age of change* (301-322). Springer, Cham. https://doi.org/10.1007/978-3-319-77682-8_18

Governo Italiano (2021). Italia domani. Piano Nazionale di Ripresa e Resilienza. Retrieved from: https://italiadomani.gov.it/en/home.html

Jiao, S., Gong, W., Zheng, Y., Zhang, X., & Hu, S. (2019). Spatial spillover effects and tourism-led growth: an analysis of prefecture-level cities in China. *Asia Pacific Journal of Tourism Research, 24*(7), 725-734. https://doi.org/10.1080/10941665.2019.1630454

La Rocca, R. A. (2014). The role of tourism in planning the smart city. *TeMA-Journal of Land Use, Mobility and Environment*, *7*(3), 269-284. https://doi.org/10.6092/1970-9870/2814

Ministero del Turismo (2022) Caput Mundi. Retrieved from: https://www.ministeroturismo.gov.it/caput-mundi-new-generation-eu-per-i-grandi-eventi-turistici/

Ministero del Turismo (2021) Turismo 4.0 – Piano Nazionale di Ripresa e resilienza. Retireved from: https://www.ministeroturismo.gov.it/wp-content/uploads/2022/03/PNRR-MITUR.pdf

Image source

Fig.1: Data retrieved from Statista (https://www.statista.com/topics/5254/global-online-art-market/#topicHeader__wrapper);

Fig.2: Ministero della Cultura. Retrieved from: https://cultura.gov.it/pnrr-borghi

Author's profile

Sabrina Sgambati

She is an engineer, Ph.D. student in Civil Systems Engineering at Department of Civil, Architectural and Environmental Engineering of University of Naples Federico II. Currently, her Ph.D. research concerns the topic of urban competitiveness.