Gert Ruepert
Tijana Ilić   *Editors*

Young Geographers

Showcasing Research Contributions in Geography

euro geo

GeoDem

Springer

Key Challenges in Geography

EUROGEO Book Series

Series Editors

Kostis C. Koutsopoulos, European Association of Geographers, National Technical University of Athens, Pikermi, Greece

Rafael De Miguel González, University of Zaragoza & EUROGEO, Zaragoza, Spain

Daniela Schmeinck, Institut Didaktik des Sachunterrichts, University of Cologne, Köln, Nordrhein-Westfalen, Germany

This book series addresses relevant topics in the wide field of geography, which connects the physical, human and technological sciences to enhance teaching, research, and decision making. Geography provides answers to how aspects of these sciences are interconnected and are forming spatial patterns and processes that have impact on global, regional and local issues and thus affect present and future generations. Moreover, by dealing with places, people and cultures, Geography explores international issues ranging from physical, urban and rural environments and their evolution, to climate, pollution, development and political economy.

Key Challenges in Geography is an initiative of the European Association of Geographers (EUROGEO), an organization dealing with examining geographical issues from a European perspective, representing European Geographers working in different professional activities and at all levels of education. EUROGEO's goal and the core part of its statutory activities is to make European Geography a worldwide reference and standard. The book series serves as a platform for members of EUROGEO as well as affiliated National Geographical Associations in Europe, but is equally open to contributions from non-members.

The book series addresses topics of contemporary relevance in the wide field of geography. It has a global scope and includes contributions from a wide range of theoretical and applied geographical disciplines.

Key Challenges in Geography aims to:

- present collections of chapters on topics that reflect the significance of Geography as a discipline;
- provide disciplinary and interdisciplinary titles related to geographical, environmental, cultural, economic, political, urban and technological research with a European dimension, but not exclusive;
- deliver thought-provoking contributions related to cross-disciplinary approaches and interconnected works that explore the complex interactions among geography, technology, politics, environment and human conditions;
- publish volumes tackling urgent topics to geographers and policy makers alike;
- publish comprehensive monographs, edited volumes and textbooks refereed by European and worldwide experts specialized in the subjects and themes of the books;
- provide a forum for geographers worldwide to communicate on all aspects of research and applications of geography, with a European dimension, but not exclusive.

All books/chapters will undergo a blind review process with a minimum of two reviewers.

An author/editor questionnaire, instructions for authors and a book proposal form can be obtained by contacting the Publisher.

Gert Ruepert · Tijana Ilić
Editors

Young Geographers

Showcasing Research Contributions
in Geography

euro
geo

GeoDem

Springer

Editors
Gert Ruepert
EUROGEO
Waardamme, Belgium

Tijana Ilić
School of Engineering and Management
University of Nova Gorica
Vipava, Slovenia

Series Editor's Foreword

EUROGEO is strongly committed to support young geographers. This European Association of Geographers created in 1979 has an overview of geographic scientific production for more than four decades. But at EUROGEO, we believe in the future of the geography thanks to the new generations of geographers who are able to analyze, to strengthen, and to increase the geographical knowledge created by the cutting-edge geographical research or geospatial technologies. The COVID-19 pandemic had an impact on everybody, but in science it was especially hard for geographers at early-stage careers, who didn't have access to travel for conferences or research visits for networking or interacting with other geographers and scholars, and consequently, they had less opportunities to disseminate their work in high impact publications.

EUROGEO and Springer organized in April 2021 the capacity building webinar *Book Publishing 101 for Geographers* to deal with the challenge of publishing in disruptive times, then call for chapters to young geographers was opened. The consequence in this book is composed of 12 chapters showing an updated overview of research about human geography topics like urban growth and urban challenges, transportation, landscape, land cover, geospatial analysis, regional planning, local development, cultural geography, and tourism. In addition to that, most of them present amazing maps and figures as outstanding expression of the needs of GIS for geography research. In short, this book demonstrates the strength of geography as a scientific discipline by providing interesting clues about how geographic research is heading to forthcoming times.

Zaragoza, Spain

Prof. Dr. Rafael de Miguel González
EUROGEO President

Contents

List of Figures

**Post-pandemic Urban Reality: COVID-19 as an Accelerator or a
Hindrance to the Development of Grassroots Urban Activism?
The Example of Poland**

**Urban Rhythmscapes—Examining the Temporal Forms of Urban
Spaces**

**Mapping Urban Integration of Archaeological Heritage. The City
Centre of Malaga, Andalusia, and Spain**

**Sensing and (Re) Imaging an Urban Enclave Through Application
of Visual Streetscape Ethnography: A Study of Twin Chinatowns
in Kolkata**

Shaping a City With(out) Canvassing Its Citizens. The Transformation of Parco Bassini in Milan: A Case Study

A Geographical Approach to European Cargo Airports

List of Tables

The scale issue in Geospatial Analysis. A Review from the Land Use Cover Change Modelling Perspective

David García-Álvarez

Abstract Geospatial data and analyses mean a simplification or abstraction of the real world, which is partially driven by the scale. Selecting the scale of our data or the scale at which our analyses will be carried out is not an easy task. However, not much information is currently available about the complexity of the scale issue in geospatial analysis, which ends in users taking many scale decisions without being well-informed about their consequences. Throughout this chapter, we first aim to provide a synthetic and comprehensive conceptual framework of the term scale and its associated concepts, to make users aware about the complexity of the scale problem. Next, we review the consequences that the scale decisions may have in a specific type of geospatial exercise Land Use Cover Change (LUCC) modelling. All in all, we provide readers with the essential information that they may need to select the proper scale for their data and analyses.

Keywords Scale · Extent · Resolution · Detail · Geospatial

Introduction

In geospatial analysis, the real world needs to be conceptualized and simplified according to the objectives of our studies. We cannot work with the full complexity of real landscapes and processes. Understanding tons of elements and how they interact at the same time is out of our capacity of understanding. In addition, all elements that make up a system may not be necessarily important for the purpose of our analyses.

The scale tells us about how that simplification is carried out. Following Wu and Li (2009), we can understand scale as a window of perception that informs us about the limitations associated to the study or observation of a specific element or process.

Choosing the proper scale is a required step to successfully achieve the objectives of our studies. When choosing one or another scale, we will be selecting the level

D. García-Álvarez (✉)
Department of Geography, Complutense University of Madrid, Madrid, Spain
e-mail: davidg@ucm.es

1

of abstraction at which we will be studying the elements, processes or systems of interest and, therefore, the degree of uncertainty that will be accepting in our study or analysis.

Through this chapter, we aim to provide to all readers a brief introduction to the scale issue in geospatial analysis, focusing on the consequences of the scale selection in a specific type of exercise: Land Use Cover Change (LUCC) modelling. To this end, in the next two sections, we explain what is scale and the main concepts associated with it. Next, we review the potential effects associated to the selection of the scale in the LUCC modelling field.

Defining Scale: Dimensions, Kinds and Components

Although very common, the term scale has been inconsistently defined, with each discipline providing a different concept (Quattrochi and Goodchild 1997). This proves the complexity behind the task of defining what is scale.

First, although scale is usually defined in spatial terms, especially in the field of geospatial analysis, the term is also used referring to other dimensions, such as the temporal, quantitative and analytical dimension (Lesschen et al. 2005).

Second, when focusing on the spatial dimension, scale will depend on the kind of space we are working with. Couclelis (1997) differentiates between an absolute, a relative and a proximal space and Gibson et al. (2000) proposed a definition of an absolute and a relative scale.

The absolute space is the usual one in geospatial analysis. Space is understood as a container, as a three-dimensional Cartesian frame of reference where we can place elements and make measurements. Then, the absolute scale is a quantitative measure based on distances, time or any other quantity. The relative space does not exist per se, and it is not geographical, but is made from the relationships between the different elements of a system. In a relative space, distances are not absolute, but relative, and depend on the connections and relationships among the different elements. Thus, the relative scale describes the functional relationships between objects or processes. The proximal space refers, in the specific context of Cellular Automata (CA) models, to the neighbour relationships between an element and its surroundings.

Some generic definitions of scale can be applied to all dimensions of scale and kinds of space. For Wu and Li (2009), scale is the window of perception that reflects the limitations at which a specific phenomenon can be viewed. Marceau (1999) defines scale as a "continuum through which entities, patterns, and processes can be observed and linked". Bailey (1985) talks about the level of perceived detail when describing the scale.

In geospatial analysis, scale is usually defined in more restrictive terms, focusing on the absolute dimension of the space. Depending on the discipline, the definition varies. In landscape ecology, scale has been usually defined as the grain, i.e. the degree of detail, and the extent (Verburg et al. 2004; Ruíz Rivera and Galicia Sarmiento 2016). This is the usual understanding of the scale that also prevails in most of the

studies carried out in the field of geospatial analysis (O'Sullivan and Perry 2013). In geography, scale is usually understood as the cartographic scale, that is, the ratio of the size of an element on a map to the size of that element on the ground (Dungan et al. 2002).

Given the complexity of the term scale and the variety of definitions associated to it, several authors have proposed different frameworks to conceptualize scale (Marceau 1999; Gibson et al. 2000; Wu and Harbin 2006; Wu 2007; O'Sullivan and Perry 2013). From those, we select here the framework of Wu and Harbin (2006) and Wu (2007). It has been widely accepted, and it is the most comprehensive of all those we have found.

Wu and Harbin (2006) and Wu (2007) distinguish between dimensions, kinds and components of scale (Fig. 1). Three are three dimensions of scale: time, space and, from the combination of the previous two, the organizational levels. Time relates with frequency or data time richness, space with spatial detail and the organizational levels with the interrelation of the components of a system at a specific time and degree of spatial detail. At each organizational level, specific patterns and processes emerge.

For each dimension, we can distinguish different kinds of scale, closely inter-related among them (Fig. 1). The intrinsic scale is the scale at which a specific phenomenon happens. The observation scale is the one at which we observe the phenomenon under study. The analysis scale is the scale at which we analyse that phenomenon. Finally, the policy scale is the scale at which we implement the policies to control or manage that phenomenon.

In a third level, for each dimension and kind of scale, Wu and Harbin (2006) and Wu (2007) differentiate four components of scale (Fig. 1). Different to the dimensions and kinds of scale, the components can be quantified and therefore refer to the absolute space. They are the cartographic scale; the coverage and the spacing; the extent; and the grain.

The cartographic scale is the ratio of the size of an element on a map to the size of that element on the ground. The coverage and the spacing refer to data sampling, meaning coverage data intensity in space or time and spacing the distance between one sample and the other. The extent is the length, in space or time, of a dataset or phenomenon. Finally, grain refers to the degree of temporal, spatial or thematic detail. The spatial grain is measured differently depending on the data format: in vector data the grain depends on the minimum mapping unit and the minimum mapping width, that is, the minimum area and width of the smallest element to be drawn on a map; in raster data, the grain is driven by the spatial resolution or pixel size.

Scale and Related Concepts

There are many concepts related to scale that are of interest to understand the concep-tualization of natural and socioeconomic processes and phenomena from a scalar perspective. In addition, there are other concepts related to the quantification and
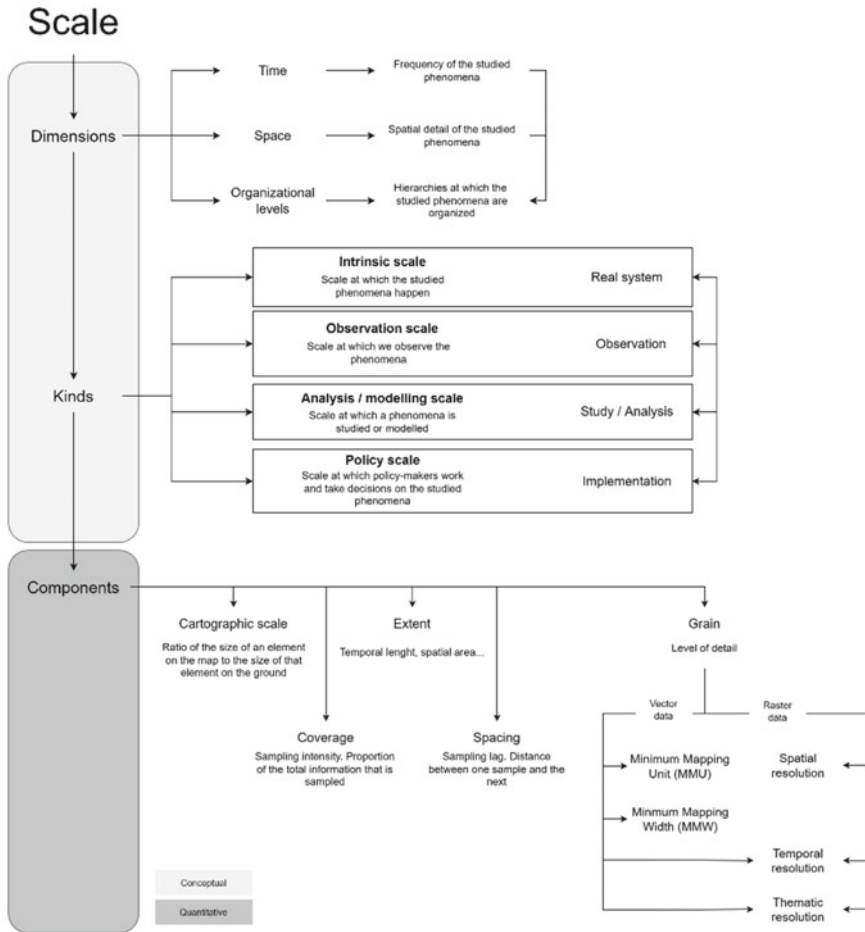
Fig. 1 Dimensions, kinds and components of scale according to the conceptual framework proposed by Wu and Harbin (2006) and Wu (2007)

analysis of scale, very common in geospatial analysis, that all readers in the field should bear in mind.

Understanding Natural and Socioeconomic Processes from a Scalar Perspective

The world is made of complex systems, which are the result of interactions and relationships between different elements and processes at different **levels** (Fig. 2). Each of these levels shows specific characteristics and patterns, which are the result
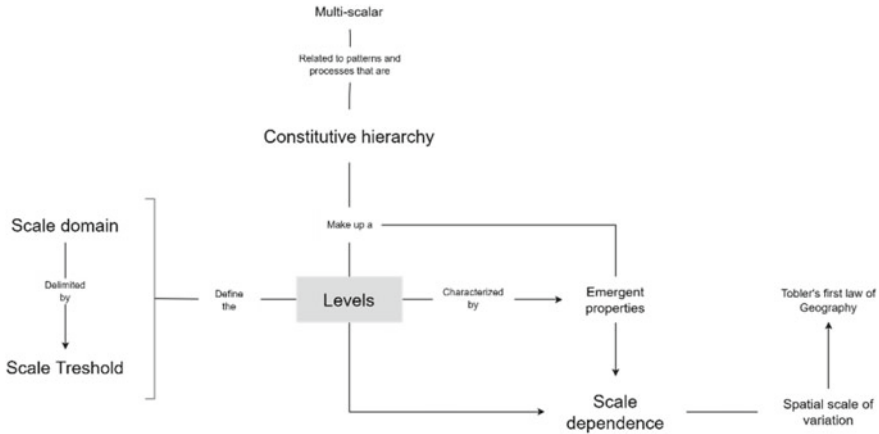
Fig. 2 Conceptual chart of the scalar conceptualization of natural and socioeconomic processes

of the interaction between a series of elements and processes that operate at the specific scale at which that level can be analysed. These characteristics and patterns that emerge at that specific level and scale of analysis are what Gibson et al. (2000) called **emergent properties**. This means that the elements and processes that we observe and study at a scale, when grouped, generate new elements and processes different to the ones in a level that is below in the hierarchy. Gibson et al. (2000) call this phenomenon **constitutive hierarchies**, which are the base of multi-scalar systems.

Those levels and associated emergent properties are explained by the **scale-dependence** of different processes and phenomena and their resulting patterns. That is, certain processes and phenomena show different properties or characteristics at different levels of analysis. On the contrary, other processes and patterns are **scale-invariant**, **self-similar**, **self-affine** or **fractal**. The scales at which those properties remain invariant, in the case of scale-dependent processes, constitute what we call the **scale domain**. On the other hand, the scale at which those properties change from one scale domain to the other constitute what we call the **scale threshold** (Marceau 1999).

The processes and phenomena that are scale-dependent usually show more heterogeneous patterns and characteristics when studied at larger extents and over larger spaces or time spans. This is what Lloyd (2014) has defined as the **spatial scale of variation**, which relates to **Tobler's first law of geography**: "everything is related to everything else, but near things are more related than distant things" (Tobler 1970). Thus, at local scales, the spatial scale of variation is very low, whereas at scales covering larger areas or times, the spatial scale of variation is higher. The further we go in space or time, the more likely a phenomenon or pattern becomes more heterogeneous.

Scale and Data from a Quantitative Perspective

Data is not always available at the level at which the properties of the system we want to study emerge. To cope with this limitation, we usually need to rescale the data, to transform data from one scale to another. This is what Wu (2007) calls **scaling** (Fig. 3). We differentiate between **downscaling**, which means decomposing information at finer scales, and **upscaling**, which means aggregating information at coarser scales (Marceau 1999).

We can also understand upscaling as a process of **GIS or cartographic generalization**. GIS generalization refers to the simplification of spatial analyses when lowering the degree of detail. On the other hand, cartographic generalization refers to the simplification and reduction of elements in a map to make it legible at coarser scales. This process is what João (2001) defined as the **competition for map space**, considered by Fisher (2005) the paradigm of cartographic production. In a similar vein, Villa et al. (2008) talk about the **class explosion problem** to explain the impossibility to represent all the complexity of natural systems through a specific classification legend, given its finite nature. Thus, users must always select a specific number of classes, whose number will depend on the scale and the quantity of information that are able to manage at that scale.

Scaling the data may introduce important sources of uncertainty. Lloyd (2014) considers that the uncertainty of our spatial databases will depend on how well we have managed the scale and scaling issues. Some of the problems associated
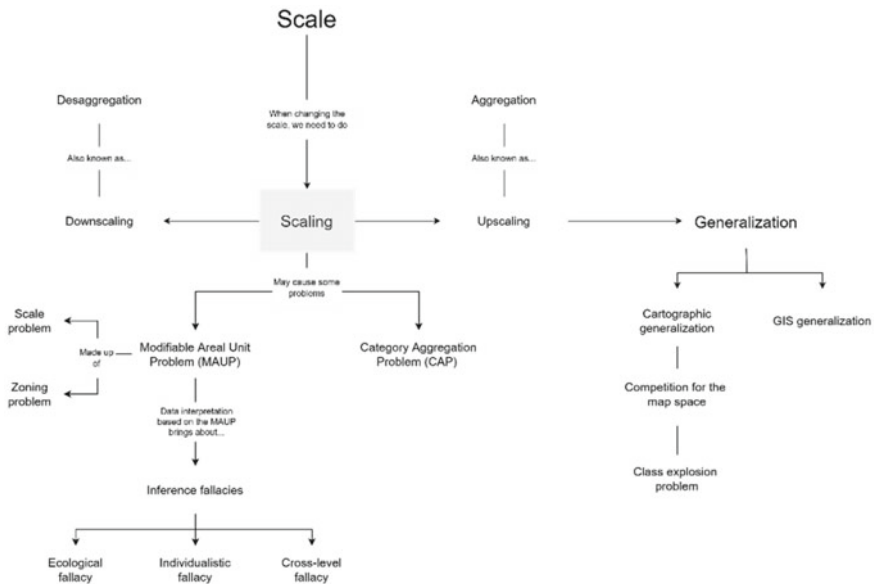
Fig. 3 Conceptual chart of the quantification of scale

with data scaling are the **Modifiable Areal Unit Problem (MAUP)**, the **Category Aggregation Problem (CAP)** and the **inference fallacies**.

The MAUP refers to the units of analysis at which we study a process or phenomenon. It is made up of the **scale problem** and the **aggregation or zoning problem** (Marceau 1999). The first refers to the variability of the results because of the aggregation of the different units of analysis. Studying a phenomenon at the council level may not lead to the same conclusions that studying it at the regional level, which relates with the constitutive hierarchies defined by Gibson et al. (2000). The zoning problem refers to the variability of the results coming from the different criteria used when designing the units of analysis at the same degree of detail. Thus, a study following a square grid when defining the units of analysis may not lead to the same conclusions than a study that makes the same analysis following a circular grid.

When not taking the MAUP into account and translating the conclusions obtained at one level of analysis to another, different, level of analysis, we fall into the called inference fallacies (Ruíz Rivera and Galicia Sarmiento 2016). If conclusions obtained at lower levels of detail are assumed at higher levels of detail, we fall into the **ecological fallacy**, the ecological inference problem or the spatial transmutation fallacy (Pontius and Malizia 2004; Wu 2007). On the contrary, if conclusions obtained at higher levels of detail are assumed in lower levels of detail, we fall into the **individualistic or atomistic fallacy** (Alker 1969; Lloyd 2014). The **cross-level fallacies** appear when we assume the conclusions from one sub-group of data into another sub-group of data (Cao and Siu-Ngan Lam 1997).

Finally, the CAP refers to the variability of the results of our analysis coming from the differences in the aggregation of the categories that make up a classification legend (Pontius and Malizia 2004). Different to the MAUP, the CAP does not refer to the variability of the unit of observation, but to the variability of the variable definition.

The Scale in the Land Use Cover Change Modelling Practice

When setting up a LUCC modelling exercise, we need to decide at which scale or scales the model will operate and, accordingly, the scale of the model input and validation data. This is not an easy, nor simple, decision. According to Marceau (1999), there is not an optimal scale, nor an ideal method to select it. García-Álvarez (2018) reviews different recommendations of scales to use in different analyses, finding important incoherencies among authors' proposals and recognizing the impossibility of this task.

A LUCC model, as any other model, means a conceptualization and simplification of a real system, which will depend to a large extent on the selected scale of analysis. The correspondence between the selected scale of analysis and the intrinsic scale of the modelled phenomenon, or between the scale of input data and the scale at which different processes and patterns emerge, will determine the degree of uncertainty of

our LUCC modelling exercises. Accordingly, those two aspects must be taken into account when deciding the proper scale for our exercise.

Below, we review how different scale decisions may affect a LUCC modelling exercise. Through this revision, we aim to provide to all interested audience information about the importance of scale selection in any geospatial analysis. Although specific studies are cited, readers must bear in mind that each system or process has its own scalar behaviour, which we must understand before taking any decision on which scale should be used (Lloyd 2014). This means that it is important to understand the heterogeneity and variability of the elements or processes under study (Leao 2016). Some methods have been proposed to this end, such as fractal, regression or texture analyses, the geographic variance method, the local variance method, variograms and semivariograms (Marceau 1999; Samat 2006; Wu and Li 2009; Lloyd 2014).

In the next sections, we address the scale issue in the different stages of a LUCC modelling exercise: the system conceptualization, the selection of input data, the model validation and the visualization and communication of the model results.

System Conceptualization

Determining the spatial and temporal extent of the studied system, the definition of the variable under evaluation or the time or spatial units that will be used to study and model the system are some of the key decisions to take when conceptualizing that system. These decisions are closely linked to the selection of scale.

The Spatial and Temporal Extent of the System

There are only a few studies that have analysed the impact of the spatial extent of the modelled area in a LUCC modelling exercise. When working with models at very different extents (e.g. national and local), Verburg and Veldkamp (2004) found that the models provided different, but complementary results: at each extent, different processes and patterns could be studied and analysed, as each extent corresponded to a different level with its own emergent properties. Verburg and Chen (2000) and Veldkamp et al. (2001) proved how the explanatory power of driving forces varied with the extent. Accordingly, when using different extents to find the relation between driving forces and land change, models can deliver very different results (Kok et al. 2001). For similar spatial extents, Pan et al. (2010) checked important model variations in a CA model. However, this is not a well explored issue in LUCC modelling.

In terms of temporal extent, Rosa et al. (2015), Paegelow (2018) and Aguejdad (2021) found an impact of the selected time extent in model calibration and estimation of quantities of change. For CA models, Verburg et al. (2004) found how neighbour relationships are different for each time extent. Modellers recommend a similar length

of both calibration and simulation periods (Rosa et al. 2015), which should fit the time when the studied dynamics of change happen.

The Spatial and Temporal Units of Analysis

Regarding the units of analysis, the research focusing on the impact of variable spatial units of analysis in the performance of LUCC models is very common. However, the interest in the temporal units of analysis is lower.

Research on the impact of the spatial units of analysis in LUCC models has mostly focused on raster LUCC models and the variation of their spatial resolution, i.e. pixel size. Díaz-Pacheco et al. (2018) concluded that, at finer spatial resolutions, there are more chances to simulate a complex and random pattern, as there are more cells to allocate. Moreira et al. (2009) pointed out how at different spatial resolutions emerge different patterns and processes. Thence, the model explains different dynamics and processes (emergent properties) at each spatial resolution (level). The spatial resolution also affects other model components, such as the explanatory power of some factors (Shchiptsova et al. 2016; García-Álvarez and Camacho Olmedo 2021) and the quantities of changes that are simulated, at least when extrapolated from input data (Blanchard et al. 2015).

Most of the research that has been carried out shows how the validation indices of LUCC models are better at coarser than finer spatial resolutions (Kok et al. 2001; Blanchard et al. 2015). At coarser resolutions, the errors coming from the spatial detail are removed and the chances to rightly allocate land changes higher, as there will not be many pixels that change, but only a few (Blanchard et al. 2015). In addition, the complexity of the model calibration and validation, as well as the required computer processing power, is lower (Kim 2013; Blanchard et al. 2015). Chen and Pontius (2011) suggest that finer spatial resolutions must only be chosen when they increase the explanatory power of the model, that is, when they explain new patterns and processes of change that the model is able to simulate.

In CA models, the spatial unit of analysis is also made of the shape and size of the neighbourhood window where the cellular automata works. Many researchers have studied the impact of these components on the LUCC modelling practice, although little agreement has been reached regarding the specific consequences. Most of the authors agree on the relationship between the model spatial resolution and the neighbourhood size, pointing out that both parameters should be decided together (Benenson 2007; Pan et al. 2010). However, whereas some authors found more model variability because of the neighbourhood window than because of the spatial resolution (Morais Viana 2014), others found the opposite pattern (Ménard and Marceau 2005). Zhao (2013) and Morais Viana (2014) also found scale domains in which the model variability is very low.

Some authors have focused on the model regionalization instead of the spatial resolution when assessing the impact of the spatial unit of analysis in the models. In this regard, they have studied how the regionalization of the model dynamics achieved better results, as the model was able to better simulate the heterogeneous

dynamics of the studied system (Evans and Kelley 2004; Kazemzadeh-Zow et al. 2016). Kazemzadeh-Zow et al. (2016) went further in their analysis and showed how model regionalization's based on administrative boundaries incurred in the MAUP zoning problem, as those boundaries may not fit well with the different heterogeneous patterns of land change.

Different authors point out at the multi-scalar nature of natural phenomena when addressing the uncertainty of models' conceptualization and advocate for integrated models working at different scales (Verburg et al. 2007; Van Delden et al. 2011). This type of model is still uncommon: most of the models tested until the moment work at a single scale (Lesschen et al. 2005). However, they have more potential to address the complexity of real systems. Nonetheless, important issues may arise when working with multi-scalar models, such as the way each model at each scale interacts with the others (Sohl and Claggett 2013). In this regard, integrated modelling is still a prominent research line that requires more developments (National Research Council 2014).

Regarding the temporal unit of analysis, Yeh and Li (2006) and Kim (2013) proved how CA models deliver different results depending on the time span of each model step: yearly, every 5 years, 10 years … The analysis of Bernard et al. (2008) points out that at finer temporal resolutions the neighbourhood rules of CA models are more realistic. Abolhasani and Taleai (2020) found that asynchronous CA models (land use states are not updated at each time step) delivered better results that synchronous CA models, as land use updates at each time step (e.g. each year) may not fit the logic of many real processes and dynamics. Not only focusing on CA models, Houet et al. (2015) warned that the dynamic or static nature of driving forces of change may significantly affect the model results.

The Definition of the Modelled Variable

The model variable definition is usually provided by the thematic resolution of the LUC datasets used as input for the models. It affects the quantity of changes estimation, the land change allocation and the land change pattern. Conway (2009) assessed how models at lower thematic resolutions simulated more quantities of change than models at higher thematic resolutions. This trend improves the model validation indices, as also noted down by García-Álvarez et al. (2019a, b), who dissasociated the better simulation scores from the better model explanatory power when lowering the thematic resolutions.

Dietzel and Clarke (2006) found that the simulated pattern is more fragmented at higher thematic resolutions. In the analyses of Cai and Wang (2020), Dietzel and Clarke (2006) and Zhao (2011), models at higher resolutions achieved better simulation scores than models at lower resolutions, as models based on a few classes usually allocate land changes following very simple patterns. According to Cai and Wang (2020), this leads to a caothic model behaviour.

Several authors agree on the fact that models at higher thematic resolutions are more complex and may make the model more uncertain, if that complexity is not well managed (Conway 2009; Hasbani et al. 2011).

Input Data

The scale of input data must be related with the decisions previously taken regarding the system conceptualization. In this regard, input data at a different scale than the one of the model conceptualization may show different processes, patterns or characteristics of the system than the ones we want to study.

However, input data is not usually available at the same spatial or thematic resolutions that the one our model may demand. Then, scaling procedures are required, which will introduce new sources of uncertainty in our studies. That is why the scale selection regarding the system conceptualization must be done taking into account data availability.

García-Álvarez et al. (2019a) checked important model differences when simulating the same system at the same resolution and using input maps distributed with different minimum mapping units and minimum mapping widths. Dendoncker et al. (2008) found how input data at different spatial resolutions and obtained through different resampling methods provided simulations more different than the ones coming, when using the same input data, from different scenarios and narratives. On the contrary, Díaz-Pacheco et al. (2018) and García-Álvarez and Camacho Olmedo (2021) analysed the impact of data transformation (vector to raster conversions, resampling …) in the model results, without finding any meaningful influence in the model performance.

Model Validation

LUCC models are usually validated against reference LUC maps. Their scale may affect the results of the validation exercises and, accordingly, our judgment about the model reliability. Paegelow et al. (2018) point out that data at different scales may end in different results when calculating the LUCC budget. Šímová and Gdulová (2012) review the important changes in the results of the spatial metrics when changing the scale. Both are common procedures for validation of LUCC models.

The temporal and spatial extent at which the validation is carried out will also impact the obtained results. Rosa et al. (2015) proved how the temporal extent of the validation period may affect the obtained validation scores. Notwithstanding, validation periods are usually related with the temporal extent of the model itself and how the system has been conceptualized. Castilla and Hay (2007) and Fassnacht et al. (2006) point out that validation exercises at only one spatial extent may be misleading, as models can work well in a portion of the study area, but not in another, especially

when working with very heterogeneous systems. In a similar vein, the same authors point out to the impact of the variable definition and the thematic resolution in the validation of the modelling exercise: global validation scores for all categories may hide errors and model problems when wrongly simulating specific categories whose process understanding is more uncertain.

To avoid those potential sources of uncertainty, authors advocate for multi-scalar approaches when validating LUCC modelling exercises (Gallardo 2014; Aguejdad et al. 2017). In terms of extent, this would mean validating the model at multiple spatial and temporal extents. Regarding the variable definition, it would require a global and individual validation per category. Finally, according to the unit of analysis, different authors have proposed and developed multi-scalar procedures or techniques for model validation.

Costanza (1989) proposed a framework for model validation at multiple spatial resolutions. Pontius Jr has also proposed a similar procedure to assess minor and major allocation disagreements (Pontius et al. 2011; Pontius and Cheuk 2006; Pontius 2002): validations at coarser spatial resolutions allow to spot major allocation disagreement, whereas validations at finer spatial resolutions allow to spot minor disagreements. The Fuzzy kappa indices proposed by Hagen (2003) and Van Vliet et al. (2013) go deeper in that idea by proposing kappa indices that consider as partial success the land change that happens in areas close to the ones where that change actually happened according to the reference data. It is therefore a validation tool that works with the idea of scale in a proximal space.

Visualization and Communication of the Results

Users and audience usually require model results at a different scale to the one at which the model operates and the dynamics happen (Van Delden et al. 2011). As the model generates multiple results, which may be not easy to follow and understand, modellers need to simplify the model outputs and make them accessible and understandable to their target audience and users. This means scaling the data, which must be done considering the impact that changes in the scale may have on what is perceived. As in the validation exercises, multi-scalar approaches can be a good solution.

Concluding Remarks

Scale is a generic concept that has been inconsistently defined. Different disciplines and researchers have used the term scale when referring to different questions. Accordingly, scale is a complex concept which, however, is very important in any geospatial analysis. It affects the way systems, processes or any landscape

are conceptualized and, consequently, the results and conclusions from any study or analysis.

To help readers understand what is scale and its complexity, we have differentiated between dimensions, kinds and components of the scale. In addition, we have reviewed all concepts related with scale, whose comprehension is essential to understand the impact of scale decisions in the design and execution of geospatial analyses.

The revision of studies addressing the scale issue in LUCC modelling provides a comprehensive overview of the importance associated to these decisions and their potential effects. Readers may extract from this review general lessons that can help them to select the scale that better fits their data and analyses.

References

Abolhasani S, Taleai M (2020) Assessing the effect of temporal dynamics on urban growth simulation: towards an asynchronous cellular automata. Trans GIS 24:332–354. https://doi.org/10.1111/tgis.12601

Aguejdad R (2021) The influence of the calibration interval on simulating non-stationary urban growth dynamic using CA-Markov model. Rem Sens 13:468. https://doi.org/10.3390/rs13030468

Aguejdad R, Houet T, Hubert L (2017) Spatial validation of land use change models using multiple assessment techniques: a case study of transition potential models. Environ Model Assess. https://doi.org/10.1007/s10666-017-9564-4

Alker HR (1969) A typology of ecological fallacies. In: Dogan M, Rokkan S (eds) Quantitative ecological analysis in the social sciences. The MIT Press, Cambridge, pp 69–86

Bailey RG (1985) The factor of scale in ecosystems mapping. Environ Manage 9:271–276

Benenson I (2007) Warning! The scale of land-use CA is changing! Comput Environ Urban Syst 31:107–113. https://doi.org/10.1016/j.compenvurbsys.2007.01.001

Bernard L, Friis-Christensen A, Pundt H, Hansen HS (2008) Quantifying and analysing neighbourhood characteristics supporting urban land-use modelling. Eur Inf Soc 283–299. https://doi.org/10.1007/978-3-540-78946-8_15

Blanchard SD, Pontius RG Jr, Urban KM (2015) Implications of using 2 m versus 30 m spatial resolution data for suburban residential land change modeling. J Environ Inform 25:1–13. https://doi.org/10.3808/jei.201400284

Cai L, Wang M (2020) Effect of the thematic resolution of land use data on urban expansion simulations using the CA-Markov model. Arab J Geosci 13. https://doi.org/10.1007/s12517-020-06248-z

Cao C, Siu-Ngan Lam N (1997) Understanding the scale and resolution effects in remote sensing and GIS. In: Quattrochi DA, Goodchild MF (eds) Scale in remote sensing and GIS. CRC Press, Boca Raton, pp 57–72

Castilla G, Hay GJ (2007) Uncertainties in land use data. Hydrol Earth Syst Sci 11:1857–1868. https://doi.org/10.5194/hess-11-1857-2007

Chen H, Pontius RG Jr (2011) Sensitivity of a land change model to pixel resolution and precision of the independent variable. Environ Model Assess 16:37–52. https://doi.org/10.1007/s10666-010-9233-3

Conway TM (2009) The impact of class resolution in land use change models. Comput Environ Urban Syst 33:269–277. https://doi.org/10.1016/j.compenvurbsys.2009.02.001

Costanza R (1989) Model goodness of fit: a multiple resolution procedure. Ecol Modell 47:199–215. https://doi.org/10.1016/0304-3800(89)90001-X

Couclelis H (1997) From cellular automata to urban models: new principles for model development and implementation. Environ Plan B Plan Des 24:165–174. https://doi.org/10.1068/b240165

Dendoncker N, Schmit C, Rounsevell M (2008) Exploring spatial data uncertainties in land-use change scenarios. Int J Geogr Inf Sci 22:1013–1030. https://doi.org/10.1080/13658810701812836

Díaz-Pacheco J, Van Delden H, Hewitt R (2018) The importance of scale in land use models: experiments in data conversion, data resampling, resolution and neighbourhood extent. In: Camacho Olmedo MT, Paegelow M, Mas J-F, Escobar F (eds) Geomatic approaches for modeling land change scenarios. Springer, Cham, Switzerland, pp 163–186. https://doi.org/10.1007/978-3-319-60801-3_9

Dietzel C, Clarke KC (2006) The effect of disaggregating land use categories in cellular automata during model calibration and forecasting. Comput Environ Urban Syst 30:78–101. https://doi.org/10.1016/j.compenvurbsys.2005.04.001

Dungan JL, Perry JN, Dale MRT et al (2002) A balanced view of scale in spatial statistical analysis. Ecography (Cop) 25:626–640. https://doi.org/10.1034/j.1600-0587.2002.250510.x

Evans TP, Kelley H (2004) Multi-scale analysis of a household level agent-based model of landcover change. J Environ Manage 72:57–72. https://doi.org/10.1016/j.jenvman.2004.02.008

Fassnacht KS, Cohen WB, Spies TA (2006) Key issues in making and using satellite-based maps in ecology: a primer. For Ecol Manage 222:167–181. https://doi.org/10.1016/j.foreco.2005.09.026

Fisher PF (2005) Models of uncertainty in spatial data. In: Longley PA, Goodchild MF, Maguire DJ, Rhind DW (eds) Geographical information systems: principles, techniques, management and applications. Wiley, pp 191–205

Gallardo M (2014) Cambios de usos del suelo y simulación de escenarios en la Comunidad de Madrid. Universidad Complutense de Madrid. https://eprints.ucm.es/25253/

García-Álvarez D (2018) Aproximación al estudio de la incertidumbre en la modelización del Cambio de Usos y Coberturas del Suelo (LUCC). Universidad de Granada. http://hdl.handle.net/10481/52908

García-Álvarez D, Camacho Olmedo MT (2021) Sensitivity of a standard land use cover change cellular automata model to resample input land use cover maps. South Afr Geogr J 103:540–560. https://doi.org/10.1080/03736245.2021.1872413

García-Álvarez D, Camacho Olmedo MT, Paegelow M (2019a) Sensitivity of a common Land Use Cover Change (LUCC) model to the Minimum Mapping Unit (MMU) and Minimum Mapping Width (MMW) of input maps. Comput Environ Urban Syst 78. https://doi.org/10.1016/j.compenvurbsys.2019.101389

García-Álvarez D, Lloyd CD, Van Delden H, Camacho Olmedo MT (2019b) Thematic resolution influence in spatial analysis. An application to Land Use Cover Change (LUCC) modelling calibration. Comput Environ Urban Syst 78:101375. https://doi.org/10.1016/j.compenvurbsys.2019.101375

Gibson CC, Ostrom E, Ahn TK (2000) The concept of scale and the human dimensions of global change: a survey. Ecol Econ 32:217–239. https://doi.org/10.1016/S0921-8009(99)00092-0

Hagen A (2003) Fuzzy set approach to assessing similarity of categorical maps. Int J Geogr Inf Sci 17:235–249. https://doi.org/10.1080/13658810210157822

Hasbani GJ, Wijesekara N, Marceau DJ (2011) An interactive method to dynamically create transition rules in a land-use cellular automata model. In: Salcido A (ed) Cellular automata—simplicity behind complexity. InTech, pp 3–22. https://doi.org/10.5772/16073

Houet T, Vacquié L, Sheeren D (2015) Evaluating the spatial uncertainty of future land abandonment in a mountain valley (Vicdessos, Pyrenees–France): insights from model parameterization and experiments. J Mt Sci 12:1095–1112. https://doi.org/10.1007/s11629-014-3404-7

João E (2001) Measuring scale effects caused by map generalization and the importance of displacement. In: Tate NJ, Atkinson PM (eds) Modelling scale in geographical information science. Wiley, Chichester, New York, Weinheim, Brisbane, Singapore, Toronto, pp 161–179

Kazemzadeh-Zow A, Zanganeh Shahraki S, Salvati L, Samani NN (2016) A spatial zoning approach to calibrate and validate urban growth models. Int J Geogr Inf Sci 0:1–20. https://doi.org/10.1080/13658816.2016.1236927

Kim JH (2013) Spatiotemporal scale dependency and other sensitivities in dynamic land-use change simulations. Int J Geogr Inf Sci 27:1782–1803. https://doi.org/10.1080/13658816.2013.787145

Kok K, Farrow A, Veldkamp A, Verburg PH (2001) A method and application of multi-scale validation in spatial land use models. Agric Ecosyst Environ 85:223–238. https://doi.org/10.1016/S0167-8809(01)00186-4

Leao SZ (2016) Assessing the trade-off between data quality and spatial resolution for the Thornthwaite Moisture Index mapping. J Spat Sci 8596:1–18. https://doi.org/10.1080/14498596.2016.1220871

Lesschen JP, Verburg PH, Staal SJ (2005) Statistical methods for analysing the spatial dimension of changes in land use and farming systems. ILRI, LUCC Focus 3 Office, Nairobi, Wageningen

Lloyd CD (2014) Exploring spatial scale in geography. Wiley, Chichester

Marceau DJ (1999) The scale issue in social and natural sciences. Can J Rem Sens 25:347–356. https://doi.org/10.1080/07038992.1999.10874734

Ménard A, Marceau DJ (2005) Exploration of spatial scale sensitivity in geographic cellular automata. Environ Plan B Plan Des 32:693–714. https://doi.org/10.1068/b31163

Morais Viana C (2014) A influência do efeito de escala nos modelos de simulação baseados em autómatos celulares. Universidade de Lisboa. http://hdl.handle.net/10451/20429

Moreira E, Costa S, Aguiar AP et al (2009) Dynamical coupling of multiscale land change models. Landsc Ecol 24:1183–1194. https://doi.org/10.1007/s10980-009-9397-x

National Research Council (2014) Advancing land change modeling: opportunities and research requirements. National Academies Press, Washington, D.C. https://doi.org/10.17226/18385

O'Sullivan D, Perry GLW (2013) Spatial simulation: exploring pattern and process. Wiley, Chichester. https://dosull.github.io/pattern-and-process/

Paegelow M (2018) Impact and integration of multiple training dates for Markov based land change modeling. In: Camacho Olmedo MT, Paegelow M, Mas J-F, Escobar F (eds) Geomatic approaches for modeling land change scenarios. Springer, Cham, Switzerland, pp 121–138. https://doi.org/10.1007/978-3-319-60801-3_7

Paegelow M, Camacho Olmedo MT, Mas J-F (2018) Techniques for the validation of LUCC modeling outputs. In: Camacho Olmedo MT, Paegelow M, Mas J-F, Escobar F (eds) Geomatic approaches for modeling land change scenarios. Springer, Cham, Switzerland, pp 53–80. https://doi.org/10.1007/978-3-319-60801-3_4

Pan Y, Roth A, Yu Z, Doluschitz R (2010) The impact of variation in scale on the behavior of a cellular automata used for land use change modeling. Comput Environ Urban Syst 34:400–408. https://doi.org/10.1016/j.compenvurbsys.2010.03.003

Pontius RG Jr, Cheuk ML (2006) A generalized cross-tabulation matrix to compare soft-classified maps at multiple resolutions. Int J Geogr Inf Sci 20:1–30. https://doi.org/10.1080/13658810500391024

Pontius Jr RG, Malizia NR (2004) Effect of category aggregation on map comparison. In: Egenhofer MJ, Freksa C, Miller HJ (eds) Geographic information science. Third international conference, GIScience. Springer, Adelphi, pp 251–268. https://doi.org/10.1007/978-3-540-30231-5_17

Pontius RG Jr, Peethambaram S, Castella J-C (2011) Comparison of three maps at multiple resolutions: a case study of land change simulation in Cho Don District, Vietnam. Ann Assoc Am Geogr 101:45–62. https://doi.org/10.1080/00045608.2010.517742

Pontius RG Jr (2002) Statistical methods to partition effects of quantity and location during comparison of categorical maps at multiple resolutions. Photogramm Eng Rem Sens 68:1041–1050

Quattrochi DA, Goodchild MF (1997) Scale in remote sensing and GIS. CRC Press, Boca Raton

Rosa IMD, Purves D, Carreiras JMB, Ewers RM (2015) Modelling land cover change in the Brazilian Amazon: temporal changes in drivers and calibration issues. Reg Environ Chang 15:123–137. https://doi.org/10.1007/s10113-014-0614-z

Ruíz Rivera N, Galicia Sarmiento L (2016) La escala geográfica como concepto integrador en la comprensión de problemas socio-ambientales. Investig Geográficas 89:137. https://doi.org/10.14350/rig.47515

Samat N (2006) Characterizing the scale sensitivity of the cellular automata simulated urban growth: a case study of the Seberang Perai Region, Penang State, Malaysia. Comput Environ Urban Syst 30:905–920. https://doi.org/10.1016/j.compenvurbsys.2005.11.002

Shchiptsova A, Hewitt R, Elena R (2016) Exploratory spatial analysis of regional urbanization patterns in the Province of Seville, Spain. Laxenburg, Austria. https://doi.org/10.13140/RG.2.2.13836.72321

Šímová P, Gdulová K (2012) Landscape indices behavior: a review of scale effects. Appl Geogr 34:385–394. https://doi.org/10.1016/j.apgeog.2012.01.003

Sohl TL, Claggett PR (2013) Clarity versus complexity: land-use modeling as a practical tool for decision-makers. J Environ Manage 129:235–243. https://doi.org/10.1016/j.jenvman.2013.07.027

Tobler WR (1970) A computer movie simulating urban growth in the Detroit region. Econ Geogr 46:234. https://doi.org/10.2307/143141

Van Delden H, Van Vliet J, Rutledge DT, Kirkby MJ (2011) Comparison of scale and scaling issues in integrated land-use models for policy support. Agric Ecosyst Environ 142:18–28. https://doi.org/10.1016/j.agee.2011.03.005

Van Vliet J, Hagen-Zanker A, Hurkens J, Van Delden H (2013) A fuzzy set approach to assess the predictive accuracy of land use simulations. Ecol Modell 261–262:32–42. https://doi.org/10.1016/j.ecolmodel.2013.03.019

Veldkamp A, Verburg PH, Kok K et al (2001) The need for scale sensitive approached in spatially explicit land use change modeling. Environ Model Assess 6:111–121. https://doi.org/10.1023/A:1011572301150

Verburg PH, Chen YQ (2000) Multiscale characterization of land-use patterns in China. Ecosystems 3:369–385. https://doi.org/10.1007/s100210000033

Verburg PH, Eickhout B, Van Meijl H (2007) A multi-scale, multi-model approach for analyzing the future dynamics of European land use. Ann Reg Sci 42:57–77. https://doi.org/10.1007/s00168-007-0136-4

Verburg PH, Schot P, Dijst M, Veldkamp A (2004) Land use change modelling: current practice and research priorities. GeoJournal 61:309–324. https://doi.org/10.1007/s10708-004-4946-y

Verburg PH, Veldkamp A (2004) Projecting land use transitions at forest in the Philippines at two spatial scales. Landsc Ecol 19:77–98. https://doi.org/10.1023/B:LAND.0000018370.57457.58

Villa G, Valcarcel N, Caballlero ME et al (2008) Land cover classifications: an obsolete paradigm. In: Chen J, Jiang J, Nayak S (eds) The international archives of the photogrammetry, remote sensing and spatial information sciences. ISPRS, Beijing, pp 609–614

Wu H, Li ZL (2009) Scale issues in remote sensing: a review on analysis, processing and modeling. Sensors 9:1768–1793. https://doi.org/10.3390/s90301768

Wu J (2007) Scale and scaling: a cross-disciplinary perspective. In: Wu J, Hobbs RJ (eds) Key topics in landscape ecology. Cambridge University Press, Cambridge, New York, pp 115–142

Wu J, Harbin L (2006) Concepts of scale and scaling. In: Wu J, Jones KB, Li H, Loucks OL (eds) Scaling and uncertainty analysis in ecology: methods and applications. Springer, Dordrecht, The Netherlands, pp 3–15. https://doi.org/10.1007/1-4020-4663-4_1

Yeh AG-O, Li X (2006) Errors and uncertainties in urban cellular automata. Comput Environ Urban Syst 30:10–28. https://doi.org/10.1016/j.compenvurbsys.2004.05.007

Zhao G (2013) Effects of spatial scale in cellular automata model for land use change. In: Gaol FL (ed) Recent progress in data engineering and internet technology. Springer, Berlin, Heidelberg, pp 101–106. https://doi.org/10.1007/978-3-642-28807-4_15

Zhao G (2011) The effect of land use categories resolution on geography cellular automata model. In: 2011 international conference on multimedia technology, ICMT. IEEE, Hangzhou, China, pp 5614–5617. https://doi.org/10.1109/ICMT.2011.6001785

West–East Differences in LEADER Program Results—The Expression of Wider Political and Governance Systems

Ana-Maria Opria, Lucian Roșu, and Ema Corodescu-Roșca

Abstract Rural development and reducing development disparities are two of the main objectives pursued at European level. Various development programs have been implemented, the LEADER program being one of the instruments offered to European rural areas for the financial support of disadvantaged communities. Despite its innovative bottom-up approach, the results on both the Western and Eastern EU countries sometimes question the program's success. The present chapter intends to construct an overall assessment of the LEADER program by performing an analysis on its results in Romania, taken as a study case for the Eastern European countries, and comparing them to the LEADER results in Western European countries. The differences observed regarding the program's performance in Europe will be discussed in relation to the wider political system and governance culture of the countries. The analysis aims at (1) drawing some general conclusions on the program's results in Western European countries, based on the evidences existing in the literature and (2) assessing the quantitative results of LEADER in Romania, as an exponent of the peripheral, less developed postsocialists countries, which are less present in the literature. The key finding of our comparative work is that while the West faces a selective behavior of the program (in favor of already developed areas), in the East, in countries like Romania, a low impact is recorded, both in developed and disadvantaged communities, because of a chaotic behavior in the program's implementation. This highlights the need to rethink the program's mode of operation so that it brings substantial results in terms of rural development. We argue that the adjustment of this mode of operation should be performed in relation to the prevailing governance culture in different countries.

A.-M. Opria (✉) · L. Roșu · E. Corodescu-Roșca
Faculty of Geography and Geology, Alexandru Ioan Cuza University of Iași, Iași, România
e-mail: anamaria.opria@uaic.ro

L. Roșu
e-mail: lucian.rosu@uaic.ro

E. Corodescu-Roșca
e-mail: ema.corodescu@uaic.ro

Introduction

The LEADER program is one of the European Union's instruments for financing rural areas. Its principal goal is to promote rural development by enhancing communities' ability to better manage local problems and find solutions that are tailored to their unique needs. This is accomplished by introducing a new bottom-up method of governance. As a result, the LEADER program aims to strengthen the involvement of local actors, as well as the community, in attaining the goal of rural development. The LEADER program envisions a shift from a centralized, top-down, to local, bottom-up governance. This will provide a more realistic image of local challenges, which will serve as the beginning point for determining the route to take and the reforms to make in order to accomplish rural development. Trying to draw a line between centralized and local governance, McAreavey (2009) claims that the distinction between the two is primarily a matter of growing decision-making power and the degree of involvement of local players in community issues. Local governance places a special emphasis on the interaction between public institutions responsible for the governing of the territory and the civil society of the respective territory, which has a major contribution in identifying those solutions adapted to local particularities (Kull 2014). Decentralization, bottom-up approach and reform of political structures are aspects that underlie the concept of good governance (McAreavey 2009).

The performance of a governing system based purely on a top-down approach has been demonstrated to be low in the past. This is because the top-down method has yet to result in more growth among local communities, owing to its limited ability to adapt to the unique characteristics of each territory. As a result, the LEADER program was created to address this issue by encouraging meaningful participation of local players in the rural development process. LEADER is regarded as a model not just for its potential to improve territorial government (Galindo-Pérez-de-Azpillaga and Foronda-Robles 2018), but also for its support and strengthening of territorial identity (Galindo-Pérez-de-Azpillaga and Foronda-Robles 2018). However, there are differences between countries regarding the LEADER results, the ability of communities to understand, support and implement this new way of governing often explaining these differences. Thus, in some cases the excessive involvement of central authorities has led to selective behavior, with LEADER funds being directed in favor of more developed communities (Nieto Masot et al. 2019), while in others the program's impact has proved to be too visible, as a result of the chaotic distribution of funds between disadvantaged and most developed communities (Opria et al. 2021).

The purpose of this study is to examine the differences in LEADER funding absorption between Western and Eastern countries, the types of LEADER initiatives that are supported, and the level of commitment of local actors to the LEADER program's excellent administration. The findings will then be explored in relation to the countries' broader political systems and governance cultures, as well as the LEADER program itself. This will show the extent to which the program's

running needs to be rethought, taking into account the prevalent governance culture in different nations, in order for the program to provide better rural development results.

The first section of the chapter looks at governance systems and how they can affect the proper execution of European initiatives for rural development. The second section highlights the outcomes of the LEADER program, which were mostly observed in Western European beneficiary communities with a decentralized management system. Following that, the LEADER findings are examined at the level of Romania, an Eastern European postsocialist state that serves as a case study for examining the LEADER program's performance inside centralized administration regions. The final section of this chapter concludes with a comparative study of the LEADER program's accomplishments at the European level, based on the results of the survey.

National Governance Systems—Obstacles or Catalysts in Engaging Bottom-Up Rural Development in Europe?

The governance system prevailing at national level plays an important role in explaining differences in local capacities to absorb funds and to promote local development, especially in rural areas (Beer 2014). Many scientific results suggest that the most decentralized-devolved countries bring greater scope for place-based policy and place leadership, while it is weaker in more centralized countries (ex. Stimson et al. 2009; Beer 2014). Bentley et al. (2017) developed a typology of four main national governance systems and their implications on sub-national leadership. According to them, even if centralist states generally inhibit sub-national leadership, they can have an opposite effect if sub-national government is in political accordance with central government or if they follow "a new centralist pattern", which include common frameworks and objectives delivered by the national government to all sub-national government accompanied by an acceptable level of constraint. On the contrary, decentralized systems, instead of their important share of responsibility devoted to sub-national governments, may give little scope for local leadership due to increased rigidity in terms of desired outcomes. Finally, Bentley et al. (2017) mention the devolved governance systems, where there is full fiscal and strategic freedom in relation to national government, therefore plenty of scope for sub-national governments either to develop a strong local leadership or to fall into inaction, due to their low leadership capacities. At the same time, beside the prevailing type of governance system at the national level at a given moment, one should take into consideration the important role played by norms, mentalities and practices which constitute an institutional heritage resulting from previous governance systems. In general, northern and western European countries have better structured governance systems, including cooperation mechanisms, complementarity of roles and awareness of their regional/local specificities, while southern and central-eastern European countries

have poorer governance systems. In the case of postsocialist countries, Damurski (2015) identifies a strong dialectic between formal institutions which are increasingly shaped by Europeanisation and new public management paradigm and informal structures still dominated by social norms and practices persisting from socialist period. Roland's (2008) theory on institutional changes in postsocialist countries differentiates between fast changing institutions (including legislation and political structures) and slow changing institutions (including cultural norms, mentalities and actual practices).

North and Smallbone (2006), in a review on a wide range of rural entrepreneurship policies provided for remote rural areas in Europe (including LEADER program) based on ten Local Action Groups (LAGs) in five European countries reach a clear conclusion on the role played by the wider governance system of the country in this respect. On the one hand, northern countries, endowed with mature and stable governance systems (Germany and the UK), were more able to deliver local growth via European policies, due to the ability of their national and sub-national governments to adjust these policies to actual local conditions. On the other hand, southern and eastern countries (Portugal, Greece and Poland) recorded less success due to their poor institutional experience and awareness of their own regional and local specificities which prevented an adequate adjustment of European policies.

LEADER Program Results at European Level—territorial Disparities

The LEADER program's results highlight disparities in beneficiary communities' capacity to understand and implement the program successfully, as it is demonstrated by the literature (Lacquement et al. 2020; Canete et al. 2020; Dax et al. 2016; Osti 2015; Maroto-Martos et al. 2020). These findings pertain to the distribution of funding between developed and disadvantaged communities, the degree of local actors' involvement in the LEADER program's excellent administration and the types of projects sponsored.

In terms of funds distribution, LEADER results differ from state to state. In Spain and France, the results of studies show that LEADER funds sometimes have an unequal distribution, which often leads to the development of already better developed communities and, implicitly, to the accentuation of disparities (Lacquement et al. 2020). Canete et al. (2020), analyzing the LEADER results in Spain, observed an increase in domestic economic gaps through the predominant financing of already developed territories, leaving behind the deeply disadvantaged rural areas. Thus, if in those LEADER beneficiary communities located near the urban poles the frequency of LEADER projects was high, in the rural communities far away from the urban centers there is a total absence of LEADER projects. Maroto-Martos et al (2020) conclude that LEADER did not meet expectations precisely because funding was also directed to developed areas, with those disadvantaged territories once again

being left behind. Thus, in the case of Spain, the results show that LEADER funds were predominantly directed to dynamic regions, those regions with a high population density and a higher level of socio-economic development (Canete et al. 2020), which favors the widening of gaps. On the other hand, in the Czech Republic, studies conducted on LEADER beneficiary communities show that underdeveloped rural areas were better supported by the program than peri-urban areas with a similar level of development (Novosak et al. 2018). This can be both a positive and a negative aspect. The fact that LEADER was able to increase rural communities' capacity to absorb funding can only be good news, as rural places are notoriously inefficient in this regard. On the other hand, where there are other equally disadvantaged regions, the overwhelming support of a single type of territory (in this case, rural) might expand the disparity (the peri-urban ones in the case of the Czech Republic). The development level of recipient areas, as well as discrepancies between them, must always be taken into account, as Novosak et al. (2018) point out, so that funding is directed primarily to the least developed communities. In Poland, the results show that the distribution of funds also takes into account unwritten local rules, aiming at a proportional and equitable division of funds between communes according to their size as a population (Furmankiewicz et al. 2021). This may contribute to a reduction of development gaps, but so far it has been found to be more conducive to innovative regions (Furmankiewicz et al. 2021).

Some researchers investigate the typology of local actors involved in the management of the program and their potential to influence local decisions in order to explain these spatial discrepancies in the way LEADER monies are dispersed. According to Lacquement et al. (2020), LEADER was dominated locally in Spain by powerful stakeholders, representatives of local political and economic interests, whereas civil society and minority groups were less involved in LEADER decision-making. In the UK, the LEADER results lead to the same conclusion, with Shucksmith (2002) noting that development programs based on an endogenous approach, such as LEADER, tend to favor strong actors. Moreover, in Austria, the results of studies show that the problem of powerful actors over-representation is even more pronounced. Thus, the inclusion of LEADER in the structure of the National Rural Development Programs (RDP), starting with 2007–2013, has led to an excessive involvement of the actors from national level in tracing the directions of intervention at local level (Dax et al. 2016). Lacquement et al. (2020) emphasize that the greatest possible diversity of actors in the LAGs management is needed in order for the decisions taken to bring real solutions to local problems, with the results of the studies highlighting the better performance of the LAGs led by a larger and more diverse group of actors. Thus, the composition and the way in which these LAGs are managed are very important. Unfortunately, Spain, the United Kingdom and Austria are not unique examples of poor management in some situations of the LEADER program at the local level, seen from the perspective of the typology of actors involved and the collaboration between them. Similar problems have been reported in Italy where Osti (2015) notes the coexistence of LAGs characterized by a close collaboration between actors and LAGs in which the actors involved pursue their own interest rather than that of the association. Canete et al. (2018) point out that this type of gap related to the degree

of collaboration between actors has also been observed among Spanish LAGs, which favors the accentuation of territorial disparities and reduces the LEADER program's capacity to achieve its objectives.

The actors participating in the local management of the LEADER program are crucial since they are the ones who determine the intervention directions in the rural areas that benefit from LEADER. In Austria, the high involvement of national bodies in local decisions, resulting from the integration of LEADER in the RDP, also meant a change in the typology of funded projects. If in the 2000–2006 financing period, most of the LEADER initiatives were of non-agricultural type, in the following one (2007–2014) there was a reorientation toward the agricultural field to the point where LEADER became rather a specialized instrument on financing projects in this category (Dax et al. 2016). According to Dax et al. (2016), many innovative projects were not funded in 2007–2013 in order to make way for agricultural projects. This can lead to the specialization of rural communities (in agriculture) and diminishes the program's potential of achieving the goal of innovating the rural territory. In fact, it is not only Austria that has reported this problem of less innovative projects from one funding period to another. The results show that most LEADER beneficiary states have experienced a decline in terms of the innovation degree of implemented projects (Dax et al. 2016). The 2007–2014 funding period was marked by a general tendency for beneficiary communities to fund smaller and less innovative LEADER projects, but which require less financial support. The problem of concentrating LEADER beneficiary communities on the predominant funding of a certain type of project is also encountered in countries such as Spain or Germany. Maroto-Martos et al. (2020) point out that in Spain most LEADER funds were directed to tourism, especially in the first funding periods (1991–1994). The results are similar in Germany, with tourism development being one of the main objectives pursued by LEADER, which (tourism) is considered a key element in rural development strategies. Moreover, the frequency of tourism projects in the first financing periods was so high that tourism was seen as a panacea for all rural problems, LEADER being criticized by some precisely because it financed so much tourism to the detriment of other directions (Maroto-Martos et al. 2020; Ballesteros and Hernandez 2018; Canete et al. 2020).

Aside from the differences discovered among the LEADER recipient states in terms of program implementation and outcomes, there are also some similarities. Studies on LEADER in Spain, Poland and France emphasize the program's minimal quantitative impact. According to Wojewódzka-Wiewiórska (2017), the results produced in Poland in terms of diversifying the labor supply by establishing new non-agricultural occupations are below the expected level. Lacquement et al. (2020) underline the same issue of minimal quantitative influence in a study conducted on Spanish and French populations. He argues that LEADER funding was insufficient in comparison with the needs of the beneficiary territories, which explains why the expected outcomes were not attained. Bureaucracy and excessive engagement of higher-level actors are also issues in Spanish rural communities, limiting the impact of projects.

Despite the less favorable results in some beneficiary countries, research shows that the program's management in Western Europe is improving. Thus, whereas

the initial years of the LEADER program's implementation in Spain were defined by a top-down strategy (Esparcia 2000), the second programming era (LEADER II) saw a shift in governance as the bottom-up method began to be better implemented (Cazorla-Montero et al. 2005). Buller (2000) notes the same pattern in France, where the LEADER program's early years of deployment did not produce the predicted benefits. However, beginning with LEADER II, there has been a stronger emphasis on encouraging local actors to participate in the community development process. Also, from one funding period to another, there has been a diversification of LEADER funding directions. Thus, in order to reduce the massive rural–urban migration and to stimulate the repopulation of rural areas, more and more actions were financed with effect on the rural economy. They aimed at consolidating local agricultural production, creating new jobs, developing rural services, etc. Positive changes have also been reported in Greece where LEADER has led to the development of rural tourism and better use of local natural resources (Arabatzis et al 2010). Beyond the quantitative contribution, LEADER stood out in particular for its rather qualitative impact on rural areas. In Germany, nonetheless, the initiative can be called a success because it has resulted in improved cooperation between local governments and groups of actors with differing perspectives (Schnaut et al. 2012). LEADER has shown to be capable of bringing together actors from various interest groups who would not have had the opportunity to collaborate in the absence of this program. Beyond the evident changes in the way the program functions and is executed between beneficiary states, LEADER remains an important development tool because it helps to increase community participation in local concerns, decision-making and accountability (Berriet-Solliec et al 2015).

Eastern European Countries Behavior in Terms of LEADER Funds Absorption—Case Study on the Romanian Rural Space

The LEADER program's results vary from state to state. Most studies focus on its accomplishments in rural Western European towns, where financial support has been granted from the program's inception (1991–1993). Studies on LEADER beneficiary communities in Eastern Europe, on the other hand, are relatively few. An examination of the LEADER outcomes in Romania will be done to evaluate to what extent the disparities observed in earlier studies are apparent also in the case of Eastern European communities. Romania can serve as a case study due to its location in the eastern reaches of both the European Union and the LEADER program's implementation region. Furthermore, it is a noteworthy example for Eastern European area because it belongs to the postsocialist category, has a centralized government structure and has accentuated internal development gaps. Moreover, the analysis of the program's results in the Romanian rural area will provide a broader picture of

the extent to which disparities in funds distribution between developed and disad-vantaged communities manifest in the Eastern European part of the continent, in a region marked by pronounced development gaps.

Romania's Profile Regarding the Types of Projects Funded Through the LEADER Program

In the two LEADER financing periods carried out so far in Romania, a number of 14,482 rural initiatives received financial support. They focused both on the economic development of the LEADER beneficiary communities, by setting up new rural enterprises or supporting existing ones, and on improving local living conditions by investing in basic infrastructure. In order to facilitate the analysis of the types of projects financed through the LEADER program in the Romanian rural area, the projects were grouped by 20 categories (see Fig. 1). Thus, the most frequent were the projects of modernizing the local infrastructure, of equipment acquisition for public enterprises, as well as the agricultural projects. They represent 37% and 20% of the total LEADER projects, respectively, together exceeding half of the number of rural initiatives supported by the program. Much less present are the projects for the estab-lishment or development of non-agricultural enterprises, which reach a percentage of only 7.5%. Other types of projects that have received financial support through LEADER are the cooperation projects or the initiatives with tourism-specific, but which together do not represent more than 4.7% of the total.

As for the funds allocated to these projects, the situation is different insofar as agricultural initiatives, although numerous, have failed to absorb more than 16.5% of

Fig. 1 LEADER projects financed in Romania between 2007 and 2020
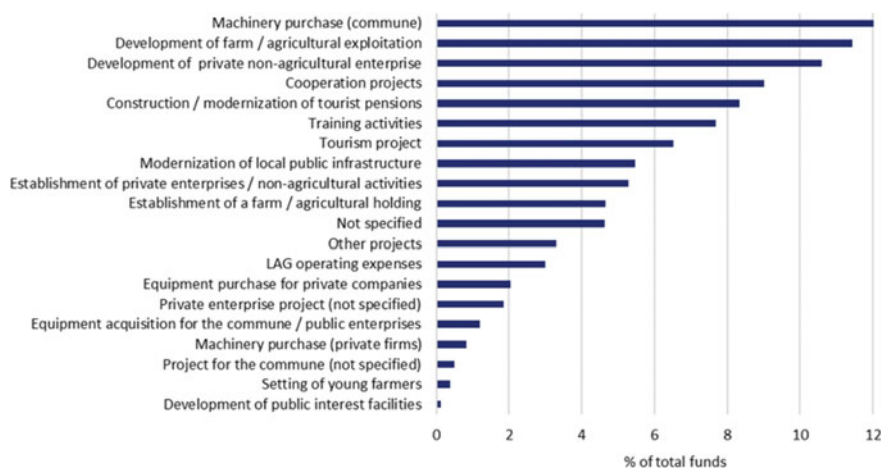
Fig. 2 LEADER funds absorbed in Romania between 2007 and 2020 by project categories

the total financial support granted through LEADER (see Fig. 2). Also, the projects regarding local infrastructure development or the ones regarding equipment acquisition for public enterprises consumed together 20.5% of the total LEADER funds. More expensive were the non-agricultural projects to which 30.1% of the program funds were directed, including the tourism projects. The situation is similar in the case of cooperation projects or training activities which, although numerically underrepresented, managed to consume almost as much as all agricultural projects together, namely 16.7% of the total.

Spatial Patterns Regarding LEADER Funding in Romania

Several spatial concentrations can be identified in the territorial distribution of LEADER projects and funds in Romania. In the center and western parts of the country, groups of communes with high values are outlined, both in terms of number of projects and the absorbed funds (see Fig. 3). The extra-Carpathian region, on the other hand, shows a contrasting pattern, presenting clusters of communes with low values for these variables. Overall, positive concentrations as a number of projects overlap positive concentrations as absorbed funds. As for the low concentrations, the same is true. In fact, this is an expected pattern, with places having a high number of LEADER initiatives undoubtedly receiving more LEADER monies.

Analyzing the spatial distribution of LEADER funds in relation to the beneficiary communities' level of development, it can be appreciated if the program favored the accentuation of the pre-existing gaps. Analyzing Fig. 4, it can be seen a slight tendency of high values as absorbed funds to correlate with the level of development expressed by Local Human Development Index (LHDI). The above-mentioned
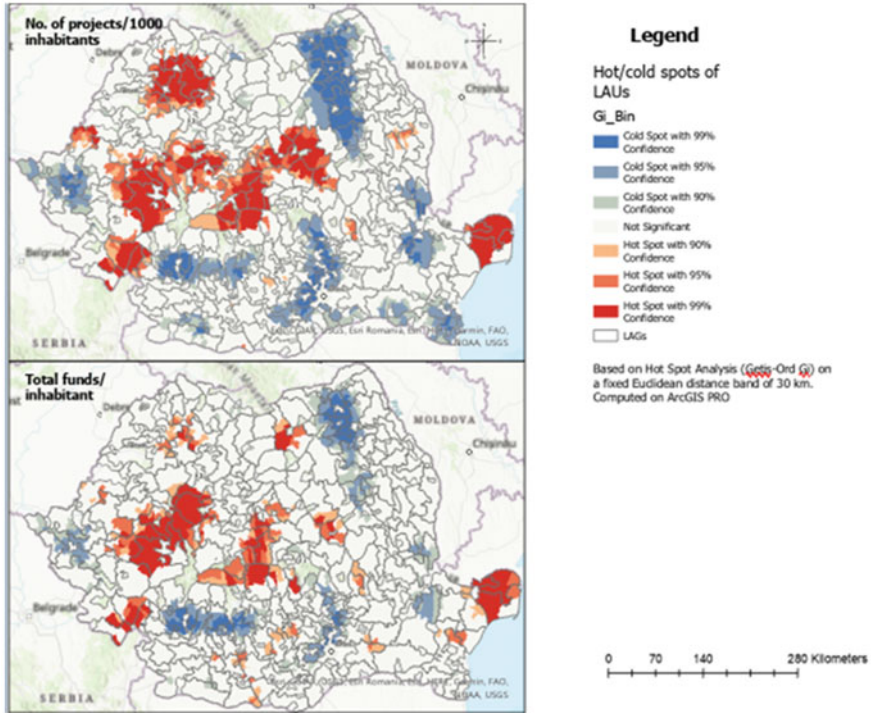
Fig. 3 Concentration of LEADER projects and total funds across the Romanian LAGs

concentrations of positive values in the central and western parts generally overlap with more developed rural communities, and the low concentrations of values in the extra-Carpathian area correspond to disadvantaged territories. The distribution of LEADER funds seems to follow the same spatial patterns as LHDI, which raises questions about the program's ability to achieve its goal, namely rural development and bridging gaps by providing support to disadvantaged rural communities. Thus, at first sight, Romania is facing a poor management of the LEADER program insofar as the financial support fails to reach mainly the target group, a problem reported also in Western Europe in countries such as Spain (Canete et al. 2020; Maroto-Martos et al. 2020) or France (Lacquement et al. 2020).

The Impact of LEADER Funding

Relations Between LEADER Fund Absorption and Development Level

Although the spatial distribution of funds suggest a slightly unbalanced pattern, in favor of already developed communities, their actual impact on rural development
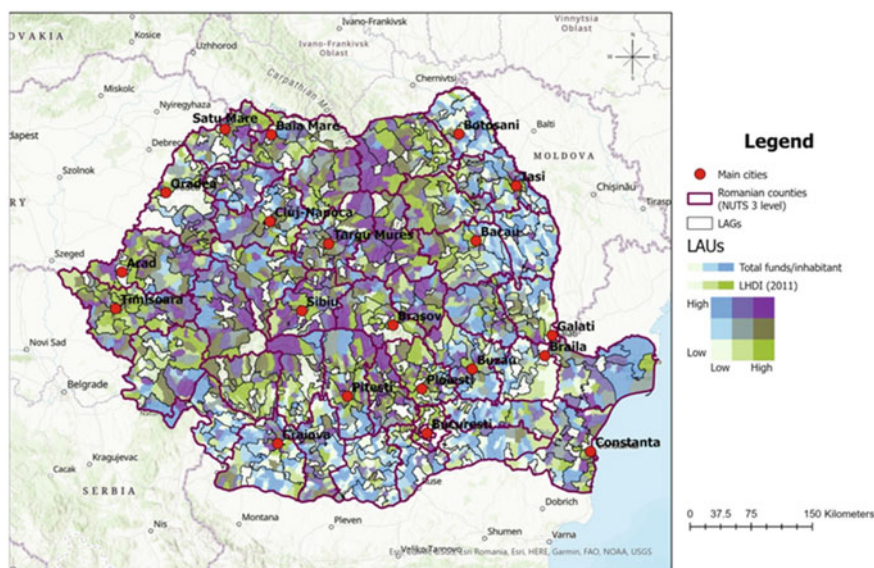
Fig. 4 Funds absorbed/inhabitant vs. local human development index

is insignificant. Table 1 represents a basic correlation matrix including six variables: two of them illustrate the amount of LEADER investments made between 2011 and 2018, and the other four are proxies for rural economic development during the same period. Insignificant and negative correlations are recorded between LEADER investments and economic development indicators at local level. Subsequent spatial analyses—namely Local Bivariate Analysis and Geographically Weighted Regression—were performed, using different regression models and conceptualizations for spatial relationships, in order to test for local significance of LEADER funds. However, no significant results were obtained in any part of Romania. Therefore, as suggested by the literature, the LEADER programme does not seem to generate a real impact on the local economy development, at least in short and medium run (Barke and Newton 1997; Krievina et al. 2015; Jalalian et al. 2021; Nieto Masot et al. 2019; Guzal-Dec and Zwolińska-Ligaj 2016).

As far as longer-term impacts are concerned, the new formal and informal governance structures which might be created as a result of LEADER cooperation might contribute to rural development, and the next section will focus on this kind of impact.

Local Stakeholders Perception Regarding the LEADER Program

A series of interviews were conducted in order to better understand the relationship between local government and the bottom-up approach of LEADER management. Stakeholders (either the executive manager or the president) from five LAGs were

Table 1 Correlation matrix between LEADER investments and the proxies for rural economic development

	LEADER Funds/ inhabitant	LEADER Projects/ 1000 inhabitants	Enterprises growth (%)	Turnover growth (%)	Employment growth (%)	Population growth (%)
LEADER Funds/ inhabitant	**1.00**	**0.85**	−0.03	−0.02	−0.03	**−0.10**
LEADER Projects/ 1000 inhabitants		**1.00**	−0.04	−0.03	−0.03	**−0.12**
Enterprises growth (%)			**1.00**	**0.91**	**0.95**	**0.18**
Turnover growth (%)				**1.00**	**0.93**	**0.21**
Employment growth (%)					**1.00**	**0.16**
Population growth (%)						**1.00**

interviewed about the LAG's difficulties, project diversity, and governance structure. While the interviews are lengthy and take many different paths, only a few insights are pertinent to the current research.

1. Local strategies are responsible for highlighting the needs and to show the way to construct a better territory through finding correct measures to be financed. In this matter, we appreciate, through both interviews and analyzing of the local development strategies, that the proposed measures are in direct relation to the territories' needs. On the other hand, the strategies proposing future projects include no genuine consultation with local communities, but rather with local administration and existing entrepreneurs. The grounds for this include a lack of community spirit and entrepreneurship in the vast majority of the questioned regions. As a result, rather than having sustainable growth in communities by supporting policies that promote social cohesion and long-term growth, the actual phase of implementing reforms through LEADER financing is increasing local disparities, favoring those who already know how to get it.

2. Decision-making process is handled mainly by the local public authorities, with no equal representation of stakeholders belonging to LAG' partnership. While the LEADER program targets the local communities, the decision is frequently made in the interests of local administration, due to a lack of private or civil sector representation and willingness to get involved. Some respondents suggest that in certain cases, public authorities themselves propose investments in local firms; therefore, the funding process is rather linear and lethargic and with a lack of innovative measures.

3. The third observation is related to the fear of local administration for implementing "soft projects". While LEADER program intends to develop innovative solutions for community engagement in future local transformation, there is a general lack of interest for these types of projects, as they cannot guarantee physical, visible, short-term results. Moreover, local authorities seem to choose the "most efficient" way for spending money, by financing "hard" infrastructural projects, with instant results on physical infrastructure but with no real impact on longer-term local development. Most mayors have chosen the acquisition of machines. As for the few "soft" projects meant to foster community involvement and leadership, the respondents complained about how difficult such projects are to achieve. As a result, "soft" projects are lacking, due to multiple factors: lack of know-how; lack of education and willingness to participate inside the community; long-term, difficult to assess impact, which is contradictory to short-term political interest. The findings of the interviews are consistent with those of other researchers in Spain (Lacquement et al. 2020), Italy (Osti 2015) and the United Kingdom (Shucksmith) (2002). The lack of community involvement together with a strong representation of local political and economic interest leads to implementation of few innovative projects and mostly dedicated to a certain group of people, but without having a real impact in the society and community building. Furthermore, this increases territorial disparities and weakens the LEADER program's capacity to achieve its goals.

Discussions and Conclusions

The studies carried out so far on the subject of the LEADER program highlight the differences that may occur both domestically, nationally and internationally between beneficiary states. These differences often consist in the typology of projects financed through LEADER and in the more or less equitable distribution of projects and funds between the beneficiary communities according to their development level. Comparing the quantitative results of the LEADER program registered in Western Europe with those in Eastern Europe, slightly different behavior can be observed. Thus, if in the West in countries such as Spain, Austria and Germany, tourism-specific projects have outperformed other types of initiatives in the first funding periods (Maroto-Martos et al. 2020; Ballesteros and Hernandez 2018; Canete et al. 2020), in Romania the tendency was to implement mainly agricultural projects and local infrastructure development projects. However, the similarity between West and East consists in the tendency to "specialize" on a certain type of project, although different between West (tourism projects) and East (agricultural and infrastructure projects). Another similarity is the high capacity of non-agricultural projects (including the tourism-specific ones) to absorb LEADER funds, and in both cases these projects consuming most of the financial support granted through LEADER. With regard to the fair distribution of this financial support, taking into account the development level

of the beneficiary communities, there are again differences at European level. Thus, if in the West the selective behavior of the LEADER program is better highlighted by the predominant distribution of funds to more developed rural communities (Lacquement et al. 2020; Canete et al. 2020; Maroto-Martos et al. 2020), in the East a rather chaotic behavior is observed, without being able to distinguish clear spatial patterns that take into account the development level of the beneficiary territories (Opria et al. 2021). The same observation is valid in the case of project distribution, in the West being more visible a slightly selective behavior, unlike in the East where there is no dependency between the development level of the beneficiary communities and their performance as a number of implemented LEADER projects.

Despite the differences in the results obtained, what remains valid both in the West and in the East is the low impact of the LEADER program seen from a quantitative point of view. This is determined on the one hand by the low amount of funds granted through the program (Lacquement et al. 2020), but especially by the way in which LEADER has been understood and implemented in the European rural area. If the West saw LEADER as a tool to support more advantaged territories, thereby creating favorable conditions for widening pre-existing gaps, the East has adopted a passive, impartial attitude, proven by the chaotic distribution of support between disadvantaged and most developed communities. Both the selective behavior, characteristic to the West, and the chaotic one, encountered in the East, have repercussions on the program's potential to achieve its goal, namely the sustainable development of the rural area. This is because, on the one hand, the chances of reducing the gap are diminished and, on the other hand, the opportunities available to disadvantaged communities are diminished.

In terms of qualitative results, in Western European countries LEADER was initially understood as a tool in the hands of public authorities with decision-making power, the top-down approach being predominant especially in the early years of LEADER implementation (Esparcia 2000; Buller 2000). Subsequently, changes in the management of the program were noted, with the bottom-up approach gradually becoming a reality in the LEADER beneficiary communities. With regard to the Romanian rural area, although at a declarative level the bottom-up approach is at the basis of the decision-making process in the LAGs, in reality the public authorities are the ones who finally establish the directions toward which to use the program funds. The participation of private actors and civil society is rather a passive one, as they do not have a real influence in making decisions regarding the development of local communities. Comparing the results in Western Europe with those in Romania, it can be said that the "mistakes" are repeated in terms of how the program is managed. Again, the first years of program implementation are marked by a top-down approach that runs counter to LEADER principles and diminishes the program's ability to achieve its goals. In Romania, unlike Western European countries, LEADER started operating much later, at a 16 years difference from the implementation of the program in Europe. Thus, this gap between West and East as years of implementation may explain the current differences in how the program is managed, the bottom-up approach being currently understood and implemented correctly in the West (Esparcia 2000; Buller 2000; Cazorla-Montero et al. 2005)

unlike the East. However, one should take into account that Romania was taken as a study case for the Eastern European countries, but the results found are not automatically valid for all eastern European countries. There are differences from country to country, particularities that could lead to different results.

One notable aspect is the greater capacity of the beneficiary Western States to reorient the program to the desired mode of governance, namely one based on a bottom-up approach. Thus, if in countries like Spain or France the second LEADER financing period brought more and more the bottom-up approach in rural areas, in Romania, after the completion of two LEADER financing periods, this approach is still not a really functional one. The devolved governance system specific to Western Europe may be the one that favored a faster reorientation of the program in the desired direction, as the responsibility and authority of the sub-national structures in the local decision-making process was already recognized at the time of the program's implementation. On the other hand, the excessive control exercised by the central, national authorities in the decision-making process at local level specific to postsocialist states, as is the case in Romania, makes it more difficult to implement the bottom-up approach promoted through LEADER. Thus, centralized systems may lead to a longer delay for LEADER beneficiary states to understand and implement the new approach correctly. This highlights the need to rethink the program's mode of operation so that it brings substantial results in terms of rural development. The adjustment of this mode of operation should be performed in relation to the prevailing governance culture in different countries. In this respect, the lack of local initiative and vision at local level, resulted from four decades of centrally-planned economy and a centralized governance system in the aftermath, could be compensated by external support from higher-level administrations in order to understand the real meaning of LEADER programme and build a genuine partnership that could lead to long-term local development.

References

Arabatzis G, Aggelopoulos S, Tsiantikoudis S (2010) Rural development and LEADER + in Greece: evaluation of local action groups. J Food Agric Environ 8(1):302–307

Ballesteros JG, Hernandez M (2018) Promoting tourism through the EU LEADER programme: understanding local action group governance. Eur Plan Stud. https://doi.org/10.1080/09654313.2018.1547368

Barke M, Newton M (1997) The EU LEADER initiative and endogenous rural development: the application of the programme in two rural areas of Andalusia, Southern Spain. J Rural Stud 13(3):319–341. https://doi.org/10.1016/S0743-0167(97)00027-2

Beer A (2014) Leadership and the governance of rural communities. J Rural Stud 34:254–262. https://doi.org/10.1016/j.jrurstud.2014.01.007

Bentley G, Pugalis L, Shutt J (2017) Leadership and systems of governance: the constraints on the scope for leadership of place-based development in sub-national territories. Reg Stud 51(2):194–209. https://doi.org/10.1080/00343404.2016.1181261

Berriet-Solliec M et al (2015) The LEADER process as a European policy for local development: a comparison of the implementation in three European member states. In: Paper presented at the 55th congress of the European regional science association: "world renaissance: changing roles for people and places", European Regional Science Association (ERSA), Lisbon, 25–28 Aug 2015

Buller H (2000) Re-creating rural territories: leader in France. Soc Rural 40(2):190–199. https://doi.org/10.1111/1467-9523.00141

Cañete JA, Nieto A, Cejudo E, Cárdenas G (2020) Territorial distribution of projects within the LEADER approach (2007–2013) in extremadura and Andalusia. In Cejudo E, Navarro F (eds) Neoendogenous development in European rural areas. Springer, Berlin, pp 87–109

Cañete JA, Navarro F, Cejudo E (2018) Territorially unequal rural development: the cases of the LEADER Initiative and the PRODER program in Andalusia (Spain). Eur Plan Stud 26:726–744

Cazorla-Montero A, De Los Rios I, Díaz-Puente J (2005) The LEADER community initiative as rural development model: application in the capital region of Spain. Agrociencia 39

Damurski Ł (2015) From formal to semi-formal and informal communication in urban planning. Insights from polish municipalities. Eur Plann Stud 23(8):1568–1587. https://doi.org/10.1080/09654313.2014.993935

Dax T, Strahl W, Kirwan J, Maye D (2016) The Leader programme 2007–2013: Enabling or disabling social innovation and neo-endogenous development? Insights from Austria and Ireland. Eur Urban Reg Stud 23(1):56–68. https://doi.org/10.1177/0969776413490425

Esparcia J (2000) The LEADER programme and the rise of rural development in Spain. Soc Rural 40(2):200–207

Furmankiewicz M, Janc K, Macken-Walsh A (2021) Implementation of the EU LEADER programme at member-state level: Written and unwritten rules of local project selection in rural Poland. J Rural Stud 86:357–365. https://doi.org/10.1016/j.jrurstud.2021.05.020

Galindo-Pérez-de-Azpillaga L, Foronda-Robles C (2018) Digital governance and information technologies in local action groups (LAGs). Cogent Soc Sci 4. https://doi.org/10.1080/23311886.2018.1528730

Guzal-Dec D, Zwolińska-Ligaj M (2016) The impact of LEADER Programme on entrepreneurship and employment in the context of multifunctionality of rural areas. A case study of UE peripheral region (Lublin voivodeship, Poland). In: Paper presented at the 160th EAAE seminar 'rural jobs and the CAP', warsaw. https://doi.org/10.22004/ag.econ.249763

Jalalian H, Naimabadi N, Brunori GA (2021) An overview on success of the LEADER approach in european countries. J Res Rural Plann 10(1):63–79. https://doi.org/10.22067/JRRP.V10I1.88362

Krievina A, Leimane I, Melece L (2015) Analysis of economic aspects of LEADER projects in Latvia [Paper presentation]. In: Kusis J (ed) Rural development and entrepreneurship. "Economic science for rural development" international scientific conference (Latvia), Jelgava. LLU-ESAF, pp 164–175

Kull M (2014). European integration and rural development. Actors, Institutions and Power. Ashgate

Lacquement G, Chevalier P, Navarro F, Cejudo E (2020) Public action and territorial development: The LEADER approach in the recomposition of rural spaces in languedoc-roussillon (France) and Andalusia (Spain). In: Cejudo E, Navarro F (eds) Neoendogenous development in European rural areas. Springer, pp 63–87

Maroto-Martos JC, Voth A, Pinos-Navarrete A (2020) The importance of tourism in rural development in Spain and Germany. In: Cejudo E, Navarro F (eds) Neoendogenous development in European rural areas, Springer, pp 181–205

McAreavey R (2009) Rural development—Theory and practice. Routledge

Nieto Masot A, Cardenas Alonso G, Costa Moreno LM (2019) Principal component analysis of the LEADER approach (2007–2013) in South Western Europe (Extremadura and Alentejo). Sustainability 11(15):1–16. https://doi.org/10.3390/su11154034

North D, Smallbone D (2006) Developing entrepreneurship and enterprise in Europe's peripheral rural areas: some issues facing policy-makers. Eur Plan Stud 14(1):41–60. https://doi.org/10.1080/09654310500339125

Novosák J, Hájek O, Górska-Szymczak J, Novosáková J (2018) LEADER and rural differentiation: Czech Republic (2007–2013). Acta Univ Agric Silvic Mendel Brun 66(1):293–301. https://doi.org/10.11118/actaun201866010293

Opria AM, Roșu L, Iațu C (2021) LEADER program—an inclusive or selective instrument for the development of rural space in Romania? Sustainability 13. https://doi.org/10.3390/su132112187

Osti G (2015) LEADER LAGs: neocorporatist local regimes or examples of economic democracy?. In: Granberg L, Andersson K (eds) Evaluating the European approach to rural development, Routledge, pp 149–164

Roland G (2008) Fast-moving and slow-moving institutions. In Kornai J, Mátyás L, Roland G (eds) Institutional change and economic behaviour, Palgrave Macmillan, pp 134–159

Schnaut G, Pollermann K, Raue P (2012) LEADER—an approach to innovative and suitable solutions in rural areas? Paper presented at the 131st Seminar, Prague, 18-19 September 2012, 135779, Eur Assoc Agric Economists. https://doi.org/10.22004/ag.econ.135779

Shucksmith M (2002) Endogenous development, social capital and social inclusion: perspectives from LEADER in the UK. Soc Rural 40:208–218. https://doi.org/10.1111/1467-9523.00143

Stimson R, Stough R, Salazar M (2009) Leadership and institutions in regional endogenous development. Edward Elgar Publishing. https://doi.org/10.4337/9781848449435

Wojewódzka-Wiewiórska A (2017) The importance of the leader programme 2007–2013 in the rural areas development in Poland. Res Rural Dev 2:97–103. https://doi.org/10.22616/rrd.23.2017.055

A Methodology to Define Urban Areas in Intermediate Cities. A Case Study on Inland Spanish Cities (Castilla-La Mancha)

Irene Sánchez Ondoño and Francisco Cebrián Abellán

Abstract Recent decades have witnessed dramatic transformations in urban structures, which are reflected in intermediate cities. Tapping sources of information other than those traditionally used to analyse urbanised and built-up areas helps understand the patterns of spatial reformulation in cities. The cadastre developed by the Spanish Government is a source that can be used for these purposes. This study presents a methodology to analyse the transformation of cities, focusing particularly on the processes of urban sprawl. As the subject of study, we have selected the five provincial capitals of the Autonomous Community of Castilla-La Mancha (Spain) and their respective urban areas to examine the spatial scope and differences in the impact of sprawl, drawing on an analysis of the evolution of the population and housing between 2000 and 2016.

Introduction

The changes associated with the process of globalisation and the reorganisation of capitalism have engendered new political, economic, social and/or cultural scenarios, which have shaped the relationships between society and space. These processes of adaptation and transformation have affected urban structures. Castells explained this by drawing on the foundations of the *Social Theory of Space*, in which space is the support for social practices. These foundations were then amended complemented

I. S. Ondoño (✉)
Department of Geography and Town and Country Planning, Faculty of Education, University of Castilla-La Mancha, Albacete, Spain
e-mail: Irene.SanchezOndono@uclm.es

F. C. Abellán
Department of Geography and Town and Country Planning, Faculty of Humanities, University of Castilla-La Mancha, Albacete, Spain
e-mail: Francisco.Cebrian@uclm.es

by the principles of the *Theory of Space of Flows*. This latter theory holds that the flows of capital, information, technology and organisational interaction are home to practices, processes, images and symbols that determine the economic, political and social framework within which today's society operates.

Castells refers to this as "a new form of space typical of the social practices that dominate and shape the network society: the space of flows… Which is the material organisation of social practices" (Castells 2000: p. 488). These changes generate a new form of spatial organisation, where mobility is one of the key elements in understanding urban sprawl in Europe (Castells 2006).

The recent stages of urban development in Western Europe, defined and characterised by a temporally sequenced logic that can be summed up in the consecutive phases of urbanisation, suburbanisation, urbanisation and re-urbanisation, have had substantial spatial impacts, especially in the increase in urban encroachment. Urban sprawl has been most prominent in the second and third of these stages. The antecedents of this process lie in events in the Unites States since the 1950s, with the onset of a new model of city, typified by low building and demographic density and an increase in daily movement (Garreau 1994). All this has given rise to an intense academic and institutional debate, the aim of which is to understand the processes and analyse the effects, without, however, solutions always being found to correct the impacts.

The concept of urban sprawl itself is one of the issues that has been the focus of much attention. According to Galster, "it explains everything and nothing" (Galster et al. 2001: p. 681). Despite the underlying conceptual complexity, this author ventured a definition of the concept based on eight complementary dimensions: density, continuity, concentration, clustering, centrality, nuclearity, mixed uses and proximity. The combination of all these factors (albeit with different weights according to the areas under study) allows categories of urban sprawl to be established. The dominant features can be summarised in the separation of land uses—residential, commercial, leisure and production; peripheral urban developments dispersed across space; the fragmentation of government responsibility, the decentralisation of employment, and the dependence on private cars, among others.

These spaces of urban sprawl form part of the organic structure of a city, functioning as entities with a life of their own, adapting to the changing circumstances of each period (Hasse and Lathrop 2003). However, the separation between urban and rural tends not to be framed in physical and functional terms, as these have apparently become obsolete, although this approach continues to hold true from a social and/or administrative perspective. From a spatial viewpoint, this process goes beyond concrete settings and has become widespread, affecting varying sociocultural contexts. Western Europe and Spain, therefore, are no exception.

The European Environment Agency has elaborated a conceptual framework under which to understand and address a phenomenon whose primary characteristic is uncontrolled urban expansion in the face of a trend towards falling rates of demographic growth (EEA 2006). Across Europe, the examples of landscape fragmentation are abound, a consequence of the uncontrollable growth of "urban concrete" (EEA 2018). These landscapes are the opposite of those of compact cities, in which

the urban centre is clearly defined and serves to articulate social relationships. In this context, urban peripheries are growing rapidly, to the detriment of historic centres, which are losing their traditionally characteristic dynamism. (Couch et al. 2008). Forms of urbanisation are emerging because of the combination of global and local logics (Brenner and Schmid 2015). The causes are multiple, and the outcomes vary according to the sociocultural contexts. In the middle of the twentieth century, in Europe, a progressive expansion of urban areas around larger cities began, due to growth by agglutination, gradually annexing nearby centres of population. At the end of the century, centreless cities were common. While, as a result of the rapid advance of industrialisation, Great Britain was at the forefront of these processes (Ferrán 2007), and Poland, for example, was slower to embrace these urbanisation dynamics (Czerny 2013). Since the 1980s, urban sprawl dynamics have progressively enveloped intermediate cities in Europe.

The structural reasons for this change of city model can be explained by the very logic of expansive neoliberal capitalism (Soja 2008), which is based around three lynchpins: global market integration, immediacy and self-regulation (Pollin 2013). These economic and ideological foundations have been laid in the context of an expansive economic scenario ongoing since the end of the twentieth century. These processes have come to fruition in the form of a change of mentality in relation to housing, which has gone from being seen as an asset for use to being one with which to speculate (de Taifa 2008). In most European countries, in a context of abundant and cheap land, there has been an increase in demand for housing, with individual ownership increasing (Borsdorf and Zembri 2004). Preferences have shifted towards larger single-family homes with more green space. Increased mobility is another factor that has fuelled the processes of urban sprawl. Added to this is the increased purchasing power of the middle class, which has made it possible to cover greater distances and to resolve the availability of private means of transport (the principles of economic profitability for public transport are not guaranteed in peri-urban areas). The result is a considerable movement of population, housing and functions towards the peripheries, in a process organised to avoid the traditional problems of the compact city (congestion, noise, pollution…).

The nomenclature that has emerged in a bid to explain this reality is diverse, and somewhat conceptually confused: diffuse, disperse, fragmented, scattered, deconcentrated, compartmentalised … Attempts have also been made to define the processes: counter-urbanisation, rural urbanisation, suburbanisation, peri-urbanisation, diffuse urbanisation and urbanalisation (Cebrián Abellán 2020). The associated collective image is that of growth and/or the extensive spread of urban sprawl towards remote peripheries, with the result being the blurring of urban edges, with a lack of clear separation between urban and rural worlds. There has been a sharp increase in mineralised land, generally given over to one-family dwellings and with a rise in the density of road infrastructures. The visible outcome is that the essence of the characteristic city/country binomial has disappeared.

The above considerations are necessary to understand the reality of the processes and the case study presented in this chapter. Morphological, functional and social processes have been triggered by the spread of urban sprawl in Spain since the end

of the 1990s. Between 1987 and 2005, there was a 50% increase in the amount of artificial area (in urban development and infrastructures), which has undoubtedly brought about a change in the new Spanish urban landscapes, which have largely been developed under the model of diffuse urbanisation. Different economic situations have affected the dynamics of the construction and housing sector. Different sub-periods can be identified. There was a decade of unprecedented urban growth from the late 1990s to 2008. This period has been variously referred to as "expansive urbanisation" (Burriel de Orueta 2008), "urbanising tsunami" (Gaja i Díaz 2008) and "spatial misgovernment" (Romero 2010). It was followed by a period of deep depression. From the first period, however, there remains a significant spatial footprint in the periphery, and a city model that differs from that bequeathed by the so-called urban urbanisation (Bellet Sanfeliú and Cebrián Abellán 2022), which has left us with more extensive, more disperse and less dense urban areas. One of the problems is that of its definition.

Different proposals have sought to define the limits of urban areas. There is some consensus on the use of statistical data at municipal level, combining their use with the implementation of statistical and cartographic techniques. From the institutional viewpoint, the most outstanding proposals are those made by *Urban Audit* and by the Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA, in its Spanish acronym). Since the 1990s Eurostat (the Statistical Office of the European Union) has been developing the Urban Audit project, the aim of which is to analyse certain aspects of European cities. Based on the Local Administrative Unit (LAU), the project defines the level of urbanisation (cities; towns and suburbs; rural areas), while the FUAs (Functional Urban Areas) refer to cities and their commuting zones, among others. Urban areas are conceptualised according to functional aspects, with the daily movement between municipalities for employment reasons being particularly important. A city is considered to be an LAU with more than fifty thousand inhabitants, and its FUA includes the municipalities in which at least 15% of the employed residents work in the city. The MITMA, meanwhile, has produced the Statistical Atlas of Urban Areas (*Atlas Estadístico de las Áreas Urbanas*), the aim of which is to define urban areas in Spain. The latest editions, from 2018 and 2021, establish differences between large areas (which have a municipality of at least 50,000 inhabitants and include municipalities of at least 1000), small areas and non-urban areas. Three groups of variables are used to establish these categories (Group 1: population statistics; Group 2: housing statistics; Group 3: spatial structure and observed urban dynamics) (Fig. 1).

The methodologies and indicators used to define urban areas at institutional level yield heterogeneous results, which vary according to the aim of the study, the scale, the sources available and the variables used in each case. The findings show highly diverse and unbalanced spatial models of cities in terms of the territorial scope included in each case. Urban Audit generates urban areas that appear oversized, as it incorporates a number of municipalities and urban areas that, on occasions, exceed a radius of 30 km. Meanwhile, MITMA does not always reflect the dynamics of the first decade of the twenty-first century, and the proposed definitions are, in some cases, undersized, which also conditions the results. The proposals for the delimitation of

ALBACETE

Municipalities included in the urban area: MITMA 1

Municipalities included in the urban area: URBAN AUDIT 7

Albacete

Albacete, Chinchilla de Monte-Aragón, La Gineta, Mahora, Tarazona de la Mancha, Valdeganga and Pozo Cañada

CIUDAD REAL

Municipalities included in the urban area: URBAN AUDIT 9

Municipalities included in the urban area: MITMA 2

Ciudad Real y Miguelturra

Ciudad Real, Alcolea de Calatrava, Carrión de Calatrava, Fernán Caballero, Miguelturra, Picon, Poblete, Pozuelo de Calatrava and Torralba de Calatrava

CUENCA

Municipalities included in the urban area: URBAN AUDIT 11

Municipalities included in the urban area: MITMA 1

Cuenca

Cuenca, Chillarón de Cuenca, Buenache de la Sierra, Cañizares, Palomera, Poyatos, Tragacete, Vega del Codorno, Villar de Olalla, Fuentenava de Jábaga and Arcas

TOLEDO

Municipalities included in the urban area: URBAN AUDIT 15

Municipalities included in the urban area: MITMA 8

Toledo, Ajofrin, Argés Bargas, Burguillos de Toledo, Cobisa, Gálvez, Guadamur, Layos, Magán, Mocejón, Nambroca, Olías del Rey, Polán and Sonseca

Toledo, Bargas, Olías del Rey, Argés, Nambroca, Cobisa, Burguillos de Toledo and Guadamur

GUADALAJARA

Municipalities included in the urban area: URBAN AUDIT 8

Municipalities included in the urban area: MITMA 7

Guadalajara, Cabanillas del Campo, Chiloeches, Fontanar, Horche, Marchamalo Yebes and Yunquera de Henares

Guadalajara, Azuqueca de Henares, Alovera, Cabanillas del Campo, Marchamalo, Villanueva de la Torre and Chiloeches

Fig. 1 Urban audit and MITMA classifications. Own preparation

urban areas drawn up at institutional level render very heterogeneous results (Fig. 1), which is mainly due to the use of different variables and methods.

Methodology

The methodology proposed in this chapter thus aims to enrich the debate. It uses complementary statistical and cartographic sources, as well as other methodologies to establish the scope and typologies. The aim is to understand the spatial structure of urban areas. In our case, a series of population and housing data was taken as a reference. Using these, indicators were established and processed using statistical analysis tools. This has allowed for an interpretation of the behaviour of the municipalities. Urbanisation dynamics are assumed to be a good indicator of the processes
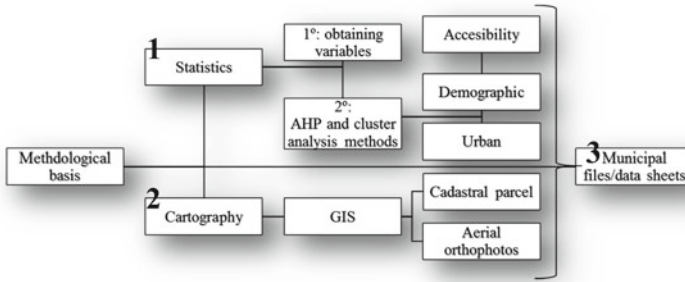
Fig. 2 Methodological proposal. Own preparation

of integration of the municipalities in the respective urban areas. The proposal is methodologically underpinned by various elements (Fig. 2):

The spatial context chosen for the case studies is that of five cities in the Autonomous Region of Castilla-La Mancha (Spain): Albacete, Ciudad Real, Cuenca, Guadalajara and Toledo. They all have the same administrative status (provinical capitaals) and are considered to be intermediate inland cities (their popualtions range from 50,000–20,000 inhabitants. They have also all undergone processes of urban dispersion (Sánchez Ondoño 2020). Nevertheless, they are contrasting examples, with different intensities and manifestations of the processes depending on the case. In order to identify the scope of the urban areas and establish a typology of municipalities included in each one, the municipalities included within a radius of 30 kms around each city were analysed, assuming that the actual spatial scope of urban dispersion is less than this reference threshold. The study universe comprises 202 municipalities: 12 in Albacete; 24 in Ciudad Real, 30 in Cuenca, 71 in Guadalajara and 60 in Toledo (Fig. 3).

The time frame used for the study extends from 2000 to 2016, divided into two sub-periods: 2000–2008 and 2008–2016. The first corresponds to the period of maximum urban expansion. The second corresponds to the economic crisis and subsequent recovery, which generated an abrupt change in dynamics, the most evident effects of which were the general stagnation of the economy and a severe blow to the health of construction sector.

Sources Used

As shown in Fig. 2, part of the method involves selecting sources and obtaining data. In this case, the variables used are essentially demographic and urban. A further two were included that focus on accessibility (distance in kilometres and time in minutes from each municipality to the central city, following the shortest route by road) (Source: Via Michelin). Absolute or relative values were used.
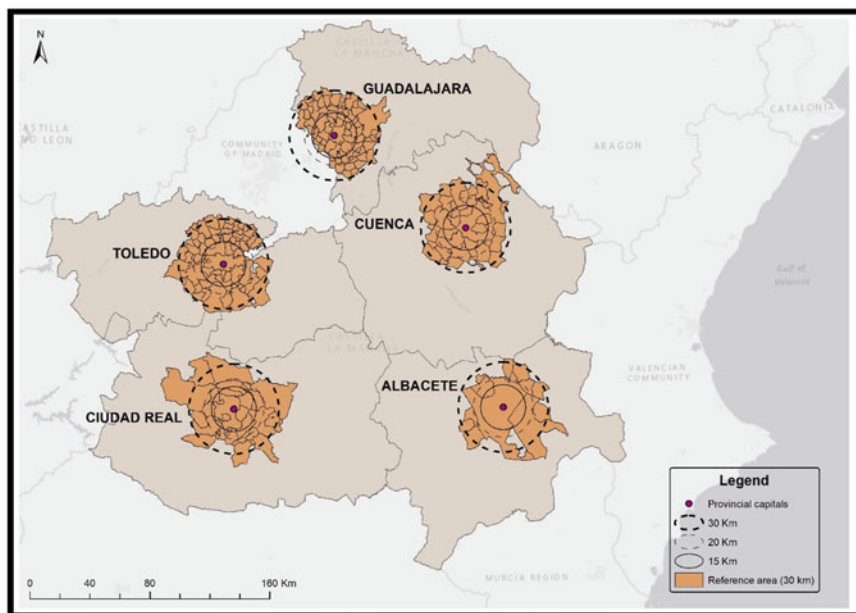
Fig. 3 Reference areas of the provincial capitals of Castilla-La Mancha. Own preparation

Data at municipal level for 2000, 2008 and 2016 were used. The population variables were downloaded from the webpage of the Spanish National Statistics Institute (INE, in its Spanish acronym) using "the official population figures from Spanish municipalities: revision of the Municipal Register" (INEbase/Lista completa de operaciones). For each municipality, this provided us with the total population, its composition by age group and nationality. To generate the urban variables, we used the *Portal of the Directorate General of the Cadastre* (https://www.catastro.meh.es/). From this institution, we downloaded the number (in units) and the surface area (in hectares) of the total and disaggregated land parcels according to building status (built or unbuilt). As a second source for analysing the transformation of the housing stock, we used the Cadastre Website (https://www.sedecatastro.gob.es/), from which we extracted the housing data (CAT files): number of dwellings per municipality, age and building type.

The use of data from the latter source for urban analysis research purposes requires complex processing. The CAT files (open access) are "Security Catalogue Type" files without line format. Each file (one per municipality) contains a wide variety of interrelated information (Table 1). The data obtained from the original source are structured such that it is necessary to convert them because the basic information (Table 1) appears in a format that prevents its use for the analysis of real property on a municipal scale (Fig. 4). To solve this problem, a specific method for the transformation of the information was created.

Table 1 Information available on the CAT files. Computerized cadastre remit file (urban, rural, and special status real estate). Own preparation

Type	Name
01	Header record
11	Land record
13	Record of constructed unit
14	Record of construction
15	Record of property
16	Record of distribution of common elements
17	Record of agricultural parcels
90	Trailer record


```
15          05900UR6923111UL5062S0021ZB03691509          000000000000028077  05ÁVILA
15          05900UR6923111UL5062S0022XZ03691518          000000000000028077  05ÁVILA
16    05900  6923111UL5062S0005   00010006000000
16    05900  6923111UL5062S0033   00010022000000
16    05900  6923111UL5062S0034   00010001000000
16    05900  6923111UL5062S0034   00020017000000
11    05900  6923112UL5062S       05ÁVILA                    900019AVILA
13          05900UR6923112UL5062S0001   05ÁVILA              900019AVILA
14    05900  6923112UL5062S0082   00750001    C 04 0G V  00001982N000009300000000000000001124
14    05900  6923112UL5062S0110   00960001    1 -2 00 AAP 00001982N000003100000000000000001134
```

Fig. 4 Image of a CAT file

Method used to obtain housing variables

The process of transforming cadastral information necessarily starts with understanding the structure of the data shown in Table 1. Once identified, a method was generated to systematise and convert the information from plain text into a relational database. This allows the required housing variables to be obtained, targeted queries to be carried out and thematic mapping at cadastral parcel level to be generated.

To implement the methodology, we created a data management platform that permits cadastral data to be processed. The data management tool, initially created in Access, using Visual Basic programming language, in accordance with the information on the computer file on changes in cadastre (urban property, rustic property and property with special characteristics), allows plain text files to be converted into files in relational database format, with eight distinct tables, one for each type of record shown in Table 1. Once ordered, the information can be consulted (Sánchez Ondoño et al. 2021).

However, in none of the eight tables obtained with this process is there a specific field for the variables required. Additionally, the complexity of elaborating queries by cross-referencing information from registers and the processing time makes its advisable to develop a more user-friendly Web application specifically designed for the study of urban dynamics (Sánchez Ondoño and Cebrián Abellán 2022). This tool works with PHP programming language and MySQL as the relational database system, based on an entity-relationship model, determining the main table, identifying the interactions between the different elements and the expected outcome.
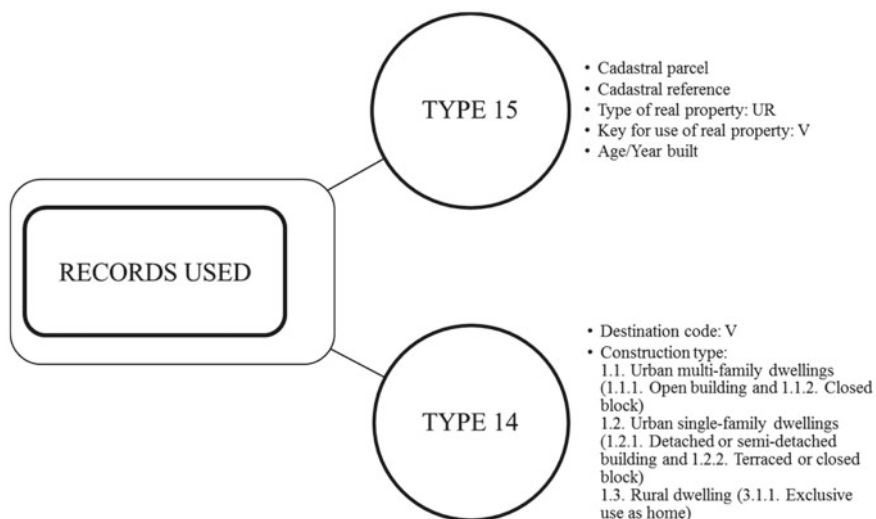
Fig. 5 Filtering for housing study in the web application. Own preparation

Although the official data are provided at municipal level, our application allows for working at more detailed levels. The information can be filtered by province, municipality and/or smaller entity. There is also the possibility of working by periods according to the age of the propery. In this case, the information contained in records 14 and 15 was used (Fig. 5).

Methods of Analysis

Once the information had been generated, two complementary data processing methodologies were used (Fig. 2): the analytic hierarchy process (AHP), which made it possible to delimit the scope of the urban areas, and cluster analysis, which was used to classify the municipalities, searching for homogeneous patterns of behaviour.

The main advantage of AHP lies in its ability to model the problem graphically and simply, using a hierarchical structure. Its three basic functions are to "structure complexity, measure on a scale and synthesise" (Osorio and Orejuela 2008: p. 248).Broadly speaking, the process is as follows: calculating the paired comparison matrices, normalising the matrix, calculating the average vector and the consistency ratio (Saaty 2008). In the research, municipalities were assigned a value according to each of the four criteria used in this case (rates of change in population, number of urban parcels, area in hectares and homes built during the period 2000–2016), taking the preferences scale into account (Saaty 1990). This makes it possible to compare the dynamics of the municipalities and to rank them according to their behaviour.

Cluster analysis enables the identification of elements (municipalities in this case) with similar behaviour, establishing homogeneous clusters. The fifty-six variables generated were grouped into four categories: population, urban land, housing and accessibility (for 2000, 2008 and 2016). Unlike AHP, the data used here are absolute, and the variables are disaggregated into more groups (population by age and nationality, built and unbuilt parcels—units and hectares—and housing by type of construction—mainly multi-family and single-family).

Once the urban areas had been defined and the municipalities classified, the results obtained from the AHP and the cluster analysis were mapped. Additionally, explanatory municipal data sheets were created, which provide information in the form of a data table (with absolute values), a graph (representing the evolution of relative data) and a cartography of the location of the municipality and the population centre. The cadastral cartography (obtained from the Cadastre Web site) was used as the basis, in which the cadastral parcels, their construction type, the year of construction of the dwellings and the number of real estate properties in each one of them is represented. This was done by means of two different maps: one with the dwellings by year of construction and their construction type; the other with the number of properties per cadastral parcel. To contextualise the dynamics of urban change, we used the orthophotos from the National Plan of Aerial Orthophotos of 1956, 1997, 2009 and 2018 have been used. In the latter case, these are WMS resources provided by the Cartographic Centre of Castilla-La Mancha.

Results

Delimitation of Urban Areas

Drawing on the rankings generated according to the average AHP vector, the group of municipalities in each urban area was found to present more dynamic behaviour than the central city in which it is integrated. The methodology allows preference scales to be assigned by means of the four criteria used. The variable that uses housing as the dominant criterion was chosen in this case (Sánchez Ondoño and Cebrián Abellán 2021), being the most dynamic in all the areas analysed during the reference period (2000–2016) (Table 3). This finding yields a substantially lower number of municipalities than previously considered in the reference areas (30 kms) (Table 2 and Fig. 6).

On applying the methodology to the three units of analysis used (central city, urban areas—AHP—and reference areas—30 km), municipalities that showed negative growth in some of the selected variables or that had lower dynamics than those of their reference city were excluded from the condition of municipalities affected by processes of urban sprawl.

The differing behaviour of the variables in the various urban AHP areas is striking (Table 3). In Albacete, the dynamics of the urban land variables are significantly

Table 2 Number of municipalities included in the reference and urban areas. Own preparation

Central city	Number of municipalities in the reference area (30 km)	Number of municipalities obtained using AHP
Albacete	12	6
Ciudad real	24	6
Cuenca	30	6
Guadalajara	71	30
Toledo	60	32

Table 3 Values for the areas of reference (30 km) and urban areas (AHP). Own preparation

Spatial context	Rate of population change (2000–2016) (%)	Rate of change in number of urban parcels (2000–2016) (%)	Rate of change of surface area in hectares (2000–2016) (%)	Overall rate of change in housing (2000–2016) (%)
Albacete	15	13	62	32
Area of reference	7	28	84	41
AHP area	16	38	93	56
Ciudad Real	23	12	6	46
Area of reference	11	30	47	42
AHP area	27	56	64	64
Cuenca	21	20	64	38
Area of reference	4	14	49	34
AHP area	56	35	97	85
Guadalajara	27	43	73	43
Area of reference	137	57	100	89
AHP area	166	87	126	114
Toledo	22	27	107	43
Area of reference	30	34	−37	53
AHP area	75	84	44	106

higher than those of the population: the surface area of parcels grew by 93%, housing by 56% and the number of urban parcels by 38%. Meanwhile, the population increased by 16%. This situation is replicated in Ciudad Real, where surface area and housing maintain the same rate (64%), followed by parcels (56%) and population (27%). In Cuenca, surface area and housing are also the two most dynamic variables

Albacete (6)

Balazote, Casas de Juan Núñez, Chinchilla de Monte-Aragón, La Gineta, Montalvos, Motilleja

Ciudad Real (6)

Carrión de Calatrava, Daimiel, Fernán Caballero, Miguelturra, Poblete, Pozuelo de Calatrava

Cuenca (6)

Arcas, Bascuñana de San Pedro, Chillarón de Cuenca, Mariana, Uña, Villar de Olalla

Guadalajara (30)

Alovera, Armuña de Tajuña, Azuqueca de Henares, Cabanillas del Campo, Cañizar, El Casar, Caspueñas, Centenera, Chiloeches, Fontanar, Fuentelencina, Fuentelviejo, Galápagos, Heras de Ayuso, Horche, Loranca de Tajuña, Malaguilla, Marchamalo, Pioz, Pozo de Guadalajara, Quer, Torija, Torre del Burgo, Torrejón del Rey, Tórtola de Henares, Trijueque, Valdeaveruelo, Villanueva de la Torre, Yebes, Yunquera de Henares

Toledo (32)

Ajofrín, Alameda de la Sagra, Albarreal de Tajo, Argés, Barcience, Bargas, Burguillos de Toledo, Burujón, Cabañas de la Sagra, Camarena, Cedillo del Condado, Cobeja, Cobisa, Chozas de Canales, Fuensalida, Gerindote, Huecas, Layos, Lominchar, Magán, Nambroca, Noez, Novés, Numancia de la Sagra, Olías del Rey, Recas, Rielves, Villaluenga de la Sagra, Villaseca de la Sagra, Yuncler, Yunclillos, Yuncos

Fig. 6 List of municipalities included in the AHP urban areas. Own preparation

(97% and 85%, respectively), while population (56%) shows a higher growth rate than urban parcels (35%).

Most noteworthy are the urban areas of Guadalajara and Toledo. The former, unlike those previously mentioned, shows a greater dynamism of change in population (166%), a higher increase than that in the surface area of parcels (126%), housing (114%) and number of urban parcels (87%). Both surface area and housing more than doubled over the period analysed, while the population tripled. Finally, the highest growth in Toledo was that in housing (106%), followed by the number of urban plots (84%), population (75%) and surface area in hectares (44%). Nonetheless, in balance, the general trend shows a significantly more pronounced behaviour in the variables of urban fabric (parcels and dwellings) than in the demographic variables.

Classification of Municipalities Integrated into the Urban Areas

Cluster analysis was used to establish a typology of the municipalities included in the urban area. Due to the characteristics of such analysis (it does not require dependent variables and, despite seeking the greatest similarities between the groups established, the heterogeneity of the data is maintained), it is a flexible technique that is well suited to the data used in this research (Ocaña Peinado 2019). The results obtained from each group using the cluster method were completed with a critical

examination derived from fieldwork. This enabled us to generate a final proposal for urban area and typology of municipalities (Figs. 9 and 10), which was the result of adjusting the first proposal obtained after applying the AHP methodology (Figs. 7 and 8).

Figure 8 shows the main characteristics of the groups of municipalities included in each cluster (Fig. 7). This was obtained using, as critical variables, demographic size, time or average distance from each municipality to its central city, and the predominant variables, including the dominant housing typologies in each case. All data were calculated based on the average of each group.

The proposed definition and classification of the respective urban areas (Figs. 9 and 10), which is the result of the combination of AHP, the cluster analysis and the critical review, is structured based on municipalities with demographic and urbanisation behaviours that exceed those of their parent city. From the spatial point of view, the main defining feature is the scope, which is situated at the threshold of 20 kms around the central city (Figs. 9 and 10).

The urban area of Albaceteis organised around five municipalities from the fourth group and one from the first group (Fig. 9).

- Group 1: Chinchilla de Monte-Aragón.
- Group 4: Balazote, Casas de Juan Núñez, La Gineta, Montalvos and Motilleja.

The centres of population of Chinchilla de Monte-Aragón and La Gineta are less than 20 km from the city of Albacete. The rest are slightly above this threshold. In
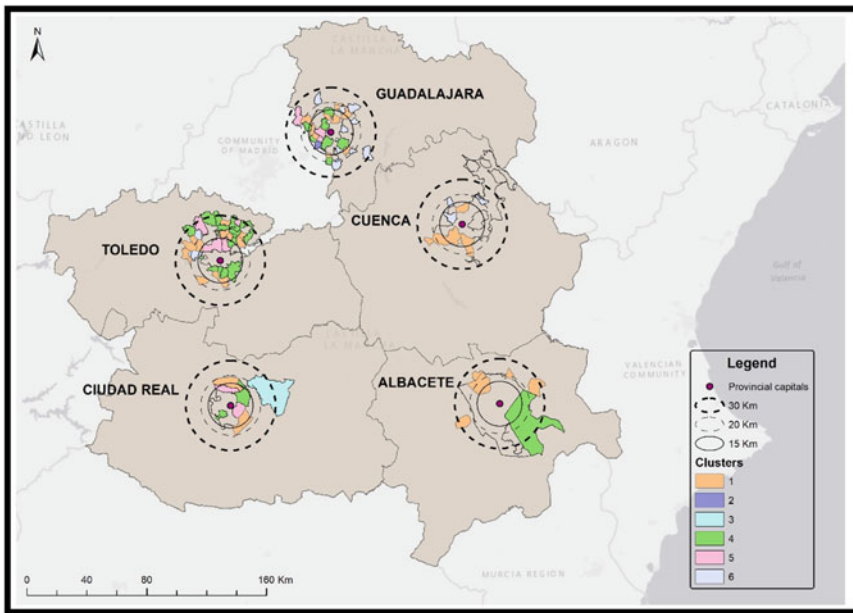
Fig. 7 First proposal for a typology of urban area. Own preparation

GROUP 1 (32 MUNICIPALITIES). "RURAL MUNICPALITIES CHARACTERISED BY NOTABLE PROCESSES OF URBAN LAND ARTIFICIALISATION"	• Inhabitants < 2000 | Time and distance: 25 minutes and 24 km • Predominance: land and housing variables | Single-family dwellings
GROUP 2 (1 MUNICIPALITY). "SMALL TOWNS"	• Inhabitants > 10.000 | Time and distance: 14 minutes and 13 km • Predominance: housing and population variables | Multi-family housing
GROUP 3 (1 MUNICIPALITY). "SMALL TOWNS"	• Inhabitants > 10.000 | Time and distance: 27 minutes and 33 km • Predominance: urban land variables | multi-family/single-family housing
GROUP 4 (24 MUNICIPALITIES). "SMALL SEMI-URBAN MUNICPALITIES, CLOSELY AASSOCIATED WITH SPATIAL RECONFIGURATION OF THE CENTRAL CITY"	• Inhabitants 2.000 – 5.000 | Time and distance= 22 minutes and 10 km. • Predominance: housing variables| Single-family dwellings
GROUP 5 (14 MUNICIPALITIES). "URBAN MUNICIPALITIES HIGHLY INTEGRATED INTO THE PROVINCIAL CAPITALS"	• Inhabitants > 10.000 | Time and distance: 20 minutes and 18 km • Predominance: housing and population variables | Single-family dwellings
GROUP 6 (14 MUNICIPALITIES). "RURAL MUNICIPALITIES WITH NO CHARACTERISTICS OF REVITALISATION DUE TO THEIR PROXIMITY TO THE CENTRAL CITY"	• Inhabitants < 1.000 | Time and distance: 32 minutes and 28km • No particular outstanding dynamic | Single-family dwellings

Fig. 8 Main characteristics of the cluster analysis. Own preparation
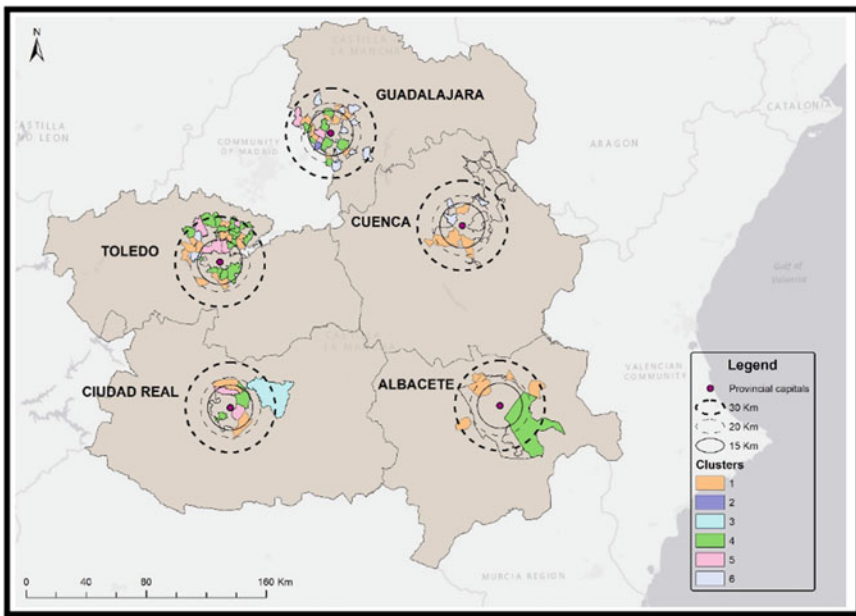
Fig. 9 Final proposal for a typology of urban area. Own preparation
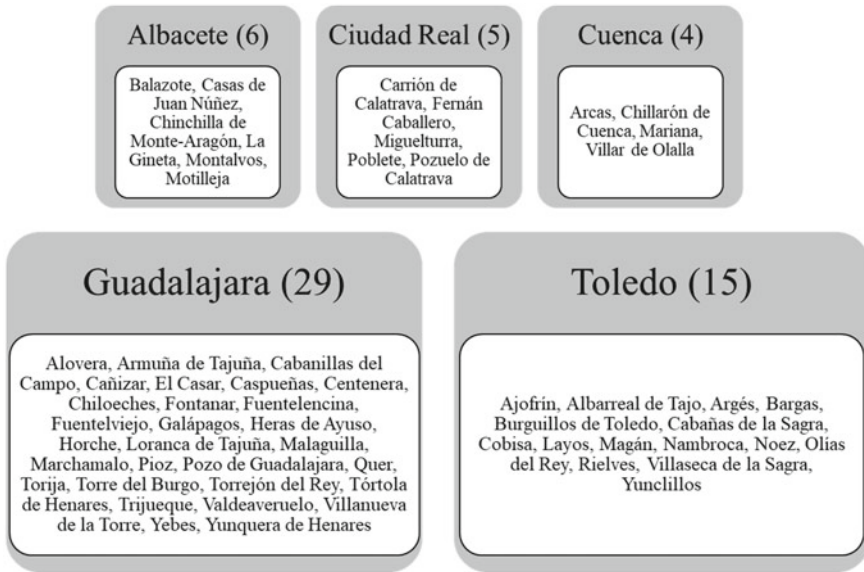
Fig. 10 Final proposal for a typology of urban area.Own preparation

the urban area of Albacete, the number of hectares of undeveloped urban land is striking.

The same situation occurs, albeit more clearly, in the case of Ciudad Real. The urban area is made up of six municipalities divided into three categories:

- Group 1: Pozuelo de Calatrava and Fernán Caballero (substantial production of urban land).
- Group 4: Carrión de Calatrava and Poblete (both bordering the capital of the province).
- Group 5: Miguelturra (part of outskirts of Ciudad Real).

All the centres of population are included within the 20-km radius, except for Daimiel, which was excluded—Group 3, Fig. 9. The latter is located more than 30 km from the central city—Ciudad Real—and its functionality and demographic size (agro-city with a certain degree of industrial activity) make it a regional centre.

In Cuenca, four municipalities are located within the urban area. They are divided between categories one and six:

- Group 1: Arcas, Mariana and Villar de Olalla.
- Group 6: Chillarón de Cuenca.

In this case, Bascuñana de San Pedro and Uña were excluded, as neither their demographic size nor their (scant) dynamics were significant in the process analysed. However, compared to the previously described provincial capitals, Cuenca is the urban area that shows the most sluggish growth.

The last two areas are the most complex because of their proximity to Madrid, the national capital (especially as regards the urban area of Guadalajara). In this case, the municipalities within a radius of 20 kms from the city of Guadalajara were included, with those distributed along the Henares Corridor being the most dynamic. The only one excluded was Azuqueca de Henares (Group 2), which has been considered part of the urban area of Madrid. The urban area is organised into 29 municipalities (Fig. 9):

- Group 1: Armuña de Tajuna, Fontanar, Galápagos, Heras de Ayuso, Pozo de Guadalajara, Quer, Torija, Torre del Burgo, Tórtola de Henares andValdeaveruelo.
- Group 4: Chiloeches, Horche, Marchamalo, Pioz, Torrejón del Rey, Villanueva de la Torre and Yunquera de Henares.
- Grupo 5: Alovera, Cabanillas del Campo and El casar.
- Grupo 6: Cañizar, Caspueñas, Centenera, Fuentelencina, Fuentelviejo, Loranca de Tajuña, Malaguilla, TrijuequeandYebes.

Finally, in the proposal for the urban area of Toledo, our AHP yielded a total of 32 municipalities. Of this group, 17 were eliminated, those most to the north, as they form part of the polynuclear metropolitan area of Madrid along the la Sagra Corridor (being the cases of Camarena, Chozas de Canales, Cedillo del Condado, Cobeja, Huecas, Lominchar, Recas, Yuncos, Yuncler, Numancia de la Sagra, Villaluenga de la Sagra, Alameda de la Sagra, Gerindote, Burujón, Barcience, Novés and Fuensalida). In this way, the 20-km radius also provesappropriate. The distribution, according to cluster group, of the 15 municipalities that make up the urban area, is as follows (Fig. 9):

- Group 1: Ajofrín, Cabañas de la Sagra, Noez, Layos, Rielves, Villaseca de la Sagra and Yunclillos.
- Group 4: Argés, Burguillos de Toledo, Cobisa, Magán, and Nambroca.
- Group 5: Bargas and Olías del Rey.
- Group 6: Albarreal de Tajo.

Example of Cartographic Data Sheet

Municipal level data sheets were generated (combining statistical and cartographic information as tool to explain the processes operated at the scale of the population nucleus,). Their use allows for a detailed understanding of the process of transformation at urban level. Only the example of Yebes is presented here (for reasons of space). It is unique both for its unusual dynamics and the differences between the trend it presents and those of the other municipalities.

Yebes is included in Cluster 6 of the urban area of Guadalajara. The municipality has experienced abnormally high growth in all the variables used during the period 2000–2016, reproducing the pattern of changes in urbanisation dynamics being more significant than those at demographic level. The data sheet (Figs. 11, 12, 13, 14, 15, 16 and 17) helps understand the transformation process in the two sub-periods for each of the variables. The change in undeveloped urban area, which increased by 9050%
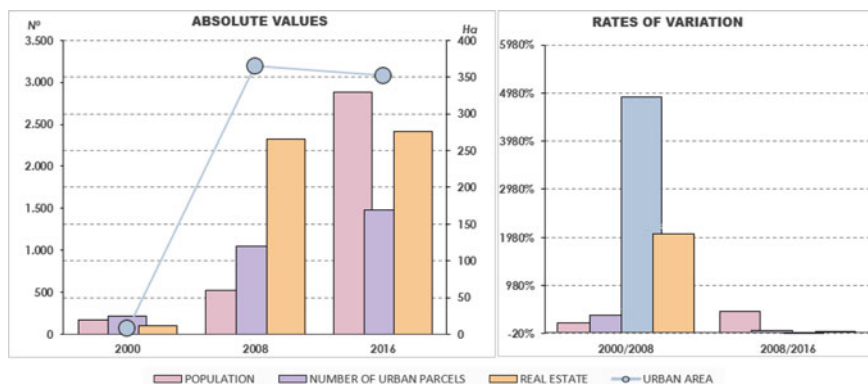
Fig. 11 Example of municipal data sheet for Yebes. Own preparation

between 2000 and 2008, is striking. The built-up area also showed notable changes during this period (rising by 1450%), although the housing production has been even more extraordinary (2051%). The number of urban parcels increased exponentially, especially the number of undeveloped plots (1115%). The least dynamic element is the rate of population change, although it did grow by 214% between 2000 and 2008. Looking at what occurred in the two sub-periods, the unique feature of the demographic variable is that the changes occurred in both the first (2008–2016) and the second (2008–2016) periods, especially since this change is more marked in the latter period (which, paradoxically, was that of the economic crisis). Another striking feature is that the dynamic was more intense in the construction type of housing blocks (1838 open building and perimeter block multi-family dwellings, for the same period), departing from the logic of urban dispersion, which is related in the rest of the cases to the production of single-family dwellings (464 detached and semi-detached buildings tover the 2000–2016 period), which were dominant in these two sub-periods in the rest of the municipalities.

In Yebes is Ciudad Valdeluz (Figs. 15, 16, and 17), considered "a symbol of the crisis only 67 kms from the Puerta del Sol in Madrid […]. Surroundedby concrete skeletons, a handful of neighbours who had bought homes of the highest quality in the middle of nowhere despaired" (Villarino 2015). This urban development created an ex-novo city that failed to meet the expectations of the (few) inhabitants who decided to settle there (Sanz Abad 2014). The special urbanisation dynamics and its characteristics are motivated by the proximity and accessibility to Madrid, the difference in land and housing prices, and the local authorities' support for unbridled urban development (Martínez Navarro and Vázquez Varela 2018).

Fig. 12 Number of dwellings and construction types (Yebes). Own preparation
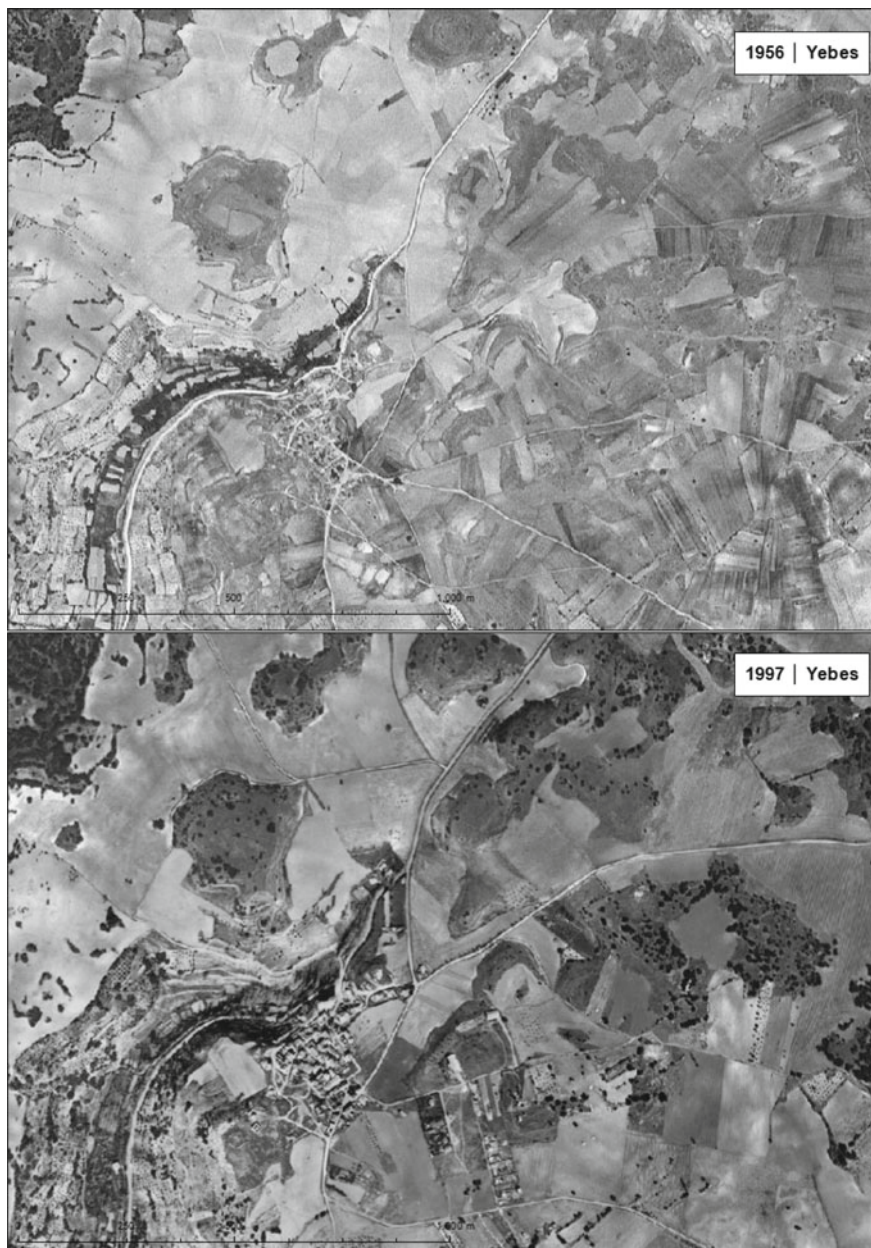
Fig. 13 Orthophotos from the National Plan of Aerial Orthophotos of 1956–1997: Yebes. Own preparation

Fig. 14 Orthophotos from the National Plan of Aerial Orthophotos of 2009–2018: Yebes. Own preparation

Fig. 15 Number of dwellings and construction types (Valdeluz). Own preparation

Fig. 16 Orthophotos from the National Plan of Aerial Orthophotos of 1956–1997: Valdeluz. Own preparation. Own preparation

Fig. 17 Orthophotos from the National Plan of Aerial Orthophotos of 2009–2018: Valdeluz. Own preparation

Conclusions

The processes of urban sprawl form part of the debate on the characteristics and dynamics of the transformation of cities. It is a widespread phenomenon, which has been replicated in the European sociocultural context, and, consequently, in Spain.

The progressive functional, morphological and social transformation of cities has given rise to less dense and more fragmented structures. These structures are also found in intermediate cities. In this case, the analysis of the processes undergone in the last two decades is addressed, using an alternative and complementary methodology to that employed by national and European institutions, based on the use of housing and population variables.

The cadastre in Europe can be a highly useful tool, although it is little tapped and its structure makes it complicated to use. The development of computer tools and instruments for urban studies has proven to be a useful option. In this case, an application was developed that allows massive downloads cadastral of housing information. Designing this application was necessary given that such data are not commonly used for the analysis of urbanisation dynamics.

Using these sources in AHP and cluster analysis methodology reveals a considerable difference between the results obtained and the proposals for definition suggested by Urban Audit (EU) and MITMA (Spanish Government). In this case, the urban areas are apparently better dimensioned and are organised in a 20-km radius around the cities that serve as their reference. The municipalities included are those that are more dynamic than their respective central cities. In addition, using these sources allow a typology of municipalities to be established, according to the processes observed. In this way, the intensity of the processes, territorial scope and municipal typology are features that enhance the use of this combination of methodologies.

The collection of municipal records makes it possible to use an inductive method to recognise how urban sprawl has expanded. It allows us to analyse in detail, case by case, the development of the process on an urban scale. Atypical examples appear (especially in the municipalities in Cluster 1) in which the growth of the urban area has taken place outside the main nucleus of population (Yebes, Ciudad de Valdeluz or Chinchilla de Monte-Aragón).

Finally, it is worth noting that when the dynamics of the central city and the urban areas are compared, it can be observed that growth has been significantly higher in the latter (except for Toledo—the central city—where there is a substantial re-zoned area) and that it has been especially intense in urbanised surface area and housing (much higher than that observed in demographic change).

References

Bellet Sanfeliú C, Cebrián Abellán F (2022) Ciudades medias en España Urbanización y políticas urbanísticas (1979–2019). 40 Años de ayuntamientos democráticos. Edicions de la Univ de Lleida, Servicio de Publicaciones Univer de Castilla-La Mancha, Asoc Española de Geografía, Lleida. ISBN 978-84-124962-0-8

Borsdorf A, Zembri P (eds) (2004) European cities: insights on Outskirts: structures. European Cooperation in the Field of Scientific and Technical Research, Brussels

Brenner N, Schmid C (2015) Towards a new epistemology of the urban? City 19(2–3):151–182. https://doi.org/10.1080/13604813.2015.1014712

Burriel de Orueta EL (2008) La "década prodigiosa" del urbanismo español (1997–2006). Rev Electrónica de Geografía y Cien Soc Scr Nova, XII, núm 1–30. Retrieved from http://www.ub.edu/geocrit/-xcol/383.htm

Castells M (2000) La Sociedad red: La Era de la información : economía, sociedad y cultura ; 1. In: Alianza (Segunda ed). Retrieved from https://cataleg.uoc.edu/record=b1012683~S1*cat

Castells M (2006) La revolución de la tecnología de la información. In: La sociedad red, pp 55–90

Cebrián Abellán F (Coord) (2020) Dinámicas de urbanización en ciudades medias interiores: ¿hacia un urbanismo más urbano? Tirant lo Blanch, Madrid

Computerized cadastre remit file (urban, rural, and special status real estate) Available in https://www.catastro.meh.es/documentos/formatos_intercambio/catastro_fin_cat_2006.pdf

Couch C, Leontidou L, Petschel-Held G (eds) (2008) Urban sprawl in Europe : landscapes, land-use change and policy. Blackwell Pubkishing, Oxford

Czerny M (2013) La emergencia del fenómeno de la ciudad difusa en Polonia. In: Cebrián F, Panadero M (eds) (2013) (Coord.) Ciudades medias. Formas de expansión urbana. Biblioteca Nueva. Madrid

de Taifa SEC (2008) Auge y crisis de la vivienda en España. Informes de Economía (5)

European Environmental Agency (EEA) (2006) Urban Sprawl in Europe. The ignored challenge. EEA Rep (10). https://doi.org/10.1002/9780470692066

European Environmental Agency (EEA). (2018). La tierra y el suelo en Europa: ¿hormigón urbano en expansión? 1–6

Ferrás C (2007) El enigma de la contraurbanización Fenómeno Empírico y Concepto Caótico. Eure 33(98):5–25. https://doi.org/10.4067/s0250-71612007000100001

Gaja i Díaz F (2008) El "tsunami urbanizador" en el litoral mediterráneo. El ciclo de hiperproducción inmobiliaria 1996–2006. Scripta Nova: Rev Electrónica de Geografía y Ciencias Sociales XII(270)

Galster G, Hanson R, Ratcliffe MR, Wolman H, Coleman S, Freihage J (2001) Wrestling sprawl to the ground: Defining and measuring an elusive concept. Hous Policy Debate 12(4):681–717. https://doi.org/10.1080/10511482.2001.9521426

Garreau J (1994) Edge cities in profile. Am Demogr 16(2):24–33

Hasse J, Lathrop RG (2003) A housing-unit-level approach to characterizing residential sprawl. Photogram Eng Remote Sens 69(9):1021–1030. https://doi.org/10.14358/PERS.69.9.1021

Martínez Navarro JM, Vázquez Varela C (2018) Dinámicas de expansión urbana en ciudades medias interiores. Análisis comparado de ciudades aisladas y ciudades situadas en entornos metropolitanos y corredores de transporte: Los casos de Cuenca y Guadalajara. In (Coord.) Cebrián Abellán F (ed) Ciudades medias y áreas metropolitanas. De la regeneración a la dispersión. Ediciones de la Universidad de Castilla-La Mancha, Cuenca, pp 175–199

Ocaña Peinado FM (2019) Técnicas estadísticas aplicadas en el ámbito de la Nutrición y la Salud. Retrieved June 20, 2020, from Curso propuesto por el Programa de Doctorado en Nutrición y Ciencias de los Alimentos website: https://www.ugr.es/~fmocan/MATERIALESDOCTORADO/Tratamientodeoutliersymissing.pdf

Osorio J, Orejuela J (2008) El proceso de análisis jerárquico y la toma de decisiones multicriterio. Red de Rev Científicas de Am Lat, El Caribe, Esp y Portugal XIV(39):247–252. 84920503044

Pollin R (2013) La lucha para derrotar al neoliberalismo global. La centralidad de las políticas sobre los mercados financieros en Ecuador y en otros lugares. In Chaves Giraldo P, Prieto del Campo C, Ramírez Gallego R (eds) Crisis del capitalismo neoliberal, poder constituyente y democracia real. Traficantes de Sueños, pp 149–174

Romero J (2010) Construcción residencial y gobierno del territorio en España. De la burbuja especulativa a la recesión. Causas y consecuencias. Retrieved from https://www.researchgate. net/publication/237026038_Construccion_residencial_y_gobierno_del_territorio_en_Espana_ De_la_burbuja_especulativa_a_la_recesion_Causas_y_consecuencias

Saaty TL (1990) How to make a decision: the analytic hierarchy process. Eur J Oper Res 48(1)9–26. https://doi.org/10.1016/0377-2217(90)90057-I

Saaty TL (2008) Decision making with the analytic hierarchy process. Int J Serv Sci 1

Sánchez Ondoño I, Cebrián Abellán F (2021) Análisis de la dispersión urbana en Castilla-La Mancha a través del Proceso de Jerarquía Analítica. In La reconfiguración capitalista de los espacios urbanos: transformaciones y Desigualdades. Asociación de Geógrafos Españoles, Las Palmas de Gran Canaria: Universidad de Las Palmas de Gran Canaria, pp 115–130

Sánchez Ondoño I, Cebrián Abellán F, Garcia-Gonzalez JA (2021) The cadastre as a source for the analysis of urbanization dynamics. Applications in urban areas of medium-sized Inland Spanish Cities. https://doi.org/10.3390/land10040374

Sánchez Ondoño I, Cebrián Abellán F (2022) El uso de la información catastral para el estudio de dinámicas urbanas. Análisis de ciudades intermedias y áreas urbanas (Ávila, Segovia, Guadalajara y Toledo). XVI Coloquio de Geografía Urbana; Asociación de Geógrafos Españoles. En prensa

Sánchez Ondoño I (2020) La dispersión urbana en el proceso de reconfiguración territorial de las ciudades medias interiores. Los casos de las capitales de provincia de Castilla-La Mancha durante el periodo 2000–2016. Tesis doctoral: Universidad de Castilla-La Mancha

Sanz Abad J (2014) Vías de tren, cauces de prosperidad: el caso de Ciudad Valdeluz. Rev De Estud Urbanos y Ciencias Soc 1(1):82–100

Soja EW (2008) Postmetrópolis. Estudios críticos sobre las ciudades y las regions. Traficantes de Sueños Madrid

Villarino Á (2015) Valdeluz, de ciudad fantasma a paraíso de mileuristas y divorcidos. El Confidencial. Retrieved from https://www.elconfidencial.com/espana/2015-09-26/valdeluz-de-ciudad-fantasma-a-paraiso-de-mileuristas-y-divorciados_1037338/

Post-pandemic Urban Reality: COVID-19 as an Accelerator or a Hindrance to the Development of Grassroots Urban Activism? The Example of Poland

Patrycja Grzyś [iD]

Abstract This chapter provides much-needed insight into the consequences of COVID-19 with particular emphasis on grassroots urban activism. Focusing on the example of Poland, the author decided to address the role of local communities which, in the situation of common distrust in the activities of both local and government authorities, revealed their potential to undertake efficient and flexible responses to crisis situations within bottom-up initiatives. The pandemic undoubtedly proved to be a game changer of our times. It has triggered a number of changes in local and regional development policies and approaches to urban crisis management. To understand these changes, it is necessary to be aware of the processes underpinning them. In this context, geography and geographers have a major role to play, whose knowledge and ability to synthesise and think wholistically can be of great importance in addressing post-pandemic urban challenges.

Keywords COVID-19 · Grassroots urban activism · Local communities · Importance of geography · Poland

Introduction

Major global events such as wars, natural disasters and pandemics are phenomena that shape our cities, communities and relationships. Each time, however, these crises reveal the adaptive power of both humans and complex systems such as cities. At the same time, never before has the concept and meaning of terms such as urban resilience or urban vulnerability been discussed so intensively.

The concept of resilience has been increasingly adopted in policy documents and normative acts at different territorial scales. It appears i. e. in the Global Strategy for the European Union, in the proceedings of UN-Habitat or in the 2030 Agenda

P. Grzyś (✉)
Department of Regional and Social Geography, University of Lodz, Lodz, Poland
e-mail: patrycja.grzys@geo.uni.lodz.pl

for Sustainable Development. Among the 17 Sustainable Development Goals that were specified in the last of these documents, one of them relates directly to urban resilience (Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable). It is worth noting, however, that it is precisely in this document that the importance of local communities and local action to solve global problems ("think global, act local") is eminently emphasised.

The impact of the COVID-19 pandemic, as one of the key global problems today, on the activity of local communities can be considered twofold. On the one hand, the pandemic revealed the bottom-up potential of local communities. In a situation of distrust in the activities of both local and government authorities, it was grassroots, informal activities of local communities that worked spontaneously and most effectively (Łapniewska 2022; Mao et al. 2021; Fernandes-Jesus et al. 2021; International Institute for Environment and Development 2020). On the other hand, however, the pandemic has undoubtedly exacerbated the already existing crisis of social contacts and unfavourable trends in urban development (Long et al. 2022; Naser et al. 2021; Philpot et al. 2021; Bil et al. 2021; Sharifi and Khavarian-Garmsird 2020).

Thus the mission of this chapter is to better understand the world in which we currently find ourselves, and in particular the post-pandemic urban reality in the context of grassroots community activism. The author's research undertakes spatial and social analysis of the effects of the pandemic. The far-reaching effects of the COVID-19 will affect the nature of human contacts, the organisation of social life and, consequently, the shape of urban spaces. Therefore, this paper treats the pandemic as a game changer in contemporary urban development and reflects on the changes it provokes.

From the perspective of geography and geographers, the following questions are fundamental in this context:

(1) As a consequence of the pandemic, how will it affect urban spaces and the functioning of local communities?
(2) What potential scenarios can be identified for the development of the existing situation (in relation to the functioning of local communities)?
(3) In this situation, can we identify potential winners (who benefit from the change) and losers (whose situation is worsened or they are marginalised by the change)?
(4) What is the role of geography and geographers in addressing this problem?

Post-pandemic Urban Reality

Throughout human history, epidemics have had a significant impact on human population and well-being. From the first documented epidemics that contributed to the fall of the Roman Empire, through the plague that decimated the population of Europe in the fourteenth century, the depopulation of the Americas due to smallpox, to the Napoleon's defeat by typhoid fever. Successful eradication of epidemics was not achieved until the introduction of vaccination and the development of microbiology

in the nineteenth century. However, this achievement did not mean the permanent threat elimination.

The COVID-19 (Coronavirus Disease 2019) pandemic caused by the SARS-COV-2 virus undoubtedly became one of the greatest global threats of the twentieth century. The first cases of infection were diagnosed on 8 December 2019 in Wuhan, China (Rose-Redwood et al. 2020). On 11 March 2020, the World Health Organisation (WHO) declared a global pandemic (Pelling et al. 2022). The first recognised case in Europe was recorded on 24 January 2020. The pandemic reorganised socio-economic life to an unprecedented degree. Governments from all over the world developed diverse national and subnational measures to response to the COVID-19 crisis (Allain-Dupré et al. 2020). Physical distancing, self-isolation, quarantining, limiting travel, social gatherings, closing businesses and enforcing lockdowns were the most frequently introduced restrictions although their scale varied depending on the country and the health policy pursued (Rose-Redwood et al. 2020). In this context, the contrast between the restrictions imposed in Denmark and Poland provides clear evidence. While in Denmark, public spaces were open to the public throughout the whole pandemic and outdoor activities were encouraged (maintaining social distance), in Poland even forests and parks were closed due to strict lockdown (Gehl 2021; Klajn 2020).

Due to global efforts against the spread of SARS-COV-2 virus, with continued increases in COVID-19 vaccination, higher levels of infection-acquired immunity it is said that the world should expect low levels of the virus transmission in the coming time. As the Murray (2022: 419) claims "COVID-19 will continue but the end of the pandemic is near". However, the WHO has not yet revoked the pandemic status, emphasising in fact that there is still a serious risk of increased cases of the disease, especially if unsafe gatherings will continue, adhering to the principle that "no one is safe until everyone is safe" (World Health Organisation 2022). The state of epidemics was introduced in Poland from 20 March 2020. It has now been abolished by the Regulation of the Council of Ministers of 13 May 2022. The state of epidemic threat applies from 16 May 2022.

In addressing the problem of pandemics, the role of geographers has proved to be enormous. Notably, there is a significant correlation between the development of pandemics and geographical factors. According to Noworól (2021), space is one of the three factors, apart from time and population density that determine the phenomenon of an epidemic. The level of epidemic risk is influenced by various combinations of factors, many of which are spatial in nature, such as the source of infection and spread of the pathogen, the mode of transmission of the disease, the spatially determined frequency of human contact or the existence of enclaves with difficult access. Moreover, as Noworól (2021) notes, in globalised societies, these factors are further strengthened primarily by the intensification of flows of people, goods and services. Nevertheless, globalisation should not only be considered as an intensification of the threat, but also as a mitigating factor due to the intensified exchange of information, which facilitates the preparation of preventive measures and disseminates knowledge about the countermeasures taken.

The coronavirus pandemic caused far-reaching consequences for social and economic life. They can be analysed in a multi-faceted way within the urban context (Table 1) However, the need to maintain physical distance and to limit social contacts has become the substrate of the vast majority of restrictions (Honey-Rosés et al. 2021). Due to the fact that the proper functioning of a city depends precisely on the functioning of its inhabitants, who interact with each other for a variety of purposes in order to fulfil their basic needs, the introduced restrictions have significantly limited the possibility of proper functioning of cities. The pandemic has also been a catalyst for many existing problems in urban spaces and has accelerated negative trends and processes. The global health crisis affecting the most vulnerable segments of society unleashed existing inequalities and deepened both social inequalities (in terms of class, race, ethnicity and gender) and economic disparities (Rose-Redwood et al. 2020; Pelling et al. 2022; Platt and Warwick 2020; Hastings 2021).

Understanding how the pandemic has affected cities so far is crucial for researchers, urban planners, governments and other decision-makers since the consequences of the pandemic will have to be considered when designing urban spaces. The future of cities and their resilience to future crises will depend on how the decisive stakeholders respond to current challenges.[1]

At the same time, it is essential that every member of society recognises that the changes that will surround them in the near future are to a greater or lesser extent the effects of a pandemic. These changes, although they have reached a global scale, have directly affected entire populations—individuals and communities on a local scale by bringing social and economic life to a near stop. Along with these processes, city life has also been diminishing. Pandemic times verified the dominant neoliberal model of urban development. As Kubicki (2020) points out, this model proved not to be resilient to the crisis caused by the pandemic:

> A business oriented on fast profits, an anonymous client and based on precarious work turned out to be poorly resistant to the crisis caused by the pandemic. In times of isolation, no one misses them and no one helps them through the difficult times. Urban community-based services have been less profitable, but thanks to the solidarity and social relations created, they are now more likely to survive the crisis.

Therefore, according to Kubicki (2020), truly resilient cities will be those whose strength and resilience derive from community spirit.

---

[1] At the time of submitting this paper (30.05.2022), World Health Organisation (2022) released information about an outbreak of monkeypox in non-endemic countries. Over 90 cases have already been confirmed, but associated deaths have not been reported to date. This alert only proves that it is important to react rapidly in order to be prepared for the next emergency.

Table 1 Implications of the changes and developing trends caused by the pandemic in specific areas of urban development

Area	Consequences and trends
Urban planning, design and social life (Honey-Rosés et al. 2021; Gehl 2020; Gehl 2021; Sharifi and Khavarian-Garmsird 2020; Florida et al. 2021; The City of Baltimore 2020; Mouratidis 2021; Załęczna and Antczak-Stępniak 2022; Kunzmann 2020)	– Change in spatial and temporal patterns (e.g. significant drop of downtown activities) – Change of social behaviour within public spaces (places no longer provide opportunities for spontaneous social interaction and formation of new social ties) – Growing importance of flexibility and multifunctionality in urban design (becoming a key feature for a resilient city) – Changing preferences and expectations towards the amount and structure of green spaces (towards decentralised network of smaller green spaces near residential areas) – Implementation of long-term strategies to improve the health of the population through appropriate urban management (attention was paid to the physical and mental health factor, not only for the elderly) – Reconfiguring streetscapes to become more pedestrian and cyclist-friendly(widening of pavements, development of new non-collision cycling routes allowing longer distances to be covered) – The process of suburbanisation and de-urbanisation has intensified (renewed urban to rural migration, especially of the upper class, causing further inequalities) – A shift in urban planning towards the creation of more compact urban environments (e.g. the 15-min city) – Increased importance of local meeting spaces (in close proximity to the place of residence) – Strengthening local social ties and social engagement (increased community-driven activities) – Exposing and deepening social and economic inequalities (limited access to services, higher exposure to risks and economic difficulties, poor living and sanitary conditions) – The growing number of abandoned offices and shopping malls in city centres and the increase in delivery-based consumption ("dark stores") have resulted in streets losing their commercial role and city centres becoming deserted – Significant growth in most teleactivities (e.g. teleworking, teleconferencing, online learning, online shopping, teleleisure and online socialising) – Boosted interest in smart city development (ICT solutions)

(continued)

Table 1 (continued)

Area	Consequences and trends
Urban mobility (Pawar, Yadav, Akolekar and Velagab 2020; Aloi et al. 2020)	– Change in everyday mobility patterns (spatial and temporal) – Reduced mobility due to the shift towards remote working/study – Increase negative attitudes towards public transportation and preference for individual travel modes (private vehicles, taxis or ride-sharing services) – Dynamic development of micromobility – Development of e-sharing industry related to transport and mobility – Pedestrianisation
Tourism and travel (Hu and Chen, 2021; Shamshiripour et al. 2020; Napierała, Leśniewska-Napierała and Burski, 2020)	– Change in travel behaviours (spatial and temporal) – Changes in the form of travel (instead of staying in popular hotels/city centres, more often one chooses niche, less crowded places), destinations (preferred small, underestimated tourist destinations instead of popular tourist destinations), travel distance (preferred shorter distances) – Considerably less interest in quick weekend trips (city breaks) – Increasing preference for spending time in nature and active pursuits, e.g. camping, hiking, etc. – The emergence and increasing popularity of new forms of leisure activities, e.g. glamping – The possibility of reducing overtourism;
Housing (Poortinga, Bird, Hallingberg, Rhiannon and William 2021; Szmytkowska, 2020)	– Exposed problem of the insufficient space in residential buildings per person – Increased need for private open spaces such as gardens, balconies attached to homes – Increased need for multifunctional shared spaces in neighbourhoods – Decline in rental housing (resulting in slowdown speculations on the rental market and lower prices) – Increased demand for second home real estates (mostly located in peripheries/rural areas) – Possible long-term decline in commercial real estate values

The Polish Background

The first confirmed case of COVID-19 in Poland was diagnosed on 4 March 2020 (ECDC 2020) although there are speculations of earlier non-confirmed outbreaks (Śleszyński 2021a, b). On 20 March 2020, the Polish Minister of Health announced

the signing of a resolution on the epidemic state in Poland. Subsequent decisions by the government to minimise the risk of spreading the virus consistently restricted international travel, introduced rules of social distancing both in open public spaces and in public enclosures, an obligation to cover the nose and mouth in public places, and restricted the activities of many public institutions.

Nonetheless, later government decisions on counteracting the effects of the spread of the virus were made very chaotically and inefficiently, which resulted in a lack of public confidence in the government's anti-crisis policy. Chaos, lack of coherence in decision-making, lack of legal regulations enabling operation in a pandemic situation or poorly drafted legal acts, which had to be repeatedly amended, resulting in public doubts about their legality, are most often enumerated as the biggest drawbacks of the implemented procedures. All these actions highlighted the weakness of crisis management policy at the government level in Poland (Małecki 2020; Jaraczewski, 2021).

Against the background of uncoordinated actions at the state level, much of the responsibility has fallen on the shoulders of local authorities. In some cases, they took action even faster than the national regulations were implemented. The most frequent actions undertaken by municipal governments in Poland in the initial period of the pandemic included: cancellation of all local mass events, changes in transport policy, such as limiting the number of passengers using public transport or abolishment of parking fees in city centres, implementation of electronic systems of customer service in public institutions, or remission of fees to entrepreneurs in municipal premises. It was also common to make urgent changes to municipal budgets and to shift expenditures from promotional purposes to those of ensuring optimum safety for all residents. Later, when the pandemic situation became more stabilised, the activities of the municipal authorities focused mainly on three main areas: the functioning of the city, support for different (especially vulnerable) groups as well as work organisation and management.

The above-mentioned activities largely depended on the audacity and proactive nature of local government officials and the level of interaction with other stakeholders such as inhabitants and local businesses. The possibility of cooperation and support of authorities for social activities as well as public support for the activities of local government significantly facilitated the implementation of various types of social innovations. Some of the initiatives forced upon us by the pandemic, to a greater or lesser extent reformulated and adapted to new conditions, such as the use of digital tools in social participation, will remain in local governments long-term.

The global scale of the epidemic, its spatial character and the lack of social approval for the actions of the state authorities resulting therefrom the lack of cooperation and agreement between science, politics and society led to rapid interest among Polish geographers in the spatial character of the pandemic. The first emerging works concerned the spatial character of the virus spread in Poland (Krzysztofik et al. 2020; Śleszyński 2021a, b), new challenges for spatial policy and development (Śleszyński, Nowak and Blaszke2020; Nowak and Blaszke 2020), changes in tourism and travel (Napierała et al. 2020; Wiskulski 2020) as well as local mobility and shift in spatial mobility behaviours (Tarkowski et al. 2020; Stępień et al. 2021).

The thematic scope of the studies that appeared in the initial period of the pandemic was associated primarily with the initial visible effects of the pandemic, i.e. the spatial distribution of cases and the closure of borders, as well as the establishment of rules of physical distance and thus a significant restriction of movement at different scales. Whereas studies on grassroots social activism were not yet emerging in this period, as it was difficult to determine the scale of non-formalised local community action. The first mentions on citizen-led initiatives began to appear in the local press and reports authored by non-governmental organisations. The Polish experience in this context is consistent with that of other countries, as can be seen from the interest of the Geographical Sciences Committee (2020) in this subject and the organisation of a special "Fall 2000" meeting devoted precisely to place-based initiatives in the context of pandemics. As part of the invitation to this event, one may read that:

> Our understanding of the geographic spread of COVID-19 has largely been based on national-scale epidemiological models, while the place-based responses to community-level impacts of the disease have mainly been informed by local-scale surveys and reports of the lived experiences of individuals within those communities.

Furthermore, another impediment to a more comprehensive analysis of the coronavirus spread under Polish conditions was the problem of data registering and availability. Open access to data on the number of infections by powiats[2] was only made available after 24 November 2020 without information on the period prior to the date of accessibility. This was driven by the poor quality of data provided by powiat sanitary inspections (Śleszyński, 2021b). The only available source of data broken down in more detail than the division into voivodships was a database created in the bottom-up effort, by Michał Rogalski (Rogalski 2020), a 20-year-old computer graphic designer, who, in opposition to the information chaos of the time, brought together a group of people to provide the more accurate data that could not be obtained centrally (Kowalski et al. 2021). As it was resonantly commented: "there could hardly be a more eloquent comment drawing attention to the weakness of the state" (Śleszyński, 2021a).

The spatial distribution of infections in Poland was uneven for the vast majority of the epidemic's development. Especially in the first phase of the pandemic, low and high-intensity regions were clearly identifiable. The area with the highest concentration of infections was south-west Poland and isolated epidemic hotspots in large cities. In contrast, the area with the lowest concentration was north-eastern Poland, in particular areas with low population density (Śleszyński 2021b). Late periods were characterised by greater irregularity, which was related to decreasing fear of travel and the removal of some restrictions during the holiday season. However, as pointed out by Kong et al. (2021), many countries have different characteristics, which predispose them to greater or lesser vulnerability to COVID-19. The factors, conducive and nonconducive to the development of the SARS-COV-2 virus under Polish conditions are presented in the (Table 2).

---

[2] The three-tier administrative (territorial) division of Poland divides the territory of Poland into voivodships, then into powiats (including gminas that are cities with powiat status) and gminas.

Table 2 Conducive and non-conducive factors for SARS-COV-2 virus transmission in case of Poland

Conducive factors	Non-conducive factors
the occurrence of spatial population overgrowth (metropolitan areas)—e.g. the Upper Silesian conurbation, the Poznań agglomeration, the Wrocław agglomeration	moderate population density in most of the country (average population density in Poland is 123 os/km^2)
large-scale population movements in the agglomeration and adjacent areas (commuting-circular migration), e.g. the Warsaw metropolitan area, the Tri-City metropolitan area	lower urbanisation rate than that observed in the majority of Europe (61%)
high share of the elderly population in the city centres	lower spatial mobility, especially international, compared to other European countries (lower "global interconnectedness")
high share of multi-family housing in large and medium-sized cities with urban design not conducive to maintaining social distance	high density of inland river network and shortage of bridges, which may constitute a spatial barrier for the virus expansion
poor air circulation conditions due to the high density of housing in large urban areas	relatively good living conditions (in terms of quality of the local environment around residential areas where people live)
existence of social problem areas with weak human capital, epidemiological awareness and attitude to restrictions	relatively high hygiene and sanitary conditions in public spaces, schools, workplaces
low level of trust in government and its initiatives, scientific reports and the work of medical professionals, resulting in increased information chaos and the development of panic	culture of spending leisure time (in comparison to Western Europe, a higher percentage of people spend time at home than outdoors
high percentage of overcrowded households	high level of social solidarity

(Own work based on Śleszyński (2021a), Di Meglio et al. (2018) and own research)

The majority of factors, as may be noted, are related to architectural-urban and social solutions (e.g. demography, human capital). To the above list of factors, one could also add, for example, meteorological factors (temperature, humidity, air quality, etc.) (Zhu et al. 2020) although there are no papers that would confirm their significant relevance in Polish conditions.

The Impact of the Pandemic on Grassroots Community Activism

In a global crisis situation, it is not the global or national scale, but the local, in the case of this paper, the urban scale, that is the environment closest to the citizens, where the reorganisation of social life occurs to the largest extent. Despite the fact

that local authorities are not the main body in charge of crisis management, they still fulfil an important role due to their proximity to the inhabitants.

In the case of crisis situations, which certainly include the outbreak of the COVID-19 pandemic, where the life and health of communities are at risk, responsiveness, flexibility and adequacy are the basic features expected from decision-makers. In view of the already mentioned chaotic and incomplete response of the Polish government to the pandemic situation in the initial period of its development, a large part of the responsibility fell on local authorities. Depending on the size of a given city, the population, the level of social involvement in local matters and the level of cooperation with the municipal government, local communities have also become involved in efforts to counteract the effects of the pandemic. Particular involvement of local communities could be observed in the initial period of the pandemic, especially in the activities of informal citizen groups. Later on, NGOs and local governments became involved. The ability of local activists to respond promptly and agilely to the actual, immediate needs of local communities stems from their place-based and community-based nature. In crisis situations, which are by their very nature emergencies, there is a need for a quick, but above all flexible reaction. Authorities react quickly, but not flexible. "We need agile reaction to fragile situation" as expressed by Mariusz Sokołowicz at the Regional Studies Association conference Regions in Recovery e-festival 2022 (Grzyś 2022). However, it must be emphasised that despite the slower pace of the higher decision-making levels, their overall capacity is often greater than that of the grassroots urban movements. This relationship is shown in Fig. 1.

These differences in speed of reaction or capacity for action do not necessarily have to be seen as a disadvantage of individual stakeholders as long as they cooperate with each other. In such cases, there is a chance to obtain a synergic effect, which would not be possible in case of individual actions of particular actors. Otherwise, if there is no cooperation between the stakeholders, the synergy effect will not occur, the actions will be more chaotic, and may even turn out to be antagonistic.

When faced with a crisis, the local community responded very quickly revealing social solidarity to assist those in immediate need (Rose-Redwood et al. 2020; Gravante and Poma 2021). In the first instance, assistance was organised for the
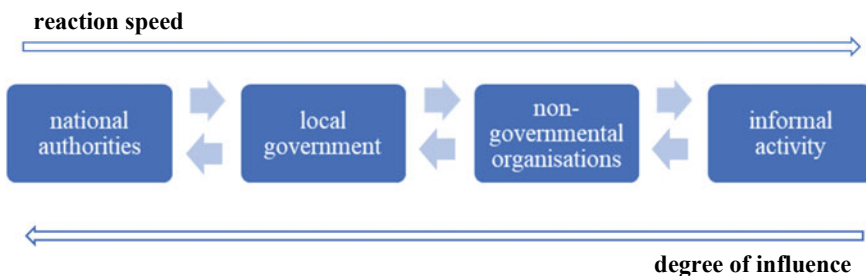
Fig. 1 The relationship between reaction speed and degree of influence on crisis occurrences between different urban stakeholders

elderly, particularly vulnerable to severe illness, and for those living alone. It was popular in Poland to post notices in the stairwells of blocks of flats offering assistance with, for example, shopping, providing medication or walking dogs. Such assistance was also offered through special groups on Internet portals (e.g. Tri-City Visible Hand). At this point, it is important to emphasise the huge role of social media and online platforms, which proved to be an alternative space for civic mobilisation to face the consequences of the pandemic (Górska et al. 2022; Waeterloos et al. 2021). In addition to material needs, the drastic reduction of social contacts has caused frustration and psychological problems for many people. In this context, bottom-up community action undertook activities such as setting up local helplines, organising online meetings or, later, community walks.[3]

Besides, informal local community activities focused mainly on providing assistance to the most vulnerable groups in immediate need; there were also activists and non-governmental organisations involved in providing assistance. Local NGOs joined the support within the framework of their organisational structures relatively later than non-formalised groups of local communities, but their activities went beyond the scale of the immediate neighbourhood and, through the availability of specific funds, competences and possibilities to act formally within the scope of the law, allowed for more effective coordination of work with a broader scope. The most common activities undertaken by NGOs in the field of preventing the negative effects of a pandemic included sewing masks, preparing visors, providing meals to medical staff or, later on, when vaccinations became available, joining vaccination promotion campaigns.

However, it is important to stress that the occurrence of a threatening situation did not have a stimulating effect in all communities. Transferring most aspects of human functioning (work, school, entertainment, culture) to the remote sphere, significant limitation of social contacts, and in some situations even forced isolation evoked stress, anxiety and panic. For a large part of society, the fear connected with the threat to one's own health and life proved paralysing. This resulted in a firm cut-off from any social contact and isolation for even longer than required. Trust in strangers and a reluctance to be in public spaces have been permanently eroded in many cases. Moreover, the pandemic revealed a diminishing sense of community in some cities and increase of self-centred behaviours (Biswas 2020). These types of behaviour are particularly revealed by more affluent people. Leonard (2020) pointed out that rich urbanites spent the time of the pandemic in their second homes generally located outside the city. This is another situation in which the pandemic has again highlighted economic inequalities and their effects. However, what can be concluded from the behaviour of communities on a global scale is that it is social status, level of human capital and attachment to place that creates a sense of solidarity with their community and a readiness to mutual help in a crisis situation. A strong sense of community and solidarity is important not only in the emergency response itself but also during the recovery processes. Strong attachment to place and readiness to mutual help have

---

[3] Activities related to meetings, walks and other activities involving direct contact with other people were organised when legally possible and safe for the participants.

shown significant success stories, such as Ho Chi Minh City (Thoi 2020). Indeed, it is in crisis situations that the strength of local communities is most evident (Brill 2022).

Towards Post-pandemic Urban Reality—It Means Where?

There is no doubt that the pandemic can be regarded as a game changer in contemporary urban development. Over a very short period of time, it forced numerous changes in many spheres of socio-economic urban life. However, its global trajectory has been uneven, resulting in different approaches to counteracting its effects. Understanding in this context how specific decisions have already affected and may affect future, urban development is crucial for the development of future policies. The author has therefore chosen to present three possible scenarios for the development of a post-pandemic urban reality, making particular reference to the role of local communities in this reality.

Pandemic as an Accelerator of Grassroots Urban Activism

The pandemic has exposed the essence of a sense of community and its potential to respond to crises. A large role in this context fulfilled grassroots urban activism and the power of collective actions. Bottom-up approaches in urban development in this scenario will become the desired direction of urban development. By spreading good practice, more and more cities will redefine the current profit-driven model in favour of community-based development. Local governments, under this assumption, will learn and understand the benefits of the synergic effect of cooperation between local government and citizens. The importance of neighbourhood spaces will increase and cities will become more compact, so that traffic will be better distributed. The amount of green space in the form of small pocket parks will increase.

For this scenario, a resilient city is a city where the citizens play the role of host. This will require the support of city authorities and modern digital technologies. Even during the pandemic, it was predicted that once the global situation had stabilised, the role of local authorities would increase, and they became in many cases a remedy for a malfunctioning state. Citizen activity on the other hand is treated as an efficient response to the shock of pandemic. Local communities, local businesses and authorities are therefore treated as potential winners, while entities focused solely on profit, treating the city only as a material resource—as potential losers.

The pandemic in this scenario is seen as an opportunity to reformulate existing policies, objectives and priorities in urban development and return to classical approaches of thinking about the city as a commonwealth.

Pandemic as a Temporary Disturbance from a State of Equilibrium

In this scenario, the pandemic is treated as a temporary distraction from existing development policies and priorities. Urban life will return to normal that will not be very different from the previous normal. Only the use of modern digital tools in various spheres of city life and functioning will increase. Due to the impact of the pandemic, there will be changes in legislation, strategies and policies to ensure greater security for the future, but no real change. Sometime from now, the pandemic will remain just an unpleasant memory that was tragic while it lasted, while the memory of its course and effects will be dimmed in time (Florida et al. 2021). Instead, the way to ensure the resilience of cities will be to adapt to new conditions and stabilise the international socio-economic situation. In this way, COVID-19 recovery will be considered as a natural part of development.

The increased activity of local communities during the pandemic period is treated in this perspective as one of many actions that were taken by various actors to improve the current situation. In this scenario, it is difficult to identify potential winners, apart from the actors involved in digital development and the technology itself, if considered as a separate entity. Instead, losers can undoubtedly be identified. The pandemic has already accentuated and exacerbated the inequalities that will continue to grow and those most vulnerable groups can be treated as the biggest losers in this scenario.

Pandemic as a Hindrance for Grassroots Urban Activism

With this scenario, the pandemic is considered as a phenomenon that represents a significant obstacle to grassroots urban activity. Vibrant social life and freedom have always been the most important pull magnets for cities. When social life practically froze, public spaces became deserted and communities were ordered to distance themselves or even isolate (which was voluntarily deepened by fear and disinformation), cities had lost their attraction. Moreover, large cities, as centres of high population density, began to be treated as a threat. Hence, even during the pandemic period, increased migration to non-urban areas could be observed, which is very likely to continue or even increase in the post-pandemic period.

Diminishing importance and position of cities and the consequent drop in revenues to local government budgets will result in a deterioration of the quality of public services and, in the long run, in a decline in the quality of life of those who remain in cities. A mass outflow of population, aggravated by a worsening quality of life, may result in weakening of the condition of civil society and deepening of the existing inequalities at many levels.

This is a scenario that favours winner-takes-all politics. Strong entities and large corporations will become even bigger and stronger while the existing gaps will

deepen. The winners, in the short term, will be those favoured by the neoliberal model of urban development. In the longer term, however, this scenario has no winners, as degradation in both the ecological, urban and social spheres will sooner or later affect each of these actors directly or indirectly.

However, the way of how the post-pandemic reality will actually develop depends on the specific policies taken by municipal governments. If they opt for populist decisions rather than the well-being of the city as a collective, the frustration of citizens affected by the pandemic crisis will be focused on the city government. If, on the other hand, the residents will be able to understand and, moreover, participate in the decisions taken by the local government, this will consolidate the social legitimacy of the local government. This, in turn, is crucial for the future of democracy and creating truly resilient cities.

Summary

Cities have always been struggling with crises. Present times are a period of dynamic change, with the development of many unfavourable trends in demographic, social, practical or economic terms. This means operating under conditions of risk and uncertainty. This uncertainty concerns not only people as individual members of society, but also larger groups, organisations and institutions at various levels of government, as well as entire states and larger structures. Policy-making in such conditions is exceedingly demanding. It should be flexible and capable of rapid transformation and adaptation to changing conditions. In this context, the pandemic has revealed the need for such adjustments earlier than expected and has exacerbated existing trends and problems. It, therefore, represents one of the most significant contemporary challenges, which requires actors at different levels of decision-making to take such actions that will minimise the current and potential effects of the spread of the SARS-COV-2 virus and, in the future, allow the shaping of cities that are safe, healthy and resilient.

Knowledge and experience gained during the current crisis provide an outstanding opportunity to comprehend how cities might be affected by crisis situations, how to counteract them, who and what actions should be taken towards reducing inequalities, support most vulnerable groups and improve the quality of life in the time of pandemic and after the recovery. In this context, the role of grassroots urban activism, the potential of which became significantly apparent during the pandemic, proved to be essential. The capacity of community-driven initiatives appeared to be a vital response to the threat and for recovery from current and future risks.

Thus, geography and geographers have a huge role to perform in addressing those problems. Geography offers the tools to understand these complex processes and, through its holistic approach, to shape reliable and flexible solutions that will provide adequate support to urban planners, policymakers and communities. Moreover, this is the moment when geography can prove its application potential. Wolman (2020) even states that "amid a pandemic, geography returns with a vengeance". The

overwhelming predominance of geography's cognitive function has over the years shaped its negative public perception as a science providing only encyclopaedic and impractical knowledge (Bański 2013). The greatest challenge facing geography and geographers today will be to exploit its application potential and serve the public, which offers opportunities to improve its perception of its usefulness and scientific value.

References

Allain-Dupré D, Chatry I, Kornprobst A, Michalun M-V (2020) The territorial impact of COVID-19: Managing the crisis across levels of government. In: OECD policy responses to coronavirus (COVID). Retrieved online https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/. Accessed 25 Apr 2022

Aloi A, Alonso B, Benavente J, Cordera R, Echániz E, González F, Sañudo R et al (2020) Effects of the COVID-19 lockdown on urban mobility: empirical evidence from the city of Santander (Spain). Sustainability 12(9):1–18

Bański J (2013) What form of geography?—determining factors and future outlooks. Prz Geogr 85(2):291–307

Bil JS, Buława B, Świerzawski J (2021) Mental health and the city in the post-COVID-19 Era. Sustainability 13:1–14

Biswas PP (2020) Skewed urbanisation and the contagion. Econ Polit Wkly 55(16):13–15

Brill F (2022) Cladding and community: coming together in the times of crisis. City 26(2–3):1–19

The City of Baltimore (2020) Design for distancing. ideas guidebook. Designs, public health resources and more to support quick, safe public space activations. Retrieved online https://static1.squarespace.com/static/5ec2e7939ccfe46b4d0946b4/t/5f45462926664655fbb1f1c7/1598375472180/DFD_Ideas-Guidebook.pdf. Accessed 13 May 2022

ECDC (2020) Data on the geographic distribution of COVID-19 cases worldwide. Retrieved online https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide. Accessed 17 Mar 2022

Fernandes-Jesus M, Mao G, Ntontis E, Cocking C, McTague Michael SA, Drury J (2021) More than a COVID-19 response: sustaining mutual aid groups during and beyond the pandemic. Front Psychol 12:1–17

Florida R, Rodríguez-Pose A, Storper M (2021) Cities in a post-COVID world. Papers Evol Econ Geogr. Retreived online http://econ.geo.uu.nl/peeg/peeg2041.pdf. Accessed 24 Apr 2022

Gehl (2020) Public space, public life, and COVID 19. Retrieved online https://covid19.gehlpeople.com/files/report.pdf. Accessed 24 Apr 2022

Gehl (2021) Public space, public life, and COVID 19. Phase 2: during the reopening phase in Denmark. Retrieved online https://covid19.gehlpeople.com/files/report_phase2.pdf. Accessed 24 Apr 2022

Geographical Sciences Committee (2020) COVID-19 and the geography of vulnerability. In: National academies. Retrieved online https://www.nationalacademies.org/event/10-27-2020/covid-19-and-the-geography-of-vulnerability. Accessed 13 May 2022

Górska A, Dobija D, Giuseppe G, Staniszewska Z (2022) Getting through COVID-19 together: understanding local governments' social media communication. Cities 121:1–5

Gravante T, Poma A (2021) How are emotions about COVID-19 impacting society? The role of the political elite and grassroots activism. Int J Soc Soc Policy 42 (3/4):369–383

Grzyś P (2022) Report on the regions in recovery e-Festival 2022. report on the special session. Retrieved online https://regions.regionalstudies.org/ezine/article/issue-12-patrycja-grzys/. Accessed 17 May 2022

Hastings D (2021) 'Abandoned by everyone else,' neighbors are banding together during the pandemic. Retrieved online https://www.pbs.org/newshour/nation/how-mutual-aid-networks-came-together-in-a-year-of-crisis. Accessed 12 May 2022

Honey-Rosés J, Anguelovski I, Bohigas J, Chireh V, Daher C, Konijnendijk C, ... Nieuwenhuijsen M (2021) The impact of COVID-19 on public space: an early review of the emerging questions—design, perceptions and inequities. Cities Health 5(sup1): 263-279.

Hu S, Chen P (2021) Who left riding transit? Examining socioeconomic disparities in the impact of COVID-19 on ridership. Transp Res Part D: Transp Environ 90

International Institute for Environment and Development (2020) Inequality in the face of COVID-19: how grassroots communities are taking action. Retrieved online https://www.iied.org/inequa lity-face-covid-19-how-grassroots-communities-are-taking-action. Accesed 14 May 2022

Jaraczewski J (2021) The new normal?—emergency measures in response to the second COVID-19 wave in Poland. Retrieved online https://verfassungsblog.de/the-new-normal-emergency-mea sures-in-response-to-the-second-covid-19-wave-in-poland/. Accessed 16 May 2022

Klajn M (2020) Bordering the threat and the questionable logic of Poland's 'closed borders' response to the coronavirus pandemic. Retrieved online http://europeanbordercommunities.eu/ blog/bordering-the-threat-and-the-questionable-logic-of-polands-closed-borders-response-to-the-coronavirus-pandemic. Accessed 17 Apr 2022

Kong JD, Tekwa EW, Gignoux-Wolfsohn SA (2021) Social, economic, and environmental factors influencing the basic reproduction number of COVID-19 across countries. PLoS ONE 16(6):1–17

Kowalski PA, Szwagrzyk M, Kielpińska J, Konior A, Kusy M (2021) Numerical analysis of factors, pace and intensity of the corona virus (COVID-19) epidemic in Poland. Ecol Inform 63:1–13

Krzysztofik R, Kantor-Pietraga I, Spórna T (2020) Spatial and functional dimensions of the COVID-19 epidemic in Poland. Eurasian Geogr Econ 61(4–5):573–586

Kunzmann KR (2020) Smart cities after covid-19: ten narratives. disP Plann Rev 56(2):20–31

Łapniewska Z (2022) Solidarity and mutual aid: Women organizing the "visible hand" urban commons. Gend Work Organ 29(5):1405-1427

Leonard K (2020) Medicine lines and COVID-19: Indigenous geographies of imagined bordering. Dialogues Hum Geogr 10(2):164–168

Long E, Patterson S, Maxwell K, Blake C, Bosó Pérez R, Lewis R, Mitchell KR et al. (2022) COVID-19 pandemic and its impact on social relationships and health. J Epidemiol Community Health 76:128–132

Małecki M (2020) Poland's coronavirus restrictions are unconstitutional, unlawful and risk years of legal chaos. Retrieved online https://notesfrompoland.com/2020/04/18/polands-coronavirus-res trictions-are-unconstitutional-unlawful-and-risk-years-of-legal-chaos/. Accessed 30 Apr 2022

Mao G, Drury J, Fernandes-Jesus M, Ntontis E (2021) How participation in Covid-19 mutual aidgroups affects subjective well-being and how political identity moderates these effects. Anal Soc Issues Pub Policy 21(1):1082–1112

Di Meglio E, Kaczmarek-Firth A, Litwinska A, Rusu C (2018) Living conditions in Europe—2018 edition. Eurostat, Luxembourg

Mouratidis K (2021) How COVID-19 reshaped quality of life in cities: a synthesis and implications for urban planning. Land Use Policy 111:1–10

Murray CJ (2022) COVID-19 will continue but the end of the pandemic is near. Lancet 399(10323):417–419

Napierała T, Leśniewska-Napierała K, Burski R (2020) Impact of geographic distribution of COVID-19 cases on hotels' performances: case of polish cities. Sustainability 12(11):1–18

Naser AY, Al-Hadithi HT, Dahmash EZ, Alwafi H, Alwan SS, Abdullah ZA (2021) The effect of the 2019 coronavirus disease outbreak on social relationships: a cross-sectional study in Jordan. Int J Soc Psych 67(6):664–671

Nowak M, Blaszke M (2020) The COVID-19 pandemic and the directions of changes in the polish spatial management system. Organizacja i Zarządzanie Kwartalnik Naukowy 4(52):89–98

Noworól A (2021) Pandemia COVID-19 jako stymulator procesów despacjalizacji [COVID-19 pandemic as a stimulator of despatialization processes]. In: Nowak M (ed) Polityka przestrzenna w czasie kryzysu [Spatial policy in the time of crisis], Wydawnictwo Naukowe SCHOLAR, Warsaw, pp 9–30

Pawar DS, Yadav AK, Akolekar N, Velagab NR (2020) Impact of physical distancing due to novel coronavirus (SARS-CoV-2) on daily travel for work during transition to lockdown. Transp Res Interdisc Perspect 7:1–9

Pelling M, Adams H, Adamson G, Barcena A, Blackburn S, Borie M, Yi L (2022) Building back better from COVID-19: knowledge, emergence and social contracts. Progress Hum Geogr 46(1):121–138

Philpot LM, Ramar P, Roellinger DL, Barry BA, Sharma P, Ebbert JO (2021) Changes in social relationships during an initial "stay-at-home" phase of the COVID-19 pandemic: a longitudinal survey study in the US. Soc Sci Med 274:1–7

Platt L, Warwick R (2020) Are some ethnic groups more vulnerable to COVID-19 than others? Retrieved online https://ifs.org.uk/inequality/chapter/are-some-ethnic-groups-more-vulnerable-to-covid-19-than-others/. Accessed 14 May 2022

Poortinga W, Bird N, Hallingberg B, Rhiannon P, William D (2021) The role of perceived public and private green space in subjective health and wellbeing during and after the first peak of the COVID-19 outbreak. Landsc Urban Plan 211:1–11

Rogalski M (2020) Covid data set. Retrieved online http://bit.ly/covid19_powiaty. Accessed 30 May 2022

Rose-Redwood R, Kitchin R, Apostolopoulou E, Rickards L, Blackman T, Crampton J, Buckley M (2020) Geographies of the COVID-19. Dialogues Hum Geogr 10(2):97–106

Shamshiripour A, Rahimi E, Shabanpour R, Mohammadian A (2020) How is COVID-19 reshaping activity-travel behavior? Evidence from a comprehensive survey in Chicago. Transp Res Interdisc Perspect 7:1–16

Sharifi A, Khavarian-Garmsird AR (2020) The COVID-19 pandemic: impacts on cities and major lessons for urban planning, design, and management. Sci Total Environ 749:1–14

Śleszyński P, Nowak M, Blaszke M (2020) Spatial policy in cities during the covid-19 pandemic in Poland. TeMA-J Land Use Mobility Environ 13(3):427–444

Śleszyński P (2021a) Geografia kryzysu w dobie koronawirusa [Geography of crisis in the time of coronavirus] In: Nowak M (ed) Polityka przestrzenna w czasie kryzysu [Spatial policy in the time of crisis], Wydawnictwo Naukowe SCHOLAR, Warsaw, pp 31–51

Śleszyński P (2021b) Stages of spatial dispersion of the COVID-19 epidemic in Poland in the first six months (4 March–20 September, 2020). Geogr Pol 94(3):305–324

Stępień J, Michalski T, Grabowski J, Waszak P, Grabkowska M, Macul A, Rojek JJ (2021) Social response and spatial mobility due to the COVID-19 pandemic in Poland. Geogr Pol 94(3):381–396

Szmytkowska M (2020) Consequences of the pandemic and new development opportunities for Polish cities in the (post-) COVID-19 era. R-Economy 6(3):196–207

Tarkowski M, Puzdrakiewicz K, Jaczewska J, Połom M (2020) COVID-19 lockdown in Poland—changes in regional and local mobility patterns based on Google Maps data. Pr Kom Geogr Komun PTG 23(2):46–55

Thoi PT (2020) Ho Chi Minh City-the front line against COVID-19 in Vietnam. City Soc 32(2):1–15

Waeterloos C, De Meulenaere J, Walrave M, Ponnet K (2021) Tackling COVID-19 from below: civic participation among online neighbourhood network users during the COVID-19 pandemic. Online Inf Rev 45(4):777–794

Wiskulski T (2020) COVID-19 and tourism—the case of Poland. Pr Kom Geogr Komun PTG 23(2):35–39

Wolman D (2020) Amid a Pandemic, Geography Returns with a Vengeance. Retrieved online
    https://www.wired.com/story/amid-pandemic-geography-returns-with-a-vengeance/. Accessed
    20 May 2022
World Health Organisation (2022) Multi-country monkeypox outbreak in non-endemic coun-
    tries. Retrieved online https://www.who.int/philippines/news/detail/06-04-2022-who-warns-
    surge-covid-19-cases-unsafe-gatherings-continue. Accessed: 30 May 2022
Załęczna M, Antczak-Stępniak A (2022) Is the impact of COVID-19 on housing construction
    activity inside and outside a large city evident? The example of Łódź (Poland). Bull Geogr
    Socio-Econ Ser 55:35–48
Zhu Y, Xie J, Huang F, Cao L (2020). Association between short-term exposure to air pollution and
    COVID-19 infection: evidence from China. Sci Total Environ 727:138704

Urban Rhythmscapes—Examining the Temporal Forms of Urban Spaces

Jani Tartia

Abstract Like music, much of the city exists in time, and rhythm, as a measure of temporality and repetition, is a key element of it. A temporal view on the city is important in understanding the dynamic form of urban space and what effects its making. This chapter draws together and further expands the key insights from my recent PhD work that developed 'rhythm' as a research methodology for the study of urban public spaces and environmental experiences in the context of day-to-day urban mobilities. The theoretical framework of the work is anchored to time-oriented urban research approaches, 'rhythmanalysis' in specific, which emphasizes the qualitative and the experienced aspects of rhythm alongside the quantitative. The main question is: how can we better understand urban space as a rhythmic phenomenon that is continuously made and remade through the practices and activities taking place in it? The term 'rhythmscape,' introduced in previous research literature is examined here as an integrating term that could be used to capture the multiplicity of simultaneous spatial rhythms and their interactions.

Keywords Urban space · Time · Rhythm · Rhythmanalysis · Rhythmscape

Introduction

Like music, the city and urban space exists in time. Music has inspired the formation of different *time-sensitive* approaches toward understanding cities and urban spaces that have examined the role of *rhythm* of human activities in the making of the city and urban spaces. Urban environments are as much temporal as they are spatial environments—or, spatiotemporal (Massey 2005)—but we, perhaps, still lack more both in tools and theoretical concepts that enable us to understand the temporal character of the environment than the spatial—*and* their interconnected relations. We are good at freezing city spaces in time in maps, zoning plans and visualizations (Dodgshon 2008, 1) but perhaps less so in regards of identifying and mapping the

J. Tartia (✉)
Faculty of Built Environment, Tampere University, Tampere, Finland

81

more dynamic and temporal view of cities and spaces and their functions and practices that fluctuate and oscillate in time (Tonkiss 2013, 49). This means a shift from space-as-a-container type of views toward more dynamic space-as-a-process kind of approaches. Looking at mobility behavior, embodied and social practices, and appropriations and negotiations of space, the chapter aims to further elaborate on the empirical and theoretical approaches on urban rhythm and how we understand it.

'Rhythm' is a term often used to describe different urban phenomena but the concrete conceptualization and research on the matter is still developing and emerging. My interest on the matter stems from urban geography, architecture and urban planning and design research fields, and revolves on the question of how we could better understand urban space as a temporal and rhythmic phenomenon that is continuously made and remade through the practices and activities taking place in it. Urban space is situated between the top-down practices (urban development, zoning, land use, management, policy-making etc.) and the down-top activities (local grass-root level activism, appropriation and occupation of space, social interaction, body-environment relations etc.), which all are temporal in nature, and affect the space fundamentally. In our daily life, we occupy already created spaces when we move around in the city, but simultaneously we also actively contribute to their future (re)making through our own actions and presence as spaces are always in the making and never finished (Massey 2005), and always subject to a possible redefinition.

This chapter draws together the key insights from my recent Ph.D. work (Tartia 2020) that developed rhythm as a research concept in the study of urban public spaces and environmental experiences in the context of day-to-day urban mobilities. The work examined how our day-to-day journeys in the urban environment both produce our temporal relations with our environments and how the mobile practices shape the urban spaces and its temporal form. This interest toward urban rhythms connects to the question on what it is exactly that keeps urban spaces 'intact': rather than moving toward increasing entropy, what keeps the temporal structures of urban spaces supported, what makes things repeat, what shapes such repetitions and what such repetitions mean for our understanding of the city and urban space?

In this chapter, these insights are further developed. The theoretical approach to urban rhythms is anchored to the French urban theorist Henri Lefebvre's (1992) and Catherine Régulier's (Lefebvre and Régulier 1985) *rhythmanalysis* framework—that emphasized the qualitative and experienced aspects of rhythm alongside the quantitative elements. Other theoretical and conceptual approaches toward the temporalities and rhythms in the city, including time geography, are also utilized. The close and detailed examination of the different elements that contribute to the temporal form of urban spaces can further our understanding of the ingredients that are the basis for sustainable, resilient and regenerative cities and urban spaces. Urban rhythms are located in between the top-down practices of formal planning, policy-making and management, and the more informal down-top practices of social and subjective practices, which means that the temporal form of an urban space is not in the hands of any single stakeholder but rather is the outcome of multiple actors doing diverse (sometimes frictional and contradictory) things.

Fig. 1 Imaginations on urban rhythms and the dynamism of the street space (as point-cloud images)

The chapter, in specific, further probes the term 'rhythmscape' that has been introduced briefly in earlier research literature as a term that attempts to capture the *multiplicity* of simultaneous spatiotemporal rhythms of a particular space (Fig. 1). Similarly to the more defined and commonly used concepts of 'landscape' and 'soundscape,' *rhythmscape* suggests a perspective that focuses on the multiplicity of rhythms of different scales, their interactions (including their possible clashes and frictions) and their production.

The structure of the chapter is as follows. First, theoretical background on the relationship between time and urban research is presented with a focus on Lefebvre's and Régulier's rhythmanalysis framework. Next, the key findings from my recent PhD work on experienced urban mobility rhythms are presented, which are then here further elaborated and examined through the lens of the term 'rhythmscape' and how the findings of the study could help to further conceptualize the term. The main conclusions are presented in the end.

On the Temporal Form of the City

Cities are temporal environments. From a research perspective, at least two different basic understandings of time's relationships with cities and urban spaces can be identified: the *linear*—the history and evolution of cities and urban spaces from the past(s) to the future(s)—and the *cyclical*—the repeating patterns of the city life, including the circadian and seasonal changes that transform urban spaces (Lynch , 1972; Adam 2004). Whereas the linear approaches often seem to focus on longer time intervals—months, years, decades, even centuries—the cyclical approaches focus more on the short-term timescales—hours, days, weeks, months, even minutes and seconds. Here, the focus is set on the latter: the cyclical and repeating, or rhythmic, times of day-to-day urban spaces.

In practical terms, rhythm refers to repetitions and the reoccurrence of a phenomenon. In the city, rhythms can be found in different temporal (seconds, hours, days, months, years etc.) and spatial scales (body, site, district, city, region etc.). Rhythm can be thought of 'as an element of dynamic stability' (Mareggi 2013: 5), where consistency, predictability and familiarity are (re)created through patterns and

repetitions (see also Adam 2004, 102; Highmore 2002, 5–7). Music has perhaps the most obvious connection to rhythm, and the term *urban rhythm* is often associated with urban cultures and musical genres, such as rap and hip hop. Music has also inspired researchers and philosophers to think urban space through the notion of rhythm—although the reference has often been more on classical music and its notation tools (see Hägerstrand 1970; Halprin 1963; Lefebvre 1992) rather than the more contemporary genres.

Rhythm is a stable part of the urban studies vocabulary—how we describe cities and urban spaces—but it has not been defined in-depth as a research concept. The word's uses in the context of cities can be traced at least from the nineteenth century onwards, and it has been used to refer to a host of different issues, from practices and activities to aesthetics and timings of cities. The hectic rhythm of modern cities—the *acceleration* of urban life (Lyon 2021, 4–5)—has been used often as a phrase to explain both the mental and the physical life in the modern city in comparison to the countryside and village-type lifestyles. (Henriques et al. 2014; also, Brighenti and Kärrholm 2018).

From a research object perspective, urban rhythms have been on the research agenda of urban studies at least over half a century. In the 1960 and 1970s, the academic interest toward the daily temporal making of the city emerged, and new conceptual and methodological approaches, such as *time geography* (see e.g., Hägerstrand 1970), *chrono geography* (see e.g., Parkes and Thrift 1978) and *time-activity studies* (see e.g., Bullock et al. 1972) were utilized to understand the city as a dynamic environment. These studies involved, for example, studying the human activity patterns in a city district, and how it changed throughout the day as people commuted to work and back. Although these approaches also received critique at the time for the simplification and homogenization of time into a single measure—and thus somewhat neglected the lived and experienced qualities of time (see Buttimer 1976; see also Mels 2004, 15–16)—these approaches remain to be influential today. They have paved the way for data-driven approaches in research, such as the use of cellular connection tracking (GPS, Bluetooth) or social media data analysis (e.g., #hashtag location and frequency) in connection with Geographic Information Systems (GIS) software that is nowadays often utilized to map the temporal population changes and daily migrations of people inside the city. These methods are used as part of not only urban research but also city governance—the development and maintenance of the daily operations of cities—as well as commercial uses. This data, collected often through automated systems, is increasingly also incorporated to user interfaces: on Google Search, for example, it is possible to check the typical hourly utilization rate of a specific shop or location. During the ongoing COVID-19 virus pandemic, such technologies were also utilized to map movements in the city and to track contagion chains and possible sites of exposure.

Later on, postmodern approaches in the study of cities and urban spaces have highlighted the interconnectedness of space and time and approached cities as spatiotemporal processes of *becoming* (Massey 2005) that are continuously made and remade through practices and human (and nonhuman) occupations of space. What differentiates this view from the one described above is that here the space (time) is not

regarded as a static container (e.g., as a 'space-time aquarium' as in time geography) but as a dynamic entity that is reciprocally affecting/being affected by the practices. Practices make spaces and vice versa. This view also highlights that time is not a homogeneous singular unit but multiple in nature: the times of an urban space are simultaneously both subjective and shared, they are experienced, and they can overlap and sometimes also contradict one another, creating frictions in relation to other timings and rhythms (Crang 2001). This plurality in the daily use of a particular space results into a continuous negotiation of these practices and rhythms (or the lack of such plurality, for example, through strict control) (see Kärrholm 2007).

Rhythmanalysis

What are urban rhythms exactly? Henri Lefebvre, together with Catherine Régulier, brings up this question in 'Rhythmanalysis' (1992; 1985), in which—by following the earlier works of Lúcio Alberto Pinheiro dos Santos and Gaston Bachelard—a focus is set on the different repetitions and recurring patterns of urban space and their analysis. Lefebvre and Régulier (1985: 86) note that rhythm is something we are all familiar with on some level through our daily experiences, but which as an analytical object is elusive and difficult to grasp as it is less 'known.' In their view, inspired by music theory, the city and urban space are presented as sites of polyphonic, intersecting and overlapping rhythms that compose the complex urban life. The elements of rhythm can be thought of as a triad: rhythm is where space, time and some kind of energy come together (Lefebvre 1992, 20–21). One of the key arguments in Rhythmanalysis is the interplay between the human-made 'linear rhythms' and the 'cyclical rhythms' of natural origin, and how the latter are transformed and subjugated by the former (see Mels 2004; Simonsen, 2005). The rhythms of everyday life in cities, thus, are not objective or natural but *socially produced* (Lefebvre 1992).

Rhythmanalysis was an attempt to formulate *a theory of the production of urban time* (Simonsen 2005) that included a strong critical component toward modern industrialized capitalistic societies that rendered everyday life rhythms as sites of *consumption* and not much else (see Highmore 2002: 113–119; Crang 2001). The aim was to examine who composes and conducts what could be called the *urban score* (see Mareggi 2013, 14) and for what purposes (Lefebvre 1992). As a social critique, Lefebvre notes that every repetition of a rhythm has the capacity of bringing change with it as no rhythm repeats exactly the same twice (Ibid., 17). This holds the key of transforming urban space for the better, which, for Lefebvre, essentially meant bringing creativity and art back to the everyday life (see Highmore 2002: 115–119).

Rhythmanalysis is incomplete as it was published only after Lefebvre's death (Elden 2004). Rhythmanalysis is best understood as more of a theoretical orientation than a practical, precise methodology—more as of 'an attitude' (Mareggi 2013: 5) or a *mode* of research (Elden 2004: xii) than a set of practical tools that could be applied directly (see also Brighenti and Kärrholm 2018; Lyon 2021). Simonsen (2005: 8) summarizes that rhythmanalysis is 'a kind of phenomenological-hermeneutic

description of the relationship among the body, its rhythms and its surrounding space.' Why rhythmanalysis is an influential approach to examine urban temporalities is that it considers both the quantitative *and* the qualitative aspects of rhythm. Rhythm is not only about the number or frequency of a repetition but also about the contents and qualities of that repetition. This qualitative aspect of rhythm considers, in specific, the interplay between different rhythms and how a temporal phenomenon or event resonates with the space and the other rhythms in it. Rhythmanalysis can be seen as sort of an extension to time geography, offering a richer and more nuanced approach to time in cities, including the less visible and more marginal rhythms that often remain in the outskirts in comparison to the more dominant and visible rhythms of the city or the urban space (Edensor 2022). Rhythmanalysis has been used to examine rhythms in different scales from the level of the body to the level of the city, for example, urban place rhythms (Wunderlich 2013; Tartia 2020), walking rhythms (Middleton 2009), rhythms of different private spaces, such as market spaces (Lyon 2021) and museum spaces (Prior 2011). Two major collections in the field of geography and social sciences have been published as well, edited by Tim Edensor (2010) and Dawn Lyon (2022) where different authors tackle the question of urban rhythm from diverse perspectives.

Case: Urban Mobility Rhythms as Temporal Elements of Urban Space

In this section, I present the key findings from my doctoral dissertation (Tartia 2020). The work attempted to develop 'rhythm' as a research methodology in the study of urban public spaces and body-environmental relations in the context of day-to-day urban mobilities. The research made use of the theoretical approach to urban times and rhythms described above, centered around rhythmanalysis.

Mobility is one of the key ingredients of cities as basically all practices incorporate movement of some sorts. The public spaces of the city have in many cases been taken over by mobility—both for the good, as suggested by different 'walkability' metrics, and for the bad, mainly the negative effects of excessive private car use, including urban sprawl. The way we move and how we experience our environments on the move is crucial for our own subjective understanding of the city and society (Middleton 2009). Mobility is planned, managed, operated, controlled and directed as much as it is lived, experienced, practiced and sensed (Cresswell 2010). Mobility is not a separate individual piece in a larger urban puzzle but is fundamentally merged with the life of people partaking in the different urban patterns.

My Ph.D. work aimed to understand how mobility practices are conducted and experienced in the city from a subjective perspective on repeated walking and car driving routes, and how such mobile practices affect the temporal composition of the space. Human (and nonhuman) mobility creates one of the most fundamental rhythmic elements of cities, but it is often neglected in a holistic sense (quantitative

and qualitative), often favoring one or the other depending on the field of study. The work made use of rhythmanalysis' focus on both the quantitative and the qualitative aspects of rhythm, and the role of the body/subject in the perception and (co-) production of these rhythms. Rhythms, here, were considered as physical practices and actions that take place in the space, including mobile practices and other spatial appropriations.

The research adopted a mobile ethnography toolset. The research data was two-folded, collected in the cities of Tampere and Turku, Finland: the first part of the data was gathered to examine the urban experience and subjective meanings through *go-along interviews* (Kusenbach 2003) and visual participatory methods, and the second part to observe urban space through audiovisual site observation methods (see Tartia 2020 for details).

The analysis of the first part of the data, the interview data, revealed different immediate, mediated and organized rhythms in the body-environment relations on the day-to-day routes and their choreographies. The first refers to the repeated immediate interactions with the environment that often share a specific rhythm as part of the route, including (expected) social encounters and playful interactions. The mediate rhythm, on the other hand, refers to how moving in the city is a way to produce knowledge about the temporality of the environment, such as the slowly evolving built environment and the various construction projects that populate the routes, and which sometimes also break the mobility habits and routines through restricted access. These immediate and mediated rhythms are part of how the routes become 'known' through repeated uses of the route, making the route and the spaces it covers familiar and predictable. The route also provides moments for relating to past experiences and memories that certain locations or landscapes bring to the foreground of the experience, connecting the active body-environment interactions on the foreground to other timings. The organized rhythms refer to the role of the practice as part of the daily organization of one's life (and clock-time) and to the context-driven mobility behavior (e.g., 'the trip to work' is different than a 'leisure stroll' even if they occupy same urban spaces) (Fig. 2).

In addition to understanding rhythmic reoccurrence in the practices and body-environment relations, the route itself also has rhythm: how it is sequentially practiced and how it unfolds in time through the movements in the space. The route connects with the rhythmicities of spaces passed by. Polyrhythmia (Lefebvre 1992, 41) refers to the multitude of different temporal uses and movements in space—what could be called 'site-specific' rhythms (Wunderlich 2013)—to which the route and subjective experiences are connected with as the body moves in the space (Fig. 3).

The second part of the data comprised of multiple site observations of street spaces that utilized videos and notes. The recorded videos and the notes taken during the observation sessions revealed the aforementioned negotiations of space, as the observed sites were polyrhythmic in nature with different uses and users. The negotiations were both something that happened between the users (e.g., how people move as part of traffic flows) and between a body and the environment (e.g., playful practices with street furniture, breaking traffic regulation and occupying different areas of the space). The observation sessions were conducted from early morning to late

Fig. 2 Photographs from the walking routes, showcasing different temporal elements of the day-to-day journey in the city, as photographed by the informants during the go-along interview

Fig. 3 A section of the route depicted by a succession of spaces and practices—or the internal rhythm of the route—as photographed by a research informant on her walking route

evenings, which also brought forward how the different times of the day affected these practices. The early hours of the day, when the spaces were populated only by few individuals, more informal practices were conducted where the uses of the space were more flexible and unorganized than during the day-time counterpart. Also during the evenings, this same flexibility of the body-environment relations emerged although here the informalities were connected more to a group behavior (e.g., as part of the night-time economy activities) (Fig. 4).

Together, the analysis of the data provides a multifaceted view on urban rhythms, both from the subjective user experience (what kind of temporal user-environment relationships emerge amidst day-to-day mobility practices and what kind of rhythms can be identified in such relations) and from the spatial perspective (what kind of temporal uses, appropriations, interactions and occupations of the space can be identified through analytical observation, and what kind of rhythms can be identified in such relations).

Fig. 4 A series of still images from the recorded site observation videos, depicting the rhythms of the mobility practices in the space

Urban 'Rhythmscape' (Discussion)

'Rhythmscape' is here used as a term to analytically approach the complexity of different simultaneous rhythms of the urban space that were described above in the case of urban mobilities and body-environment relations. The term is something that has been introduced briefly in other research literature but which has not been further elaborated on. The term is connected to the other adjacent words with—*scape* that refer to 'a view or picture of a scene,' as described by the Merriam-Webster dictionary. Terms like streetscape and cityscape are often used to describe the urban environment as a *whole*, often, but not exclusively, from visual standpoints. This notion of things coming together to form a larger whole is also something that Lefebvre (1992, 41) notes in reference to 'polyrhythmia': the multitude of different, simultaneous rhythms that overlap and interact with one another. Rhythm is not singular or isolated from others but works as parts of larger wholes, similarly to a *symphony*, as in Lefebvre's terms. Here, insight for further elaboration of 'rhythmscape' is drawn from two major '-scapes' in specific: landscape and soundscape.

Landscape has a long history as an object of academic research. From visual art and geography to architecture and design, landscape is the object of diverse research methodologies. Tracing the uses of 'landscape' in geology, urban planning, arts and other fields, Barbara Bender notes that landscapes are always in the making, and ultimately subjective as they are perceived and experienced individually, and thus always also 'multivocal and polyvalent' (2002, 103). For Ingold, the landscape is similarly 'perpetually under construction' and gaining form through the (temporal) activity taking place in it (Ingold 1993, 66). Landscape is not a thing or a product—even if it often might be seen as such (see e.g., Relph 1976, 135–137 on urban neighborhoods as landscapes that are designed hierarchically)—but the result of active engagement with the environment (Ingold 1993). Soundscape is a more 'recent' and perhaps less studied concept that focuses on the acoustic environment. F. Murray Schafer writes in regard to (acoustic) rhythms that as a person is a 'random-to-orderly arranger and tries to perceive patterns in all things,' rhythm is a way to divide the whole into parts (1977, 226). This is the same process described above—from individual parts to a

whole—but starts from the other end: the whole that is divided into individual parts. The discussion on both landscape and soundscape highlights that they are continuous dynamic processes. How do these insights reflect with rhythms and the rhythmscape?

'Rhythmscape,' as a term, appears in literature on urban rhythms as a phrase that expands on the visual or aural senses (landscape, soundscape) to more broadly on activities, practices and multisensory experiences of the environment. Mareggi (2013, 11) notes the term in reference to urban landscape and the everyday life practices that compose urban life. Prior (2011, 207) writes that museum spaces as multivocal rhythmscapes 'disclose diverse, contradictory possibilities, even if these possibilities are constrained within certain limits.' Elliott (2017, 76) connects the term to acoustics and notes the possibilities of landscape and its objects to be *potential* acoustic rhythmscapes. These perspectives resonate also with other similar descriptions about the multiplicity of urban rhythms such as Wunderlich's (2013) work on public space rhythms that she refers to an urban aesthetics that resembles music in its complexity and variety of different kinds of rhythms contributing to the making of the place (Wunderlich 2013). Lyon (2021), examining the rhythms of a marketplace, notes the montage-like rhythmicity of the space where the clock-time directs the rhythms in the space. As these examples highlight, rhythmscapes can be thought of as assemblages (see Tartia 2020) or as arrangements (see Pokorný 2021) of multiple heterogeneous rhythms. These rhythmscapes are negotiated as they are comprised from heterogeneous practices and uses that are produced by a diverse set of actors. Here, the question about the power relations between different users and practices—the interactions, hierarchies and dominance of specific rhythms—is important to note: the way the rhythms are produced, overseen, managed and engaged with are produced in a social context. People are both the perceivers and the producers of urban rhythms (Lefebvre 1992; see also Mels 2004), and as Mareggi writes, 'city's rhythms are not free to roam where they will' (Mareggi 2013: 6).

The conceptual implications of the rhythmscape are presented in Fig. 5 in four (4) frames, illustrating how a pluralistic view on urban rhythms suggested by rhythmanalysis affects how the relationship between spaces and practices can be thought of, moving from a simple rhythmscape to more complex ones. The lines on the y-axis present different practices occurring in the space (that can be infinite in number) with the markings representing a temporal section-cut of a practice and the x-axis is (linear) time. The first frame (1) presents a purely spatial view on urban space—omitted of time—where space is seen as made of static practices (for example, 'A city square is used to sit down, socialize, and to skateboard.'). The second frame (2) adds a general notion of time into the view but without noting rhythm in their occurrence ('People spend different amounts of time in the city square to sit down, socialize, and skateboard.'). The events are temporal, but repetition of them is not here considered. The third frame (3) adds more variation to this temporal view, and differentiates, for example, how the uses of the city square change between the daytime and the nighttime or between good weather and bad weather ('During the day and with good weather, people sit down, socialize and skateboard in the city square for different amounts of time, during the night or at times of bad weather, there is only pass
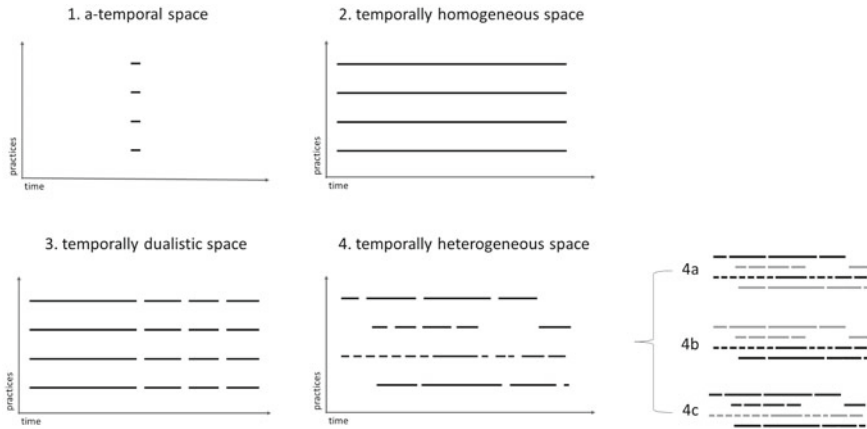
Fig. 5 Imaginations of the relationship between urban space, time and practices (or rhythm) and the formation of rhythmscapes. The x-axis representing time can be imagined e.g., as a 24 h time frame read from the left to right (which then would reset and repeat from the origin). The figure is inspired by Melvin Webber's diagram on non-place urban realm (Webber 1964, 119, reprinted in Relph 1976, 120)

by movements.'). Here, rhythm is added to the picture on a dualistic level (oscillation between the high [day/good weather] and the low [night/bad weather]). Finally, the variation into the practices and their repetitions, including the possible frictions between the rhythms ('The city square is used for various uses that are each temporal in nature, reoccurring in different intervals, and resonate with one another, sometimes frictionally.'). The additional frames (4a-c) present the multiplicity of subjectively experienced rhythmscapes—that similarly to landscapes described above, are ultimately subjectively experienced—and where different rhythms can be stronger or weaker depending on the interplay with the perceiving subject/body and its own rhythms. The rhythmscape is no longer fully shared between the people participating in it but transforms according to the contexts of the bodies partaking in the rhythmscapes.

In terms of city design, this has implications on how the planning and design of urban space is approached. Talking about inclusion and resiliency, we need spaces that can support different kinds of rhythms, also the ones originating from the grassroot level, not just the ones decided as fit from the 'above.' In terms of sustainable urban mobility, for example, rhythm-based approaches that note both the quantitative and the qualitative aspects of body-environment relations in transport can help us move from purely efficiency and speed-based thinking in how we plan and design our streets and other urban spaces in terms of mobility. The elements that are part of walking practices, for example, are complex and many, and they relate to a more holistic 'being in the environment' and the temporal interaction with other users of the space (both the positive and desired interactions as well as the negative and unwanted interactions) than just the aim to move from point A to point B as

quickly and efficiently as possible (Tartia 2020). The way our environments take shape temporally should be considered as polyrhythmic processes—they change, oscillate and transform in different intervals, producing different *possibilities* (as noted above) for (mobility) practices, experiences and engagements with the space. Rhythmscape can be one way of describing these possibilities of space related to the practices and events—the variations of the urban temporal form—as the users of the space are always both perceiving as well as producing these rhythms through their practices and appropriations of the space (and time). Rhythmscapes are 'created as a continuous process, they are not predetermined or predesigned. Understanding which rhythms resonate with what kind of other rhythms, and the ones that do not, we can, perhaps, approach more sustainable and inclusive spaces that are not just available for temporary uses (as predesigned practices) but also for temporal appropriations where the uses are defined by the users in the moment. The COVID-19 pandemic showed globally, in a rather unprecedented way, how public space, and the public life it supports, is rather fragile in the sense that it is surprisingly prone to changes.

Conclusion

This chapter has presented time-related research approaches in the study of urban space and cities, as well as key insights from my recent Ph.D. research that has aimed to develop the research methodology on urban rhythms. As the chapter has presented, the research narrative on urban rhythms is still emerging and gaining shape as rhythm easily escapes precise definition as a mobile and fluid concept (Henriques et al. 2014). Following in the footsteps of rhythmanalysis and other influential approaches toward urban time studies, the empirical research of day-to-day mobility practices, body-environment relations and urban spaces revealed different heterogenous timings of the public space and their interrelations. Rhythmanalysis, in specific, can provide a critical view to urban time that insists a view of multiple urban time-spaces and situated mobile contexts, as it manages to put important stress on the qualitative side of times and rhythms along with the quantitative. Continuing from here, the chapter has also elaborated on the notion of rhythmscapes as a possible terminology to depict this multiplicity of simultaneous urban rhythms and how they are experienced. Borrowing from studies on landscapes and soundscapes, the view on rhythmscapes is that they are always in the process of making and that they are ultimately subjectively experienced—a kind of an active dialogue between the body and the environment, an active process of *rhythm-making*.

Cities today are underlined by the notion of increasing complexity and multiplicity in their spatiotemporal forms (Smith and Hetherington 2013). These notions have slowly also seeped into urban policy as well, at least to some minor extent, as exemplified by the application of 'night mayors' or 'skateboarding coordinators' to manage and operationalize those spatial uses and timings that have previously been seen as alternative, and even harmful ways of inhabiting public space from policy perspective. Cities are also facing major challenges, such as the ongoing climate

crisis and the COVID-19 global pandemic have shown. As calls for the sustainability, resilience and regeneration of cities are increasingly heard amidst such challenges, we need more detailed understanding of cities and urban spaces and how they function. Rhythmanalysis reminds us that next to measuring and mapping the numbers and frequencies of events and movements in the city—that we are increasingly doing, and often in automated fashion as described earlier—we should pay close attention to what those patterns of human (and nonhuman) activity *mean*: what are their contents, what are the shared and subjective meanings related to them, and how they interact and relate to one another. As Lefebvre (1992) reminds us, as urban rhythms are always ultimately *socially produced* (and thus not objective or 'natural' in the sense of how social rhythms are produced and how the social 'wraps' itself around the natural rhythms), there is always also the possibility to change and transform them as well.

References

Adam B (2004) Time. Polity, Cambridge

Bender B (2002) Time and landscape. Curr Anthropol 43(Supplement):103–111

Brighenti AM, Kärrholm M (2018) Beyond rhythmanalysis: towards a territoriology of rhythms and melodies in everyday spatial activities. City Territ Archit [Online]:1–12

Bullock N, Dickens P, Steadman P (1972) The modelling of day to day activities. In: Martin L, March L (eds) Urban space and structures. Cambridge University, Cambridge

Buttimer A (1976) Grasping the dynamism of lifeworld. Ann Assoc Am Geogr 66(2):277–292

Crang M (2001) Rhythms of the city: temporalised space and motion. In: May J, Thrift N (eds) Timespace: geographies of temporality. Routledge, London

Cresswell T (2010) Towards a politics of mobility. Environ Plann Soc Space 28(1):17–31

Dodgshon RA (2008) Geography's place in time. Geogr Ann Hum Geogr 90(1):1–15

Edensor T (ed) (2010) Geographies of rhythm: nature, place, mobilities and bodies. Ashgate, Farnham

Edensor T (2022) Afterword: rhythmic multiplicities: seeking order and excitement. In: Lyon D (ed) Rhythmanalysis: place, mobility, disruption and performance. Emerald, Bingley

Elden S (2004) Understanding Henri Lefebvre: theory and the possible. Continuum, London

Elliott R (2017) Species of sonic space. Literary Geographies 3(1):69–86

Hägerstrand T (1970) What about people in regional science?Reg Sci Assoc Pap XXIV:7–21

Halprin L (1963/1972) Cities: Revised Edition. M.I.T, Cambridge (Mass.)

Henriques J, Tiainen M, Väliaho P (2014) Rhythm returns: movement and cultural theory. Body Soc 20(3–4):3–29

Highmore B (2002) Everyday life and cultural theory: an introduction. Routledge, New York

Ingold T (1993) The temporality of the landscape. World Archaeol 25(2):152–174

Kärrholm M (2007) The materiality of territorial production: a conceptual discussion of territoriality, materiality, and the everyday life of public spaces. Space Cult 10(4):437–453

Kusenbach M (2003) Street phenomenology: the go-along as ethnographic research tool. Ethnography 4(3):455–485

Lefebvre H, Régulier C (1985/2013) The rhythmanalytical project. Bloomsbury, London

Lefebvre H (1992/2013) Rhythmanalysis: space, time and everyday life. Bloomsbury, London

Lynch K (1972) What time is this place? M.I.T, Cambridge (Mass.)

Lyon D (2021) Rhythmanalysis: research methods. Bloomsbury, London

Lyon D (ed) (2022) Rhythmanalysis: place, mobility, disruption and performance. Bingley, Emerald

Mareggi M (2013) Urban rhythms in the contemporary city. In: Henckel D (ed) Space-time design of the public city: urban landscape perspectives, vol 15. Springer, London

Massey D (2005) For space. Sage, London

Mels T (2004) Lineages of a geography of rhythms. In Mels T (ed) Reanimating places: a geography of rhythms. Aldershot, Ashgate

Middleton J (2009) 'Stepping in time': walking, time, and space in the city. Environ Plan A 41(8):1943–1961

Parkes D, Thrift N (1978) Putting time in its place. In: Carlstein T, Parkes D, Thrift N (eds) Timing space and spacing time: volume 1: making sense of time. Edward Arnold, London

Pokorný V (2021) Polyrhythmic arrangements: rhythm as a dynamic principle in the constitution of environments. Open Philos 2021(4):394–403

Prior N (2011) Speed, rhythm, and time-space: museums and cities. Space Cult 14(2):197–213

Relph E (1976) Place and placelessness. Pion, London

Schafer FM (1977/1994) The soundscape: our sonic environment and the tuning of the world. Destiny, Vermont

Simonsen K (2005) Bodies, sensations, space and time: the contribution from henri lefebvre. Geogr Ann Hum Geogr 87(1):1–14

Smith RJ, Hetherington K (2013) Urban rhythms: mobilities, space and interaction in the contemporary city. Soc Rev 61(S1):4–16

Tartia J (2020) The temporality and rhythmicity of lived street space. Dissertation, Tampere University. https://trepo.tuni.fi/handle/10024/118618

Tonkiss F (2013) Cities by design: the social life of urban forms. Polity, Cambridge

Webber M (1964) The urban place and the non-place urban realm. In: Webber M, Dyckman JW, Foley DL, Guttenberg AZ, Wheaton WLC, Wurster CB (eds) Explorations into urban structure. University of Pennsylvania

Wunderlich FM (2013) Place-temporality and urban place-rhythms in urban analysis and design: an aesthetic akin to music. J Urban Des 18(3):383–408

Mapping Urban Integration of Archaeological Heritage. The City Centre of Malaga, Andalusia, and Spain

Llorenç Quetglas-Llull, Daniel Barrera-Fernández, and Marco Hernández-Escampa

Abstract Archaeological remains represent a challenge for urban planning and urban regeneration projects mainly due to their usual underground nature. However, they are a particularly attractive asset for tourist purposes because they offer character and differentiation to the historic urban landscape. This research analyses the tourist use of the underground heritage in Malaga. In recent years, this city has experienced a notable increase in tourist activity, particularly in its city centre. The objective of this research is to analyse the integration and use of archaeological assets based on the interventions that led to their restoration, reuse, and adaptation, and their current role as components of the cultural tourism in the city. The methodology consists of creating an inventory of archaeological remains subject to tourist use and spatial analysis through the production of maps showing current use, accessibility, type of ownership, and state of conservation. The results show the integration and use of archaeological heritage in the city centre. It is possible to observe how tourist use predominates over the rest. Heritage assets with tourist use present a higher state of conservation, which reinforces the relationship between archaeological remains and cultural tourism.

Keywords Archaeology · Heritage · Tourism · Urban planning · Tourism

L. Quetglas-Llull
Department of Physical Geography and Regional Geographical Analysis, University of Seville, Seville, Spain
e-mail: lloquellu@alum.us.es

D. Barrera-Fernández (✉)
Department of Human Geography, University of Seville, Seville, Spain
e-mail: dbarrera@us.es

M. Hernández-Escampa
Department of Prehistory and Archaeology, University of Seville, Seville, Spain
e-mail: mhernandez4@us.es

Introduction

Archaeological vestiges represent a challenge for integration in urban planning and urban regeneration projects mainly due to their usual underground nature. However, they constitute a particularly attractive asset for tourist purposes because they offer character and differentiation to the urban historic landscape (Brida et al. 2012). Mapping the reuse of heritage assets is a useful geographical contribution to the current debates on mass urban tourism.

This research analyses the tourist use of underground heritage in the historic centre of Malaga. In recent years, the city experienced a remarkable increase in tourist activity, particularly in its city centre, resulting in a process of urban transformation to satisfy such demand (Urry 2001). The preservation of heritage has been one of the key elements in the touristification of the city centre of Malaga (Barrera-Fernández 2021). This is a key action for urban regeneration and is the subject of several current public policies.

The objective of this research is to analyse the integration and use of archaeological assets based on the interventions that led to their restoration, reuse, and adaptation, and their current role as components of urban cultural tourism. The methodology consists of the creation of an inventory of archaeological remains subject to tourist use and the production of maps for spatial analysis. The inventory was elaborated through the review of urban plans and lists of heritage assets. The maps reflect the current use, accessibility, type of ownership, and state of conservation. This information was obtained through interviews with key actors and fieldwork. The results show the integration and use of archaeological heritage in the city centre. It is possible to observe how tourist use predominates over other uses such as academic, commercial, or government uses. Heritage assets with tourist use present a higher state of conservation, which reinforces the relationship between archaeological remains and cultural tourism. The methodology implemented in this research is expected to be used in other cities of the Mediterranean coast which have similar problems due to the tourist pressure exerted on the urban territory.

Theoretical Framework

The integration of archaeological heritage in cities is one of the most complex processes in current urban planning (Mubaideen and Al Kurdi 2017). In many European historic centres, the urban dynamics of recent years have led to major changes in land use, causing strong pressures on the heritage assets in general, and particularly on underground archaeological remains, many of them discovered during ongoing building processes (De Noronha Vaz et al. 2012). Archaeological heritage is highly vulnerable when it comes to integrating it into the urban system and its enhancement, due to several factors such as inefficiency in building controls and development pressures (Pereira Roders et al. 2009). Traditionally, land management has been carried

out from the perspective of geography, urban planning, and architecture, which did not pay special attention to archaeological heritage itself (Nilson and Thorell 2018). However, with the growth of tourism and the need to create an attractive tourist offer, cities have embarked on a process of integrating archaeological heritage into urban regeneration initiatives.

There is a great diversity of definitions regarding the concept of archaeological heritage (COST 2022; Pace 2019).

The International Council on Monuments and Sites (ICOMOS 1990) states that archaeological heritage "comprises all vestiges of human existence and consists of places relating to all manifestations of human activity, abandoned structures, and remains of all kinds (including subterranean and underwater sites), together with all the portable cultural material associated with them" (art. 1). The Council of Europe (2012) considers that archaeological heritage "covers architectural/structural features that have been excavated or found as partially represented/preserved elements that cannot be considered as individual, separate heritage elements ("objects") in the wider context of the environment, that is, they indicate the presence of a number of buildings (monuments), settlements or other type of structure (and infrastructure) associated with the organised life of the people in the past on the location" (p. 16). As can be seen in the previous definitions, archaeological heritage includes a wide range of historic and even contemporary assets as long as they can be considered material culture linked to a particular society. Thus, more definitions have appeared in recent years, which focus on more specific archaeological remains.

Since the case study of this research is the city of Malaga, located in Andalusia, Spain, the legal definitions of archaeological heritage in the Andalusian and Spanish laws are also included. The first time that archaeological heritage was considered in Spanish regulation was in 1933; it was defined as any property susceptible to be studied through archaeological methodology, which is linked to the urban evolution up to the last half of the twentieth century (Spanish Government 1933). The current Spanish law defines it as movable or immovable property of a historic nature, susceptible of being studied with archaeological methodology, whether or not they have been extracted, and whether they are found on the surface or in the subsoil, in the territorial sea, or on the continental plate. This heritage also includes geological and paleontological elements related to the history of humankind and their origins and antecedents (Spanish Government 1985). The Andalusian Government is the institution in charge of preserving the Andalusian archaeological heritage, it adopts the Spanish definition and creates three figures for the protection of archaeological heritage: Historic Ensemble, Historic Site, and Archaeological Sites. Historic Ensemble is defined as a homogeneous collection of urban or rural buildings with historical, archaeological, artistic, scientific, social or technical interest and sufficient to form a clearly identifiable unit. Historic Sites have special historical, archeological, artistic, scientific, social, or technical interest and they imply the delimitation of identifiable boundaries with the rest of the surrounding elements. Finally, Archeological Sites are a clearly delimited area where there are archeological remains of interest (Andalusian Government 2007).

Archaeological heritage has a very positive impact on urban development and regeneration, leading to significant economic growth for the local and regional society in which these heritage elements are located (Theodora 2020). Furthermore, we must emphasise the importance of these heritage elements for the construction of an identity anchored to the territory and a feeling of cohesion (Labadi 2011). The construction of a society around its archaeological heritage elements is reflected in a large number of cities all around the world, some examples include Athens and the Parthenon, Cairo and the Great Pyramids, Granada and the Alhambra, Mexico City and the Templo Mayor, Rome and the Colosseum, and Sicily and Agrigento. Each of these heritage assets is at the core of the identity of the city where it is located.

Many cities in Southern European countries have evolved on a rich cultural and historic heritage that lies beyond their surface. The discovery of this heritage increased hand in hand with the development of urban infrastructure, such as underground trains, car parks, and sewage (Admiraal and Suri 2015; Seeley 2001) and the loss it implied. Faced with this situation, the first currents of conservation of archaeological heritage arose. The discovery of archaeological assets at construction sites has traditionally been seen as a limitation since this caused a delay in the works and increased costs. The importance of the emergence of legislation in favour of the conservation of the antiquities present in the subsoil has meant that we currently enjoy a huge amount of heritage elements, which to a large extent have lost their original use and have come to have a tourist use (Rodríguez Temiño 2004).

Focusing on tourist use or archaeological remains, many cities became attractive for cultural tourists since the development of the Grand Tour in the late eighteenth and early nineteenth centuries (Sweet et al. 2017). In those early urban tourist destinations, the visit to archaeological remains was a primary resource. During the twentieth century, there was a rise on mass tourism to coastal destinations; however, cities continued to be visited and new segments were incorporated, such as business tourism and health tourism (Bramwell 2004). The tourist appeal of cities has dramatically increased in the last two decades due to several factors, such as lower fares in flight tickets, increase of short break trips, and P2P accommodation (Vera et al. 2011), among other factors.

As a result of both trends, urban development, and tourism pressures, many cities have a vast number of archaeological sites in the urban subsoil that present a challenge to conserve and integrate them without losing their heritage values. An interesting case in this sense is Athens. The Greek city is one of the most famous worldwide for the importance of the classical world in its territory and for the large number of archaeological sites that it preserves today, being its main tourist attraction. The beginning of underground construction in 1992 in the context of the preparation to host the Olympic Games was one of its largest archaeological excavation projects, which lasted for more than six years. As a result of this project, many archaeological remains were exhibited in the stations (Papageorgiou 2015). A very similar case was the opening of the underground in Mexico City for the 1968 Olympic Games. As a result of the excavations, museums were created in some stations with the remains found during the construction works (Mexican Government 2010). Both

cases adopted a similar trend in the treatment of archaeological heritage. The characteristic element consisted of not moving the findings to be exhibited later in museums. Instead, it was decided to exhibit the heritage at the same place where it had been found (Admiraal and Suri 2015). This represents a successful practice of the integration of heritage located in the subsoil of the urban fabric since archaeological heritage became a direct part of the present-day city. Today, underground stations together with other techniques such as archaeological windows are extraordinary examples of the integration of archaeological heritage into the urban system (United Cities and Local Governments Committee 2018). Due to these initiatives, the archaeological remains have not only been preserved but they also constitute a major tourist attraction for urban tourists.

Objectives, Methodology, and Case Study

As will be seen in the case study, this potential of use commonly implies the promotion of tourist activity and the use of underground heritage as a visitor attraction. The main objective of this research is to analyse the integration and use of the archaeological heritage in the centre of Malaga, focusing on tourist activity. In addition to the main objective, we have determined four specific objectives:

- To identify the archaeological heritage based on the different urban plans and protection figures.
- To draw up an inventory with the most relevant information on each of the heritage elements.
- To obtain information from local agents on how archaeological heritage has been transformed into a tourist attraction.
- To produce maps in order to summarise, share, and disseminate the results.

The methodology developed in this research includes bibliographical review work, consultation of plans, and official legislation at local, Andalusian, and Spanish levels. In addition, fieldwork and visits to heritage elements were conducted in the city of Malaga. During these visits, analyses of the state of conservation and the current use of heritage elements were carried out. Throughout these field trips, we were able to conduct interviews with key agents, with whom we discussed issues such as the financing of heritage preservation, how it was discovered, and how the public administration is involved in the conservation of heritage. All this work has resulted in a cartographic output showing the integration and use of archaeological heritage within the city centre of Malaga. The details of each method employed are below:

- Firstly, a legislative review was carried out focusing on the protection of archaeological heritage and tourism activity in Malaga. This method was useful to highlight heritage lists and plans including archaeological heritage assets and the most visited area in the city centre.

- The second step was to develop an inventory of the archaeological heritage of the central district of the city based on the different protection figures. The protection figures on which this research is based are the General Catalogue of Andalusian Historic Heritage and the Catalogue of Archaeological Protection of Malaga. The General Catalogue of Andalusian Historic Heritage protects the assets deemed to have the highest heritage value in Andalusia. It was established in 1991 although it is rooted on the former Spanish lists dating back to the 1930s. The Catalogue of Archaeological Protection of Malaga was put into operation in 2009 together with the General Urban Plan (Plan General de Ordenación Urbanística), which has jurisdiction over the entire municipal territory of Malaga. It protects heritage assets that do not belong to the Andalusian list but are considered of interest at a local level. The inventory developed on the basis of these two lists indicates the name of the site, the main historical period, the state of conservation, the typology, whether or not it can be visited, the type of ownership, and a brief description. The inventory was the basis for fieldwork and maps.
- With the selected information reflected in the inventory, several fieldwork trips were organised with the aim of contrasting the information obtained through the bibliographic review and to observe the current use of the selected heritage assets.
- Interviews were conducted with key actors related to archaeological heritage. From the eight interviews, information was obtained on conservation and restoration funding, changes in the volume of visits after making archaeological heritage accessible, and on the tourism activities related to the specific sites.
- Finally, based on all the information obtained, a cartographic output was made using ArcGIS software.

The case study focuses on the city of Malaga and especially on its city centre. Malaga is located in the south of the Iberian Peninsula, being the second most important city in Andalusia in terms of population volume with a total of 577,405 inhabitants (Instituto Nacional de Estadística 2022). The climate is one of the great attractions of the city, which can be defined as Subtropical Mediterranean, whose main characteristics are the mild temperatures in winter close to 15 °C and low rainfall (López Ontiveros 2003). The urban morphology of the city of Malaga shows clear evidence of its industrial past and the importance it has had for Andalusia. The moment of maximum magnificence took place from the end of the nineteenth to the middle of the twentieth century. This was mainly due to the industrialisation of the city, centred on the iron, steel, and textile industries. At the end of the nineteenth century, the industrial sector in Malaga underwent a major crisis, which coincided with the time when tourism as we know it today appeared (Cebrián Abellán 2018). The emergence of tourist activity in the Andalusian city is strongly linked to the settlement of a British colony at the end of the nineteenth century. This English colony helped to promote new industrial and commercial activities in the city, as well as to shape the first tourist model of Malaga as a winter resort, inspired by English seasonal cities such as Blackpool or Bournemouth (Darío 1904). Subsequently, the climate of Malaga became the main tourist attraction of the city, initially drawing wealthy visitors from Europe during winter. After the consolidation of sun and beach
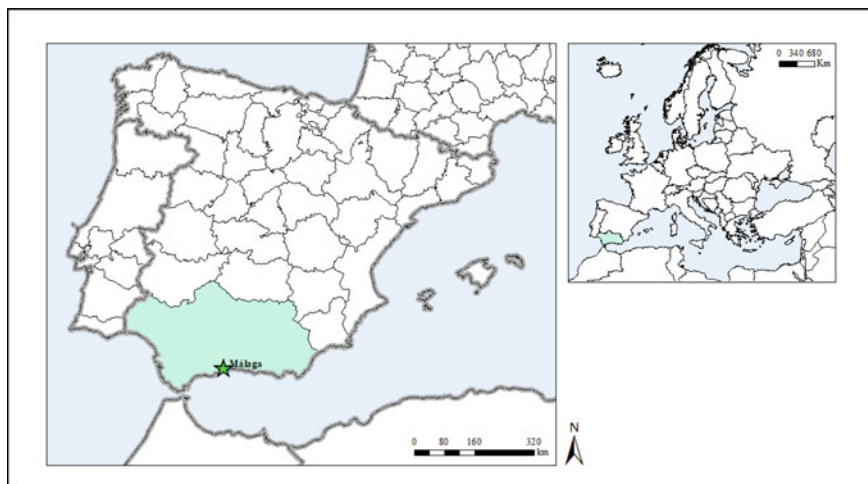
Fig. 1 Location of Malaga in Spain and Europe. *Source* The authors

tourism on the Costa del Sol in the 1970s, the tourist model in the city underwent a major change, since Malaga mostly became the point of access for tourists heading to (Fig. 1).

Today, Malaga bases its tourist activity on an urban and cultural offer. Due to the specialisation on cultural tourism, the city has increased the preservation of the local heritage. According to López García and Navarro Jurado (2007), Malaga has based its tourist offer on the creation of its own identity as a tourist destination, the orientation towards sustainable tourism, the enhancement of historic heritage, and the adaptation of the city to international tourists. With the aim of creating a competitive tourist offer, the need to develop new tourism policies played a central role. It was under this need that the Tourist-Cultural Development Plan (1996–1998) was born. This plan was the first to highlight the local built heritage and was the basis for future policies that have placed Malaga as one of the cities with the highest efforts to preserve heritage (Pascual Villamor 2006). Furthermore, Malaga City Council recently developed an Archaeological Protection Catalogue, which includes archaeological heritage assets throughout the city. In the central district, there are a total of 45 heritage elements protected by this figure.

Malaga is one of the most important tourist cities on the Spanish Mediterranean coast. The increase in the number of tourists is one of the most representative indicators for understanding the new reality of this economic sector in the Andalusian city. The volume of airplane passengers in 2019, the last statistical year without the influence of the restrictions derived from the COVID-19 pandemic, was 19,597,999; only surpassed at the national level by the airports of Palma de Mallorca, Barcelona, and Madrid (EUROSTAT 2022). Although it is the most important airport in Andalusia, Malaga is the second most visited city after Seville. This difference can be well explained due to the rise of sun and beach tourism on the Costa del Sol, which

led to the strategic position of Malaga as an administrative centre and as the place where visitors first arrive since the airport is located in the western sector of the city. Throughout the 1970s and 1980s, the majority of tourists arriving at Malaga airport went directly to the beach resorts of the Costa del Sol and did not visit the capital. As explained, this situation started to change thanks to the specialisation of Malaga in cultural and urban tourism; thus, motivating a larger quantity of tourists to overnight in the city.

Results and Discussion

According to the explained methodology, the first step was a review of local and Andalusian lists and plans protecting archaeological heritage assets. No differences were found between elements protected by the Andalusian Government and those protected by the Malaga City Council. The Andalusian Government (2022) has included so far 67 heritage elements in the General Catalogue of Andalusian Historic Heritage in the city as a whole. At the local level, there are hundreds of listed buildings of different types in the general protection list. However, there is a specific catalogue of Archaeological Protection for archaeological heritage. The current version included in the 2009 General Urban Plan was consulted, which identifies 91 elements of archaeological heritage in the city (Malaga City Council 2009). This is significantly higher than the number of heritage elements mentioned in the 1983 plan. The reason is largely due to the objective of the plan since it was focused on organising the growth that the city was experiencing and not on heritage conservation (Fig. 2).

After an analysis and comparison of both lists, we decided to reduce the study sample to elements located within the central district that can be considered archaeological heritage according to the definitions provided in the theoretical framework. Certain listed elements include archaeological remains located in different places, such as the mediaeval wall. The heritage elements finally selected for this study can be seen in the following list and map, The first map shows the relationship between the type of ownership and whether the element can be visited or not. The second map shows the link between the state of conservation and current use. Current uses have been classified into four groups. Commercial use considers all heritage elements that are located within a commercial establishment such as shops. They are integrated within the store and can be visited although they are not a tourist attraction on their own. The second use is architectural, covering all heritage elements that are currently part of the structure of the building, such as foundations, columns, or load-bearing walls. These elements can be visited but again are not primarily intended to attract tourists. The third use corresponds to the tourist use, and, as its name indicates, the main activity of this heritage element is to be part of the tourist offer. Finally, the fourth use is devoted to archaeological assets that have not yet been excavated. Their location is known, but for certain reasons, they remain unexcavated, mainly due to lack of funding or conflict of use with overground buildings and infrastructure (Table 1 and Fig. 3).
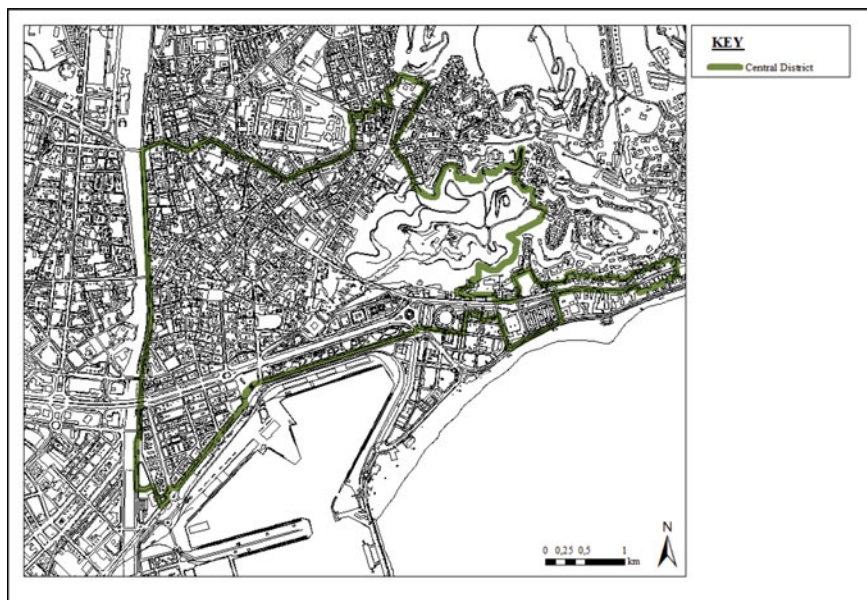
Fig. 2 Location of the central district of Malaga. *Source* The authors, cartographic basis: Andalusian Government 2016

After locating the elements, a summary table was made for each of them, resulting in an inventory reflecting the key information for this research. One of the main characteristics that help to understand the integration of archaeological heritage in the city of Malaga is its ownership, whether private or public. The results are as follows: two heritage elements of a public–private nature, eight of a public nature, and seventeen of a private nature. Public–private ownership refers to all assets that present this duality. The Spanish Heritage Law of 1985 dictates that archaeological heritage discovered prior to the enactment of the law remains private, and all remains discovered after 1985 are public property. For this reason, there are sites with public and private elements. It can be noticed that public-owned elements are only a minority. Government bodies at different scales have very limited power over private elements, resulting in a limitation on their integration and potential visit. As a result, most of the elements that allow an open visit are in public ownership.

The inventory also reflects which of the heritage elements can be visited and which of them cannot. Seventeen elements in total are not open to visitors, and only nine can be visited. As can be seen on the map, the elements that can be visited coincide exactly with those that currently have a tourist function. Another point to note is that many of these heritage elements have been discovered recently and all have been fitted out as spaces to be visited, evidencing the change of paradigm in the conservation of heritage giving the leading role to those archaeological remains that are attractive to tourists.

Table 1 Summary of the archaeological heritage assets in the city centre of Malaga

General Catalogue of Andalusian Historic Heritage	Catalogue of Archaeological Protection of Malaga
Funerary Mosques in Aguas Street	Pheno-punic wall of Mlk
Atarazanas Gate	Malaga Roman Theatre
Birthplace of Pablo Ruiz Picasso	Roman Villa of the Puerta Oscura Garden
Santa María del Sagrario Church	Industrial Site of Roman-Tardic Basins
La Encarnación Cathedral	Roman Wall
Episcopal Palace	Alcazaba
Buenavista Palace	Gibralfaro Castle
Miguel de Cervantes Theatre	Remains of the Mediaeval Wall
Museum of Malaga	Atarazanas
House in Calle Salinas	Remains of the Great Mosque
City Hall	Islamic Necropolis of Jabal Faruh
Stella Maris Church	Archaeological Window of the Castle of San Lorenzo
Santiago Church	Remains of the Roman Wall
Historic Centre of Malaga	
English Cemetery	
Desfile del Amor Building	
Alcazaba	
Nasrid Wall and Harbour Wall	
Gibralfaro Castle	
Roman Theatre	
Building in 18, Alameda Principal	

Source The authors, based on Andalusian Government 2022; Malaga City Council 2022

Finally, the inventory shows the state of conservation of the heritage elements. To be able to classify the heritage elements according to their state of conservation, four levels were established: destroyed, low, medium, and high. The first result is that most of the archaeological assets are in a low state of conservation and, in many cases partially destroyed. One of the most important results is that most of the heritage elements that are used for tourism are in a good or high state of conservation. This is evidence of the link between good heritage conservation and tourist activity. This explains why the archaeological heritage in the city of Malaga has undergone a process of enhancement in recent years, largely due to the change in perspective that the tourism model of the city of Malaga has undergone. Another relationship

Fig. 3 Location of the selected archaeological heritage in the city centre of Malaga. *Source* The authors, cartographic basis: Andalusian Government 2016

between the tourist area and the state of conservation of archaeological heritage is related to the distance from the most touristic areas. In other words, the closer the tourist centre of the city is, the highest the state of conservation of the elements found in the area. A clear example of this is the Roman theatre or the remains of the Phoenician wall located inside the Picasso Museum. Both spaces are located in the tourist centre of Malaga and have a high level of conservation, confirming the above statement (Fig. 4).

After the inventory, fieldwork was carried out to verify the results. A visit was made to each of the selected assets and the information contained in the inventory was checked, namely ownership, openness to visits, and state of conservation. Pictures of the archaeological heritage assets were also taken. Fieldwork confirmed the information obtained through legislative and bibliographical analysis.

Interviews were conducted with key actors with the aim of obtaining information on the conservation and restoration processes, funding, and how businesses were affected by the presence of archaeological elements. All the interviews were delivered to private sector, as it was not possible to contact the public sector. The interviews are freely accessible on Quetglas-Llull et al. (2022). The first main conclusion that can be drawn is the disconnection between the public and private sectors. All interviewees explained the difficulty they had encountered in obtaining funding to be able to preserve the heritage. In conjunction with the above, it is more complicated to carry out urban integration of these elements and at the same time make them accessible to visitors just relying on private funding. This leads to a disconnection between archaeological heritage and society.

Alcazaba			
Historic period	Islamic medieval	Typology	Military and civilian architecture
State of preservation	High	Accessible	Yes
Ownership	Public		
Description			
The monument, built in the eleventh century, has given its name to the hill where it is located, and constitutes a true fortress by means of a distribution of enclosures inscribed with triple order of walls, whose complexity is interpreted by following, in its origin, Byzantine guidelines. It houses a palatial nucleus, the so-called Cuartos de Granada, its rooms articulated around two courtyards, the Naranjos and the Alberca, defended on the eastern flank by a magnificent Torre del Homenaje (Homage Tower). Its location housed the acropolis or high city since the founding of the city, overlapping the first Phoenician settlement, a continued population during the Punic, Roman, late Roman, Byzantine and Visigothic periods, according to the materials excavated inside and accessible on its slopes. After the Christian conquest, its military character prevailed until the eighteenth century, masking itself under a popular urbanization that became strongly degraded until the mid-twentieth Century when the city began the restoration of its monuments.			

Fig. 4 Sample of the inventory. *Source* The authors, based on Andalusian Government 2022; Malaga City Council 2022

The second assertion drawn from the interviews is the connection between the enhancement of archaeological heritage and proximity to the centre. All interviews were carried out with key agents of businesses that have archaeological elements within the boundaries of the city centre. Analysing the moment when this heritage was discovered or included in regeneration projects, it can be stated that the heritage elements located in the main tourist area were integrated before those close to the limits of the central district.

The third evidence obtained from the interviews is the noncorrelation between integrating archaeological heritage and an increase in visits or sales. This is especially true for "small or moderately small" vestiges. The integration of archaeological heritage and the new uses have led to the creation of tourist routes to visit it, despite the fact that many archaeological elements do not have a tourist function, as is the case of the Atarazanas Gate, which is of Islamic origin, it is included in tourist routes and has an architectural function, as it is currently part of the market building, but rarely do tourists pay major attention to it. The owners of the buildings where archaeological heritage elements are located stated that there has been no increase in visits or sales in commercial establishments. Nevertheless, archaeological elements act as points of interest once customers are already on site. Therefore, in some cases, there is no evident relationship between increased sales and economic performance of businesses and the existence of archaeological heritage. On the contrary, major

Fig. 5 Roman Theatre with tourist use. *Source* The authors

vestiges such as the Roman Theatre and the Alcazaba constitute basic attractions for the city as far as archaeology concerns (Figs. 5 and 6).

After analysing all the data obtained, a cartographic output was produced where the selected elements of the archaeological heritage elements of the city centre of Malaga are shown. The first map shows the type of ownership and if the element is open or close to public visit. As mentioned above, public-owned sites are mainly open to visits, while it is more difficult to access private and public–private premises (Fig. 7).

Fig. 6 Remains of the
Roman Wall inside a hotel.
Source The authors
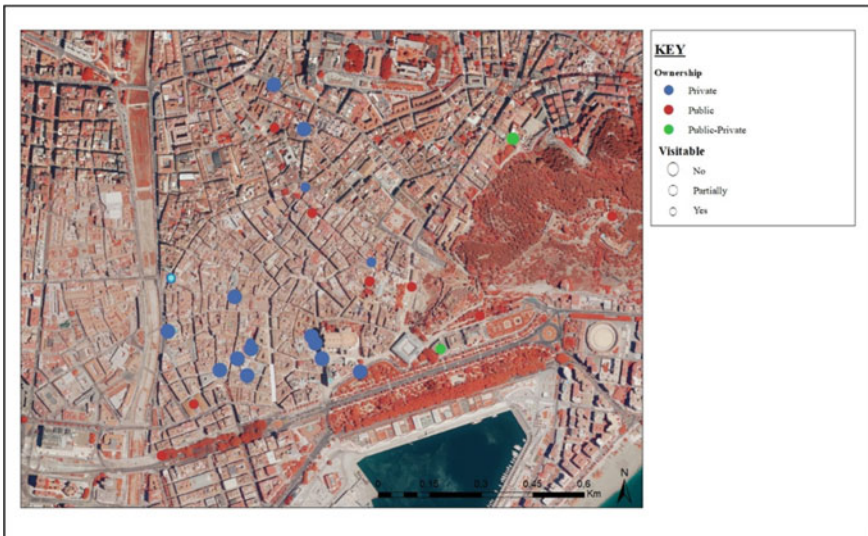
Fig. 7 Relationship between the type of ownership of heritage assets and their possibility to be
visited. *Source* The authors. Cartographic basis: Andalusian Government 2016
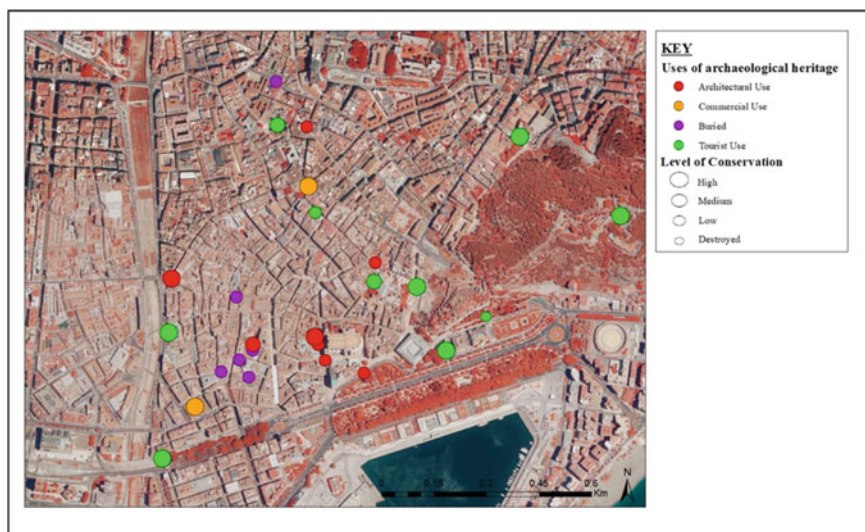
Fig. 8 Relationship between the level of conservation of archaeological heritage assets and their current use. *Source* The authors. Cartographic basis: Andalusian Government 2016

The second map represents the relationship between the state of conservation of elements of archaeological heritage and their current use. There is a clear relationship between a high state of conservation and tourist use. The rest of the uses show low or moderate conservation states, except for certain elements with commercial and architectural use (Fig. 8).

Conclusions

Archaeological heritage has been one of the most important elements in the urban integration of many cities worldwide in recent years. Mediterranean cities in particular have undergone major transformations, both in terms of urban planning and economics. Tourism has become one of the main contributors to the economic sector of these cities. This has led to an increase in the intention to create a tourist offer based on local historic particularities, where archaeological heritage plays a key role.

In the case of Malaga, the archaeological heritage has been enhanced since the beginning of the twenty-first century, largely due to the development of an urban and cultural tourism offer to differentiate the city from the Costa del Sol sun and beach destination. This has led to the creation of catalogues and plans to protect these heritage elements. The conservation and restoration of this heritage have made it possible to make archaeological remains accessible and to give them new uses, tourism being the main current activity in the sites with the highest state of conservation. It is also possible to suggest that the presence and diffusion of significant

archaeological remains such as the Roman Theatre and the Alcazaba, which constitute points of interest in the city, might have provided foundations for further cultural assets of the city, such as the Picasso related theming and the new museums. These consequences of the availability of cultural heritage represent further research challenges. Another reflection relates to the fact that most archaeological assets are located within the core tourist zone and therefore there is a bias in archaeological preservation terms towards elite-related material culture.

The methodology applied in this research can be useful for future studies on the tourist use of archaeological heritage in cities facing similar trends as Malaga. In this city in particular, future work could deal specifically with industrial archaeology because industrial heritage has been particularly affected by the urban regeneration of the port and the waterfront for tourism purposes in recent years, and it has been less studied and integrated in the city's cultural policies.

References

Admiraal H, Suri SN (eds) (2015) Think deep: planning, development and use of underground space in cities. International Society of City and Regional Planning (ISOCARP) and International Tunnelling and Underground Space Association (ITACUS)

Andalusian Government (2007) Ley 14/2007, de 26 de noviembre, del Patrimonio Histórico de Andalucía. Boletín Oficial de la Junta de Andalucía, 248, 19 Dec 2007

Andalusian Government (2016) Servicio WMS. Ortofotografía de Andalucía. https://www.ideandalucia.es/wms/ortofoto2016. Accessed 15 May 2022

Andalusian Government (2022) Catálogo General del Patrimonio Histórico de Andalucía. https://www.juntadeandalucia.es/organismos/culturaypatrimoniohistorico/areas/bienes-culturales/catalogo-pha/consulta.html. Accessed 15 May 2022

Barrera-Fernández D (2021) Málaga: Urbanismo, Turismo y Patrimonio. Tirant Lo Blanch

Bramwell B (2004) Mass tourism, diversification and sustainability in Southern Europe's coastal regions. In: Bramwell B (ed) Coastal mass tourism: diversification and sustainable development in southern Europe. Channel View Publications, pp 1–31. https://doi.org/10.21832/9781873150702-003

Brida JG, Riaño E, Aguirre SZ (2012) Percepciones de los residentes acerca de los impactos del turismo de cruceros en la comunidad: un análisis factorial y de clústeres. Cuadernos De Turismo 29:79–107

Cebrián Abellán F (2018) Ciudades medias y áreas metropolitanas de la dispersión a la regeneración. Ediciones de la Universidad de Castilla La Mancha

COST—European Cooperation in Science & Technology (2022) Underground4value. https://underground4value.eu/

Council of Europe (2012) Guidelines on cultural heritage. Technical tools for heritage conservation and management

De Noronha Vaz E, Cabral P, Caetano M, Nijkamp P, Painho M (2012) Urban heritage endangerment at the interface of future cities and past heritage: a spatial vulnerability assessment. Habitat Int 36(2):287–294

Darío R (1904) Tierras Solares. Editor Leonardo Williams

EUROSTAT (2022) Air passenger transport by main airports in each reporting country. https://ec.europa.eu/eurostat/databrowser/view/avia_paoa__custom_2518939/default/table?lang=en. Accessed 15 May 2022

ICOMOS (1990) Charter for the protection and management of the archaeological heritage. Prepared by the International Committee for the Management of Archaeological Heritage (ICAHM) and approved by the 9th General Assembly in Lausanne in 1990

Instituto Nacional de Estadística (2022) Cifras oficiales de población resultantes de la revisión del Padrón municipal a 1 de enero. https://www.ine.es/jaxit3/datos.htm?t=2882. Accessed 15 May 2022

Labadi S (2011) Evaluating the socio-economic impacts of selected regenerated heritage sites in Europe. European Cultural Foundation

López García I, Navarro Jurado E (2007) El Patrimonio arqueológico como dinamizador del turismo cultural: actuaciones en la ciudad de Málaga. Baética. Estudios de Arte, Geografía e Historia 29:155–171

López Ontiveros A (2003) Geografía de Andalucía. Ariel

Malaga City Council (2009) Catálogo de Protección Arqueológico

Mexican Government (2010, June 30) Metro, parteaguas de hallazgos. https://www.inah.gob.mx/boletines/1686-metro-parteaguas-de-hallazgos

Mubaideen S, Al Kurdi N (2017). Heritage conservation and urban development: a supporting management model for the effective incorporation of archaeological sites in the planning process. J Cult Herit 28:117–128

Nilson T, Thorell K (2018) Cultural heritage preservation: the past, the present and the future. Halmstad University Press

Pace G (2019) Underground built heritage as catalyst for strategies of community engagement and regeneration policies. Cities, regions and digital informations: opportunities, risks and challenges. COST—European Cooperation in Science & Technology

Papageorgiou M (2015) Networking underground archaeological and cultural sites: the case of the Athens Metro. In: Admiraal H, Suri NS (eds) Think deep: planning, development and use of underground space in cities. International Society of City and Regional Planners, pp 59–60

Pascual Villamor I (2006) Centro Histórico de Málaga 1995–2005: Programas de apoyo económico. In: Marín Cots P, Viva la Calle (eds) Las actuaciones de revitalización del centro histórico de Málaga desde 1994 a 2005, Ayuntamiento de Málaga, pp 393–403

Pereira Roders A, Tarrafa A, Imon S (2009) Tackling tourism-driven development in world heritage cities: a comparison between Macao, China and Evora, Portugal. In: Institute for Tourism Studies: Macao, Challenges and Opportunities. Institute for Tourism Studies, pp 1–10

Quetglas-Llull L, Hernández-Escampa M, Barrera-Fernández D (2022) Entrevistas realizadas a gestores del patrimonio arqueológico de uso turístico en el centro de Málaga. Data set. https://idus.us.es/handle/11441/137336

Rodríguez Temiño I (2004) Arqueología urbana en España. Ariel

Seeley D (2001) Report on mission to report on the impact of subway construction on the World Heritage values of the historic areas of Istanbul (Turkey). Museum of London Archaeology Service

Spanish Government (1933) Ley de 13 de mayo de 1933 relativa al Patrimonio Artístico Nacional. Gaceta de Madrid, 145, 25 May 1933

Spanish Government (1985) Ley 16/1985, de 25 de junio, del Patrimonio Histórico Español. Boletín Oficial del Estado, 155, 29 June 1985

Sweet R, Verhoeven G, Goldsmith S (eds) (2017) Beyond the grand tour: northern metropolises and early modern travel behaviour. Taylor & Francis

Theodora Y (2020) Cultural heritage as a means for local development in Mediterranean historic cities—the need for an urban policy. Heritage 3(2):152–175. https://doi.org/10.3390/heritage3020010

United Cities and Local Governments Committee (2018) Cultural heritage and sustainable cities key themes and examples in European cities. http://www.agenda21culture.net

Urry J (2001) Globalising the tourist gaze. Lancaster University

Vera J, López F, Marchena M, Antón S (2011) Análisis territorial del turismo y planificación de destinos turísticos. Tirant Lo Blanch

Sensing and (Re) Imaging an Urban Enclave Through Application of Visual Streetscape Ethnography: A Study of Twin Chinatowns in Kolkata

Kunaljeet Roy

Abstract The relationship between an ethnic group and the physical environment is a reflexive set of social, spatial and economic interactions. The urban environment inside an ethnic enclave within a globalized World is getting constantly affected by **multiple socio-political and identity making forces**. Under such forces, there are regular conflicts between economic and social drivers within the space and these two forces create the nature of the said enclave concurrently. The visual outcome of an urban space reflects the changing dynamics of a neighbourhood by connecting and reinforcing **Soja's notion of 'third space'** between ethnic (enclave) culture and the host culture. Scholars of urban ethnography argue about Chinatowns as a social construction with a cultural history and a tradition of imagery and institutional practice which gives it the cognitive and physical reality. Residents of Chinatowns act as prime agents towards constructing their own **'place' and 'imaginary geographies' of ethnic place-making**. Here Kolkata is considered as a unique urban space where two separate Chinatowns (Cheenapara and Tangra) exist with striking variations in its physical and cultural form. By keeping in mind **Lynch's concept of 'image of the city', the author explored street elements consisting paths, edges, nodes, landmarks and community 'emotional' points** in and around the twin Chinatowns. To understand the in-depth connection between the space-ethnicity notions of ethnographic city elements, this research has focused on the visual observations of streetscape elements through purposive walking. This was done to understand the role of **activity and awareness space** in the course of everyday life and place-making as a part of symbolic identity formation of the Chinese. The building porticos of 'huiguans' and the Chinese living quarters found in Kolkata, with their paths and streets, bear explicit characteristics making the Chinese identity through their physical and visual image landscape. These unique characteristics are determined by continuous and homogeneities of topography, materials, textures, spaces, forms, symbols, building patterns, activities, inhabitant characters, colours and exterior arts etc. Hence a **'streetscape'** study in accordance with purposive walking has been

K. Roy (✉)
School of Social Sciences and Languages, Vellore Institute of Technology, Chennai, Tamil Nadu, India
e-mail: kunaljeet.roy@vit.ac.in

conducted with the help of navigation devices (GPS and Google Earth). Following **Tuan's principles of 'space and place' perceptions,** the study also explores critically the '**imaginary Geography' of the Chinatown 'enclaves' (as a place) and the transformation of the same towards a non-ghettoized 'gentrified' post-global neighbourhood (as a 'disneyfied' space)** and its impact on the community identity. This study is greatly inclined towards establishing the importance of visual ethnography as a useful qualitative method for a young geographer to study the connection between everyday geography of 'real' ethnographic spatiality and 'imagined' perspectives of identity through place-making narratives.

Introduction

Geographical information is presented through use of maps, photographs, visual descriptions and diagrams (Rodaway 1994). Geographers today are increasingly explicit in their use of multiple methods (qualitative, quantitative and cartographic) as a way to weave together data from multiple sources and engage in rigorous, interactive, context sensitive analysis. We are now poised to put into practice the potential of not only multiple methods, but mixed methods in which both quantitative and qualitative approaches are combined in the research design making the blending of research practices reflective and integrated, mixed methods consist of a research design encompassing both theoretical assumptions and the methods of investigation. The central premise is that the use of qualitative and quantitative perspectives in combination allows for a better understanding of the problems under research than adopting a single perspective (Creswell and Clark 2017).

This research is aimed towards blending of qualitative (mostly ethnographic) and mapping approaches. Streetscape study and purposive walking, visual ethnographic analysis will follow this to concrete the theoretical and empirical everyday observations. Rose (2016) used the term visual culture to refer to the plethora of ways in which the visual is part of social life. Both anthropology and geography have used visual images as research tools since their inception as academic disciplines. Social interactions inside an ethnic enclave are 'place' dependent and the existence of social interactions whereby decisions, behaviours, as well as norms of individuals are influenced by neighbours in the local environment.

'*Streetscape*' through *purposive walking* is regarded as one of the significant qualitative research methods which is applied here to determine the role of activity and awareness space in the course of everyday place-making and its transformation in these said urban ethnic districts. Streets are significant segments regarding making and re-making of visual 'space'. Here 'space' is the visual outcome of community's cultural cum everyday living aspirations. Streets are an essential component of cities. Streets may be seen as caravans of progress for community and merchandise. Instead

the street may also be spectacled as a community breathing space where people can walk, rest and mingle. The connotation of a street as a civic sphere is one of the most important characteristics within the public domain inside cities. Several cultural texts portrayed urban streets as active public spaces which offer an amphitheatre for variety of socio-cultural and -political activities that construct elegant urban environment (Cutts et al. 2009; Fernando 2007; Dovey and Polakit 2007; cited in Karuppannan and Sivam 2013). Hence, keeping this in mind the space, land use and ethnicity-emotional complex related to the 'Social Space' of the Indian-Chinese living quarters of the city of Kolkata (Calcutta), have been studied on the basis of cross-sectional landscape approach by applying 'visual' ethnographic analysis of this minority 'streetscapes' inside a multi-racial city environment. This has been a critical foresee of everyday minority belongingness which entails an unwavering commitment to not simply tolerating and respecting difference but ensuring that all people are welcomed and felt that they belong to this society.

Conceptual Framework

The conceptual framework has been on space, place and the phenomenon of ethnicity, economy and survival strategies and challenges for the Chinese in Kolkata and put forth in this section. The different concepts applicable to this study has been based on the literature search and the situational analysis of the Chinese in the urban spatial context of Kolkata. A concept is an intellectual representation of some aspect of reality that is derived from observation made from phenomena. The culture or group activities need to be validated with the 'social cohesion' concept and the survival strategies of Chinese in the context of 'spatial practice', 'territoriality', 'place' and 'space'. The following table illustrates the conceptual framework, developed after Graham (2005) (Table 1).

Consideration of urban emotions have been studied by scholars ranging from studies tracking emotional responses to focus on specific emotions such as happiness or fear as marked by 'Topophilia' and 'Topophobia' by Tuan (1977). The lives of diverse people from different parts of the world, with different social and cultural

Table 1 Conceptual framework

Geographical knowledge	Research objectives	Ethnographic research methods
Ethnicity and place-making through neighbourhood enclave dynamics	Is ethnicity the agent for bounded (co-ethnic) identity construction?	Streetscape analysis through visual study (with behavioural mapping) and GPS survey
Landscapes of ethnic economy and transformation of ethnic entrepreneurship	Does ethnic economy result in a unique Chinatown landscape with its cultural attributes?	

Source Literature search

identities, interests and power/knowledge and occupying different and unequal socioeconomic positions intersect in place, which becomes the site of encounters. Based on the essence of visual ethnographic research of complexity of daily interactions between people and the materialities of urban space, this study portrays the social contours of segregated emotions attached with multi-racial neighbourhoods of Kolkata's unique 'twin' Chinatowns (Cheenapara and Tangra).

Research Methods and Methodology

Ethnography is regarded as the key qualitative research method which deals with the human behavioural aspects (O'Reilly 2005). It usually begins with the researcher availing him or herself of the range of information on the topic or people being studied (Whitehead 2005). Geographers are often concerned with the everyday rhythms and textures of people's day-to-day life; in the frequency and duration of particular social practices and how such practices are related to other events that are involved in structuring person's daily, weekly or monthly life path. Rose (2016) used the term visual culture to refer to the plethora of ways in which the visual is part of social life. Since their inception as academic disciplines, anthropology and geography have used visual images as research tools. The way an image is interpreted depends on the scholar's point of view (Sarkar 2017). Different locations (such as Chinese school, clubs, temples, the breakfast market, streets and the residential pockets) have their own individual economies, their own disciplines that affect how a particular image is seen. The visual images can be interpreted more appropriately through the qualitative than the quantitative methods. Kevin Lynch's early research looked into what the urban environment contributes to residents' 'image of the city', stepping into investigating the social meaning of built environment (Lynch 1960). During the field research I have studied street elements of paths, edges, nodes, landmarks and points of interest in the Chinese enclaves of the city as stated by Lynch (1960). To understand the indepth connection between the space-ethnicity notions of ethnographic city elements, this research has focused on the visual observations of streetscape elements through purposive walking. This was done to understand the role of activity and awareness space in the course of everyday activities and place-making as a part of symbolic identity formation of the Chinese whose cultural backgrounds differ significantly from the dominant 'host' Indian culture in this city, erected 'Chinatown' as an outstanding cultural space. This has manifested most directly in the visual and spatial makeup of the streetscape. '*Streetscape*' through purposive walking is regarded as one of the significant qualitative research methods which is hereby applied to determine the role of activity and awareness space in the course of everyday Chinese living and place-making as a part of symbolic identity formulation. Streets are significant segments regarding making and re-making of 'space'. Here 'space' is the visual outcome of community's cultural cum everyday living aspirations. Streets are an essential component of cities. Here, I have walked around the streets of city's two

Location of 'Twin Chinatowns' in Kolkata
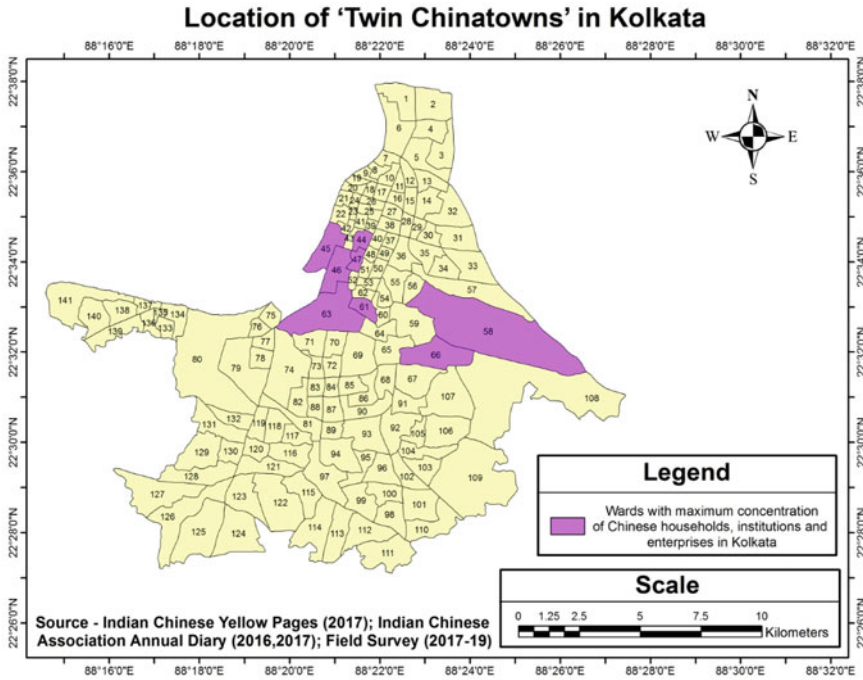
Fig. 1 Location of the 'Twin Chinatowns- Cheenapara and Tangra' in Kolkata

Chinese settlements, i.e. Cheenapara and Tangra (which is more of an insular one) (Fig. 1).

Any specific paths as per Lynch (1960) have three elements: identity, continuity and directional quality. The building porticos can reinforce the importance of the path and give it obvious identity if they are distinctive and have similar features. The building porticos of 'huiguans' and the Chinese living quarters found in Kolkata, with their paths and streets, bear explicit characteristics and hence they help making the Chinese identity through their physical and visual image landscape. Edges are considered as linear components or as section of the paths or streets. Edges help us to differentiate two separate areas or localities in terms of distinct visible characteristics i.e. certain elements of landscape, architectural patterns, height of the buildings, variation of housing, variation of activity spaces, social neighbourhood differences etc. These unique characteristics are determined by continuous and homogeneities of topography, materials, textures, spaces, forms, symbols, building patterns, activities, inhabitant characters, colours and exterior arts etc. Kolkata is such a unique urban space in the entire world where two separate Chinatowns exist with striking variations in its physical and cultural form. Lynch proposed the impact of visual environment regarding understanding the social and behavioural images and their role to frame up people place-making identity. Hence, one needs to invest focus on the idea of

imageability after Lynch (1960) and related city elements like the paths, edges, nodes, landmarks, districts and points of interest.

Paths

The building designs and alignment along the streets represent the importance of the layout of the path and give it obvious identity if they are distinctive and have similar features. Hereby, one can cite the examples of paths and streets found inside the Chinese living quarters in Kolkata which bear explicit characteristics marking the Chinese identity through their physical and visual attire. For example, we may take the case study of Blackburn Lane in Tiretta Bazaar to analyse the role of paths (streets) regarding representation of community identity through place-making. Blackburn Lane has the maximum concentration of Chinese built up structures along the path which has great connection with the existence of the Chinese community living inside 'Cheenapara'. The narrow street in between the Chinese establishments like the Gee Hing and Sei Voi Leung temples and stretches along the households, restaurant and alms house portrays the vivacity of the place. The colours and vibes of the place are very much similar to representing spirited Chinese existence in the city (Fig. 2).

This path has the three important elements as specified by Lynch (1960) as in case of the **identity**, route to Chinese traditional dragon dance parade on the very day of Chinese new year follows a typical path. The streets which the possession basically moves through are pre-decided routes as per the density of Chinese owned households and establishments found. Thus the path corresponds to the identity and spatial foothold of the community and remains as a symbolic **continuity** of keeping the Chinese quotient alive through the construction and appearance of its buildings with long hanging verandas having wooden railings and beautifully crafted wooden staircases. They certainly bear the legacy of the Cantonese traditional carpentry works mostly found inside many Chinese households and the association premises. The walls and balconies are typically constructed with semi to full concrete structure with unique style of architecture bearing the colour shades of red, gold and green
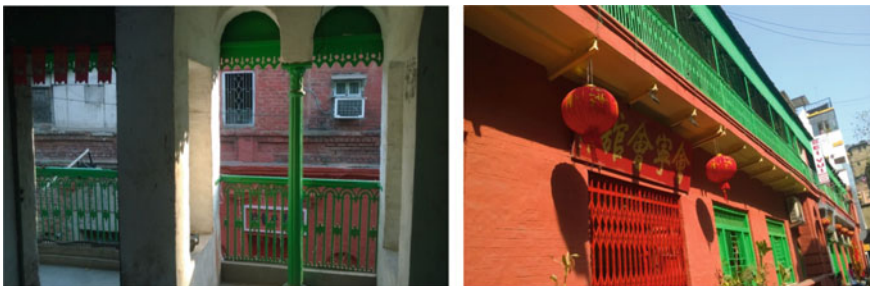
Fig. 2 Unique Chinese architecture in the neighbourhood of Backburn Lane

over the walls both exterior and interior. The community is of now trying to renovate the existing Chinese spaces and utilizing them in rational ways by keeping their identity and authenticity intact. The laminated wooden outfit with glassy outlook and the Chinese signs and symbols provide the authentic look along with modern orientation. Inside the dining space of the Sei Vui restaurant, there are murals and glass paintings along with a huge drawing of the Great Wall of China symbolizing the homeland connection from the perspectives of the diaspora identity of the community. In respect of the third important element of paths, i.e. the **directional quality** is also to be mentioned of the said stretch. The Gee Hing and Toong On temples lying opposite corners of the Blackburn lane as the Lu Shun Sarani (New CIT Road) crisscrossed the said stretch as stated earlier. Thus the very presence of these two landmarks, one can easily understand the pivot of Chinese enclave in old Chinatown (Cheenapara) and through the path it will be easier to dig inside the belongingness of the community within the mixed ethnic fabric of the neighbourhood.

Edges

Edges are considered as linear components or considered as section of the paths or streets. They usually act as boundaries between two phases, linear breaks in continuity like the walls or street corners found in the Chinatown here. Edges help us to differentiate two separate areas or localities in terms of distinct visible characteristics like certain elements of landscape, architectural patterns, height of the buildings, variation of housing, variation of activity spaces, social neighbourhood differences etc. Edges or street corners act as boundaries amongst variable characters found inside both the Chinatowns in Kolkata. Like that of the edge of the Sei Vui leung association (club and temple) building having the Hupeh association office (including temple) at the top, creates a round edge and meets with the corner of the junction where the Muslim neighbourhood starts. Hence the edge of the building and the outer walls act as an invisible line of separation of two different built up characters. Thus the change of built up forms and land use characters with the edges of streets can lead to an observer understanding the visual vibrancy of the Chinese clusters of the city (Fig. 3). The 'edge' here is dissecting the Chinese cultural spaces of Blackburn Lane and the adjacent quarter of the Muslim neighbourhood of Damzen Lane. However, there's a spatial overlapping found amongst the Chinese and Muslim quarters of this lane as two of the Chinese temples Choonghee Dhong Thien Haue and Nam Soon (the first one belongs to the Hakka and the latter one to the Cantonese) found sandwiched between the Muslim owned quarters of Mico House and 'Hathi Darwaza', two locally known landmarks bearing traditional 'Sultani' and colonial architecture.

Fig. 3 'Edge' separating Chinese and Muslim quarters (Blackburn Lane- Damzen Lane)

Districts

Here the term districts signify the character areas perceived to have common spatial features and visual identity from the rest of the environment. These unique characteristics are determined by continuities and homogeneities of topography, materials, textures, spaces, forms, symbols, building patterns, activities, inhabitant characters, colours and exterior arts etc. All these components give a district (character area/locality) its unique identity, create intimacy between its segments and also provide numerous positive outcomes related to its existence over the possible future layout of urban planning in the said area. Chinatowns—a clear visual 'microcosm' of unique urban built up cluster led by community aspirations—bear unique and dynamic forms which change their exterior attire more often for coping with changing fallacies of associated urban macro-forms. However, they remain traditional within and thus every Chinatown has some kind of similar typologies and patterns regarding their internal and to some extent external characteristics. Thus Lai (1988) quite rightly pointed the 'Chinatowns' as 'towns within towns/cities' as based on his assessment of Chinatowns found in Canada. Lovra (2019) thus applied the concept of **'urban tissue analysis'** as a part of **'urban typo-morphological assessment'** (a contemporary method highly related to the ecological study of urban built up structure specified by the Chicago Geographers in early twentieth century). The primer 'urban tissue' analyses the characters of built environment and landscape to describe and illustrate the historical process of urban development and its spatial consequences. Hence, the idea of linking the Chinatown cluster (both existing and previous) with its core functional (active) nucleus and other associated tissue forms like street patterns, household architecture and heritage outputs gets validity. The 'nucleous' of 'Cheenapara'

is around the Blackburn Lane, Chattawalah Gulley and Sun Yat Sen Street breakfast market quarter. This core remained the hub of Chinese ethnic and commercial activities in the cluster until the administrative intrusion of reconstruction of urban planning through newly formulated buildings and construction of the thoroughfare (in the form of the New CIT Road as already stated) which dissected the integrity of the ethnic cluster and its unique functional tissues like its traditional temple or household architectures, community meeting spaces, signs and symbols. They got some what dismantled and scattered and only a fraction of such uniqueness remains till date. To find out the dynamic urban morphological pattern inside this Chinatown, the everyday geography of Cheenapara has been transcribed using the 'cognitive/ behavioural mapping applied as a part of 'emotional cartography'. Kaplan (2018) explained the process of ethnic place-making as a geographical phenomenon focusing on how ethnicity actually plays out on the ground and this has been done through 'purposive walking' (Fig. 4).

The community owned spaces inside or around Cheenapara symbolize the ethnic bonding between the Chinese and their spatial identity. Ethnic precincts visually reflect the ethnic economy and ethnic diversity of Calcutta's landscape with a prominent and long established Chinatown in the downtown area. Image of 'Chineseness' making is made more consistent with the architectural motifs and symbols of China. Such place-making characteristics include huigans (native associations), sacred spaces (temples referred to as churches), interaction and leisurely spaces (clubs), celebration spaces (lion dance performance on the streets of the Cheenapara and in front of the Chinese residential dwellings), commercial spaces (shoe shops, restaurants) or mourning spaces (Alms House). The religious and funerary institutions were established to meet the material and spiritual needs, the living space being
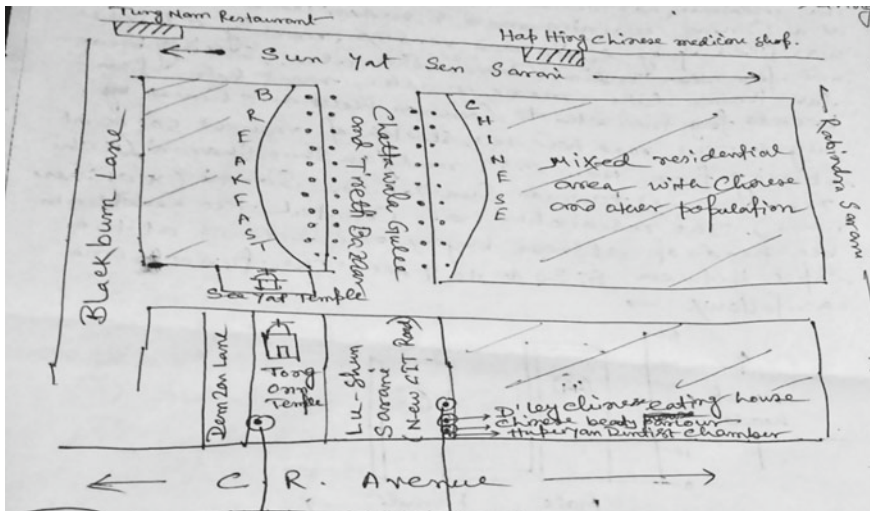
Fig. 4 Behavioural (cognitive) map of Cheenapara breakfast market and the core activity space

the quarters of the Chinese homeowners; their livelihood space being the commercial; the leisurely and recreational the clubs for a smooth daily holistic everyday life of the closed community. Such highly visible institutionalized neighbourhood and economies also bear witness to power of these immigrants as an engine of economic growth and social transformation, transformation of local business and residential geographies transforming the cultural, social and economic life of Tiretta bazaar area. Inside a culturally pluralistic society, the role of ethnic and social institutions is very significant in respect of keeping the ethnic identity quotient alive. Thus, an ethnic group's history, traditions and customs are important components of an individual's ethnic belongingness.

Everyday Cultural Landscape of Kolkata Chinatown

Many social science scholars, particularly geographers prefer to apply more visually embodied concepts, such as place, environment, landscape, etc., in their studies than the earlier abstract notion of space. Qualitative ethnographic inquiries into human behaviour in a spatial context emphasize on studying everyday activity patterns by spatial scientists, geographers and social anthropologists. The link between the 'social' and the 'spatial' which Soja (1989) marked as 'socio-spatial dialectic', is an interactive one, where people make places and places make people. 'Place' refers to how people are attracted to a certain space and is broader than a location created by human experiences, activities and everyday neighbourhoods (Tuan 1977). Here, the principal notion of 'space' and 'territoriality' (Tuan 1977) has been justified by the visual inquiry of the everyday activity sphere of the Chinatowns of Kolkata and its association with the cultural landscape transformation by the Chinese community. The Concept of 'cultural landscape' as borrowed from renowned American Geographer Carl Ortwin Sauer's (1925) idea has been applied in context of Chinese cultural landscape inside this city consists of temples, cemeteries (necro-spaces), lion dance and martial art centres and of course the native 'huigans' which literally represent the image of 'Chineseness'. This has been made more consistent with their architectural motifs and symbols of China. These clubs cum associations try their best to meet up all the required aspirations from the members who live here like an extended family. They serve as community gatherings through community halls, as sponsors of community run schools, guest houses, for maintaining bodies of graveyards (cemeteries), housing temples and clubs belonging to the Chinese community. The daily course of life for a Chinese in this very city rotates across these community capitals and functional spaces which Basu (2016) termed as 'everyday lived spaces'.

Huiguans (Native Chinese Associations)

Zhang and Sen (2013) emphasized on the role of native associations or 'Huiguan' on the daily rhythm of Chinese life in the city of Kolkata. They are named after their source regions inside Guangdong province in southern China. Sometimes, they also serve as community halls, sponsors of community run schools, guest houses, maintaining bodies of graveyards (cemeteries), temples belong to the Chinese community (Fig. 5a). Toong On and See Ip (Sze Yap) 'huiguan's (locally mentioned as 'church') are situated along the Blackburn Lane-Chattawallah Gully stretch. The first impression for a visitor in front of the grand architecture of Toong On is quite splendid. Red coloured outfit with Gothic style layout displays its uniqueness as a cross-cultural landscape entity. Since 1924, the temple serves as an important religious institution for the Cantonese community. The temple has two floors, the upper one has prayer hall coupled with traditional Chinese deity of 'Kuan Ti' (The Good of War) and lower one has a statue of Lord Buddha gifted from Thailand. Two important cultural institutions are situated inside the Damzen Lane, each belongs to the Hakka and Cantonese community. The Choonghee Dhong Thien Huae, a two storied 'huiguan' building belongs to the Hakka community. The Nam Soon is the most beautiful 'huiguan' premise within Cheenapara though not been able to attract tourists and cultural enthusiasts owing its location. The courtyard inside the temple is quite spacious followed by the worship hall with three traditional Chinese deities. The temple committee runs an English medium institution naming CKC School with a Chinese principal and remaining non-Chinese teachers and local students (Fig. 5b).

Temples/Shrines (Outside 'Huiguans')

In the newer Chinatown of Tangra, everyday cultural spaces include sacred spaces of the Hakka worship at the temples notably the Laotze and Shing Yin temple. Inside their exclusive community spaces such as the Pei Mei Chinese School, there is a religious space (temple) on the top floor with the traditional deities of Kuan Ti/Guan Yu (God of War) and Caishen (God of Wealth) in addition to motifs and symbols. The Chinese Fo Guang Shang Buddhist temple (Kolkata Centre) situated along the Tangra First Lane was established on 16th May 1998. In addition to the traditional religious space devoted by the community, there are also signs of assimilation with that of other religious spaces in Tangra. The most notable one is the 'Chinese Kali Mandir', a Hindu temple (the term *mandir* denotes a Hindu temple). It is a unique landmark symbolizing religious synthesis situated along the South Tangra Road near Kafulok restaurant. The deities of the Hindu Goddess and God, Kali and Shiva are worshipped by local Hindus along with the Chinese residing here with a hint of Chinese makeover. The level of assimilation and acculturation by both communities is demonstrated through the idols being that of Hindu faith and the *prasad* served with traditional Chinese dishes of noodles and dumplings by the local residents as
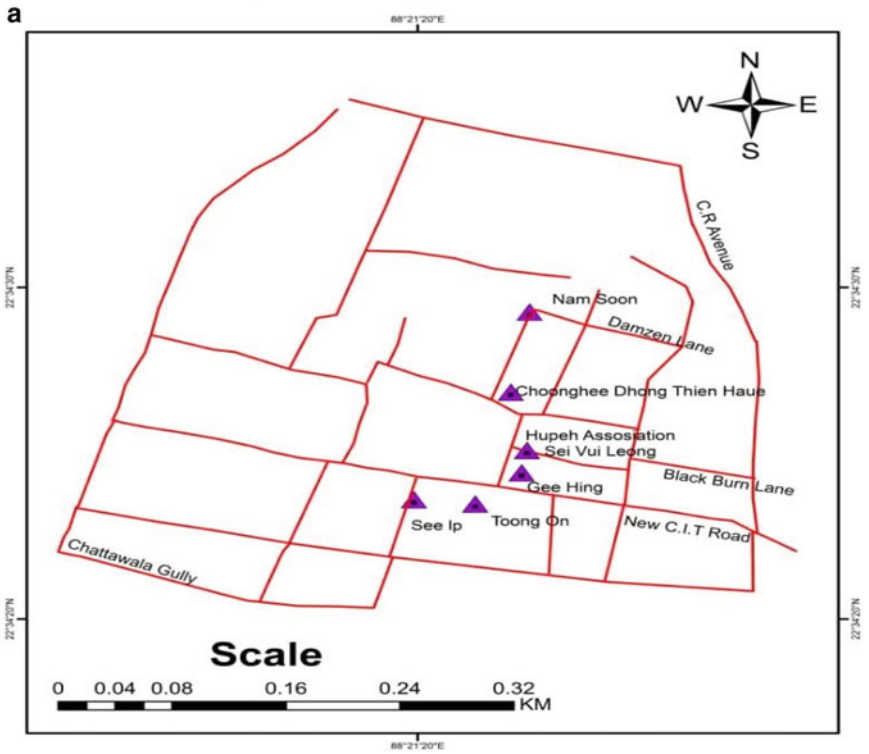
Fig. 5 **a** Native 'huiguans' of Cheenapara. **b** Chinese 'huiguans'—symbol of ethnic belongingness (Toong On and Nam Soon)

Fig. 6　a, **b** Chinese shrines of Tangra (mixing of exclusive and 'overlapping' faith)

perceived by the researcher Bonnerjee (2015) and mentioned in her study about the offering of '*bhog*' (sacred food) of noodles and chopsuey to the Hindu Goddess by the local Chinese residents of Tangra which I also observed during field survey (Fig. 6a, b).

Cemeteries (Necro-Spaces)

Cemeteries or grave spaces are significant parts of community associations; a kind of sacred 'necro' place-making connecting the community with their ancestral roots. They help in preserving the rituals of mourning of the departed community members and observation of the ancestral cult practices. Chinese cemeteries represent the perennial elements of cultural transmission from mainland China replicated and transmitted across generations amongst members of the associations. The duties performed in relation to managing the dead thus continue till date. These cemeteries function as a space of adaptation, a space of practice reflecting the anchoring of the Chinese in this country and hence into this city (Gueguen 2016). They are the territorial landmarks for the Chinese in an urban cultural environment where the Hindu beliefs dominated when they settled down in Calcutta. Found as enclosed spaces and as sacred landmarks, these burial places have given rise to a culturally constructed landscape specific to the local Chinese community residing here. The cemeteries and grave spaces were constructed outside the core city (i.e. the peripheries) in accordance with the notion of geomancy and compiled with the health and hygiene regulations set by the then English administrative authorities (Gueguen 2016). The Chinese graves are mostly horse shoe-shaped because of the myth and belief of the Chinese that the celestial journey of the soul is through the horse as a carrier of the

Table 2 Chinese cemeteries in and around Tangra

Cemetery	Location	Distance from Tangra
Nam Soon	Kulia Tangra 2nd Lane, Beliaghata	1.7 km
Toong On	Matheswartala Road, Tangra	Inside Tangra
Sei Voi Coon Koon	New Tangra Road, Tangra	Inside Tangra
See Ip	Tangra 2nd lane, Tangra	Inside Tangra
Gee Hing	Canal South Road, Beliaghata	2.7 km
Choonghee Dhong/ Choong Ye Thong	(1) D.C. Dey Road, Beliaghata (2) Chowbaga Road	(1) 2.5 km (2) 3.7 km

Source Datta (2014), Gueguen (2016) and Field survey (2019)

divine spirit to heaven (Oxfeld 1993); linear shape graves are also found inside these cemeteries (Table 2 and Fig. 7).

The grave spaces are important space-ethnicity aspects of Tangra and are named after the 'huiguans' they are associated with. There are a host of linear patterned graves lying over a patch of green pasture inside the Toong on Cemetery. The green patched sacred courtyard holds more than 45–50 small to medium size graves with both linear and horse shoe-shaped grave structures and a large horse shoe-shaped pavilion with the guardian deity. The notion 'discontinuity' is created by a strict and sometimes brutal separation that transforms space and allows the foundation of more or less visible geographic structures. Due to the recent surge of space crunch in Tangra due to rapid real estate constructions, the contestation of space resulted in the Chinese community to consider the cemeteries as part of their historical and cultural background in Kolkata and desired them to be considered as permanent landmarks.

Fig. 7 Chinese 'necro'-spaces in Tangra

'Leisurely' Spaces

The leisurely spheres of Kolkata Chinese are very much linked with gossiping inside the huiguans/clubs and reading the Chinese newspaper. Oxfeld (1993), Zhang and Sen (2013) mentioned how the Huiguans serve as both worship places in presence of the Chinese deities and as place to play Mahjong (especially at Gee Hing). A group of senior Chinese men and women are seen playing the traditional game of 'Mahjong' inside the Gee Hing Church/Temple. The presence of aged women along with men of similar ages make it more colourful indeed and from the perspective of an outsider, the game will surely provide a visual impression of how the notion of making profit is attached with all the Chinese overseas spread over the globe. Oxfeld (1993) in this regard cited the significant observation made by Skinner (1968), where he had discussed about the role of wealth amongst Southeast Asian Chinese communities. For the Chinese in Calcutta what becomes important consideration for their sustenance is about how much wealth they can manage to acquire for decent living in this overseas diaspora space (Fig. 8a, b). Oxfeld (1993) highlighted about the role of gambling (like that of playing the Mahjong) in respect of the Hakka community living in Tangra during weddings, birthdays and all other gatherings. She mentioned about the other non-Chinese forms of gambling like lotteries or betting during horse races which she found not so common amongst the Chinese in the city. She applied these literary analysis to her findings about the idea of Chinese gambling in Calcutta and hence she admitted by citing Hsu (1981) that, Chinese gambling games are habitually played with certain tools; the participants sit in certain points, know each other and meet at regular intervals. Hence, the leisurely meeting space where the community rejoices their community aspirations of being 'entrepreneur' from ancestral perspectives who wish to earn and gamble money for certain justifiable perspectives. Besides being such leisurely space, these huiguans serve as community gathering points for the community members. The sole Chinese newspaper 'Overseas Chinese Commerce in India' also acts as a source of contact amongst the Kolkata Chinese and the Chinese on a global scale of Chinese Diaspora. The news of intra-community marriages, mourning messages, Chinese Overseas programmes, community gatherings is obtained. It helps in linkage between the community living in Kolkata with those living overseas in cities like Toronto, Sydney or New York. In addition, the e-technology has brought them closer through internet surfing, blogs and social media platforms of Facebook, Twitter etc. particularly the younger generation.

Everyday Economic (Co-ethnic) Landscape of Kolkata Chinatown

The occupational specialties of Chinese were divided amongst regional origins carrying their legacy of ancestral professions of carpentry amongst Cantonese, leather tanning amongst Hakka community, dentistry and teeth setting amongst Hubeinese,

Fig. 8 **a**, **b** Everyday leisurely spheres of 'Mahjong' and 'Overseas' Chinese daily

silk trading and paper decoration amongst Shanghai migrants. Later, however, food provision and restaurant business became popular amongst all these Chinese communities. These occupational specializations provided the gateway of ethnic production of Chinese economic spaces inside the city and need a detailed account. Specialization may stem from many factors: the skills that ethnics bring with them, the opportunities available in a particular context, the legacy of longstanding activity in a sector and the structural barriers set by host societies that prevent ethnic minorities from entering certain economic sectors. Zhuang (2019) highlighted about the role of ethnic entrepreneurship in urban place-making as everyday ethnic economy shapes the retail and trading output of an ethnic business enclave. How ethnic economy helps shape the landscape is manifested through physical landscape of Chinatown home-owners, organization and businesses transforming the cultural, social and economic life of the area. Ethnic entrepreneurship and ethnic economy reflects institutionally complete ethnic neighbourhood of business (Kaplan and Li 2006), social, religious and cultural organizations representing character and tradition of the Chinese society that they have left behind in their place of origin. The migratory movement of the Chinese to Calcutta was partly voluntary and partly involuntary initially housing a stream of male sojourners resulting in a 'coolie' enclave. A series of Cantonese carpenters migrated to the port for working under the colonizers in the mid-nineteenth century doing repair work. In the second phase (1870s till late 1880s), being highly skilled and better crafted than their Bengali counterparts, they started establishing carpentry outlets. Late 1880–1900 with the new wave of Chinese immigration to Calcutta due to political and civil unrest in China mainly by the Hakkas resulted in an increase in Chinese population (Hakkas) in Bow Bazaar area. People shifted from the dock area to inner city in 1930s and 1940s, near the commercial core (CBD) of the city Bow Bazaar and Esplanade areas, thus culminating in the visual aspects of a Chinatown which began in the early 1900s.

Everyday Ethnic Economy: Carpentry (Cantonese) and Shoe Making (Hakka) 'Spaces'

Grant (1862) highlighted about the Cantonese carpenters who were attached to the shipping service at Calcutta (Kidderpore) port. Zhang and Sen (2013) by citing Yu (1956) recorded about the Cantonese owned business enterprises around Kolkata port and adjacent areas along Hugli River. As per their speculation, there were around 300 Cantonese carpenters working at Kidderpore dock and 20 carpentry factories were operational till 1950s. The entire area of Tiretta bazaar has more than three dozens of carpentry and furniture shops, but at present only few are owned by the Cantonese community. Chen's carpentry is the most notable carpentry units of Chinatown serving for more than a century. Besides this legendary house, Chen's stylized furniture, another trusted Cantonese brand also serves their customer base with modernized furnishing and home décor solutions through their manufacturing cum selling outlet within the Blackburn Lane. Other units include the New Wise furniture at Chattawallah Gulley, Wu's carpentry of Robert Street and St. Joseph's carpenters of Elliot Road. The geographical distribution of Chinese carpentry units is concentrated at the old Chinese quarter of Tiretta Bazaar and its adjacent areas. Initially, they relied upon the native co-ethnic mastery and craftsmanship which they inherited for centuries; later, however, dwindling community labour prohibited them from expanding further. The existing carpentry units struggle with the changing dimensions of the furniture business. Smaller household dwellings now prefer light weight stylized furniture and traditional wooden art is not the choice for the most. As a coping strategy for survival, two of the carpentry units have diversified their business to modern décor, though remaining four units still remain traditional. Liang (2007) pointed towards the initial Chinese commercial units of shoe business of Hakka Chinese around the urban wards of 40, 41 and 42 (i.e. around Lower Chitpur Road, Bowbazar Street and Bentinck Street) of the city. The shoe shops are located in a linear fashion starting from Chitpur crossing in the north up to Dharamtollah (near 'Y' channel and mosque) with host of other commercial activities performed by diverse communities. Hakka owned shoe shops are John Hing, Foley Shoes, Sen Fo, Chin Shoe, Indo-China, Woon Son, Yun Thai, Ahon Brothers, etc. Recent field studies reflect that out of 132 shoe shops along the flanks of Rabindra Sarani and Bentinck Street, about 13 shoe shops remain to Chinese ownership (Fig. 9a, b).

Everyday Ethnic Economy: Peripheral Tanning (Hakka) 'Spaces'

A geographical perception entails probing the role that location plays in helping, hindering or shaping ethnic economies. Much of the immigrant economic activities occur near the ethnic enclave and are also often established where rentals/ land value are lesser in comparison to the core city; i.e. they are established in the inner cities or
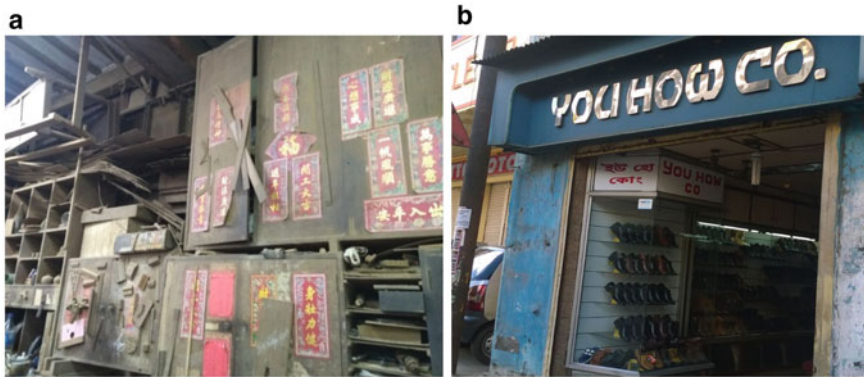
Fig. 9 **a**, **b** Everyday carpentry (Cantonese) and shoe business (Hakka) 'spaces'

along the city peripheries. Such an example is the tannery dominated insular ethnic-economic identity formation amongst the Hakkas. The geographical peripherality of the Chinese tanning community, the impurity of tanning within caste ideology and the mistrust and apprehension was expressed about the Hakkas by the host society. The identification of another person as a fellow member of an ethnic group implies a sharing of criteria for evaluation and judgement. Friedrich Barth's (1969) observation relating to the idea of making and maintaining the 'ethnic boundary' stands significant. This is because in most societies having multiple ethnicities, 'the ethnic boundary' channelizes the social life with complex behaviour and social relations. The reasons behind the monopoly of Hakka leather tanning units in Tangra are through a two-fold strategy of business management cited by Oxfeld (1993) and Liang (2007) as: *Firstly*, they created a peripheral enclave of residential cum commercial enterprises for leather processing. Closer proximity between Tangra, Park Circuss and Tiljala helped them acquire cheap source of raw hides and labour from upcountry Muslims; *secondly*, being affluent in leather processing, the Hakkas formed cohesive ethnic economy which made a parallel business setup inside the mainstream economy of the city. They continued their shoe business at Rabindra Sarani-Bentinck Street (Cheenapara) where an elite class and a densely populated area served as a rich consumer base (Fig. 10).

Everyday Ethnic Economy: The 'Ethnic' Food and Culinary 'Spaces'

Food processing and culinary activities of the Chinese are renowned throughout the World and Chinatowns of Kolkata are no exceptions. They have engaged themselves with ethnic professions of manufacturing of Chinese herbal medicine, sauces and other food products. Chinese provision and food production units of Sing Cheung,
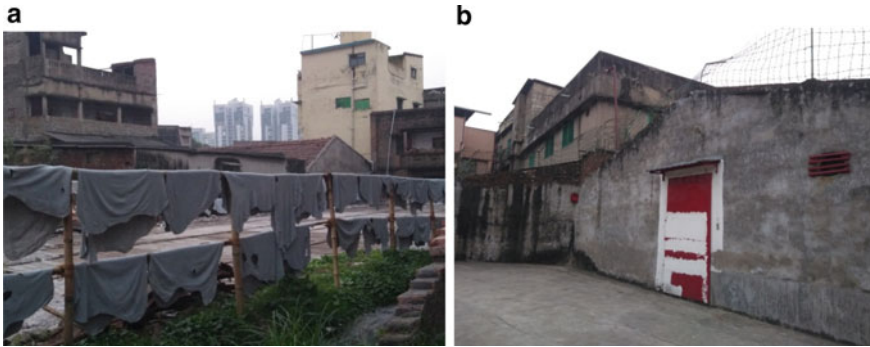
Fig. 10 Segregated Hakka tannery 'spaces' of Tangra

Pou Chong and Hap Hing (presently closed) serve quality sauces for making dishes for many city eateries. The sauces have the right admixture of ingredients maintaining quality freshness with a distinctive sense of 'place'. The 'Kim' branding of Pou Chong Agro Ltd. with the traditional boat symbolizes the great voyage of the Chinese seafarers and fortune seekers as the Lee family (owner of Pou Chong) which recalls the arrival of their fore fathers by boat to the port of Kidderpore (Calcutta). The caption of the Sin Cheung sauce factory claiming that of '*bringing China to your doorsteps*' also signifies the linking of their ethnic brands with their sense of 'entrepreneurial identity' and 'place of origin'. The community is engaged in the lucrative and demand-driven restaurant business as Chinese cuisine is popular amongst bulk of Kolkata population. The restaurant business indicates a broader than enclave economy amongst the Chinese. Chinese ethnic food in Kolkata can be classified into two heads—spatially (i.e. locational entity) and period of consumption (i.e. temporal entity). As per spatiality or locational pattern, Kolkata Chinese cuisines are of two categories. The first one is the Chinese street food of Tiretta Bazaar which is an iconic gateway of authentic Chinese breakfast on any Sunday morning and the second is the Chinese owned and functioning eateries. Traditional Chinese food items like bouzi, wanton, suimai, dumplings along with Tibetan delicacies like momo, thukpa, local Indian cuisines like potato (aloo) chop, kamala puri are mostly sold on the street space (Fig. 11).

The other kind of ethnic food spaces are the consumer services through Chinese eateries found not only in the twin Chinatowns but also in other parts of the city. Traditionalist attitude is the essence of most of these Chinese restaurants where city food enthusiasts find mouth-watering Chinese delicacies with less pocket pinch. Eateries are famous for their exclusive and classic ethnic dishes. Notable amongst them are Eau Chew (Ganesh Chandra Avenue near Cheenapara) for Josephine noodles and chimney soups; Tung Nam (Chattawala Gully, Cheenapara) for pork cuisines particularly the chilly roast pork; and D'Ley Eating House at Blackburn Lane for its mixed gravy noodles. The temporal aspect linked with the Chinese ethnic food space of the city is of two types, i.e. (i) everyday food space/regular consumption by all is mostly

Fig. 11 Unique food 'space' of Cheenapara breakfast market

simple and traditional type of food and (ii) the sacred food space (consumed exclusively by the community members during the Chinese festivals). The sacred food items include the whole roasted pig (sacrificed and slaughtered); first offered to the ancestors and later distributed amongst the community members at the community dinner. This was observed on the 'All Souls Day' at the See Ip temple by myself with prior permission as it was intruding of their private 'space'. For the last three decades, Chinese eateries are opening their branches and newer outlets outside the exclusive 'Chinatown' environment. This is regarded as the transformation of Chinese culinary economy from enclave formation towards diffusing spatially across the city (Fig. 12).

Tangra also has some unique heritage architecture rendering community identity and belongingness. Though it's true that the structures of Tangra are more recent than that of the 'Cheenapara', they are also important from the community's perspective. Similar to the Blackburn Lane in Cheenapara, Matheswartala Road is the pivotal core of Tangra. Majority of the tannery units, restaurants, food processing units, some of the grave spaces and Chinese households are situated along this road stretch. I started the purposive walking along this stretch following the route map proposed by Pauer et al. (2010) in their study. Matheswartala Road has its southern end connecting the JBS Haldane Avenue (Park Circus Connector) near the Science City and towards the north up to the Dhapa Road. All the adjoining streets of New Tangra Road, Tangra 1st and 2nd Lane join Matheswartala Road. The western segment, i.e. the side of Topsia-Sealdah connection, the Gobinda Chandra Khatick Road connects Tangra with Sealdah, the busiest rail junction station of Kolkata. Chinese run popular eateries like Beijing, Big Boss, China Gate, China Garden, Lee Eating House, Kim Ling are situated along the Matheswartala Road and South Tangra Road (Fig. 13).
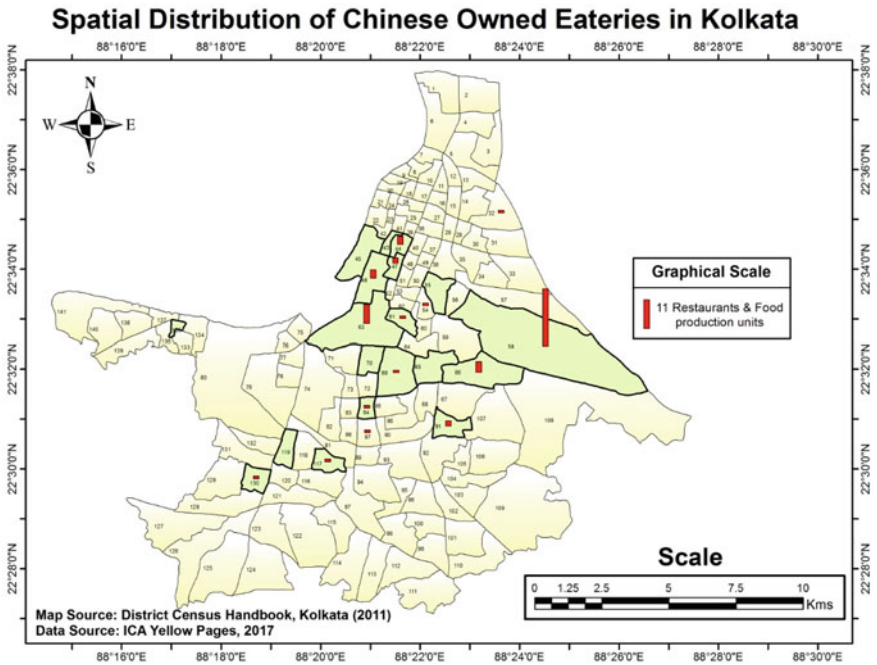
Fig. 12 Spatial distribution of Chinese eateries (in and around Chinatown) in Kolkata

Fig. 13 Chinese culinary 'spaces' of Tangra

Everyday Ethnic Economy: Laundry, Dentistry and Makeover (Salon) 'Spaces'

The units of Chinese laundry in the city show a scattered and diffused geographical distribution. This business indicates a broader than enclave economy amongst the Chinese. They have not clustered inside Chinatown, rather spread across the city space. Some of the known units of Shanghaian laundry services around Cheenapara

and central Kolkata are Peeking, Shanghai, Chung King, etc. Though these units till day possess a high reputation of delivering quality service, they are suffering financial losses due to fall in the number of customers with a large section refraining from availing Chinese laundry services. Currently, there are 20 clinics run by 17 Hupeh dentists in the state of West Bengal, out of which 18 are functioning in Kolkata. Dentists like Dr. Mao Chi Wei, Dr. Mao Melvin and Dr. Chang have earned reputation as successful practitioners amongst the locals. Hupeh dentists have established their dispensaries across the city. During interview with two of the Hupeh dentist at Tiretta Bazaar and Shakespeare Sarani respectively, I witnessed the same. Making of paper flowers has now become an obsolete practice amongst the Hupeh community. One of the respondents who runs a beauty parlour with his wife, shared childhood memories during an interview where he used to sell paper flowers and lanterns near Tea Board at Brabourne Road. Nowadays, the paper flowers are used in Chinese traditional festivals and religious offerings as Oxfeld (1993) marked paper money as a symbol of Chinese entrepreneurship ideology (Fig. 14a, b).

For the last few decades, Chinese enterprises in Kolkata have switched over from traditional to newer ventures like tattoo parlours, jewellery, electronics and photography signalling towards post-global transformation of ethnic Chinese proprietorship. The traditional attire of the Chinese ethnic commerce is rapidly turning to its post-liberal 'westernized' outfit and the co-ethnic customer base is being replaced by growing base of non-Chinese youth 'space' of this city. Such 'disneyfication' of traditional Chinese ethnic spaces evokes further complexities of 'space' and belongingness research and may be subject to further investigation.

Conclusion

Research is a systematic and scientific process of searching knowledge. This chapter discusses about the components connecting a marginalized 'Diaspora' minority with its identity and belongingness which is little explored by geographers. Being an outsider to community, the author whilst exploring their everyday ethnography adopted such 'visual' ethnographic research methodology to portray the mosaics of cultural vibrancy of 'Chinatown'. This was done to understand the role of activity and awareness space in the course of everyday living and place-making as a part of symbolic identity formation of the Chinese. Kolkata is such a unique urban space in the entire world where two separate Chinatowns (Cheenapara and Tangra) exist with striking variations in its physical and cultural form. The unique 'space' geography of Kolkata shaped the ethnic economy of the city which demonstrates that ethnic economy is geographical by nature. How ethnic economy helps shape the landscape is manifested through physical landscape of Chinatown homeowners, organization and businesses transforming the cultural, social and economic life of the area. Ethnic entrepreneurship and ethnic economy reflects institutionally complete ethnic neighbourhood of business, social, religious and cultural organizations representing character and tradition of the Chinese society that they have left behind in their
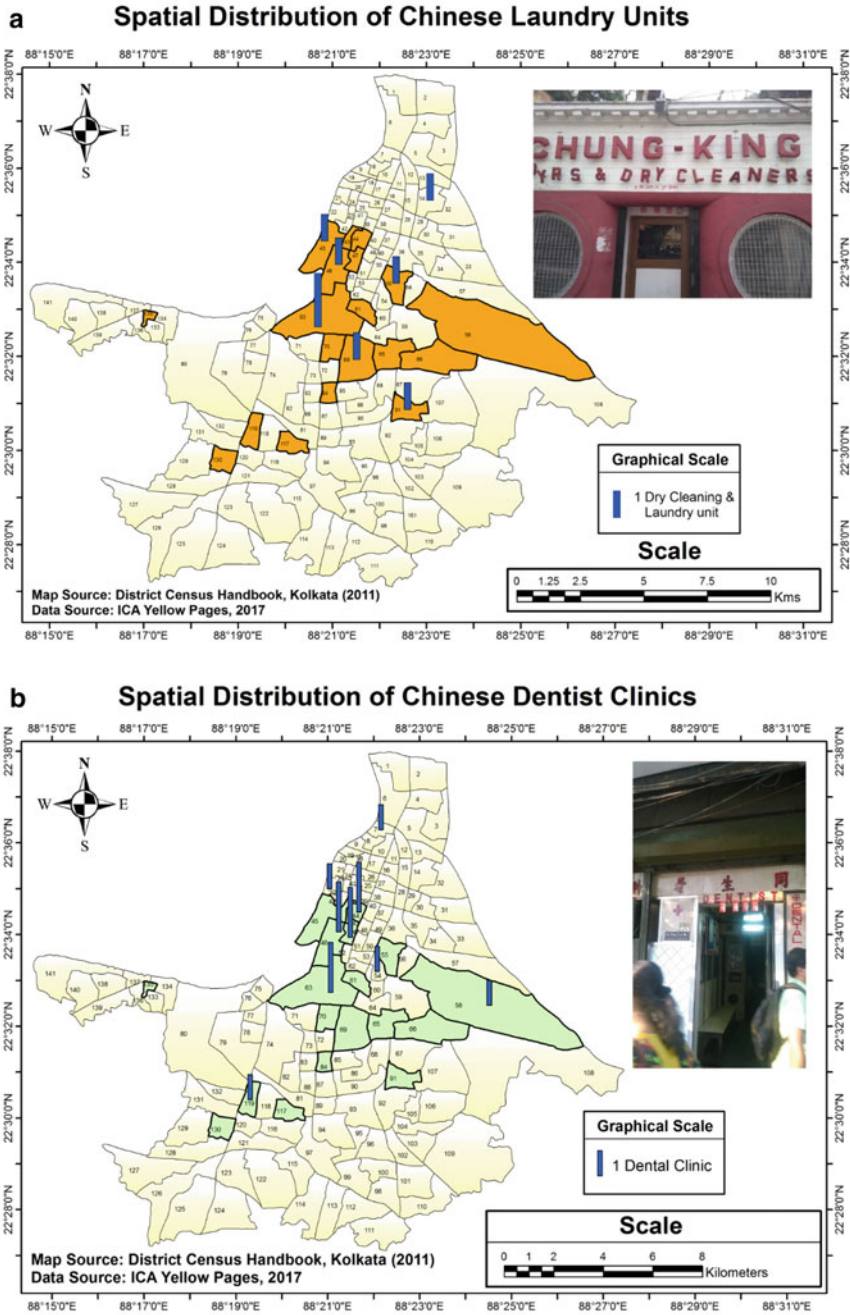
Fig. 14 **a** Chinese laundry business in Kolkata. **b** Chinese 'Dentist' clinics in Kolkata

place of origin. The highly visible institutionalized neighbourhood and economies, bear witness to power of these immigrants as an engine of economic growth and social transformation, transformation of local business and residential geographies transforming the cultural, social and economic life of Chinatown. Large Chinese signboards with decorated motifs, carvings on roofs of Chinese 'huiguans', red and gold paintings on the walls of Chinese educational institutions and households created a physical appearance of a full-fledged Chinese colony in the city along with other community dwellings and mixed residential units. The research objective of whether ethnicity is the agent for bounded (co-ethnic) identity construction or not is dealt with in this chapter based on ethnicity and place-making through neighbourhood enclave dynamics of everyday activities. Laundry and restaurant business indicates a broader than enclave economy amongst the Chinese of Cheenapara. Such an ethnically controlled economy leads to sectoral concentration of ethnic economy reinforcing that ethnic identity based on territories and social network still persists. Tangra Chinatown was initially constructed as a tannery cum residential town, mostly fortified in nature. The tanning operations involve processing of raw hides and skins and thus the Hakka tanners established their niche near the Muslim slaughtering hub of Tiljala and Park Circus. Tangra with its insular character housed schools, temples, graveyards and provision units for catering the needs of the Hakka community there. The everyday geography of Tangra is different from that of Cheenapara. The dominating Hakka way of peripheral/segregated livelihood impacted Tangra's designing of streets, markets and architecture resulted in complex space-ethnicity outcomes. Tangra being constructed over the marshy, swampy lands destined only for tanning operations. The post-global transformation of traditional Chinatown economy and inter-generational link amongst the Chinese in Kolkata and their relatives, friends living abroad has created the inseparable chain of ethnic family entrepreneurial linkage. '*Ethnic packaging*' of community assets resulted in harnessing community benefits in the context of 'global–local' linkage of 'Calcutta Chinese' Diaspora. This kind of 'ethnic packaging' of the place may help to create better employment opportunities for the Chinese youth in coming times. The need of the hour is to create an alternative master plan which can cater to the needs and aspirations of the Chinese youth in the city. This can be done by tying up with their co-ethnic global networks of kinship and family 'Diaspora'. It can benefit the Chinatown economy through transnational channel of Chinese Indian networks.

References

Barth F (1969) Introduction. In: Barth F (ed) Ethnic groups and boundaries. Little Brown, Boston, pp 1–38

Basu S (2016) Everyday lived spaces of the Chinese community in central Kolkata. Hill Geographer 32(1):87–104

Bonnerjee J (2015) Beyond boundaries? Hindu spaces in the Chinatowns of Kolkata and Singapore. In: Bhattacharya J, Kripalani C (eds) Indian and Chinese immigrant communities: comparative perspectives. Anthem Press, ISEAS, Singapore

Creswell JW, Clark VLP (2017) Designing and conducting mixed methods research, 3rd edn. Sage Publishing, USA

Graham E (2005) Philosophies underlying human geography research. In: Flowerdew R, Martin D (eds) Methods in human geography: a guide for students doing a research project. Pearson Prentice Hall, Harlow, England, pp 8–29

Grant C (1862) Anglo-Indian domestic life: a letter from an artist in India to his mother in England. Baptist Mission, Calcutta

Gueguen C (2016) Discontinuities and the maintenance of Chinese cemeteries in Kolkata. J Chinese Overseas 12(2):315–335

Kaplan DH (2018) Navigating ethnicity: segregation, placemaking and difference. Rowman & Littlefield, New York

Kaplan DH, Li W (eds) (2006) Landscapes of ethnic economy. Rowman and Littlefield, USA

Karuppannan S, Sivam A (2013) Comparative analysis of utilisation of open space at neighbourhood level in three Asian cities: Singapore, Delhi and Kuala Lumpur. Urban Des Int 18(2):145–164

Lai DC (1988) Chinatowns: towns within cities in Canada. The University of British Columbia Press. Available at: https://books.google.co.in. Accessed 17 Mar 2017

Liang J (2007) Migration patterns and occupational specialisations of Kolkata Chinese: an insider's history. China Report 43(4):397–410

Lovra E (2019) The urban typology matrix (1867–1918). In: Proceedings of the XXV ISUF international conference "Urban form and social context: from traditions to newest demands". Krasnoyarsk State Medical University. Available at: https://core.ac.uk/display/224957282?utm_source=pdf&utm_medium=banner&utm_campaign=pdf-decoration-v1. Accessed 14 November 2021

Lynch K (1960) The image of the city. The MIT Press, Cambridge, Massachusetts and London

O'Reilly K (2005) Ethnographic methods. Taylor & Francis

Oxfeld E (1993) Blood, sweat and mahjong: family and enterprise in an overseas Chinese community. Cornell University Press, Ithaca and London

Pauer L, Wilson AD, Herzog J, de Meuron P, Herz M, Rahbaran S, Zhou Y (2010) Invisible Chinese. Eth Stduio, Basel

Rodaway P (1994) Sensuous geographies: body, sense and place. Routledge, London & New York. Available at: https://books.google.co.in/books?isbn=1134880707/pdf.ld. Accessed 15 Oct 2016

Rose G (2016) Visual methodologies: an introduction to researching with visual materials, 4th edn. Sage, London

Sarkar S (2017) The street children of Kolkata: a socio-spatial study with special reference to Sealdah Railway Station Area. Thesis, Department of Geography, West Bengal State University, Barasat, Kolkata

Sauer CO (1925) The morphology of landscape. University of California Press, Berkeley

Soja EW (1989) Postmodern geographies: the reassertion of space in critical social theory. Verso, London and New York

Tuan Y (1977) Space and place: the perspective of experience. University of Minnesota, Minneapolis

Whitehead TL (2005) Basic classical ethnographic research methods. CEHC Working Papers. Available at http://tony-whitehead.squarespace.com/tools-products. Accessed 17 Aug 2019

Zhang X, Sen T (2013) The Chinese in South Asia. In: Tan C (ed) Routledge handbook of the Chinese diaspora. Routledge, London and New York, pp 205–226

Zhuang ZC (2019) Ethnic entrepreneurship and placemaking in Toronto's ethnic retail neighbourhoods. Tijdschr Econ Soc Geogr 110(5):520–537

Shaping a City With(out) Canvassing Its Citizens. The Transformation of Parco Bassini in Milan: A Case Study

Valentina Capocefalo and Giuseppe Gambazza

Abstract This contribution focuses on the urban conflict generated from the functional recovery of the former Parco Bassini, a small green area located northeast of Milan, after the city's Polytechnic University radically changed its urban destination, in order to build the new University Chemistry Department in winter 2020. This sudden transformation provided a contrast between two fronts: on the one hand, there were the Institutions who had promoted it and, on the other, the citizens who were opposing it. The purpose of this research is to reconstruct the reasons why the initial impetus of the social movement in defence of the Parco Bassini has gradually faded. From a theoretical point of view, the study presented is based on the TPSN (Territory, Place, Scale, and Network) Framework, a multidimensional model developed also to investigate the different forms of contestation, resistance, mobilization, and bottom-up struggles. Thus, the concept of place has been favoured here as an epistemic principle from which to start the analysis: with its symbolic and relational features, it allows to identify the meaning and attachment to the spaces of everyday life. Additionally, to broaden the investigation perspective, inter and multi-scale relationships between the actors involved have been included to better understand their interactions and influence on the spatial processes. These different geographical lenses have also been adopted to examine the stages of the citizens' protest from its initial fervour to its weakening and its end. In particular, the lens of the place has been chosen to observe the origin of the conflict, while the lenses of the scale and the network have been selected to understand the agency of all the players involved. The analysis has been conducted referring to bibliographic, documentary, and cartographic sources and using qualitative methodologies such as archived work and in-depth interviews. The preliminary results all point to the Parco Bassini case as an example of how a conflict linked to a closed space may involve supra-local dynamics. This study case is also significant for young geographers because of the growing relevance of urban

V. Capocefalo (✉) · G. Gambazza
Department of Cultural and Environmental Heritage, University of Milan, Milan, Italy
e-mail: valentina.capocefalo@unimi.it

G. Gambazza
e-mail: giuseppe.gambazza@unimi.it

139

space and its transformation processes, which often involve junior researchers and activists.

Keywords Green areas · Urban conflict · Governance · Participation · Social movements · TPSN framework

Introduction[1]

In a historical moment characterized by staunch environmental concern, urban planning in Italy is measured by the need to rebalance the complex relationship between human habitation and the natural environment (Di Pirro et al. 2022). This places the design emphasis on the management and the protection of green spaces which are often at the heart of conflicts between citizens and public administrations (Wagner et al. 2019).

To this effect, the case of Milan is paradigmatic. It starts from the fact that the major parks are concentrated in the liminal portions of the consolidated city,[2] often crossing the municipal boundaries and extending into the neighbouring municipalities. Parco Nord Milano is one case in point, comprising of seven different municipalities. Another instance is the Grande Parco Forlanini which is part of an exemplar "green belt" (also including the Parco Lambro and the Parco Media Valle Lambro) where various inter-municipal safeguarding projects of the river Lambro ecosystem are administered: the participating municipalities are Milan, Segrate, Sesto San Giovanni, Brugherio, and Cologno Monzese.

Towards the south, Parco del Ticinello and Parco della Vettabbia are both located in the larger Parco Agricolo Sud Milano, whose surface covers a total of sixty municipalities of the Metropolitan City of Milan.[3] Only to the west can large green areas be found entirely within the perimeter of Milan municipality highlighted by the presence in this area of three adjacent parks: Parco delle Cave, Aldo Parco Aniasi, and BoscoinCittà (Fig. 1).

As noted above, the green belt areas in and around Milan often constitute a confluence which separates/unites different territories rather than representing an area included in a well-defined political-administrative region. It is by virtue of this conformation that their protection is increasingly promoted by means of the introduction of planning and management tools. These tools are unconventional with regards to the urban planning logics currently in force which give the municipal authority greater decision-making powers on the issue (Filpa and Talia 2021).

---

[1] This paper takes up and expands on a text presented in September 2021 at the *XXXIII Congresso Geografico Italiano.*

[2] Smaller parks are located closer to the centre of the city with the exceptions of the Parco Sempione and the Giardini di Porta Venezia.

[3] The Metropolitan City of Milan is a political entity which replaced the Province of Milan in April 2014.
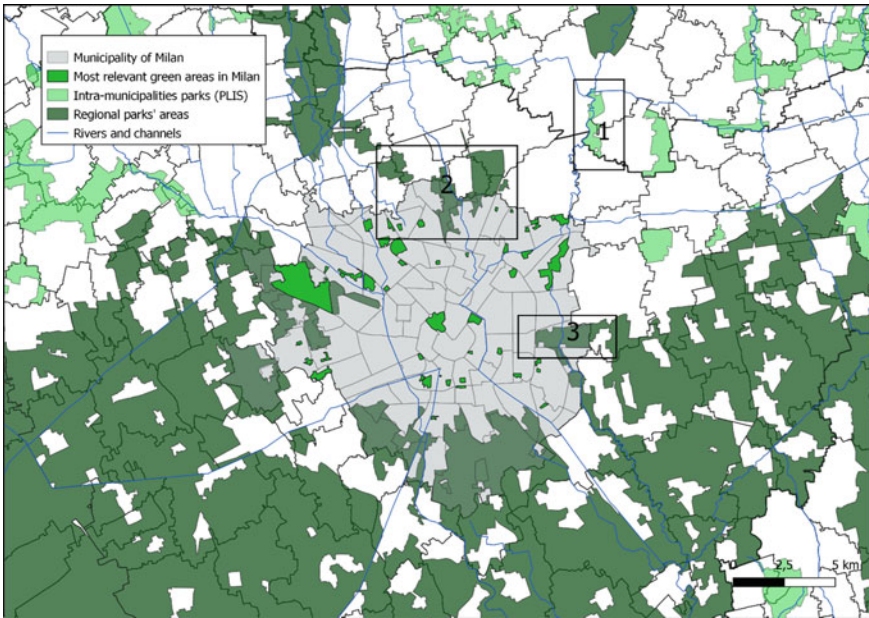
Fig. 1 Green urban areas in the Metropolitan City of Milan. The map shows the position of the Parco Media Valle Lambro (1), the Parco Nord Milano (2), and the Grande Parco Forlanini (3). *Source* Capocefalo and Gambazza 2022

The resolution adopted in November 2013 by the Municipality of Milan is in line with this principle which, in addition to emphasizing the importance of green areas as a common good, establishes the fact that the activation of good practices relating to green spaces must depend on the creation of a multi-level governance which is able to involve active subjects on both a metropolitan and local scale.

The urban planning, therefore, becomes a matter of collective interest, whereby various public, semi-public, or private stakeholders involved in various capacities in territorial policies[4] are called upon to take charge of it. Therefore, both the Metropolitan City of Milan and the various sub-local administrations (the so-called *Municipi*[5]) must be called into question. Their growing relevance is demonstrated by the approval in May 2019 of the regulation governing the use of Urban Heritage Areas (Feinberg et al. 2021). Finally, civil society is also called upon to take on a central role in green planning practices, especially those concerning the supervision of existing areas.

---

[4] In this regard, see the *Regolamento d'uso e tutela del verde pubblico e privato* (Regulations for the protection and use of public and private green areas), adopted by the City Council in December 2017.

[5] The city of Milan is divided into nine sub-local entities which are arranged in a radial pattern around the historic centre named *Municipio 1*, analogous to many other European cities.

The principles presented within the legislative means are only partially reflected in daily practice. If, on the one hand, the sub-local entities are only minimally autonomous,[6] on the other, the direct action by the Metropolitan City of Milan appears weak from the start due to significant structural elements (Onida 2015). Often, not even citizens benefit from adequate administration venues to participate in urban green planning policies; reasons for which can push civil society to seek alternative dialogues and new forms of expression which can lead to the birth of antagonistic movements.

This controversial scenario would therefore seem to confirm the pre-eminence of the municipal authority in the definition of urban planning strategies related to green areas—unless its role was often supported or overlapped by that of other administrative actors such as the Region and the State. In this sense, the example represented by the *Rubattino Urban Redevelopment Program*, a residential area located not far from the one that used to host Parco Bassini is one of importance. Over the years, it has seen the joint action of the Municipality of Milan, the Lombardy Region, the Ministry of Public Works, and the Ministry of Infrastructure and Transport.

In the territorial and regulatory framework described above is the re-functionalization of the former Parco Bassini. It was completed in the winter of 2019–2020 at the behest of several administrations active at various levels. Consequently, a dynamic citizen protest arose to oppose this project. It was led by a social movement of a heterogeneous nature, whose impetus—initially involved a growing number of people—gradually faded away until the final dissolution.

This research will try to investigate the reasons behind the failure of the protest that arose in defence of the former Parco Bassini while adopting a multidimensional perspective based on the theoretical concepts of the TPSN (Territory, Place, Scale, and Network) Framework. Through the use of privileged geographical lenses, such as those of place, scale, and networks, we will try first of all to identify the characteristics of the park which made it the subject of the dispute. The use of a multi-scale viewpoints will also make it possible to understand the agency of the various actors and to observe their ability to move between international environmental awareness and local activation, between central power and local administrations.

To conclude, we will reflect on the lack of incitement on a widespread network of activists critical to intensifying the message and helping to legitimize motivation which in turn could have made the opposing movement prevail.

A Park for the City: Elements for a Scenario

Parco Bassini was located in the north-eastern area of the consolidated city, which boundary is designated by the river Lambro and by the land comprised in the Grande Parco Forlanini project. From an administrative point of view, it is part of *Città Studi*, a district belonging to *Municipio 3,* originally coinciding with the perimeter

---

[6] The sub-local entities are responsible for the scheduled upkeep of public green areas.

outlined by the buildings of the Polytechnic and the five scientific faculties of the University of Milan. Over time, the above-mentioned district would progressively expand until it assumed its present semblance. It is a densely inhabited and highly urbanized area in which university institutions are bordered by other important public and private entities, such as the *Istituto Nazionale per lo Studio e la Cura dei Tumori* (National Institute for the Study and Treatment of Tumours) and the *Istituto Nazionale Neurologico Carlo Besta* (Carlo Besta National Neurological Institute).

The historical vocation to education to which the district owes its name is still intact and clearly recognizable despite the transformations; confirmed by the presence of numerous primary and secondary schools, but even more so in the role assumed by the historic universities in taking control of their urban destinies. Particularly influential in this regard is the Leonardo Campus. It is mainly concentrated within a perfect quadrilateral, marked to the north by Via Bassini, to the east by Via Valvassori Peroni, to the south by Via Celoria, and to the west by Via Ponzio.

The campus was inaugurated in 1927 and is located in Piazza Leonardo da Vinci. It comprises of numerous buildings used mainly as halls of residence, for teaching (university classrooms, nursery school), research, catering (canteen), and secretariate.[7]

The space which extended for 6000 m^2 also included the area corresponding to the former Parco Bassini. It was a large tree-lined area which offered various leisure facilities and was also frequented by people with no affiliation to the University (Fig. 2).

From 2013, the area was part of a transformation project which involved the demolishing of such facilities to make way for the future construction of the Chemistry Department. A complex and discontinuous process of re-functionalization followed which was countered by lively dissent. Despite being privately owned, the former park was considered common good by its local citizens—thanks to some of its specific characteristics such as free access, the perceived landscape-environmental value, and the proprietor's public nature.

The method of realization and the purpose of the urban planning operation were the focal point of the protests. The university which claimed to be inspired by sustainability and urban participation[8] was blamed for turning its back on these values and lambasted for taking away an important communal area in a context already depleted of urban parks: the green area per capita in *Città Studi*, equal to 3.6 m^2 per inhabitant.[9] It is in fact well below the (already low) city average, corresponding to 17 m^2 per inhabitant[10] (Fig. 3).

---

[7] Cfr. https://www.polimi.it/fileadmin/user_upload/Trasparenza/amministrazione_trasparente/beni_immobili_patrimonio/2015_12_23_patrimonio_immobiliare.pdf (last access: 30/11/2021).

[8] *From a Città Studi sustainable campus to a sustainable Città Studi: universities for the renewal of the city*, Guidetti and Morello (2015).

[9] Urban green space in *Città Studi* extends a total of 130,506 m^2, benefiting a population of about 36,300 (http://allegati.comune.milano.it/territorio/PGT_NIL/NIL_22.pdf; last access: 2/12/2021).

[10] According to the data of the XXVIII Urban Ecosystem report (2020), Milan was placed 73rd in terms of Italian city with availability of urban green areas to its number of inhabitants (https://lab24.ilsole24ore.com/ecosistema-urbano/indexT.php; last access: 29/11/2021).

Fig. 2 Aerial view of the former Parco Bassini. *Source* Foti 2019
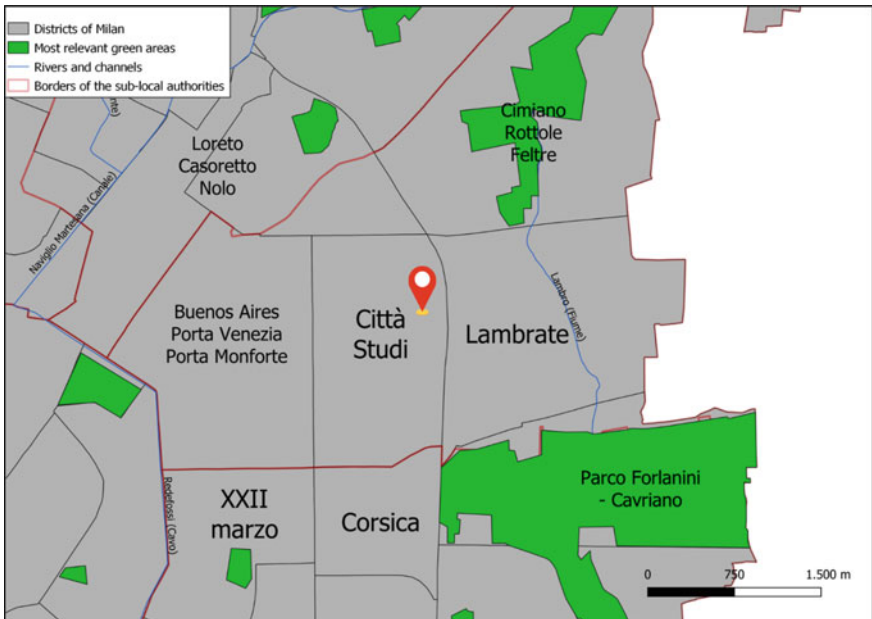
Fig. 3 Green urban areas in the North-eastern part of the Municipality of Milan. The placemark indicates the position of the former Parco Bassini. *Source* Capocefalo and Gambazza 2022

The Geography of Social Movements: Place, Network, and Scale

Since the 1970s, geographers and other social scientists, notably Marxist and radical ones, have shown interest in investigating the dynamics related to social movements (Harvey 1973; Castells 1983). Nevertheless, it is only in more recent times that this debate has placed greater attention to the category of spatiality, re-evaluating it and placing it at the centre of this field of study.

Assisting this spatial turn were some papers which appeared at the advent of the 2000s.[11] They recognized the importance of spatial categories as privileged instruments of investigation. They also contributed to outlining more clearly the specific contribution that geography can have on this issue (Ripoll 2008).

As Koopman explains:

"What geographers have brought to the understanding of the work of movements is a focus on space. Social movement studies had until recently tended to write about movements as if they happened 'on the head of a pin'. Geographers have asked: How do movements use space? How does space shape movements? How do movements shape space?" (Koopman 2015, p. 437).

The aforementioned turning point was therefore conclusive to reassess the value of some concepts such as space, place, scale, city, region, networks, and mobility and from that moment on considered more commonly as interrelated elements and not as alternative categories to each other. According to the recognised paper by Leitner et al. (2008), in order to be effective, the socio-geographical survey must abandon the use of a "master-spatiality", replacing it with a methodology based on various "co-implicated" spatialities.

As described in the debate above, the relational nature of space is also evident in the analysis of the activities promoted by social movements. According to Miller (2000, 2013), the relationships between the different spatialities, constitutive of various types of sociality, would be indispensable elements for the creation (and study) of the values, practices, and imaginaries that are at the basis of social movements:

"Why is it that spatialities matter at all? Space matters because it is relational. It is the medium through which all social relations are made or broken – and making and breaking relationships is at the core of all questions of collective action. This very simple idea belies a tremendous complexity, as different spatialities vary in their implications for making and breaking relationships. The construction of relationships has enormous implications for social and political power, so it should come as no surprise that the construction of spatialities is born of struggle, and social and political struggle is bound up in the construction of spatialities" (Miller 2013, p. 286).

There are several contrasting approaches within this new discipline of study which are based on a conception of relational space and have developed advantageous multidimensional models to investigate the different forms of contestation, resistance, mobilization, and bottom-up struggles. The TPSN framework is one in particular

---

[11] Worth remembering *Geography and social movements* (Miller 2000).

which stands out.[12] It places a "polymorph(ic) … socio-spatial relation" (Jessop et al. 2008: 392) at the centre of reflection on the dynamics of social movements which is a consequence from the interdependence of at least three of the following spatial categories: territory (T), place (P), scale (S), and (N) network.

Following Leitner's et al. (2008) outline, this scheme does not privilege any single spatiality. Instead, it encourages investigations based on the interconnections between the different spatial dimensions of social relations. According to the proponents of the TPSN framework, focusing on a single dimension can, in fact, be justified as the initial step of a complex investigation. To accomplish this, it is necessary to combine the different dimensions of socio-spatial analysis with the characteristics of the researched object in question.

The theoretical framework of this research was structured starting from the approach described above by virtue of its particular focus on the interrelation between the different socio-spatial dimensions.

Notably, we hypothesize the concepts of place, scale, and network[13] which may prove to be useful tools to study the dynamics which characterized the fateful protest triggered by social movements in defence of the former Parco Bassini.

The concept of place was chosen as the epistemic principle from which to proceed with the research. Intended as an arena for negotiation, contention and/or contestation, it represents an area in which divergent visions, ideals, and planning are confronted and capable of generating "an itinerary of significant public issue mixed with intense private feelings" (Turco 2014, p. 159). Analyzing its values therefore acquires heuristic significance since it allows us to rediscover a community's sense of belonging which if threatened can trigger forms of social tension (Magnaghi 2020).

This concept is able to explain the reasons why movements are induced in a specific location in addition to providing information on their specific characteristics: since movements often arise as a result of conflicts between state and economic power and the daily life of people. They configure places as "terrains of resistance" to be understood both in a material sense (through the construction of barricades) and metaphorically (Routledge 1994, 2007, cited in Koopman 2015).[14]

Once the origins of the dispute have been investigated, our attention then focuses on the characteristics of the opposing sides involved in the conflict—on their internal organization, their policies, and their room for manoeuvre.

The progressive broadening of the investigation perspective is made possible through the use of the concept of scale. The aim will be to reveal the hierarchical relationships underlying the nascent spatial processes resulting from a debate between

---

[12] In addition to the TPSN framework, the Assemblage approach deserves a mention referring to McFarlane (2009) and Davies (2012).

[13] We chose to exclude the concept of territory in its political declination as the domain of a single political-administrative body. We believe it would be restrictive in the analysis of the chosen case study.

[14] In the study of social movements and the relevance of place see also the contributions of Dechézelles and Olive (2019) and Della Porta et al. (2013).

active entities on an international, national, regional, and local level[15] (Nicholls 2007, 2009). The use of the scalar dimension allows us to identify which institutional and state powers affect the transformation and allocation of resources in certain locations. It additionally makes it possible to recognize the formation of local identities/communities created in opposition to regional or national practices/values.

In the case study presented here, the scalar relationships are significant between the ranks of both opposing sides. On one side, we have the associations *Resilient Gap*,[16] *Fridays for Future Italia* (Milan section), and *Extinction Rebellion.* Their activities aim at locally declining an environmental awareness elaborated at other scales. On the other side, there are the proposals for advanced territory transformation by the institutions which are defined as a composite negotiating framework involving national and local authorities (Della Porta 2009). The analysis of the governance strategies activated by the Institutions will also allow us to understand how they were able to impede the most radical agents of the dispute thereby limiting its reach and weakening its impact.

To investigate the outcomes of social conflict, the concept of network will also be utilized. The fate of a conflict many a time favours those who manage to share a wide-ranging idea which could be embraced in other contexts and therefore reterritorialized (Featherstone 2012). By means of network dimension, it is possible to investigate the topological and "horizontal" connections capable of mobilizing people, resources, skills, etc. Such relationships can therefore create favourable conditions for the construction of mostly weak ties, through which common identities can be created.

In order for a protest to be able to deplete consensus and increase its bargaining power in relation to the mainstream forces, it is thus imperative that an increasing number of people share its requests: this happens whenever the activities and narratives proposed by activists manage to reach and involve distant recipients (Maggioli and Tabusi 2016). Meritorious in this regard is the so-called *Occupy Phenomenon*, conceived on the 17 September 2011 with the demonstrations in Zuccotti Park in New York, which thanks to a message of global importance then spread to numerous city squares all over the world (Tabusi 2013).

In this case study, we will examine the ways the opposing side tried to increase discord to a wider audience by electing the Park as a symbol of shared values.

---

[15] According to Neil Smith (1992), the impact force of movements is highly strengthened when they "jump scale".

[16] The most active group in the protest which is a reflection of glocal civic identity (Messina 2020). Its members, *aim to combine the global scale of the climate issue […] with local activism* (https://resilientgap.org/chi-siamo; last accessed: 13/04/2022).

Research Methods

As noted in the Introduction, the main aim of this research is to investigate the reasons behind the failure of the protest that arose in defence of the former Parco Bassini. To achieve this purpose, it has tried to give concrete answers to the following questions:

- What factors contributed to the formation of the urban conflict?
- What were the main phases of the conflict and what were the strategies implemented by the opposing sides involved?
- What factors have contributed to the lack of effectiveness in the practices adopted by the activists involved in the conflict?

In order to investigate and understand the elements which made the former Parco Bassini the scene of a conflict that involved citizens, civil society, public and private actors, it required the analysis of the available literature and numerous inquiries carried out.

The aim was, therefore, to outline the opposing standpoints from which the conflict originated through informal interviews and the examination of documentary sources.

On one side, we identified the profile of a compact multi-level institutional front in which the presence of Milan Polytechnic—the owner of the area—and the action of supra-local institutions stand out. On the other side, a variegated and composite oppositional movement emerged, uniting members of "global" environmental movements and exponents of recently formed groups made up of students, professors, and technical-administrative staff of the university.

The administration of fifteen semi-structured interviews (see Annex), "organized around ordered but flexible questioning" (Dunn 2021, p. 158), finally, it made it possible to perform an examination of the various phases of the conflict. The answers of the respondents, analyzed through Content analysis, will also enable to reflect on possible future developments in the area.

In this last research phase, the following key informants were involved, all contacted thanks to snowball sampling[17]:

  (i)   four students/members of student associations;
 (ii)   two professors;
(iii)   a member of the administrative staff;
(iv)   four residents;
 (v)   two municipal administrators;
(vi)   an external expert.

[17] Despite repeated attempts, it was not possible to contact some members of the administrations such as the Councillors for Urban Planning, Green Areas and Agriculture of the Municipality of Milan and the President of the Territory Commission, Environment, and Institutional Affairs of *Municipio* 3.

Conflict Analysis: Spaces, Actors, and Policies

The sources of evidence and semi-structured interviews identify how the dynamics of the conflict arose primarily from divergent visions on the area in question: it is in fact the socio-spatial category of place, in its symbolic and relational aspects, which is key to understanding the origins of the conflict.

For the Institutions, the area was not identifiable as a real park, but as a green area with no particular affective significance. From this point of view, Parco Bassini represented a fungible asset, the suppression of which would have been quantifiable in ecosystemic terms: thus, the idea was born—currently under definition—to counterbalance the ecosystemic loss with the replanting of the removed trees (and planting of new) in other areas of the city.[18]

In addition to complaining about the absence of a detailed report regarding the environmental consequences related to the operation, the oppositional movement also blamed the compensatory strategy for neglecting the park's high emotional value to the community which frequented it. This value is reflected in the interviews with some key informants for whom the park represented a space for aggregation and conviviality and the setting for significant personal memories. On the contrary for the institutional actors involved, this site would instead have no specific identity characterization: some even contested the use of the term "park", believing it improper to describe the space in question.

Hence the emergence of a conflict that was characterized by a long *latent phase* and a very short *visible phase* which was immediately followed by the transformative work (De Marchi and Ruffato 2019).

Milan Polytechnic (protagonist of the first phase inaugurated in 2013) was able to devise a plan for the transformation of the area and to involve some supra-local authorities to obtain authorization. The agreement between multi-level entities was consummated by the signing of the so-called *Intesa Stato-Regione* (State-Region Agreement),[19] with which the responsibility for examining building procedures and permits was transferred to the *Provveditorato Interregionale delle Opere Pubbliche* (Interregional Superintendence of Public Works).

By virtue of importance of the work to be carried out, a passage of scale thus materialized which stripped away the powers normally attributed to the municipal body and entrusting them instead to a state body. This step which led to the streamlining of the transformation procedure allowed the management of the entire project to be based on a top-down decision-making logic (DAD: Decide-Announce-Defend).

---

[18] The compensation emerged both within a session of the Academic Senate on 18 November 2019 and within the session of the municipal Commission advising n. 8 (6 December 2019), appointed to supervise the choices relating to environmental policies. The compensatory dynamics are envisaged and described in the green areas regulation of Milan Municipality. They contain specific indications regarding the requests for authorization, building permits, and the drafting of technical reports by expert agronomists.

[19] The agreement was approved on 4 September 2019 by the Department of Infrastructure and Transportation.

The result being that citizens had little involvement in project matters (Faggi and Turco 2001; Komendantova and Battaglini 2016).

Shortly after the signing of the Agreement, the *visible phase* of the conflict began in the autumn of 2019 and lasted for a few months, during which the fate of the former Parco Bassini was defined. We observed the development of an oppositional movement which composed of people in various capacities who gravitated around the Polytechnic. Their actions evolved mainly through motions and official press releases[20] at locations used for university politics.

In the subsequent weeks, the conflict moved away from university classrooms and began to engage some residents of *Città Studi*, who together with groups of professors, members of the technical-administrative staff, students, and members of environmental associations, led to the creation of the movement *Salviamo Parco Bassini* (Save Parco Bassini). The intensification of the dispute needed little encouragement since the district had already been affected by a previous conflict connected to the relocation of the University of Milan's science buildings to the new MIND campus (*Milan Innovation District*). This conflict would lead to the creation of two distinct movements: *Salviamo Città Studi* (Save Città Studi) and *Che ne sarà di Città Studi?* (What will become of Città Studi?). Components of these then merged into the newly created movement *Salviamo Parco Bassini* which was created specifically to defend the park by taking action through online petitions, leaflets, and awareness-raising activities on the environmental consequences of the ongoing redevelopment.

From this moment, students strived to expand the network of demonstrators and shape the case of Parco Bassini within a broad narrative. By underlining the more global instances of the protest—related for example to the defence of the environment and public green areas—the members of *Resilient GAP*, *Friday for Future* and *Extinction Rebellion*s ought to bolster the pool of activists.

A significant moment within the *visible phase* of the conflict took place on 4 December 2019, when clearance workers attempted to cut down trees in the park. In retaliation, a permanent encampment was set up by professors, students, and residents which became a place where events were organized to raise awareness in the community[21] (Fig. 4).

The mobilization also had the effect of urging the municipal body to take an active part in the process assuming the role of moderator and organizer of locations and meetings between the opposing poles.[22] The Municipality of Milan introduced participatory policies into the dispute for the first time without offering its own

---

[20] One session was the Academic Senate of 18 November 2019, in which professors in favour of and against the realization of the project were heard. At the end of the meeting, the professors in favour were to prevail and prove decisive in sealing Parco Bassini's fate. Furthermore, in the same session, the Academic Senate decided to allocate a sum equal to 200,000 euros for the planting of new trees. This choice should have ensured the environmental sustainability of the entire operation.

[21] The awareness-raising activity culminated with the presentation of an open letter to the Mayor of Milan, the President of the Lombardy Region and the ministers responsible for the environment, cultural heritage, and education.

[22] This actually happened within the Commission advising n. 8. In addition to the city councillors, the Councillor for Urban Planning, Green and Agriculture of the Municipality of Milan, the President
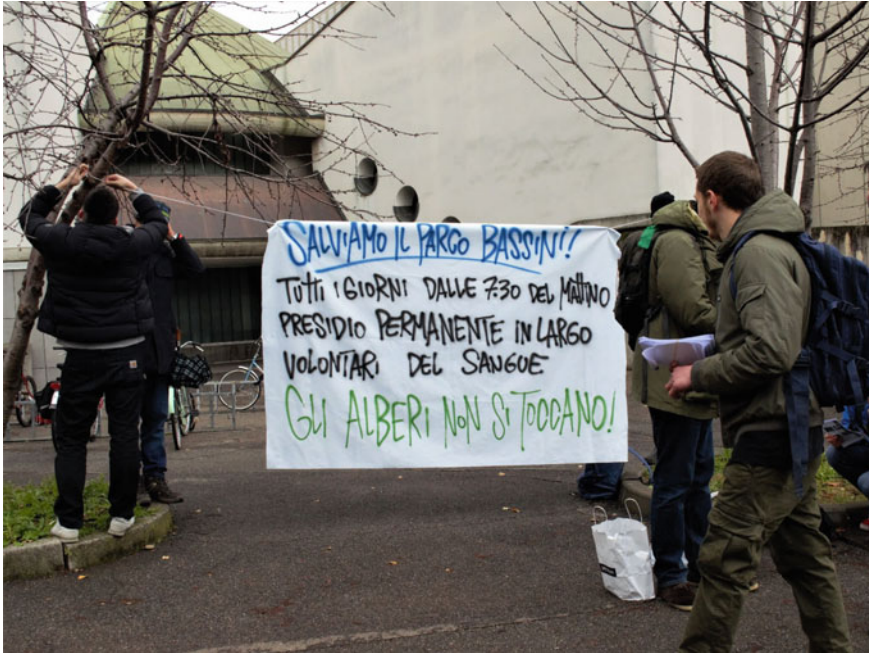
Fig. 4 *Salviamo Parco Bassini* activists organizing the encampment. The billboard reads: "Save Parco Bassini! Permanent encampment in Largo Volontari del Sangue every day from 7.30 in the morning. Save the trees!". *Source* Forconi 2019

planning vision for the park's future.[23] A brief phase of negotiation was to follow between the Institutions and the oppositional movement which was defunct during the Christmas holidays: on 2 January 2020 a group of workers began the operation of tree felling, protected by a cordon of police officers (Fig. 5). This indicated the end of the conflict: the spirit of the protest was extinguished that day and, although many activists considered the action of the authorities as an intolerable prevarication, they were not able to carry out further demonstrations of objection inside the area concerned.

The final substantial act of the conflict which was organized after the felling of the trees was a torchlight procession on 9 January 2020 (Fig. 6). It did not have the effect of reigniting the protests or expanding the number of activists, but instead was played out as more of a symbolic funeral.

of *Municipio 3*, the Dean of the Milan Polytechnic and some of the teachers and students involved in the protests took part in the session.

[23] The role of *Municipio 3* appears controversial, which on the one hand complains of not having been adequately involved in the decision-making process (session of the Commission on 6 December 2019) while on the other it appears to have taken part in the University conference of November 14th 2019 expressing favour of the redevelopment work (153rd minute of 21 November 2019 of the City Council).

Fig. 5 The park during the demolishing (aerial view). *Source* Foti 2020

Fig. 6 Torchlight procession on 9 January 2020. The billboard reads: "Stop soil sealing! At the Parco Bassini and throughout Milan". *Source* Forconi 2020

Following the falling of the trees decreeing the end of Parco Bassini, the protest moved from a sub-local scale to a municipal one. Within this limited timeframe, which ended with the administrative elections of October 2021, a *Rete dei comitati* (Network of committees)[24] was established and developed which helped to create an

---

[24] Other significant situations converged within the network such as the movement against the re-functionalization of *Parco della Goccia* in the Bovisa district and the park located in Piazza d'Armiwithin the Baggio district.

electoral list, which included insurgent activists, in defence of green (and non-green) areas threatened by unwanted choices of re-functionalization in the Milan area. In contrast to what was achieved for the proposing side, the opposing side did not gain any tangible benefit—not even from an electoral point of view.

Discussion and Conclusions

The case study focused on the conflict that arose following the re-functionalization of the former Parco Bassini, the causes, developments, and main outcomes of which were investigated. The geographical analysis, aimed at researching the causes of the protest's failure, attempted to answer specific research questions.

The first one has focused on the factors that contributed to the formation of the conflict. By referring to the spatial category of place, it has been shown how the clash also arose from the diversity of interests and visions that the local actors expressed conducive to the same area: for professors and students it represented a site with a high landscape-environmental importance, rare and therefore precious in a highly urbanized territorial context; for the residents the park, a frequent destination of their daily routines, expressed above all a notable relational-symbolic value. Finally, the planners took a more rational and detached perspective towards a space considered as a fungible good.

A contrast was thus outlined between a heterogeneous group of demonstrators—mainly made up of students, professors, and civil society—and an institutional front which included the Polytechnic (owner of the land and client of the project) and other supra-local institutions such as state and regional authorities, which authorized the commencement of the project.

The second research question has addressed the dynamics of the conflict by analyzing the main strategies implemented by the opposing sides involved in it. The analysis of inter- and trans-scalar relationships identifies the alignment between state and regional convictions—often mistakenly considered to be actors in conflict (Salone 2018). This confirmation is even more evident if our case study is compared with other urban planning choices previously adopted in neighbouring areas of the city. Confirming the same state and regional actors working in synergy.

Here, the limitations of the intermediate governance scale (which coincides with the Metropolitan City of Milan) are clear to be seen.

Despite appearing several times within the analyzed documentary sources relating to green area planning, it was not authoritative in decreeing the fate of Parco Bassini. In fact, the Metropolitan City of Milan is not directly involved in the conflict and the ecological and environmental value of the park is rarely compared to that of the wider metropolitan context.

The transformation work, which was both extemporaneous and time limited, fueled widespread discontent among the oppositional movement: the rare moments of confrontation within the transformation process seemed more similar to hollow

rituals rather than to significant moments of enrichment for the project in question (Barbanente 2020).

The absence of a clear, adequate spatial and temporal framework where the involved parties could openly discuss the project, decreed the loss of a key element for participatory democracy, thus jeopardizing the realization of the very idea of social justice in the interior of the urban space (Lancione 2010). This led to the widespread suspicion among the demonstrators that the local authorities—often more inclined to regulate the urban ferment rather than favour its innovative drive (Rossi and Vanolo 2010)—made use of these participatory tools not for the purpose of including principles and alternative values within the transformation process, but rather to limit its more radical components, dampening its resonance and therefore weakening its force of impact. The absence of a sufficiently structured participatory process to be implemented within the conflictual dynamics generated by unwanted processes of re-functionalization of the urban area is linked to the shadow role of the Municipality of Milan. During the dispute, the Municipality of Milan always remained on the sidelines barring the organization of concertation tables which, for a brief spell, were open to all citizens: it should have played a leading role from which it partially eschewed. On the other hand, the choices of the sub-local body, the *Municipio* 3, are difficult to interpret. It, in fact, manifested discontent with the marginal role it played but, when asked, it agreed to the project, demonstrating a distancing from the opinion of civil society.

The analyzed case study, therefore, seems to confirm what scholars such as Alberto Magnaghi deem to be the crux of the problem within urban governance: the difficulty in entrusting the inhabitants with the power to concretely determine their own living environments (Magnaghi 2018). Social movements such as *Salviamo il Parco Bassini* attempt to respond to this urgency.

Finally, the third research question sought to understand what factors have contributed to the lack of effectiveness in the practices adopted by the activist. In this regard, the interviewees were asked to detail the contributing circumstances to such a sorrowful finale of the movement, to which they blamed the defeat on a plurality of intertwined elements: from the togetherness of the Institutions and the equivocal role played by the Municipality of Milan to the fragility of the oppositional movement partly due to an excessive pluralism present within it. The internal heterogeneity typical of social movements is often considered as an advantage to expand the number of demonstrators (Della Porta 2019). However, in this particular case, it is interpreted as an element of weakness. Student campaign actions may have had the effect of showing a flaw (albeit not self-evident) among the individuals of the committee. The strong appeal to the values of international environmentalism, to which professors and students strongly adhered, ended up marginalizing the residents' requests for whom the relevance of the Park had not only the landscape-environmental value, but also by those symbolic and relational aspects which are connected to those who inhabit it and frequent it—Frémont (1999) would say—the "daily representation" from a lead actor who is on stage every day (Dumont 2021). The tacit differences between the student and the resident elements regarding their ideas of the Park made

it more difficult to create a coherent narrative which was capable of creating a bond of supra-local belonging that could have perhaps changed the outcome of the protests.

Internal fraying among members of the activist group, therefore, weakened their vocal vigour and their protesting position. In particular, it seemed that a fundamental inconsistency about the authentic value of Parco Bassini favoured the narration of the Institutions, ever-ready to shift the discussion solely to an economic-environmental level and introducing the issue of environmental compensations. Also, for these reasons, the committee which was set up to preserve the green area couldn't expand its sphere of influence or rally larger numbers of local citizens to converge around a common goal.

The case of the former Parco Bassini highlighted how a spatially circumscribed conflict was able to call into question visions, forces, and subjects of a multidimensional nature. It appears that the outcomes of the conflict are the consequence of a series of concomitant factors. More generally, the case study seems to confirm the validity of the TNSM framework for the study of conflicts generated by unwanted urban transformations and to comprehend the social movements involved in them. Each of the geographical lenses considered here has allowed us to explore specific aspects that have jointly contributed to defining its dynamics.

This study has also allowed us to reflect on public green space conservation in the city of Milan, framing the issue within a broader political-administrative framework in which various subjects operate.

The knowledge attained from the Parco Bassini case can therefore open up new horizons of research aimed, on the one hand, at understanding the relationship which is no longer dichotomous between the public and private sectors in the production of urban space and, on the other, at examining the complex dynamics internal to social movements. The components of these movements are frequently characterized by disharmonious rapports and weakened by strategies which, initially, seem to welcome their divergent visions but are unable to unify them when a final decision needs to be made.

Appendix

Semi-structured Interviews: Grid of Questions

1. What did the former Parco Bassini mean to you?
2. Before the transformation work started, were you used to frequent the park? How often? With whom? Doing what?
3. How do you evaluate the transformation work that has taken place in the former Parco Bassini? At the end of the process, this place will be improved or worsened compared to the past. Why?
4. Which actors were more involved in the process of transforming the area?
5. What was the composition of the oppositional movement?

6. Do you think that the citizens of Milan have been adequately informed and involved in the process?
7. How do you assess the compensatory strategy which has been proposed by the Institutions?
8. Do you think the protest was justified since the former Parco Bassini was located on a private area?
9. How do you assess the actions of the public authorities during the protest?
10. Do you think that the inhabitants of Città Studi are participatory/receptive with respect to the territorial transformations of the area?

(The following questions were only asked to the oppositional movement members)

11. What prompted you to join the protest?
12. In your opinion, what were the key moments of the protest?
13. Are you part of an association/committee/informal group involved in the defence of the former Parco Bassini? Which one? For how long? What role do you play in the organization?
14. If you are not part of an association, what initiatives were taken by your association? In which ones have you participated?
15. What steps have been taken to strengthen the opposing front?
16. What were the reasons behind the failure of the protest?
17. What strategies could be taken to re-boost the contestation?

References

Barbanente A (2020) Democrazia in azione e governo del territorio: divergenze e connessioni possibili. Scienze del Territorio 8:12–19. https://doi.org/10.13128/sdt-11926

Castells M (1983) The city and the grassroots: a cross-cultural theory of urban social movements. Arnold, London

Davies AD (2012) Assemblage and social movements: Tibet support groups and the spatialities of political organisation. Trans Inst Br Geogr 37:273–286. https://www.jstor.org/stable/41427946

De Marchi M, Ruffato M (2019) Abitare i conflitti socio-ambientali. In: Salvatori F (ed) L'apporto delle geografie tra rivoluzioni e riforme. Atti del XXXII Congresso Geografico Italiano, Rome, pp 1117–1124

Dechézelles S, Olive M (eds) (2019) Politisation du proche. Les lieux familiers comme espaces de mobilisation. Presses Universitaires de Rennes, Rennes

Della Porta D (2009) Social movements and multilevel governance: the external dimension of democracy. In Della Porta D (ed) Democracy in social movements. Palgrave Macmillan, London, pp 100–126

Della Porta D (2019) Movimenti sociali e partecipazione democratica. Feltrinelli, Milano

Della Porta D, Fabbri M, Piazza G (2013) Putting protest in place: contested and liberated spaces in three campaigns. In: Nicholls W, Miller B, Beaumont J (eds) Spaces of contention: spatialities and social movements. Ashgate, Farnham, pp 27–46

Di Pirro E, Sallustio L, Sgrigna G, Marchetti M, Lasserre B (2022) Strengthening the implementation of national policy agenda in urban areas to face multiple environmental stressors: Italy as a case study. Environ Sci Policy 129:1–11. https://doi.org/10.1016/j.envsci.2021.12.010

Dumont I (2021) Dopo quasi mezzo secolo, riflessioni sulla regione "spazio vissuto." Geogr Notebooks 4:221–224. https://doi.org/10.7358/gn-2021-002-dum2

Dunn K (2021) Engaging interviews. In: Hay I, Cope M (eds) Qualitative research methods in human geography, 5th edn. Oxford University Press, Don Mills, pp 148–185

Faggi P, Turco A (2001) Conflitti ambientali. Genesi, sviluppo, gestione. Unicopli, Milan

Featherstone D (2012) Solidarity: hidden histories and geographies of internationalism. Zed Books, London

Feinberg A, Ghorbani A, Herder P (2021) Diversity and challenges of the urban commons: a comprehensive review. Int J Commons 15:1–20. https://doi.org/10.5334/ijc.1033

Filpa T, Talia M (2021) Fondamenti di governo del territorio: dal piano di tradizione alle nuove pratiche urbanistiche. Carocci, Rome

Fremont A (1999) La région espace vécu. Flammarion, Paris

Guidetti R, Morello E (2015) Da Città studi campus sostenibile a Città studi sostenibile: le università per il rinnovamento della città. Scienze del Territorio 3:131–139. https://doi.org/10.13128/Scienze_Territorio-16259

Harvey D (1973) Social justice and the city. Arnold, London

Jessop B, Brenner N, Jones M (2008) Theorizing sociospatial relations. Environ Plan d: Soc Space 26:389–401. https://doi.org/10.1068/d9107

Komendantova N, Battaglini A (2016) Beyond Decide-Announce-Defend (DAD) and Not-in-My-Backyard (NIMBY) models? Addressing the social and public acceptance of electric transmission lines in Germany. Energy Res Soc Sci 22:224–231. https://doi.org/10.1016/j.erss.2016.10.001

Koopman S (2015) Social movements. In Agnew J, Mamadouh V, Secor AJ, Sharp J (eds) The Wiley Blackwell companion to political geography. Wiley, Chichester, pp 339–351

Lancione M (2010) Giustizia sociale, spazio e città. Un approccio teorico metodologico applicato a un caso di studio. Rivista Geografica Italiana 117:625–652. https://www.repository.cam.ac.uk/handle/1810/253457

Leitner H, Sheppard E, Sziarto K (2008) The spatialities of contentious politics. Trans Inst Br Geogr 33:157–172. https://www.jstor.org/stable/30133354

Maggioli M, Tabusi M (2016) Energie sociali e lotta per i luoghi. Il "lago naturale" nella zona dell'ex CISA/SNIA Viscosa a Roma. Rivista Geografica Italiana 125:365–382

Magnaghi A (2018) La bioregione urbana nell'approccio territorialista. Contesti. Città territori progetti 3:26–51. https://doi.org/10.13128/contest-10629

Magnaghi A (2020) Le condizioni di crescita della democrazia dei luoghi. Scienze del Territorio 8:29–37. https://doi.org/10.13128/sdt-12372

McFarlane C (2009) Translocal assemblages: space, power and social movements. Geoforum 40:561–567. https://doi.org/10.1016/j.geoforum.2009.05.003

Messina S (2020) Da parco urbano ad "agorà" pubblica: un progetto multifunzionale per un'identità civica glocale. Scienze del Territorio 8:145–153. https://doi.org/10.13128/sdt-11811

Miller BA (2000) Geography and social movements: comparing antinuclear activism in the Boston area. University of Minnesota Press, Minneapolis

Miller BA (2013) Spatialities of mobilization: building and breaking relationships. In: Nicholls W, Miller BA, Beaumont J (eds) Spaces of contention: spatialities and social movements. Ashgate, Farnham, pp 285–298

Nicholls W (2007) The geographies of social movements. Geogr Compass 3:607–622. https://doi.org/10.1111/j.1749-8198.2007.00014.x

Nicholls W (2009) Place, networks, space: theorising the geographies of social movements. Trans Inst Br Geogr 34:78–93. https://doi.org/10.1111/j.1475-5661.2009.00331.x

Onida V (2015) La Città metropolitana fra logiche istituzionali e "peso" della storia. In: Lodigiani R (ed) Milano 2015. La Città metropolitana: sfide, contraddizioni, attese. Franco Angeli, Milan

Ripoll F (2008) Espaces et stratégies de résistance : répertoires d'action collective dans la France contemporaine. Espaces Et Sociétés 134:83–97. https://doi.org/10.3917/esp.134.0083

Rossi U, Vanolo A (2010) Geografia politica urbana. Laterza, Bari-Rome

Routledge P (1994) Backstreets, barricades, and blackouts: urban terrains of resistance in Nepal. Environ Plan D: Soc Space 12:559–578. https://doi.org/10.1068/d120559

Routledge P (2007) Transnational political movements. In: Cox KR, Low M, Robinson J (eds) SAGE handbook of political geography. London, Sage, London, pp 335–349

Salone C (2018) La dimensione regionale nel prisma della statualità post-nazionale e delle regioni urbane globali: le innovazioni in atto e il ritardo della ricerca. Contesti. Città territori progetti 3:90–107. https://doi.org/10.13128/contest-10633

Smith N (1992) Contours of a spatialized politics: homeless vehicles and the production of geographical scale. Social Text 33:55–81. https://doi.org/10.2307/466434

Tabusi M (2013) Lo spazio è (o può divenire) un' «arma» sociale? Riflessioni sul movimento Occupy. ESO_Tavaux et documents 35:73–82

Turco A (2014) Il luogo, bene comune. In: Turco A (ed) Paesaggio, Luogo, Ambiente. La configuratività territoriale come bene commune. Unicopli, Milano, pp 149–186

Wagner A, Mager C, Schmidt N, Kiese N, Growe A (2019) Conflicts about urban green spaces in metropolitan areas under conditions of climate change. A multidisciplinary analysis of stakeholders' perceptions of planning processes. Urban Sci 15:Article e3010015. https://doi.org/10.3390/urbansci3010015

A Geographical Approach to European Cargo Airports

Carlos López-Escolano

Abstract The economic growth of emerging countries, international relocation of production, new consumption habits and the growing supply of transport have reorganised the global freight transport systems. Air cargo transport plays a fundamental role in the organisation of global freight transport due to the specialisation required and the high value of the goods. A few large-scale airports handle most of the air cargo traffic worldwide, similarly to passenger transport. A network of secondary airports in terms of passengers but highly specialised in air cargo serves as a connection between local and global scales. Most of these airports do not offer long-haul passenger flights that also carry cargo, but specialised air carriers do operate in them as they have certain geographical advantages. However, the emerging concerns about climate change and the economic impact of the COVID-19 pandemic are undoubtedly driving the debates, policies and plans about air transport. This chapter focuses on studying the largest European airports specialised in cargo traffic by means of a comprehensive geographical analysis. Specifically, the case studies analysed are Leipzig/Halle, Liège, Luxembourg and Zaragoza. This analysis helps to better understand the air cargo transport networks at all scales.

Keywords Transport geography · Air cargo · Intermediate airports · European airports

Introduction: Air Cargo and Geography

Nowadays, the flexibilisation of economic activities involves a growing segmentation of production and distribution processes in several geographic locations, while globalisation has led to the extension to a global scale of the geographic framework for economic relations (López Trigal et al. 2015). In this respect, both processes have resulted in specialised regional configurations: purely productive areas (e.g.

C. López-Escolano (✉)

Department of Geography and Territorial Planning, University of Zaragoza, Institute for Research in Environmental Sciences of Aragon, Zaragoza, Spain
e-mail: cle@unizar.es

East Asia), transit or intermediary areas (e.g. Persian Gulf countries) and primarily consumer areas (e.g. Europe, North America). This spatial classification also differentiates between national, regional and local scales. In practice, this implies the need to increase the mobility of people and goods, one of the most evident and characteristic dynamics of today's world. In fact, this is a topic of growing interest in social science studies regarding what Sheller and Urry (2006) define as a "mobility turn". In this context, the current development of freight transport systems is, at all scales, part of the economic globalisation process, which is changing the organisational structure of the global economy through the intensification, integration and interdependency of the economic activity between countries (Coe and Yeung 2015).

On a global scale, most goods—more than two-thirds of the total volume—are transported by seagoing vessels (Dubucs 2021), while land transport (road and rail) is mainly used for distributing goods on a national or, at the most, continental scale (e.g. New Eurasian Land Bridge). The transport of goods by air is insignificant in relation to the total movement of goods, despite its strategic role in international trade (Yamaguchi 2008). Its reliability and speed, however, make it essential for many economic sectors (Kasarda and Green 2005; Chang and Chang 2009). As air transport is more expensive than other modes of transport, it is generally reserved for products that require quick distribution (fruit, flowers, live animals, fashion), or urgent (spare parts, print media, mail) or have high economic value (pharmaceuticals, electronics and technological material) (Morrell 2011; Sales 2017; Lotti and Caetano 2018; Dubucs 2021).

The transport of goods by air has a major economic impact, aggravated by the spatial processes of globalisation, which are showing great prospects for the development of the air cargo sector (Kasarda and Green 2005; Chang and Chang 2009). In 2000, 118 billion tonnes of goods were shipped by air, rising to more than 221 billion in 2019 (World Bank 2022), which represents a growth rate of 87.3% until the outbreak of the COVID-19 pandemic. The interest in air cargo transport is also increasing due to the rapid growth in electronic commerce (Hylton and Ross 2018), the main business sector that airports will compete for in the coming years (Van Asch et al. 2019a).

Against this background, this study focuses on gaining greater knowledge of the geographical factors that explain how certain secondary European airports for passenger traffic are among the leading airports for cargo traffic. By analysing different case studies, the aim is to discover how this specialisation in air cargo is driven by different strategies and local and regional responses to the dynamics and needs of the global economy. The knowledge obtained is of particular interest for understanding the global logics of air cargo transport, but also due to its role in regional economic and territorial development and in providing better guidance for European land planning and transport infrastructure policies.

Specific Factors of Air Cargo Transport

Although the air transport of goods and passengers uses the same vehicles (airplanes) and infrastructure (airports), they differ in multiple factors (Bowen 2012). Van Asch et al. (2019b) have studied in depth the factors that make airports competitive for the transport of goods and have identified four components—cargo marketplace, product differentiation, airport operations and territory. Each of these components has, in turn, various factors; for instance, the territorial component, specifically, includes factors related to the geographical location of the airport, such as site, local origin–destination demand and capacity.

Air cargo requires several specific aspects associated with the airport facilities (País-Montes et al. 2017) that need to be managed to minimise problems such as delays and congestion (Wong and Wong 2002). The size of the airports makes it possible to take advantage of economies of scope by transporting both passengers and cargo; this means that the existence of passenger flows generates associated cargo flows (Chow and Fung 2009). The availability of space for storing goods and air containers is also a fundamental factor that contributes to consolidating the hubs (Wu 2010). For these reasons, cargo-carrying airlines develop strategies to maximise cargo capacity and use of runways (Cao and Kanafani 2000; Takebayashi 2011), so the planning of terminals, control of the structure of the land operators, the intersection with other flows of goods and the type of products transported are also key factors to consider (Rong and Grunow 2009). Legal certainty, customs' agility, land accessibility and connectivity, among others, are important determinants in controlling the final costs (Tovar et al. 2015). Lastly, location has a major impact, since the existence of various competitors contributes to increasing flows and improving efficiency (Chi-Lok and Zhang 2009). In this respect, central and intermediate locations are spatial qualities that improve the traffic levels of the transport hubs and determine which spaces are strategically located within the global or regional transport systems (Fleming and Hayuth 1994).

In this organisational context of air cargo, there is a mix of "integrated" and "non-integrated" airlines (Dobruszkes 2016). Integrated airlines are capable of integrating the entire freight transport process, from collecting the package from the customer to delivering it to the recipient, with no limit on location or distance, and contractually guaranteeing the delivery date (Dubucs 2021). To provide this service, they have their own dedicated fleet of cargo aircraft. The "big four" are a representative example of this type of company: *FedEx*, *UPS*, *DHL* and *TNT*. A specific characteristic of integrated airlines is that they operate night flights, once they have organised the shipments at the end of the day, so that the goods arrive at their destinations the following morning (Dobruszkes 2016). "Non-integrated" airlines provide air cargo transport services to other companies that need them, namely carriers offering airline-only scheduled services (Dobruszkes 2016). These can be subdivided into "mixed" and "all-cargo" airlines. "Mixed" companies include the big airlines that provide cargo transport in addition to their passenger transport business; they are usually traditional airlines, or "flag carriers", that use the holds of the planes, especially

those of their transcontinental networks, to transport goods. "All-cargo" companies are airlines that supply planes to other companies—such as the North American group *AAWW*—or independently establish a global network of regular connections between the main global industrial centres.

The growth in electronic commerce has led to the emergence of another type of air cargo company. Initially, the major e-commerce companies were important customers for *air cargo integrator*s but, as they handle higher volumes of goods they tend to exert greater control over the supply chain, including the air cargo segment. In this context, the e-commerce giant *Amazon* founded in 2016 *Amazon Air* (formerly *Prime Air*).

General Patterns of Cargo Airport Locations

As already described, the different strategies and types of airlines make up the global map of air cargo transport. These are reflected in transport flows that converge in hubs, that is, in airports chosen for their specific characteristics. Over many years, global supply chains have been adapting to an air transport model that, as is the case with passenger transport, is focused on a few main flows where a small number of airports function as the central hubs of the system, in pursuit of greater efficiency (Guimerà and Amaral 2004). Thus, the 20 airports that handled the highest volume of cargo in 2019 accounted for 42% of the total global air cargo (ACI, 2019), which demonstrates the extremely high concentration of the sector.

The global, spatial trend is that mixed non-integrated airlines and all-cargo airlines establish their hubs in the major gateway airports, while integrated airlines usually opt for smaller airports where they can enjoy lower costs and easier scheduling (Boquet 2009; Gardiner and Ison 2008). Some states strengthen their terminals and connections artificially with subsidies, as is the case with some airports in the Persian Gulf (Al-Mehairi 2019). This partly explains the significant development of air transport in some areas; however, the geographical position is also fundamental, since these airports are equidistant from the main European, Asian and African poles.

In summary, these characteristics impose a spatial distribution of airports that differs, in part, for cargo flows and for passenger flows. Based on this model of the spatial organisation of air cargo, there are two large groups of cargo airports (Mayer 2016; Dubucs 2021):

- Airports that serve as global hubs for passenger traffic and take advantage of economies of scale to also handle goods: Hong Kong, Shanghai, Dubai-International, Tokyo-Narita, Los Angeles-International, Doha, Singapore, Frankfurt, Paris-Charles de Gaulle, Miami, Beijing-Capital, Chicago-O'Hare, London-Heathrow or Amsterdam-Schiphol, among others.
- Intermediary airports that, given their strategic location in the goods distribution networks, specialise in the cargo traffic and are also the home base, or regional office, of the largest cargo airlines: Memphis, Anchorage, Louisville, Indianapolis,

Cincinnati, Incheon, Guangzhou, Kansai, Dubai-Al Maktoum, Leipzig-Halle, Luxembourg or Cologne-Bonn.

The case of the United States deserves special mention—a large country with a solid integration of economic dynamics and growing development of air cargo. The hubs of the major non-integrated airlines play a key role in operating cargo as they use their passenger flights to transport goods in the hold at the same time. Airports such as Atlanta (*Delta*) and Dallas-Fort Worth (*American Airlines*) benefit from this practice. However, the geographical factors are also fundamental to positioning other airports among the top cargo airports, even if they are of little relevance for passenger transport. Thus, a central location—equidistant from the economic and demographic poles—accessibility and connectivity to land transport networks, land availability for logistics activities, etc. are particularly relevant for this purpose. This airport type is characteristic of integrated companies such as *FedEx* (Memphis) and *UPS* (Louisville). The airport of Anchorage, in Alaska, serves as a layover and facilitates connections between North America and Asia while the *Amazon Air* hub is located in Cincinnati.

Air Cargo Transport in Times of Global Pandemic and Global Change

The transport sector in general and, in particular, the air transport sector faces multiple challenges in a highly complex and unstable international environment. Projections prior to the outbreak of the COVID-19 pandemic in early 2020 estimated that the total value of goods transported by air that year would exceed 7.1 billion dollars and that airlines would transport more than 52 million metric tonnes of goods, which accounts for only 1% of the volume of global trade but more than 35% of its value (IATA 2019). The final impact of the pandemic on goods traffic is still uncertain, though the initial impact, in March 2020, showed a fall of 19% worldwide in the volume of goods transported compared to the previous year. This was due to a sharp reduction in the cargo capacity of passenger flights (31% less cargo in this type of flight), although, at the same time, capacity on cargo flights increased by 9% (ICAO 2020) due to the immediate need to distribute medical supplies and the increase in electronic commerce. During this period, several airlines adapted passenger planes for the transport of goods as a strategy to avoid greater economic losses.

In Europe, all-cargo flights recorded 3–4 times their normal market share, as a result of using passenger aircraft for cargo. In the first wave of COVID-19 (April and May 2020), boosted by the need to ship medical equipment, flights in the all-cargo segment of the market decreased by "only" 6% (EUROCONTROL 2021). All-cargo is the only market segment that maintained flight counts above 2019 levels. More recently, the all-cargo segment reported a market share of 10–11%, which is more than triple the normal figure (EUROCONTROL 2021).

The analysis of the changes caused by the pandemic in terms of the traffic volume of the top cargo airports must distinguish between the "normal" pre-pandemic figures of 2019 and the figures of the first year with available post-pandemic data, 2021 (Table 1). The crisis has slightly altered the hierarchical relationship due to the constraints on international flights, which further strengthened solid domestic markets such as the United States. Air cargo volumes increased by 4.5% versus 2019, rising to a record figure of 125 million metric tonnes in 2021. Meanwhile, air cargo volumes in the top 20 airports in the world—representing around 44% (54.8 million metric tonnes) of global share volumes in 2021—increased by 13.4% with respect to 2019 (ACI 2022). No European airport ranked among the top ten although Frankfurt and Paris-Charles de Gaulle came close to the figures of the global top ten.

Table 1 Top cargo airports in the world, 2019 and 2021[a]

Airport	Country	Position 2019	Position 2021	Freight (millions of tonnes)		Increment 2019–2021 (%)
				2019	2021	
Hong Kong	China	1	1	4.81	5.02	4.37
Memphis	United States	2	2	4.32	4.48	3.70
Shanghai	China	3	3	3.63	3.98	9.64
Anchorage	United States	6	4	2.70	3.55	31.48
Seoul-Incheon	South Korea	5	5	2.76	3.33	20.65
Louisville	United States	4	6	2.79	3.05	9.32
Taipei	Taiwan	10	7	2.18	2.81	29.90
Los Angeles-International	United States	9	8	2.20	2.69	22.27
Tokyo-Narita	Japan	11	9	2.10	2.64	25.71
Doha-Hamad	Qatar	8	10	2.21	2.62	18.50
Chicago-O'Hare	United States	18	11	1.76	2.54	44.32
Miami	United States	13	12	2.09	2.52	20.57
Dubai-International	United Arab Emirates	7	13	2.51	2.32	− 7.57
Frankfurt am Main	Germany	14	14	2.09	2.27	8.61
Paris-Charles de Gaulle	France	12	15	2.10	2.06	− 1.90
Guangzhou	China	17	16	1.92	2.04	6.25
Singapore-Changi	Singapore	15	17	2.06	1.97	− 4.37
Amsterdam-Schiphol	The Netherlands	20	18	1.59	1.68	5.66
Leipzig/Halle	Germany	n.a	19	1.24	1.59	28.23
Shenzhen-Bao'an	China	n.a	20	n.a	1.57	n.a

Source Airports Council International (2022). Airports are ordered with data from 2021
[a] In 2019, Beijing-Capital ranked 16 and London-Heathrow 19

The sector faces another fundamental challenge, climate change, since the policies to combat it must result in maximum energy efficiency. The aviation sector as a whole account for 3.8% of the carbon emissions of the European Union (European Parliament 2022) although the actual data are likely triple the official figures (El Salto 2020). This shows the importance of moving towards a reduction in emissions and the transport of goods accounts for a growing part. This requires different political actions that will lead to an effective response to the climate challenge although this will have a significant impact on aviation (Stern 2006).

Looking at European Air Cargo Geographies

The aviation sector is one of the best-performing areas of the European economy as up to 2 million people in the EU work directly in it and airports have a central role in the connectivity provided by airlines to passengers and cargo customers within the EU. However, overcoming capacity and congestion problems by applying better air traffic management is critical to meet the increased demand for flights, including cargo (European Commission 2022). In this context, developing European Community regulations on air transport and infrastructure planning and construction are key factors in European policies. In 2014, the European Commission adopted new guidelines on state aid in the aviation sector that aimed to ensure that airports located in regions with specific air transport needs could be granted public funding. Through the Connecting Europe Facility, 26.25 billion euros are available from the EU's 2014–2020 budget to co-fund transport projects (European Commission 2022).

This socio-economic relevance is the basis for this research, although there is very little specific work to date regarding the geography of airports specialising in cargo in Europe. The work of Klaver et al. (2007), who developed the *Atlas of Cargo Airports in Europe*, is of particular interest, although the information it contains is outdated as time has passed and the sector has been restructured. Dobruszkes (2016) contributed a chapter entitled *Geographies of European Air Transport* characterising the general aspects of the European aviation sector. It shows how, in 2010, the top ten cargo airports catered for both airline models; therefore, the leading passenger airports also hold top positions in terms of goods traffic (Table 2), except for Leipzig/Halle, Liège, Luxembourg and Cologne/Bonn, which are among the top cargo airports but are not relevant for passengers traffic.

A simple geographical analysis shows how the majority of these airports are located in Western Europe and, specifically, in the Central European backbone or "Blue banana" (Fig. 1), which shows how air transport is used for carrying high-value goods and high-tech industries in mature markets (Dobruszkes 2016).

Currently, after the economic restructuring initiated in 2008 and as a consequence of the effects of the COVID-19 pandemic on aviation, the European map of air cargo shows evidence of a reconfiguration that is boosting airports specialising in cargo. The rate of increase in total cargo transport in 2021 compared to 2010 shows greater growth for this type of airport (e.g. + 140.12% in Leipzig/Halle, + 120.97% in Liège,

Table 2 Main cargo airports in Europe, 2010 and 2021

Airport	Country	Position 2010	Position 2021	Freight (millions of tonnes)		Increase 2010–2021 (%)	Integrated airlines hub	Non-integrated airlines
				2010	2021			
Frankfurt	Germany	2	1	2.28	2.32	+ 1.89	DHL, FedEx/TNT	Lufthansa (hub)
Paris (Charles de Gaulle + Orly)	France	1	2	2.40	2.14	− 10.67	FedEx, La Poste[a]	Air France (hub)
Amsterdam-Schiphol	The Netherlands	4	3	1.54	1.68	+ 9.30	FedEx, UPS	KLM (hub), AirBridge Cargo, Cathay Pacific
Leipzig/Halle	Germany	6	4	0.66	1.59	+ 140.12	DHL	Aerologic
London-Heathrow	United Kingdom	3	5	1.55	1.45	− 6.25	DHL, UPS	British Airways World Cargo (hub)
Liège	Belgium	8	6	0.64	1.41	+ 120.97	FedEx/TNT	Ethiopian Cargo
Luxembourg	Luxembourg	5	7	0.71	1.13	+ 59.57		Cargolux (hub)
Cologne/Bonn	Germany	7	8	0.66	0.99	+ 50.30	UPS, FedEx, DHL	Lufthansa
Milan-Malpensa	Italy	10	9	0.43	0.74	+ 71.36	DHL, FedEx	ITA Airways (hub), Cargolux Italia
Brussels	Belgium	9	10	0.48	0.67	+ 39.17		Brussels Airlines (hub)
Madrid-Barajas	Spain	12	11	0.37	0.52	+ 40.21		Iberia (hub), Air Europa (hub)
East Midlands	United Kingdom	n.a	12	0.07	0.45	+ 548.57		

(continued)

Table 2 (continued)

Airport	Country	Position 2010	Position 2021	Freight (millions of tonnes)		Increase 2010–2021 (%)	Integrated airlines hub	Non-integrated airlines
				2010	2021			
Zurich	Switzerland	11	13	2.28	2.32	– 4.15		Swiss (hub)
Copenhagen	Denmark	n.a	14	2.40	2.14	+ 91.33		
Vienna	Austria	13	15	1.54	1.68	– 13.00		Austrian Airlines (hub)
*Zaragoza	Spain	n.a	n.a	0.04	0.19	+ 357.17		AirBridge Cargo, Qatar Airways Cargo

Sources Aena (2022), Dobruszkes (2016), Van Asch et al. (2019b), and Upply (2022)
[a] Out of the top 15
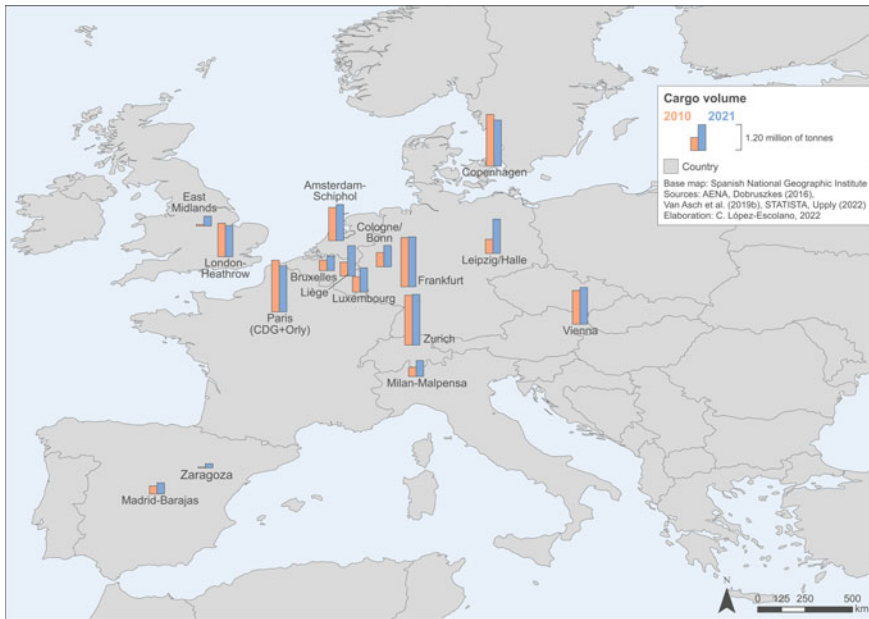
Fig. 1 Map of main air cargo airports in Europe, 2010 and 2021. Own elaboration

+ 357.17% in Zaragoza), but more modest growth in the large passenger airports that also handle cargo (+9.30% in Amsterdam, + 1.89% in Frankfurt); some airports in this latter group have also suffered setbacks (Paris, London-Heathrow, Zurich, Vienna). Other large passenger airports, however, show significant growth in cargo (+91.33% in Copenhagen, + 71.36% in Milan-Malpensa and + 39.17% in Brussels).

Cargo-Only Airports in Europe: Illustrative Examples

In Europe, there are different airports specialising in cargo operations that are characterised by the operations of integrated companies as well as those specialising in cargo, but not by using passenger flights for cargo traffic. This chapter presents four specific case studies that, due to their interest, contribute to understanding and contextualising this type of airport. These four infrastructures serve as an example of different regional contexts: two central locations (Liège and Luxembourg), another in a space of transit (Leipzig/Halle) and a peripheral one (Zaragoza). To these, we can add other specialised airports such as Milan-Bergamo (Italy), Vitoria-Gasteiz (Spain), East Midlands (United Kingdom) and Bergen and Stavanger (Norway), among others.

Leipzig/Halle (Germany)

The metropolitan area of the cities of Leipzig and Halle (just over 1 million inhabitants) is home to the second-busiest cargo airport in Germany, after Frankfurt am Main and ahead of Cologne/Bonn, Frankfurt-Hahn and Munich; in 2021, this airport was the fourth-largest cargo-handling airport in Europe. The airport is located next to an important transport hub in East Germany: *autobahn* 9 Munich-Nürnberg-Leipzig-Berlin and *autobahn* 14 Dresden-Leipzig-Magdeburg-Wismar. Berlin, Munich, Frankfurt, Hamburg, Dortmund and Prague can be reached within four hours (Fig. 2).

The airport is directly connected to the main German, European and international airports and offers flights to 41 different countries (Table 3). *DHL* and *AeroLogic* have their main European hubs at this airport. *DHL* had to relocate from Brussels to Leipzig/Halle (Dobruszkes 2016) due to the social problems resulting from night aircraft noise. *DHL* connects with up to 43 European destinations and *AeroLogic* mainly with intercontinental destinations, 26 in total. *Lufthansa*, the main German airline, does not operate in Leipzig/Halle; instead, the company focuses its strategy on the hubs at Frankfurt and Munich to leverage their dense network of passenger flights. Leipzig/Halle Airport handles e-commerce, airmail, live animals, dangerous goods, perishable goods and pharmaceuticals (Leipzig/Halle Airport 2022).

Fig. 2 Leipzig/Halle airport. Own elaboration

Table 3 Main cargo destinations from Leipzig/Halle Airport (2022)

Airlines	European destinations	Destination outside of Europe
AeroLogic	Brussels, Cologne/Bonn, East Midlands, Frankfurt, Stavanger	Bahrain, Bangkok, Bengaluru, Chennai, Chicago-O'Hare, Cincinnati, Dallas, Delhi, Dubai-Int., Guadalajara, Ho Chi Minh, Hong Kong, Houston, Los Angeles, Mexico, Miami, Mumbai, New York-JFK, Seattle-Tacoma, Seoul-Incheon, Shanghai-Pudong, Shenzhen, Singapore, Tashkent, Toronto-Pearson, Tokyo-Narita
AirBridge Cargo	Brussels, East Midlands, Krasnoyarsk, Milan-Malpensa, Moscow-Sheremetyevo, Oslo	Cincinnati, Dubai-Int
Amazon Air	Cologne/Bonn, East Midlands, Katowice, Madrid-Barajas, Milan-Malpensa, London-Southend	
Cargojet	East Midlands	
DHL Aviation	Amsterdam, Athens, Barcelona, Basel/Mulhouse, Belgrade, Bergamo, Bologna, Bratislava, Brno, Brussels, Budapest, Cologne/Bonn, Copenhagen, Dublin, East Midlands, Edinburgh, Frankfurt, Gdánsk, Geneva, Helsinki, Katowice, Kyiv, Linz, Ljubljana, London (Heathrow, Luton), Madrid-Barajas, Marseille, Milan-Malpensa, Moscow-Sheremetyevo, Munich, Nantes, Oslo, Ostrava, Paris-CDG, Pisa, Riga, Rome-Ciampino, Shannon, Sofia, Stockholm-Arlanda, Stuttgart, Treviso, Turku, Vilnius, Vitoria-Gasteiz, Warsaw-Chopin	Almaty, Bahrain, Bangkok, Bengaluru, Cincinnati, Delhi, Dubai-Int., Ho Chi Minh, Hong Kong, Istanbul, Lagos, Lahore, Los Angeles, Miami, Mumbai, New York-JFK, Seoul-Incheon, Shanghai-Pudong, Sharjah, Singapore, Tashkent, Tel Aviv
MNG Airlines	Cologne/Bonn, Istanbul	

Source Leipzig/Halle Airport (2022)

Liège (Belgium)

The Belgian city of Liège has barely 200,000 inhabitants and just over 700,000 in its metropolitan area. However, in 2021, its airport ranked sixth in Europe in terms of cargo volume, outranking even the airport of the Belgian capital, Brussels-Zaventem, which ranked tenth. Liège benefits from its central geographical location, very near the borders with the Netherlands, Germany, France and Luxembourg. Amsterdam, Brussels, the ports of Rotterdam and Antwerp, Dusseldorf and Cologne are within 2 h, and the metropolitan region of Paris within four. The airport has direct access

to the European motorways E-40 (from the port of Calais, Brussels, Liège, Aachen, Dresden, Kraków, Lviv and Kyiv to Central Asia) and E-42 (from the port of Dunkirk to Aschaffenburg, an important transport hub in the east of Frankfurt). Liège is also well-placed in a sector that is key to its future development: cross-border e-commerce, particularly with China. The route to Qingdao, which opened in November 2020, was clearly designated a new Air Silk Road. Liège wants to establish itself as a European hub based on a multimodal strategy, with particular emphasis on the use of rail transport (Upply 2022; Fig. 3).

Liège connects directly mostly with destinations outside Europe, which reflects its focus on global air connectivity as it relies on air-land intermodality to redistribute goods to European destinations. The number of cargo-aircraft movements rose from 34,310 in 2020 to 38,393 in 2021, an increase of 12% (Air Cargo News 2022). Liège handles the transport of non-perishable goods, express transport of perishable goods, exceptional transport, and the transport of live animals, medicines, organs and stem cells. Both integrated companies and companies specialising in cargo operate at the airport. In addition to the leading airlines (Table 4), *ROM Cargo*, *ACT Airlines*, *Allied Air Cargo*, *ATC Aerotranscargo*, *Bluebird Cargo* and *DHL* are also based there. The hub of the integrated airline *FedEx/TNT* in Liège was inaugurated in 1998 and later expanded in 2007. The company now has over 1500 employees and this operations base handles all the European air cargo and then dispatches it worldwide by air or by road (Liège Airport 2022).

Fig. 3 Liège airport. Own elaboration

Table 4 Main cargo destinations from Liège Airport (2022)

Airline	European destinations	Destinations to other continents
AirBridge Cargo	Kazan, Milan-Malpensa, Moscow-Sheremetyevo	Atlanta, Karaganda
Air China Cargo		Hangzhou, Shanghai-Pudong
ASL Airlines Belgium		Chicago-O'Hare, Halifax, Hangzhou, Jinan, New York-JFK, Shanghai-Pudong
Astral Aviation		Nairobi-Jomo Kenyatta
Atlas Air		Tel Aviv
CAL Cargo Air Lines	Larnaca, Oslo	Atlanta, Mexico, New York-JFK, Tel Aviv, Toronto-Pearson
CMA CGM Air Cargo		Atlanta, Chicago-O'Hare, Hong Kong
Ethiopian Cargo	Zaragoza	Abidjan, Accra, Addis Ababa, Chongqing, Guangzhou, Hong Kong, Johannesburg, Juba, Lagos, Miami, New York-JFK, Shanghai-Pudong
Icelandair Cargo	Reykjavik-Keflavik	
Qatar Airways Cargo		Atlanta, Chicago-O'Hare, Doha, Houston-Intercontinental, Los Angeles, Mexico

Source Liège Airport (2022)

Luxembourg

Luxembourg Airport is the only one in the country (Fig. 4). Its annual transshipment capacity is 1.2 million tonnes and it is the sixth-largest air cargo platform in Europe and the twenty-fifth in the world. It has air connections with 30 countries in 2022 (Table 5). The strategic location of the airport, near large industrial and population centres such as Frankfurt, the Ruhr Basin and Brussels (within 3 h) and Paris (within 4 h), explains its potential.

The importance of this airport lies in the presence of *Cargolux*, a cargo specialist which has yielded excellent results since the pandemic caused a massive drop in available capacity in the holds of passenger aircraft. In 2021, *Cargolux* achieved double-figure growth rates for a second consecutive year. Its total traffic exceeded one million tonnes for the first time last year (Upply 2022). Several freight forwarders also operate at Luxembourg airport, providing logistics services (*Bolloré Logistics*, *DB Schenker*, *DHL*, *DSV/Panalpina*, *Kuehne+Nagel*, among others) and the final distribution of the goods to the airport's area of influence.

Fig. 4 Luxembourg airport. Own elaboration

Table 5 Main cargo destinations from Luxembourg Airport (2022)

Airline	European destinations	Destinations to other continents
Cargolux	Zaragoza, Amsterdam, Budapest, Milan-Malpensa, Prestwick, Tbilisi,	Atlanta, Bahrain, Bangkok, Beijing, Calgary, Chicago-O'Hare, Curitiba, Dallas, Dubai, Guadalajara, Hanoi, Ho Chi Minh, Hong Kong, Houston, Incheon, Indianapolis, Jakarta, Johannesburg, Komatsu, Kuala Lumpur, Los Angeles, Mexico, Miami, Muscat, Nairobi, New York-JFK, San Juan de Puerto Rico, Rio de Janeiro, Riyadh, Settle, Shanghai-Pudong, Singapore, Taipei-Taoyuan, Tokyo-Narita, Viracopos, Xiamen, Zhengzhou
Air China Cargo	Prague	Delhi, Mumbai, Taipei-Taoyuan
China Southern Airlines		Shanghai-Pudong
Emirates SkyCargo		Dubai-Al Maktoum
Qatar Airways Cargo		Atlanta, Chicago-O'Hare, Doha, Mexico, São Paulo-Guarulhos
Sik Way Airlines		Baku

Source Luxembourg Airport (2022) and Cargolux (2022)

Zaragoza (Spain)

Spain is peripherally situated above the economic and demographic centre of Europe and none of its airports are among the busiest in Europe in terms of cargo traffic. Madrid-Barajas accounts for half of the cargo volume transported in Spain as it is in the geographical centre and enjoys excellent international connectivity with long-haul passenger flights, particularly with Latin America. The other three important airports are located in north-eastern Spain: Barcelona, Zaragoza and Vitoria-Gasteiz. Zaragoza is only the fifth-largest city in Spain in terms of population (700,000 inhabitants) but is strategically located in the centre of the area with the greatest economic activity, with similar travel times to Madrid, Barcelona, Valencia and Bilbao (3 h). It has access to the E-90 motorway and has a railway terminal for containers connected to the ports of Valencia (Mediterranean) and Bilbao (Atlantic) (Fig. 5).

In 2021, Zaragoza Airport offered connections with 81 other airports—78 of these international—and its routes provided access to 49 countries (Table 6). The airport owes its strength to its proximity to the logistics platform of the multinational clothing company *Inditex* (*Zara*), which operates a large number of flights to different international destinations to distribute fast fashion (Escalona-Orcao and Ramos-Pérez 2014). Zaragoza serves as a hub for importing textile products, mainly from Asia, to later redistribute them to other countries. Thanks to this business, the airlines fill their flights with orders from other companies and the airport is the leader in Spain for cargo-only flights (Cruz Alonso and López-Escolano 2021). The planes
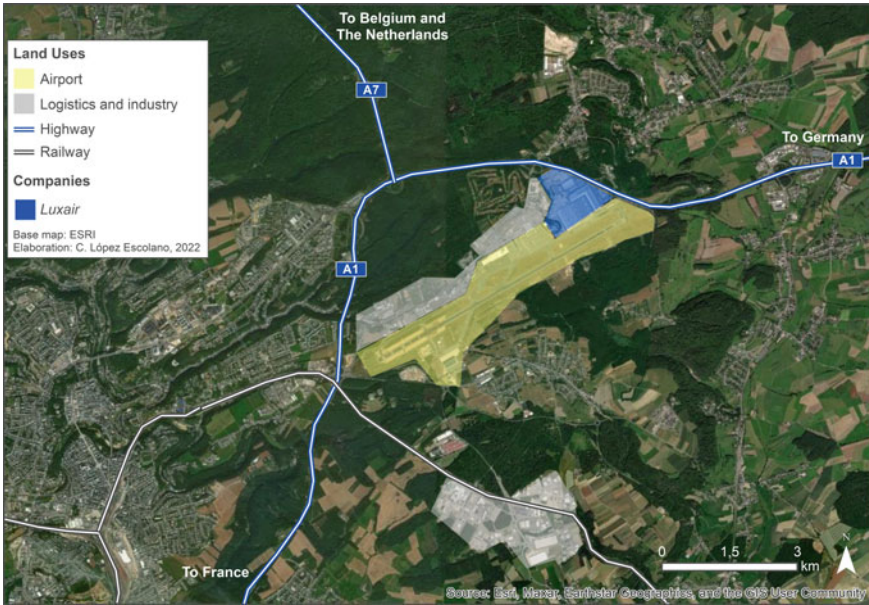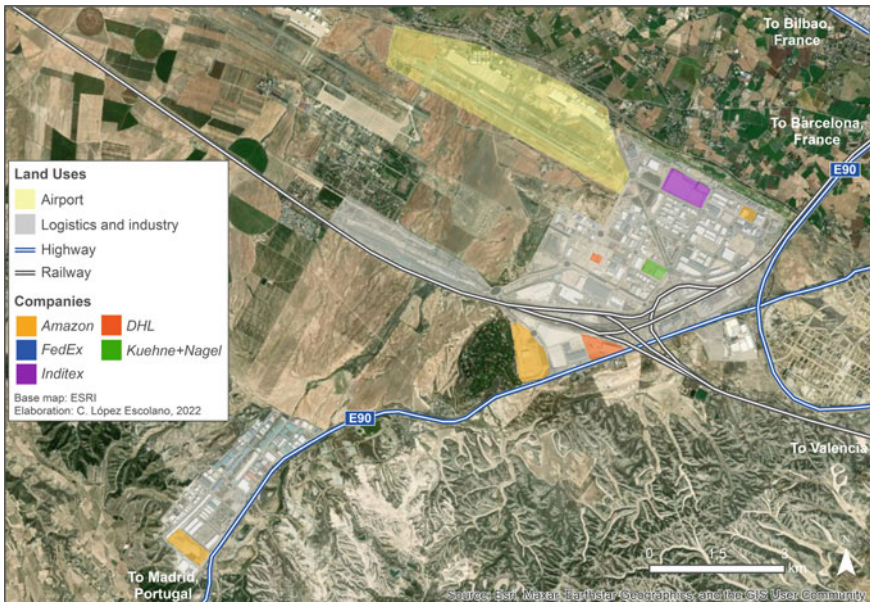

Fig. 5 Zaragoza Airport. Own elaboration

Table 6 Main cargo destinations from Zaragoza Airport (2022)

Airline	European destinations	Destinations to other continents
AirBridge Cargo	Moscow-Sheremetyevo	
Air China Cargo	Amsterdam	Shanghai-Pudong, Tianjin
Atlas Air		Istanbul, Mexico, Miami, Tel Aviv, Zhengzhou
Avianca Cargo	Amsterdam	Bogotá, Miami
Cargolux	Luxembourg	
China Cargo Airlines	Amsterdam	Shanghai-Pudong
Emirates SkyCargo		Dubai-Al Maktoum, Mexico, Quito
Ethiopian Cargo	Liège	Addis Ababa, Bogotá, Guangzhou, Mexico, Miami
Qatar Airways Cargo	Luxembourg	Beirut, Chicago-O'Hare, Dhaka, Doha, Houston-Intercontinental, Los Angeles, Mexico, New York-JFK, Quito
Saudia Cargo		Damman, Riyadh
Korean Air Cargo		Seoul-Incheon
Turkish Cargo		Istanbul

Source Aena (2022)

export fruit to Europe and horses and alfalfa to Persian Gulf countries and import technological products, industrial components and fish. During the COVID-19 crisis, the airport was a reference in Spain for receiving medical supplies from China. The flights are operated by companies specialising in cargo transport that, generally, are subsidiaries of the leading Spanish air companies (Table 6). *Amazon*, *DHL* and *Kuehne+Nagel* have logistics hubs near the airport.

Prospects and Conclusions

Geography is one of the main factors explaining the location of economic activities. Nevertheless, in terms of air cargo, geography is not the only factor that determines the location of successful international hub airports and airlines, since the availability of suitable infrastructure, workforce and tax regimes, as well as historic, cultural and trading links is also relevant (European Commission 2022). Globalisation and, in

particular, industrial relocation and the growth of electronic commerce, are driving functional specialisation of certain cargo airports that help to secure and interconnect global supply networks.

As explained above, there is a growing diversification in the type of airports handling cargo, an activity that responds to the needs of the territory they serve as well as the strategies of the air companies (integrated or specialised), to operate flights that are profitable for their business. This leads to a functional specialisation of certain airports in the operation of cargo-only flights, and their interest lies in their location in medium-sized cities that play an important role in European economies. This is possible thanks to the location with respect to their market areas, but also to the excellent accessibility to other modes of transport that allow efficient intermodality and to the availability and lower costs of land for logistics activities compared to large cities. These airports also benefit from the congestion of the large passenger hubs.

In the case of Europe, we have analysed four airports—Leipzig/Halle, Liège, Luxembourg and Zaragoza—to illustrate and characterise these dynamics. Some of these airports already compete directly with large airports for the operation of cargo flights. In any case, the European cargo airport rankings are heavily dominated by Western European airports, but it will be interesting to see if the Air Silk Road enables some of the Eastern European airports to upscale positions (Upply 2022). In the future, we should keep a close eye on the development of airports such as Budapest—whose traffic has grown recently thanks to the cooperation between the governments of Hungary and China to establish a branch of the Air Silk Road with Zhengzhou—or Poland Central Airport, which is currently under construction between Warsaw and Lodz and will boost cargo traffic (Upply 2022).

Lastly, knowing the real reach that policies will have against climate change in the aviation sector will be of interest. A restriction on short and medium-haul passenger flights could strengthen, however, the intermediary and specialised airports, since they do not depend on the cargo transported in the holds of passenger planes. Developments in international armed conflicts should also be monitored, as should the impact of the change in the energy model on a global level.

References

Aena (2022) Estadísticas de tráfico aéreo. https://www.aena.es/es/estadisticas/inicio.html. Accessed 25 Sept 2022

Airports Council International (ACI) (2019) Preliminary world airport traffic rankings released. ACI Media Releases. https://aci.aero/news/2019/03/13/preliminary-world-airport-traffic-rankings-released/. Accessed 01 Jul 2022

Airports Council International (ACI) (2022) Final data released: top 20 busiest airports confirmed. https://aci.aero/2022/07/25/final-data-released-top-20-busiest-airports-confirmed/. Accessed 28 Jun 2022

Air Cargo News (2022) Liege reports record cargo volumes for 2021. https://www.aircargonews.net/cargo-airport/liege-reports-record-cargo-volumes-for-2021/. Accessed 08 Sept 2022

Al-Mehairi JM (2019) Dubai´s geographic location and its advantages for the air transportation industry. Arab World Geogr 19(3–4):352–367

Bansard (2022) 2021 World's top 10 busiest air cargo airports. https://www.bansard.com/en/news/2021-worlds-top-10-busiest-air-cargo-airports#:~:text=On%20the%20European%20side%2C%20the,London%2DHeathrow%20(LHR). Accessed 27 Jun 2022

Boquet Y (2009) Les grands aéroports de fret. Bulletin De L'association De Géographes Français 86(4):472–484

Bowen JT Jr (2012) A spatial analysis of FedEx and UPS: Hubs, spokes, and network structure. J Transp Geogr 24:419–431

Cao JM, Kanafani A (2000) The value of runway time slots for airlines. Eur J Oper Res 126(3):491–500

Cargolux (2022) Flight destinations. https://www.cargolux.com/network/. Accessed 23 Sept 2022

Chang Y-H, Chang Y-W (2009) Air cargo expansion and economic growth: finding the empirical link. J Air Transp Manag 15(5):264–265

Chi-Lok AY, Zhang A (2009) Effects of competition and policy changes on Chinese airport productivity: an empirical investigation. J Air Transp Manag 15(4):166–174

Chow CKW, Fung MKY (2009) Efficiencies and scope economies of Chinese airports in moving passengers and cargo. J Air Transp Manag 15(6):324–329

Coe NM, Yeung HW-c (2015) Global production networks: theorizing economic development in an interconnected world. Oxford University Press, Oxford

Cruz-Alonso D, López-Escolano C (2021) Tipología y evolución de los aeropuertos españoles en relación con el transporte de carga. Cuadernos Geográficos 60(2):6–30

Dobruszkes F (2016) Geographies of European Air Transport. In: Goetz AR, Budd L (eds) The geographies of air transport. Ashgate, Aldershot, pp 167–186

Dubucs H (2021) L'essor des flux de marchandises et des services. In: Balaresque N (ed) La mondialistaion contemporaine. Rapports de force et enjeux. Paris, Nathan, pp 61–79

Escalona-Orcao AI, Ramos-Pérez D (2014) Global production chains in the fast fashion sector, transports and logistics: the case of the Spanish retailer Inditex. Investigaciones Geográficas, Boletín Del Instituto De Geografía 85:113–127

El Salto (2020) La Comisión Europea reconoce que emisiones de la aviación triplican los datos oficiales. https://www.elsaltodiario.com/aviacion/comision-europea-reconoce-emisiones-triplican-datos-oficiales. Accessed 24 Jul 2022

Eurocontrol (2021) EUROCONTROL Data Snapshot #5 on the market share of cargo flights. https://www.eurocontrol.int/publication/eurocontrol-data-snapshot-all-cargo-flights-market-share. Accessed 15 Jul 2022

European Commission (2022) Mobility and transport. Airports. https://transport.ec.europa.eu/transport-modes/air/airports_en. Accessed 09 Jul 2022

European Parliament (2022) Emisiones de aviones y barcos. https://www.europarl.europa.eu/news/es/headlines/society/20191129STO67756/emisiones-de-aviones-y-barcos-datos-y-cifras-infografia. Accessed 09 Jul 2022

Fleming DK, Hayuth Y (1994) Spatial characteristics of transportation hubs: centrality and intermediacy. J Transp Geogr 2(1):3–18

Gardiner J, Ison S (2008) The geography of non-integrated cargo airlines: an international study. J Transp Geogr 16(1):55–62

Guimerà R, Amaral LAN (2004) Modeling the world-wide airport network. Eur Phys J B 38(2):381–385

Hylton P, Ross CL (2018) Air cargo forecasting in an age of electronic retail. Transp Res Rec: J Transp Res Board 2672(29):48–58

International Air Transport Association (IATA) (2019) La guerra comercial desploma la demanda aérea de carga (Comunicado número 50). https://www.iata.org/contentassets/46677daffdd040d2a184bbd5a0b9db5c/2019-09-05-01-sp.pdf. Accessed 10 Jul 2022

International Civil Aviation Organization (ICAO) (2020) Effects of novel coronavirus (COVI-19) on civil aviation: economic impact analysis. https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf. Accessed 12 Jul 2022

International Forwarding Association (IFA) (2019) Largest and busiest cargo hubs in Europe. Retrieved from: https://ifa-forwarding.net/blog/european-logistics/largest-and-busiest-cargo-hubs-in-europe/

Kasarda JD, Green JD (2005) Air cargo as an economic development engine: a note on opportunities and constraints. J Air Transp Manag 11(6):459–462

Klaver S, Gordijn H, Harbers A (2007) Atlas of cargo airports in Europe. https://www.pbl.nl/sites/default/files/downloads/Atlas_of_cargo_airports_in_Europe.pdf. Accessed 08 Jul 2022

Leipzig/Halle Airport (2022) All types of cargo freight at Leipzig/Halle airport. https://www.mdf-ag.com/en/air-cargo/types-of-cargo-freight/. Accessed 21 Sept 2022

Liège Airport (2022) The FEDEX/TNT sorting centre. https://www.liegeairport.com/flexport/en/case-studies/tnt/. Accessed 22 Sept 2022

López Trigal L (dir.), Rio Fernandes JA, Savério Sposito E, Trinca Fighera D (coords.) (2015) Diccionario de Geografía aplicada y profesional. Terminología de análisis, planificación y gestión del territorio. Universidad de León, Servicio de Publicaciones

Lotti R, Caetano M (2018) The airport choice of exporters for fruit from Brazil. J Air Transp Manag 70:104–112

Mayer R (2016) Airport classification based on cargo characteristics. J Transp Geogr 54:53–65

Morrell PS (2011) Moving boxes by air: the economics of international air cargo. Routledge, Abingdon

Pais-Montes C, Freire-Seoane MJ, González-Laxe F (2017) La conectividad en el sector español de carga aérea: 2004–2014. Revista de Evaluación de Programas y Políticas Públicas 9:113–138

Rong A, Grunow M (2009) Shift design for freight handling personal at air cargo terminals. Transp Res Part E 45:725–739

Sales M (2017) Air cargo management: air freight and the global supply chain. Routledge, Abingdon

Sheller M, Urry J (2006) The new mobilities paradigm. Environ Plan A: Econ Space 38(2):207–226

Stern N (2006) The economics of climate change: the stern review. Cambridge University Press, Cambridge

Takebayashi M (2011) The runway capacity constraint and airlines' behavior: Choice of aircraft size and network design. Transp Res Part E: Logist Transp Rev 47(3):390–400

Tovar B, Hernández R, Rodríguez-Déniz H (2015) Container port competitiveness and connectivity: tThe Canary Islands main ports case. Transp Policy 38:40–51

Upply (2022) Airports: Benelux airports strengthened by freight traffic recovery. https://market-insights.upply.com/en/airports-benelux-airports-strengthened-by-freight-traffic-recovery#:~:text=Frankfurt%20stayed%20in%20first%20place,returned%20to%20growth%20in%202021. Accessed 18 Sept 2022

Van Asch T, Dewulf W, Kupfer F, Cárdenas I, Van de Voorde E (2019a) Cross-border e-commerce logistics—strategic success factors for airports. Res Transp Econ 79:100761

Van Asch T, Dewulf W, Kupfer F, Meersman H, Onghena E, Van de Voorde E (2019b) Air cargo and competitiveness. J Air Transp Studies 10(2):48–75

Wong CK, Wong SC (2002) Lane-based optimization of traffic equilibrium settings for area traffic control. J Adv Transp 36(3):349–386

World Bank (2022) Transport. https://www.worldbank.org/en/topic/transport/overview#1. Accessed 12 Jul 2022

Wu Y (2010) A dual-response forwarding approach for containerizing air cargoes under uncertainty, based on stochastic mixed 0–1 programming. Eur J Oper Res 207(1):152–164

Yamaguchi K (2008) International trade and air cargo: analysis of US export and air transport policy. Transp Res Part E: Logist Transp Rev 44(4):653–663

Conflicting Interests in Transport Infrastructure Planning: Theoretical Approaches and Practical Implications of Conflict Management in Planning Processes

Maruša Goluža

Abstract Planning transport infrastructure, such as highways requires collaboration among different actors. Various understandings of the physical environment and the infrastructure itself are inherent in the planning processes, often causing conflicts. They differ not only within the expert and local communities but also in different socio-spatial contexts. Therefore, planners need to develop a deeper understanding of the diverse social perceptions of space and infrastructure in different social and spatial contexts. To enhance conflict management and to implement environmentally and socially sound infrastructure projects, case studies are important. In this chapter, we examine and discuss how conflict management is conceptualized in planning theory and how these theoretical approaches are translated into practice. We contribute to the growing literature that redefines the understanding of conflict management in spatial planning, using the case of the Third Development Axis Highway in Slovenia, as an example. Rather than attempting to evaluate various theoretical conflict management approaches, we focus on the potential practical ways of addressing spatial conflict in highway planning. We develop the concept of dynamic planning approach adaptable to different socio-spatial contexts. We propose that a planning process should be based on continuous deliberation among multiple actors, including those from academia, which is often overlooked.

Keywords Spatial conflicts · Conflict management · Infrastructure · Context-based planning · Deliberation

M. Goluža (✉)
Research Centre of the Slovenian Academy of Sciences and Arts, Anton Melik Geographical Institute, Ljubljana, Slovenia
e-mail: marusa.goluza@zrc-sazu.si

Introduction

Planning transport infrastructure, such as highways, is extremely complex. Spatial conflicts often extensively prolong planning processes, which is of increasing concern not only for planning practitioners but also for spatial planning scholars. Emerging publications deal with conflicts and their implications for decision-making practices (Pløger 2004; Forester 2009; Gunn and Hillier 2014; Gualini 2015; Cieślak 2019; Guštin and Potočnik Slavič 2020; Goluža 2022). Within planning research, the participatory approach is often characterized as a rather non-realistic and unfeasible model of decision-making for practitioners, who are increasingly confronted with unequal power relations, irrational or emotionally driven interests, NIMBY syndrome, and questions of spatial (in)justice (Flyvbjerg and Richardson 2002; Hillier 2003; Davoudi 2005; Philippopoulos-Mihalopoulos 2010). Spatial conflicts are often portrayed as civil society oppositions to spatial plans, and as localized, temporary stagnations in the planning process, independent of different socio-spatial contexts (Goluža 2022). Rational, comprehensive, and communicative approaches have traditionally been used by scholars and practitioners for defending either formalization and rationalization or for democratization of decision-making processes. The rational/comprehensive approach aims at conflict prevention or avoidance, usually by granting responsibilities for making decisions to experts and minimizing public participation (Healey 1997). Planning theory has been tightly linked to wider debates within social and political sciences. Since the mid-twentieth century, planning theory has been prominently influenced by democratic theory, headed by critical theorist Jürgen Habermas as a beginner of deliberative democracy, and more recently, by political theorist Chantal Mouffe as a representative of the agonistic view on decision-making.

However, rather than concur with the position that conflicts can be avoided or resolved through rationalization or democratization of decision-making processes, I argue that conflicts are inherently present in all social relations. Existing conceptions of spatial conflicts primarily stem from the division between decision-makers and the public which is misleading and gives false impressions that they can be resolved with public inclusion. I argue that such narratives not only ignore the potential diversity of conflicts but also create an illusion of the objective, rational, and non-conflictive nature of science. By suggesting a focus shift from the state-public contestations to the issue of the inherently conflictive nature of social relations, I propose that planning scholarship should move beyond solely concentrating on public participation. Rather, it ought to engage with the actual planning processes that are always potentially conflicting. They should focus on how actors conceptualize places and planned spatial developments, how their arguments gain or lose legitimacy within actor networks, and how conflicts between them are managed (De Roo 2012).

I advance this argument by focusing on public participation. For decades, it has been considered as a key mechanism in planning and governance literature, for legitimizing future spatial developments. Today, in times of exacerbation of climate crisis and increasing complexity of the world we live in, it is particularly relevant

to speak of democratic deliberation, not only in the context of public participation but also broader, within actor networks, including experts, public, state institutions, and economic actors (Goluža 2022). Yet, rather than reiterating calls for more meaningful public participation, the chapter explores how planning processes are not immune to irrationalities, ideologies, different contextual factors and power relations, neither in the scientific/expert domain nor in the domain of the (lay) public. First, the chapter examines the dynamics of the actual decision-making process and conflicts among actors. I show that none of the three prominent planning approaches—rational/comprehensive, communicative, and agonistic—is immune to the influence of the changing socio-spatial context. Second, I examine the specific sites of contestations. Please for democratic repair through institutional innovations that propose more and different approaches to public participation often fail. I argue that this is because too often they overlook the multiplicity of conflicts, not only in terms of the actors involved, but also in terms of the places and times where and when conflicts may emerge. I thus intervene in emerging debates on spatial conflicts. I believe that what is missing is an engagement of the idea of planning processes as dynamic trajectories of multiple actors whose roles, interests, and arguments are always more or less subjective, strategic, and dependent on the specific socio-spatial context. I will illustrate this with reference to the recent planning process of the third development axis highway, Slovenia. The preparation of the spatial development plan lasted from 2004 and 2017. However, due to several conflicts during and after the planning process, the project has not been realized.

Various approaches to conflict management had been proposed during the decision-making process, from the rationalization and reliance on the objectivity of expert knowledge to deliberative dialogues such as public hearings. Nevertheless, none of these approaches has led to the legitimacy of the final decision and the spatial plan. All efforts to involve the public had been futile because conflicts had not been recognized and adequately addressed in other arenas throughout the decision-making process. I argue that practitioners committed to achieve legitimacy of major infrastructure projects (and spatial development in general) must confront the dynamic nature of decision-making processes in order to tackle their inherently conflictual nature (de Roo 2012). More context-adapted approach to conflict management in different stages of planning processes, would enhance the Sustainable Development Goal 16, that focuses on developing strong institutions that are free from corruption and promote transparency and participatory decision-making (The Sustainable Development Goals Programme 2022).

The chapter is structured as follows: First, it illuminates social sciences literature on spatial conflicts to conceptualize a working definition of conflicts. Second, drawing on literature review, it analyzes how different planning models address the question of conflict management. Third, based on case study analysis, it scrutinizes different conceptions of planned highway and its influence on place and people in specific localities. Furthermore, it explores arenas where these conflictual conceptions were articulated, how they were dealt with within planning process, and with what consequences for the legitimacy of the final spatial development plan. Lastly, it asks how conflict resolution can be tackled, suggesting analytical shifts and its

respective practical implications. I suggest taking into account the dynamic nature of decision-making processes and context-dependent approach that (1) understand conflicts as inherent to planning processes, not only in state-society relations but also broader contexts, and (2) view planning practitioners as transdisciplinary actors being able to recognize conflicts and having the authority to adjust and enable deliberation in different arenas within planning processes.

Sources of Spatial Conflicts: Social Construction of Space, Spatial Justice, and the Particularities of Highway Planning

Typically, analyses assume either positivist or post-modernist rationalizations of spatial conflict. Positivist rationalizations are typical of the rational/comprehensive planning concept that views conflicts as problems with clear causality, independent of socio-spatial context. In this case, authors focus on the so-called land-use conflicts and use qualitative methods to reveal causes, typologies, spatial distribution, and other objective features of conflicts (von der Dunk et al. 2011; Guštin 2015; Cieślak 2019; Guštin in Potočnik Slavič 2020). The primary goal is to rationalize planning processes and prevent further land-use incompatibilities. In contrast, postmodern rationalizations focus on social relations and the social production of space. Conflicts have been named variously in planning literature. Besides conflicts (e.g. Gualini 2015), also differences and public disputes (Forester 2009), strife (Pløger 2004), dissent (Hillier 2002), tensions (Gunn in Hillier 2014), and wicked problems (Rittel and Webber 1973; Innes and Booher 2016). Conflicts in this sense are understood as an inevitable part of planning processes, beneficial for democracy (Mouffe 2005). They are the result of different interests, values, social relations, structural causes, and withheld information (Almeida et al. 2017). It is assumed that conflicts should be resolved through public participation and deliberation (Innes in Booher 2016) although critics have exposed several shortcomings of such a planning model. They question the appropriateness of the ultimate openness of decision-making processes (Rorty 2000) and the inevitability of power relations and exclusion (Laclau and Mouffe 2001; Flyvbjerg and Richardson 2002; Hillier 2003). Before addressing the overly narrow perception of spatial conflicts in the three prominent planning paradigms, which are limited to the state-society relationship, I focus firstly on formulating a definition of conflict that will guide this chapter.

Defining Spatial Conflicts Through Social Construction of Space

To define spatial conflicts, I follow the spatial sociology literature, which reflects on space as a social category and on the interconnectedness between geographic and

social spaces. Space is viewed as a social construct and relational. The focus is on how social actors produce space, what meaning it has for them, and how space structures individual behaviour. Space is seen as dynamic, enabling, and changeable (Schroer 2018). Henry Lefebvre, French spatial sociologist, distinguishes between three types of spaces: lived, conceived, and perceived spaces (Fig. 1). The lived space refers to the space of the inhabitants. It represents their attitudes towards space, their personal, also emotional, attachments to space, memories, and intuitions. The pluralism of perceptions of space leads to different interests and is thus one of the main reasons for spatial conflicts (Lefebvre 2013). Conceived space is the space of knowledge and logic. It is a mental construct of spatial planners, scientists, and technocrats with their respective theoretical models of space. These influence the way space is perceived and governed, while also being its consequence (Lefebvre 2013; Schroer 2018). Scientific understandings of space are therefore always contextual, dynamic, and changeable over time. As such, conceived space can also be a source of conflict due to scientists' and technocrats' differing conceptions of space and their dependence on scientific progress (Lefebvre 2013). Perceived space represents the common-sense understanding of space as it is experienced, used, and reproduced in everyday life. We modify space through individual and collective spatial practises that are evident in the territorial organization and the administrative division of space, as well as in national spatial politics. However, the territories of states are governed by different sectors with their respective influences and interests in space, which can also lead to conflicts—between different levels of administration or between different sectors. Space in the sense of territory is always potentially conflictual, also because of public opposition to authorities (Kos 1997).

Lefebvre's concept of the social production of space (2013) opens up some key aspects of spatial conflict. The first is the individual understanding and perception of space reflected in the diversity of interests, desires, and needs related to spatial development. Another aspect of spatial conflict is the struggle for governing the

Fig. 1 Lefebvre's triad of space production (adapted from Lefebvre 2013)
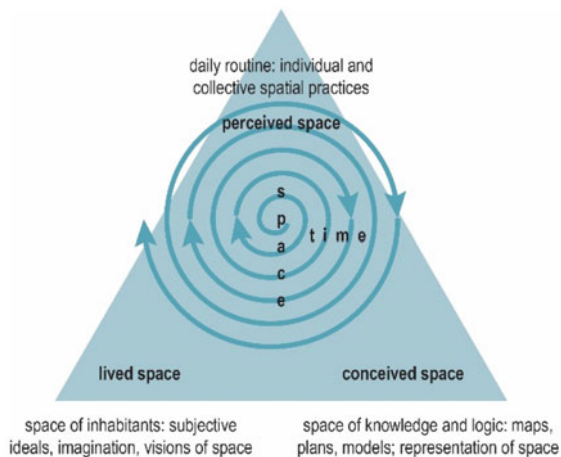
space, which manifests itself between different levels of administration and between different ministries. Spatial conflict can also be the result of public opposition and distrust of the national authorities and existing spatial policies. This is most evident in the increasing emergence of citizens' initiatives in spatial planning. The third aspect of spatial planning conflict is the issue of scientific knowledge, which is neither uniform nor universal. Scientific knowledge and the resulting professional discourses change over time, and as knowledge production increases, they also become more specialized and difficult to reconcile. As a result, professional and scientific judgments about the appropriateness of spatial developments are often inconsistent, either within individual professions or between them. Conflict management is becoming an increasingly important aspect of achieving legitimacy for spatial planning.

Space as a Limited Resource: Access to Space and the Question of Spatial Justice

Spatial conflicts are also a consequence of the fact that physical space is a limited resource. It belongs to the so-called common-pool resources, whose availability is reduced by use, unlike the public good (e.g. light, air, or road) (Šmid Hribar et al. 2018). As use of space increases, so does the likelihood of conflicts. Space usually does not allow simultaneously different land uses which is why coordination of different interests is necessary.

Physical space is one of the fundamental levers of state authority, but it is also used and managed by individuals. Therefore, private property is also an important aspect for understanding spatial conflicts. Property gives individuals the right to restrict access to space to some degree. Therefore, public policy must also take into account citizens' property rights. Although, these are never absolute: property owners cannot use their land in a completely arbitrary manner, as the use is formally restricted (Simoneti 2010), primarily to prevent conflicts. Spatial policies formally protect and realize the public interest through the state's system of spatial planning. The state's authority to pursue the public interest is established through two levers: formally through representative democracy and technically through the rational and, at least on paper, apolitical orientation of spatial development (Gualini 2010). Property, on the other hand, gives landowners certain rights to enforce their own private interests, which are not necessarily in the public interest. Therefore, the state must regulate the rights that arise from property in order to pursue the public interest. The purpose of spatial planning is to prevent arbitrary decisions by individuals, investors, or landowners. Indeed, they are supposed to act according to the principles of economic logic, which often does not take into account the possible negative environmental consequences of their actions. However, public interest is a vague concept, both in terms of political representativeness and utilitarian benefits (Alexander 2002). It follows that the legitimacy of spatial planning rests on a balance between public and private interests. Thus, determining the "rational" use of space is never limited to
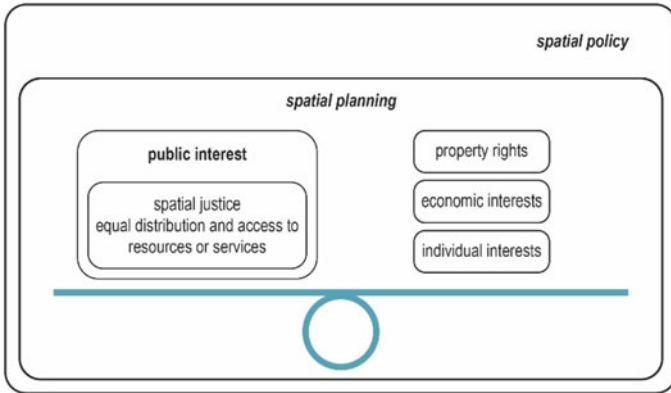
Fig. 2 Relations between spatial policy, planning, and public and private interests

determining the use of physical space. It is about balancing the general public interest and individual private interests of residents (Fig. 2).

The concept of public interest is tightly related to the concept of spatial justice that has its origins in the long-standing scholarly debates of the 1970s and 1980s (Harvey 1996; Philippopoulos-Mihalopoulos 2010). Considerations of spatial justice are essential considerations of how resources and activities are distributed in space and how accessible they are for residents (Soja 2009). In spatial and regional planning theory, the concept was established in the late 1990s with the cohesion concept of the European Spatial Development Perspective (1999). European cohesion policy is one of the main EU policies to reduce interregional disparities and promote balanced development in Europe. Article 174 of the 2007 Lisbon Treaty speaks of balanced development, i.e. economic, social, and territorial cohesion. The latter emphasizes spatial justice and was also highlighted in the Territorial Agendas (2007, 2011, and most recently 2020).

Highway Planning and Wicked Problems

Transport infrastructure planning takes place in specific socio-spatial contexts and is characterized by a great variety of interests that are often conflicting. Different economic, technical, environmental, social, and other criteria are used in planning processes to determine the future location of object and its optimal route. The mere utilitarian logic, which, for example, location theories in economic geography were based on, is no longer acceptable or legitimate. Shortest and financially most afford-able way to connect points A and B nowadays cannot be the only criteria to determine the location of highways or other transport infrastructure. There are several regulations, interests, and discourses that should also be considered.

The fact that social conditions had changed and affected spatial planning practice was recognized already by Rittel in Webber in the 1970s. The authors pointed out that the pluralism of interests and the inability of scientists to predict future trends in space prevent spatial planners from pursuing spatial developments suitable for all. Spatial conflicts are therefore impossible to resolve completely, which is why they called them "wicked problems". These are conflicts that we cannot fully define, understand, explore, or resolve, as we cannot anticipate all possible solutions and their consequences. In solving wicked problems, different notions of the problem and social values can become equivalent or even superior to facts and figures (Rittel and Webber 1973; De Roo 2012). Rittel and Webber (1973) observed that social conditions had become increasingly complex, making the legitimation of spatial developments more and more demanding. They defined wicked problems as problems that allow multiple rationalizations and solutions. Therefore, decisions on spatial developments cannot be correct or false, but are reliant on ambiguous and uncertain political judgements. As such, solutions should be achieved through the process of argumentation (Fig. 3).

Fig. 3 Characteristics of wicked problems (adapted from Rittel and Webber 1973)

Relatedly, de Roo (2012) describes planning of major infrastructure projects as very complex and dynamic. The placement of road infrastructure in space materializes in specific geographical, social, and temporal circumstances. Actors' positions about the adequacy of the future transport infrastructure are therefore highly ambivalent. Roads are one of the biggest human interventions in the environment. Today, diverse economic, technical, environmental, and other criteria are used to define locations of future roads or other spatial developments. The efficiency as the only criterion which, for example, location theories in economic geography were based on, is no longer an acceptable or legitimate reduction. Many other interdependent criteria should be considered, such as protected areas of natural and cultural heritage, settlement systems, development interests of local communities, and many others. Therefore, planning processes should facilitate the harmonization of actors' diverse interests through argumentation at different stages, from the initial idea, expert analyses, to public participation.

Conflict Management in Theoretical Planning Models with Empirical References to the Third Development Axis Highway, Slovenia

"Rational/comprehensive", "communicative", and "agonistic" planning paradigms all serve as a normative guidance for conflict management. Each of the three is inspired by different rationality: (i) technical, (ii) communicative, advanced by Jürgen Habermas, and (iii) agonistic pluralism as proposed by Chantal Mouffe. They focus on how we should make decisions in a procedural sense, rather than asking of how actually planning processes play out in modern democracies and planning practice (Flyvbjerg 1998) (Table 1).

In the following section, I want to turn the focus on actual planning practice. Through the prism of the three theoretical planning paradigms, I will scrutinize the actual planning of the third development axis highway, Slovenia. I will focus on the section F that crosses the Savinjska region. It is going to link the Koroška region with the existing national highway network (see Fig. 4). I will outline how conflictual conceptions of space and infrastructure have intertwined throughout the planning process and how conflicts have been managed.

Rational/Comprehensive Approach

The rational/comprehensive planning paradigm has evolved since the Second World War. It has built on scientific and technological knowledge evolution. Objective science played a key role in defining problems, anticipating spatial development and its consequences. Impartial scientific reason has thus become the basis of performing

Table 1 Dealing with conflicts in the three prominent planning models: rational/comprehensive, communicative, and agonistic (adapted from Kühn 2021)

	Rational/ comprehensive	Communicative	Agonistic
Approach to conflict	Passive	Reactive	Proactive
Perception of conflict	Conflict as a disturbance	Conflict as an occasion for participation	Conflict as a catalyst for change
Conflict management strategies and goals	Avoidance, rationalization	Deliberation, consensual solution	Acceptance of dissent
The role of spatial planner	Expert	Moderation, mediation	Creating arenas for the expression of conflicting interests
Form of democracy	Representative	Deliberative, pluralistic	Radical, pluralistic
Power relations	Planning sovereignty, government	Negotiation in actor networks, governance	Discursive hegemony
Main critique	Alienation from public interest, biased expert knowledge	Ideal, impossible to attain in practice	No rational framework for decision-making

just social and spatial policy (Healey 1997). Scientific knowledge has become a means for justifying decisions, often characterized by a strong logic of economic efficiency (Healey 1997).

However, critics of the rational/comprehensive planning approach have argued that absolute reliance on the objectivity of scientific arguments can lead to undemocratic illegitimate decisions (Latour 2011). Habermas (1974) for example criticized such a positivist, rational approach for being alienated from interests and values in society. Critics of a rational/comprehensive approach also argued that even seemingly objective work of scientists is always imbued with power relations and dependent on socio-spatial contexts (Latour 2011). The selection of professions and individual experts who have the opportunity to participate in decision-making processes, in practice depends on several factors, including the subjective decision-makers' criteria. Therefore, some experts are inevitably excluded from formal decision-making process. Experts' arguments also depend on their personal values, and can be under pressure from various interest groups. Consequently, the role of experts as independent, rational actors is thus questionable, which reduces the legitimacy of "rational" decisions (Moore 2017).

Despite modern planning theory putting greater emphasis on the democratization of decision-making processes, scientific rationality still plays an important role, because it provides decision-makers and other actors with information and consequently shapes their arguments (Gutmann and Thompson 2004; Moore 2017). Scientific knowledge thus represents a counterbalance to the sometimes selfish, simplistic, or banalized arguments, but can also itself become a means of politicization. When
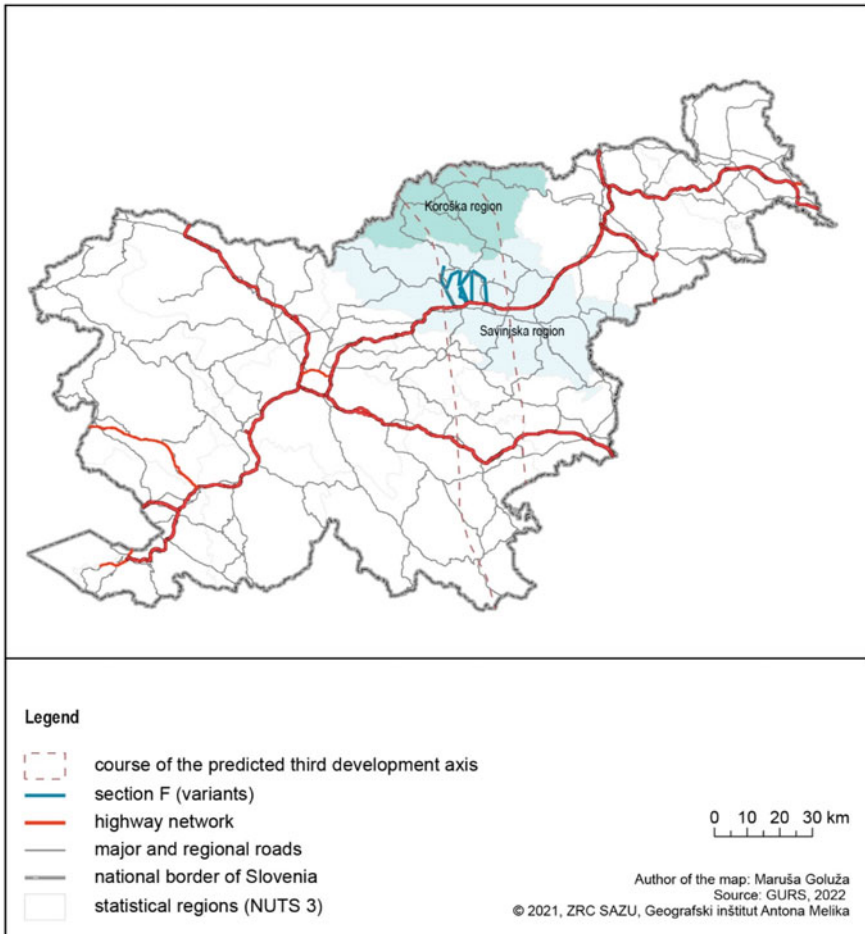
Fig. 4 The course of the predicted third development axis (section F) in a national and regional contest

actors use individual information as the only and absolute truth to obtain narrow individual interests, it points to weak democratic standards of decision-making processes (Latour 2011).

What do these findings bring to the understanding of the rational/comprehensive approach to conflict management in actual planning process? Spatial planning legislation in Slovenia prescribes process of preparing spatial development plans. It grants experts responsibility for projecting the new object, and in the case of transport infrastructure also possible variants. This is followed by an in-depth expert analysis as a key instrument to obtain rational arguments for the most suitable route.

In the case of the third development axis highway, the first step was made with preliminary projections of possible routes taking into account four main guidelines:

(i) the route that avoided protected areas, (ii) financially most efficient route, (iii) route that linked the largest towns, and (iv) the route that linked largest towns with railway. All four options were then analyzed on the basis of different scenarios and projections, such as projected traffic flows and use of public transport, anticipated urban and economic development of towns, expected environmental impacts, etc. The preliminary analysis ended with the exclusion of the option (iv) that predicted a railway connection because it was evaluated as economically inefficient. From this decision on, only the highway option was considered even though later in the planning process several actors warned the decision-makers that a four-lane highway is oversized for the existing and projected traffic flows on the route. They claimed that railway connection would be more in line with contemporary endeavours to minimize automobile traffic and promote public transport instead. This example clearly shows, how experts may act in accordance with their own ideologies even though they are at odds with the state's overall sustainable development goals. This case also shows that experts' arguments may be conflictual and thus need to be deliberated and confronted with wider community of experts.

The identification of possible options for highway construction was followed by the formal expert analysis of variants. This is based on four groups of criteria: (i) technical, (ii) financial, (iii) urban/spatial, and (iv) environmental. The results showed that the two options that scored the highest received the same number of points (F2 and F6, see Fig. 5). Despite equal scoring, the group of participating experts decided in favour of variant F2 without a clear justification. Therefore, in the audit of the planning process, examiners identified several shortcomings. The first was related to the anticipated impacts on the high-value agricultural lands in the Savinjska region (section F). Although the future highway would take up a significant amount of agricultural land, the impacts were evaluated as minor because mitigation measures were provided, in line with formal regulations (e.g. noise and green barriers). This is an example of how formal regulations in some cases do not confer legitimacy, but create conflict. Such an assessment, while consistent with formal regulations, was clearly illegitimate for several actors, not only from the local community but also from the academia and the ministry responsible for agriculture.

The second shortcoming of the expert analysis was the arbitrary nature of the criteria set forth by each of the four expert groups for evaluating highway options. For example, it was not clear whether the highway would be better located in a forestland or in an agricultural area. This ambiguity was a direct consequence of the vagueness of the highway project as a whole. The state prioritized the benefits of the new infrastructure for the Koroška region, while the benefits for the Savinjska region and Slovenia as a whole were not clearly defined in the project documentation. This example shows how local lobby groups (from Koroška region) influenced the state-led project. This also complicated the work of the experts, who were forced to analyze the variants according to their own knowledge, values and beliefs, rather than in the public interest. The case also highlights how even expert analyses can be biased—seemingly objective experts do not always act in a completely rational and objective manner. One of the examiners of the planning process also concluded that the third development axis highway was planned in the interest of the investor.
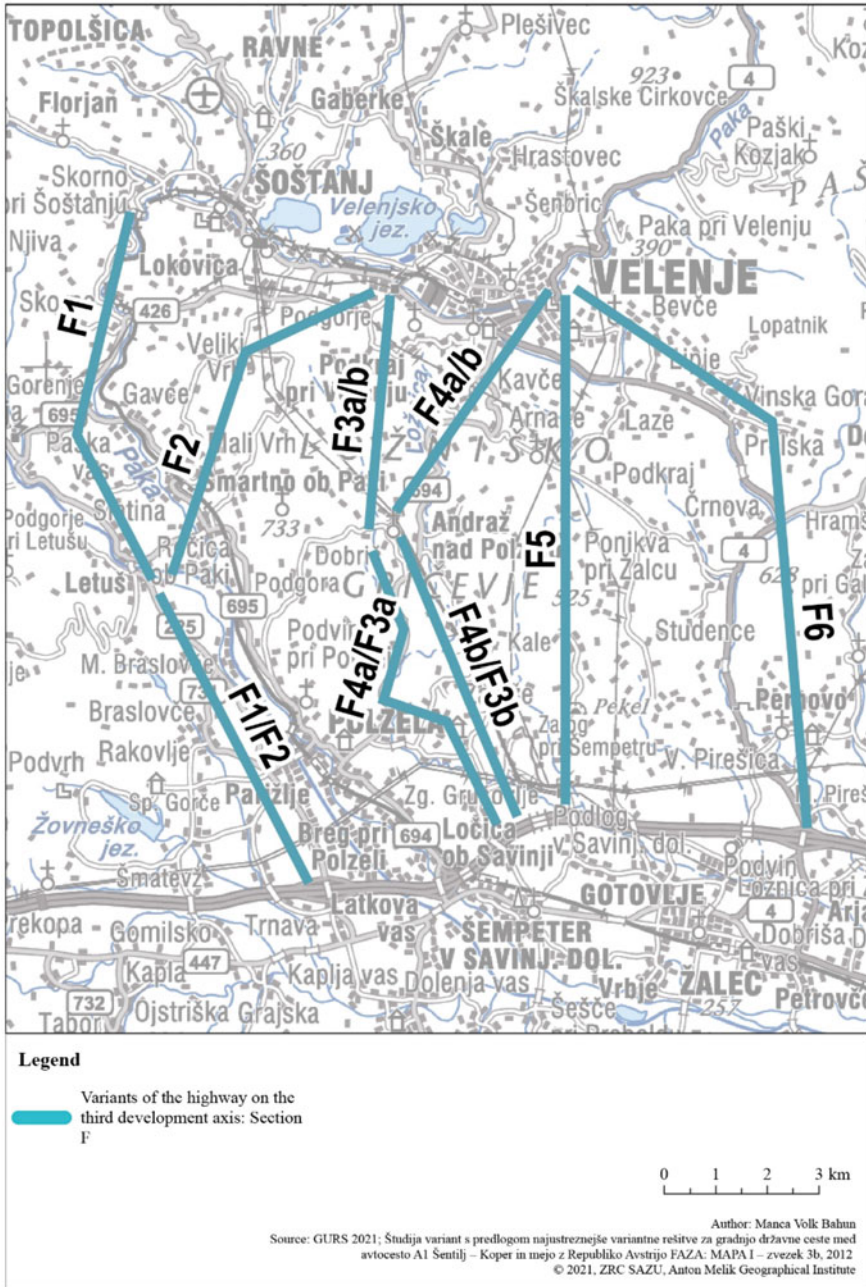
Fig. 5 Variants of the third development axis highway on the section between Velenje and the Šentilj–Koper A1 motorway, Slovenia

Although several experts suggested reconstruction and modernization of the existing road network and believed that this would suffice the expected traffic flows, the decision-makers opted for the expensive four-lane highway with several technically challenging structures, planned as a highway. The examiner believed that the main reason for highway option was the fact that tolls are obligatory for users of Slovenian highways. He stated that financial interests in the case of the third development axis had outweighed rationality.

In practice, the seemingly objective expert knowledge as the main pillar of the rational/comprehensive approach to conflict management was based on exclusion, shaped by discourses and automobile ideology, and was susceptible to financial interests. Conflicts that have arisen in the rational/comprehensive approach to planning have not been adequately managed, but rather avoided. This enabled the politicization of experts' arguments in planning process and thus contributed to the overall illegitimacy of the project of the third development axis.

Communicative Approach

The communicative approach originated as a critique of the rational/comprehensive planning approach and has evolved since the 1960s. For example, urbanist Paul Davidoff (1965) pointed out that the actions of experts cannot be completely neutral and just in practice. Experts, including spatial planners, have different value systems that influence their goals and decisions (Davidoff 1965). Sharry Arnstein (1969) used her ladder of participation to show different levels of public influence on decisions. Her account of public participation was a call for democratizing planning processes and moving from avoidance (non-participation) and tokenism to higher levels such as partnerships, delegated power, and citizen control (citizen power) (Arnstein 1969).

Since the 1980s, communicative approaches, under the influence of Habermas's Theory of communicative action, have become a central framework in planning science, referring to communicative rationality. This shift assumes that the legitimacy of social action can only be acquired through public debate in an open and inclusive decision-making process that aims to achieve rational consensus among participating actors. Deliberation is viewed as a pragmatic activity of equal actors, including the public, working to reach a common understanding with each other through reasoning. They are said to act according to truth, normative rightness, and sincerity. Finally, a decision is reached when all participants in a deliberation agree on one rational argument (Habermas 1983). Although Habermas admits that his discourse ethics is an unattainable ideal, he nevertheless considers it a model to which practitioners should aspire (Habermas 1996).

The idea of deliberative decision-making and democratization of planning processes has been taken up by several planning scholars (Forester 1999; Healey 1997; Innes and Booher 2004, 2010) and applied to the international planning policy level. The Torremolinos Charter (1983) institutionalized four principles for planning, which were to be democratic, comprehensive, functional, and long-term. The basis

of all four principles is deliberation, which allows actors to express their interests, values, and goals, and to have a say in deciding future spatial development. The right of citizens to participate in environmental decision-making was also further institutionalized with the Aarhus Convention (1998), which gives individuals access to information, the right to participate in decision-making, and access to justice in environmental matters.

The communicative approach to conflict management was also applied in the case of the third development axis highway planning process. The Slovenian spatial planning legislation formally prescribed two approaches that enabled and facilitated deliberation. The first is a coordination conference facilitating the participation of sectoral ministries, affected municipalities, economic actors, interest groups, and organized civil society. The conference allowed participating actors to express their interests, suggestions, and requirements for the subsequent planning process. It was organized before possible variants were defined, thus allowing actors to have a say in the design of the planned infrastructure. However, the conference was held only at the beginning of the planning process, when the residents of the affected municipalities did not have much information about the future infrastructure. Therefore, civil society in a form of organized public interest groups had not yet been formed. Therefore, the interests of local residents in participating in this conference was low.

The second approach is public hearings and public displays, which enable active participation of local communities. According to the spatial planning legislation, they were organized after the expert analysis. From a conflict management perspective, such an approach is not sufficient, as the case study has shown. Local residents could not have influenced the final decision, but were only informed about the results of the expert analysis and could have made suggestions for optimizations of the "objectively/rationally" selected variant. The case of the third development axis showed that such an approach is similar to the tokenistic approach to participation described by Arnstein (1969) and also does not comply with the Aarhus Convention (1998). Although the decision-making process was organized and carried out in accordance with the formally prescribed preparation of the spatial development plan, it was not legitimate because the decisions made did not reflect the consensus of scientists/experts or the consensus in the relationship between the state decision-makers and the public.

Agonistic Approach

Agonistic approaches to conflict management emerged as a critique of communicative planning theories. Inspired by postmodern thinkers, they criticize communicative approaches for neglecting conflict and instead focusing too much on consensus (Kühn 2021). Habermas's Theory of communicative action is considered one of the last grand narratives whose time has passed (Kos 1993). The scientific claim to truth has been replaced by the plurality of small narratives and the emancipation and individuation of social groups that were excluded from political decision-making

(Ruitenberg 2018). One of the main building blocks of this critique lies in the relativization of scientific discourse. While in the communicative approach, science is still the framework for judging arguments; in postmodernism, it has lost its consecrated status and has become one of many equal frameworks for interpreting truth (Kos 1993). This means that we cannot rely on one objective truth upon which we could decide between different conflicting values, arguments, and practices. Planning scholars have argued that the democratization of planning processes has unveiled new problems of legitimacy, methodology, and epistemology (Swingedgouw 2005; Allmendinger in Haughton 2012). Without an objective methodological framework for assessing the relevance of actors' arguments, legitimizing decisions became much more challenging. Moreover, planning scholars argue that decisions made in planning practice are always context-dependent. What matters is not what the absolute truth is, but what is considered as appropriate and legitimate decision (Gordon 2009). Thus, actors' actions are sometimes pragmatic and strategic, depending on their private (even selfish) interests (Forester 2009). One of the criticisms of communicative approaches to decision-making is also the inevitable problem of exclusion, either in terms of particular interest/social groups or in a substantive sense. In practice, conflict management is therefore often based on tokenism rather than inclusive deliberation (Nared et al. 2015).

A significant theoretical contribution to the agonistic approach to conflict management was made by political philosopher Chantal Mouffe. The author criticizes consensual deliberative democracy, as proposed by Habermas, for excluding conflict from the political. She argues instead that conflict is essential to the existence of democracy. This means that we must foreground conflict in our democratic endeavours. The goal is not conflict resolution, but the achievement of mutual understanding among actors and the legitimization of arguments (Mouffe 2005). However, final conflict resolution or consensus is not possible because any stabilization of conflict is based on power relations and exclusion (Laclau and Mouffe 2001). Therefore, as a result of different rationalities and values, conflicts cannot be resolved rationally. This stance does not justify a flight into relativization of arguments or indifference, but on the contrary, increases the importance of deliberation and our endeavours to justify and ground our decisions (Latour 2011). The goal of the agonistic approach is to transform antagonisms—conflicts between enemies—into agonisms—conflicts between adversaries, and thus stabilize tensions in human relations (Mouffe 2000).

In the case of the third development axis highway planning, the agonistic approach and the communicative approaches were intertwined. Since conflicts were not appropriately addressed within the formally prescribed planning process, decision-makers organized several additional, formally unspecified approaches to conflict management, such as coordination meetings, additional public hearings, and inter-sectoral expert groups. These arenas provided for the expression of conflicting interests were intended to reduce the conflicting nature of the planning process but had no real benefit. Due to the rigidity of the planning process, the reliance of decision-makers on the results of expert analysis, and their rejection of stepping back from already taken decisions, no transformation of antagonisms into agonisms was achieved.

Moreover, during the planning process, several citizens' initiatives emerged, which mainly felt that they were excluded from the planning process. Their opposition to the chosen F2 variant was supported by several local residents, scientists, and political representatives. Failed formal attempts to tame conflict over the third development axis highway encouraged civic initiatives to organize various informal forms and arenas of expressing conflicting interests, such as through media coverage, websites, and protests. However, antagonisms between the proponents of the highway on route F2 and the opponent of the destruction of high-value agricultural lands have not transformed into agonisms. Tensions within expert community and between decision-makers and local communities in the Savinjska region have not stabilized. As a consequence, the decision for the F2 variant will be realized, regardless of its illegitimacy.

Interrogating Conflict Management in Planning Processes: Analytical and Practical Implications for Highway Planning

In the preceding sections, I have explored how various theoretical planning models account for conflict management and how reality does not always live up to the theoretical expectations. I have developed this argument in two ways. First, I have foregrounded the entanglements between people and space to illustrate why and in what ways our conceptions and planned changes in space can differ and also conflict. And second, I presented theoretical models of conflict management in spatial planning as a lens for interpreting the concrete planning process—the third development axis highway, Slovenia (section F).

I showed that in practice, all three theoretical models are essential for planning practice and are intertwined. They use rationality, deliberation, and conflict expression as a means for conflict management, yet none of these approaches account for the dynamic and context-dependent nature of decision-making processes. Rational/comprehensive and communicative models of conflict management remain blind to conflicts within scientific arena and to the fact that even experts' arguments depend on their personal worldviews, values, economic interests, established power relations, formal institutional frameworks, and regionally specific perceptions of the planned infrastructure. Relatedly, structural avoidance to conflict dominate agonistic approaches as well. The attempts to recognize, confront, and stabilize conflicting interests are futile when decision-making processes are not adaptive to the constant possibility of conflict and at the same time uphold the consecrated status of science as a generator of objective truth.

I have illustrated these conceptual findings with reference to the actual planning process of the third development axis highway, Slovenia, to tackle rigid and context-ignorant dynamics of planning practice. To challenge this issues, I subsequently propose three adaptations of future analytical approaches to planning processes and the corresponding implications for planning practice.

The Change of Focus from Public Oppositions to the Entire Spectrum of Conflicting Interests

First, I propose to broaden the focus from public participation that tackles conflicts between the decision-makers and the public to the entire spectre of actors. If planning practitioners want to manage conflict more effectively, they should address it in multiple arenas, including academia, public institutions, business, and the general public. The focus of planning scholars and practitioners should be on actors' interests and perceptions of place and planned spatial developments, rather than relying on theoretical assumptions about how to manage conflict in a procedural sense (de Roo 2012). This shift requires critical reflections on epistemology of conflict, which is not only in the domain of public oppositions to the national authorities but is also inherent in all social relations (Počkar et al. 2009). In this perspective, conflict cannot be avoided with rational/comprehensive expert analyses, nor managed exclusively with public participation and conflict expression. According to Laclau and Mouffe (2001), it is impossible to reach an ultimate solution of the conflict and consider all interests and aspirations. And yet, the need for making decisions persists, especially in spatial planning. Thus, there is always a need for constant balance between unavoidable exclusion and the necessity for making decisions.

All three approaches to conflict management overlook the dynamic and context-dependent nature of planning processes. Planning practitioners, as transdisciplinary experts responsible for the preparation of spatial development plans, have a dual role and responsibility. On the one hand, they have the task of representing the planning profession in planning processes. On the other, they are responsible for conducting planning processes. Therefore, they should also be able to recognize constant power imbalances and possibilities of potential conflicts in the network of actors. Conflict management, therefore, means continuous endeavours or taming conflicts and responsible exclusions of certain options throughout the whole planning process, including rational/comprehensive and communicative approaches.

Conflict Management as an Integral Part of Planning Processes Rather Than One-Time Inclusionary Event: Implications for Context-Dependent Adaptive Planning Practice

Relatedly, I propose a second analytical change that has its implications in the shift of conflict management perception from a one-time inclusionary event to a continuous deliberative action. Institutionalization of planning procedures has established a rigid division of work between experts, public institutions, and the public. Each group of actors acts in accordance with formal regulations, whereas only the public participation aspect of the planning procedure assumes the possibility of conflict. In order to tame antagonisms in different decision-making arenas, including

academic, institutional, and public, planning processes should be treated as dynamic, context-dependent, and adaptive processes.

Institutionalized planning procedure and sectoral regulations are without a doubt important for taming increasing complexity in planning practice. But at the same time, these formal regulations should also allow for expressing conflicting interests and predict respecting adaptations of decision-making process to specific socio-spatial contexts. Research showed that conflict management in the case of the third development axis highway was largely based on formally prescribed state-led planning approaches, often showing tendencies to avoid conflict. Both preliminary analyses and expert analyses of variants were state-led and carried out in a closed, "rational" way, with criteria, that did not take into account the specifics and values of the local environment and broader community of experts. Formally not prescribed, additional public hearing was an attempt to facilitate conflict management, but was also based on conflict avoidance. Decision-makers refused to consider different arguments and relied on supposedly objective expert analyses. Despite the assessed influences of a highway on agricultural lands in the study, the case was legally correct, but they proved to be illegitimate and thus highly conflicting. Agricultural land was considered to be of great importance, not only for the local community but also for the state's self-sufficiency in food production. Rigidity of planning procedure and reproduction of power imbalances allowed decision-makers to avoid conflict management with referencing to formal regulations.

As the work of experts is also subject to various contextual influences (Latour 2011), decision-making processes should be more context-dependent and adaptive. Concretely, this could be achieved with facilitating "expert deliberation". The expert analyses of variants should first be followed by the confrontation of results not only with other experts participating in this procedure, but also with the wider community of experts, to verify the representativeness of the results. Expert deliberation would reduce the possibility of conflicts in the following planning procedure. Otherwise, as the planning practice has shown, expert arguments for decisions taken can easily become biased, politicized, and as such unconvincing in front of the expert and lay public. Increasing variability of expert arguments does not justify indifferent relativization, but needs to be the motivation for strengthening deliberation within the expert community as well as in the relation with the public, to achieve "conflictual consensus" (Mouffe 2005)—as I perceive it, a consensus that is based on responsible and justified exclusions of some options.

Active Citizenship and Its Contribution to Conflict Management

Lastly, recognition of conflicts as inherent to all social relations, and of planning processes as continuous deliberative actions of actors that strive for making responsible and justified decisions, entails active citizenship. This requires viewing spatial

conflicts not as an anomaly in planning processes but as part of all social relations. As I have shown with the case of highway planning, planning processes are imbued with conflicts of interests, power imbalances, ideologies, biases, different value judgements, etc. that are unpredictable and constantly require democratic and adaptable deliberative actions. Therefore, I argue that the efficiency of planning processes depends on the cultivation of democratic culture that goes beyond state-led planning approaches to conflict management. Democratic and adaptable planning approach should step back from ideal models of planning. We propose a renewal of planning practices to become more context-adaptive and enabling continuous democratic encounters of actors in different formal and informal arenas throughout the entire planning process. This does not require merely a procedural but also behavioural changes, requiring active citizenship. Active citizenship here is not limited to local community or residents, but citizens in general, including scientists/experts, decision-makers, municipal officials, and residents. It is meant as all actors' preparedness to share information and own perceptions, to hear others' rationalizations of issues, to enable democratic encounters, and to be actively involved in a decision-making process. Only well-informed actors can equally participate in decision-making processes and critically assess arguments that can be scientifically—or value-based (Gutmann and Thompson 2004).

Conflict management goes hand in hand with planning process and is not a single, one-time event. It requires all actors to cultivate democratic values. This means that decision-makers, local authorities, and experts should ensure continuous up-to-date and transparent information about the project to residents. In an adaptive, deliberative decision-making processes, they should provide opportunities for deliberation and be open to counter arguments, if they are relevant and feasible. However, residents should make an effort to accept and consider the given information and to be actively involved and seize the opportunity to participate and deliberate throughout a decision-making process. Acknowledging conflicts as an integral part of planning processes and continuous efforts to tame them are important to effectively counter authoritarian and exclusionary tendencies. The success of adaptable deliberative approaches to conflict management in different contexts remains unpredictable. Nevertheless, such an approach offers opportunities for ongoing conflict management, which could contribute to preventing stagnations in planning processes, mistrust, and environmentally harmful spatial developments.

Concluding Thoughts

By analyzing the third development axis highway planning process, I showed how even seemingly objective and rational decisions of experts are prone to economic interests, how scientific aspects of decision-making are based on exclusion, and how the concepts of deliberation and agonistic approaches overlook conflicts within the scientific arena. The planning process studied revealed power asymmetries that perpetuate the avoidance of deliberation not only in the relationship between

decision-makers and the public, but also within the expert community. Exclusion is not only a problem of civil society, but also of the experts who are excluded from formal expert analyses. Finally, the analysis has shown that even formal regulations should sometimes be reconsidered and deliberated in relation to the specific socio-spatial context. Conflicts are unpredictable, as are actors' perceptions of space and planned spatial developments. Therefore, planning practice should be adaptable and continuously deliberative.

References

Alexander ER (2002) The public interest in planning: From legitimation to substantive plan evaluation. Plan Theory 1(3):226–249. https://doi.org/10.1177/147309520200100303

Alexander ER (2000) Rationality revisited. Planning paradigms in a post-postmodernist perspective. J Plan Educ Res 19:242–256. https://doi.org/10.1177/0739456X0001900303

Allmendinger P, Haughton G (2012) Post-political spatial planning in England: A crisis of consensus? Trans Inst Br Geogr 37(1):89–103. https://doi.org/10.1111/j.1475-5661.2011.00468.x

Almeida J, Costa C, Nunes da Silva F (2017) A framework for conflict analysis in spatial planning for tourism. Tourism Manage Perspect 24:94–106. https://doi.org/10.1016/j.tmp.2017.07.021

Arnstein S (1969) A ladder of citizen participation. J Am Inst Plann 35:216–224. https://doi.org/10.1080/01944366908977225

Aarhus Convention (1998) Convention on access to information, public participation in decision-making and access to justice in environmental matters. https://unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf. Accessed 6 June 2022

Cieślak I (2019) Spatial conflicts. Analyzing a burden created by differing land use. Acta Geogr Slov 59(2):43–57. https://doi.org/10.3986/AGS.5181

Davidoff P (1965) Advocacy and pluralism in planning. J Am Inst Plann 31:331–338. https://doi.org/10.1080/01944366508978187

Davoudi S (2005) Understanding territorial cohesion. Plan Pract Res 20:433–441. https://doi.org/10.1080/02697450600767926

de Roo G (2012) Spatial planning, complexity and a world 'out of equilibrium': outline of a non-linear approach to planning. In: Complexity and planning: systems, assemblages and simulations. Routledge, New York, pp 141–175

European Spatial Development Perspective (1999). https://ec.europa.eu/regional_policy/sources/docoffic/official/reports/pdf/sum_en.pdf. Accessed 6 June 2022

Flyvbjerg B (1998) Rationality and power. Democracy in practice. University of Chicago Press, Chicago.

Flyvbjerg B, Richardson T (2002) Planning and Foucault. In search of the dark side of planning theory. In: Planning futures. New directions for planning theory. Routledge, London in New York, pp 44–62

Forester J (1999) The deliberative practitioner. Encouraging participatory planning processes. MIT Press, Cambridge

Forester J (2009) Dealing with differences. Dramas of mediating public disputes. Oxford University Press, New York

Goluža M (2022) Konflikti pri umeščanju prometne infrastrukture v prostor v Sloveniji. Doktorska disertacija. Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo, Ljubljana

Gordon R (2009) Power and legitimacy: from weber to contemporary theory. In: The SAGE handbook of power. SAGE Publications, pp 256–273. https://doi.org/10.4135/9780857021014.n14

Gualini E (2010) Governance, space and politics. Exploring the governmentality of planning. In: The Ashgate research companion to planning theory. Conceptual challenges for spatial planning. Routledge, New York, London, pp 57–85. https://www.routledgehandbooks.com/doi/https://doi.org/10.4324/9781315279251.ch1. Accessed 6 June 2022. https://doi.org/10.4324/9781315279251.ch1

Gualini E (2015) Planning and conflict. Critical perspectives on contentious urban developments. Routledge, New York in London

Gunn S, Hillier J (2014) When uncertainty is interpreted as risk: an analysis of tensions relating to spatial planning reform in England. Plan Pract Res 29:56–74. https://doi.org/10.1080/02697459.2013.848530

Guštin Š (2015) Prepoznavanje in prostorska razmestitev konfliktov na podeželju. Geogr Vestn 87(1):81–101. https://doi.org/10.3986/GV87105

Guštin Š, Potočnik Slavič I (2020) Conflicts as catalysts for change in rural areas. J Rural Stud 78:211–222. https://doi.org/10.1016/j.jrurstud.2020.06.024

Gutmann A, Thompson DF (2004) Why deliberative democracy? Princeton University Press, Princeton

Habermas J (1974) Theory and practice. Heinemann, London

Habermas J (1983) The theory of communicative action, vol 1. Reason and the rationalization of society. Beacon Press, Boston

Habermas J (1996) Between facts and norms. Contributions to a discourse theory of law and democracy. Polity Press, Cambridge

Harvey D (1996) Justice, nature and the geography of difference. Blackwell Publishers, Malden in Oxford

Healey P (1997) Collaborative planning. Shaping places in fragmented societies. Palgrave, London. https://doi.org/10.1007/978-1-349-25538-2

Hillier J (2003) Agon'izing over consensus. Why Habermasian ideals cannot be 'real.' Plan Theor 2:37–59. https://doi.org/10.1177/1473095203002001005

Hillier J (2002) Direct action and agonism in democratic planning practice. In: Planning futures. New directions for planning theory. Routledge, London in New York, pp 110–135

Innes IE, Booher DE (2010) Planning with complexity. An introduction to collaborative rationality for public policy. Routledge, London in New York

Innes IE, Booher DE (2004) Reframing public participation. Strategies for the 21st century. Plan Theor Pract 5:419–436. https://doi.org/10.1080/1464935042000293170

Innes JE, Booher DE (2016) Collaborative rationality as a strategy for working with wicked problems. Landsc Urban Plan 154:8–10. https://doi.org/10.1016/j.landurbplan.2016.03.016

Kos D (1997) Členjenje prostorskih politik. Urbani izziv 30(31):14–18

Kos D (1993) Racionalnost neformalnih prostorov. Fakulteta za družbene vede, Ljubljana

Kühn M (2021) Agonistic planning theory revisited: the planner's role in dealing with conflict. Plan Theor 20(2):143–156. https://doi.org/10.1177/1473095220953201

Laclau E, Mouffe C (2001) Hegemony and socialist strategy. Towards a radical democratic politics. 2. izdaja. Verso, London in New York

Latour B (2011) Pandorino upanje. Študentska založba, Ljubljana

Lefebvre H (2013) Produkcija prostora. Studia Humanitatis, Ljubljana

Moore A (2017) Democracy and problem of expertise. In: Critical elitism. Deliberation, democracy, and the problem of expertise. Cambridge University Press, Cambridge, pp 34–58. https://doi.org/10.1017/9781108159906.003

Mouffe C (2000) The democratic paradox. Verso, London in New York

Mouffe C (2005) On the political. Thinking in action. Routledge, London

Nared J, RazpotnikVisković N, Cremer-Schulte D, Brozzi R, Cortines Garcia F (2015) Achieving sustainable spatial development in the Alps through participatory planning. Acta geographica Slovenica 55:363–373. https://doi.org/10.3986/AGS.1631

Philippopoulos-Mihalopoulos A (2010) Spatial justice: law and the geography of withdrawal. Int J Law Context 6:201–216. https://doi.org/10.1017/S174455231000011X

Pløger J (2004) Strife. Urban planning and agonism. Plann Theor 37:71–92. https://doi.org/10.1177/1473095204042318

Počkar M, Andolšek S, Popit T, Barle Lakota A (2009) Uvod v sociologijo. DZS, Ljubljana. Accessed 3 September 2021. http://vedez.dzs.si/datoteke/uvod-v-soc-1.pdf

The Sustainable Development Goals Programme (2022). https://www.springernature.com/gp/researchers/sdg-programme. Accessed 21 Sept 2022

Rittel HWJ, Webber MM (1973) Dilemmas in a general theory of planning. Policy Sci 4

Rorty R (2000) Universality and truth. In: Rorty and his critics. Blackwell Publishers, Oxford

Ruitenberg CW (2018) Postmodernism and poststructuralism. In: International handbook of philosophy of education. Springer international handbooks of education. Springer, Cham, pp 689–702. https://doi.org/10.1007/978-3-319-72761-5_51

Schroer M (2018) Spatial theories/social construction of spaces. The Wiley Blackwell encyclopedia of urban and regional studies. Wiley Online Library. https://doi.org/10.1002/9781118568446.eurs0313

Simoneti M (2010) Čas je za spremembe v urejanju prostora. Državni svet Republike Slovenije, Ljubljana. http://www.ds-rs.si/sites/default/files/dokumenti/zbornik_cas_za_spremembe_v_urejanju_prostroa.pdf. Accessed 6 June 2022

Šmid Hribar M, Kozina J, Bole D, Urbanc M (2018) Javno dobro, skupni viri in skupno. Vpliv zgodovinske zapuščine na sodobno dojemanje v Sloveniji kot tranzicijski družbi. Urbani izziv 29:43–55. https://doi.org/10.5379/urbani-izziv-2018-29-01-004

Soja EW (2009) The city and spatial justice. https://www.jssj.org/wp-content/uploads/2012/12/JSSJ1-1en4.pdf. Accessed 6 June 2022

Swyngedouw E (2005) Governance innovation and the citizen. The Janus face of governance-beyond-the-state. Urban Stud 42:1991–2006. https://doi.org/10.1080/00420980500279869

Torremolinos Charter. Resolution No. 2 on The European regional/spatial planning charter. https://rm.coe.int/6th-european-conference-of-ministers-responsible-for-regional-planning/168076dd93. Accessed 6 June 2022

Territorial Agenda 2030. A future for all places. https://territorialagenda.eu/wp-content/uploads/TA2030_jun2021_en.pdf. Accessed 6 June 2022

Von Der Dunk A, Grêt-Regamey A, Dalang T, Hersperger AM (2011) Defining a typology of peri-urban land-use conflicts. A case study from Switzerland. Landsc Urban Plan 101:149–156. https://doi.org/10.1016/j.landurbplan.2011.02.007

Spatial Distribution of Land Cover in North Eastern Region of India: An Appraisal Using Geospatial Technology

Krishna Das and **Ashok Kumar Bora**

Abstract Land cover represents spatial information on different types of physical coverage of the earth's surface. Appraising the spatial distribution of land cover is crucial for better understanding of the earth's surficial characteristics, environmental processes, ecosystems interactions and human imprints on landscape. Nowadays, geospatial technology plays a vital role in land cover mapping as this approach provides accurate results of land cover estimation at local, regional and global scales with high, moderate and coarse resolution remotely-sensed data. This study appraises the spatial distribution of land cover in north eastern region of India using geospatial technology from a global remote sensing land cover data product with 100 m spatial resolution. The north eastern region of India comprising eight states has a unique geographical personality. The study observes ten different major land cover types in the region during 2019. Remote sensing land cover data, GIS administrative layer and SRTM data have been incorporated in this study to show the state-wise and elevation-wise distribution of land cover in the region. The study also tries to depict the land cover distribution within a buffer zone of 7 km radius around every state capital location of the eight north eastern states. The study has found that the north eastern region has more proportion of forests as compared to that of the entire country. Among the eight states of the region, Assam has a maximum proportion of cropland, built-up and permanent inland water. Moreover, maximum distribution of forests and herbaceous vegetation cover is observed in the high elevation zones of the north eastern region. The entire study provides a significant scientific methodology for regional level land cover appraisal based on geospatial technology.

Keywords Land cover · Remote sensing data · Spatial distribution · SRTM · GIS · North Eastern Region

K. Das (✉)
Department of Geography, Pragjyotish College, Guwahati, India
e-mail: krishna@pragjyotishcollege.ac.in

A. K. Bora
Department of Geography, Gauhati University, Guwahati, India
e-mail: ashokkumarbora@gauhati.ac.in

Introduction

Land is an important natural resource of the earth's environment. Land cover is the primary element of the earth's surface which provides information on human-ecosystem interactions. The Food and Agricultural Organization (FAO) defines land cover as 'the observed bio-physical cover on the earth's surface'. Land cover denotes the physical and biotic assemblage and character of the earth's surface (Meyer and Turner 1992). Land cover also refers to all the natural and human-made features that cover the earth's immediate material surface (Thompson 1996). Land cover is considered as one of the significant parameters for understanding about the earth's ecosystem and human imprints over the earth's surface. Land cover is a critical variable for understanding the earth's dynamic environment at local, regional and global scales (Congalton et al. 2014). Assessing the spatial distribution of recent land cover of the earth's surface is an essential factor for addressing various geo-environmental issues such as climate change, natural resource management, biodiversity depletion, environmental pollution, and also for implementation of sustainable development policy framework at global levels (Grekousis et al. 2015). For the better and accurate assessment of recent land cover distribution of any area over the earth's surface, the updated land cover data of the concerned area are the prime requirements. The recent and updated land cover data can only be accurately obtained from the earth observation satellite remote sensing data products. Satellite remote sensing data are of high quality in terms of ground resolution, synoptic coverage and temporal records as compared to conventional maps (Rees 2012). The 'Landsat-1' remote sensing earth observation programme of United States Geological Survey (USGS) and National Aeronautics and Space Administration (NASA) was the first ever satellite remote sensing programme which provided remote sensing data for public use globally during 1970's, and since then satellite remote sensing data played a vital role as an ideal data source for land cover mapping, classifications and estimations (Franklin and Wulder 2002).

The modern land cover mapping, classifications and estimations using remote sensing data were first carried out by Anderson et al. in 1976 for the entire USA. Anderson et al. adopted Landsat satellite data for highest order of land cover and land use classification, i.e. the 'Level-I' land cover classification scheme categorising the surface land cover of the USA into built-up land, agricultural land, rangeland, forest land, water, wetland, barren land, tundra and perennial snow or ice cover classes (Rozenstein and Karnieli 2010). After the pioneering works of Anderson et al. on land cover and land use classification system using remote sensing data, the remote sensing data, especially the freely available satellite data, become the prime data sources for land cover and land use classification, mapping and estimation over the earth's surface. Several studies by various researchers around the world incorporated remote sensing data of different spatio-temporal resolutions for land cover classification, mapping and assessment at local, regional, national, continental and global level observations (Tucker et al. 1985; Giri and Shrestha 1996; Defries and Belward 2000; Hansen et al. 2000; Eva et al. 2004; Bartholomé and Belward 2005;

Chen et al. 2015; Rujoiu-Mare and Mihai 2016; Wulder et al. 2018; Sulla-Menashe et al. 2019). Besides, some of the leading space research organizations of the world such as NASA, European Space Agency (ESA), Indian Space Research organization (ISRO) and Japan Aerospace Exploration Agency (JAXA) widely exercised land cover assessments at country and global scales using varieties of multi-temporal and multi-resolution remote sensing data for numerous geo-environmental and socio-economic applications (Gong et al. 2013; Kotharkar and Bagade 2017). These organizations have also created web-geo-portals to disseminate their satellite-derived land cover data products to the researchers for further problem-specific applications, research and development. Many researchers from different parts of the world have extensively utilized these satellite-derived land cover data products in their thematic research studies as these data products are readily accessible and free-and-open-source with maximum accuracy results (Gutman et al. 2013; Takahashi et al. 2013; Li et al. 2016; Reddy et al. 2015; Roy et al. 2016; Zhang and Roy 2017; Duong et al. 2018; Vilar et al. 2019).

As described above, the freely accessible remote sensing data products are reliable and authentic sources for land cover assessment. This present study is also an attempt to utilize one of the existing satellite-derived remote sensing land cover products for appraising the spatial distribution of land cover in the North Eastern Region of India. The North Eastern Region of India, located in the north-eastern corner of the country, comprising the eight states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, is one of the global biodiversity hotspots with rich flora and fauna (Lele and Joshi 2009; Goswami et al. 2012). The North Easter Region of India has a unique physiographic setting with varying altitudes from high elevated mountains, hills to low elevated valley plains (Das and Bora 2021). The main aim of this study is to appraise the current land cover distribution in the North Eastern Region of India as land cover is an essential parameter to understand the unique interactions of human-ecosystems in this rich biodiversity region. Besides, appraising the current land cover distribution in this region will also provide basis for sustainable regional development planning, natural resource management, policy implementation and future research studies in this region of the country. In view of the main aim of this study, following major objectives are considered:

(a) to map and estimate the land cover in the study area based on a recent satellite-derived remote sensing dataset.
(b) to show the spatial distribution of state-wise and elevation-wise land cover in the study area.
(c) to observe the land cover distribution within the state capital buffer area for each of the eight state capitals in the study area.
(d) to analyse the temporal land cover change in the study area based on temporal satellite-derived datasets.

Methodology

Study Area

The study is confined to the north eastern region of India comprising eight states of the country namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. North eastern region is approximately located between 20° north to 29°30′ north latitudes and 87°97′ east to 97°30′ east longitudes with a geographical area of 262,179 km² which is around 8% of the country's total land area (Chatterjee 2008). The north eastern region of India shares international boundary with Bangladesh, Bhutan, China, Myanmar and Nepal (Fig. 1). The Sikkim-Arunachal and Patkai-Purvanchal Himalayas, the Karbi-Meghalya plateaus and the Barak-Brahmaputra-Imphal valleys are major physiographic features of the north eastern region (Dikshit and Dikshit 2014). The region mostly experiences tropical monsoon climatic system. As per the 2011 Census of India records, the north eastern region of India has a total population of 45,587,982 persons (around 4% of the country's total population) with a population density of 174 persons/km² (Table 1).

Fig. 1 Location of North Eastern Region, India

Table 1 Some basic statistics of North Eastern Region, India, 2011

State	Geographical area (km²)	Total population (persons)	Population density (persons/km²)	Literacy rate (%)
Arunachal Pradesh	83,743	1,382,611	17	65.38
Assam	78,438	31,169,272	398	72.19
Manipur	22,327	2,721,756	115	79.21
Meghalaya	22,429	2,964,007	132	74.43
Mizoram	21,081	1,091,014	52	91.58
Nagaland	16,579	1,980,602	119	79.55
Sikkim	7,096	607,688	86	81.42
Tripura	10,486	3,671,032	350	87.22
North-Eastern Region	262,179	45,587,982	159	78.87

Source Basic statistics of North Eastern Region, 2015

Remote Sensing Data Sources

The land cover data products of Copernicus Global Land Service (CGLS) and the Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM) are the two specific remote sensing datasets incorporated in this study. One significant advantage of these two remote sensing datasets used in this study is the open-source nature with free availability at global scale for research studies. The CGLS data products are used to appraise the spatial land cover distribution in the study area, and the SRTM DEM data are used for understanding the elevation pattern of the study area. The satellite-derived annual global land cover map (CGLS-LC100) of Copernicus Global Land Service (CGLS) with 100 m ground resolution is downloaded from CGLS web-geo-portal (https://land.copernicus.eu/global/products/lc) as *GeoTIFF* file format at 20° by 20° tile with WGS84 (EPSG:4326) coordinate reference system for the study area. The downloaded discrete land cover map is of version 3.0 CGLS data products that contains 11 discrete land cover classes under 'Level-1' legend classification code with more than 80% overall accuracy validation for 2019 which are classified under CGLS programme using PROBA-V satellite data following the United Nations Food and Agriculture Organization Land Cover Classification System (Buchhorn et al. 2020a, 2020b). The SRTM DEM data have been downloaded at 90 m pixel resolution from SRTM web-geo-portal (https://srtm.csi.cgiar.org/srtmdata/) as *GeoTIFF* file format at 20° by 20° tile with WGS1984 coordinate reference system for the study area.

Methods

This study primarily used GIS procedures and methods for addressing the objectives of the study, and incorporates the open-source Quantum GIS or QGIS 3.16 software package (https://www.qgis.org/en/site/forusers/download.html) as the key GIS platform for geoprocessing, analysis and geo-visualization of the GIS datasets.

The satellite-derived CGLS land cover dataset as well as SRTM DEM dataset are first downloaded in WGS1984 geographic coordinate reference system and then using GIS environment these datasets are transformed to projected coordinate system with WGS84/Pseudo-Mercator (EPSG:3857) for further GIS analyses and mapping. Similarly, the vector-based study area boundary shapefiles are first extracted in WGS84 (EPSG:4326) coordinate reference system (from https://static.fossee.in/mapathon/Mapathon2020_Data/) and transformed to WGS84/Pseudo-Mercator (EPSG:3857) projected coordinate system. The SRTM DEM data have been used to create the major elevation zones of the study area using raster reclassification tool in QGIS (Fig. 2). This classified elevation map is again resampled at 100 m pixel resolution from 90 m using raster resampling technique for further integration with land cover maps of the study area. The state-wise land cover maps are created based on CGLS Level-1 discrete land cover dataset in QGIS using raster extraction tool with vector boundary layer of each state. While, using buffer vector geo-processing tool in QGIS, the buffer influence area around every state capital has been created. This buffer capital area of each capital location is used as mask layer to extract and prepare the buffer capital land cover map. Now, to prepare the major elevation class-wise land cover maps of the study area, the elevation map is integrated with the land cover map of the study area in QGIS using raster reclassification and raster overlay operations. Moreover, to analyse the temporal change of land cover in the study area, the 2015 CGLS land cover datasets have been used as the base data layer. The CGLS 2015 datasets is similar to CGLS 2019 datasets having 100 m pixel size with 'Level-1' discrete land cover classes.

Results and Discussion

A General Distribution Pattern of Land Cover

The CGLS annual landcover dataset of 2019 comes with 11 discrete land cover classes under 'Level-1' legend classification code viz. forest, shrubland, herbaceous vegetation, herbaceous wetland, moss and lichen, bare/sparse vegetation, cropland, built-up, snow and ice, permanent inland water bodies, and sea (Fig. 3). These discrete land cover classes are based on the Land Cover Classification System (LCCS) developed by the United Nations (UN) Food and Agriculture Organization (FAO) (Table 2).
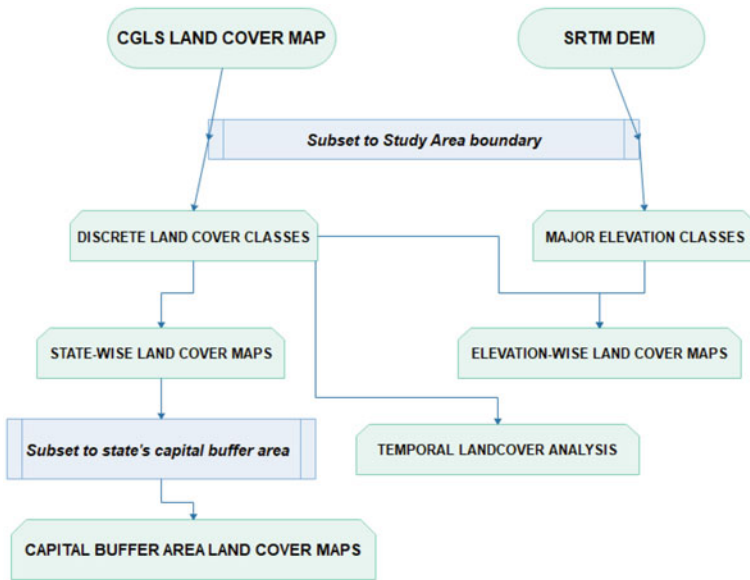
Fig. 2 A step-by-step flowchart of GIS-derived maps in this study

This 2019 CGLS discrete land cover dataset is used to create the general land cover map of the North Eastern Region of India in GIS environment. The GIS-derived land cover map of the study area is of 2019 that depicts the distribution of 10 major discrete land cover classes in North Eastern Region (Fig. 4). The land cover map of the study area shows forest as the major and significant land cover class in the region followed by cropland. The dense forest distribution is observed in the northern and southern parts of the study area, while cropland distribution is mainly concentrated in the central region. Forest represents about 74% of the region's total geographical area, whereas, cropland shares about 16% of the region's total geographical area. The distribution of moss and lichen is observed as very insignificant land cover class in the region with less than 1 km^2 area coverage (Table 3).

State-Wise Distribution Pattern of Land Cover

The forest is the dominant land cover class in Arunachal Pradesh, and almost the entire state is covered with forest except the northern and eastern peripheral areas that are covered with snow and herbaceous vegetation (Fig. 5). Cropland is concentrated mainly in the middle eastern parts of the state, while built-up land is observed in a dispersed distribution pattern in small pockets in southern parts of the state. Forest represents maximum proportion of total area in the state with more than four-fifth share (Table 4). The other significant land cover classes other than forest in the

LEVEL 1						
value map	grouping	group code	R	G	B	class name
0		0	40	40	40	unknown (no input data available)
111	X	10	0	100	0	forest
113						
112						
114						
115						
116						
121						
123						
122						
124						
125						
126						
20		20	255	187	34	shrubland
30		30	255	255	76	herbaceous vegetation
90		90	0	150	160	herbaceous wetland
100		100	250	230	160	moss & lichen
60		60	180	180	180	bare / sparse vegetation
40		40	240	150	255	cropland
50		50	250	0	0	built-up
70		70	240	240	240	snow & ice
80		80	0	50	200	permanent inland water bodies
200		200	0	0	128	sea

Fig. 3 The 'Level-1' legend of the CGLS-LC100 discrete map product (after Buchhorn et al. 2020a, 2020b)

state are herbaceous vegetation (around 10%), sparse vegetation (around 2%) and cropland (around 2%). Besides these classes, other remaining land cover classes represent about 2% total area of the state.

Assam is covered with 8 land cover classes out of 11 'Level-1' CGLS discrete land cover classes. Among these land cover classes (viz. forest, shrubland, herbaceous vegetation, cropland, built-up, bare/sparse vegetation, permanent water bodies and herbaceous wetland), cropland and forest are prominent landcover classes in the state which altogether represent about four-fifth of state's total area (Table 4). Cropland is mainly distributed in the northern, southern, eastern and western parts of the state, while forest cover is mainly observed in the central part. The permanent water bodies class is mainly distributed in a linear pattern in east–west direction in north central part of the state and this linear patter of permanent water is the mighty

Table 2 The CGLS-LC100 discrete land cover class definition (after Buchhorn et al. 2020a, 2020b)

Land cover class	Definition according UN LCCS
Forest	Closed evergreen needle leaf forest, closed deciduous needle leaf, closed evergreen broad leaf, closed deciduous broad leaf, open evergreen needle leaf forest, open deciduous needle leaf, open broad leaf, open deciduous broad leaf and mixed forests
Shrubland	These are woody perennial plants with persistent and woody stems and without any defined main stem being less than 5 m tall. The shrub foliage can be either evergreen or deciduous
Herbaceous vegetation	Plants without persistent stem or shoots above ground and lacking definite firm structure. Tree and shrub cover is less than 10%
Herbaceous wetland	Lands with a permanent mixture of water and herbaceous or woody vegetation. The vegetation can be present in either salt, brackish, or fresh water
Moss and lichen	Moss and lichen
Bare/sparse vegetation	Lands with exposed soil, sand, or rocks and never has more than 10% vegetated cover during any time of the year
Cropland	Lands covered with temporary crops followed by harvest and a bare soil period (e.g., single and multiple cropping systems)
Built-up	Land covered by buildings and other man-made structures
Snow/ice	Lands under snow or ice cover throughout the year
Permanent water bodies	Lakes, reservoirs, and rivers. Can be either fresh or salt-water bodies
Sea	Oceans, seas. Can be either fresh or salt-water bodies

Brahmaputra River of Assam (Fig. 5). The built-up land's distribution in the state is a dispersed pattern with random distribution of built-up patches. Herbaceous wetland, herbaceous vegetation, bare/sparse vegetation are other significant land cover classes found in Assam that share about 10% of the state's total area.

Except the central region, almost the entire Manipur is covered with forest and forest represents nearly 90% of the state's total area (Table 4). Other than forest, the cropland, built-up and permanent water bodies are the prominent land cover classes in the state which are distributed compactly in the mid-central region (Fig. 5).

Forest is the dominant land cover class in Meghalaya which covers almost the entire state. Cropland is the second prominent land cover class in the state which is mainly distributed in the western periphery region and eastern region of the state (Fig. 5). Forest shares about 90% of the state's total area, remaining proportions are represented by other land cover classes viz. shrubland, herbaceous vegetation, cropland, built-up, bare/sparse vegetation, permanent water bodies and herbaceous wetland (Table 4).

Forest, shrubland, herbaceous vegetation, cropland, built-up, permanent water bodies and herbaceous wetland are the land cover classes observed in Mizoram (Fig. 5). The entire state is covered with forest with nearly 97% share to the state's
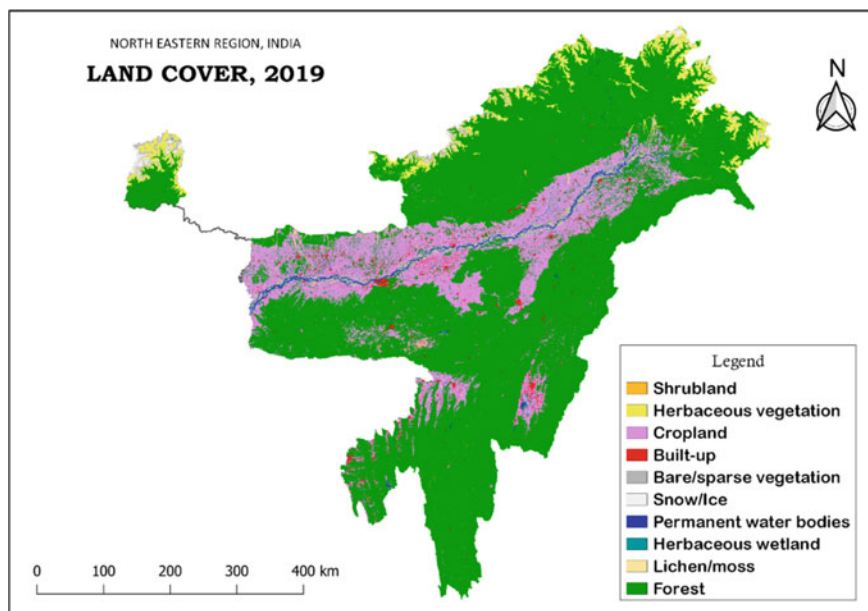
Fig. 4 Land cover map of the study area

Table 3 Land cover statistics of the study area, 2019

Land cover class	Area in km^2	Proportion in %
Shrubland	863.92	0.33
Herbaceous vegetation	11,023.70	4.20
Cropland	43,035.83	16.41
Built-up	3396.26	1.30
Bare/sparse vegetation	4699.42	1.79
Snow/ice	1268.11	0.48
Permanent water bodies	2178.93	0.83
Herbaceous wetland	1723.08	0.66
Moss and lichen	0.69	0.0002
Forest	193,989.06	73.99
Total area	262,179.00	100.00

total area. The remaining 3% state's share is represented by other land cover classes (Table 4).

Forest represents about 96% of state's total area followed by cropland (around 3%) and built-up (around 1%) in Nagaland (Table 4). Forest covers almost the state, while cropland is mainly distributed in the north-western periphery region of the
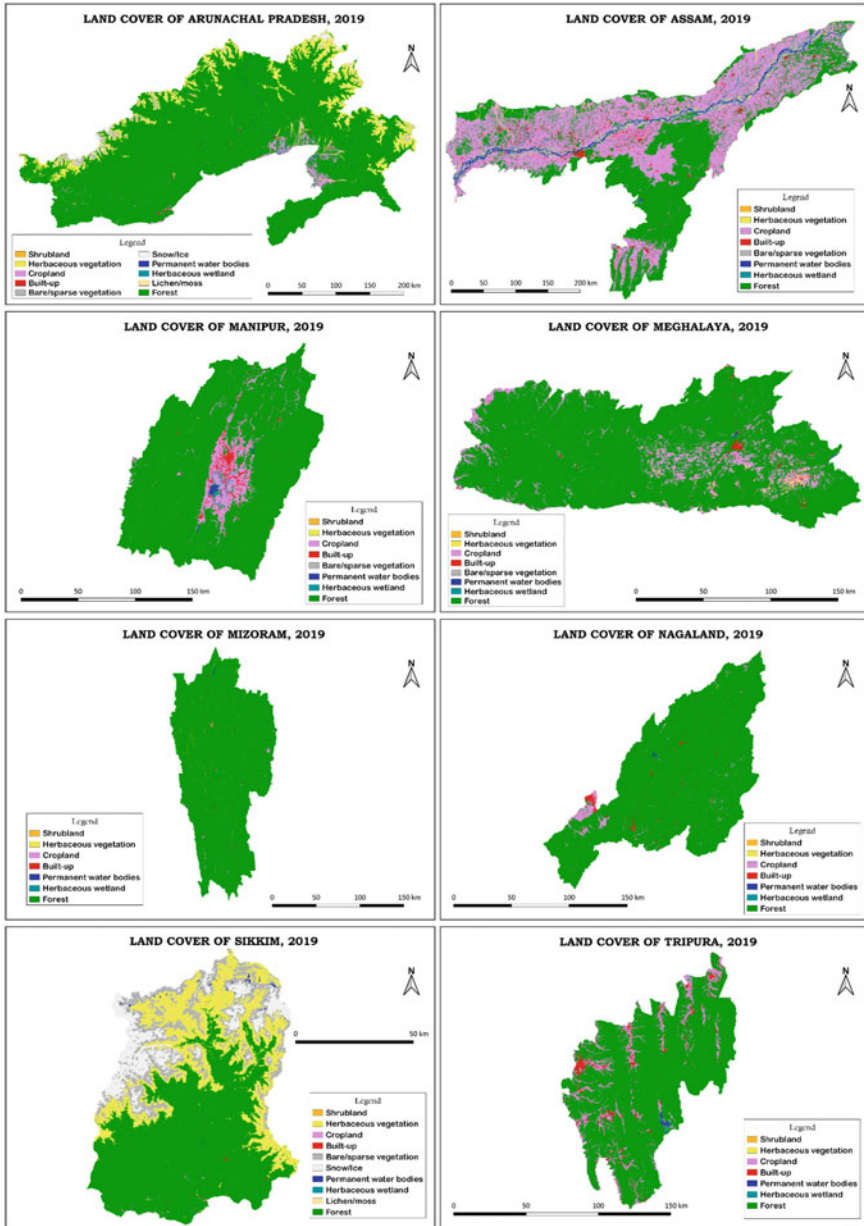
Fig. 5 Land cover maps of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura

Table 4 Land cover statistics of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, 2019

Land cover class	Area in km^2	Proportion in %
Arunachal Pradesh		
Shrubland	324.32	0.39
Herbaceous vegetation	8033.65	9.59
Cropland	1392.87	1.66
Built-up	111.60	0.13
Bare/sparse vegetation	1611.89	1.92
Snow/ice	599.54	0.72
Permanent water bodies	161.76	0.19
Herbaceous wetland	124.35	0.15
Moss and lichen	0.60	0.0007
Forest	71,382.41	85.24
State's total area	83,743.00	100.00
Assam		
Shrubland	350.09	0.45
Herbaceous vegetation	1135.44	1.45
Cropland	36,239.26	46.20
Built-up	2249.76	2.87
Bare/sparse vegetation	2046.81	2.61
Permanent water bodies	1883.21	2.40
Herbaceous wetland	1420.96	1.81
Forest	33,112.47	42.21
State's total area	78,438.00	100.00
Manipur		
Shrubland	22.81	0.10
Herbaceous vegetation	9.75	0.04
Cropland	1827.26	8.18
Built-up	395.37	1.77
Bare/sparse vegetation	0.59	0.002
Permanent water bodies	56.94	0.26
Herbaceous wetland	118.29	0.53
Forest	19,895.99	89.11
State's total area	22,327.00	100.00
Meghalaya		
Shrubland	69.74	0.31
Herbaceous vegetation	63.19	0.28
Cropland	1923.05	8.57
Built-up	154.83	0.69

Table 4 (continued)

Land cover class	Area in km^2	Proportion in %
Bare/sparse vegetation	0.73	0.003
Permanent water bodies	9.49	0.04
Herbaceous wetland	16.40	0.07
Forest	20,191.56	90.02
State's total area	22,429.00	100.00
Mizoram		
Shrubland	67.55	0.32
Herbaceous vegetation	2.47	0.01
Cropland	89.31	0.42
Built-up	40.76	0.19
Permanent water bodies	6.91	0.03
Herbaceous wetland	9.04	0.04
Forest	20,864.96	98.98
State's total area	21,081.00	100.00
Nagaland		
Shrubland	3.61	0.02
Herbaceous vegetation	3.13	0.02
Cropland	378.94	2.29
Built-up	159.30	0.96
Permanent water bodies	7.81	0.05
Herbaceous wetland	3.83	0.02
Forest	16,022.39	96.64
State's total area	16,579.00	100.00
Sikkim		
Shrubland	21.37	0.30
Herbaceous vegetation	1630.26	22.97
Cropland	6.49	0.09
Built-up	3.14	0.04
Bare/sparse vegetation	997.01	14.05
Snow/ice	656.95	9.26
Permanent water bodies	18.86	0.27
Herbaceous wetland	3.78	0.05
Moss and lichen	0.08	0.001
Forest	3758.06	52.96
State's total area	7096.00	100.00
Tripura		
Shrubland	0.65	0.01

Table 4 (continued)

Land cover class	Area in km^2	Proportion in %
Herbaceous vegetation	2.41	0.02
Cropland	1010.81	9.64
Built-up	287.37	2.74
Permanent water bodies	21.24	0.20
Herbaceous wetland	18.39	0.18
Forest	9145.13	87.21
State's total area	10,486.00	100.00

state. Built-up land is mainly distributed in the north-western region along with the cropland (Fig. 5).

Sikkim's total land cover is represented by forest, shrubland, herbaceous vegetation, herbaceous wetland, moss and lichen, bare/sparse vegetation, cropland, built-up, snow/ice and permanent water bodies. Among these land cover classes, the forest, herbaceous vegetation, bare/sparse vegetation and snow and ice are the dominant land cover classes in Sikkim. Forest is mainly distributed in the southern and central region that represents about half of the state's total area. Herbaceous vegetation and bare/sparse vegetation are mainly observed in the northern and north-central parts of the state with around 23% share and 14% share respectively (Table 4). While, snow/ice represents around 10% of state's total area and observed mainly in north-western periphery region and north-eastern corner of the state (Fig. 5).

Forest, cropland and built-up are the major land cover classes in Tripura. Other land cover classes of the state include shrubland, herbaceous vegetation, permanent water bodies and herbaceous wetland. Forest represents around 88% of the state's total area followed by cropland with around 10% share and built-up land with around 3% share (Table 4). Cropland is distributed in a linear-dendritic pattern mainly in north-central and west-central parts of the region (Fig. 5).

Elevation-Wise Distribution Pattern of Land Cover

The SRTM digital elevation data is used for preparation of the elevation map of North Easter Region. The SRTM 90 m DEM data of the study area is resampled to 100 m pixel resolution and reclassified into four distinct user-defined elevation zones viz. 'below 500 m' elevation zone, '501–1500 m' elevation zone, '1501–3000 m' elevation zone and 'above 3000 m' elevation zone (Fig. 6). The 'below 500 m' elevation zone covers maximum area of the region (around 46%) and mainly observed in the vast central and south-western parts of the study area. Whereas, the 'above 3000 m' elevation zone is mainly distributed in the northern periphery parts of the study area that represents around 10% of the study area and this zone shares minimum proportion among the four elevation zones (Table 5).
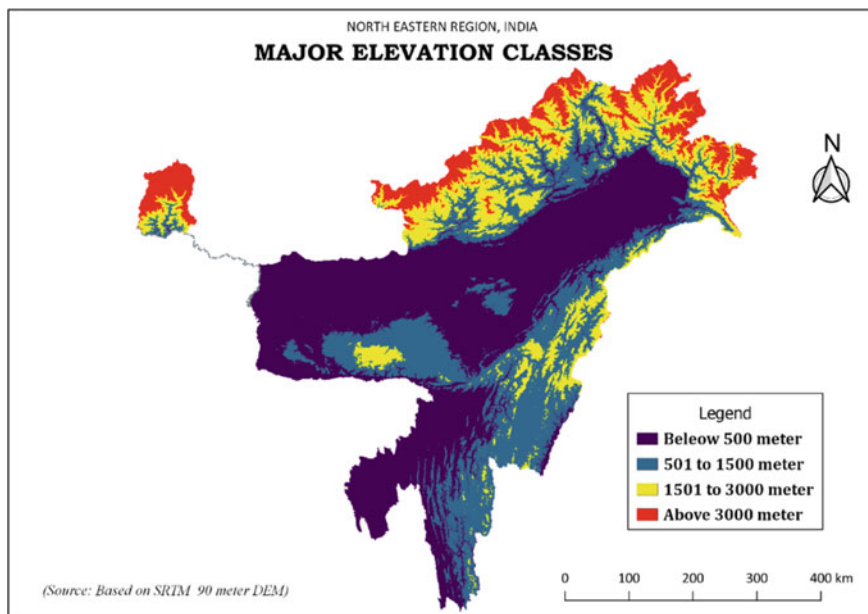
Fig. 6 Major elevation zones of the study area

Table 5 Elevation zones' statistics in the study area

Elevation class	Area in km^2	Proportion in %
'Below 500 m'	120,172.61	45.84
'501–1500 m'	76,792.67	29.29
'1501–3000 m'	40,565.01	15.47
'Above 3000 m'	24,648.71	9.40
Total area	262,179.00	100.00

Now, the land cover map of North Eastern Region (Fig. 4) is overlaid onto the elevation map of North Eastern Region under GIS platform using raster multiplication technique with the raster calculator tool of QGIS to find out the elevation-land cover relationship in the study area. The resultant map of elevation-wise land cover in North Eastern Region reveals that the forest is the dominant land cover class in each of these four elevation zones in the study area, and except the elevation zone 'above 3000 m', forest shares more than 50% of the elevation zone's total area (Table 6). Moreover, the cropland, built-up, permanent water bodies and herbaceous wetland are mainly concentrated in the elevation zone 'below 500 m, whereas, snow/ice, herbaceous vegetation, sparse vegetation and lichen/moss land cover classes are mainly found in the elevation zone 'above 3000 m' in North Eastern Region (Fig. 7).

Table 6 Elevation-wise land cover statistics in North Eastern Region, 2019

Elevation class	Land cover class	Area in km^2	Proportion in %
Below 500 m	Shrubland	559.52	0.47
	Herbaceous vegetation	1418.26	1.18
	Cropland	39,612.51	32.96
	Built-up	2742.29	2.28
	Bare/sparse vegetation	2185.59	1.82
	Permanent water bodies	2038.87	1.70
	Herbaceous wetland	1569.65	1.31
	Forest	70,045.92	58.29
501–1500 m	Shrubland	90.95	0.12
	Herbaceous vegetation	78.15	0.10
	Cropland	2697.93	3.51
	Built-up	559.24	0.73
	Bare/sparse vegetation	1.00	0.001
	Permanent water bodies	80.45	0.10
	Herbaceous wetland	139.01	0.18
	Forest	73,145.93	95.25
1501–3000 m	Shrubland	44.76	0.11
	Herbaceous vegetation	113.90	0.28
	Cropland	673.59	1.66
	Built-up	92.29	0.23
	Bare/sparse vegetation	0.68	0.001
	Permanent water bodies	1.31	0.003
	Herbaceous wetland	3.25	0.008
	Forest	39,635.24	97.71
Above 3000 m	Shrubland	169.03	0.69
	Herbaceous vegetation	9458.59	38.37
	Cropland	24.51	0.10

Table 6 (continued)

Elevation class	Land cover class	Area in km^2	Proportion in %
	Built-up	0.53	0.002
	Bare/sparse vegetation	2538.84	10.30
	Snow/ice	1283.92	5.21
	Permanent water bodies	58.05	0.24
	Herbaceous wetland	10.19	0.04
	Moss and lichen	0.69	0.00
	Forest	11,104.37	45.05
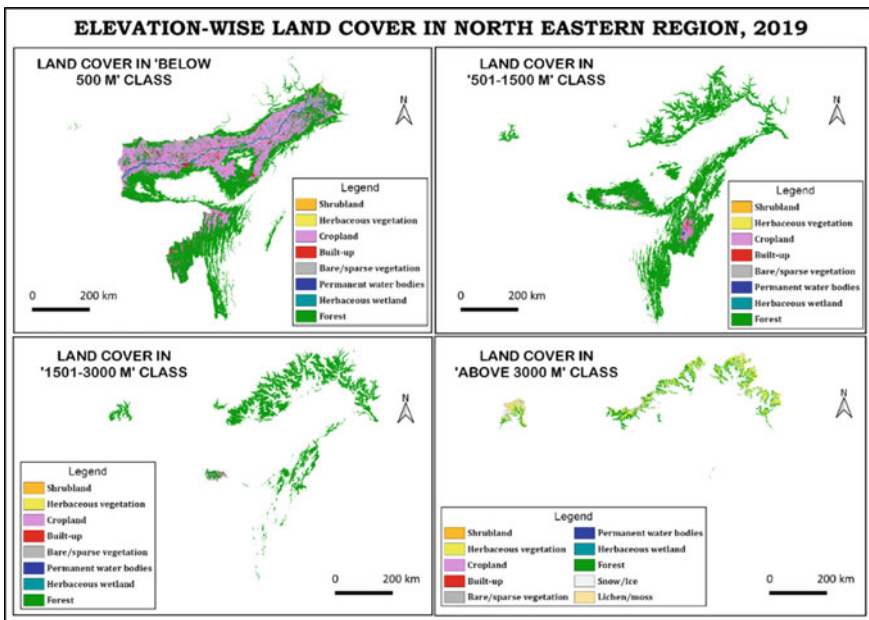
Fig. 7 Elevation-wise land cover distribution in the study area

Observing Land Cover Distribution Within Capitals' Buffer Area

The capitals of North Eastern states are also the primate urban centres, and hence, the land cover pattern in the capital regions will be helpful to understand the generalize pattern of urban land cover in North Eastern Region of India. To find out the land

cover pattern in the eight capitals of North Eastern Region, the capitals' hypothetical central point locations are first extracted from the 'Goggle Earth Pro' platform, and then these capital points locations are superimposed onto state boundaries of the study area in QGIS (Fig. 8). Subsequently, a buffer area is created with 7 km radius around each of the eight capital central point locations in QGIS to hypothetically determine the capital city boundary zone. Now, the land cover map for each of the eight capital buffer zones is prepared in QGIS through integrating the land cover map of the study area (Fig. 4) with the capital buffer zone (Fig. 9). The results show that the built-up is the prime land cover at the central downtown location of every capital region in the study area. Moreover, there is maximum proportion of built-up land distribution within the buffer area circle in Dispur, Imphal and Agartala capital regions. On the contrary, forest shares maximum proportion within the buffer area circle in Aizawl, Kohima, Gangtok and Shillong capital regions of the study area (Table 7). This variations in land cover distribution pattern in these capital regions indicates that the capital urban area is horizontally expanding in all directions in Dispur, Imphal and Agartala as these capitals are situated at low-relief and in Aizawl, Kohima, Gangtok and Shillong due to the high-relief locations the capital urban area is limited and mainly concentrated at the central place.
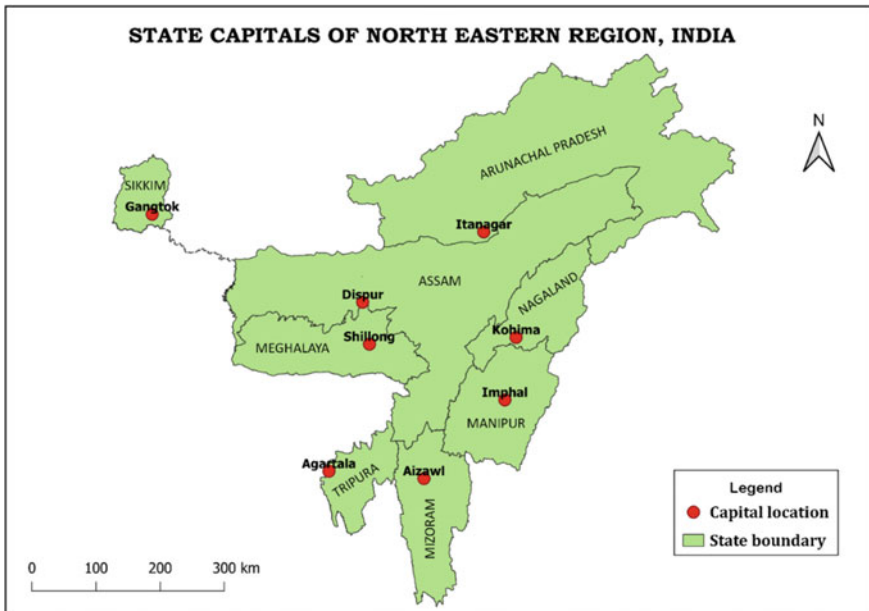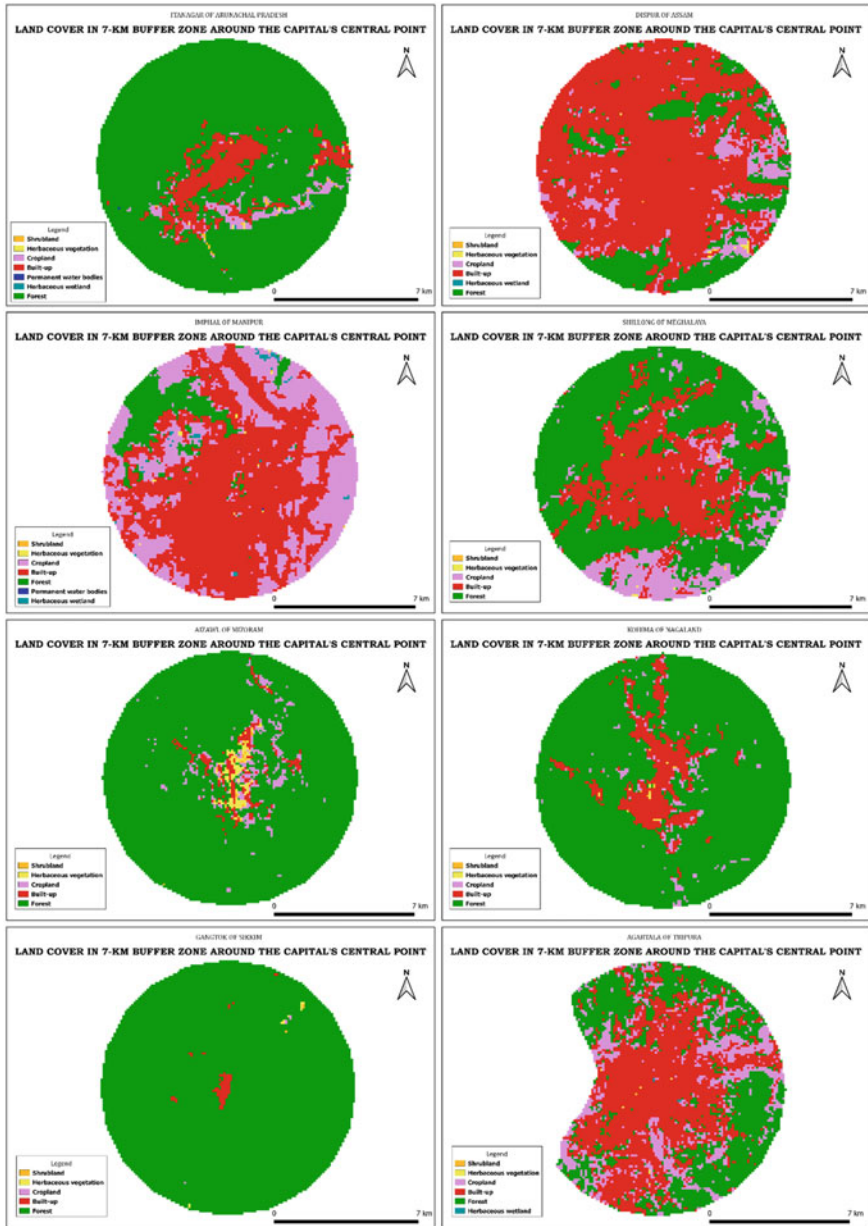

Fig. 8 Location of capitals in the study area

Fig. 9 Land cover distribution in each capital buffer region of the study area

Table 7 Land cover statistics in capital regions, 2019

Capital buffer region	Land cover class	Area in hectare	Proportion in %
Itanagar	Shrubland	28.74	0.19
	Herbaceous vegetation	24.43	0.16
	Cropland	534.51	3.53
	Built-up	1587.74	10.50
	Permanent water bodies	1.44	0.01
	Herbaceous wetland	10.06	0.07
	Forest	12,940.43	85.54
Dispur	Shrubland	7.18	0.05
	Herbaceous vegetation	27.30	0.18
	Cropland	1494.34	9.88
	Built-up	10,627.08	70.25
	Permanent water bodies	4.31	0.03
	Forest	2967.13	19.61
Imphal	Shrubland	4.31	0.03
	Herbaceous vegetation	22.99	0.15
	Cropland	5211.52	34.45
	Built-up	8374.07	55.36
	Permanent water bodies	1.44	0.01
	Herbaceous wetland	83.34	0.55
	Forest	1429.68	9.45
Shillong	Shrubland	7.18	0.05
	Herbaceous vegetation	17.24	0.11
	Cropland	2069.09	13.68
	Built-up	4336.47	28.67
	Forest	8697.36	57.49
Aizawl	Shrubland	31.61	0.21
	Herbaceous vegetation	215.53	1.42
	Cropland	597.74	3.95
	Built-up	422.44	2.79

(continued)

Table 7 (continued)

Capital buffer region	Land cover class	Area in hectare	Proportion in %
	Forest	13,860.03	91.62
Kohima	Shrubland	10.06	0.07
	Herbaceous vegetation	21.55	0.14
	Cropland	408.07	2.70
	Built-up	1630.85	10.78
	Forest	13,056.82	86.31
Gangtok	Shrubland	4.31	0.03
	Herbaceous vegetation	15.79	0.10
	Cropland	7.18	0.05
	Built-up	123.47	0.82
	Forest	14,976.60	99.00
Agartala	Shrubland	2.87	0.02
	Herbaceous vegetation	10.06	0.08
	Cropland	2445.55	18.56
	Built-up	5918.46	44.91
	Herbaceous wetland	7.18	0.05
	Forest	4793.39	36.38

Temporal Change of Land Cover in the Study Area

The 2019 land cover distribution in North Eastern Region of India has shown the recent status of land cover distribution in the region. To find out the temporal change of land cover in the region, the 2015 global annual land cover map from CGLS has been used as the base year data. This 2015 CGLS-LC100 satellite-derived landcover map has 100 m pixel size which is also downloaded from CGLS web-geo-portal as *GeoTIFF* file format that contains 11 discrete land cover classes under 'Level-1' legend classification code (Table 2 and Fig. 3). Now, the 2015 land cover distribution map of the North Eastern Region is prepared in GIS environment to show the spatial distribution pattern based on 2015 CGLS-LC100. The 2015 GIS-derived land cover map of the study area shows distribution of 10 discrete major land cover classes viz. forest, shrubland, herbaceous vegetation, herbaceous wetland, moss and lichen, bare/sparse vegetation, cropland, built-up, snow and ice, and permanent inland water bodies. This has been observed from the land cover distribution map of 2015 in the study area that forest is the dominant land cover class in the region followed by cropland, whereas the distribution of moss and lichen land cover is found very insignificant in the study area (Fig. 10). For assessing the temporal land cover change

in the study area, this 2015 land cover map is chosen as the base year data and the 2019 land cover map is considered as the current year data. Using QGIS platform's raster layer statistics tool the pixel level statistics have been extracted for each of 2015 and 2019 land cover maps of the study area to know the change statistics of the 10 discrete land cover classes. After extraction of the land cover statistics, the temporal land cover change in the study area is found out in terms of absolute change value and proportional change of land cover between 2015 and 2019. The absolute land cover change is observed by subtracting base year land cover data from the current year data, and the proportional change is calculated using the arithmetic formula, i. e. *{(current year value of land cover − base year value of land cover)/ (base year value of land cover) * 100%}*. This has been observed from the temporal land cover change statistics in the study area from 2015 to 2019 that among the 10 discrete major land cover classes, the herbaceous wetland and permanent water bodies recorded high positive changes, and the bare and sparse vegetation followed by cropland and herbaceous vegetation recorded the maximum negative changes. The herbaceous wetland and permanent water bodies registered around 173% and 76% rates of change from 2015 to 2019, and the bare and sparse vegetation registered around 19% rate of change during the period. Besides, snow and ice and built-up land cover classes also showed positive increase from 2015 to 2019, whereas, forest and shrubland land cover classes recorded negative changes (Table 8 and Fig. 11). The moss and lichen land cover from 2015 to 2019 remained almost same. The conversions of bare and sparse vegetation, cropland, herbaceous vegetation, forest and shrubland into herbaceous wetland, permanent water bodies, built-up and snow and ice land cover classes between 2015 and 2019 due to physical and anthropogenic processes could be the reasons behind the temporal changes in land cover in the study area.

Conclusion

The Copernicus Global Land Service land cover data product of 2019 with 100 m spatial resolution is used to map the spatial distribution of land cover in North Eastern Region of India. The overall land cover distribution, state level land cover distribution, elevation-wise land cover distribution, and capital region-wise land cover distribution maps are prepared in this study using geospatial technology to understand the regional land cover pattern based on recent satellite-derived data product.

This study observes forest as the dominant land cover in North Eastern Region with nearly three-fourth proportional share. Arunachal Pradesh, Mizoram, Meghalaya, Nagaland, Sikkim and Tripura show highest proportional distribution of forest. While, Assam is the only state having cropland as dominant land cover with highest proportion. Significant distribution of snow, sparse vegetation and herbaceous vegetation is seen in Arunachal Pradesh and Sikkim only. This has been also observed that there is variation in land cover distribution within North Eastern Region in terms of elevation. Maximum proportions of cropland, built-up, permanent waterbodies and
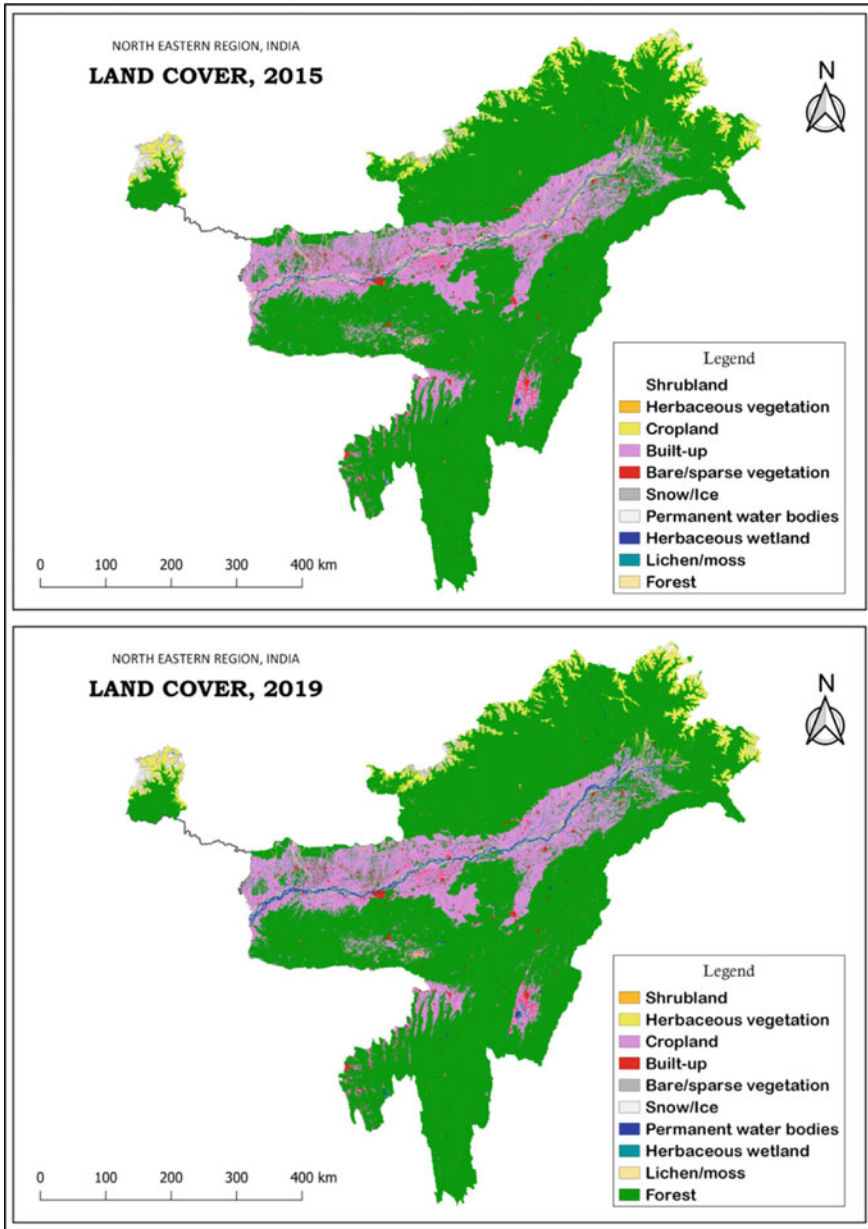
Fig. 10 Land cover distribution in the study area, 2015 and 2019

Table 8 Temporal land cover change statistics in the study area, 2015–2019

Year	2015		2019		*Change*	
Land cover class	Area in km^2	Proportion in %	Area in km^2	Proportion in %	*Absolute (km^2)*	*Change (%)*
Shrubland	909.79	0.35	863.92	0.33	−45.87	−5.04
Herbaceous vegetation	11,488.14	4.38	11,023.70	4.20	−464.44	−4.04
Cropland	43,541.02	16.61	43,035.83	16.41	−505.19	−1.16
Built-up	3372.46	1.29	3396.26	1.30	23.80	0.71
Bare/sparse vegetation	5791.27	2.21	4699.42	1.79	−1091.85	−18.85
Snow/ice	1115.50	0.43	1268.11	0.48	152.61	13.68
Permanent water bodies	1239.16	0.47	2178.93	0.83	939.77	75.84
Herbaceous wetland	632.17	0.24	1723.08	0.66	1090.91	172.57
Moss and lichen	0.71	0.00	0.69	0.0002	−0.02	−2.19
Forest	194,088.79	74.03	193,989.06	73.99	−99.73	−0.05
Total area	262,179.00	100.00	262,179.00	100.00		
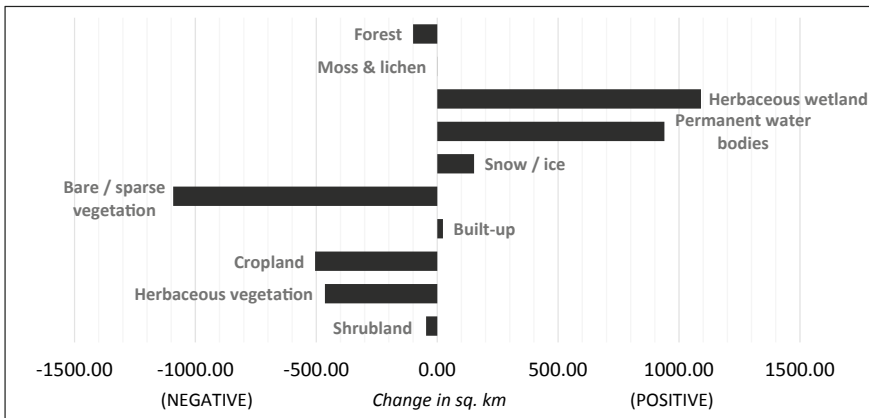
Fig. 11 Land cover change in the study area, 2015–2019

herbaceous wetland are found in areas having elevation less than 500 m. Maximum proportions of forest are found in areas of the region with elevation between 501 and 3000 m. Whereas, herbaceous vegetation, sparse vegetation and snow are mainly found in areas having more than 3000 m of elevation. Moreover, the land cover distribution of capital buffer regions shows built-up land concentration in central areas of the capital regions, while forest and cropland distributions are found in surrounding

areas. Dispur, Imphal, Agartala and Shillong capital regions have shown maximum proportional distributions of built-up areas within the buffer region which reveal the extent of urbanization in these capital city regions. The temporal change assessment of land cover in North Eastern Region from 2015 to 2019 shows the increase of surface water in the region with snow and ice cover and built-up lands, and decrease of vegetation cover with forest, shrubland and cropland areas. Among these land cover classes, the significant temporal changes are observed for permanent water bodies, herbaceous wetland, sparse vegetation and cropland in the study area.

This study will certainly help in regional land cover inventory which can be used as a basis for further studies. The study also provides a recent spatial account of the major land cover pattern in North Eastern Region which has meaningfully identified and mapped the spatial variations of land cover patterns within the region in terms of administrative level and relief level. This study can be also used as reference database for future land use planning and urban planning in North Eastern Region of India.

The study has incorporated a coarse resolution land cover data product of a single year for regional level inventory and mapping of land cover distribution in North Eastern Region of India. Due to the moderate resolution of the CGLS land cover data product which is for 2019 only, the study may have certain limitations in terms of detail inventory land cover mapping at local, district and sub-district scales, and absence of long-term temporal land cover change observation.

References

Anderson JR (1976) A land use and land cover classification system for use with remote sensor data, vol 964. US Government Printing Office

Bartholome E, Belward AS (2005) GLC2000: a new approach to global land cover mapping from earth observation data. Int J Rem Sens 26(9):1959–1977

Basic Statistics of North Eastern Region (2015) North Eastern Council. Government of India

Buchhorn M, Lesiv M, Tsendbazar NE, Herold M, Bertels L, Smets B (2020a) Copernicus global land cover layers—collection 2. Rem Sens 12(6):1044

Buchhorn M, Smets B, Bertels L, De Roo B, Lesiv M, Tsendbazar NE, Fritz S (2020b) Copernicus global land service: land cover 100 m: Collection 3 Epoch 2015, Globe. Version V3.0.1

Chatterjee S (2008) Biodiversity conservation issues of Northeast India. Int for Rev 10(2):315–324

Chen J, Chen J, Liao A, Cao X, Chen L, Chen X, Mills J (2015) Global land cover mapping at 30 m resolution: a POK-based operational approach. ISPRS J Photogramm Rem Sens 103:7–27

Congalton RG, Gu J, Yadav K, Thenkabail P, Ozdogan M (2014) Global land cover mapping: a review and uncertainty analysis. Rem Sens 6(12):12070–12093

Das K, Bora AK (2021) Physiography and terrain characteristics of North-East India. In: Bora AK, Das K (eds) North-East India physical landscape and environment. EBH Publishers (India), Guwahati, pp 1–19

DeFries RS, Belward AS (2000) Global and regional land cover characterization from satellite data: an introduction to the Special Issue. Int J Rem Sens 21(6–7):1083–1092

Dikshit KR, Dikshit JK (2014) North-East India: land, people and economy. Springer, Dordrecht

Duong PC, Trung TH, Nasahara KN, Tadono T (2018) JAXA high-resolution land use/land cover map for Central Vietnam in 2007 and 2017. Rem Sens 10(9):1406

Eva HD, Belward AS, De Miranda EE, Di Bella CM, Gond V, Huber O, Fritz S (2004) A land cover map of South America. Glob Change Biol 10(5):731–744

Franklin SE, Wulder MA (2002) Remote sensing methods in medium spatial resolution satellite data land cover classification of large areas. Prog Phys Geogr 26(2):173–205

Giri C, Shrestha S (1996) Land cover mapping and monitoring from NOAA AVHRR data in Bangladesh. Int J Rem Sens 17(14):2749–2759

Gong P, Wang J, Yu L, Zhao Y, Zhao Y, Liang L, Chen J (2013) Finer resolution observation and monitoring of global land cover: first mapping results with Landsat TM and ETM+ data. Int J Rem Sens 34(7):2607–2654

Goswami UC, Basistha SK, Bora D, Shyamkumar K, Saikia B, Changsan K (2012) Fish diversity of North East India, inclusive of the Himalayan and Indo Burma biodiversity hotspots zones: a checklist on their taxonomic status, economic importance, geographical distribution, present status and prevailingthreats. Int J Biodivers Conserv 4(15):592–613

Grekousis G, Mountrakis G, Kavouras M (2015) An overview of 21 global and 43 regional land-cover mapping products. Int J Rem Sens 36(21):5309–5335

Gutman G, Huang C, Chander G, Noojipady P, Masek JG (2013) Assessment of the NASA–USGS global land survey (GLS) datasets. Rem Sens Environ 134:249–265

Hansen MC, DeFries RS, Townshend JR, Sohlberg R (2000) Global land cover classification at 1 km spatial resolution using a classification tree approach. Int J Rem Sens 21(6–7):1331–1364

Kotharkar R, Bagade A (2017) Local climate zone classification for Indian cities: a case study of Nagpur. Urban Clim 24:369–392

Lele N, Joshi PK (2009) Analyzing deforestation rates, spatial forest cover changes and identifying critical areas of forest cover changes in North-East India during 1972–1999. Environ Monit Assess 156(1):159–170

Li W, Ciais P, MacBean N, Peng S, Defourny P, Bontemps S (2016) Major forest changes and land cover transitions based on plant functional types derived from the ESA CCI Land Cover product. Int J Appl Earth Obs Geoinf 47:30–39

Meyer WB, Turner BL (1992) Human population growth and global land-use/cover change. Annu Rev Ecol Syst 23(1):39–61

Reddy CS, Jha CS, Diwakar PG, Dadhwal VK (2015) Nationwide classification of forest types of India using remote sensing and GIS. Environ Monit Assess 187(12):1–30

Rees WG (2012) Physical principles of remote sensing. Cambridge University Press

Roy PS, Meiyappan P, Joshi PK, Kale MP, Srivastav VK, Srivasatava SK, Krishnamurthy YVN (2016) Decadal land use and land cover classifications across India, 1985, 1995, 2005. ORNL DAAC, Oak Ridge, Tennessee, USA

Rozenstein O, Karnieli A (2011) Comparison of methods for land-use classification incorporating remote sensing and GIS inputs. Appl Geogr 31(2):533–544

Rujoiu-Mare MR, Mihai BA (2016) Mapping land cover using remote sensing data and GIS techniques: a case study of Prahova Subcarpathians. Procedia Environ Sci 32:244–255

Sulla-Menashe D, Gray JM, Abercrombie SP, Friedl MA (2019) Hierarchical mapping of annual global land cover 2001 to present: the MODIS Collection 6 Land Cover product. Rem Sens Environ 222:183–194

Takahashi M, Nasahara KN, Tadono T, Watanabe T, Dotsu M, Sugimura T, Tomiyama N (2013, July) JAXA high resolution land-use and land-cover map of Japan. In: 2013 IEEE international geoscience and remote sensing symposium—IGARSS. IEEE, pp 2384–2387

Thompson M (1996) A standard land-cover classification scheme for remote-sensing applications in South Africa. S Afr J Sci 92(1):34–42

Tucker CJ, Townshend JR, Goff TE (1985) African land-cover classification using satellite data. Science 227(4685):369–375

Vilar L, Garrido J, Echavarría P, Martinez-Vega J, Martín MP (2019) Comparative analysis of CORINE and climate change initiative land cover maps in Europe: implications for wildfire occurrence estimation at regional and local scales. Int J Appl Earth Obs Geoinf 78:102–117

Wulder MA, Coops NC, Roy DP, White JC, Hermosilla T (2018) Land cover 2.0. Int J Rem Sens 39(12):4254–4284

Zhang HK, Roy DP (2017) Using the 500 m MODIS land cover product to derive a consistent continental scale 30 m Landsat land cover classification. Rem Sens Environ 197:15–34

Assessment of the Potential of Viticultural Areas in Serbia as Smart Tourist Destinations

Radmila Jovanović, Fernando Almeida-García, and Rafael Cortés-Macías

Abstract The wine-growing regions of Serbia are mostly related to rural areas, where, especially in developed countries, wine tourism has been highlighted as a product of rural tourism. Most wineries in Serbia are also trying to be innovative by placing new technologies and attractiveness in wine tourism and providing smart tourist services. The aim of this study is to assess and identify the viticultural areas that would have the greatest potential for development into smart wine destinations. By mutual comparative analysis and assessment, the concept of smart tourism destinations is defined as 6A (attractions, accessibility, amenities, available packages, activities and ancillary services) using geographic information system (GIS) and analytic hierarchy process (AHP). The analysis shows that the offer of wine tourism is considered as complementary element of tourism offer. The results highlight that Serbia has the potential for the development of wine-growing districts as a smart tourist destination: most of these areas are located in the poor potentiality zone with a share of 46.88%. Wine-growing district areas with very good potentiality make up only 1.10% and need to be further improved.

R. Jovanović (✉)
The Institute of Agricultural Economics, Belgrade, Serbia
e-mail: radmila.jovanovic@uma.es

R. Jovanović · F. Almeida-García · R. Cortés-Macías
Faculty of Tourism, University of Malaga, Malaga, Spain
e-mail: falmeida@uma.es

R. Cortés-Macías
e-mail: rcortes@uma.es

Introduction

Tourism is a dynamic, multidisciplinary and complex socio-economic activity, which is why it is necessary for the management of tourist destinations to develop sustainable and innovative strategies with the application of information and communication technology (ICT) and effective stakeholder participation, to transform tourist destinations in intelligent areas. Smart tourist destination (STD) can be understood as an innovative space based on the territory with the most modern technological infrastructure, dedicated to sustainability (environmental, social and economic) and equipped with information system (IS), to analyse and understand the situation in real time and facilitate interaction between tourists and the environment, improving the tourism experience is relevant (López-Ávila and Sánchez-García 2013; Santos-Júnior et al. 2017, 2019). STDs aim to stimulate and facilitate the greatest tourist satisfaction and experience. The ideal STD should provide a smart experience, which has been defined as a technology-mediated tourism experience and improved through personalization, contextual awareness and real-time monitoring (Buhalis and Amaranggana 2015). STD innovation and competitiveness are based on tourism applications (Buhalis and Amaranggana 2013; Cimbaljević et al. 2019) which increase the freedom and independence of tourists in the development of tourism activity (Jeong and Shin 2019; Um and Chung 2019). Improving the tourist experience is the ultimate goal of the STD and to do so, it must maximize the competitiveness of the destination and consumer satisfaction (Del Vecchio et al. 2018). Providing tourism information is one of the tourism management areas that need to be improved when destinations become STDs (Ivars-Baidal et al. 2019).

A smart tourist wants to communicate with a destination (Gahr et al. 2014). A smart tourist destination successfully implements the mind, which is stimulated by open innovation, investment in human and social capital and participatory management, in order to develop the collective competitiveness of the tourist destination and thus promote social, economic and environmental prosperity for all stakeholders (Buhalis 2000). In terms of supply and demand, the priorities of smart tourist destinations are: improving the travel experience, providing intelligent platforms for collecting and distributing information among key stakeholders, efficiency and effectiveness of tourism resource allocation and integration of tourism suppliers to ensure that tourism profits are evenly distributed within local society (Chiappa and Baggio 2015).

Smart culture influences the accelerated development of the concept of smart tourism: knowledge about the culture of a country and society becomes widely available with the introduction of digitalization of heritage. Smart tourism aims to provide an interface between visitors and destinations, characterized by a high degree of innovation using smart technology and a platform to provide a unique experience to visitors (Bajaj and Sharma 2018; Milošević et al. 2019).

Smart tourist destination means innovation in the destination, based on the infrastructure of the latest technology that guarantees sustainable development of tourist areas, increasing the quality of experiences at the destination and providing tourists with interaction and integration into the environment (Gretzel et al. 2015).

Smart tourist destinations are a special focus of smart cities; i.e. they apply the same principles and infrastructure that are characteristic of these cities. Accordingly, the basic components or factors of the development of smart cities are at the same time the factors of the development of smart tourist destinations as an element of smart tourism. Nam and Pardo (2011) view technology, human capital and the institutional framework as core components of smart cities. Gretzel et al. (2015) deal with the analysis of the technological and business basis of smart tourism. In their study, Boes et al. (2015, 2016) analyse leadership and entrepreneurship, innovation, human and social capital, as the main carriers of smart destinations.

Cooperation between the private and the public organization is a mandatory feature of a smart destination, since this connection allows the generation of numerous data and information from different types of media. The teamwork of different players allows the destination to be smarter and work as a dynamic system, which applies and analyses all available information, ranging from destination management, private and public companies to tourists (Gahr et al. 2014).

The concept of smart tourism has evolved from the concept of smart cities in which city technology is used in order to increase the quality of life of citizens and improve city services (Guo et al. 2014). The analysis of the factors of smart tourism development in Serbia derives from the concept of a smart city and is still in development.

Bradić-Martinović and Miletić (2017) believe that Serbia has a solid ICT infrastructure in relation to its competitors, but also that there is a possibility for improving ICT in Serbia. These authors conclude that Serbia lacks the capacity to make a real impact on ICT, as a transformation of the economy and society of potential benefits from ICT in terms of establishing sustainable development and improving the quality of domestic tourism.

The wine sector and the wine tourism are currently showing a significant change (Williams 2001), as wine production increases significantly and many regions are now aggressively advertising to attract wine tourists. Specific natural conditions have enabled certain regions of the world to develop quality grape varieties and traditional wine production. These regions are most often associated with rural areas, where over time, wine tourism has stood out as a product of rural tourism. Initially, wine tourism filled the region's tourist offer (tours of wine-growing districts, wineries, wine tastings, etc.). With the development of the tourist offer in traditional wine-growing regions, the development of accommodation facilities with authentic architectural style, blended into the wine-growing district landscape, with accompanying elements such as wine festivals and additional activities (grape harvest, squeezed wines, spa and wellness pools based on wine), began is the development of a wine tourism product.

Wine tourism in Serbia is important for attracting tourists and developing rural areas. This type of tourism is carried out outside the city centres, so it has a positive effect on the economic development of rural areas involved in wine production. In these areas, the employment of the local population is increasing, investments are growing, and wineries are operating at a profit and increasing revenues from the sale of other products and services. Although wine tourism in Serbia is growing, one of the most important problems in wineries is their cooperation as well as gathering

information about visitors. This can be applied in particular by making "smart" management and marketing decisions, such as the services and activities they should offer and when, with whom they should cooperate in terms of other wineries or tour operators.

Santos et al. (2021) believe that the use of the innovation process in wine tourism should be viewed through the primary classical issues of innovation and entrepreneurship. For example, the process of creation related to nature and sustainable reservation systems, mechanisms and exchange of information as a form of competitive advantage over other tourist destinations (social networks), marketing from nature and sustainable, natural wine tourism (products and services) and other activities that can increase business synergies.

Smart technology helps tourist destinations to improve the efficiency of management of tourist resources and their promotion, then the use and sustainable development of tourist resources, improve the quality of life of permanent residents and tourists. An increasing number of attractions for visitors have adopted smart technologies, such as the Internet of things (IoT) and artificial intelligence (AI), in order to improve the tourist experience. For example, virtual reality (VR) technology provides tourists with a physically, spiritually and emotionally integrated tourism experience (Méndez and Muñoz-Leiva 2015). With the popularization of mobile smart devices, the number of mobile tourism users continues to grow, as does the penetration rate of mobile tourism and mobile Internet users (Zhang et al. 2022). Tourist destinations are becoming "smart" by applying smart technology while increasing competitiveness (Shen et al. 2020). Tourists use available smart technologies to make decisions, such as organizing trips planned on their mobile phones, communicating with other tourists and sharing their tourism experiences (Yang et al. 2017).

Literary Review

According to Santos-Júnior et al. (2020) and Neirotti et al. (2014), they pointed out that the role of ICT in smart places is related to technological infrastructure, connectivity and smart sensor networks, information system and smart applications. Other authors highlight the dynamic role of the urban areas related to smart cities (Femenia-Serra and Neuhofer 2018; Ivars-Baidal et al. 2017; Trencher and Karvonen 2019).

During the COVID-19 pandemic, travel and tourism industry were affected severely by this epidemic, showing its weakness due to stop in tourism flows (Dwyer et al. 2010). During the first six months of 2019, global tourist arrivals fell historically to −93%. Also, international tourist arrivals for the first six months of 2020 decreased by 65% in the first 6 months of 2020 (UNWTO 2020). Technology, as a point of interaction between tourists and destinations, will be a key aspect of recovery (García-Milon et al. 2020). One of the ways of quick recovery is recognized in wine tourism, which has been proven to be a driver of regional development. This can be seen through the direct attraction of new investments as well as increasing economic development, investment and the development of new wine cellars and

wineries (Sanders 2004). However, tourism marketing quickly finds virtual solutions and satisfies people's desire to travel, then virtual museum tours and even a virtual reality concert in Helsinki that attracted over a million spectators (Chandler 2020). As a consequence of this situation, avoiding activity in overcrowded premises and preferring attractions, a new term for "contactless tourism has emerged, which has appeared in South Korea (El-Assasy 2020).

Some researches show that smart tourism technologies (STTs) are associated with tourism experiences (Vicini et al. 2012; Egger 2013; Buhalis and Amaranggana 2015) as a significant factor influencing the level of tourist satisfaction (Vicini et al. 2012; Carbonell and Rodríguez-Escudero 2015). Therefore, many tourist destinations and attractions have adopted and implemented STTs to provide tourists with a convenient, friendly and personalized tourist experience to increase their satisfaction.

A traditional city with physical infrastructure is becoming a modern city with virtual infrastructure that collects, integrates and analyses data and on the basis of which decisions are made (Harrison et al. 2010). Larger urban centres dominate most of Serbia's wine-growing area, which are also the centres of the region or, as the capital Belgrade, in the region of the same name. The development of cities as smart destinations directly supports the idea of developing into wine tourism smart destinations. Kruševac is the first city in Serbia to draft a Sustainable Urban Mobility Plan, followed by Valjevo, Belgrade, Pirot, Šabac and Kladovo. The application of electronic systems, services and data has started in other urban centres (Kragujevac, Niš, Subotica, Užice). The best example is the use of public transport, where passengers get the necessary information using Google Maps about desired locations, bus lines, etc. Some of the good examples in Kruševac are: "Wi-Fi tree" in Bagdal Park, which enables free use of the Internet, development of optical network and video surveillance of intersections, installation of bicycle counters with displays, reconstruction of public lighting for energy conservation. In Kruševac, there is free transportation within two mini electric buses, for citizens and tourists (Smart Cities of Serbia 2021).

An example of good practice and digitalization of data in tourism are the services developed by the city of Priboj. This city is located on the border of Serbia, Montenegro and Bosnia and Herzegovina, with 27,133 inhabitants (according to the last census, from 2011). As the territory of the municipality of Priboj is rich in tourist attractions, new ways of open data are offered, which influences the development of new tourist guides of platforms and applications (Pametni Gradovi Srbije 2021).

Study Area

Viticultural part of Serbia consists of 3 wine-growing units, 22 wine-growing regions, 79 wine-growing districts. The largest viticultural region is Central Serbia (19,922.14 km^2), located between two other wine-growing units: Kosovo and Metohija (1329.83 km^2) and Vojvodina (2423.01 km^2). The most popular wines from Serbia are: Chi

Chichateau (Black Wine), Cabernet Sauvignon Reserve (Red Wine) and Ergo Rose Temet (Rose Wine). Of these, the most common grape varieties for white wines are Sauvignon blanc, Riesling, Riesling Italico and Chardonnay, as well as domestic varieties Zupljanka, Smederevka and others. In the production of red wine, the international varieties Merlot, Pinot, Noir, Cabernet Sauvignon, Prokupac and others are dominant. Other grape varieties are Muscat de Hamburg and Cardinal (Jovanović et al. 2022). *We analysed nine* wine *viticultural* regions of Serbia, which are showed in Fig. 1.

(1) **Belgrade wine-growing region** (total area 2473.9 km^2) encompassing the area to the Sava and Danube in the north, to Kolubara and Ljig in the west, to Velika Morava in the east and to Turija (a tributary of Kolubara) in the south, i.e. Jasenice (with tributaries Lug and Kubrušnica), Horse river (basin of Velika Morava).

(2) **Wine-growing region South Banat** (total area 653.6 km^2) is located in the southern and south-eastern part of Banat, encompassing several morphological forms: Vršac Mountains, Banat (Great or Deliblato) sandstone surrounded by the Banat light plateau and the Valley of Bela Crkva.

(3) **Wine-growing region Knjaževac** (total area 1779.25 km^2) is the area between the Serbian-Bulgarian border, in the East of the country

(4) **Wine-growing region of Negotin** (total area 1197.84 km^2) is located in the East of Serbia and stretches along the Danube, between three borders of the Serbian-Romanian-Bulgarian border.

(5) **Wine-growing region Srem** (total area 865.85 km^2) is the biggest wine-growing region in Vojvodina region. This wine-growing region encompasses the slopes of the mountain and the National Park Fruška gora and has only wine-growing district: Fruška gora (510.62 km^2).

(6) **Wine-growing region Subotica** (total area 397.41 km^2) stretches in the northern part of Serbia, along the state border with Hungary and is located on the Subotica (Bačka) sandstone.

(7) **Šumadija wine-growing region** (total area 2484.2 km^2) stretches between Velika Morava in the east, the upper and middle reaches of the Horse River in the north, the southwestern and western slopes of Bukulja and Rudnik, and the northern slopes of the Gledić Mountains and Kotlenik in the south.

(8) **Toplica wine-growing region** (total area 910.83 km^2) belongs to the area of the same name in Toplica, surrounded by the southern slopes of Mali and Veliki Japstrebac.

(9) **Wine-growing region of Three Morava** (total area 2869.21 km^2) covers most of the flow of the Great Morava and part of the Western and Southern Morava.
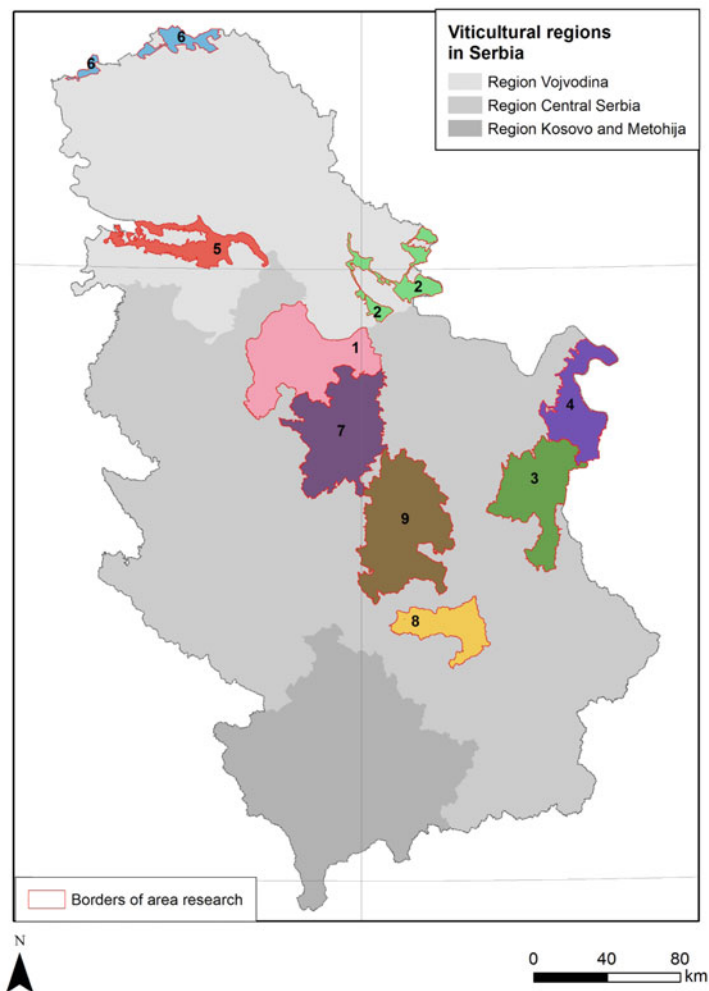
Source: Elaborated by authors

1	Belgrade wine growing region	6	Subotica wine growing region
2	South Banat wine growing region	7	Šumadija wine growing region
3	Knjaževac wine growing region	8	Toplica wine growing region
4	Negotin wine growing region	9	Wine growing region of Three Morava
5	Srem wine growing region		

Fig. 1 Location of study area. Serbian viticultural regions as smart destinations. *Source* Elaborated by authors

Methodology

The concept of smart tourist destinations has gained in importance with the development of smart cities and the implementation of smart technology. According to Buhalis (2000) and Gozdegul et al. (2019), the concept of smart tourism destinations is defined as 6A parameters:

1. Attractions: which can be divided into natural (mountains, rivers, etc.) and artificial (events, festivals, parks, etc.).
2. Accessibility: refers to the transport system within the destination and consists of public transport and accessible roads.
3. Amenities (amenities): refers to services that provide a pleasant stay (accommodation, restaurants and leisure activities).
4. Available packages: refer to the availability of the service for the needs of tourists.
5. Activities: all available potentials of the destination that encourage tourists to visit it and visit.
6. Ancillary services: refer to additional, important services, such as banks, medical care, grocery and non-food stores.

The selection of viticultural wine regions in this study was selected on the basis of data collected from local travel agencies, surveys and the state of development of wine tourism in the field, tourist program offerings, presentations on the Internet, etc. All six parameters indicate that the local population and the community pay a lot of attention to this type of tourism in relation to other wine regions of Serbia. Also, in analysed wine regions, grapes are not imported or processed, but there is a process from growing vines to the production and sale of wine, which is the basis of wine tourism.

According to Tran et al. (2017), Buhalis (2000) and Gozdegul et al. (2019) and based on current conditions and the state of development of (wine) tourism in the wine-growing regions of Serbia, it has been adapted and modified for this research, evaluation and assessment of possible wine-growing regions as potential smart tourist destinations (Table 1).

When assessing the possibility of developing wine areas, as smart tourist destinations, within 6A, the element of available packages was singled out, as a subject of special analysis.

For this research, data were collected using geodata open sources: digital elevation models (DEM), OpenStreetMaps (OSM), CORINE Land Cover (2012), data of temperature and rainfall, field research, literature reviews and by reviewing data available from the official websites of local tourist organizations and the Tourist organization of Serbia and analysis popular websites (clubs, theatres, cinemas, etc.), social media, etc.

In this research as the main method for the purpose of assessing the potential of viticultural areas in Serbia as smart tourist destinations was used analytic hierarchical process (AHP). AHP is one of the multiple-criteria decision-making (MCDM) techniques used most frequently (Saaty 1980; Saaty and Vargas 2001). AHP method was

Table 1 Reclassified data for evaluating viticultural areas as smart tourism destinations

Attraction	Accessibility	Amenities	Activities	Ancillary services
Monuments	Road traffic	Accommodation facilities	Places for hiking	Banks
Churches	Air traffic	Food and beverage facilities	Places to swim	Medical services
(Wine) Events	Railway traffic	Nacional Park	Places to ride a bike	Pharmacies
Cinema	River traffic	Landscape of outstanding qualities	Places for other activities, sports, recreation and entertainment	Grocery stores
Bar and (night) clubs	Internet	Nature Park	Wine tasting places	Postal services
Shopping malls		Reserve and special nature reserve		
Museums		Lakes for swimming		
Zoo park		Relief (topography of the terrain)		
		Climate		

Source Elaborated by authors

introduced by Thomas Saaty (1980) as a useful tool for complex decision-making that can help the decision-maker set priorities. By reducing complex decisions, comparing pairs and synthesizing results, the AHP method helps to understand the subjective and objective aspects of the decision.

The AHP method is known as a level analysis method that seeks to break down problems into a branched structure and establish a class structure level, with mutual influence, allowing more accurate decisions on complex issues (Crouch and Ritchie 2005). This method allows comparison between two items of each level with different measurements and setting of comparative matrices in pairs for vector calculation, which is a priority of significant elements at a certain level of structure (Saaty 2008).

The AHP method takes into account a set of evaluation criteria and a set of alternative options among which the best decision is made. Some of the criteria may be opposite, and it is incorrect that the best option is the one that optimizes the individual criterion, but the one that achieves the most suitable compromise between the different criteria (Fig. 2).

The scale values vary from 1 that indicates equal preference of criteria in the pairwise comparison matrix to 9 represented extremely preference of criteria in the pairwise comparison matrix (Table 2).
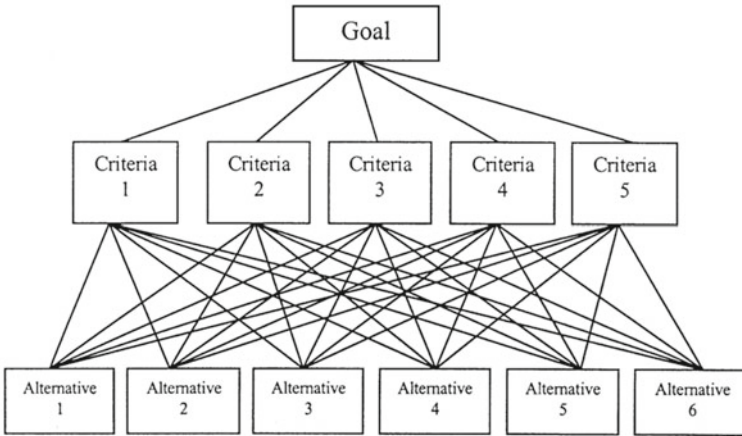
Fig. 2 Example of a hierarchical model in AHP. *Source* Saaty (1980)

Table 2 Scale of absolute numbers (Saaty 2008)

Scale	Degree of preference	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one factor over another	Experience and judgments slightly favour one activity over another
5	Strong essential importance	Experience and judgments strongly favour one activity over another
7	Very strong importance	An activity is favoured very strongly over another, and dominance is demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the hugest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgments	When compromise is needed between two adjacent judgments

Source Elaborated by authors

Based on the Saaty scale (Table 2), we were made adapted and modified Table 3 of the needs of this research, through the example of assessment and reclassification of elements evaluations analysed in this article:

Matrix A is built for each level of hierarchy comparison by various criteria and subcriterion or (i, j) and it is possible to derive from A the normalized pairwise comparison. The value of a_{ij} is determined (Table 2), and the value of a_{ji} represents the reciprocal value of a_{ij}. The importance coefficient for each criterion and subcriterion (w_i) is calculated according to the formula:

The weight coefficient for each criterion and subcriterion (w_i) is calculated according to the formula:

Table 3 General overview of the categories of values and estimation of the elements

Value	Interpretation of element evaluation
1	Tourism potential/element of neutral importance
2	Tourism potential/element of low importance
3	Tourism potential/element of slightly greater importance
4	Tourism potential/element of moderate importance
5	Tourism potential/element of expressed importance
6	Tourism potential/element of more pronounced importance
7	Tourism potential/element of predominantly high importance
8	Tourism potential/element of strictly dominant importance
9	Tourism potential/element of absolute importance

Source Elaborated by authors

The consistency ratio index (CR) is satisfactory if the value obtained is lower than 0.1. If the CR is higher than 0.1, then it is necessary to carry out new comparisons in the matrix. The consistency ratio is calculated according to the formula:

$$CR = CI/RI$$

A perfect consistency index (CI) should always be CI $= 0$ or smaller values of contradiction (inconsistency) can be tolerated.

and CI is calculated according to the formula:

$$CI = (\lambda_{max} - n)/(n - 1)$$

RI values are taken from Table 4.

AHP methodology enables and facilitates the assessment and identification of which wine-growing areas would have the greatest potential for development into smart wine destinations (in future). For this purpose, the aforementioned model 6A was taken with a number of different criteria and sub-criteria that were analysed. Selected criteria and sub-criteria can be seen in Table 5.

All thematic layer and map calculations, as well as the final map of potential smart wine destinations, were created using ArcMap and Expert Choice software. Using geographical values for multi-criteria analysis evaluation, reclassified maps were obtained. These maps form the link between evaluation and spatial data (Fig. 3).

Table 4 Ratio index values

m	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

Source Saaty (1980)

Table 5 Geographical values for multi-criteria analysis

Group	Criterion	Attributes	Category
Attraction	Monasteries, Churches, Monuments, Museums	Cultural assets of great importance	9
		Cultural assets of great importance	7
		Other cultural assets	5
	Cinema, Bar and (night) clubs, Shopping Malls	Zone (km)	Value
		1	9
		2	7
		3	5
		4	3
		5	1
	ZOO Parks	Value	9
	Type of (wine) event	Local	3
		Regional	5
		National	7
		International	9
	Relief (Topography)	Elevation (m)	Value
		> 200	3
		200.1–366	5
		366.1–532	7
		532.1–698	8
Accessibility	Road traffic	Highway	9
		First-order roads	7
		Second-order roads	5
	Railway traffic		7
	Air traffic	30 km	9
		70 km	7
		100 km	5
	River traffic		9
	Areas covered by the Internet		9
Amenities	National Park		9
	Landscape of exceptional features		8
	Park of nature		7
	Reserve and special nature reserve		6
	Lakes for swimming		9
	Facilities for accommodation, food and beverage	Zone (km)	Value
		1	9
		2	7
		3	5

(continued)

Table 5 (continued)

Criterion	Attributes	Category	Criterion	Attributes	Category
	< 698.1	9		4	3
	> 2	9		5	1
Slope (°)	2.1–5	8	Ancillary Services	Banks, Medical Services, Pharmacies, Grocery stores, Postal Service	Zone (km) / Value
	5.1–12	7		1	9
	12.1–32	5		2	7
	< 32.1	3		3	5
	S	9		4	3
Aspect (°)	SW, SE	7		5	1
	E, W	5	Activities	Places for hiking, to ride a bike; for other activities, sports, recreation and entertainment; wine tasting places	Zone (km) / Value
	NE, NW	3		1	9
	N	1		2	7
	3.2–10	5		3	5
Temperature (°C)	10.1–10.6	6		4	3
	10.7–11.2	7		5	1
	11.3–11.8	8			
	11.9–12.3	9			
	> 600	4			
Perception (mm)	600.1–650	5			
	650.1–700	6			
	700.1–750	7			
	750.1–800	8			
	< 800.1	9			

Source Elaborated by authors
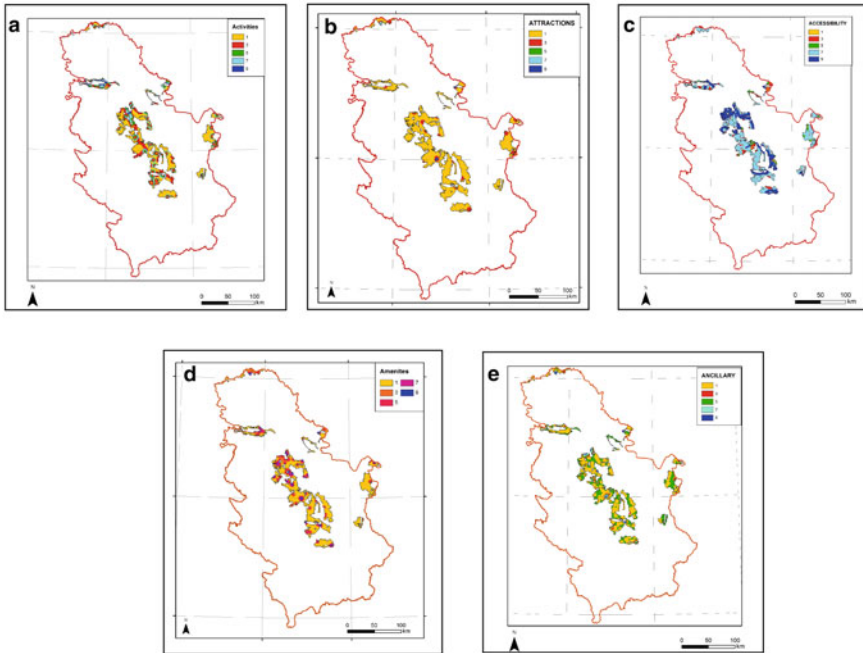
Fig. 3 Map results of multi-criteria analysis. *Source* Elaborated by the authors. *Note* A) Activities, B) Attractions, C) Accessibility, D) Amenities, E) Ancillary (Scale of keys in Table 6)

Analysis of Results

In order to obtain the potential map, five classes were identified. Each class describes the current state and the possibility of developing wine areas as smart tourist destinations.

Very poor (26.19%) and **poor** (46.88%) areas represent the least potential for development into smart tourist destinations of viticultural areas. Very poor and poor zones show the largest share of 73.07% in the total study area, and by wine-growing region, South Banat has the largest share (54.68%) in category 1 (very poor). Wine-growing region Toplica with a share of (46.35%) in category 3 (poor). An overview of this situation in the wine-growing region Toplica shows that in all evaluated criteria, these wine regions show the lowest value. For the same reason, values are shown by wine-growing region Negotin (44.61%) and wine-growing region Knjaževac (44.77%). In the case of the wine region South Banat, these areas are weak index, so it has a low population. The Belgrade[1] wine-growing region has the lowest value in the same category (1) 13.18%, which is logical because in this viticultural region

---

[1] In particular, it should be pointed out that the entire area of the city of Belgrade was not included in the wine-growing areas in the wine-growing territory division in 2015. The part of the city of Belgrade that is in the wine-growing zone is valued.

is the location of the capital of the Republic of Serbia, with all the benefits that this city provides for the development of smart city destination (Fig. 4).

   Moderate potentiality shows the average development potential of viticultural areas into smart destinations, occupying an area of 21.93%. It has almost identical value as the potential in the poor zone. Moderate potentiality area is located between urban and sparsely populated areas. The greatest potential in the moderate potential zone is realized by wine-growing region Srem with a share of 40.71%. This wine-growing region is known for its long wine tradition, located along the right bank of the Danube, between the two largest cities in Serbia: Belgrade and Novi Sad. Thus, this value is influenced by the proximity of the two largest cities, their good connections,
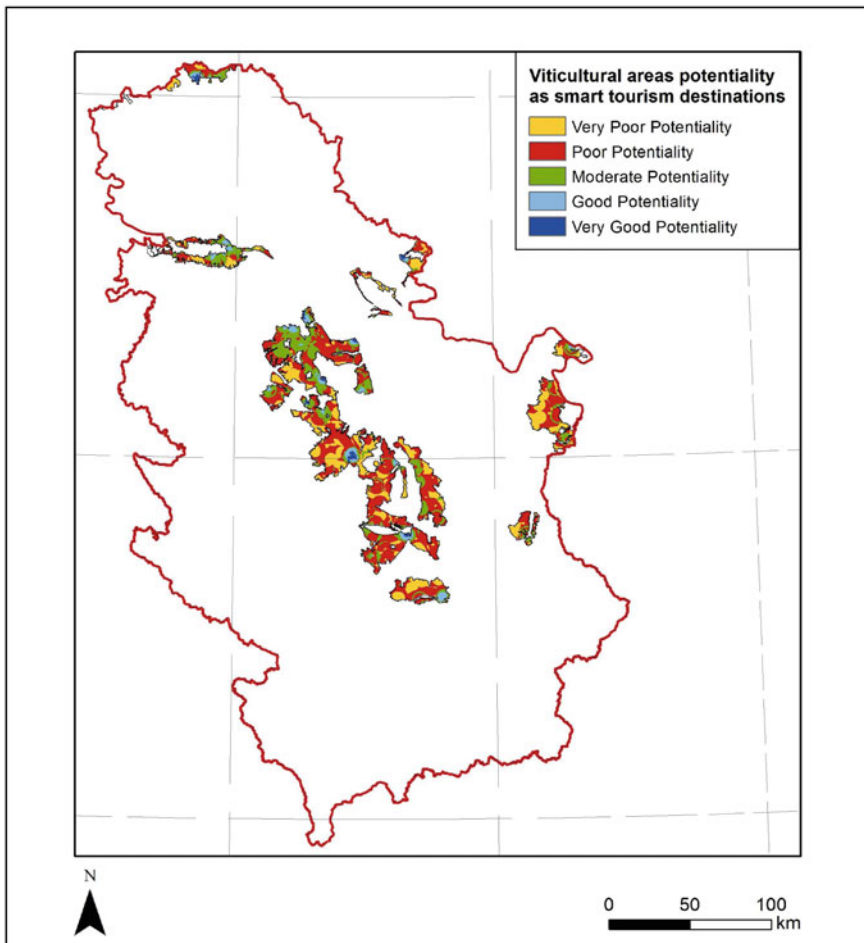
Fig. 4 Potential map for smart tourist destinations in viticultural areas in Serbia. *Source* Elaborated by authors

rich cultural and historical heritage, the immediate presence of the National Park and Mount Fruska Gora, as well as its location along one of the largest rivers in Europe—the Danube. This wine region also has a large number of settlements. On the other hand, in this zone, the South Banat wine-growing region has the lowest value with a share of 6.40% (Fig. 4).

Good potentiality offers an opportunity that reflects a set of favourable conditions for the development of a smart destination with a share of 3.90% in relation to the total analysed area. Wine-growing region Subotica (8.07%), wine-growing region Srem (7.90%) and wine-growing region Beograd (5.26%) have the greatest potential in this category. Wine-growing regions Negotin has the lowest development chance as a smart viticultural destination (0.90%) (Fig. 4).

The very good potentiality zone of the viticultural area for development into a smart tourist destination shows the greatest value for ecotourism potential. The very good zone covers 1.10% of the research area. The most dominant area coincides with the urban centres of wine-growing regions: Subotica (6.46%), South Banat (3.07%), Šumadija (2.11%), Belgrade (1.11%). Some city centres are not covered by the entire regionalization process (Belgrade, Jagodina) or are in the immediate vicinity of wine-growing regions (Novi Sad, Negotin, Ćuprija, Paraćin), while some smaller ones are (Vršac, Subotica, Kragujevac, Prokuplje, Kruševac, Aranđelovac, Smederevo, etc. (Fig. 4)).

Conclusion

The use of state-of-the-art information and communication technology improves the efficiency and sustainability of the tourism industry and many countries have decided to implement smart tourism tools as a strategy for adapting to the ever-changing tourist profile (Castillo Vizuete et al. 2021).

The traditional tourism industry in Serbia needs new, digital technologies to reduce costs and increase efficiency (Luo and Zhou 2021). Today's tourists have become more demanding and informed by discovering new ways of seeking information (Buhalis and Law 2008). These changes have shaped the digital tourist (Benckendorff et al. 2014). The use of state-of-the-art information and communication technology improves the efficiency and sustainability of the tourism industry, and many countries have decided to implement smart tourism tools as a strategy for adapting to the ever-changing tourist profile (Castillo Vizuete et al. 2021).

Studies on smart tourism suggest that technology is the key to improving destination competitiveness (Zach and Krizaj 2017) while the application of smart technologies has proven important for the complete tourism experience, from travel planning to tourists staying in a given destination (Gajdosik 2019).

According to Savić and Pavlović (2018), it is necessary to develop and advance innovation policy in order to create conditions and measures to encourage and raise the country's potential. One example is working on existing ones and applying for new projects can provide the necessary funds to invest in research and development.

On the other hand, starting from the connection between innovation and man and capital, greater cooperation between universities and industrial sectors in the field of research and promotion of technological development is necessary.

Based on the analysis, tourist attractions in certain viticultural areas are mostly insufficiently affirmed and unrecognizable, although they are numerous. Attractiveness has shown good results in wine-growing districts that are surrounded by cities that have an extremely good attraction base and are well-known tourist centres. These wine-growing districts are complementary tourist values to the city centres in which they are located. In terms of accessibility, the results of the research showed that some wine-growing districts have excellent traffic access, while the remaining majority should work on improving and developing traffic infrastructure.

The results of the research, the interest of tourists so far, wine routes, long tradition of wine production, etc., indicate the existence of several wine-growing regions of Serbia with possible potential for the formation of wine tourism product. The wine-growing districts of Serbia have great potential in future for the formation of a wine tourist product, but at the moment, that is not feasible, because no wine-growing districts has integrated elements of a tourist product. The wine-growing districts that are closest to fulfilling the form, place their product as a complementary content of the tourist space.

In accordance with the partial existence of 6A, regarding the viticultural areas of Serbia, the facts show that in these wine districts there were no generation of tourist wine tourism products and the formation of available packages but remained on the offer of wine tourism as a complementary element of tourist offer. For example in the Vršac wine district, the wine tourism is being built, and the tourist offer is not integrated, which consists of bunch of the activities that are simply not related; Fruška Gora wine district shows interest for wine tourism and develops centres such as Sremski Karlovci, as well as tourism in nature, given that there is a national park of the same name. Connecting and integrating the elements themselves would lead to the creation of a wine tourism product and the sixth element of smart tourism destinations (6A).

The viticultural areas of Serbia are diverse, from those with traditional architecture located in the Negotin wine-growing region (Rogljevo and Rajac wine-growing districts). Then, small family wine-growing districts, some of which are dedicated to wine tourism and newer wineries. Newer wineries in Serbia, in relation to developed countries and wine tourism, are trying to be innovative in placing new attractions in wine tourism: new menu within wine restaurants, development of authentic resources, stone wine cellars, rural buildings similar to other stone structures, then wine presses, etc. In addition to specific accommodation, other complementary services should be developed: wine therapy, one-day farmer, flying over the wine-growing district. Special offers can be found in Šumadija wine-growing region (Oplenac wine-growing district), Three Morava wine-growing region (wine-growing district of Aleksandrovac) and Srem wine-growing region (Fruška gora wine-growing district): Museum of Wine and Viticulture (Aleksandrovac), Museum of the Royal Winery (Oplenac) and Fruška gora Wine Shop). In addition to accommodation, well-developed tourist

infrastructure, a very important role in the overall experience is left by the quality of service, marketing, presentation (image), development of new activities and others.

References

Bajaj R, Sharma V (2018) Smart Education with artificial intelligence-based determination of learning styles. Procedia Comput Sci 132:834–842

Benckendorff P, Sheldon P, Fesenmaier D (2014) The digital tourism landscapes. Tourism information technology, 2nd edn. CABI, Wallingford, UK, pp 22–52

Boes K, Buhalis D, Inversini A (2015) Conceptualising smart tourism destination dimensions. In: Tussyadiah I, Inversini A (eds) Information and communication technologies in tourism. Springer, Cham, Switzerland, pp 391–403

Boes K, Buhalis D, Inversini A (2016) Smart tourism destinations: ecosystems for tourism destination competitiveness. Int J Tour Cities 2:108–124

Bradić-Martinović A, Miletić B (2017) ICT readiness as a factor of competitiveness of Serbian tourism. In: The second international scientific conference tourism in function of the development of the Republic of Serbia, University of Kragujevac, Faculty of Hotel Management and Tourism, Vrnjačka Banja, pp 448–469

Buhalis D (2000) Marketing the competitive destination of the future. Tour Manage 21(1):97–116

Buhalis D, Amaranggana A (2013) Smart tourism destinations. Inform Commun Technol Tourism. https://doi.org/10.1007/978-3-319-03973-2

Buhalis D, Amaranggana A (2015) Smart tourism destinations enhancing tourism experience through personalisation of services. Inform Commun Technol Tourism 377–389. https://doi.org/10.1007/978-3-319-14343-9

Buhalis D, Law R (2008) Progress in information technology and tourism management: 20 years on and 10 years after the Internet—the state of eTourism research. Tour Manag 29:609–623

Carbonell P, Rodríguez-Escudero AI (2015) The negative effect of team's prior experience and technological turbulence on new service development projects with customer involvement. Eur J Mark 49:278–301

Castillo Vizuete DD, Gavilanes Montoya VA, Muñoz Jácome AE, Chávez Velásquez CR, Alexandru Borz S (2021) An evaluation of the importance of smart tourism tools in the Riobamba Canton, Ecuador. Sustainability 13:9436. https://doi.org/10.3390/su13169436

Chandler S (2020) Virtual reality concert in Helsinki attracts over 1 million spectators. Available at https://www.forbes.com/sites/simonchandler/2020/05/05/virtual-reality-concert-in-helsinki-attracts-over-1-million-spectators/#621fcdf61281 (13 April 2022)

Cimbaljević M, Stankov U, Pavluković V (2019) Going beyond the traditional destination competitiveness–reflections on a smart destination in the current research. Curr Issue Tour 22(20):2472–2477. https://doi.org/10.1080/13683500.2018.1529149

Crouch GI, Ritchie JB (2005) Application of the analytic hierarchy process to tourism choice and decision making. A review and illustration applied to destination competitiveness. Tourism Anal 10(1):17–25

Del Chiappa G, Baggio R (2015) Knowledge transfer in smart tourism destinations: analyzing the effects of a network structure. J Destin Mark Manag 4(3):145–150

Del Vecchio P, Mele G, Ndou V, Secundo G (2018) Creating value from social big data: implications for smart tourism destinations. Inf Process Manage 54(5):847–860. https://doi.org/10.1016/j.ipm.2017.10.006

Dwyer L, Peter F, Dwyer W (2010) Tourism economics and policy. Channel View Publications, Bristol

Egger R (2013) The impact of near field communication on tourism. J Hosp Tour Technol 4:119–133

El-Assasy A (2020) How does Korea response to COVID-19? Sada El balad English 1. Available at https://see.news/how-does-korea-response-to-covid-19-sada-elbadalad-englis/ (05 May 2022)

European Environment Agency, 2013. CORINE Land Cover (CLC) 2006, Version 17. CRC/TR32 Database (TR32DB). Accessed from https://www.tr32db.uni-koeln.de/data.php?dataID=1152 on 2021-10-05

Femenia-Serra F, Neuhofer B (2018) Smart tourism experiences: conceptualisation, key dimensions and research agenda. J Reg Res 42:129–150

Gahr D, Rodríguez Rodríguez Y, Hernández-Martín R (2014) Smart destinations: the optimization of tourism destination management. In: conference: Canarian economy seminar, Tenerife, Canary Islands, Spain

Gajdosik T (2019) Smart tourists as a profiling market segment: implications for DMOs. Tour Econ 26:1042–1062

García-Milon A, Juaneda-Ayensa E, Olarte-Pascual C, Pelegrín-Borondo J (2020) Towards the smart tourism destination: key factors in information source use on the tourist shopping journey. Tourism Manage Perspect 6. https://doi.org/10.1016/j.tmp.2020.100730

Gozdegul B, Dogan O, Al-Turjman F (2019) Smart tourism destination in smart cities paradigm: a model for Antalya. In: Al-Turjman F (ed) Artificial intelligence in IoT. Springer, pp 63–92

Gretzel U, Reino S, Kopera S, Koo C (2015) Smart tourism challenges. J Tourism 16(1):41–47

Guo Y, Liu H, Chai Y (2014) The embedding convergence of smart cities and tourism internet of things in China: an advance perspective. Adv Hospitality Tourism Res 2(1):54–69

Harrison C, Eckman B, Hamilton R, Hartswick P, Kalagnanam J, Paraszczak J, Williams P (2010) Foundations for smarter cities. IBM J Res Dev 54(4):1–16. https://doi.org/10.1147/JRD.2010.2048257

Hydro-meteorological Institute of the Republic of Serbia (RHMZ) (2010) Hydro-meteorological data, Belgrade. Accessed from http://www.hidmet.gov.rs/

Ivars-Baidal JA, Celdrán-Bernabeu MA, Mazón JN, Perles-Ivars ÁF (2019) Smart destinations and the evolution of ICTs: a new scenario for destination management? Curr Issue Tour 22(13):1581–1600. https://doi.org/10.1080/13683500.2017.1388771

Ivars-Baidal J, Celdrán Bernabéu MA, Femenia-Serra F (2017) Guía de Implantación de Destinos Turísticos Inteligentes de la Comunitat Valenciana

Jeong M, Shin HH (2019) Tourists' experiences with smart tourism technology at smart destinations and their behavior intentions. J Travel Res. https://doi.org/10.1177/0047287519883034

Jovanović R, Almeida García F, Rafael Cortés-Macías R (2022) Evaluation of suitability areas for ecotourism using multi-criteria analysis. The case of central Serbian viticultural region. Eur J Geogr 13(3):019–041. https://doi.org/10.48088/ejg.r.jov.13.3.019.041

López-Ávila A, Sánchez-García S (2013) Destinos turísticos inteligentes. Harvard Deusto Bus Rev

Luo L, Zhou J (2021) BlockTour: a blockchain-based smart tourism platform. Comput Commun 175:186–192

Méndez JH, Muñoz-Leiva F (2015) What type of online advertising is most effective for eTourism 2.0? An eye tracking study based on the characteristics of tourists. Comput Hum Behav 50:618–625

Milošević RM, Milošević MD, Stević MD, Stanojević DA (2019) Smart city: modeling key indicators in Serbia using IT2FS. Sustainability 11:3536. https://doi.org/10.3390/su11133536

Nam T, Pardo TA (2011) Conceptualizing smart city with dimensions of technology, people, and institutions. In: Proceedings of the 12th annual international digital government research conference: digital government innovation in challenging times. College Park, Maryland, USA, pp 282–291. https://doi.org/10.1145/2037556.2037602

Neirotti P, De Marco A, Cagliano AC, Mangano G, Scorrano F (2014) Current trends in smart city initiatives: some stylised facts. Cities 38:25–36

OpenStreetMap Contributors (2020). OpenStreetMap. https://www.openstreetmap.org, Last accessed on 2020-04-19

Republic Statistical Office of the Republic of Serbia. https://www.stat.gov.rs/

Saaty TL (1980) The analytic hierarchy process. McGraw Hill, New York

Saaty TL (2008) Decision making with the analytic hierarchy process. Int J Serv Sci 1(1):83–98

Saaty TL, Vargas LG (2001) Models, methods, concepts and applications of the analytic hierarchy process. Springer

Sanders D (2004) Wine tourism and regional development: a case study of the Margaret River wine region, Western Australia. In: Carlsen J, Charters S (eds) International wine tourism research. Proceedings of the international wine tourism conference. Vineyard Publications, Margaret River, Western Australia, Perth

Santos V, Ramos P, Sousa B, Valeri M (2021) Towards a framework of the global wine tourism system. J Organ Chang Manag. https://doi.org/10.1108/JOCM-11-2020-0362

Santos-Júnior A, Augusto-Biz A, Almeida-García F, Luiz Mendes-Filho L (2019) Entendiendo la gobernanza de los destinos turísticos inteligentes: el caso deflorianópolis—Brasil. Int J Inform Syst Tourism 4(1):29–39

Santos-Júnior A, Almeida-García F, Morgado P, Luiz Mendes-Filho M (2020) Residents' quality of life in smart tourism destinations: a theoretical approach. Sustainability 12:8445. https://doi.org/10.3390/su12208445

Santos-Júnior A, Mendes-Filho l, Almeida-García F, Manuel-Simões J (2017) Smart tourism destinations: un estudio basado en la visión de los stakeholders. Revista Turismo em análise, 28(3):358–379

Savić J, Pavlović G (2018) Analysis of factors of smart tourism development in Serbia. Hotel Tourism Manage 6(1):81–91. https://doi.org/10.5937/menhottur1801081S

Shen S, Sotiriadis M, Zhang Y (2020) The influence of smart technologies on customer journey in tourist attractions within the smart tourism management framework. Sustainability 12:4157

Pametni Gradovi Srbije—Inovativnost i rezilijentnost lokalnih zajednica u Srbiji 2021. godine, PALGO smart, Beograd (2021) (Smart Cities of Serbia—Innovation and resilience of local communities in Serbia in 2021, PALGO smart, Belgrade)

Tran MH, Huertas A, Moreno A (2017) (SA)6: a new framework for the analysis of smart tourism destinations. In: Actas del Seminario Internacional Destinos Turísticos Inteligentes: nuevos horizontes en la investigación y gestión del turismo, pp 190–214. https://doi.org/10.14198/Destinos-Turisticos-Inteligentes.2017.09

Trencher G, Karvonen A (2019) Stretching "smart": advancing health and well-being through the smart city agenda. Local Environ 24:610–627

U.S. Geological Survey, 2019, 3D Elevation Program 1-Meter Resolution Digital Elevation Model (published 20200606). Accessed 23 Oct 2019 at https://www.usgs.gov/the-national-map-data-delivery

Um T, Chung N (2019) Does smart tourism technology matter? Lessons from three smart tourism cities in South Korea.Asia Pacific J Tourism Res 1–19. https://doi.org/10.1080/10941665.2019.1595691

United Nation World Tourism Organization (UNWTO) (2020) Tourism and Covid-19. UNWTO, Madrid

Vicini S, Bellini S, Sanna A (2012) How to co-create Internet of things-enabled services for smarter cities. In: Proceedings of the first international conference on smart systems, devices and technologies, vol 27. Stuttgart, Germany, pp 55–61

Williams P (2001) Positioning wine tourism destinations. An image analysis. Int J Wine Mark 13(3):42–59

Yang S-B, Hlee S, Lee J, Koo C (2017) An empirical examination of online restaurant reviews on Yelp.com. Int J Contemp Hosp Manag 29:817–839

Zach F, Krizaj D (2017) Experiences through design and innovation along touch points. Tour. Verge. Springer Cham

Zhang Y, Sotiriadis M, Shen S (2022) Investigating the impact of smart tourism technologies on tourists' experiences. Sustainability 14:3048. https://doi.org/10.3390/su14053048

Index