

Article

The Challenges of Implementing Sustainable Development: The Case of Sofia's Master Plan

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Abstract: In this paper, we explore how master planning promotes and implements particular urban development patterns and, more generally, contributes to sustainability. Our goal is to understand the link between urban growth intentions articulated through the master planning process and realisation of its specific forms, e.g., monocentric or polycentric, compact or dispersed. As a case study, we examine the current General Urban Development Plan (GUDP) of the Bulgarian capital Sofia against the city's actual development pattern. We observe that the primary goals of the GUDP are to promote a polycentric urban structure and low-density expansion, as well as preserve green edges. While the question of whether and how these goals reflect the sustainability ideal requires further consideration, there are some indications that Sofia's GUDP may not be effective in encouraging sustainable forms of growth. Substantial inconsistencies exist between the plan's overall goals and some of its measures and implementation tools. The results on the ground suggest that, despite the plan's low-density aspirations, Sofia is becoming more compact and densified, while losing its green edges and failing to redirect growth to its northern territories where ample space and opportunities exist. We conclude that employing the achievements of research on sustainability and developing relevant implementation tools such as more effective zoning regulations and viable suburban transportation infrastructure are necessary for realising both the patterns proposed through master planning and achieving sustainable urban growth.

Keywords: efficiency of planning; sustainable forms of urban growth; polycentric urban development; suburbanisation in Southeastern Europe; instruments of urban planning

1. Introduction

About a quarter of a century ago, the Brundtland Report [1] and Agenda 21 [2] gave a powerful impetus to the idea of sustainability, highlighting the importance of preserving natural resources and balancing environmental, social and economic issues. Urban growth and its forms are closely related to sustainability because they involve the consumption of natural resources such as land, biodiversity, and non-renewable sources of energy. In recent decades researchers have been particularly interested in studying two forms of growth: dispersed expansion, i.e., sprawl, and polycentricity. Sprawl, as a low-density and dispersed form of urban expansion, is generally considered to be a threat to sustainability: it is characterised by overconsumption of land and natural amenities, inefficient modes of transit, overdevelopment of expensive infrastructure and car dependency. Researchers maintain that the negative aspects of sprawl can be neutralised through promoting polycentricity [3–5]. Polycentric urban areas are compact yet separated—or, rather, connected—by large green areas and enclaves; thus

land resources are used economically, and urban and green environments are integrated. Polycentricity provides for economical use of land and savings in investment and energy.

Despite the considerable achievements of sustainability research, major problems arise in their application. In Europe, for instance, scientists have long warned of the problems of sprawl, and the European Environment Agency [3] identified it as a major threat to sustainable development. Still, cities continue to exhibit inefficient development patterns [6]. In most parts of the European continent, sprawl remains one of the major causes of the degradation of natural capital [7] and high rates of soil sealing [8]. These facts suggest a great difficulty of incorporating the insights from sustainability research into planning practice. Studies on the performance and efficiency of planning [9–11] have found that planners often fail to establish proper planning goals consistent with the findings of research on urban development and market trends. The planners face even greater difficulties in devising relevant tree structures of sub-goals, planning measures and solutions. Finally, they are least successful in the elaboration of implementation tools [11].

Therefore, to promote sustainable urban growth, planning would need to manage two challenges: (1) how to choose the proper form of growth by defining relevant development goals and (2) how to realise these goals—i.e., implement the intended urban form. Clearly, if planning fails in either of these two challenges, it cannot facilitate improvements in urban sustainability. Studies focusing on the first challenge—i.e., aiming to define the proper form of growth—are abundant. In this paper, we focus on the second challenge to planning—the ability to achieve development goals by implementing the intended form of urban growth. We discuss concepts of sustainable urban form as the premise for studying the alignment between goals established in master planning documents and their realisation through urban development.

As a case study, we analyse the current General Urban Development Plan (GUDP) of the Bulgarian capital Sofia (prepared 1998–2003 and enforced from 2007) and we evaluate the plan's performance and effectiveness in achieving the defined forms of urban development. Sofia is a suitable case study because, like other large cities in Southeastern (SE) Europe [5], following the fall of communism, between 2001 and 2011 it experienced a substantial growth of the city's population (10.3%) [12]. Similarly to many other world regions, growth in SE Europe is realised through expansion and suburbanisation [13–15]. Sofia is thus a typical example of a SE European suburbanising city [13], although the trends also exhibit certain local peculiarities [15,16].

The paper proceeds first with a brief discussion of basic theoretical issues concerning the forms of growth. Then we explore the GUDP of Sofia by identifying what type of growth the plan promotes. To analyse the provisions of the GUDP concerning the form of urban growth and its realisation in practice, we pose the following questions:

- What is the general position of the GUDP on the form of urban growth, as set forth in its form-related goals?
- Are the provisions and solutions outlined by the GUDP consistent with the plan's goals regarding the form of urban growth?
- Is the GUDP succeeding in promoting an intended form of urban growth?

The ultimate aim of our study is to understand whether planning in principle and Sofia's master plan in particular is able to promote the desired form of growth as a way to achieve urban sustainability. We explore the importance of the plan's performance for sustainable urban development.

2. Literature Review: Urban Growth, Planning and Implementation

In this section, we first outline the main forms of urban growth in terms of structure and compactness with their advantages and disadvantages. We also discuss how planning can realise intended forms of growth through implementation process and tools. This literature review informs the methodology we use to analyse Sofia's master plan and its performance.

2.1. Urban Growth and Forms: Structure and Compactness

2.1.1. Structure

Monocentric structure is a traditional and well-researched urban form. In his pioneering work of 1925 Burgess [17] defines the monocentric city by its dominant centrally located business district (CBD) and a series of zones in concentric circles around it. In 1945, Harris and Ullman [18] contribute to this concept by introducing the “multi nuclei” model in which cities are still characterised by a single major CBD, but smaller centres (nuclei) develop in peripheral areas. Although the studies focused on the monocentric city model prevailed until the 1970s [19], the phenomenon of polycentricity originated in the late nineteenth century and the first half of the twentieth century—with the work of Ebenezer Howard on garden cities (1898, 1902) and Christaller’s central place theory (1933). Yet defining a polycentric urban system could be challenging. Morphologically, polycentric systems comprise multiple urban centres/nodes [19], but this is the only feature on which researchers agree. Hall [20] finds that “polycentricity can occur at multiple levels or spatial scales, and what is monocentric at one level can be polycentric at another—and vice versa”. The ESPON 1.1.1 Report [21] defines three levels of European polycentric structures: macro (intra-regional), meso (interregional) and macro (European). Davoudi [19] also notes the differences in the meaning of polycentricity in different contexts and at different scales. She distinguishes between three scales: intra-urban (“characterized by the development of multiple sub-centres within one built up area”), inter-urban (“characterized by separate and distinct cities or smaller settlement which interact with each other to a significant extent”) and inter-regional scales (referring to the concepts of megalopolis and polynucleated urban field). The first two scales are relevant to our case study: the intra-urban scale refers to internal urban structure, and the inter-urban scale refers to the municipal urban region.

The analysis of the functioning of polycentric systems at different levels/scales highlights the role of hierarchy. Urban systems with clear hierarchical structures dominated by one city are generally considered monocentric [22]. However, the links between the lower-tier nuclei could be complex even in the context of monocentricity and single hierarchical structure. The criteria used to define a centre helps us distinguish between monocentric and polycentric urban forms. Davoudi’s definitions suggest that a centre or a node is characterised by a higher intensity of urban functions and higher population and development densities. Morphologically, polycentric nodes are urban forms/settlements with high densities [23] (p. 6). Functionally, a criterion introduced by OECD [22,24] and adopted by the European Commission (EC) [25] emphasises the intensity of urban functions—namely, the provision of jobs attracting employees from other nodes in a polycentric system [22].

2.1.2. Compactness

Another dimension of urban form is defined by compactness. As a result of various historical factors, cities around the world have evolved in either compact or dispersed urban forms [26]. Compact cities are consistently characterised by high densities. By comparing the densities of 52 metropolitan areas, Bertaud [27] (pp. 9–10) finds that densities of cities around the world differ substantially—from about 6 persons/ha in some American cities (e.g., Atlanta) to 360–390 persons/ha in Seoul, Guangzhou, Hong Kong and Mumbai. Bertaud thus observes that “densities (are) strongly influenced by cultural factors” [27] (p. 9). Similarly, for cultural but also other reasons, densities vary considerably even within a single continent, e.g., within Europe [28]. But as Bertaud notes, the cities he studied “are all reasonably successful”, so he concludes that “there is no ‘right’, ‘correct’, ‘manageable’ or ‘acceptable’ range of density per se” [27] (p. 10). Indeed, low densities are not necessarily inefficient on their own, but mostly in cases when they are manifested as urban sprawl or lacking adequate transport or other infrastructural support.

As a type of urban form, sprawl is synonymous with dispersion. Dispersed or sprawling urban forms are the opposite of compact: they are “patchy, scattered and strung out, with a tendency for discontinuity” [1] (p. 6); they may also follow ribbon-like or leap-frogging patterns [29,30]. Besides

its physical appearance as a dispersed low-density urban form, sprawl is a complex phenomenon, generally considered inefficient and unsustainable. Sprawl is criticised for high car dependence, lack of public transit-based access to jobs and services, extensive demand for infrastructure, absence of vibrant local centres and public spaces, high levels of social segregation and, above all, overconsumption of natural resources [3,29–33]. From this point of view, sprawl is defined as “*excessive spatial growth*” [33,34] consuming disproportionate amounts of natural resources [3,34,35] such as land, raw materials, non-renewable sources of energy, natural amenities and biodiversity, and thus in conflict with the Brundtland definition of sustainability.

Thus far, we have identified two characteristics that define urban form: spatial structure (monocentricity versus polycentricity) and compactness (compact versus dispersed forms). Both compact and dispersed cities/systems may be monocentric or polycentric, and, therefore, four combinations are possible: monocentric-compact, monocentric-dispersed, polycentric-compact and polycentric-dispersed. Yet distinguishing between monocentric-dispersed and polycentric-dispersed forms may be difficult when the system is organised around one dominant centre. A polycentric-dispersed form is easy to identify when the system is dominated by two or more cores at the highest tier. But if only one major centre dominates the system (as in the case of Sofia), then this structure should be defined either as polycentric-compact when the lower-tier nodes are strong enough to form secondary centres, or as monocentric-dispersed when the nodes are small and weak and cannot be clearly distinguished from the dispersed grains. Therefore, in systems dominated by one centre which is much stronger than the lower-tier nodes, the polycentric-dispersed type has little relevance. In such systems (of which Sofia is one example), three rather than four options can be identified: monocentric (when the lower-tier nodes are too weak), polycentric-hierarchical (when the lower-tier nodes form strong sub-centres) and dispersed.

Again, our goal is not to discuss whether the three forms of growth are properly evaluated as sustainable or not. Rather, we explore whether planning is able to utilise the findings of research on sustainability and be effective in establishing and implementing urban development goals.

2.2. Linking Planning Goals and Their Implementation

Because urban development is a complex process involving many factors and actors, establishing sound planning goals which are based on scientific knowledge and appropriate to local circumstances and needs is of great importance. However, even when it stipulates relevant and well-defined goals, planning sometimes fails to ensure their realisation. The difficulties in balancing urban development and regulating sprawl in Europe [7,36–38] are illustrative of this problem. The efficacy of urban planning is an even greater issue in the countries of Eastern and Southeastern Europe, given their lack of experience in planning under market conditions. In a market society, the realisation of plans is more challenging because it depends on the actions of numerous market players [16,38–41] and the plans' effectiveness in realising the goals.

To perform well, an urban plan should not be a static statement of ultimate goals, but rather a dynamic tool of governance. Thus the preparation and implementation of a plan form a cycle of management [42,43]. According to Taylor [9] each cycle comprises several phases: (1) analysis of the current situation; (2) definition of the main planning goals; (3) elaboration of a tree of goals, sub-goals, and planning measures/solutions; and (4) development of a system of implementation tools. Finally, once the plan is used for guiding urban development, its implementation should be monitored and evaluated so that planning can be improved in the next cycle. According to Slaev [11,44], the number of errors in plans tends to grow with each subsequent phase within a planning cycle. In examining six regional and master plans, he observes that, despite occasional omissions and mistakes in the analysis of ongoing urban development, market forces and trends, planners usually are most successful in the first phase. Problems are more likely to emerge in the second phase, and there are further issues in the process of developing implementation tools and employing instruments of monitoring and policy control. This is because each subsequent phase compounds the shortcomings of the previous phases, and a cumulative effect is created. While these observations may seem obvious, they are generally

neglected in planning practice, and planners as a rule pay the least attention to the most difficult and problematic phases of the planning cycle. Similar conclusions are drawn by Waldner [45].

Getting more specifically into the issue of implementation of plans, Bertaud [10] argues that urban governance and planning should be focused on creating a framework within which the urban market may function. This framework includes three categories: land-use regulations; the primary infrastructure; and local fees and taxes. Detailing these categories, Webster et al. [46] outline more than a dozen measures and tools of governance that may be used to enhance the land use efficiency in periurban areas. These measures are: market-based determination of land prices; growth or service boundaries; standardised tools for assessment of farmland; zoning standards and floor area ratios (FARs) aimed to promote hierarchy of nodes; development of mass transit systems; regulations for auctioning industrial land; strengthening of urban property rights; rules for brown-field redevelopment; impact fees; FAR standards to induce higher suburban densities; awareness-raising among developers and consumers regarding the value of access; green space designation; and infrastructure planning.

The efficacy of urban planning is measured by two approaches: conformance-based and performance-based methods. The former focus on the conformance between the plan's goals and the actual spatial outputs [47]. The latter are concerned with the plan's outcomes as well as other impacts [48,49]. Faludi [49] maintains that the conformance approach is more appropriate for evaluating project-oriented plans. In this paper, we assess whether an implemented plan is achieving its (defined) goals, and, therefore, we employ the conformance-based approach. Further, the focus of Sofia's master plan on polycentricity requires consideration of planning methods and instruments that can contribute to polycentric growth. Density is an important factor for polycentricity [23] (p. 19), insofar as it is difficult for low-density nodes to attract commercial and public services and jobs, and "weak" nodes tend to be more dispersed. Urban cores in polycentric systems are also characterised by well-developed services and a mix of uses. To this end, zoning regulations allowing for higher densities and mixed uses are essential. However, transport connections are just as important. It is well known that car dependency is a key feature of urban dispersion/sprawl [4,50], whereas efficient public transit systems are a key factor in "captur(ing) the benefits of high densities" and polycentric form [51] (p. 68), [52,53]. Therefore, we identify two instruments used to promote high-density polycentric structure: (1) zoning laws/regulations, which foster a system of high-density mixed-use nodes; and (2) development of public transit infrastructure and networks.

3. Methodology

The empirical part of this research employs a case study of Sofia's master plan which is evaluated against the city's urban development trends and patterns. We first present the information on Sofia's historically established urban structure. Next, we address the first question about the intended form of growth and the second question on the plan's promotion of the particular form by examining the details of Sofia's master plan (GUDP). We identify the plan's goals in relation to urban form and investigate the coherence between the goals and the measures and instruments of planning employed to realise these goals: the zoning regulations and the planned development of transportation networks and infrastructure. To find out whether the results on the ground over the past years reflect the GUDP's goals, we analyse the actual urban development in suburban areas.

To measure the form of growth (monocentric, polycentric or dispersed), we use three indicators: population (residential) density, rate of monocentricity, and perimeter-to-area ratio. Density is a commonly used and instrumental indicator for this purpose. However, we underline the importance of availability of data relevant to the scale of polycentricity, as the data on densities should be available for the units considered for measuring the urban structure. In Sofia population data are available only at the level of a district, which prevents identification of nodes within a district. In addition to supporting the assessment of urban structure (monocentric vs polycentric), density can be used to investigate compactness especially when suburban forms are analysed [23]. Growing suburban densities suggest increase in compactness, whereas decreasing densities suggest a trend toward dispersion.

To determine the structural feature of monocentricity/polycentricity, we employ an indicator that we term the “rate of monocentricity”. This is the share of the population living in the urban core. This indicator is useful for our study insofar as very high levels of monocentricity limit the potential for polycentric development. Understanding the relationship between monocentricity and polycentricity is important for this research, because one of the main goals of Sofia’s master plan is to reduce the city’s monocentricity and promote polycentricity. While it may be possible to have a strong dominant centre and still have a high degree of polycentricity, very high levels of monocentricity limit the possibility of polycentric development, especially if dispersed small settlements prevail in the suburban region. If, for instance, in a system with one dominant city and many small settlements, 80% or 90% of the population live in the urban core, secondary nodes can hardly compete with the dominant one to attract employees (as suggested with the OECD/EC criterion). In Sofia’s case, there are three small towns and 33 villages in the municipal territory (which coincides with the city’s urban region). A settlement that is much smaller than the dominant city can play the role of a grain in a dispersed urban form, but not of a node in a polycentric system. Therefore, if a plan maintains very high levels of monocentricity (e.g., 80% or more), then we have grounds to conclude that it cannot effectively promote polycentricity. Therefore, whereas the rate of monocentricity is only a rough indicator and an approximation, it can be useful for studying urban systems with very strong dominant centres like Sofia.

We measure the compactness/dispersion feature using the *perimeter-to-area* ratio. This is the ratio between the perimeter, i.e., the total length of the outer boundaries of all urbanised zones (nuclei/cores) and their total area. “Outer boundaries”, are all boundaries with non-urban lands. The perimeter-to-area ratio is a common indicator used in many studies [54–56] to measure the level of fragmentation (dispersion). More fragmented urban forms are characterised by a larger number of smaller nuclei, which increases the length of the outer boundaries. In contrast, more compact urban forms are characterised by a smaller number of nuclei, which generally enclose larger urban areas, and result to a lower total length of outer boundaries. Higher values of the perimeter-to-area ratio indicate high dispersion, and lower values indicate high compactness.

Calculations to measure urban form and growth are performed using data from the National Statistical Institute (NSI) [12], Census 2011, the Cadastre Agency, Sofia’s municipal planning company Sofproekt, and the Corine Land Cover datasets available for download from the European Environment Agency. Data are manipulated at the urban and district levels. The territory of Sofia Metropolitan Municipality contains 24 city districts, and data are available by district (Figure 1). We distinguish between the southern and the northern suburban districts, because, as we explain later in the paper, the planning goals, urban features of and trends in these two suburban regions differ substantially. Whereas the picturesque areas at the foot of Vitosha Mountain adjacent to Vitosha Natural Park in the southern areas are particularly attractive to new residents [13], lands to the north of the city have a predominantly agricultural character and have proved to be of much less interest. Two districts, Ovcha kupel (a southern district) and Vrabnitsa (a northern district), are “mixed” urban-suburban.

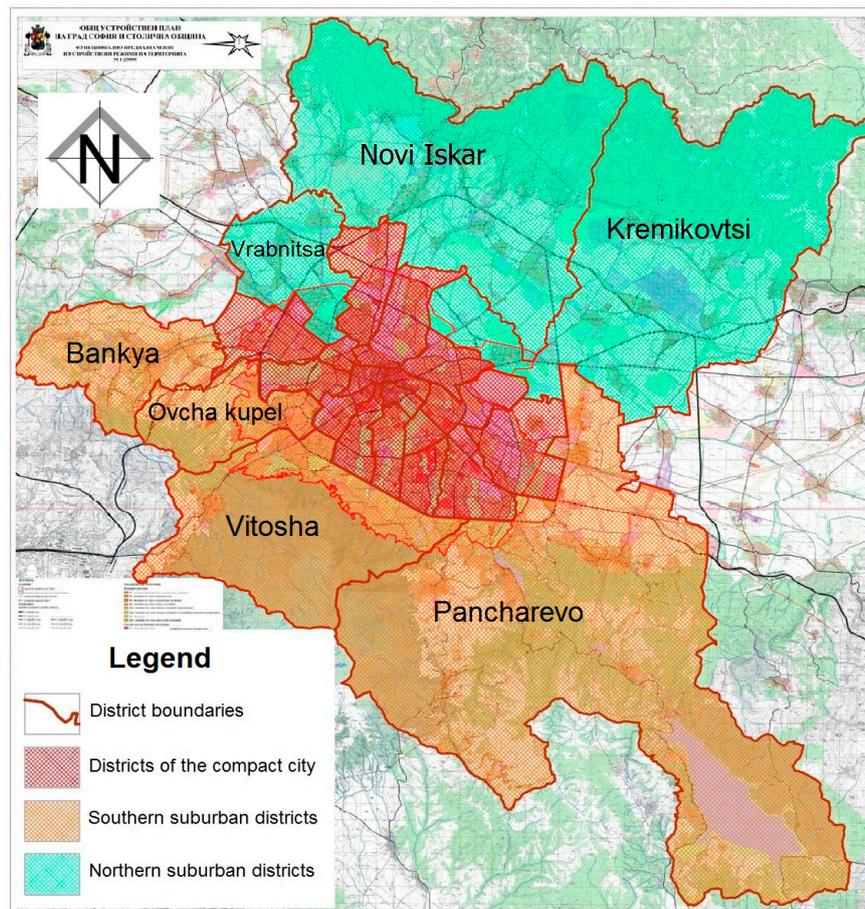


Figure 1. Map of Sofia Metropolitan Municipality and its suburban districts. Prepared by the authors based on a map from Sofproekt (Sofia municipality's planning body) [57]. Reproduced with permission from Sofproekt. Note: Sofia Metropolitan Municipality shown in this map is the scope of the General Urban Development Plan.

4. Analysis, Results and Discussion

4.1. Sofia's Growth and Urban Form before the Current 2007 Master Plan

In 1879, when Sofia was proclaimed the capital city after Bulgaria's liberation from the Ottoman Empire, its population was only about 20,000. By 1939, its population reached 400,000 [12]. In this period, Sofia developed a strong monocentric urban structure, typical of European cities at the time. Over the next half a century, the city's population grew to reach 1,200,000 by 1985. The main reason for this substantial increase was the so-called economic policy of "socialist industrialisation", which boosted the rates of rural-to-urban migration and urbanisation and related need for new housing. Under the conditions of state socialism in Bulgaria, high rates of housing construction could be achieved only by prefabricated construction technologies. The large state plants for prefabricated housing needed vast undeveloped territories, which were found at the urban periphery. The new peripherally located estates of prefabricated housing were developed at high densities [13,15,16], and reinforced the monocentric structure of the city.

Following the fall of communism in 1989, the new political and economic conditions in the period of transition to a market society resulted in radical changes in the processes of urban development. Due to tentative and incomplete political reforms, the crisis of the transition in Bulgaria lasted for more than a decade, and the economy experienced major difficulties [58]. The overall rates of Sofia's urban development decreased during this time [12,59]. Figure 2 depicts the population trends in

the municipality (which coincides with Sofia’s urban region)—the compact urban centre and the suburban settlements—towns, villages and suburbs. Evidently, the only increase is recorded in the southern suburban districts. The “rate of monocentricity” indicator shows a minor decrease of 3.16% between 1985 and 2001, confirming that Sofia remains to be highly monocentric. The capital city (population of 1,208,930) is about one hundred times larger than the largest of the other settlements in the Sofia Metropolitan Municipality—Novi Iskar (13,619) and Bankya (8950).

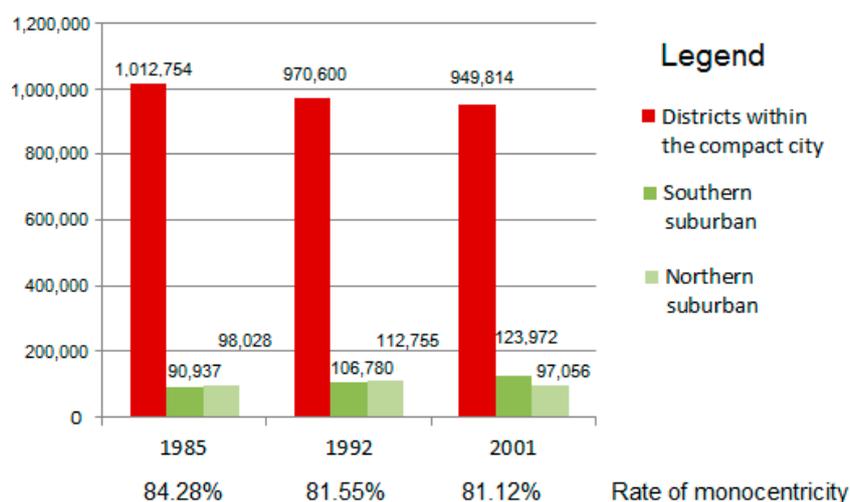


Figure 2. Number of residents in the compact city and in suburban areas, 1985–2001. Source: diagram prepared by the authors, based on data from NSI, 2012 [12] (pp. 18–34).

4.2. The General Urban Development Plan (GUDP)’s Position on Forms of Growth

The current master plan of Sofia was developed between 1998 and 2003. It was adopted by the Parliament in 2007. An amendment of the GUDP was undertaken and completed in 2009. The plan covers the whole of Sofia Metropolitan Municipality, which generally coincides with Sofia’s urban region.

In this section, we answer our first question: What is the general position of the GUDP on the form of urban growth, as set forth in its form-related goals?

4.2.1. Compactness

For the preparation of the most recent plan, a competition was organised by Sofia Metropolitan Municipality in 1998. At the final stage, two plans promoted two alternative concepts of development: one expansionary and one compact. The expansionary concept won. This was due to the prevailing perception among planners that Sofia needed to balance the “overdevelopment” of “the territory of the [compact] city of Sofia” by boosting development in the “underdeveloped” suburban areas, especially in the northern territories [60] (p. 19). The plan therefore aims to restrict growth in central areas and promote both polycentric and low-density dispersed suburban forms. Another key reason the GUDP aims to create “new markets for single-family housing” and promotes low-density expansion is the view that the city lacks areas for “high-category” habitation to meet the needs of “the growing middle class” [61] (pp. 25–26).

Still other provisions of the GUDP balance the expansionary vision with other planning goals. The ecology section calls for an economical use of land, maintaining that land and water are an “absolutely limited resource” [60] (p. 147) and requiring “restrictions on the territorial expansion of settlements in Sofia valley” (i.e., the northern areas), as well as controlling the expansion in the southern territories to preserve the large green areas (known as “green edges”) between the city and Vitosha Natural Park. These are the instances of the plan where the limits to the city’s expansion are suggested, to some extent in contradiction to the overall expansion concept.

Regarding urban sustainability, in a number of places the GUDP refers to the need to comply with the “imperatives of sustainable development” [60] (p. 41) and to provide for ecological balance [60] (pp. 147–149, 313), sustainability of the living environment [60] (p. 102, 104, 113) and sustainability of urban landscapes [60] (p. 37, 110, 150). Although the plan declares the need for sustainability, it never accounts for how the same would be impacted by particular types of urban growth. In general, the GUDP does not explicitly consider the nature, causes, and ecological and social implications of contemporary suburbanisation. In fact, the text of the GUDP does not mention the term “suburbanisation”, or “sprawl”.

4.2.2. Structure

The concept of polycentricity as a form of growth has been often revisited in Sofia’s master plans. The plans of 1937, 1948 and 1961—as well as the present GUDP—follow that tradition. In this most recent plan, polycentric structure is considered a “fundamental principle in the organization of the territory” [61] (p. 19). However, due to the existing dominance of the capital city of Sofia, this has to be a polycentric system with one (extremely) prevailing centre. The plan treats the urban structure both at the intra-urban level and the inter-urban level of the urban region. Polycentricity is considered mainly at the intra-urban level where the sub-centres are higher-density multi-functional nodes within the compact city and their role is primarily in service provision. Although the GUDP also designates lands for suburban centres at the level of the urban region, i.e., outside the compact city, the issues of inter-urban polycentricity are not explicitly forwarded.

The GUDP does not elaborate on the aims of the intra-urban polycentric development, but it emphasises the need to change the existing “strong monocentric” urban form. The plan aspires to foster “macrospatial restructuring of the city” by means of “remodelling the existing monocentric structure of the city towards a more polycentric one, within the scope of several spatial variations: point, linear or mixed centres, unified by one spatial network” [60] (p. 103). The projected “macrostructure units” are in effect five axes of development along five radiant transportation corridors, “along which the city opens outward, coupled by a gradual spilling out (or reallocation) of functions and services from the central city towards the secondary service centres in the periphery” [61] (pp. 29–31). This rather complicated vision is presented in Figures 3 and 4.

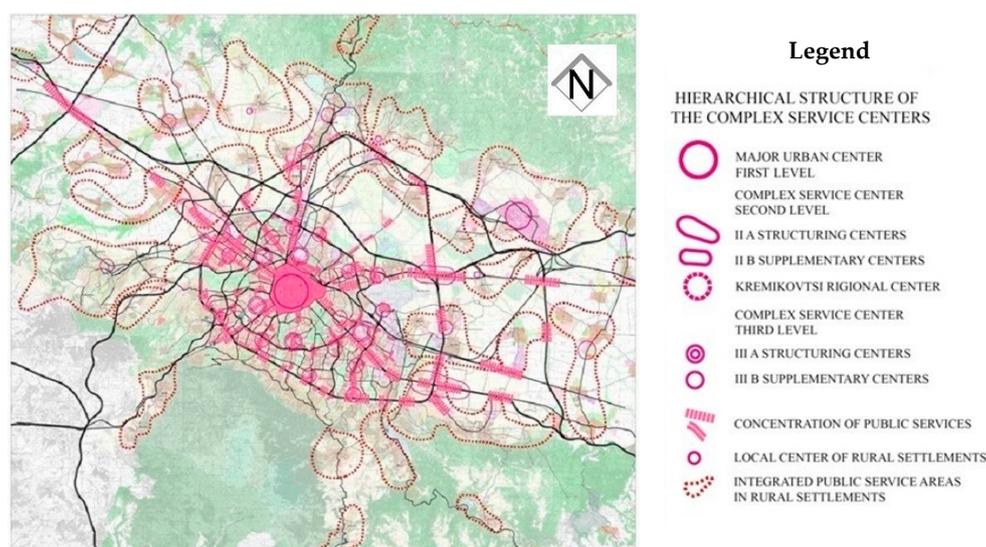


Figure 3. Polycentric structure of Sofia’s centres for service provision. Source: Sofproekt [57]. Reproduced with permission from Sofproekt.

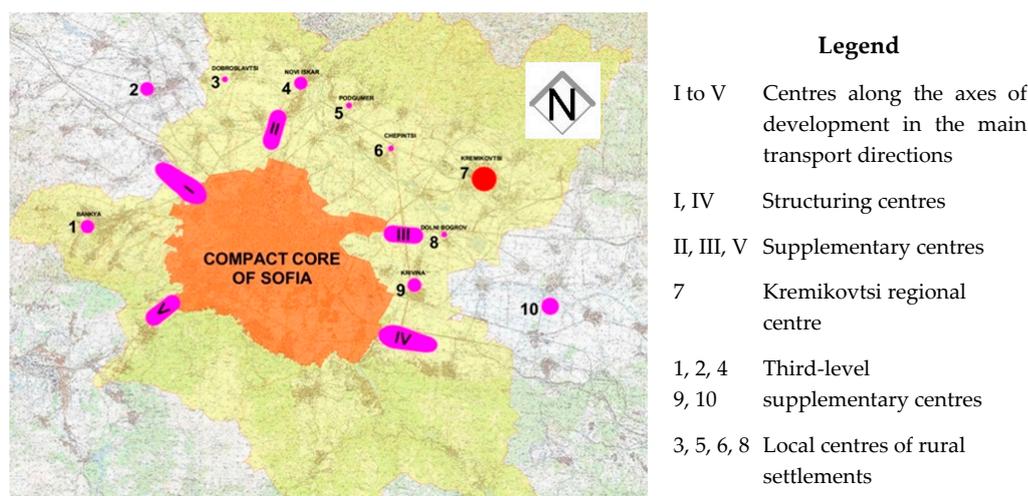


Figure 4. The concept of polycentricity as a system of axes and nodes in Sofia’s GUDP. Source: Authors, based on the GUDP [60].

Therefore, to answer the first question regarding the form of urban growth, we observe that the GUDP of Sofia has set two goals, which amount to low-density expansion and polycentric development. The plan acknowledges the importance of urban sustainability, but it does not seem to consider the form of growth—even suburbanisation or sprawl—as a related issue. The GUDP strives to promote polycentric development, but does not regard polycentricity as a method to overcome potential negatives of sprawl that may result in dispersed expansion.

4.3. Planning Provisions and Solutions Concerning Polycentricity and Suburbanisation

This part of the paper deals with the second question: Are the provisions and solutions outlined by the GUDP consistent with the plan’s goals regarding the form of urban growth? As we have emphasised, the GUDP aims to stimulate both polycentricity and urban expansion. In the literature review section, we identified two effective instruments to promote polycentric development: (1) zoning regulations fostering a system of high-density, mixed-use nodes and (2) proper development of transportation networks and infrastructure.

4.3.1. Zoning Regulations

GUDP’s zoning regulations in suburban areas are meant to support the goals of low-density expansion and polycentricity. Priority is given to low-density single-family housing and “high-category” habitation, as evident in the housing standards (Table 1). Information in the table is compiled from the GUDP [61] and refers to the periurban region as a whole; these data are not available for specific districts or territories. A total of 98% of suburban residential land is allocated to five types of low-rise housing. We should note, however, that Bulgarian standards for low-rise development generally allow for rather high densities. The prevailing type of low-rise housing in the GUDP allows for a floor-space ratio (FSR) as high as 1.3 (1300 sq. m. floor space in a lot of 1000 sq. m.). Areas designated for this housing type comprise 45.85% of all suburban residential land. Three types allow for FSR of 0.6 to 1.0, and only one housing type sets really low parameters of density—FSR of 0.1 to 0.3 (0.5). The latter housing type covers only 2% of all housing areas in the suburban region.

The GUDP takes a different approach to zoning the northern and the southern suburban areas. In the plan, most of the vast lands in the northern territories of Sofia Metropolitan Municipality remain agricultural. These areas are kept as the main reserve for urbanisation where the plan zones for development of various uses: low-rise housing, mixed (compatible) uses, production and warehousing. Zoning regulations indeed seem to promote both dispersed and polycentric development, which

seems acceptable in view of this region's abundant land resources. The situation is more complex in the southern suburban region where the GUDP emphasises the need to preserve the green areas (edges) to maintain the connection between the city and the Vitosha Mountain and Vitosha Natural Park. However, the picturesque landscapes of these territories are in high demand, and as a result of pressure from landowners, virtually all available land resources have already been converted to buildable land.

Table 1. Suburban housing areas by housing type in the 2003 (2007) GUDP and the 2009 Amendment.

Housing Types	Parameters		GUDP 2003 (2007) [ha]	GUDP-Amendment of 2009			
	FSR Max.	Greenery min. %		Municipality Total [ha]	Compact City [ha]	Suburban Areas [ha]	Suburban Share [%]
Areas for predominantly high-rise housing	3.5	20	524.05	524.05	524.05	0.00	0.00%
Areas for housing estates	3.0	40	2466.94	2449.74	2367.44	82.3	1.16%
Areas for medium-rise housing	2.3 (1.5)	35	1099.75	939.04	863.25	75.79	1.07%
Areas for predominantly low-rise housing	1.3	40	5683.78	5447.13	2204.67	3242.46	45.85%
Areas for low-rise housing in natural environment	0.6 (0.9)	70	981.24	985.48	179.31	806.17	11.40%
Areas for low-rise housing with specific requirements	1.0 (0.8)	60	1982.57	2196.75	1399.74	797.01	11.27%
Areas for low-rise housing with limited parameters	0.3 (0.5)	80	417.65	667.25	523.2	144.05	2.04%
Villa areas	0.8 (0.6)	60	1938.59	2060.74	136.91	1923.83	27.20%
			15,094.57	15,270.18	8198.57	7071.61	100.00%

Source: Authors, based on GUDP, 2009 Amendment, [61], p. 25. Note: The FSR in brackets is allowed under certain conditions.

4.3.2. Transportation Networks

The development of the transportation networks is crucial for urban growth. However, as suggested in previous research, well-developed road networks could induce dispersed development, whereas well-developed public transport networks would more likely stimulate polycentricity. The GUDP acknowledges the role of transport networks in establishing a polycentric structure (evident in Figure 5), but it does not consider the different impacts of road and public transport networks.

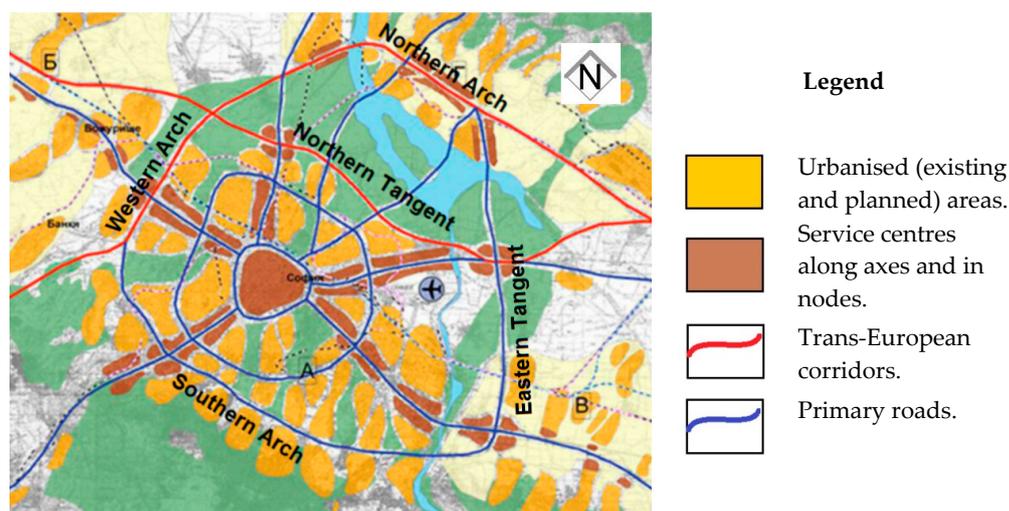


Figure 5. Scheme of the primary road network and its role in polycentricity. Source: Sofproekt [62]. Reproduced with permission from Sofproekt.

The plan stresses the “misbalance between the southern and the northern districts” due to the poor accessibility of the northern suburban areas [60] (pp. 61–62). Nevertheless, the focus is on the development of transportation networks primarily within the compact city, particularly the metro (subway) railway. The GUDP pledges to improve accessibility to suburban territories by developing the connections to the national and Trans-European corridors (marked in red in Figure 5) ([60], pp. 224–231). At the same time, the major provisions and all urgent measures are directed to the compact city, because the transport issues in the central areas are most pressing. In the suburban territories, priority is given to upgrading the sections of the ring road (the Eastern Tangent, the Southern Arch, the Western Arch, the Northern Tangent and the Northern Arch from a two-lane to a six-lane road, while local connectors are neglected. In the northeast the GUDP does plan for a subway (metro) line to Kremikovtzi in the northeast supported by a high-speed tram route (see Figure 6). Another subway (metro) line is projected to reach areas in the north in the direction of Novi Iskar. However, these subway lines are planned for “distant perspective” with no specific time line.

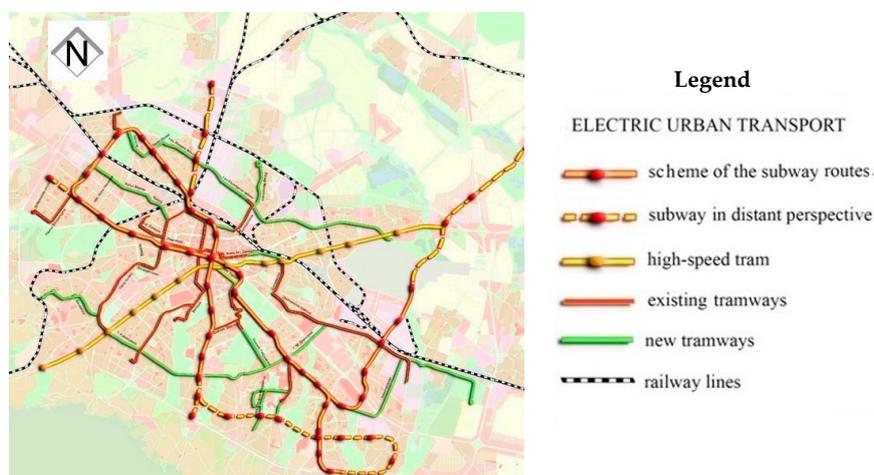


Figure 6. GUDP of Sofia Scheme of the public railway transport. Source: Sofproekt [57]. Reproduced with permission from Sofproekt.

Thus, in answering the second question, we observe that the provisions and solutions of the master plan are not always consistent with its goals. It is difficult for the GUDP to establish a coherent structure of zoning standards relevant to both its goals of suburban expansion and polycentricity. One reason for the observed inconsistencies could be the tendency in planning documents to overlook the important links between goals and instruments of planning. As for the transportation networks, their planned development is much stronger in the compact city, which could reinforce the existing monocentric urban order. The development of public transportation in suburban territories is planned for later periods.

4.4. Effects of the GUDP on the Form of Urban Growth

This part of the paper addresses the third research question: whether the plan is facilitating the realisation of the intended form of urban growth. In analysing suburban development, we start by examining the transportation networks, because their development is a precondition for enabling of urban growth.

4.4.1. Development of the Transportation Networks

The upgrade of the ring road is no doubt the most significant application of the master plan’s transportation policy in suburban areas so far. Parts of the Eastern Tangent were upgraded before the adoption of the GUDP. The Southern Arch was completed in 2012, and its upgrade has considerably

accelerated the development of the southern region. The Western Arch and the Northern Tangent should be completed by the end of 2016. However, two routes in the northern section of the ring—the Northern Arch and the Northern Tangent—have different timelines of construction. Because the Northern Tangent is adjacent to the compact city, it has little impact on suburban development. When developed, the Northern Arch would play the key role in providing access to the nodes of the planned polycentric structure; however, it is planned for a “distant perspective”.

Aside from the ring road, infrastructural development in Sofia’s periurban region has been minimal. The total length of the new suburban roads constructed between 2006 and 2011 is less than 12 km [59].

4.4.2. Effects of the GUDP’s Implementation on Urban Development Form

In this final part of the paper, we examine the form of Sofia’s suburban growth since the GUDP took effect. To assess the changes, we analyse the rates of population growth and we employ three indicators: density, the perimeter-to-area ratio and the rate of monocentricity.

NSI data [12] in Table 2 indicate a significant population growth in the southern suburban region. Growth in this region is on average three times more intensive than growth in the compact city. In contrast, the rate of growth in the northern districts is the lowest in Sofia’s urban region and has not increased after the adoption of the plan.

Table 2. Population growth in the different types of districts, 2001–2011.

	2001	2006	Population Growth	% Change 2001–2006	2011	Population Growth	% Change 2006–2011
Compact city	949,814	997,472	47,658	5.02%	1,034,384	36,912	3.70%
Southern suburban	123,972	141,050	17,078	13.78%	156,606	15,556	11.03%
Northern suburban	97,056	99,366	2310	2.38%	100,601	1235	1.24%

Data from Census 2011 [12].

The southern region in general and the Vitosha collar in particular have been subject to the most intensive suburbanisation trends since 2003 [15,63]. These trends were due to the attractiveness of the Vitosha collar, but also an increased access after the development of the Southern Arch, which accelerated local development. Planners regard these trends as a serious problem for the city, because of overdevelopment and the loss of the green edges that are important for the city’s connection with the Vitosha Mountain and Vitosha Natural Park.

Next, we examine the changes in the densities. Data availability only at the district level prevents an examination of the location and size of nodes within districts. Still, data on densities can be used to examine the trends of suburbanisation and sprawl (Figure 7). The trends in the districts of Vrabnitsa and Ovcha kupel should not be taken into account, because, as stressed in the methodology section, these districts are “mixed” urban-suburban and their trends of development are in part typical of the compact city and in part similar to those in suburban areas. The substantial growth in densities in the southern suburban districts is notable and suggests that suburbanisation in the southern region is not taking the form of sprawl. This is evident in all southern areas, but especially in the Vitosha district, where densities have increased above the densities intended by the GUDP. The changes in the northern districts are minimal and do not allow for specific conclusions.

To explore the changes in the rates of dispersion (fragmentation) of the urbanised patches, we employ the perimeter-to-area indicator. Data in Table 3 show a drop in this indicator in the southern areas, which signifies that suburban patterns have become less dispersed. This confirms our observations based on the growing densities. The drop is most significant in the Vitosha district—from 42.20 to 28.92 m/ha, which indicates a substantial increase in compactness. Thus it is a second indicator supporting the conclusion that suburbanisation patterns in Vitosha are not typical for sprawl. This feature is evident in Figure 8. The urbanised areas in Vitosha district in 2006 are shown in grey

colour. A total of 56% of the open spaces and woodlands that had been left to serve as green edges maintaining the connection of the city’s green areas with the Vitosha Mountain are now converted to urban land (marked as newly urbanised, 2006–2013, for housing or mixed use). In effect, suburban growth to the south is increasingly compact rather than dispersed.

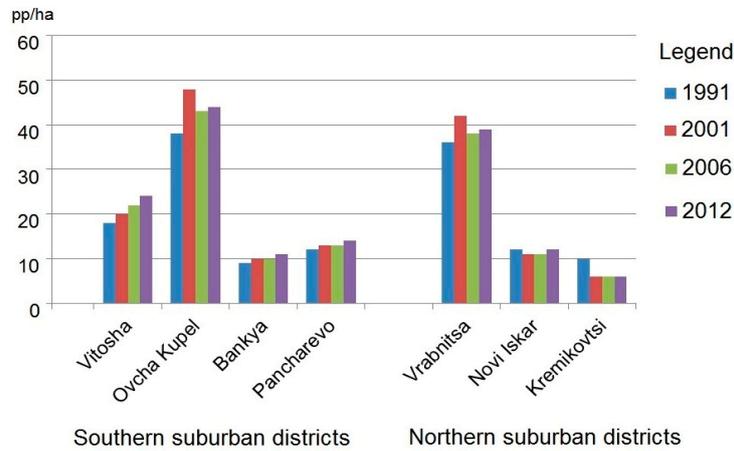


Figure 7. Trends in densities in Sofia’s suburban districts in selected years. Source: NSI (2012) [12] and the CLC database of EEA [64], processed by IAUS.

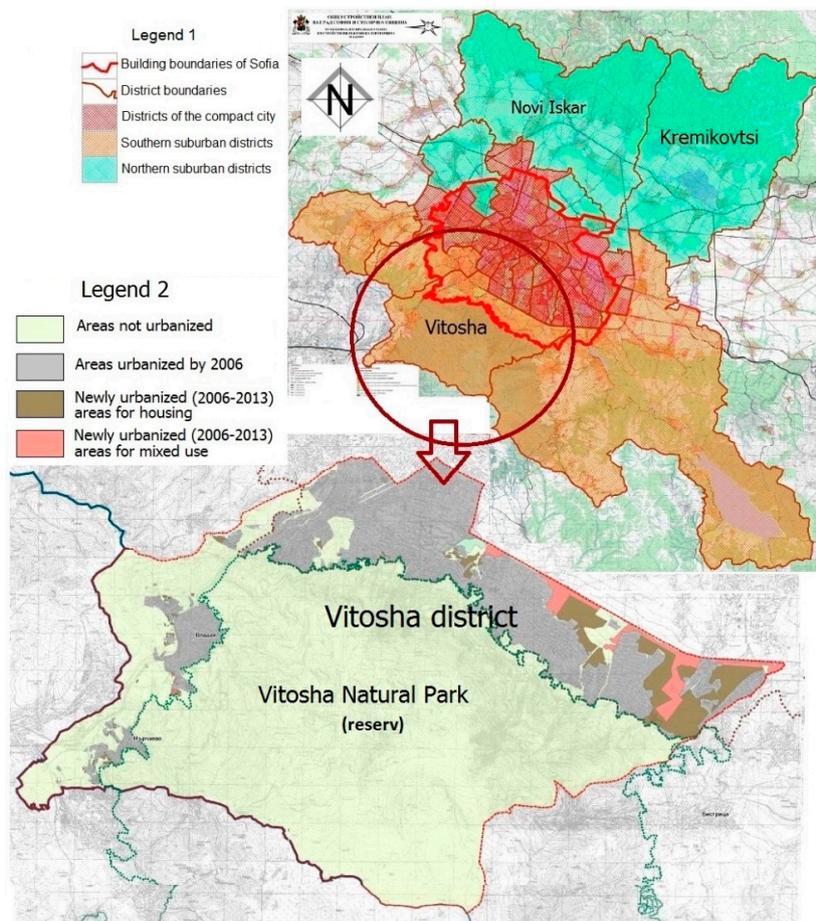


Figure 8. Newly urbanised areas in the district of Vitosha 2006–2013. Source: Authors based on a map from Sofproekt [62]. Reproduced with permission from Sofproekt.

Table 3. Perimeter-area indicator—length of outer borders per hectare of the urbanised area in three suburban districts of Sofia, 2006–2013.

Factors	Vitoshka Southern Suburban		Novi Iskar Northern Suburban		Kremikovtsi Northern Suburban	
	2006	2013	2006	2013	2006	2013
Total urbanised area UA-[ha]	2514.43	3131.27	2751.44	2806.42	3405.68	3707.55
Length of outer borders (bordering non-urban land) OB-[m]	106,104	90,569	213,688	229,330	146,033	168,248
Perimeter-area ratio—outer borders/urbanised area OB/UA-[m/ha]	42.20	28.92	77.66	81.72	42.88	45.38

Table based on data from Sofproekt [62]. Reproduced with permission from Sofproekt.

To the north, however, we see the opposite trend occurring. As we have already observed, population growth in the northern districts is the lowest in Sofia Metropolitan Municipality —its rate is only about one-third of the rate of growth in the compact city. The levels of the perimeter-to-area ratio in the northern districts are higher than those in Vitoshka and are growing further, indicating an increase in fragmentation. Accordingly, the development in the northern areas is weak and dispersed. This can be attributed to the lack of market demand in these territories, inconsistent zoning regulations (some inducing dispersion and others polycentricity), and the delayed development of mass transit systems.

Finally, to assess the trend of overall development, we examine the rates of monocentricity at the city level in the years 2006–2011 against those in earlier periods (Figure 9). The results confirm that, despite the trends of suburbanisation and a half percent decrease in the rate of monocentricity, Sofia Metropolitan Municipality continues to be a highly monocentric urban region.

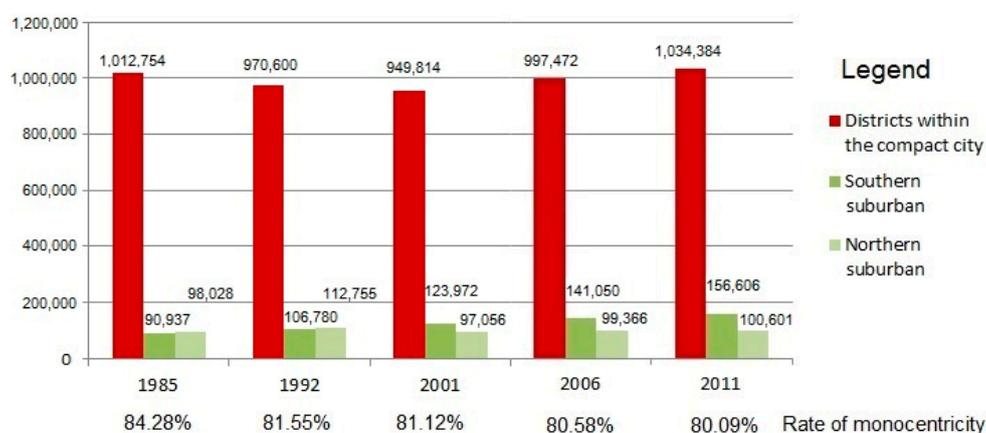


Figure 9. Number of residents in the compact city and in suburban areas, 2001–2011. Diagram prepared by the authors, based on data from NSI, 2012 [12], pp. 18–34. Note: To compare the trends before and after the enforcement of the GUDP, this diagram covers both periods, i.e., including the period, already shown in Figure 2.

With regard to the third research question, we conclude that so far there is no indication that the GUDP is changing the form of Sofia’s growth. In the southern districts, against the plan’s intentions to promote low-density “high-category” housing (i.e., sprawl) and save the green and open spaces, the development is increasingly compact. In the northern districts, the GUDP aimed toward polycentric development, but could not stimulate it. The growing fragmentation (dispersion) of urban form to the north suggests that no compact polycentric nodes are developing. As a whole, Sofia Metropolitan Municipality continues to be highly monocentric, with the GUDP exhibiting difficulties in realising the intended forms of urban growth (Table 4).

Table 4. Assessing the relationship between the GUDP's performance and urban sustainability.

Southern Suburban Areas	Northern Suburban Areas
Goals	
(1) Low-density expansion (2) Preservation of the green edges	(1) Low-density expansion (2) Polycentric urban growth
Actual development	
(1) Substantial expansion with relatively high-density and compact urban forms (2) Disappearing green edges (56% loss of open spaces 2006–2013); realisation of the second goal is jeopardised.	(1) Low growth, exhibiting neither expansion (low or high density) nor polycentricity (2) Favourable conditions for polycentric development still exist - ample space and sparse network of villages
Key findings	
(1) Development could be considered sustainable, i.e., dense and compact. However, this type of development form was not envisioned as the plan's goal for this area and has not resulted from the plan's implementation. (2) The plan's inability to prevent the loss of the green edges is likely to bear negative consequences on the sustainability of the city of Sofia and its urban region.	(1) The plan has little effect on the area's sustainability. (2) Because favourable conditions for polycentric development still exist, it can be realised, if the plan introduces proper tools of implementation, especially regarding the development of infrastructure.

5. Conclusions

This research is set to investigate the capacity of master planning to promote and ensure realisation of desired urban forms, and, more generally, contribute to sustainability. As a case study, we examine the current master plan of Sofia and its implementation. We acknowledge that the period of nine years may be too short to fully realise a plan's goals and to observe its effects. While only minor changes in urban structure and form could be achieved over such a short term, one decade is an adequate milestone for an interim evaluation of progress and reassessment of master planning's goals and provisions. Thus, in evaluating the implementation of Sofia's General Urban Development Plan (GUDP), we observe that the plan has aimed to reduce the historically established very high level of monocentricity and promote two different forms of growth: low-density expansion and polycentricity, but without explicitly stating how the promoted forms relate to and influence the city's sustainability. Furthermore, we find that the plan does not include a coherent system of planning solutions, measures, and tools such as relevant zoning standards and transportation infrastructure improvements, which would facilitate the realisation of the forms of urban growth it advocates for its goals. Over the past decade, Sofia's GUDP has been only partly effective in fulfilling its own goals and has had a limited impact on improving the area's sustainability.

The relationship between a plan's performance and its impact on sustainable urban development is our key point of research. Regarding the sustainable urban growth and form, the trends in Sofia are mixed. The loss of the green areas in the southern territories is a negative outcome of extensive development pressures, which could not be contained by the plan. In contrast, the high-density compact expansion pattern in the same areas could be considered a step towards sustainable development, with lower environmental impacts of the urban system and more efficient consumption of land, natural resources and amenities. However, this positive feature could not be attributed to the GUDP, because it was not its goal. The plan also could not easily redirect growth towards the northern territories and stimulate the polycentric structure, particularly within such a short window of time. In those terms, Sofia's GUDP contribution to promoting sustainable urban forms has been limited. Nevertheless, it offers a valuable example of the importance of the link between the planning objectives and its performance via various implementation mechanisms.

These findings provide the basis for more general conclusions about how a master plan could realise its goals and promote sustainability. In line with Sofia's GUDP statement that sustainability has become "imperative", it is essential that planners account for the impacts of proposed urban forms on sustainability. Identifying a sustainable form of growth, especially when considering specific local context and conditions, is a difficult task. Our research highlights the fact that implementation of plans and the realisation of urban forms are even more challenging. Establishment of mutually coherent goals, sub-goals and solutions, along with relevant tools of implementation is crucial for any plan

to be effective. Clearly, the capacity of master planning to achieve its goals is essential to promoting sustainability. There is much to learn from the past efforts. When a plan is viewed as a dynamic tool and a cycle of governance rather than a static statement of goals, then the new period is an opportunity to avoid the observed omissions or mistakes. An interim evaluation and update of goals, solutions and tools of a plan are essential for the realisation of sustainable urban form and overall development.

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