Towards an unsustainable urban development in post-war Sarajevo

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Sarajevo, the capital of Bosnia and Herzegovina, is located in a karst geomorphological environment. The topographical setting strongly influences the urban geographical distribution and urban development, as well as the sustainability policies implemented in the city. The incorporation of an environmental agenda and the focus on sustainable development have characterised urban planning in cities in Central and Eastern Europe that are transitioning from socialist to capitalist economic systems. Environmental policies in Sarajevo are defined within the Sarajevo Canton Development Strategy developed under the supervision of international experts at the end of the three-and-a-half years of siege in December 1995, and this is expected to last until 2015. This paper argues that, despite the consensus achieved for developing Sarajevo through strategies aligned with European regulations for sustainability, the built environment of the city has moved in an increasingly unsustainable direction as a result of the need to deal with vulnerable groups in the population and the international policies that tend to promote a neoliberal urban development. The first section of analysis focuses on Sarajevo's existing particular geomorphological constraints on the development of a secure and sustainable built environment. The second section examines the increase in the geomorphological risks of new construction developed after the conflict in relation to the post-war and post-socialist urban processes.

Key words: Sarajevo, Bosnia and Herzegovina, post-socialist cities, geomorphology, urban sustainability, strategic planning

1. Introduction

The geomorphological vulnerability of urban environments has been widely studied over the last decades from a broad range of perspectives (Gupta and Ahmad 1999; Huang and Mu 2000; Adeli and Khorshiddoust 2011; de Waele *et al.* 2011). Flash flooding has been identified as one of the major hazards in Mediterranean karst terrains that can cause significant damage to urban areas (Maréchal *et al.* 2008). For cities in Eastern and South Eastern European karst environments, several papers have focused on the impacts that geomorphological processes (namely, floods, slope processes, ground deformation and collapses) may have on newly emerged suburban areas (Stecchi *et al.*

2012; Papadopoulou-Vryniotia *et al.* 2013). However, the significant devastation produced by the recent floods of May 2014 in Bosnia and Herzegovina (BiH) has shown evidence that these geomorphological risks need to be considered more seriously and assessed in a better way.

The geographic setting in many cities strongly affects the population distribution in urban areas and the geomorphological risks to which these cities are exposed. This is the case for the area of Sarajevo, the capital of BiH. The interactions between the urban environment and the geomorphology in this city have been little studied (e.g. Golobic and Cof 2010). In Sarajevo, the major urban processes which occurred after the end of the Bosnian War (1992–1995) have favoured the expansion of urban and suburban sprawl (Dematteis 1998; Champion 2001). This process was a result of the demographic pressure which emerged in the years immediately following the war, as well as of the neoliberal urban policies driven by international actors (Martín-Díaz 2014). The major cause was the increasing demographic pressure driven by refugees and internally displaced persons (IDPs) as mentioned in the Dayton Peace Agreement (DPA). In this sense, new urban developments in Sarajevo and its suburban areas came up against the rugged geomorphological setting of the city, putting at risk the accomplishment of the environmental agenda, which was approved in line with European regulations for sustainability (KS 2000).

This paper identifies and examines those urban and suburban areas in Sarajevo that are potentially affected by some critical geomorphological risks, such as flooding and landslides, during the post-war period. The analysis of such urban geomorphological risks will take into account the implementation of Sarajevo's environmental agenda in the very complex social, ethnic and political environment that has emerged after the Bosnian War. Despite the consensus reached for developing Sarajevo through strategies

aligned with the European regulations for sustainability, the built environment of the city has increasingly moved in an unsustainable direction, on the one hand as a result of the need to deal with vulnerable groups of population and, on the other hand, due to land liberalisation policies.

The paper is structured in two sections. The first one focuses on Sarajevo's existing particular geomorphological constraints on the development of a secure and sustainable built environment. The second section examines the increase in the geomorphological risks of new construction developed after the conflict in relation to the post-war and post-socialist urban processes.

2. Study area

The Sarajevo Canton has a total area of 1,276 km^2 and a population of 438,443 inhabitants (FZS 2013), with a density of 343.37 inhab/km^2. The population is mainly concentrated in the four municipalities distributed in the narrow urban corridor along the Miljacka River, which constitute the City of Sarajevo: Stari Grad, Centar, Novo Sarajevo and Novi Grad.

Sarajevo is located at 518 m above sea level and surrounded by the Dinaric Alps, with elevations exceeding 2,000 m nearby (Treskavica, 2,088 m; Bjelašnica, 2,067 m). This mountain range is formed by Secondary and Tertiary sedimentary rocks, mostly limestones and dolomites. Sarajevo is placed in a depression drained by Miljacka River running from ENE to WSW. The source of the Miljacka River is located in a karst environment (Kadin Selo region) and, down-valley this river drains the runoff of the mountains surrounding Sarajevo. As in other rivers with a Mediterranean climate influence, the maximum discharge of this river takes place between October and December. Furthermore, in only 15 km, it drops more than 1,000 m in altitude (7.3%

slope gradient), which enhances erosion activity up-valley and mass wasting processes, together with the risk of flash floods in the Sarajevo area.

The local climate is characterised by the influence of the mid-European continental climate and the maritime influence of the Mediterranean Sea. The air condensation flowing from the Adriatic Sea when passing over the coastal mountain ranges affects precipitations of almost 900 mm per year, mostly concentrated in spring and autumn. The rough local topography can trigger intense rainfall events during these seasons, which may have severe impacts on settlements and infrastructures.

3. Methods

A fieldwork campaign was carried out between April and July 2010 with the purpose of identifying the geomorphological risks of new urban construction developed over the post-war period in Sarajevo. Both suburbanisation and densification processes were identified and examined according to their geomorphological vulnerabilities. The second phase of the field research was conducted between July and December 2013 with the objective of analysing the urban development policies adopted in Sarajevo after the war. This task focused on examining the adoption of both new planning tools by local institutions and the role of international actors in the implementation of the liberal peace-building agenda. Technicians and managers from the main local and international organisations working on urban planning and development were consulted, from institutions such as the Development Planning Institute of the Sarajevo Canton, the City Council and the Office of the High Representative (OHR), responsible for overseeing and implementing the civil aspects of the DPA.

In order to build a GIS-based model to consider the landslides and flooding risks in Sarajevo, two methodological approaches were performed using GIS software (ArcGIS

10.1). The first was the delineation of the potential areas under water considering a scenario in which the river level rises 2.5 m, corresponding with the maximum level reached by the Miljacka River during the flood event in May 2014 (Sarajevo Times 2014), which was the worst floods in the region in more than a century (Agencies 2014). This spatial analysis focuses on the elevation differences between the river level and the surrounding areas. The second approach comprised the creation of a slope surface using the spatial analyst tools extension provided in the ArcGIS software. However, there is a significant lack of data from local and regional institutions to help generate an accurate Digital Elevation Model (DEM) from this area. Despite this constraint, maps have been produced with the elevation data available from international data sources, at a resolution of 30 m. Data have been provided by the Advanced Spaceborne Thermal Emission and Reflection Radiometer, used in the elaboration of geomorphological maps (Kääb *et al.* 2003; Kamp *et al.* 2005). Figure 1 shows the location of Sarajevo in context.

Figure 1.

4. Geomorphological implications for the urban setting in contemporary Sarajevo

Sarajevo is distributed in a sedimentary catchment at elevations of 500–600 m, with limestone massifs reaching 1,000–1,500 m encircling the city. The Miljacka and Bosna Rivers drain the hydrographic basin of Sarajevo-Zenica, which opened in the Tertiary period (Hrvatović 2005). The infill of the Sarajevo plain is constituted by Quaternary sediments overlying the basal rocks of Miocene age. As in other extensive parts of the Balkan region, the regional setting is characterised by the widespread distribution of karst landforms. The contact between carbonaceous materials (limestones) and water

(from rainfall, runoff or groundwater) initiates the dissolution of the original bedrock (Jennings 1985). In the region of Sarajevo, the karstification processes are very intense and have originated a wide range of karst morphologies.

Sarajevo's basin is flanked by a series of stepped ridges following the faults system (Hrvatović 2005). The depressions closed by these mountain steps constitute areas with internal drainage systems known in karst environments as poljes (Sweeting 1973). Their dimensions vary from decametric to kilometric size. Stretching between these mountains, there is the elongated alluvial plain in which Sarajevo is located. In this plain there are also other karst landforms of metric or decametric size, such as the dolines.

In Sarajevo, most of these landforms are hidden by urban constructions. However, the local toponymy gives evidence of the wide distribution of karst landforms in the area. Dolina Street and places like Bijelo Polje, Skrbino Polje, Lasicko Polje or Grlicko Polje confirm the karst context in which the city is settled. In this sense, it should be noted that, in the Bosnian/Croatian/Serbian language, the polysemic term ´polje´ is used both to describe the geomorphological unit as well as the field areas, which reflects the close relationship between the landform and the landscape.

The Miljacka river flows along the main faults in the area before streaming into the Bosna River. After crossing a steep calcareous gorge in the eastern limit of Sarajevo, the river turns suddenly to the left, meandering when entering the city, where it gradually opens, forming an elongated alluvial plain parallel to the bed of the river. The contact between the basin and the surrounding relief is pronounced, especially on the left bank of the Miljacka, where the escarpment is steeper. By contrast, the slopes on the right side are gentler. However, the present day distribution of the urban settlements is

widespread on both slopes. Doubtlessly, lithology and mountainous terrain affect the geomorphological setting which, in turn, have profound implications on the distribution of the population along the Miljacka valley. Showing a lower population density than in the flat valley bottom, the houses in the hillsides are distributed upslope in sequential steps, most of them as a result of the rapid urban development which occurred after the war.

On the banks of the river, sediments were deposited during floods of the Miljacka River over the last millennia, which contribute to the fertility of the soil, which historically has favoured agricultural activities. However, the expansion of the city and the higher frequency and larger magnitude of the floods over the 18th century in the Balkan region (Xoplaki *et al.* 2001; Wanner *et al.* 2004) influenced the channelling of the Miljacka River in the time of the Austro-Hungarian administration to mitigate the damage caused by these floods (Donia 2006). The system, which still exists today, consists of a series of steps that reduce the velocity of the flow and the sediment transport capacity. The margins of the river were subsequently substituted by urbanised areas that currently are being renewed with new central tertiary and residential areas.

In mid-May 2014, major floods occurred in Sarajevo, causing severe damage to equipment, infrastructure and housing (FENA 2014a 2014b). The impact of the floods was larger in the western outskirts of the city, where the Miljacka and Željeznica tributaries converge with the Bosna river, flooding an extensive area of the Ilidža municipality. Also, several landslides took place on the northern edge of the city (Jukić 2014a). This extreme rainfall event primarily damaged the urban and rural areas in northern Bosnia. Across the whole country, up to 3,000 landslides were quantified between the 14 and 16 May, when 27 people perished and 100,000 buildings were destroyed or damaged (Agencies 2014; Jukić 2014b).

5. Increasing the geomorphological risks of the built environment

Percolation water processes through bedrock are very intense in karst regions and may reach between 30% and 40% of the total annual rainfall (de Vries and Simmers 2002; Zagana *et al.* 2007). Percolation is especially significant in Mediterranean karst environments (Lange *et al.* 2010; Hartmann 2011), where heavy precipitations can occur in short-time periods and water flows suddenly through the bedrock to lower areas. This may cause flash floods, especially when recent rainfalls saturate the aquifer before the storm, which increases runoff (Wittenberg *et al.* 2007; Fleury *et al.* 2013). This is what happened between the 14th and 18th of May 2014 in BiH. Following several weeks of heavy rain events in the Balkan region, an extremely active low-pressure system named Tamara (AW 2014) caused highly abundant precipitations and generated major floods, which also affected Sarajevo. This extreme rainfall event, together with the karst lithology of the area and the unstable nature of the soils in Sarajevo and its surroundings (Golobic and Cof 2010) triggered significant damage to settlements and infrastructure.

Similarly to other areas of the country, many built environments are exposed to this kind of geomorphological risks in the area of Sarajevo. Actually, the surface potentially affected by geomorphological risks has increased in the last two decades as a consequence of urban sprawl, triggered by the arrival of refugees and IDPs in Sarajevo after the war. The magnitude of this urban and demographic challenge is reflected in the fact that forced displacements then represented the largest refugee crisis in Europe since the Second World War (Hitchcock 2003), with about half of 4.4 million Bosnian population having been displaced during the conflict (UNHCR 1999).

The Development Planning Institute of Sarajevo anticipated the wave of returns and expected urban sprawl by modifying the regulatory regime, managing urban development in the neighbourhoods with higher slope gradients. Regulation plans became mandatory to urbanise the slope areas, raising legal and procedural requirements for new construction, while guaranteeing the provision of basic services. The decision showed the desire of local authorities to plan, rationally, the urban sprawl foreseen in the city after the war.

Once the OHR was empowered in December 1997 to invigorate the implementation of the DPA, it quickly focused on Annex 7 of the Agreement, which granted all refugees and displaced persons the right to freely return to their homes of origin. Sarajevo became one of the most intervened in cities in all of BiH in order to rebuild a multi-ethnic capital.[1] The Sarajevo Declaration set out a comprehensive approach in February 1998 aiming to promote returns and making such urban and demographic processes sustainable (OHR 1998). Actually, the subsequent removal of the discriminative housing legislation favoured the mass return of refugees and IDPs.

The process of housing repossession implied the eviction of those IDPs who had been sheltered in Sarajevo during the war. The reluctance of many of them to return to areas controlled by other ethnic groups, either Serbs or Croats, triggered the wave of illegal construction of housing in the late 1990s, which had been mainly built on the roofs of existing buildings or as new single detached dwellings in the suburbs. The consequent sprawl in high-gradient sectors, regulated by the Urban Plan of 1986, was resumed after the war in some areas, with steep slopes at high geomorphological risk, such as in the

[1] This policy contrasted with the passivity of the international actors in the political and military field during the episodes of ethnic cleansing carried out during the war.

neighbourhoods of Aneks, Pofalići and Vraca[2], with a very different nature and meaning since most of the new single family dwellings were a consequence of formerly forced displacements (Čengić 2011).

In these steep neighbourhoods, the topography of the stability of the superficial material and the geohydrologic character of the bedrock affect slope instability (Vierrether 2013). Actually, landslides have been periodically generated by illegal construction and the development of poor quality infrastructure, such as sewer or water canalisation (FENA 2014c). More specifically, a total of 816 landslides have been registered by the cantonal authorities in Sarajevo since 2000, with 523 in the four central municipalities (see Figure 2 and 3). There were 205 landslides considered as very dangerous, while the cost of restoring 123 landslides was 26 million KM (about 13.4 million €) until January 2014 (KS 2014). During the floods of May 2014, landslides occurred mainly in the municipality of Vogošća (FENA 2014c).

Figure 2.

Figure 3.

Despite the increase in planning regulations for the most vulnerable areas, the Development Planning Institute of Sarajevo estimates that illegal constructions completed during the post-war period totalled between 25,000 and 50,000 units in the

[2] Suburbanisation on the slopes, mainly illegally developed, was inherited from the socialist period due to the existing housing shortage (Topham 1990). It was actually a concern for local authorities in the 1970s, when the programme for "Rehabilitation of Housing Area on the Slopes of the City" was launched to tackle the development in those areas considered a potential threat to the overall development of Sarajevo (Čengić 2011).

area of Sarajevo.[3] This urban sprawl in vulnerable sites, as the result of the convergence of the demographic pressure in an area constrained by the geomorphology, undermined the urban development strategy of Sarajevo, as approved until the year 2015 (KS 2000). Actually, the introduction of strategic urban planning in European post-socialist cities must be seen as a response to the decline of comprehensive plans (Maier 1994; Tsenkova 2007). These strategic urban plans contain a strong environmental rhetoric, following the European Union Action Plan ´Towards Sustainability´, i.e. the Fifth Environmental Action Programme published by the European Commission in 1993 in order to implement Agenda 21 (EC 1993).

The importance of the environmentally friendly visions for the urban development of Sarajevo (see KS 2000, 7) showed a desire to improve the existing environmental conditions. In fact, some of them, such as air pollution, had been improved as a consequence of the economic downturn of the late 1980s and the reduction of industrial activity during the war (Majstorovic *et al.* 2006). However, the development strategy adopted by the City Council of Sarajevo was not embedded in the planning legislation. Moreover, the actualisation of the Urban Plan was limited, including only some of the visions of the plan, such as the creation of a real estate market, the possibility of constructing temples or the development of new cemeteries.[4]

In a context in which ethno-national parties aimed at consolidating ethnic territorialisation after the war (Toal and Dahlman 2006), the OHR supervised land allocations during the period 1999–2003 (OHR 1999 2000). It was in May 2003 that the High Representative enacted the Law on Construction Land, moving land management back to the municipalities by dividing the socially owned construction land into state

[3] Official data will not be available until the publication of the first Census since the independence of BiH in 1992, which took place in October 2013.
[4] Anonymous technician of the Development Planning Institute.

owned and private land on the basis of whether it had already been developed by a private actor or not (Williams 2013). The new law was a significant step in the efforts of international actors to create a real estate market, which had started three years before when the United States Agency for International Development was asked to analyse the status of real estate in BiH, while recommending its reform (Rabenshort 2000). The convergence of the urban policies, moving land into privatisation and policies pursuing economic liberalisation, produced a real estate bubble in the city 10 years after the end of the war.

However, many of these new urban projects have been developed in areas with high geomorphological risk. As shown by recent floods, several weeks of intense rainfalls had saturated the calcareous aquifer of the Miljacka catchment, and the storm in May 2014 triggered the major avenue. If the canalisation of Miljacka contained the avenue in most of the central parts of Sarajevo, the margins of the river flooded in the confluence with Bosna River, where the valley bottom has a flat topography. The pressure on the margins of the Miljacka has actually increased since 2005, when a significant number of the new major urban projects built during the post-war period were developed on the alluvial plain of the river. This urban densification has, thus, increased the risk of flood affecting properties since several of them are located in the most floodable areas (Figure 4).

This is the case of the Central Business District (CBD) in the Marijin Dvor area and the Bulevard Meše Selimovića, where the development of new office buildings and commercial property, some of them also illegally constructed,[5] have played a central role in the urban restructuring and the spatial reorganisation of Sarajevo (Martín-Díaz

[5] Anonymous technicians of the Development Planning Institute and the City Council.

2014). This process of urban densification has been occurring mainly in the central and western neighbourhoods of Sarajevo, emerging during the socialist regime. The urban structures inherited from the socialist period have thus been reshaped under neoliberal forms of planning and development (Harvey 1989; Brenner and Theodore 2005; Tasan-Kok 2012). These developments have been eroding a sustainable feature of the urbanism predominant in Central and Eastern Europe's cities, which had urban structures that are generally more environmentally friendly and sustainable than capitalist urban forms (Hirt and Stanilov 2009), being more compact and with more green spaces (French and Hamilton 1979; Szelenyi 1996).

Figure 4.

6. Conclusions

The geomorphological context of the central areas of Sarajevo in the Miljacka valley has influenced the historical urban development of the city. The high demographic pressure on Sarajevo in the years following the Bosnian war (1992–1995) added another layer of complexity to the management of urban development. Anticipating the potentially significant return of refugees and IDPs to the city, the Development Planning Institute increased the regulation required on the slopes to better control its urban growth. The approval of regulation plans was thus aimed at providing basic services for a safe environment for people in precarious situations after the conflict, despite the poor environment of the higher gradient areas of the city. The construction of housing on these sites has increased the existing geomorphological risks, as shown by the significant number of landslides and the costs of restoration since the early 2000s. Furthermore, policies implemented by international actors had significant environmental implications in moving the built environment in Sarajevo further along a

long-term unsustainable direction. Land liberalisation policies led to an urban densification in central Sarajevo with enhanced urban sprawl in the surroundings of the city.

The recent extreme rainfall events which occurred in mid-May 2014 confirm the unsustainable direction of highly densified urban areas as well as in new suburban neighbourhoods located on steep slopes and floodable areas of Sarajevo (e.g. Ilidža). Hence, along with the poor translation of the environmental visions into the rest of the planning hierarchy, both the creation of a real estate market and the post-war demographic pressure have been continuously undermining the very foundations of the sustainable development agenda in Sarajevo, as shown in the evolution of the built environment. In vulnerable geomorphological urban settlements the elaboration and implementation of a comprehensive sustainable strategy of urban development must be seen as a priority, even though it deals with complex social and urban processes. In this sense, the proximity of the ending of the Sarajevo Canton Development Strategy and the Urban Plan in 2015 is a great opportunity to develop a more balanced social and environmental sustainable strategy, taking into account not only the particular geomorphological setting of Sarajevo, but also its political, socio-economic and symbolic specificities.

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