Land use consequences of the evolution of cemeteries in the Bucharest Metropolitan Area

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Land use consequences of the evolution of cemeteries in the Bucharest Metropolitan Area

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The uncontrolled development of built-up areas determines the inclusion of peripheral and ex-urban land uses inside the settlements. In the present study, we investigated the geographic differences in the rate of land conversion to cemetery areas, considered as peripheral areas, from the Bucharest Metropolitan Area. Using geospatial data about the cemeteries and their adjacent land uses, we evaluated the spatial changes of cemeteries at LAU2 (Local Administrative Units level 2) level (i.e. municipalities, cities, communes). Between 1975 and 2008, we observed an increase in the number of cemeteries with a surface area of 100.8 ha, mainly in areas with poor environmental quality in proximity of Bucharest city. Cemeteries tend to become common land uses within the built-up areas, occupying increasing surface areas (up to 3.5%), with important consequences, especially in areas close to Bucharest city. Cemeteries are a good example of peripheral land use, characterised by a permanent impact on human settlements. The inclusion of peripheral land uses inside the settlements promotes urban sprawl, favours inefficient strategic planning and generates new land use interactions. An increase in the management efficiency of peripheral land uses can alleviate negative interactions and favour sound planning options for the sustainability of settlements.

Keywords: land use changes; peripheral land uses; cemeteries; Bucharest Metropolitan Area

1. Introduction

Existing land uses in areas in proximity to large cities are subject to swift changes (Feranec et al. 2010), such as the conversion of open spaces, the concentration of built-up areas, the transfer of functions between the core and surrounding areas, and the abandonment of economically inefficient land uses (Jaeger et al. 2010). Land use changes mainly occur due to a high connectivity between the core area of a city and the settlements under its influence (Daniels 1999; Hasse and Lathrop 2003). The effectiveness of land use policies influences the impact of these changes on land use arrangements (Munroe, Croissant, and York, 2005).

Inadequate implementation of land use policies has created patchy, scattered and/or strung out land uses, defined as urban sprawl (Jaeger et al. 2010; EEA 2011). Urban sprawl affects the overall economic competitiveness (Pauleit, Ennos, and Golding 2005), infrastructure (Barrios 2008), population (Neumann, Boyle, and Belf 2009) and environmental quality (Hersperger 2006). An important result of urban sprawl is the

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The inclusion of peripheral land uses inside the settlements (Hewitt and Escobar 2011). In past years, former peripheral land uses (e.g. heavy industrial areas, cemeteries, contagious diseases hospitals) have been relocated to the new periphery because of the complex economic, social, environmental or sanitary problems that they generated (Verhoef and Nijkamp 2002). The inclusion of these peripheral land uses inside the human settlements has significantly increased the risk of conflicts (Henderson 2005), such as mutually exclusive land uses with their negative externalities (Taleai et al. 2007). This has led to the association of new land uses, which have increased further the potential for land use conflicts (von der Dunk et al. 2011). Therefore, newly-developed areas are prone to become incompatible with the existing areas or with the strategic vision of the local authorities regarding the sustainability of the settlements (Beinat and van Drunen 1998).

1.1. Cemeteries – public resources or source of environmental degradation

Cemeteries represent an essential land use for settlements (Coutts, Basmajian, and Chapin 2011) and are therefore included in the infrastructure of human settlements (Ianoș, Peptanatu, and Zamfir 2009). Generally, cemeteries are discussed from two different approaches: as a public resource (Kjøller 2012) and as a problematic land use (Uslu 2010). The efficiency of their management determines the amplification of their use value and the limitation of negative effects (Johnson 2001). Generally, cemeteries are regarded as an outcome of cultural practices, propriety, time, ownership, accountability and responsibility, which can be either complementary or conflicting (Francis, Kellaher, and Neophytou 2000).

For example, cemeteries may generate nature conservation, as they are considered green spaces with a specialised use (Attwell 2000; Iojă et al. 2011). Certain cemeteries have a special cultural and spiritual value, induced by their planning, architecture of funeral monuments or the memorials of buried people (Francis 2003; Worpole 2003). Cemeteries are spiritual centres associated with pilgrimage and permanence, which establish religious connections with people by providing a space for introspection (Rugg 2000a).

In several countries, such as Great Britain (Rugg 2000b), Denmark (Kjøller 2012), Turkey (Uslu 2010), the USA (Basmajian and Coutts 2010; Coutts, Basmajian, and Chapin 2011) or Italy (Santarsiero et al. 2000a), cemeteries are considered an external or peripheral land use. In Romanian territorial planning cemeteries are placed at the boundary of urban growth (Petrișor, Ianoș, and Tâllângă 2010). Special planning regulations deal with the potential impact of cemeteries on residential areas, such as safety distances from residential and sensitive areas (Johnson 2001). Therefore, the location of cemeteries should be subject to planning consent and designed according to the national and international provisions for environmental health (Santarsiero et al. 2000b).

There have been several investigations examining the adverse impacts of cemeteries on human life, such as hygienic conditions (World Health Organization – Regional Office for Europa 1998; Simonovicova, Godyova, and Sevc 2004; Jim and Chen 2009), psychological perceptions (Santarsiero et al. 2000a), social conditions (Hui et al. 2007), environmental contamination (Engelbrech 1998; Spongberg and Becks 2000; Żychowski 2012) as well as planning issues (Coutts, Basmajian, and Chapin 2011). Furthermore, the management of cemeteries is a difficult task because they are very different from other types of public services in terms of functionality (Kjøller 2012).

We selected cemeteries as a representative example for peripheral land uses and their environmental consequences as they are considered indispensable for communities, with
varying functions and characteristics supporting people’s demands. However, the location and the management of cemeteries are often influenced by inefficient land use regulations, unplanned development of settlements and/or real estate market forces. These have determined the location of cemeteries close to other land uses which could conflict with the spiritual and recreational use of cemeteries.

1.2. Definition and features of Romanian cemeteries

Since the communist breakdown in Romania, the unplanned development of settlements has favoured the inclusion of peripheral land uses in settlements (Suditu et al. 2010). Some of these peripheral land uses were relocated (e.g. industrial areas), while others remained stable (Iojă et al. 2010). Cemeteries represent one of the most commonly accepted peripheral land uses within Romanian settlements (Petrişor, Ianoş, and Tâlângă 2010).

The Romanian legislation considers cemeteries as areas incorporated or not into the built-up area, which have been or have to be used for burial (Ministry of Health 1997). Romanian cemeteries can be public cemeteries (managed by local authorities), confessional cemeteries (managed by different religious cults) and commemorative war operas (managed by the military authorities) (Romanian Government 2004).

The burial practices are conducted according to the rituals imposed by the religious cult of the deceased, mainly in coffins buried at 2 m depth (Ministry of Health 1997). Cremation is a practice forbidden by Romania’s dominant orthodox cult (Ghinoiu 2003), and therefore few places exist where cinerary urns can be deposited.

The establishment of cemeteries is the responsibility of local authorities which have to ensure there are burial places (i.e. small areas in the cemetery designated for the individual burials) needed for their community. In the post-communist period, the management of cemeteries shifted from the local authorities to the religious cults (90% of the total number of cemeteries) (APADOR-CH 2008), being mainly a religious and cultural issue, with little input from local government (Coutts, Basmajian, and Chapin 2011). The right to buy burial places has transformed certain cemeteries as targets of real-estate investments (ACCU 2010).

A deficiency in planning of cemeteries aimed at finding short-term solutions for the needs of the communities has determined: (1) the overcrowding of burial places in cemeteries; (2) the diversification of burial places (architecture, colours, sizes); (3) the degradation of infrastructures; and (4) a significant decrease in the areas covered by vegetation (ACCU 2010). Furthermore, the inefficient management of burial places has increased the negative environmental impact of cemeteries upon other land uses.

The aim of this paper is to analyse the geographic differences in the rate of land conversion to cemetery areas, considered as an example of peripheral areas and their environmental consequences. For our study, we examined cemeteries from the Bucharest Metropolitan Area. The objectives of this paper are as follows: (1) to analyse the spatial distribution of cemeteries from the Bucharest Metropolitan Area and their changes between 1975 and 2008; (2) to emphasise the factors which influenced the surface area of cemeteries in 1975 and 2008; and (3) to discuss the environmental consequences of land conversion to cemetery areas.

1.3. Study area

The Bucharest Metropolitan Area has 98 level 2 Local Administrative Units (LAU2 – municipalities, cities, communes, corresponding to the former European Union
Nomenclature of territorial units for statistics category 5) and five level 1 Administrative Units (LAU1, counties, corresponding to the former EU Nomenclature of territorial units for statistics category 4) (Bucharest Master Plan 1998) (Figure 1). We selected the Bucharest Metropolitan Area for our study because of its high diversity. This area represents one of the most dynamic areas of Romania in terms of land use changes. We have not included the city of Bucharest in our analysis because the large surface area of cemeteries and residential areas within the city, compared to those in other municipalities, would generate biased results.

The total study area covers 5080 km$^2$ and overlaps with the central-southern part of the Romanian Plain. The land uses are mainly agricultural (76.8%), with the built environment representing only 4.65% of the Metropolitan Area’s total surface area.

The total population of the area is 566,700 inhabitants, with 21.6% over 60 years of age. The average population at LAU2 level is 5782 inhabitants, with notable variations: the minimum being 1586 inhabitants in Nicolae Balcescu village, which is 52 km from Bucharest, and the maximum being 28,630 inhabitants in Voluntari city, which is 8 km from Bucharest.

Bucharest, with a population of 1.6 million inhabitants, represents the most developed city and the main economic centre of Romania, comprising 21.7% of the national GDP. The economic structure of the Metropolitan Area is dominated by industrial and tertiary activities from Bucharest and from the proximal localities (Nae and Turnock 2011). Agricultural activities represent an important aspect of the landscape; however, the landscape has more recently been influenced by abandonment, excessive fragmentation of private properties and particularly its subsistence character (Andrusz, Harloe, and Szelenyi 1996; Iojă et al. 2007).
2. Methodology

2.1. Background data

To extract geospatial information, we used the 1975 edition of the cadastral plans, with an average resolution of 0.5 m, and the 2008 edition of aerial images, with an average resolution of 0.5 m (www.ancpi.ro, accessed on 10.06.2012).

The analysed data concern characteristics of cemeteries (i.e. surface area, location and distance from Bucharest city) and their adjacent land uses (four types: agricultural, forest, built-up and residential).

The distance between each cemetery and Bucharest was calculated as the Euclidian distance in metres, measured from the external boundary of the cemetery to the Bucharest city administrative limit.

For assessing the assimilation of cemeteries into human settlements, we established three main categories of cemeteries: (1) Inside, i.e. cemeteries included inside the settlement area, surrounded by residential and/or non-residential areas; (2) Peripheral, i.e. cemeteries located in suburban areas; and (3) Outside, i.e. cemeteries located in the ex-urban areas (Figure 2).

For the 2008 land use data, we performed a qualitative accuracy analysis of the input data through field verification. We tested the validity of the classification by sampling 250 random points and compared the field observations (considered to have 100% accuracy), the statistical report of the LAU2 administration and the aerial images. Land use categories corresponded in 90% of the cases. The existing errors were caused by processing the data four years after the images were collected (thus explaining differences between the remote sensing data and the reference ground-based data).

Using LAU2 limits for 1975 and 2008 from the National Authority for Cadaster and Real Estate (www.ancpi.ro, accessed on 05.09.2011), we determined the cemetery surface areas, number and the percentage of cemetery surface areas from total LAU2 and calculated the built-up surface areas. We obtained the demographic data (i.e. number of inhabitants, mortality rate) from the National Institute for Statistics (www.insse.ro, accessed on 10.08.2012).

2.2. Spatial changes in the surface of cemeteries

Using GeoMedia Professional 6.1. (Intergraph Inc., Huntsville, AL, USA), we overlapped the surface area of cemeteries from cadastral plans (1975) with that from aerial images (2008) to quantify which areas were characterised by changes in the surface areas of cemeteries (including the establishment or closure of cemeteries).

In addition, we analysed the location of cemeteries for 1975 and 2008, and we defined six directions of change: (1) no change (cemeteries that kept the same structure within the

![Figure 2. Categories of cemeteries classified by their position in the settlement.](image)
settlements area); (2) inside direction (cemeteries that were included in the settlement area); (3) peripheral direction (cemeteries that were included in the peripheral category in 2008); (4) outside direction (cemeteries that remained in ex-urban areas); (5) closed cemeteries (cemeteries closed after 1975); and (6) newly-created cemeteries (cemeteries established after 1975).

We analysed the spatial changes in the surface areas of cemeteries at LAU2 level, using 1975 as the reference year.

Using the Spearman rank correlation, we tested the association between social and physical parameters and cemetery surface areas for the years 1975 and 2008. The correlation parameters were thus: (1) the number of inhabitants, as an indicator of the need for burial places which influenced dynamics of this land use change; (2) residential surfaces, as limiting factor of the expansion of cemeteries; (3) total surface area of LAU2, to provide evidence of the existing available area for human activities; (4) distance to Bucharest, relevant for the influence of the main polarising centre on the spatial dynamic of cemeteries; and (5) mortality, as a factor with direct influence on the size and usage of cemeteries.

We considered total surface of LAU2 and distance to Bucharest to be constant for the study period.

2.3. Assessing the interface between cemeteries and residential areas

To extract data about residential areas adjacent to cemeteries, we constructed a polygon around edges of cemeteries, with 50 m buffer distance (i.e. safety area for cemeteries after Ministry of Health 1997). From the resulting buffer, using polygon in polygon analysis, we extracted different categories of land uses: residential surfaces, economic activities, forestry and aquatic surfaces. Using Spearman rank correlation, we correlated the changes in the surface of residential areas adjacent to cemeteries, with the changes in: (1) the number of residents and population density as the main indicator for emphasising the increasing need for residential areas; (2) mortality for justifying cemeteries dynamic; and (3) cemetery surface area for explaining the closeness of cemeteries to human settlements.

3. Results

3.1. Spatial distribution of cemeteries

In the Bucharest Metropolitan Area, we identified 338 cemeteries, covering 0.06% (313 ha) of the total surface (Table 1, Figure 3). The average surface area of a cemetery is 0.93 ha (range = 0.01–14.96; SD = 1.17). In total, 70.8% of the cemeteries are less than 1 ha. The cemeteries with an area greater than 1 ha account for 58% of the total surface areas of all cemeteries. The cemeteries are located mainly in the periphery of the settlement areas (56.50% of the cemetery surface areas). The largest cemeteries (>10 ha) are located in close proximity to Bucharest (i.e. Pantelimon, Popesti-Leordeni and Chiajna administrative units).

The number of cemeteries per LAU2 ranges from one to nine, with 68% of the LAU2 having two to four cemeteries (median = 3). Cemetery surfaces occupy between 0.016% (in the case of Butimanu, located at 32 km from Bucharest) and 0.62% (in the case of Chiajna, located 9 km from Bucharest) of the LAU2’s total surface area.

Cemetery surface areas per LAU2 are correlated positively moderately with the number of inhabitants, residential surfaces and LAU2 surfaces. The distances to
<table>
<thead>
<tr>
<th>Location of cemeteries</th>
<th>Total surface area (ha)</th>
<th>% of total surface area of cemeteries</th>
<th>Average surface area</th>
<th>Number of cemeteries</th>
<th>Total surface area (ha)</th>
<th>% of total cemeteries surface area</th>
<th>Average surface area</th>
<th>Number of cemeteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside</td>
<td>59.1</td>
<td>27.9</td>
<td>0.62</td>
<td>94</td>
<td>89.82</td>
<td>28.7</td>
<td>0.78</td>
<td>115</td>
</tr>
<tr>
<td>Peripheral</td>
<td>101.31</td>
<td>47.8</td>
<td>0.6</td>
<td>166</td>
<td>176.8</td>
<td>56.5</td>
<td>1.03</td>
<td>183</td>
</tr>
<tr>
<td>Outside</td>
<td>51.74</td>
<td>24.4</td>
<td>0.84</td>
<td>62</td>
<td>46.33</td>
<td>14.8</td>
<td>1.2</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>212.15</td>
<td>100</td>
<td>0.65</td>
<td>322</td>
<td>312.95</td>
<td>100</td>
<td>0.93</td>
<td>338</td>
</tr>
</tbody>
</table>
Bucharest and mortality rate were not significantly correlated with the surface area of the cemeteries (Table 2).

### 3.2. Cemeteries between 1975 and 2008

Between 1975 and 2008, the overall surface area of cemeteries increased by 47.5% (100.8 ha) (Figure 3), with a larger increase in localities close to Bucharest city. The increase was determined by the expansion of existing cemeteries (+76.76 ha) and the establishment of 55 new cemeteries (+39.81 ha) (Figure 4). The largest increase in cemetery surface (> 5 ha) was in the areas of LAU2 in proximity to Bucharest, such as Pantelimon, Popesti-Leordeni and Chiajna, where the public services and activities from Bucharest have been transferred (e.g. landfills, wastewater power plant, heavy industrial activities). This growth pattern was not found in all study areas (Figure 5). Between 1975 and 2008, 39 cemeteries were closed (16.17 ha), most of them due to hydrotechnical construction projects (e.g. the Arges-Danube channel, the irrigation systems Mostistea I and II, and reservoirs). The total surface of cemeteries decreased in 18 LAU2 (range = 0.08–1.11 ha), and increased in the other localities (range = 0.06–13.47 ha).

![Figure 3. Changes in the number and surface area of cemeteries between 1975 and 2008 in LAU2 from the Bucharest Metropolitan Area.](image)

**Table 2. Correlation between surface area of cemeteries and influencing factors in the Bucharest Metropolitan Area.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Factors of influence</th>
<th>$\rho$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>No. inhabitants</td>
<td>0.35</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Residential areas</td>
<td>0.49</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>LAU2 areas</td>
<td>0.56</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Distance to Bucharest</td>
<td>0.20</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
<td>-0.03</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>No. inhabitants</td>
<td>0.58</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Residential areas</td>
<td>0.57</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>LAU2 areas</td>
<td>0.35</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2008</td>
<td>Distance to Bucharest</td>
<td>-0.17</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
<td>-0.18</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Figure 4. Evolution of cemeteries in the LAU2 from the Bucharest Metropolitan Area.

Figure 5. Changes in the surface area of cemeteries and proximity to residential areas in the Bucharest Metropolitan Area (1975–2008).
The location of cemeteries within the settlement areas changed significantly. The tendency for cemeteries to be a part of the settlement areas is confirmed by the increase of cemeteries from the Peripheral (+31 cemeteries, with 50.6 ha) and Inside (+29 cemeteries, 67.58 ha) categories. Many cemeteries (224) remained in the same location, and their surface area increased. Outside cemeteries registered the most important increase, mostly due to the lack of barriers to their development (Table 3, Figure 6).

### Table 3. Changes in the location of cemeteries in the Bucharest Metropolitan Area.

<table>
<thead>
<tr>
<th>Type</th>
<th>Changes between locations</th>
<th>Number</th>
<th>Areas in 1975 (ha)</th>
<th>Areas in 2008 (ha)</th>
<th>Dynamic (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change</td>
<td>Inside &gt; Inside</td>
<td>78</td>
<td>48.78</td>
<td>57.53</td>
<td>+15.21</td>
</tr>
<tr>
<td></td>
<td>Peripheral &gt; Peripheral</td>
<td>122</td>
<td>79.88</td>
<td>110.63</td>
<td>+27.79</td>
</tr>
<tr>
<td></td>
<td>Outside &gt; Outside</td>
<td>24</td>
<td>17.90</td>
<td>27.12</td>
<td>+34.02</td>
</tr>
<tr>
<td>Inside direction</td>
<td>Peripheral &gt; Inside</td>
<td>27</td>
<td>15.33</td>
<td>20.65</td>
<td>+25.76</td>
</tr>
<tr>
<td></td>
<td>Outside &gt; Inside</td>
<td>2</td>
<td>4.80</td>
<td>8.26</td>
<td>+41.82</td>
</tr>
<tr>
<td>Peripheral direction</td>
<td>Inside &gt; Peripheral</td>
<td>4</td>
<td>3.65</td>
<td>3.82</td>
<td>+4.38</td>
</tr>
<tr>
<td></td>
<td>Outside &gt; Peripheral</td>
<td>27</td>
<td>24.47</td>
<td>45.50</td>
<td>+46.22</td>
</tr>
<tr>
<td>Outside direction</td>
<td>Inside &gt; Outside</td>
<td>1</td>
<td>1.18</td>
<td>0.96</td>
<td>−23.29</td>
</tr>
<tr>
<td></td>
<td>Peripheral &gt; Outside</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Closed cemeteries</td>
<td>Inside &gt; ~</td>
<td>11</td>
<td>5.49</td>
<td>0.00</td>
<td>−100.00</td>
</tr>
<tr>
<td></td>
<td>Peripheral &gt; ~</td>
<td>17</td>
<td>6.10</td>
<td>0.00</td>
<td>−100.00</td>
</tr>
<tr>
<td></td>
<td>Outside &gt; ~</td>
<td>9</td>
<td>4.58</td>
<td>0.00</td>
<td>−100.00</td>
</tr>
<tr>
<td>New cemeteries</td>
<td>~ &gt; Inside</td>
<td>8</td>
<td>0.00</td>
<td>3.38</td>
<td>+100.00</td>
</tr>
<tr>
<td></td>
<td>~ &gt; Peripheral</td>
<td>30</td>
<td>0.00</td>
<td>16.84</td>
<td>+100.00</td>
</tr>
<tr>
<td></td>
<td>~ &gt; Outside</td>
<td>15</td>
<td>0.00</td>
<td>18.25</td>
<td>+100.00</td>
</tr>
</tbody>
</table>

The location of cemeteries within the settlement areas changed significantly. The tendency for cemeteries to be a part of the settlement areas is confirmed by the increase of cemeteries from the Peripheral (+31 cemeteries, with 50.6 ha) and Inside (+29 cemeteries, 67.58 ha) categories. Many cemeteries (224) remained in the same location, and their surface area increased. Outside cemeteries registered the most important increase, mostly due to the lack of barriers to their development (Table 3, Figure 6).

### 3.3. Environmental consequences of cemeteries expansion

The expansion of cemeteries has generated sensitive consequences for environmental quality, especially in LAU2 near the Bucharest city. Thus, the land conversion to cemeteries due to their extension or new establishments was 116.57 ha, mostly from agricultural land with medium and high productivity.

Residential areas in the LAU2 from the Bucharest Metropolitan Area had the most significant increases. In the analysed period, the increases had values between 132–253% in the LAU2 situated in the proximity of the central city. In addition, residential areas within 50 m of a cemetery increased to 78.67 ha. Increases more than 2 ha were registered in LAU2 located close to Bucharest city, where urban sprawl is a specific process.

In this context, cemeteries have become neighbourhoods for residential areas, providing an unsecure area predisposed to favour conflicts.

The growth of residential areas within 50 m of a cemetery was correlated with the expansion of cemeteries ($\rho = 0.41; p < 0.001$) and the population increase ($\rho = 0.22; p < 0.001$). However, the growth was not correlated with changes in the residential surface areas ($\rho = 0.17; p = 0.31$) (Figure 5). The proportion of residential areas that were proximal to cemeteries remained low (1.12%, range per LAU2 = 0–4.29%). Since 1975, the areas proximal to cemeteries have become predominantly residential (42.60% in 2008, compared with 23.5% in 1975).
Figure 6. Location of cemeteries in relation to their distance to Bucharest.
4. Discussion

4.1. Cemeteries and land consumption

This paper shows that the highest increase in cemetery surface areas was recorded in the administrative units within the proximity of Bucharest, where the actual land supply cannot fulfill the needs of development projects and urban sprawl occurs (Nae and Turnock 2011). These increases represent evidence of land use changes (þ13.5 ha in Pantelimon, þ10.5 ha in Popeşti Leordeni) dominated by losses of productive agricultural fields, resulting in a deficit of this valuable land use. The causes of conversion of agricultural areas in favour of cemeteries are mainly top-down decisions, unlike in other countries (e.g. the US, UK), where the demand for burial places has created problems with cross-cutting community land (Rugg 2000a; Coutts, Basmajian, and Chapin 2011).

Between 1975 and 2008, the number of cemeteries with a surface area greater than 1 ha has increased and the number of cemeteries with a small surface area has decreased. However, the surface area of cemeteries in the Bucharest Metropolitan Area is considerably smaller than in metropolitan areas from other countries. In the US many cemeteries are between 2 and 40 hectares (Coutts, Basmajian, and Chapin 2011), whereas in the Bucharest Metropolitan Area only a few cemeteries exceed 2 ha. Meanwhile, small cemeteries are more manageable as specialised green spaces (Kjøller 2012) but they can augment urban sprawl (Jaeger et al. 2010).

The number of inhabitants and the surface area of the LAU2 are determinant factors for the size of cemeteries. This suggests that land consumption for the expansion of cemeteries will increase, considering that the number of deaths will rise as an effect of pronatalistic policies promoted during the communism period, after 1966. The distance to Bucharest is a factor at the limit of statistical significance ($\rho = 0.20; p = 0.05$), which supports the findings from other studies (Coutts, Basmajian, and Chapin 2011) where the distance to a central city is not a determinant factor for the dynamic of the surface area of cemeteries.

With regard to the size of cemeteries’ spatial dynamic, the largest increases occur particularly in LAU2 characterised by a low environmental quality, caused either by the historical pollution or by the presence of important sources of environmental degradation at the metropolitan level (e.g. regional landfills, polluting industrial units). Similarly to other studies (Taleai et al. 2007; Uslu 2010), in the Bucharest Metropolitan Area the surface areas affected by poor environmental quality are preferred by potentially conflicting peripheral land uses.

4.2. Environmental consequences of land conversion to cemeteries

Cemeteries from the Bucharest Metropolitan Area, which previously represented an ex-urban and suburban land use, have become an internal land use in many settlements. This pattern is characteristic mainly for localities with a significant increase in scattered built-up areas. Similar to other regions and studies (Jim and Chen 2010), the unplanned expansion of built-up areas has dissolved the safety distances between peripheral land uses and residential or other sensitive land uses.

This is obvious as the total surface area of cemeteries in the Inside and Peripheral categories has increased from 48% to 56%, while the total surface area of Outside cemeteries has decreased significantly (from 24% to 15%).

Thus, the inclusion of peripheral land uses inside the settlements promotes urban sprawl and favours a reduced implementation of strategic planning for controlling urban sprawl developments (Jaeger et al. 2010). It can be further correlated with the continuity/
discontinuity of built-up area developments. This issue has the potential to intensify, especially in the close proximity of Bucharest.

Cemeteries tend to become a usual land use in the built-up areas of settlements and occupy large surfaces (e.g. 3.5% in Pantelimon, 1.9% in Dobroesti, 1.8% in Glina). This increase has important environmental consequences (such as a change of neighbourhood structure, loss of initial landscape, groundwater pollution or psychological discomfort) (Figure 7). Residential spaces situated within 50 m of cemeteries have increased in surface area, representing an average of 2.22 ha per LAU2 (range = 0–11.18 ha; SD = 1.73). This has favoured a high potential for Romanian cemeteries to generate problems that could influence the population’s state of health and comfort. These problems are not characteristic of well-managed cemeteries (Kjøller 2012). Visual discomfort, the development of opportunistic organisms and groundwater pollution are among the most common problems related to cemeteries (Santarsiero et al. 2000a; Tudor et al. 2013).

Therefore, a new land use arrangement generates other land use interactions (Hersperger 2006). Peripheral land use management should be co-ordinated with landscape planning and citizens’ demands. Residents who initially accepted peripheral land uses as an adjacent land use are now disturbed by them (e.g. due to visual discomfort in the case of cemeteries) (Iojă et al. 2010; von der Dunk et al. 2011). Due to poor management, peripheral land uses can become a significant source of conflicts. In the case of cemeteries, when their potential functionality does not bring the same number of benefits as other types of urban green spaces, the conflict appears (Barbosa et al. 2007).

These adjustments have led to reconsideration of cemetery management as a component in the green infrastructure of human settlements and not as an unhealthy, land consuming and conflicting service. Cemeteries are important for planning in the medium- and long-term because the unplanned and unjustified immobilisation of large land

Figure 7. Consequences of the increase in surface area of cemeteries in the Bucharest Metropolitan Area.
surfaces for urban services can disturb the sustainable evolution of settlements and affect territorial cohesion (Antrop 2006).

The land consumption behaviour of cemeteries has favoured urban sprawl. This can be the case for other external land uses which in co-operation with economic, political and social causes can add pressure on the peripheral land towards development in an inefficient manner (EEA 2011). The demand for land by infrastructure and residential projects has made it more difficult for land use planning to be implemented efficiently (Barrios 2008).

Future analyses could assess the perceptions of inhabitants living in close proximity to cemeteries and use these data as a defining element in both regional planning and environmental quality. These analyses can also sustain future improvement measures for alleviating conflicts between these two land uses; one consideration would be the relocation of cemeteries or, more realistically, the enhancing of their management. Therefore, it is important to evaluate the problems associated with peripheral land uses not only for current users but also for benefits over time, enhancing land use and environmental sustainability as well as avoiding conflicts (von der Dunk et al. 2011).

5. Conclusions
Cemeteries are a good example of peripheral land use, characterised by a permanent dual action on human settlements: land use resources and source of environmental degradation. The efficient management of cemeteries and their neighbourhoods is a key element in controlling the environmental, social and ecological impacts, if the relocation of the peripheral land use is not possible.

The number of peripheral land uses within settlements has generally increased and has already recorded environmental problems. Their assimilation into human settlements followed by the process of urban sprawl has contributed to the increase of negative externalities experienced by residential and other sensitive areas. These have determined specific local and regional planning issues that are frequently encountered in many countries that are in a transition to become well-established market economies (e.g. countries that recently joined the European Union).

Although the magnitude of specific land use changes in the Bucharest Metropolitan Area is currently low (with a tendency to increase when aggregated with other dysfunctions), they could represent potential precursors of complex conflicts and environmental issues. If these issues are not addressed, they could lead to an imbalance in environmental quality and the potential for housing development and overall competitiveness between municipalities (Hersperger 2006).

The distance from external and peripheral land uses to settlements represents a problem that should be addressed so it becomes environmentally sound. Relocating these land uses outside of the settlement area is an unlikely alternative due to the ignorance of spatial planning in this area. Improving the management of the use of land, with particular attention to territorial relations, can be an important step in developing a positive link between adjacent land uses.

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References


