ACCESSIBILITY TO GENERAL AMENITIES; DETERMINING THE ATRACTIVITY OF METROPOLITAN AREA OF IAȘI CITY

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Abstract: The expansion of city beyond its limits, even if it is a widely researched theme, represents a barrier for the geospatial analysis due to the process’s complexity and the factors that generate it. On the other hand, accessibility - as the main concept on which this paper focuses on - is the main parameter for highlighting the different levels of development. In the same time facilities and their distribution explain the relationships (seen as flows of information, ideas, finances, people) between the elements of the analyzed system, bonds that in this case induce a core-periphery functionality. The outputs (classification of the localities by different levels of accessibility) offer a complex image upon the study area and could be considered also an important instrument for the policy makers’ multiscalar analyses.

Keywords: time-distance travel, urban fringe, facilities, suburbanisation, network analyst.

1. INTRODUCTION

The existing research and literature concerning urban growth is voluminous and presents it as a multidimensional phenomenon emphasising on its spatial configuration and dynamics. In this general context, one of the most important features of modern urban areas is the decentralisation of people and employment from central cities towards their inner and outer suburbs (Gaschet, 2002, p. 63), in other words the process of suburbanisation.

The theoretical approach of this process includes two groups of concepts, which are interdependently connected, namely one that tackles the issue of urban growth (metropolitan area, suburbanisation and periurbanization) and the other one which explains some of the principles concerning the organization and functionality of space (attractiveness, accessibility and least effort principle).

Metropolitan area is a general term for large urban settlements. According to Romanian Urbanism Law (351/2001) a metropolitan area represents an area established by
a volunteer partnership that joins together the biggest cities in the country (the capital and those included in the first rank category), urban centres and rural settlements located within no more than 30 kilometers distance to each other, which also cooperate at different levels.

Suburbanisation is a process whereby people, housing, industry, commerce, and retailing spread out beyond traditional urban areas, forming dispersed landscapes that are still connected to cities by commuting (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009, pp. 731-732).

Even if the literature does not offer a concrete distinction between suburbanization and perirurbanisation and, in addition, some researchers consider they define the same reality the only difference being their origin, we will analyze them as two processes.

The concept of periurban emerged due to limitations in the dichotomy between rural and urban. Much research has identified the inadequacy of this simplistic dichotomy, some authors even suggesting its analytical relevance is long past. Others have argued more specifically that only the dichotomous construct has outlived its usefulness not the underlying distinction between degrees of ruralness and urbaness (Rambaud 1973). A key feature of periurban environments is their dynamic nature, wherein social forms and arrangements are created, modified and discarded. They are areas of social compression or intensification where the density of social forms, types and meanings increases, fomenting conflict and social evolution (Iaquinta & Drescher, p. 4).

The concepts that explain the functionality of a metropolitan area are accessibility, attractiveness and the principle of least effort.

The standard definition of accessibility is the ease with which people can reach desired activity sites, such as those offering employment, shopping, medical care or recreation. Because many geographers and planners believe that access to essential goods and services is an important indicator of quality of life, measures of access are used to compare the accessibility levels of different groups of individuals and households, or of different places or locations. Most measures of accessibility entail counting the number of opportunities or activity sites available within certain travel times or distances of a specified origin (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009, pp. 2-3). Accessibility is the main "product" of a transport system. It determines the locational advantage of an area (i.e. a region, a city or a corridor) relative to all areas, including itself. Indicators of accessibility measure the benefits that the households and firms in an area enjoy from the existence and use of the transport infrastructure relevant for their area (Spiekermann & Neubauer, 2002, p. 7).

The more central a place is regarding the existing services (stable), the more attractive (which mean he has a diversified and important offer) and accessible to other places becomes (Groza, 2005).

The least effort principle is considered to be the main principle that controls the daily activity of humans – if an activity can be accomplished through many ways, the person who is doing it will choose the way that implies the least effort concerning money, energy or time. For a geographer, minimizing the effort usually means minimizing the distance and motion (Groza, 2005).

The definitions presented above (which stand out the idea of expanding beyond the traditional limits of the city) offer a background for highlighting the main goal of this paper – creating clusters of localities according to their general accessibility to a set of facilities, aspect that can provide an idea of their level of development.
Thus, the paper is structured according to the following objectives:

a. identifying all types of facilities by grouping them into eight main categories
b. geolocating all facilities within the study area
c. analyzing the distribution of facilities observing their spatial behavior
d. creating clusters using as criterion accessibility to amenities.

2. MATERIALS AND METHODS

Our research design methodology has been accomplished due to a combination of several quantitative methods. Collecting data fields from different sources and assembling them into one analyses provided sufficient background for highlighting the attractiveness of the localities induced by facilities located within metropolitan area of Iași city.

2.1 Study Area

Our analyses take into consideration the metropolitan area of Iași city, composed of 13 communes and the city of Iași, summarizing a total of 76 localities. Iași Metropolitan Area is the first entity of its kind in Romania, established in 2004 (Clipa, 2012) and represent a densely populated region, (400.323 people – 47,81% of county population) on a relative small area (808 km² – 14,74% of county surface) (Cîmpianu & Corodescu, 2013).

Fig. 1. Metropolitan Area of Iași and surroundings
2.2 Data collection

Geospatial analysis methods that were used to classify different scales of attractiveness for the localities which were taken into consideration needed the following spatial data:

a. Roads network classified by type (E - European Road, DN - National Road, DJ -Regional Roads, DC - Communal Roads), Length, Speed and Time-Distance length. The network was extracted from Open Street Map and corrected according to field observations.

b. Built-up areas (extracted from Corine Land Cover 2006), administrative limits of communes and the localities (Cuguat-TIGRIS).

c. General amenities were collected as following:

Table 1 – Amenities database collection and data source

<table>
<thead>
<tr>
<th>Type of amenities</th>
<th>Facility</th>
<th>Number</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>Urban bus stations</td>
<td>126</td>
<td><a href="http://www.ratp-iasi.ro">www.ratp-iasi.ro</a></td>
</tr>
<tr>
<td></td>
<td>Taxi stations</td>
<td>31</td>
<td>OSM, Field observations</td>
</tr>
<tr>
<td></td>
<td>Train stations</td>
<td>10</td>
<td><a href="http://www.cfr.ro">www.cfr.ro</a></td>
</tr>
<tr>
<td></td>
<td>Metropolitan bus stations</td>
<td>60</td>
<td><a href="http://www.autobuze.ro">www.autobuze.ro</a></td>
</tr>
<tr>
<td>Economical services</td>
<td>Enterprises &gt; 500 employees</td>
<td>31</td>
<td><a href="http://www.doingbusiness.ro">www.doingbusiness.ro</a></td>
</tr>
<tr>
<td>Religious sites</td>
<td>Churches</td>
<td>161</td>
<td><a href="http://www.biserici.org">www.biserici.org</a></td>
</tr>
<tr>
<td>Educational services</td>
<td>Kindergarten</td>
<td>54</td>
<td><a href="http://www.edu.ro">www.edu.ro</a></td>
</tr>
<tr>
<td></td>
<td>Primary school</td>
<td>56</td>
<td><a href="http://www.edu.ro">www.edu.ro</a></td>
</tr>
<tr>
<td></td>
<td>Secondary school</td>
<td>59</td>
<td><a href="http://www.edu.ro">www.edu.ro</a></td>
</tr>
<tr>
<td></td>
<td>High school</td>
<td>30</td>
<td><a href="http://www.edu.ro">www.edu.ro</a></td>
</tr>
<tr>
<td>Medical services</td>
<td>Pharmacy</td>
<td>194</td>
<td>OSM</td>
</tr>
<tr>
<td></td>
<td>Hospitals</td>
<td>24</td>
<td><a href="http://www.ms.gov.ro">www.ms.gov.ro</a></td>
</tr>
<tr>
<td>Cultural services</td>
<td>Cultural attractions¹</td>
<td>30</td>
<td>Field observations</td>
</tr>
<tr>
<td>Recreation services</td>
<td>Bars concentration</td>
<td>6</td>
<td>OSM</td>
</tr>
<tr>
<td></td>
<td>Restaurants</td>
<td>97</td>
<td>OSM</td>
</tr>
<tr>
<td></td>
<td>Sport Facilities</td>
<td>31</td>
<td>Field observations</td>
</tr>
<tr>
<td></td>
<td>Hall Centers</td>
<td>8</td>
<td>Field observations</td>
</tr>
<tr>
<td></td>
<td>Parks</td>
<td>26</td>
<td>Field observations</td>
</tr>
<tr>
<td></td>
<td>Picnic Areas</td>
<td>8</td>
<td>Field observations</td>
</tr>
<tr>
<td>Commercial Facilities</td>
<td>Shopping center</td>
<td>9</td>
<td>Field observations</td>
</tr>
<tr>
<td></td>
<td>Hardware stores</td>
<td>6</td>
<td>Field observations</td>
</tr>
<tr>
<td></td>
<td>Market Place</td>
<td>9</td>
<td>Field observations</td>
</tr>
<tr>
<td></td>
<td>Clothing centers</td>
<td>13</td>
<td>Field observations</td>
</tr>
</tbody>
</table>

2.3 Data analyses

The data were analyzed to mark out different levels of attractiveness. Using ArcGIS - Network Analyst extension (Closest Facility and OD cost-matrix tools), each locality obtained a value (time-distance measure) for each type of facility. For each group of

¹ Theatres, Museums, Libraries, Arts-Centers, Other Attractions
amenities a distinct cost-distance (rate) was calculated by summing up the values derived from the first step. The final index represents an average of the values for each group of amenities.

The final index was calculated by giving a weight to each time-distance from each incident to facilities according to the formula presented below:

$$Final\ index = a \times 0.3 + b \times 0.2 + c \times 0.2 + d \times 0.13 + e \times 0.08 + f \times 0.08 + g \times 0.02 + h \times 0.01,$$

where

- $a =$ transportation
- $b =$ economical services
- $c =$ educational services
- $d =$ religious sites
- $e =$ commercial facilities
- $f =$ recreation services
- $g =$ medical services
- $h =$ cultural services

The weight factor for each amenity is an inverse ratio with the occurrence and importance of those amenities, being taken into consideration that the highest occurrence and least frequency is the one less explanatory for the degree of accessibility (Tudora, 2010).

In order to calculate the time-distance between Facilities (the services provided to population) and Incidents (road junctions inside the built-up area of municipalities), the road network was divided into three categories (within Iasi city, in villages' built-up areas and outside localities) and then new attributes were added (type, rank, quality, speed); each of the three categories were also classified according to their type and rank: 3 for European Roads, 4 for National Roads, 5 - Regional Roads, 6 - Regional Roads that need improvements, 7 for Communal Roads, 8 – Communal Roads of low quality. The quality was established considering the previous two attributes namely 1 for roads with rank 3 and 4, 2 for roads with rank 5 and 3 for those with rank 6 and 7, and 4 for the last category of roads. The next attribute was the speed limit which takes into consideration the regulation speeds and the other attributes mentioned above; the data used are drawn in the table below (table 2). All these features were used to calculate the time-distance and the cost-distance.

The first parameter uses the length and speed and the second one the speed and quality, being an estimation based on the fuel efficiency (liters per 100 kilometers) and car maintenance costs. The time-distance was determined using the following expression: $[(60 \times \text{Length})/\text{Speed}] \times 1000$.

**Table 2 - Attributes of the road network**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td></td>
</tr>
<tr>
<td>Quality [1]</td>
<td>70 km/h – outside localities and the city of Iasi</td>
</tr>
<tr>
<td></td>
<td>50 km/h – villages’ built-up area</td>
</tr>
<tr>
<td></td>
<td>40 km/h – inside the city</td>
</tr>
<tr>
<td>Quality [2]</td>
<td>65 km/h – outside localities and the city of Iasi</td>
</tr>
<tr>
<td></td>
<td>45 km/h – villages’ built-up area</td>
</tr>
<tr>
<td></td>
<td>35 km/h – inside the city</td>
</tr>
<tr>
<td>Quality [3]</td>
<td>50 km/h – outside localities and the city of Iasi</td>
</tr>
<tr>
<td></td>
<td>30 km/h – villages’ built-up area</td>
</tr>
<tr>
<td></td>
<td>25 km/h – inside the city</td>
</tr>
<tr>
<td>Quality [4]</td>
<td>40 km/h – outside localities and the city of Iasi</td>
</tr>
<tr>
<td></td>
<td>20 km/h – villages’ built-up area</td>
</tr>
</tbody>
</table>
The OD cost matrix finds and measures the least-cost paths along the network from multiple origins to multiple destinations. When configuring an OD cost matrix analysis, you can specify the number of destinations to find and a maximum distance to search (ArcGIS Resource Center, 2012). Using HAC (Hierarchical Ascendant Classification), the localities were clustered into three major categories (high, medium and low accessible), providing a better focus on accessibility to each type of facility. Based on these analyses, localities were classified according to accessibility. The entire database was processed using several specialized software (ArcGIS 9.3, Xphil, PhilCarto 5.6, Office 2010, Adobe Illustrator).

3. RESULTS

This section presents the main output which was obtained after all the methods presented above were applied, highlighting the attractiveness of the settlements included in the Metropolitan Area of Iași. In order to identify different stages of development for each locality which is being taken into consideration in this paper the following methods were used: facilities’ density, weighted time distance to facilities and Hierarchical Ascendant Classification. Altogether, the methods create a general image upon the importance played by the accessibility in the individual development of the settlements that shape the analyzed study area.

3.1 Spatial distribution of facilities in 2’30” range

As a preliminary step of the analysis the amenities were grouped into eight categories based on the services they provide to the inhabitants – transport, economic, religious, educational, medical, cultural, recreational and commercial services (the facilities included in these groups are listed in table 1); these were selected so that they could draw an image on the degree of dependence or independence of each locality on the city; thus they could provide information about the stage of suburbanization and periurbanization processes in the study area.

Analyzing figure 2, it becomes rather self-explanatory that the study area functions according to center-periphery model, aspect sustained by the clustering of facilities, customers and highly skilled workers mainly in the city. This model shows how economic integration may lead to a
dramatic increase in the geographic concentration of facilities via self-reinforcing agglomeration process (Rikard & Gianmarco, 2003), leading to a continuous process of urban sprawl. The theoretical model of locating the facilities, which implies a homogenous and isotropic land, assumes that the catchment area of those would be represented as concentrically circles; in reality the analysis is biased by different factors: landscape architecture, historical evolution of the city, real estate prices, transportation system. The main factor that reshapes the study area is represented by transportation network (roads of high quality compress the distances mainly in the western and southern side).

The higher the distance to city center is the lower the number of facilities becomes. Thus, the highest densities are located in the inner center of the city (41-8 facilities/sq.km), aspect that demonstrates the important role played by the city in the region – it polarized the hole localities from its vicinity (existence of all types of facilities). On the other hand, there are some facilities that are grouped together outside of the city limits, aspect that reveals the relative independence of some settlements. This is the case of Tomești and Holboca villages - even if they are well connected to the city’s transportation system, they have developed their own facilities, due to a highly densification of population. Other examples are Valea Lupului, Miroslava, Lunca Cetățuii, villages that are mainly occupied by commuters. Beside basic amenities (transportation, schools, medical) these villages are provided with other facilities (recreational areas, commercial facilities) which offer a higher degree of quality of life. At a distance higher than 15’, localities have only basic facilities – the most frequent are the religious, followed by educational and transportation facilities.

The density of incidents (which represents the intersection of the road network within built-up areas of localities) was grouped in service areas of 2’30". This value represents the minimum average time distance to all facilities and it is located in Valea Lupului, which is the closest incident to all facilities. In the same time, the minimum 2’30” represents the optimal break value for having a more accurate image upon the degree of accessibility to general amenities and implicitly upon the degree of suburban development. A larger service area (5’ for example) would concentrate most of facilities in the first ring buffer, creating a larger gap between the city and outskirts.

3.2 Weighted time-distance to facilities

According to the index presented in the methodology section, a classification of the localities has been realized, the results being displayed in figure 3. The statistical units (settlements) were divided into 3 groups (the limits of the classes were considered the breaks observed in the scatter plot distribution) according to the weighted time distance to facilities:
a. Municipalities located within 9’30” to facilities - these are also the statistical units that have a better connection with high speed roads (Miroslava, Voinești, Ciurea, Lețcani) or developed some real estate projects due to favorable landscape (Breazu).

b. Municipalities with values from 9’30” to 15’ - The result points out that from each incident it takes on average 15’ to reach any closest facility. These incidents have a diffuse distribution in the territory; in some cases the landscape presents features of the periurbanisation (Păun, Bârnova, Rediu) or suburbanization process (Tomești).

c. Municipalities situated beyond 15’ limit, in most of the cases being considered peripheral areas (Victoria, Ungheni, Schitu-Duca). As a result, the interaction with facilities has a low intensity, aspect that corresponds with the level of the economic development, even if they are part of the Metropolitan Area of Iași.

3.3 Hierarchical Ascendant Classification

The Hierarchical Ascendant Classification (HAC) provides a much refined result than the output presented in figure 3. The changes induced by this method are visible in the accessibility to each facility, grouping all localities according to a pattern model, keeping in the same time the classes provided by the above mentioned results.

The dendogram reveals the position of each statistical unit to each group of amenities highlighting two main results:

a. The ease of reaching each facility, correlated with the frequency of their distribution. There are some facilities that have a high recurrence (churches, educational and transport facilities), being a proof of basic needs. On the other hand, medical and cultural facilities are the most difficult to reach.
b. Localities that have the same characteristics regarding the accessibility to amenities are grouped into three classes:

- Highly accessible localities are positioned very close to all facilities (and in the same time to the city). They offer the best image of what researchers call urban sprawl through their different morphological structures (suburbanization-Dancu, Tomești, Holboca, periurbanisation-Miroslava, Uricani, Valea Lupului, Rediu).
- Settlements with medium accessibility - Even though accessibility to facilities is not a major force for their development, some of them managed to gather some characteristics necessary for the emergence of urban sprawl process (Sorogari, Poieni), but most of them remained at a rural development level (Cogeasca, Cucuteni, Popricani). Urban behavior is scattered at this scale, being represented by few individuals that have passed through the distance barrier.
- Settlements with low accessibility – there is clear evidence that the distance has a major role in localities’ development, because most of them are presenting rural features (Pocreaca, Slobozia, Ungheni, Bosia). The only amenities that are easy to reach are the religious and the educational ones; in some cases (Schitu Duca, Poiana, Cotu Morii – located along major roads) the transportation facilities are also accessible, offering more possibilities for a future development.

4. DISCUSSIONS AND CONCLUSIONS

Measuring attractiveness of Metropolitan Area of Iași is an approach that should take into consideration factors such as commuters, real estate price, and evolution of built-up area, households and enterprises. Using the ease of reaching facilities instead of the factors mentioned above is an alternative method that provides an image of the degree of the attractiveness of each statistical unit taken into consideration. This method has both advantages (the databases are easy to build, edit and process, the analysis can be multiscalar and the results are readable for the policy makers) and some disadvantages (limited to only a few parameters - distance, number of facilities).

The analyzed study area functions according to core-periphery model. Still along the transport axes the time-distance diminishes and offers a visible advantage to localities located near them. In the same time, localities positioned between axes have a lower degree of development caused by higher values of time-distances. Therefore, these areas are considered peripheral and rural (even if they are at 10 km away from the core), presenting typical characteristics and behaviors.

The relative attractiveness of facilities on suburban fringe highlights the major role that city (core) plays in modeling the interactions between core and periphery, transferring different urban features (suburban and periurban) and behaviors.

Attractiveness of the urban fringe is not necessary explained by proximity to core (facilities), but rather other factors (landscape view, policy makers decisions) could have a local influence, changing urban-rural interactions.

There is a direct relation between the attractiveness to urban fringe and the distribution of amenities within Metropolitan Area of Iași (most of them are concentrated in the core area); in this way decision makers can draw development direction for a balanced evolution of the entire territory.
REFERENCES


