THE TOURISTIC ACCESSIBILITY IN THE HUNEDOARA COUNTY IN TERMS OF ROAD NETWORK

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ABSTRACT:
Studying the accessibility of an area is an important issue regarding territorial planning. This study aims to highlight, by using GIS techniques, the most accessible areas in terms of tourism in Hunedoara. Thus, in order to calculate the Tourism Accessibility Index (TAI) two factors were summarized: the level of service given by the road network and the density of points of interest for tourists. In order to obtain the accessibility given by the first factor, the Service Area tool from Network Analyst extension in ArcGIS 10,1 software was used. The points of interest density was also calculated in ArcGIS, by using the Point Density tool. These factors were converted from vector to raster dataset and then, by summarizing the factors, the Tourism Accessibility Index (TAI) was finally obtained. The highest values are recorded in the central part of the county, around the main polarizing centers, respectively Deva and Hunedoara cities.

Key-words*: accessibility, road network, Hunedoara, points of interest for tourists*

1.INTRODUCTION

Studying tourism accessibility in Hunedoara county and not only, from the perspective of road network represents an important part, especially regarding the planning of the respective area, so that it can be used more efficiently, in terms of tourism. Therefore, such studies may help to determine the correct placement of human objectives (Job & White, 2009). In Romania, studies referring to accessibility of a territory from the perspective of road network have been made by Cârjan, Ghițuleasa and Petrișor (2011), Csongor (2011) or Costache and Tudose (2012). Internationally, similar issues were treated by Lincoln and Friedland (1978), Selivestrova (2006), Jakimavičius and Burinskienė (2007), Semm and Palang (2010). The present study aims to highlight the most accessible touristic areas in Hunedoara, according to road network. For this purpose, the Service Area tool from Network Analyst extension which is included in ArcGIS 10.1 software was used. This extension was used in our country by several researchers, like: Nicoară and Haidu (2011), or Bulai and Ursu (2012). The study is important due to changes in economics which tend to focus on the tertiary sector, to the detriment of the industry which is continously declining (Erdeli & Dumitrache, 2010).

Hunedoara was chosen for this study because it has multiple objectives that belong to different tourism practices, like historical tourism (The Hunyad Castle, Sarmiszegetusa Fortress), as well as winter-sport activities. Potential tourists can access this area from different parts of the country using transport facilities, such as roads, that cross the county.

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2.STUDY AREA

Hunedoara county (**Fig. 1**) is located in the central western part of Romania, in the contact area of the Western Carpathians with the Southern Carpathians. It is located at the intersection of the parallel of 46 degrees north with the meridian of 23 degrees east.

Hunedoara has a temperate transition climate, with an annual average of 10° C. The study area is of 7063 square kilometers. The county is predominantly mountainous (68%), with altitudes often exceeding 2000 meters. The main river is Mureș, that crosses the region from east to west, through the center (Ghinea, 2000).

The county population is about 396.000 inhabitants, according to 2011 census data (INS, 2011).

The roads crossing Hunedoara belong to all categories, from forest roads to European roads.

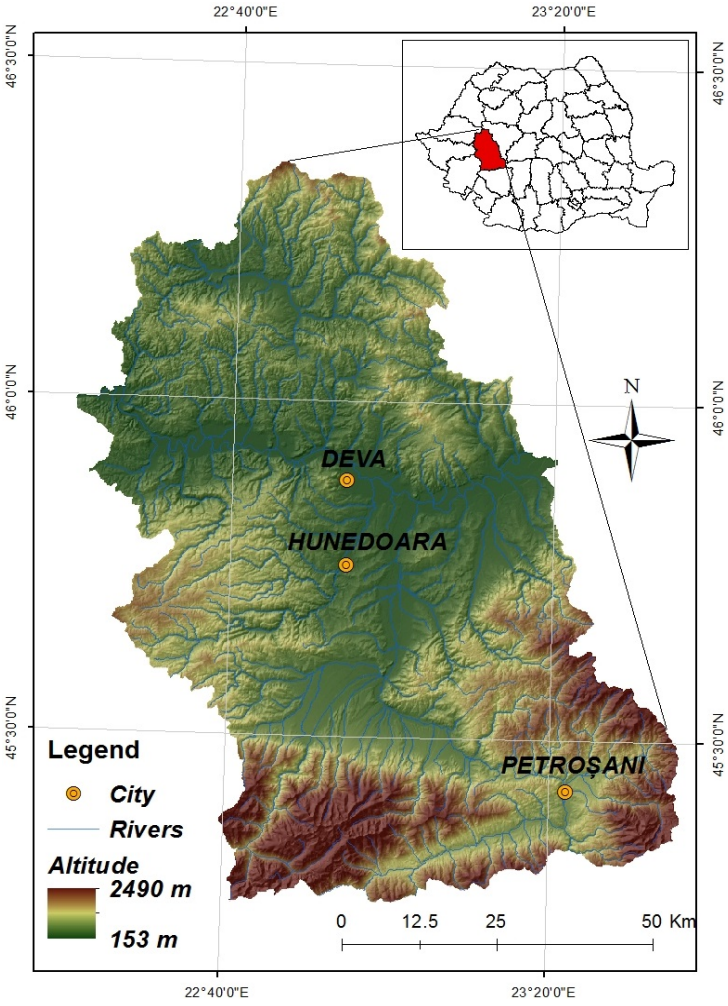

Fig. 1. Hunedoara's position in Romania

Thus, the major roads that cross the county are: E 68 (DN 7) located on the Mureș valley, crosses Hunedoara from west to east through Deva, Simeria and Orăștie, E 79 (DN 66, DN 76), crosses the county from north to south through the cities of Petroșani, Hațeg, Călan, and Brad. Other important routes are the national roads: DN 68 connects the city of Hateg with Caransebes, DN 68 A connects the city of Deva with Lugoj, while DN 74 connects the city of Brad with Abrud and Cluj Napoca (Atlasul Rutier si Turistic Romania si Republica Moldova, 2012).

Hunedoara has a huge tourism potential, with natural and anthropogenic attractions of a great importance. Tourism is closely linked to the multiple activities and possibilities offered by the variety of natural landscape, numerous objectives (historical, archeological, architectural, socio-cultural), the richness of ethnographic elements, and the presence of spa resorts (Erdeli & Dumitrache, 2010).

Among the points of interest for tourists in Hunedoara may be included: Retezat Național Park, Natural Park Grădiștea Muncelului – Cioclovina, Cheile Crevadiei, Dinosaur Geopark –Țara Hațegului, Huniazilor Castle, Fortress of Deva, resorts Parâng, Straja for wintersports, Densus Church, Gold Museum in Brad, Sarmizegetusa Regia and Ulpia Traiana. Types of tourism in the county are: medical spa in Geoagiu, Călan – Băi and Vata de Jos, rest (practiced throughout the Hunedoara county), leisure tourism, cultural tourism (Deva, Orăștie, Hunedoara, Petroșani), sports tourism (Straja, Lake Cincis) or business tourism (Deva, Geoagiu) (Minciu, 2004).

In 2010, the registered number of tourists was approximately 72.000, while the number of accommodation facilities was 94 (hotels, motels, cottages, villas, hostels) (INS, 2011).

3.METHODOLOGY

In order to highlight the level of accessibility of tourism in Hunedoara, given by the road network, we used our own methodology described in the algorithm from **Fig. 2**. We took into account an overlapping of two categories of factors: network service to major interest points in Hunedoara and the density of points of interest for tourists.

The Accessibility Index given by the Road Network Index (RAI) was initially proposed, calculated and spatially modeled. In the specialty literature, for the road accessibility determination, other indices were calculated, such as: RAODCI (road connectivity index) (Rusu, Man & Moldovan 2013) **–** based on the formula: **RAODCI = RQ + RT + RD –** where **RQ** – the rank and quality of the roads, **RT** – data regarding trafiic, **RD** –the distance to the nearest central place; another alternative of RAI index (Costache, Popescu & Ștefan, 2013, in press), which involves density calculation for each road category and the weighted sum (depending on the classes of the roads) of the densities (RAI = $3.33*\mathbf{D_{DE}} + 2.66*\mathbf{D_{DN}} + 2*\mathbf{D_{DJ}} + 1.33*\mathbf{D_{DC}} + 0.68*\mathbf{D_{DT}}$ - where $\mathbf{D_{DE}}$ - european roads density, $\mathbf{D_{DN}}$ - national roads density, $\mathbf{D_{DJ}}$ - county roads density $\mathbf{D_{DC}}$ - local roads density, $\mathbf{D_{DT}}$ - other categories of roads density).

The choice of determining the RAI Index in this study was based on the the objectivity provided by the calculation of the service area given by the road network from the seven points taken into account (the entrances into Hunedoara from important parts of Romania and the acces form the center of the county), by using Service Area tool in ArcGIS 10.1.

The database used is represented by all categories of roads: European, national, municipal, commune, commune, forest roads. They were taken in vector format, using the European OSGeo.org database. Newly obtained road network for Hunedoara was integrated

in GIS environment and processed using Network Analyst extension from ArcGIS 10.1 software.

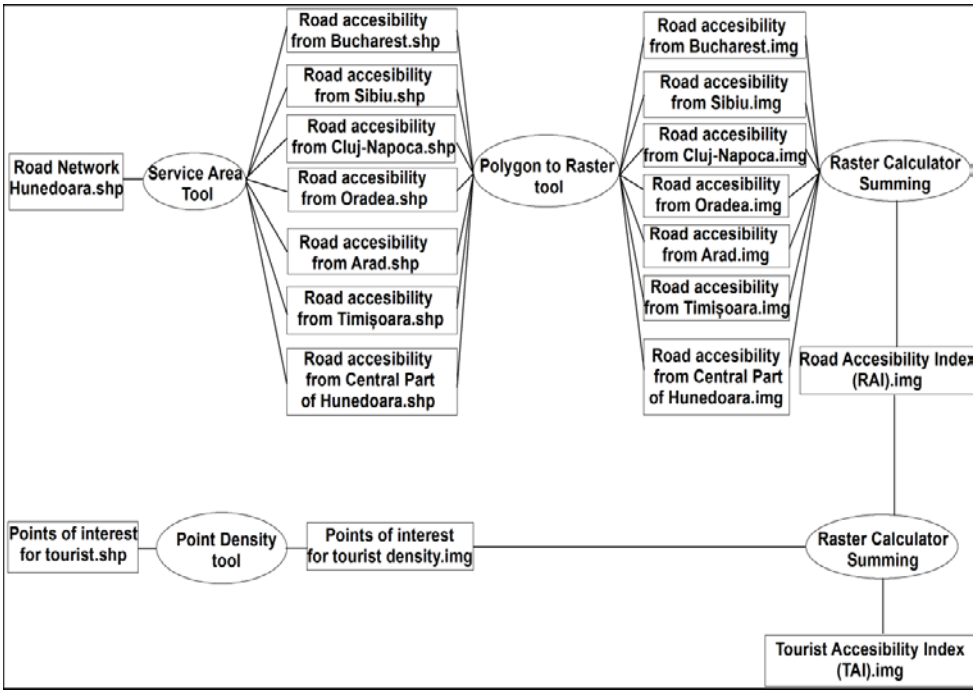

Fig. 2.The algorithm of the computation of Tourist Accessibility Index (TAI)

Thus, from this extension, the Service Area tool was utilized to highlight the level of service given by the roads from the most representative points of access in Hunedoara, but also by the central point (**Fig. 4**). As a result, with the help of Service Area tool, using the points mentioned above, five distance intervals were established (0-20 km, 20-30 km, 30, 40 km, 40-50 km, over 50 km), each interval representing a specific level of accessibility conferred by the road network, starting from the first (0-20 km – very high accessibility) to the last (over 50 km – very low accessibility). After modeling the road network in GIS environment, polygonal areas were obtained representing the areas of service given by roads for the seven points taken into account, with the five levels of accessibility from the distance intervals previously set (**Fig.3, Fig. 4**).

The obtained polygons were converted to raster format with the cell size of 30 m, after which the values of the cells were given bonitation scores from 1 to 5, according to the level of road network, highlighted by each characteristic of the new raster. After obtaining the reclassified rasters, these were summarized by using Raster Calculator tool from ArcGIS 10.1 software.

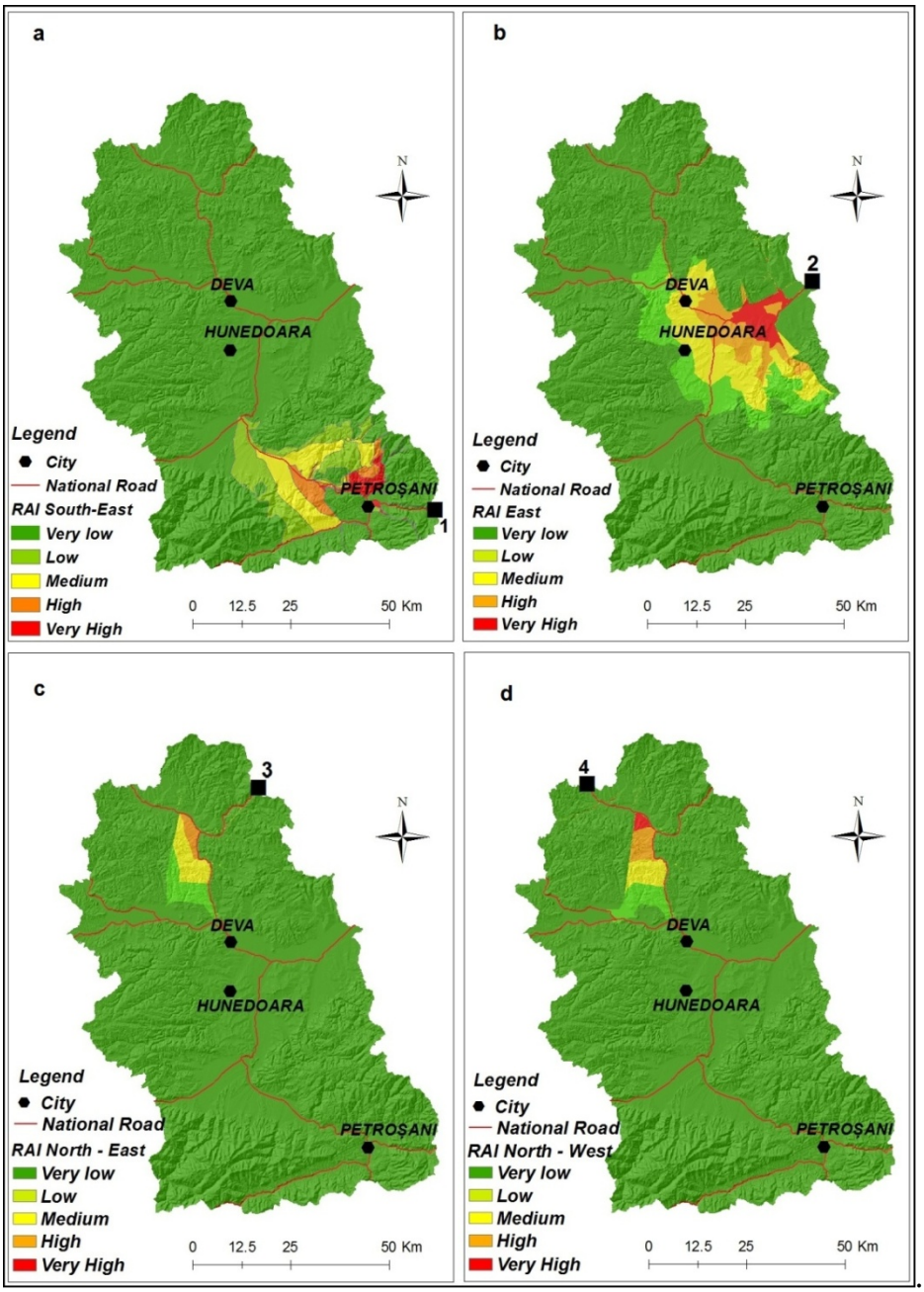

Fig. 3. Road Accessibility Index in Hunedoara from different points of access:
(a) from Bucharest, b) from Sibiu, c) from Cluj-Napoca; d) from Oradea)

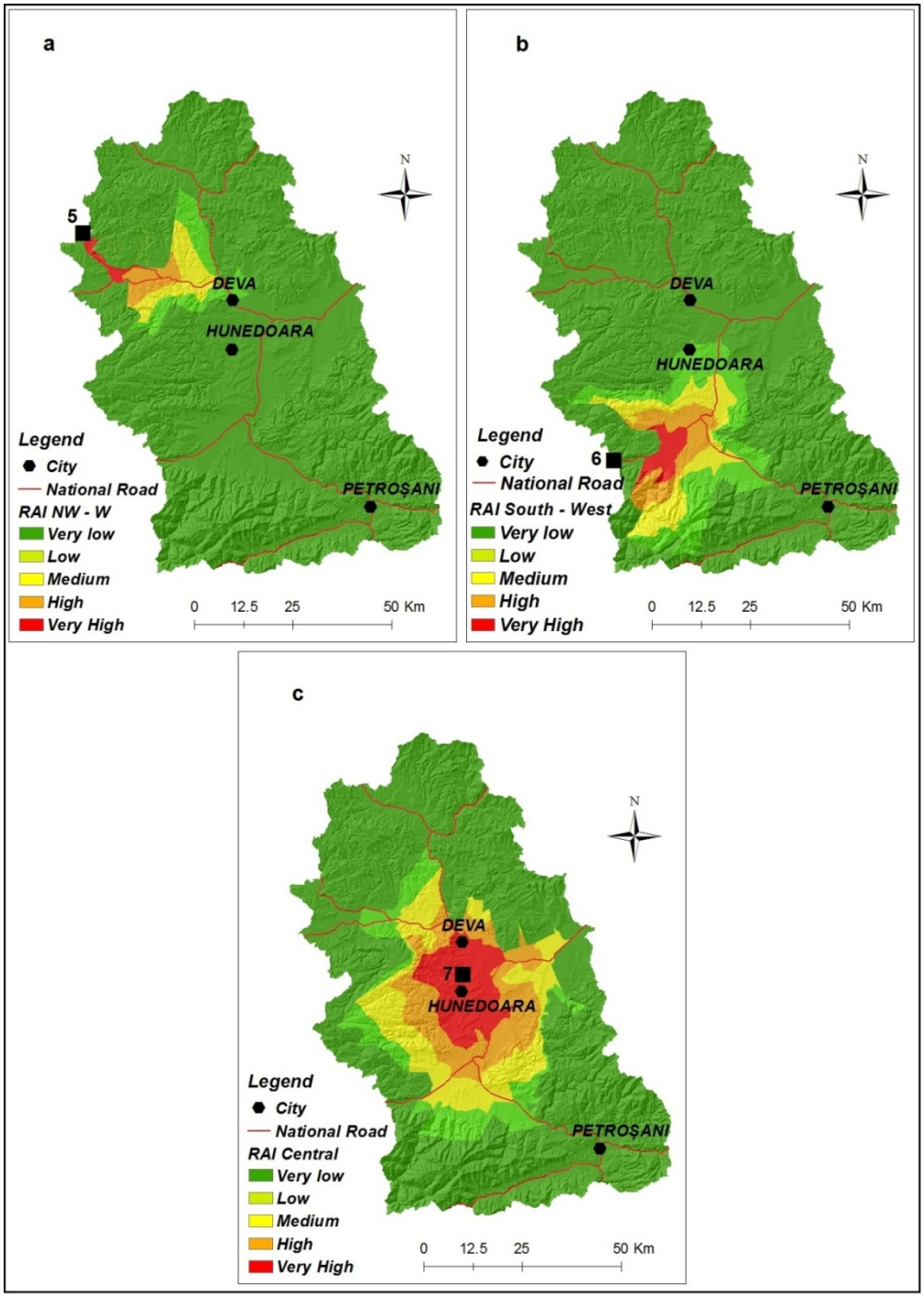

Fig. 4. Road Accessibility Index in Hunedoara from different points of access: **(a) from Arad, b) from Timișoara, c) from the central point of the county)**

Finally, the Road Accessibility Index (RAI) was obtained (**Fig. 5**), with values between 0 and 14.

In the second phase of the study, the touristic level of attractiveness was highlighted. It was obtained by calculating the density of points of interest for tourists, based on the formula: $\boldsymbol{D = P/S}$, where D – points of interest density, P - points of interest, S – area (100 square km). In GIS environment, the density of the points of interest for tourists in Hunedoara county was calculated, by using the Point Density tool in Spatial Analyst extension of ArcGIS 10.1 (**Fig. 6)**. Those points were taken from OSGeo.org database, the same as for the road network.

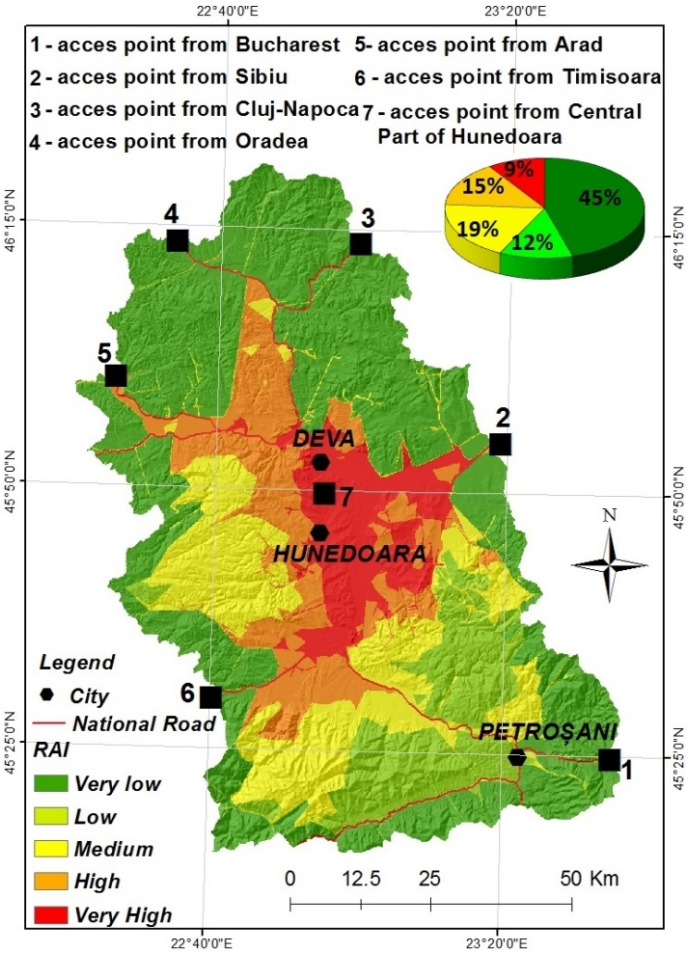

Fig. 5. Road Accessibility Index in Hunedoara (RAI)

The density values for the points of interest, obtained in raster format (**Fig. 6**), were grouped into five classes, receiving bonitation scores from 1 to 5, 1 representing the areas with a very small density, while 5 represents areas with a very high density of points of interest for tourists.

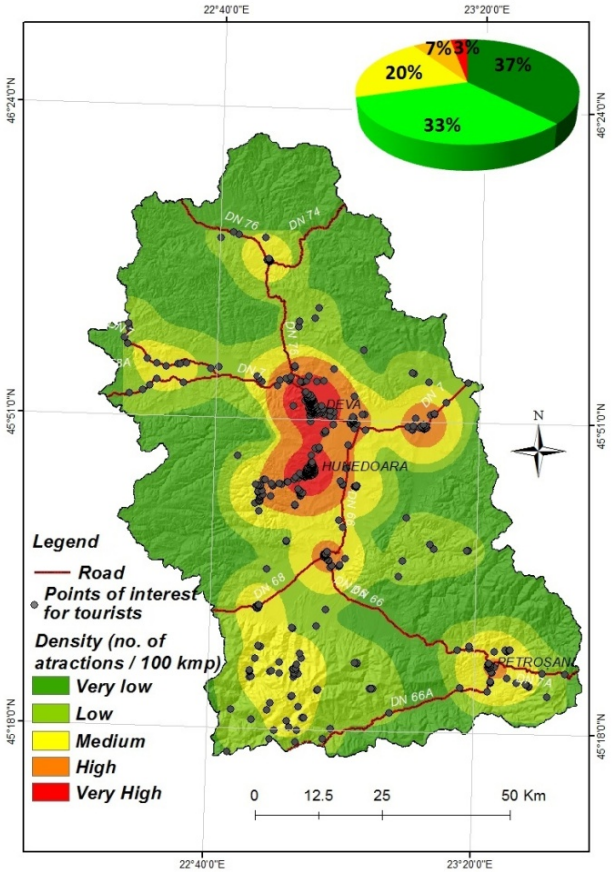

Fig. 6. Points of interest for tourists density in Hunedoara

After the final Index of Density for the points of interest for tourists was reclassified, it was summed with the raster corresponding to Road Accessibility Index, obtaining the Tourist Accessibility Index (TAI). The touristic accessibility index (TAI) for Hunedoara was chosen to be calculated as the sum between road accessibility and density of points of interest for tourists, because the two components are the most important in attracting touristic flows.

Finally, the hierarchization of the most touristic accessible territorial-administrative units from Hunedoara was performed. The *Zonal Statistic* tool of ArcGIS 10.1 was used for the TAI average values computation, for each locality.

4.RESULTS

The Tourist Accessibility Index (TAI) was obtained and spatially modeled by applying the methodology described above, depending on the service given by roads and the density of points of interest (**Fig. 6**). The index values are between 1 and 18. These were grouped into five classes, using Natural Breaks method from ArcGIS 10.1 software.

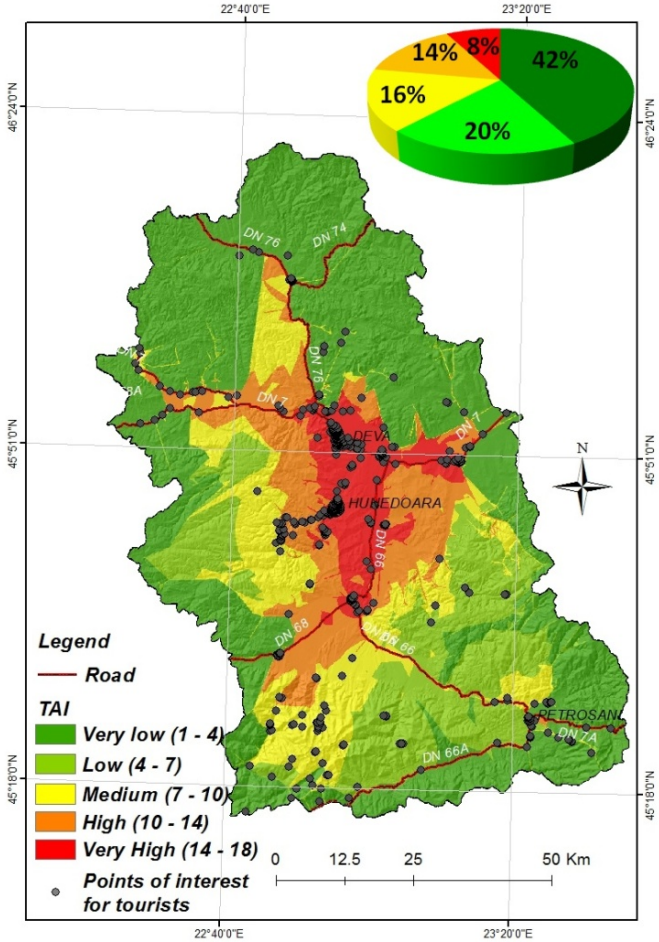

Fig. 7. Tourist Accessibility Index (TAI) for Hunedoara

Thus, the index recorded high values between 14 and 18 in the center of the county, these areas totalizing approximately 8% of Hunedoara county. High values of the index were obtained due to the high level of service given by roads, but also because of the nigh densities of objectives, hotels and other points of interest for tourists. The area includes Deva, Hunedoara, cities with over 55.000 inhabitants, Hațeg, Simeria, Călan and Orăștie. Also, in this part of the county, near Simeria, two European roads traversing Hunedoara intersect. The area contains important objectives, such as Huniazilor Castle and Fortress of Deva, but also Călan-Băi resort or Simeria Dentrological Park.

Average tourist accessibility covers 20% of the county area and it is located in the lowlands and mountain areas (Metaliferi Mountains, Hațeg Depression, Poiana Ruscăi Mountans, Orășiței Valley, Streiului Valley). Among the objectives we find Retezat Național Park or Sarmizegetusa.

TAI with small and very small values occupy the largest share of total county surface, (62%), and contains mainly mountainous areas, and regions with a low road density and less numerous points of interest for tourists.

Jiu Valley recorded a low index due to low road density, but also because of the absence of important objectives in some areas.

In Hunedoara, due to the high density of the road network only in the center of the county and in the important valleys, and numerous points of interest for tourists in the center, the share of small and very small index values exceeds the average, high and very high values (62% vs. 38%).

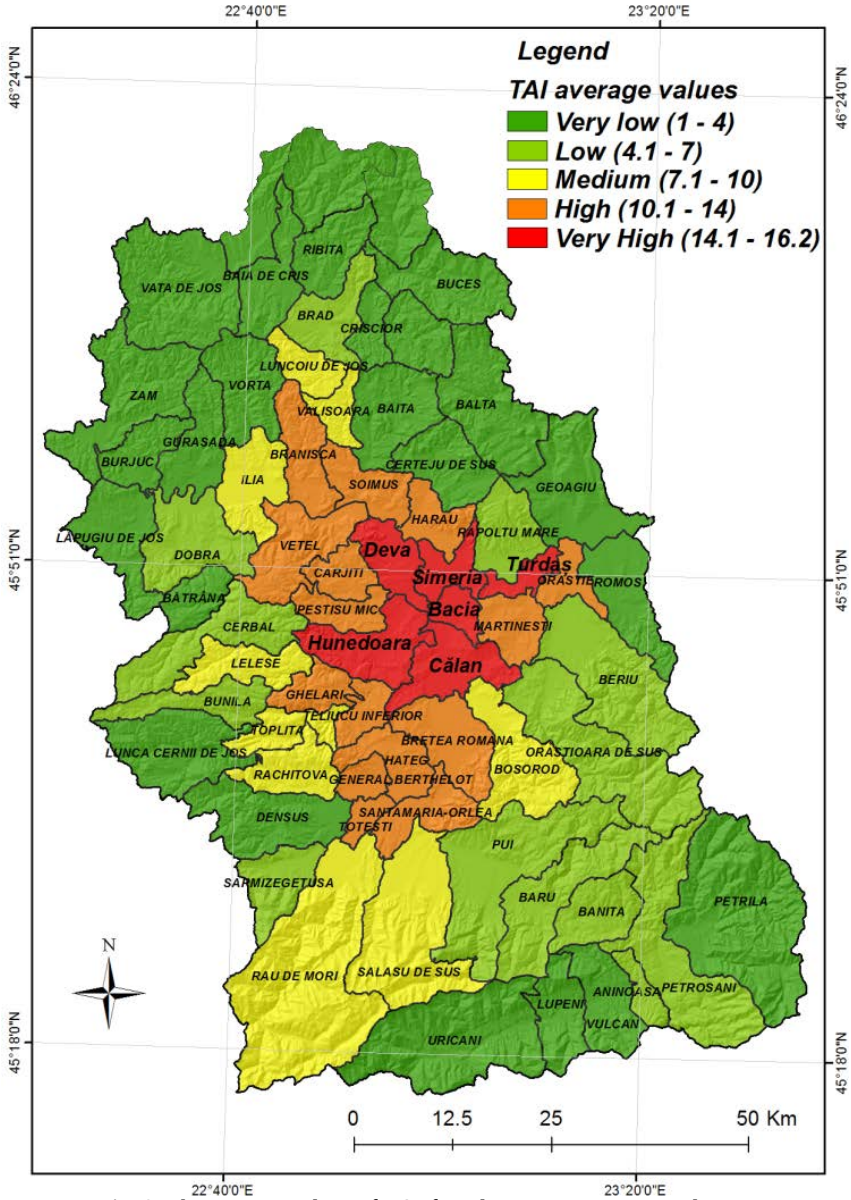

Fig. 8. The average values of TAI for administrative-territorial units

Areas where high values of the index (10-14) were registered (10% of the county's surface) are those surrounding the area with very high values (Mureș Valley, Hațeg Depression, Orăștie Corridor, east of Petroșani Depression, Brad Depression). Here we have high densities of road network, but also important objectives. The points of interest we can find are: Lake Cincis, Sarmizegetusa Ulpia Traiana and Geoagiu Băi resort.

The TAI average repartition within territorial-administrative units, which is shown in **Fig.8**, demonstrates that values exceeding 14 were registered by 6 localities. These are: Bacia, Calan, Deva, Hunedoara, Simeria și Turdas.

All of these territorial-administrative units are generally located in the central part of Hunedoara County, and are characterized by a high density of roads and many points of interest for tourists (**Fig.6**).

5.CONCLUSION

Hunedoara is a county with an important tourism potential, unexploited enough, that requires investing in the infrastructure. Over half the county has reduced tourist accessibility. The cities in the central part have a high accessibility because of the presence of numerous objectives and a high road density, the cities being served by a lot of roads.

The used methodology in this study is one of the most adequate for identifying the areas with a high touristic accessibility in terms of road network. This is due to considering in our analysis two important elements that define the touristic accessibility of a territory, respectively road network and points of interest of tourist. By using *Service Area* tool, the degree of touristic accessibility given by road network was highlighted, for each of the six points of access to Hunedoara County and also from the central point of the county.

Such a study finds application in:

-identifying areas with tourism accessibility for various tourist accommodation structures that can be built (in the vicinity of tourist attractions, on major roads);

-identifying areas with important objectives and limited road infrastructure, finding solutions for investments that can lead to the revitalization of these zones.

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