MEANS OF SPITAL ANALYSIS APPLIED TO ADMINISTRATIVE UNITS IN THE COUNTY OF CLUJ, WITH THE PURPOSE OF IDENTIFYING COMMUNES WHICH MAY BE PART OF THE METROPOLITAN AREA

BY

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Abstract. The study reflects an accessible and objective way of processing and analyzing the contained information in the documentation of urban and regional planning of the County of Cluj in order to obtain a ranking of "capabilities" of the administrative-territorial units, respectively of the central arrangement of the localities. There have been taken into consideration those data which are significant for the studied phenomenon.

As a consequence of the mathematical operations, of the spatial techniques and analysis applied on the database, an appropriate score has been obtained for each administrative-territorial unit. The highest score in an area revealed the existence of a polarizing center – the city of Cluj-Napoca. The scores obtained by the administrative units in the proximity of the poles pointed out the areas of influence.

Key words: GIS, analysis network, administrative-territorial units.

1. Introduction

The county of Cluj is part of the North-West Region (Northern Transylvania), which was created based on the law 151/1998 (as amended through the Law 315/2004) through the voluntary association of local public administrations in the counties of Bihor, Bistriţa-Năsăud, Cluj, Maramureş, Satu-Mare and Sălaj. It is not an administrative-territorial unit and has no legal personality. The constitution of the region represents the premise of shaping a socio-economic functioning system, as an integrant part of the national macro-system.

The objective of the study consists in the application of GIS technologies for the investigation and analysis of the network of settlements in the county of Cluj taking into account the identification of the existing polarizing centers in this area.

Polarizing centers are complex systems with areas of influence commensurate with their stage of development. The plans of development drawn up for the micro regions they belong to, must take into consideration the social, cultural, educational, economic progress, the protection and conservation of the values of the archaeological sites and historical monuments, the environmental protection including appropriate plans and measures for the protection of the population and assets against natural risks etc.

In order to identify the polarizing centers in the county we should consider its integration in the system of the North-West Region and to take into account many elements of analysis, such as: the geographical location of settlements, their distribution in the territory according to the main forms of relief, the position towards the main means of communication, the quality of living, the supply facilities, habitable areas, green spaces, housing equipment, the quality of drinking water etc.

To achieve the purposed objective, the following should be established:

a) the election of the entry data and their synthesizing so that they can reflect the analysis of some phenomena, which occur frequently on domains, at county level,

b) the selection of the assessment procedure for domains as well as for the entire process,

c) the application of some operations, methods, techniques and analysis using GIS technology on data, in order to obtain possible polarizing centers and their areas of influence,

d) the establishment of the database and the development of informatics thematic applications.

Outspread on an area of 6674.4 km ^{2}, Cluj represents 2.8% of the country and occupies the 13th place among the counties in the country, regarding the size. It is situated at the contact of three natural representative units, the Apuseni Mountains, the Someş Plateau and the Plain of Transylvania. One of the important elements in the analysis of the network of settlements is relief. From this point of view, the county of Cluj falls within the administrative units of the country with resources above average.

The systemic function of the North-West Region relies on a network of cities constituted mainly of small and medium-sized cities, which can ensure, through the diversity of their functions, the balance of the territory. Small and medium-sized cities in the region, point out, with insignificant exceptions (Turda – Campia-Turzii, Gherla-Dej) a dissipated currency, which gives them benefits in terms of the outlining of an area of its own polarization. Urban hierarchy has at its top the city of Cluj-Napoca, with economic, cultural and scientific advantages uncontested in the region.

2. The Single Layer Model

The database was built through vectorising of the topographic maps of the county of Cluj scale 1:100.000, in projection map WGS84 UTM Zone. Layers have been constructed containing overall data corresponding to the studied areas. Alphanumeric data used in this study derive out of the documentations of urban and regional planning existing at the Department of Urban and Territorial Planning (GIS) of Cluj County Council, updated in the light of possibilities, with information from the Regional Department of Statistics Cluj.

From the analysis of the types of data it has been noticed that they generally refer to a territorial limit of a commune or to certain areas with custom extension. Thus, for structuring the database the main goal was the obtaining of two types of layers, one with global values on the administrative-territorial division of the commune and the other with totalizing values on each custom area representing a given field.

Thematic layers were created in conformity with the pursued phenomenon, for the analysis of the territory of the county: the distribution of population, its density, the migration of labor, the level of education, the endowment with educational establishments and specialized teachers, the endowment with health units and specialized staff , the location of archaeological sites and architectural monuments, the ensuring with utilities of the settlements, the location of natural protected areas, areas of natural risk, the state of viability etc.

The method of summing the scores obtained on the fields was applied for the global assessment. There were three methods for granting scores on the fields. They were chosen so as to distort as little as possible the final result. The first method consisted of granting a score directly proportional to the value obtained. Through the following method, based on the "rule of three" the score has been settled. The third method was applied for example, for the data that relate to the migration of labor. Thus, the value taken into account was positive or negative as the labor force was drawn or not, in the administrative territorial unit.

For example, in a vector type layer under Fig. 1, were concentrated the information on zoning the territory according to the temporary migration of the population, the cultural, educational, architectural and historical value of the area and taking account of the existing facilities. The score given to each area reflects its complexity.

In Fig. 2 is the table with the score for each area of the County of Cluj, according to her profile.

From The Plan for Development of the County of Cluj for the years 2007–2013, drawn up by the "CIVITAS" Foundation Cluj, the Center for Public Policy and a numerous staff of Cluj County Council has taken the index of

development of agriculture and the index for the global development of the economy on the administrative and territorial unit. Separate layers have been constructed, classified according to their degree of development: very small, small, medium, high, very high, maximum. Each class was given a proportionately score.
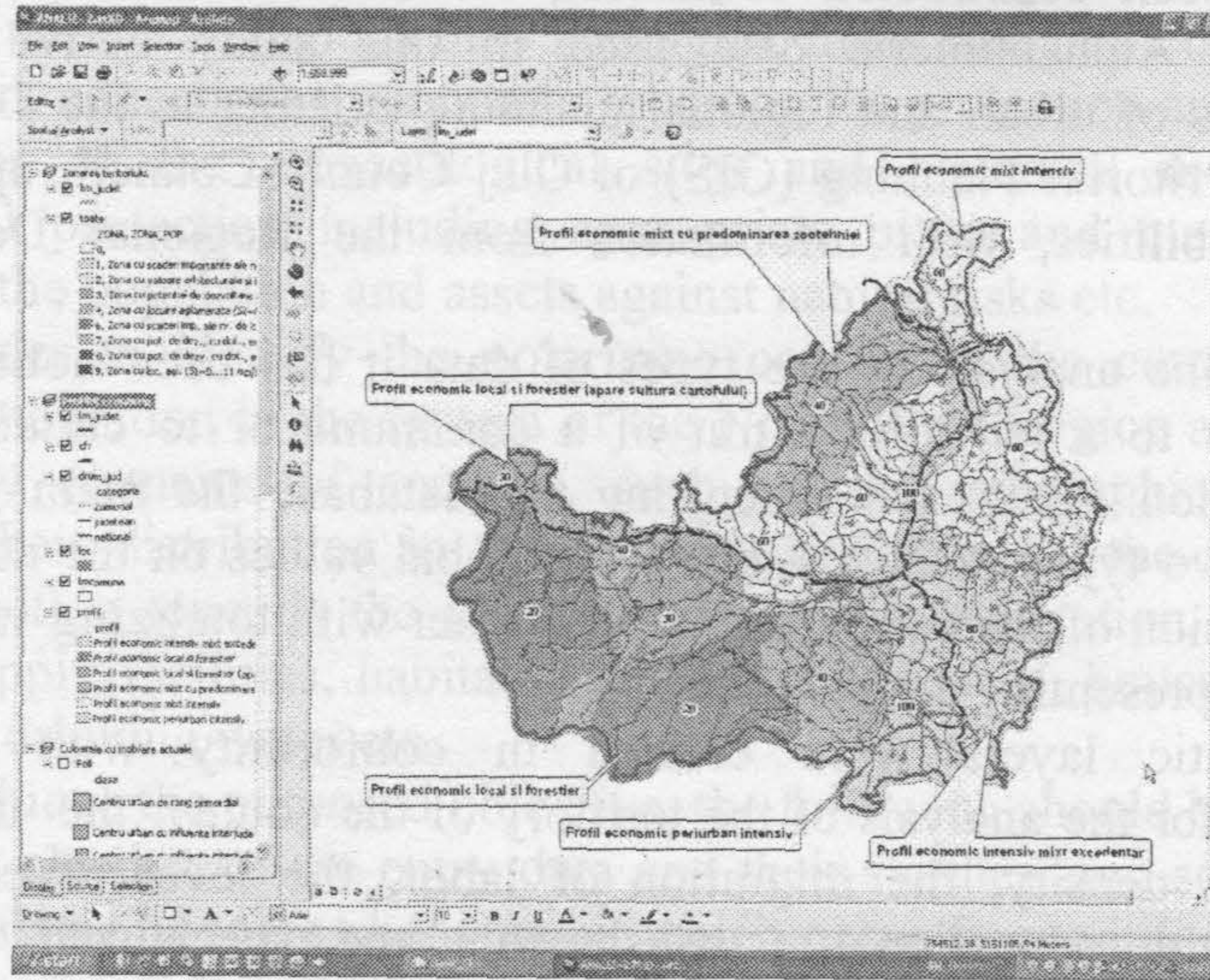

Fig. 1 – Zoning of the county territory.

Fig. 2 – The maximum points given to the economic profile
within the county.

The functional region (polarized) is defined by the system of relationships established between a center of polarization and the points, the settlements polarized by it. North-West Region is a region with multiple nodes because of the polarization centers with upper rank. These nodal centers are being determined by empirical analysis as well as the development axes connecting the various centers. These centers have polarized functional spaces which are equivalent to the areas of influence. Functional relationships are very fluctuating.

The analysis of the relationships between the regional polarizing center and his sphere of influence allows the establishment of the settlements

polarization, the spatial hierarchy which results from different degrees of centralization of the settlements. This analysis must be permanently evaluated due to the changes that occur in space processes.

In The Land Planning Draft of the North-West Region "The network of settlements has been studied in the light of density in the territory, the size and degree of polarization. Contrasting aspects were found between the settlements in the mountain area (with lower density) and those from corridors of the valley or plateau where the index increases. The range of variation of the parameters is extremely large due to implication of other historical, economical or social factors."

This documentation was developed in 2003 by a multidisciplinary team of specialists from the Babes-Bolyai University, the Faculty of Geography. As it results out of this documentation, *11 categories of influence centers* were put in evidence in the North-West region, some of them with urban character and other with rural character. In accordance with this documentation, Cluj-Napoca occupies the second rank in the national hierarchy as a potential of polarization, after the capital city, his influence being manifested over the whole space of Transylvania. It occupies the first place in the region, in the urban hierarchy.

Due to the evolutional transformation and in order to take into consideration the new trends in regional planning which tend to align with those of the European Community, there may be restricted 4 categories of polarizing centers in the North-West:

1. Centers of regional importance;
2. Balanced role centers in the development of the region;
3. Inter-communal centers;
4. Communal Centers.

The centrality attributed to a polarizing element relates to the property, its quality of possessing an overflow of functions in the area and does not refer to its geographical location. This cannot be measured, but it can be established only on the basis of analysis of indicators made on the basis of rules of calculation.

Based on the analysis of the strategic options for the development of the North-West Region has made an option for a model of *polycentric development* (a development policy sustained by a network of localities with roles of development poles), focused on economical growth through functional specialization of the territory.

In the polycentric development has occurred, thus, the need to strengthen the potential for training of the county's residence, as well as the need to strengthen and/or increase the potential training of a minimum of other cities, which by the end of 2013 can be classified in a rank above the current one. Their development must take into account, especially of the functional and sectional specialization of the territories in the area of influence.

"In the Regional Development of North-West, nine main categories of axes of development are outlined, being grouped into three ranks", according to

Land Planning Draft of the North-West Region. In Fig. 3 are presented for the county of Cluj the axes of development.

The axis of development Oradea - Cluj-Napoca (Ib) is the main area for flows of goods, raw materials and passengers and the main vector of cross-border connections. This axis connects the main poles of development, the cities of Cluj-Napoca and Oradea.

The axes of development of second rank develop along Someşul Mic, between Cluj-Napoca and Dej, on Someşul Mare, between Dej and Satu Mare, on Someş, carrying on with Şieu and Bistriţa, between the municipalities of Dej and Bistriţa. At the same rank, but of a lower class (Ic) falls the axis of development Cluj-Napoca – Zalău – Satu Mare, with the leak to Marghita – Valea lui Mihai.

The axes of development of the third rank penetrate the peripheral sectors at the regional level. They are developing along the railways and the modernized roads, but they have a lower intensity of traffic because of the barriers imposed by the forms of relief.

The class b, from the same rank (3), consists out of the modernized roads in the county, such as the axis of the median section from Plain of Transylvania, Someş Plateau and the eastern sector of the Plopiş Mountains. Axes of rank III, class c, are those of Suplaiului Hills, from the eastern part of the Transylvanian Plain and the Sălaj Hills.
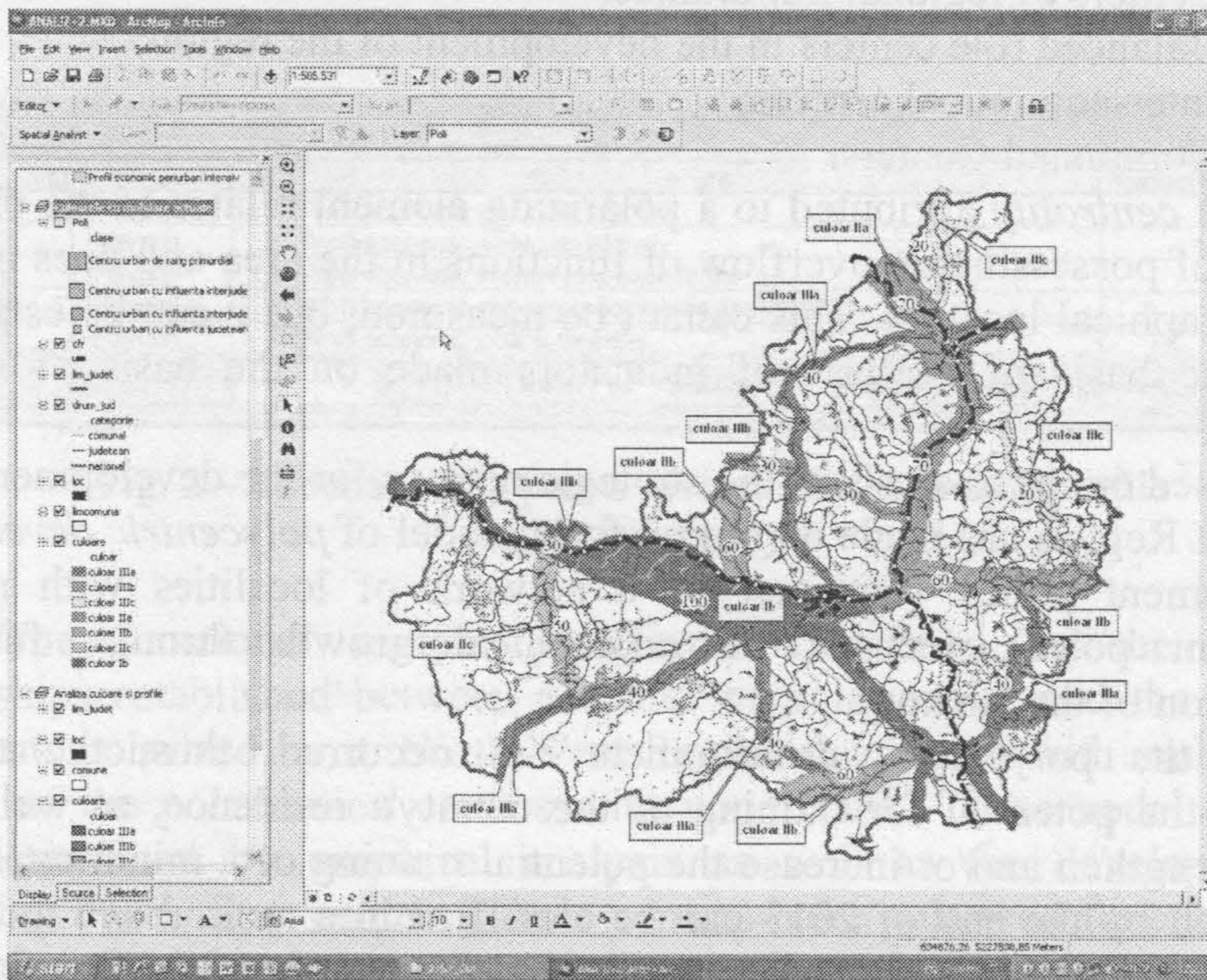

Fig. 3 – The corridors of development in the county of Cluj.

The values are directly proportional with the importance of the rank attributed by experts (Fig. 4).

	FID	Shape *	Id	etapa	culoar	punctaj
▶	0	Polygon	0	dezvoltare actuala	culoar Ib	100
	1	Polygon	0	dezvoltare actuala	culoar IIa	70
	2	Polygon	0	dezvoltare actuala	culoar IIb	60
	3	Polygon	0	dezvoltare actuala	culoar IIa	70
	4	Polygon	0	dezvoltareactuala	culoar IIb	60
	5	Polygon	0	dezvoltare actuala	culoar IIc	50

Fig. 4 – Scoring for the corridors of development.

The layers resulted from final tests on the domains were managed with the help of two thematic applications. Of those listed above one could see that some partial scores allocated to the studied phenomena refer to an administrative-territorial area and others to areas with different shapes. By applying the mathematical map overlay, a prior step has been made for the final analysis where we obtained a layer with scores that relate to the administrative-territorial unit and a layer containing the scores given to various areas of different shapes resulting from overlay (Fig. 5).

A layer was created with final scores derived from the algebraic addition of partial scores. It was properly classified and displayed according to the values. A thematic application was created through which totalizing operations had been made. The addition of partial scores for each object (administrative-territorial unit or area) was achieved with the help function "Field Calculator" available in the ArcView 9.1.
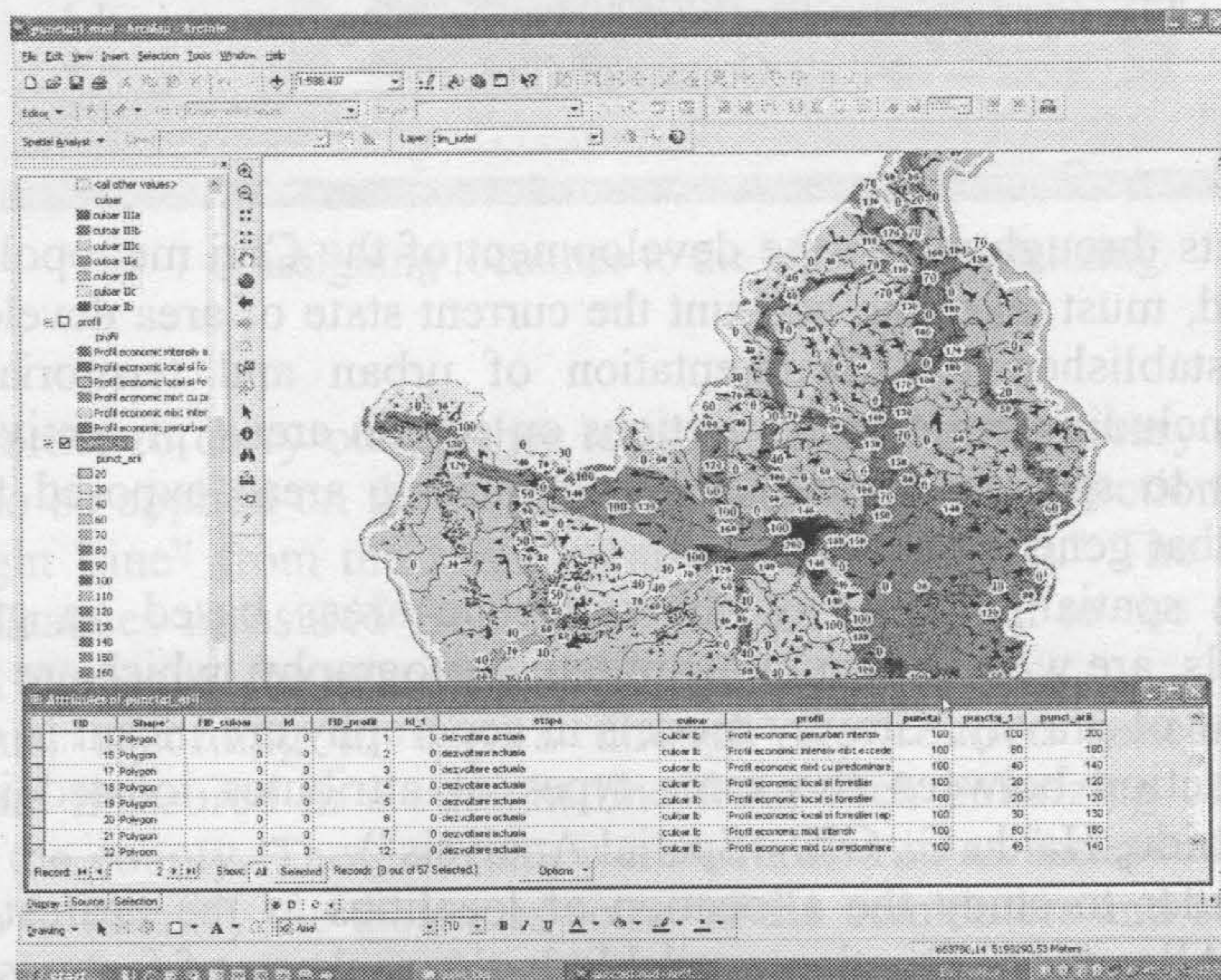

Fig. 5 – Scores obtained for each area of interest.

On the above shown map are being particularly highlighted those areas which have been endowed along the analysis with a higher score. Operations, techniques and analysis made on phenomena by using GIS technology, have led to the identification of the four categories of polarizing centers existing in the county of Cluj (Fig. 6).
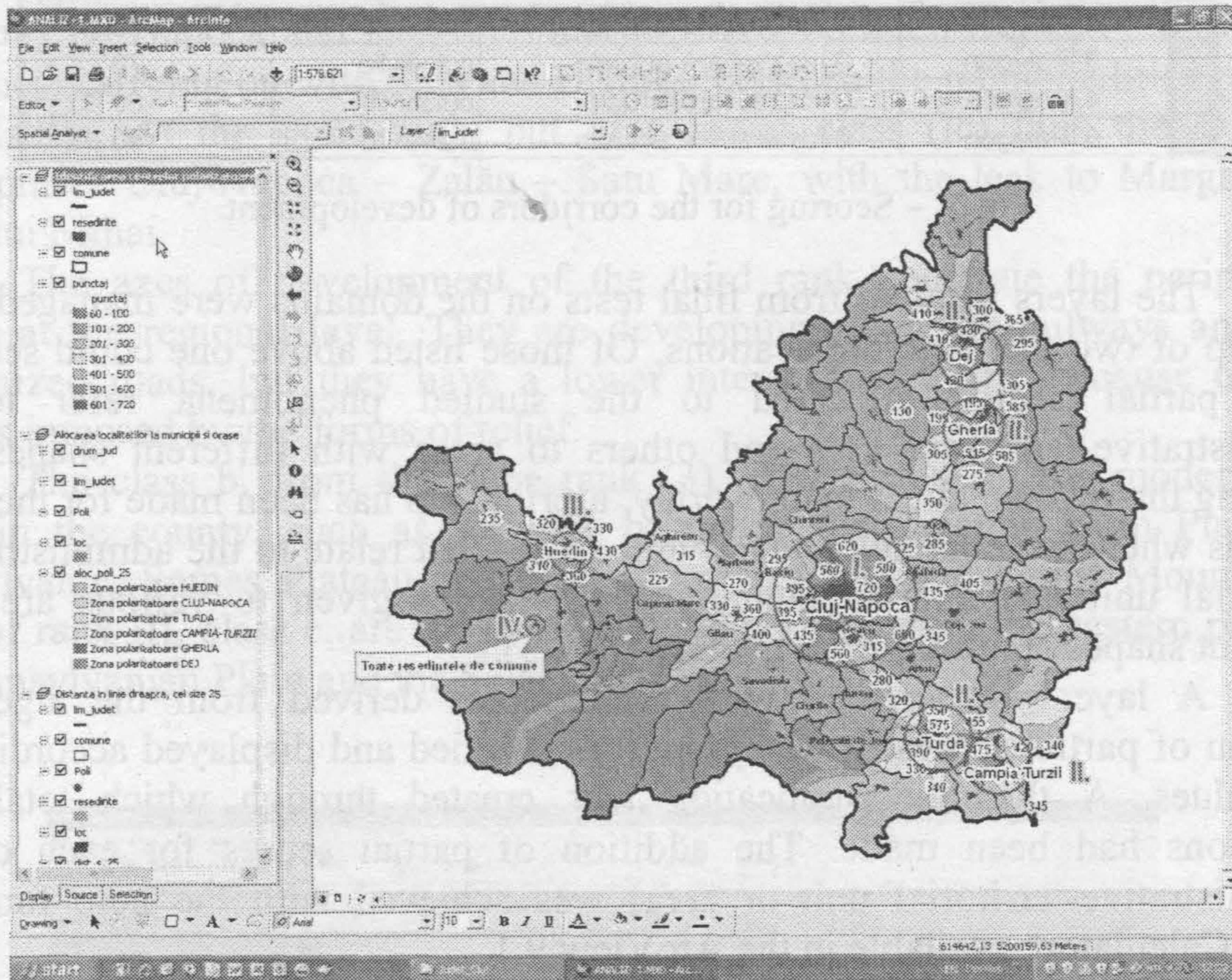

Fig. 6 – The identification of the polarizing centers in the County of Cluj.

Projects through which the development of the Cluj metropolitan area is being studied, must take into account the current state of area development, all the rules established by documentation of urban and territorial planning developed, including building restrictions on certain areas, protective measures which apply to specific targets or whole places, areas exposed to physical phenomena that generate natural risks.

"The spatial analysis of the influence areas based on gravitational family models, are well-known in quantitative geography, which are inspired by Newton's law of gravity. Gravity models in geography are meant to express the spatial interaction between the same types of attributes located in different places "(I. Haidu, Haidu C., GIS - Spatial Analysis").

In order to study the allocation of localities to the nearest polarizing center, the "Allocation" function available in the package of features for spatial analysis "Spatial Analyst" in the ArcView 9.1., was used.

This operation has been applied on the punctiform layer, specially created for the representation of polarizing centers identified above. "The size of an influence area is defined by the attractivity or the influence that each point detains in the Layer (I. Haidu, Haidu C. "GIS - Spatial Analysis"). The system allocates the cells from raster to the nearest source. Thus, the allocation function identifies with mathematical precision, for each cell which is the nearest polarizing center, in a straight line.

Optionally one can specify a maximum distance to which the search is running. The cells outside the distance will not be taken into account or will receive a No Data value. If this parameter is not specified, then there will be no deadline to which the distance can be measured. In Fig. 7 is presented the outcome.
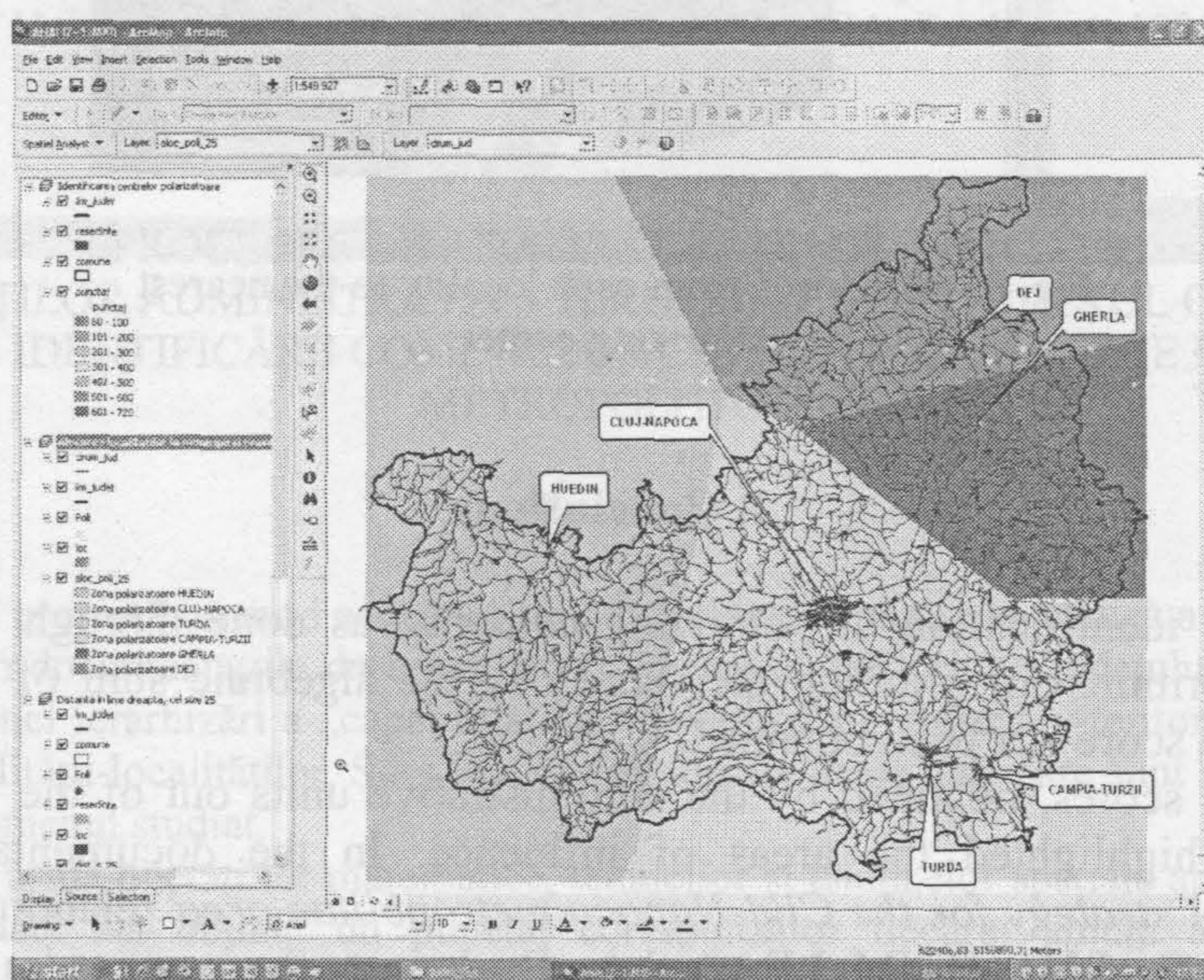

Fig. 7 – Assigning localities to the identified polarizing.

In order to carry out further tests, such as the temporary migration of labor, are to be applied on the same punctiform layer the functions "Distance" and "Straight Line" from the same menu "Spatial Analyst." The output raster contains distances measured from the center of each cell to the center of the cell, which represents the nearest source.

Thus, according to Fig. 8 through the colored concentric circles, distances are measured in a straight line from each polarizing center to each locality in the county. These results were obtained in an independent thematic application to identify the distances some of the commuters and some students have to cover from the place of residence to the localities where work or study (polarizing centers).

In both cases presented above, Euclidian distances are measured, in units of measure in which the map is being displayed on the screen.
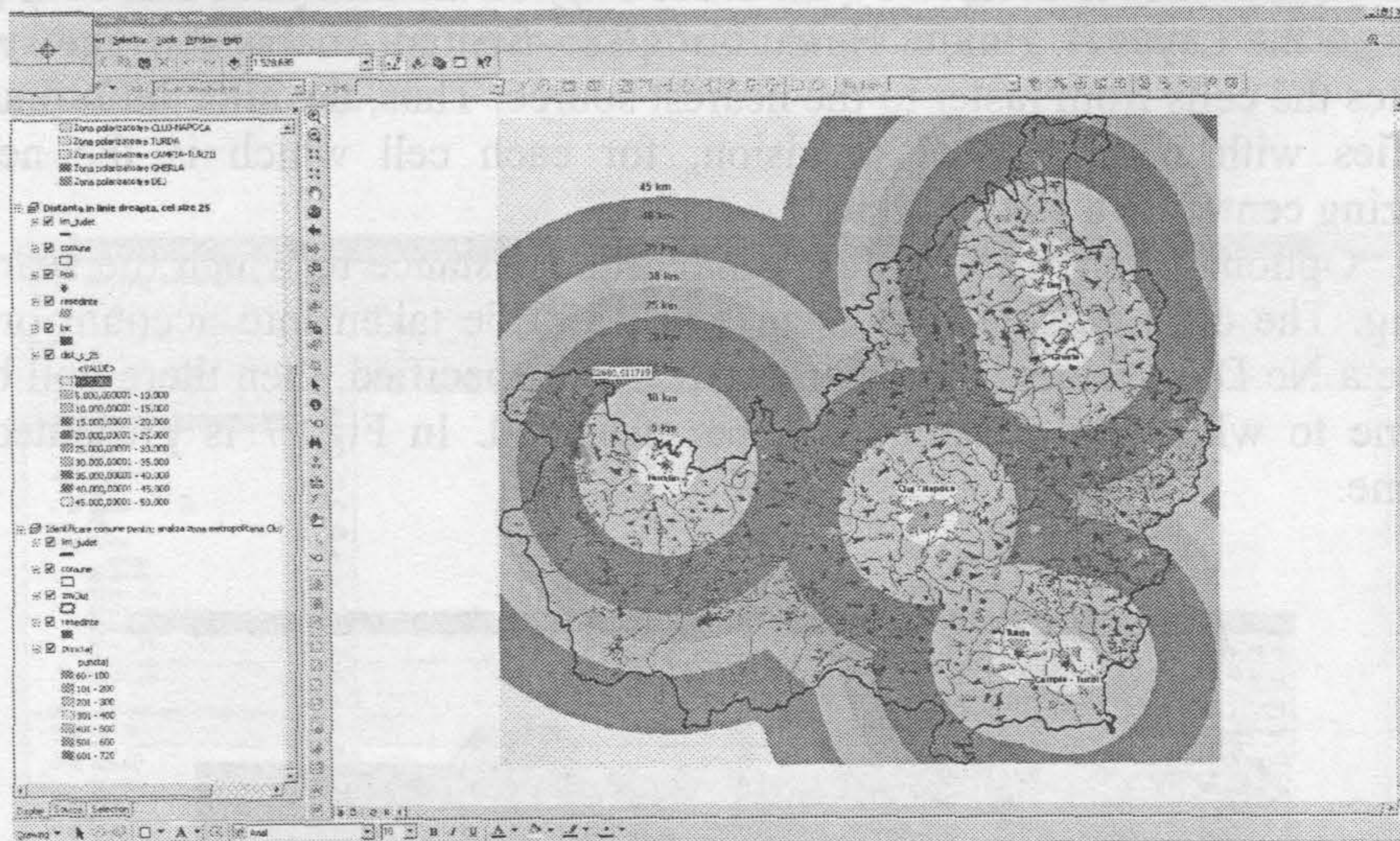

Fig. 8 – Distances from each locality to the nearest
polarizing center.

3. Conclusions

The identification of polarizing centers was done through the use of simple algorithms for granting the score. By the algebraic sum of the partial scores, final score has been obtained.

The scores, obtained by the administrative units out of the vicinity of the poles, highlighted the areas of influence. In the documentation "*The development strategy for the Cluj-Napoca metropolitan area*" elaborated by the company S.C. QUANTUM LEAP S.A. Bucharest, the same administrative-territorial units were bounded to take part in the influence area of the first rank pole – the city of Cluj-Napoca.

The mathematical modeling of the analysis processes helps and supports the classical work of analysis of the experts, but it cannot replace it. The mathematical results carried out on the data are rigorous, without human influence, but we should not forget that the computer modeling process depends on the professional performance of the one who perform it.

The presented study is a modest example of analysis which may be performed with geographical information systems and was conducted in order to find an accessible mathematical support for classical analysis. In particular, the work was carried out so as, to incite and to prove to experts in the field of urban and territorial planning that the thoroughgoing study of the computer science is not necessary so that in the current activity they can be assisted by a geographic information system.

This simple procedure of granting scores was designed for the particular case of the county of Cluj. It can be applied to other territories as well, but of course that a complete analysis is required because, certainly there are particular developments of the phenomena in those areas.

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REFERENCES

1. * * * The Land Planning Draft of the North-West Region. Babes-Bolyai University, Cluj-Napoca, Faculty of Geography, 2000-2003.
2. * * * The Plan for Development of the County of Cluj for years 2007-2013"CIVITAS" Foundation Cluj, the Center for Public Policy, Cluj County Council, 2005.
3. Haidu I., Haidu C., *S.I.G. - Spatial Analysis,* Publ. HGA, Bucharest, 1998.

PROCEDEE DE ANALIZĂ SPAŢIALĂ APLICATE
UNITĂŢILOR ADMINISTRATIV - TERITORIALE DIN JUDEŢUL CLUJ, CU
SCOPUL IDENTIFICĂRII COMUNELOR CARE POT FACE PARTE DIN ZONA
METROPOLITANĂ

(Rezumat)

Se prezintă un mod accesibil şi obiectiv de prelucrare şi analiză a informaţiilor conţinute în documentaţiile de urbanism şi amenajare teritoriului judeţului Cluj pentru obţinerea unei ierarhizări a „capabilităţilor" unităţilor administrativ-teritoriale, respectiv a centralităţii localităţilor. S-au luat în considerare acele date care sunt semnificative pentru fenomenul studiat.

În urma operaţiilor matematice, tehnicilor şi analizelor spaţiale aplicate asupra bazei de date s-a obţinut un punctaj corespunzător fiecărei unităţi administrativ-teritoriale. Punctajul cel mai mare dintr-o zonă a evidenţiat existenţa unui centru polarizator – municipiul Cluj-Napoca. Punctajele obţinute de către unităţile administrative din vecinătatea polilor au pus în evidenţă ariile de influenţă.