

A PRACTICAL METHODOLOGY FOR THE DETERMINATION OF DENSITY AND DEPTHS INDICATORS IN THE HABITAT FRAGMENTATION CAUSED BY GEOPROCESSING

*Tudor BORŞAN, Assoc. Prof. Dr. Eng., „1 Decembrie 1918” University of Alba Iulia,
Romania, borsant@yahoo.com*

*Ionuț MAICAN, PhD. Eng., “Transilvania” University of Brașov, Romania,
mionu77@gmail.com*

Abstract: The present paper proposes a methodology consisting of a guide for the capitalisation of analytical principles that offer quantitative valences to the habitat by using the geoprocessing functions of GIS. The analysis is based on a complex of processes and operations performed in toolsets and leading to the determination of specific coefficients of the density and depth of habitat fragmentation.

Keywords: Geomatics, Geomorphology, Geoprocessing, Horizontal and Vertical Fragmentation, Gridding, Overlay

1. Introduction

We will use for the illustration of the morphometrical indicators a cartographic base consisting of the permanent and temporary hydrographic networks in the area and the contouring entities that can generate elevation numerical models (level curves and ground reference points). The cartographic products from the processes present a large theoretical and practical applicability; their parameters can be useful in several direction of the quantitative and qualitative analysis of the landforms.

2. Theoretical Aspects

The horizontal fragmentation represents the discontinuity degree of the morphological surfaces in a region on a horizontal plan. It appears as a result of the modelling and compartmentalisation of the land under the action of exogenous factors and it can be observed in the field in the forms of alternance between valleys and interfluvial spaces. The frequency of alternations is in direct relation with the horizontal habitat fragmentation. The determination of this morphometric factor requires the calculation of the ratio between the total length of the permanent and temporary water network and the surface unit.

The habitat fragmentation depths (the habitat energy, the vertical fragmentation intensity, the relative height or altitude, and the difference or distance to the thalweg) is generated by streams and represents the intensity or depth to which the vertical erosion manifests. The fragmentation depths coefficient relates to a general basic level (sea level) or to a local level (the streams thalwegs or the lake basins). This also shows the equivalence between the fragmentation depths and the absolute height, for the second case. The values of the morphometric factor are in indirect relation with the differences between the absolute height and the relative height, indicating that the habitat is intensely vertically fragmented, because the erosion bases deepened very much in relation with the confluence line. The value

of the fragmentation depth is calculated as the difference between the maximum height and the minimum height and is expressed in m/km² or m/ha.

3. The Habitat Fragmentation Density and Depth

To represent these indicators, we created a grid structure, with square cells of 1000x1000m, on the existing model offered by the presence of the surface water for the fragmentation density (vector model) and on the elevation model for the fragmentation depth (raster model). In case we had not used this type of model, we would have needed to mark the maximum and minimum values of the coordinates in the area of interest.

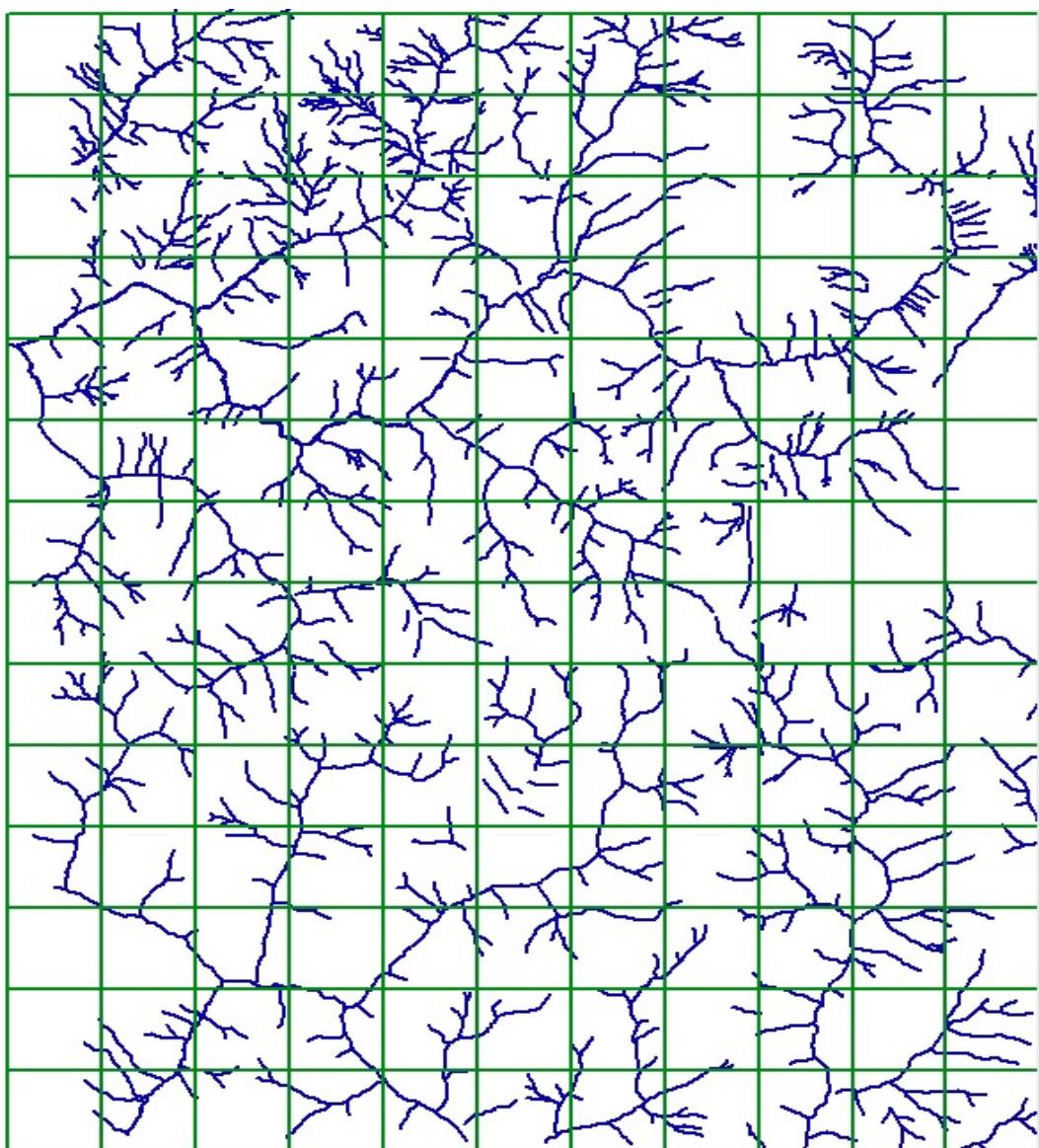


Fig. 1 The application of the linear grid network on the permanent and temporary hydrographic network

The network was created on a linear vector. To encapsulate other objects from the category of lines, points or polygons, functioning based on a unique ID, it is necessary to convert the linear grid in a polygonal grid. The aim is to offer an inclusive character to the spatially covered structures, for which are responsible the polygons generated through

conversion. The function “Intersect” in the subset Overlay finds its applicability on one hand in the relation between the attribute tables of the two layers and, on the other hand, in creating breaks of the entities inscribed at the intersection with the module squares of the grid. It is absolutely necessary to recalculate the value of the entities (lengths or surfaces) that were intersected and interrupted by each module square; therefore, a new evaluation will highlight the frequency of occurrence in the squares.

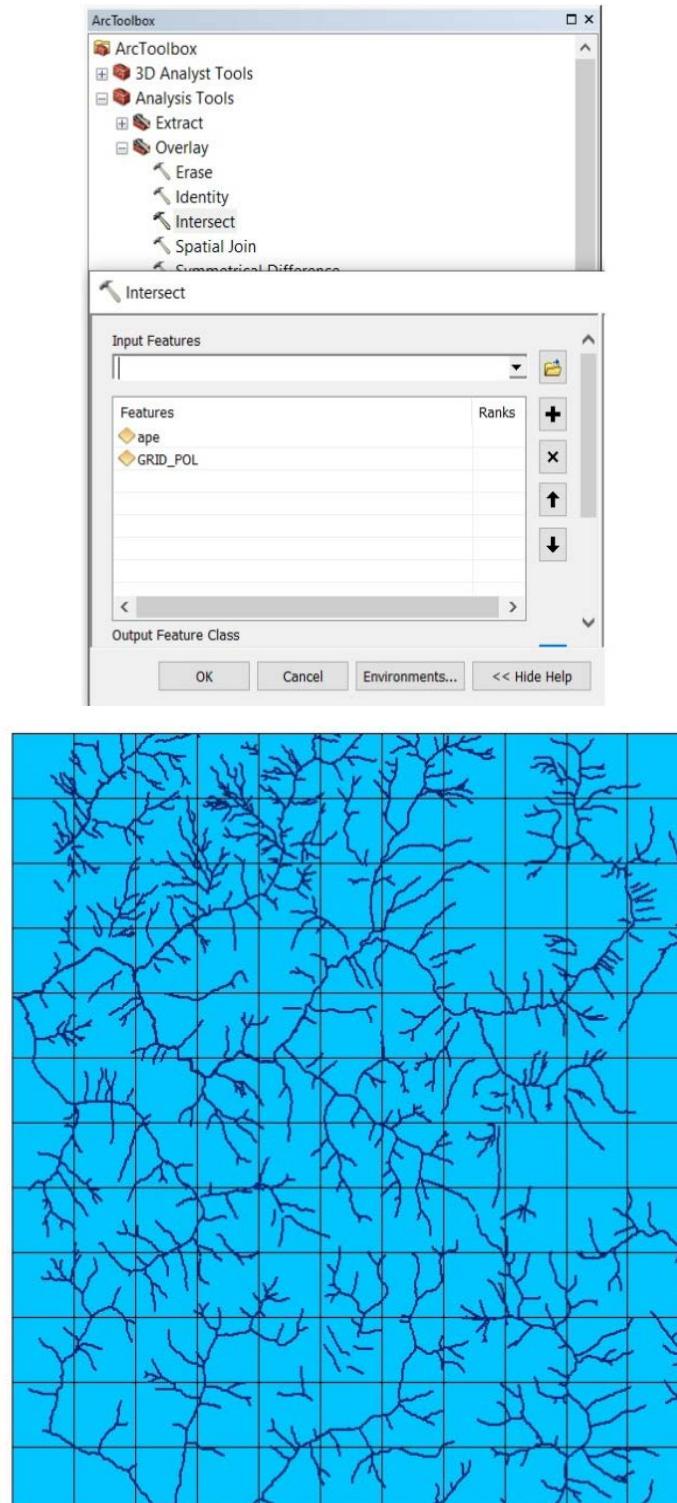


Fig. 2 The intersection of the water with the grid structure

This aspect can be achieved by using a static summarizing function which allows a summarizing of the lengths/ surfaces of the entities/ module squares and shows, in the same time, their number.

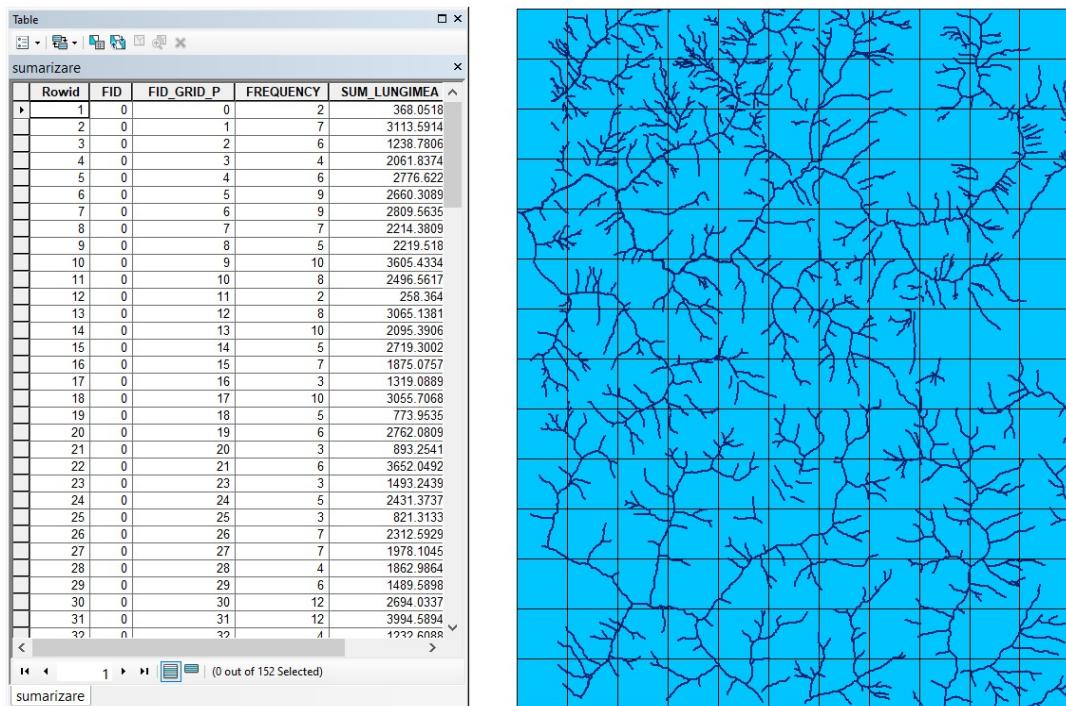


Fig. 3 The generation of the summarizing indicator

To materialize the summarization of the length/ surfaces of the entities, a connection between the polygonal grid and the statistic table is created by using a primary key represented by unique identifiers. All the setting from the statistic table applies to the layer possessing the spatial structure.

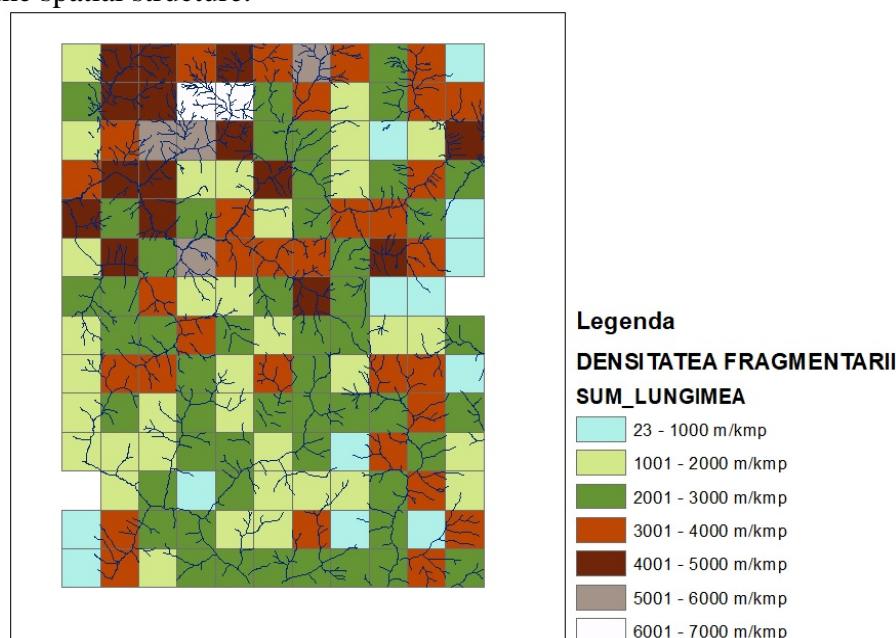


Fig. 4 The calculation of the habitat fragmentation density

The calculation of the habitat energy requires to establish the difference between the altitudes on a specific surface, using grids, sliding windows (for digital raster formats) or hydrographic basins. The procedural stages are the same, but the model consists of a composite raster, resulting from the conversion TIN to Raster. The application of the Overlay function for spatial intersection requires the reconversion of the raster in a polygonal vectorial structure. To obtain the vertical differences in the grid, we use the same summarizing static functions; the affected field contains the absolute cotes inscribable in the grid squares. The statistics illustrates the maximum difference (RANGE).

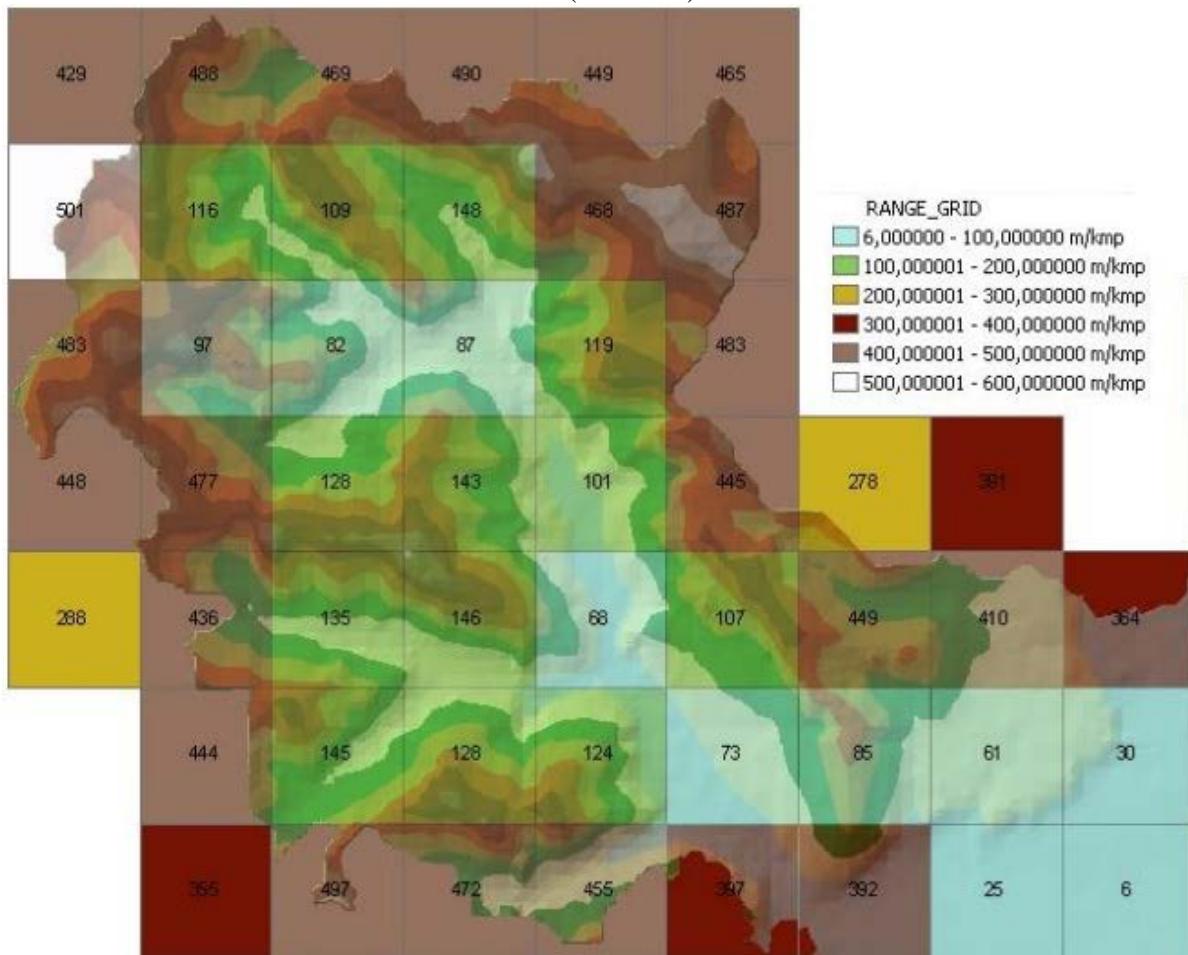


Fig. 5 The calculation of the habitat fragmentation depth

4. Conclusions

It is very important to know the horizontal and the vertical fragmentation of the habitat in various areas, for the agricultural and forest lands to be economically capitalized to their real potential, as well as for the emplacement of the communication paths and localities. The study of the horizontal fragmentation of the agricultural lands aims to establish which land presents a low level of fragmentation, offering good accessibility and operativity for the machines and equipment, and which land presents a higher fragmentation level and requires anti-erosive works. The second category includes the lands placed in morpho-hydrographic basins, permanently developing their reception area through torrential formations.

In the same time, knowing the dynamics of the habitat fragmentation depth creates the possibility to take appropriate measures by stopping the damaging phenomena that are naturally or anthropically created – e.g. stabilizing the areas affected by landslide. Because

the agricultural land usually overlays the morpho-hydrographic basins, for a better performance of the agricultural works, we need to study the habitat energy, as well as the ground profile and the potential factors for the washing and accelerated recession of its horizons. Practically, the study of the influence of this factor on the natural components of the geographic habitat is important for the technical-economical constructions (hydrotechnical works for water supply, dams, and retention ponds) and for the prospections necessary for the exploitation of the ground and underground.

5. References

1. Borșan, T., *Topografie arheologică și GIS. Fundamente teoretice și aplicații practice*, Editura Risoprint, Cluj Napoca, 2015;
2. Borșan, T., Dimen, L., Ludușan, N., Filip, L., *The Applied Methodology for the Hydrographic Network Configurations and the Determination of Surface Water Flow Patterns in the Area of Alba Iulia*, 15th SGEM GeoConference on Informatics, Geoinformatics And Remote Sensing, www.sgem.org, SGEM2015 Conference Proceedings, ISBN 978-619-7105-36-0 / ISSN 1314-2704, June 18-24, 2015, Vol. 1, 593 - 600 pp;
3. Dimen, L., Borșan, T., Ludusan, N., Vintan, I., *GIS Analysis of Morphometric Factors in the Zlatna Depression, Alba County*, RevCAD, Journal of Geodesy and Cadastre, No. 14, pp. 85-94, 2013;
4. Dimen, L., *Cartarea environmentală a zonelor critice. Depresiunea Zlatna*, Editura Aeternitas, Alba Iulia, 2007;
5. Grecea, C., Ienciu, I., Dimen, L., Bala, A. C., Oprea, L.: *Impact of Surveying Engineering on the Environmental Protection Problems*, Journal of Environmental Protection and Ecology, 13 (1), 2012, pp. 352-360;
6. Grigore, M., *Reprezentarea grafică și cartografică a reliefului*, Editura Academiei R.S.R., București, 1979.