THE UTILIZATION OF GIS AND SATELLITE IMAGES IN THE VEGETATION AND SOIL COVERS' MAPPING FROM CIRIC BASIN (IASI COUNTY)

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Ciric river, tributary on the left of Bahlui, is a small-dimensioned basin, but the anthropic influence being visible on this territory through the extension of the urbanization process in its lower compartment, in the form of reservoirs, and agricultural terrasses .

On the basis of the satellite images we wanted to analyze: the mapping of the natural (forested and herbaceous) and anthropic ecosystems types (perennial and annual crops); the delineation of the degraded soils and ecosystems, relieving the advantages and disadvantages in the mapping of the vegetation and soils on the basis of the satellite images.

The satellite images (SPOT and ASTER) allow the mapping of the degraded sectors through erosion, landslide processes and vegetal association. The limits of this vegetal association are clearly delineated, often of a rectilinear aspect, fact that differentiates it from the herbaceous association, which has similar colors but dendrite forms in river meadow. In Ciric basin a high degree of homogeneity is specific to the vineyards but this is differentiated from other cultures by the roads between the parcels, aspect perceived by satellite image in texture. The landslide body occurs on the satellite image under the form of a mixture of colors specific to vegetation (nuances of red) and to the terrains lacking vegetation (blue) and the sliding cornice may be clearly drawn when the landslide body is delineated at the upper part by cultivated terrains.

The difficult for mapping the anthropic areas is given by limits of localities and the multitude of the object inside the localities and from the neighboring areas, and in some cases by anthropic materials for example in down sector of basin.

***Keywords**: ecosystems, satellite images, soil, degradation.*

The natural factors that influence the distribution of the vegetal associations do not impose significant spatial variations.

From a geological viewpoint, the level of the slopes unaffected by landslides, the loamy or loamy-clayey deposits do not induce differentiations in the structure of the vegetation and the soil cover. At the highest altitude level, over the fine sandstones and sands, are discordantly met sandy clays [1], case in which the soil inherits a loamy or fine texture.

The relief of the basin maintains the typical characteristics of the fragmented initial floodplain, with elongated ridges oriented NW-SE, with altitudes that hardly exceed 200 m (216.7 m in Aroneanu Hill). The terraces of Bahlui river in the area of Tătăraşi residential district (20-25 m relative altitude) and from Ciric Hill (the 60-70 m relative altitude terrace) [2] have a faded geomorphology, and thus they do not influence the bio-pedogeographical landscape.

The active geomorphologic processes such as the landslides and gully erosion are present mainly on the western-oriented slopes along Ciric, and in the case of the tributaries the slopes are modeled mainly by landslides.

Both the characteristics of the landscape and the lithology (in a smaller proportion) have been modified through anthropic intervention. About 1 km upstream the confluence with Bahlui, Ciric's floodplain has been elevated with 2-3 meters over the invert through the deposition of earth material with fragments resulted from the demolition of buildings, partially covered with segetal and ruderal vegetation. The pressure of the accelerated urbanization has determined the partial inclusion of the respective deposits in the urban perimeter of the Green Park residential area.

The right bank of Ciric river, on the alignment of Dorobanţ - Aroneanu – north Iaşi localities has been modeled through terracing, at the slope level being still maintained on large surfaces orchards and vineyards plantations.

The 1960s have been characterized by the complex improvement of Ciric's floodplain, materialized in the Dorobanţ, Ciric I, II and III reservoirs.

The general geographic allows the classification of the vegetation in the large silvo-steppe unit [3], respectively of the northern silvo-steppe with common oak (*Quercus robur*) and tatarian maple (*Acer tataricum*) in association with continental meadows, with a biomass production of 5-6 t/ha/year for the forests and 2 t/ha/year for the grasslands [3].

MATERIALS AND METHODS

In the purpose of vegetation mapping we have used the Aster 2 (RGB, 2000) and Spot satellite images, and the mapping was realized with the help TNT Mips 6.9 software. Besides the basic cartographic support (topographic maps scaled 1:25,000 and plans scaled 1:5,000) we have used and a series of models realized in the TNT Mips GIs software (elevation model, terrain declivity, slope exposition, etc.).

For the identification of the vegetation's characteristics and the correlation with certain geographical particularities of the territory, we have used *visual interpretation*. This method has a higher subjectivity degree in comparison with the automatic classification based on the spectral analysis of the pixels. In the case of the automatic classification may occur errors between two totally different surfaces that are "seen" as being identical (for example roads, landslide cornices and constructions have the same color).

Because Ciric basin has low widths, it is accessible and may be easily traversed, and thus the visual interpretation of the satellite images doesn't raise special problems.

In this context we have realized a correlation between the colors from the satellite images with the vegetation types and with other landscape characteristics (for example landslides, constructions etc.), with the texture and shape of the areas. On the Aster and Spot the vegetation, but also the other elements, are rendered in false colors.

RESULTS AND DISCUSSION

The forest vegetation is represented on the ASTER image in nuances of red and green with a mosaic aspect. In these areas are detached the young plantations and especially those made of allochthonous species (coniferous). The forest areas are neighbored most often by cultivated parcels, case in which the colors specific to the forest vegetation on the SPOT image are close in nuance to those associated to the cultivated terrains, but it is clearly differentiated from other categories (constructions, roads, etc.). The SPOT image (fig. 1 a), in comparison to the ASTER one (fig. 1 b), allows the easier separation of the objects on the image, such as the land use types, the vegetation types, etc.

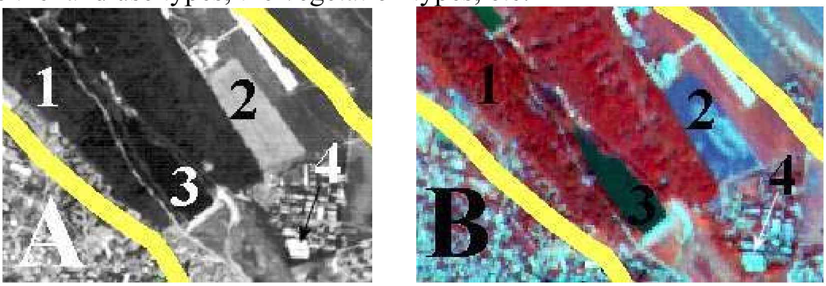

Figure 1. **The differences and similarities of the objects from the SPOT (a) and ASTER (b) satellite images**

The herbaceous vegetation occupies mainly the slopes affected by active geomorphologic processes of the gully erosion and landslides type, and the floodplains of Ciric and its effluents.

In the case of the floodplains the shape of the areas differs according to the characteristics of the slopes that limit them. Thus, in the case of the floodplains limited by slopes affected by landslides, as it is the case of Cotimani valley, the colors specific of their vegetation extend on the slopes as a consequence of the higher humidity from the negative micro-landforms. The general aspect of the ASTER image for the two landforms is mosaic tessellated. In the case of the slopes unaffected by landslides or where these are stabilized the dendritic form of the hydrographic network are reflected and in the disposition of the herbaceous vegetation from the level of the floodplain. As the parcels of agricultural terrain get closer to the floodplain, the contrast of the colors is more obvious and the shape of the floodplain is clearer.

In the case of the smaller tributaries of Ciric we witness a simplification of the forms, represented by lateral outgrowths. And in this situation the contrast is maximum only if the valleys are limited by cultivated terrains.

For the differentiation of the anthropic ecosystems we had in view the texture of the images for different crops. The cultivated terrains have in general polygonal shapes, uniform texture, but are different one from another through

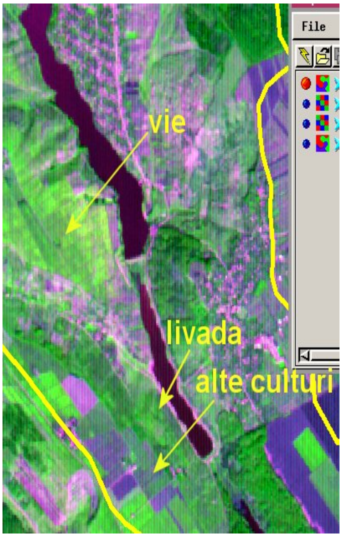

Figure 1. **Types of crops on the ASTER image**

color, especially in the case of weeding crops (fig 2). In the case of a cultivated parcel, the color from the ASTER image may be uniform if the plants from the respective parcel have a similar height, if the soil does not impose modifications through erosion, salinization or other degradation processes. Sometimes the vegetation structure is disturbed by the presence of invasive species such as reed, situation observed in the upper part of the basin. In this case it's hard to qualitatively differentiate a crop from another, as well as an abandoned parcel invaded by segetal and ruderal species cannot be separated through color or texture from a cultivated terrain.

The vineyards have a polygonal shape, and the roads between the parcels differentiate them as texture from the previous parcels. The texture is homogeneous only in the case of the flat or low-sloped (<3^0) and uniform terrain surfaces. The slope degree and the exposition modify the color characteristics of the satellite image.

Having in mind the same criterion of the representation mode on the satellite image, we have separated the characteristics of the ecosystems on the basis of their homogeneity. In fact, the whole landscape of Ciric basin has been modified, aspect observed mainly from the vegetation structure. The forests are formed of oak and acacia; on some surfaces have been identified plantations of coniferous trees (Cârlig Hill). The crops, although are heterogeneous as typology of the cultivated plants, may constitute together a homogeneous system. On the overall, the anthropic cultivated ecosystems may be considered homogeneous systems, due to their large surfaces. The heterogeneous ecosystems are those inside the localities and from the neighboring areas. The heterogeneity degree is given by the multitude and diversity of objects on a small area (buildings, roads, diverse crops, etc.) (fig 3). To evidence the high heterogeneity degree of the objects from the built perimeters we have proceeded to the analysis of the ASTER image raster through filters, on the basis of the texture, using standard deviation (fig. 4). The obtained raster has the advantage of accentuating the contour of the objects with different properties from the satellite image. In the analyzed situation are separated the homogeneous surfaces, as it is the case of the forests and the cultivated terrains with surfaces bigger than 1 km^2, which are shown in grey nuances. The contour of the objects of smaller dimensions is thickened, and their high concentration on a restrained area will evidence the diversity of the objects.

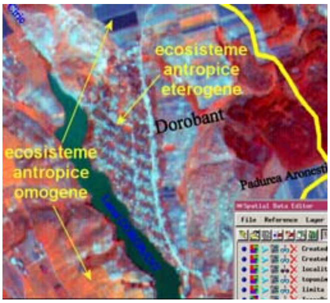

Figure 1. **Types of anthropic ecosystems**

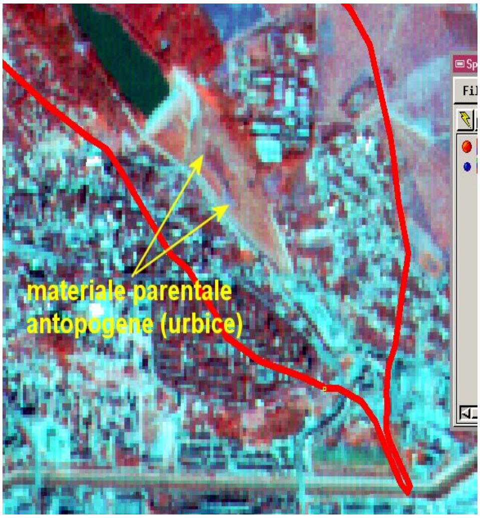

Figure 1. **Anthropic materials between Ciric lake and the Ciric-Bahlui confluence**

The anthropic materials from the lower Ciric basin, represented mainly by fragments that come from constructions, have over-raised the floodplain. The soil forming conditions are variable on a small area (approximate 1km^2). The presence of the hard fragments has limited soil formation, the respective areas occurring on the ASTER satellite image through combinations of colors in the case of the constructed perimeters and of the cultivated terrains, from this motive the automatic classification of the information being able to induce errors, eliminated in this case through field surveys (fig. 5). The mapping of these areas is difficult, because the limit of the anthropic materials is sinuous and at the same time complicated by the herbaceous vegetation that has more or less favorable conditions here. At the same time, according to the quantity of precipitations, the anthropic materials may be covered by vegetation similar to that of the abandoned terrains.

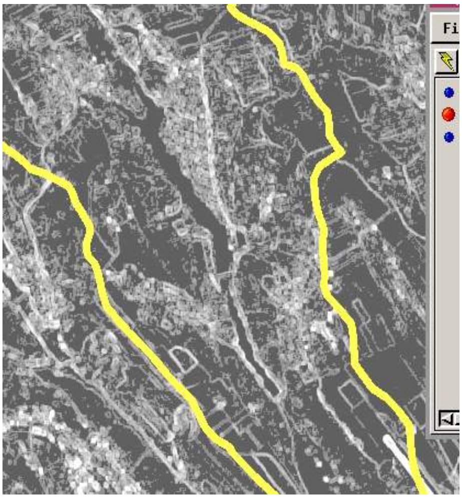

Figure 1. **The standard deviation - filtered ASTER raster**

The terrains degraded through geomorphologic processes of the landslide type may be separated from other terrain types. When the relief energy is sufficient enough and the landslide process still active, the sliding cornice is clearly delineated separating the cultivated terrains from those improper to cultivation from the body of the landslide. In the situation given, the landslide body occurs on the satellite mage under the form of a mixture of colors specific to vegetation (nuances of red) and to the terrains lacking vegetation (blue) and the sliding cornice may be clearly drawn when the landslide body is delineated at the upper part by cultivated terrains. The flat surfaces and the micro-depressions from the level of the landslide body, that allow the installation of vegetation, are easily identifiable, because they are covered by vegetation. The fragments from the landslide body separated by erosion differ by those presented previously through their color nuances (blue). In the case of the active landslides with stair-like diluvium the colors are intercalated as bends (red and blue), due to

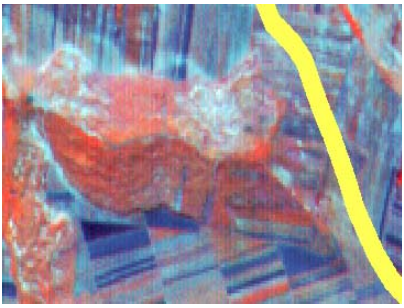

Figure 6. **The bended aspect of the active landslide**

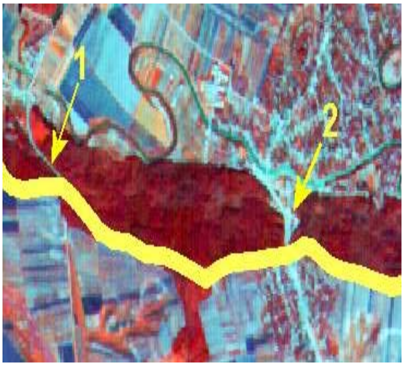

Figure 7. **Differences on the ASTER image between a correctly drawn road, according to relief characteristics (*1*) and the erosion-degraded one (*2*)**

the succession of surfaces with and without vegetation, sometimes interrupted by the presence of cultivated surfaces (fig. 6).

The degradation processes of the terrains through gully erosion may be induced by the cutting of roads upright the high slopes (level curve). Not always gully erosion may be separated from the similar natural processes. Still, in the case of Ciric basin the roads cut upright the level curve and that pass over the abrupt hill ridge induce gully erosion. The phenomenon is determined by the weak differentiation of the soil texture from the level of the hill ridge (sandy-loamy) in comparison to the lower part of the hill (mainly loamy). In the first case the phenomenon has a higher intensity, evidenced by the lateral swinging of the road, which becomes impracticable as erosion advances (fig. 7). On the hill ridge, in the analyzed sector the runoff is maximum, fact evidenced and by the runoff analysis on the SPOT raster through watershed analysis procedure.

Erosion is also accentuated by the cutting down of the trees along the roads, in this way rainfall and runoff having a higher contact surface.

CONCLUSION

The use of the ASTER and SPOTR image and on the basis of the observations conducted in Ciric basin we have identified several categories of terrains with different uses (roads) or degraded (active landslides, depositions) at whose level soil forming processes do not manifest or are in an incipient state.

BIBLIOGRAPHY

1. Brânzilă M., 1999 - *Geologia părţii sudice a Câmpiei Moldovei*, Edit. Corson, Iaşi. p. 221.
2. Barbu, N., Ungureanu, Al. coord. 1987, *Geografia municipiului Iaşi*, Edit. Universităţii „Al. I. Cuza" din Iaşi, 312 p.
3. Doniţă, N., Ivan, D., Coldea, Gh., Sanda, V., Popescu, A., Chifu, Th., Păucă-Comănescu, M., Mititelu, D., Boşcaiu, N. şi colab. 1992 - *Vegetaţia României*, Edit. Tehnică Agricolă, Bucureşti, 407 p.
4. TNT manual - http://www.microimages.com