REMOTE SENSING METHODS FOR THE SPATIAL ANALYSIS OF LAND DEGRADATION UNITS

METODE ALE TELEDETECŢIEI UTILIZATE ÎN ANALIZA SPAŢIALĂ A DEGRADĂRII TERENURILOR

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Abstract. *Romania's transition process increased the human pressure on natural resources (soils, forests, and water bodies) and the probability of natural hazards occurrence (floods, landslides, lake plugging). The objective of the study is to analyze the spatial distribution of the degradation forms, within the specific conditions of Suceava Plateau in North Eastern Romania. The instrument for the actual delineation of degradation formations was represented by aerial orthorectified images, obtained by comparing ground data to corresponding images. The results of the study show a good comparability between the ground and aerial photo mapping for the degradation forms present in these areas. Spatial variability of land degradation forms was analyzed through geo-statistical methods, within ArcGIS 9.3.*
Key words: land degradation, spatial variability

Rezumat. *Procesul de tranziţie din România a intensificat presiunea antropică asupra resurselor naturale (soluri, păduri, cursuri de apă) şi probabilitatea producerii de hazarde naturale (inundaţii, alunecări de teren, desecări). Obiectivul studiului este acela de a analiza distribuţia spaţială a formelor de degradare, în condiţiile specifice din Nord Estul ţării. Formele de degradare luate în calcul sunt eroziunea în adâncime, de suprafaţă, deplasări de teren, zone mlăştinoase, zone afectate de procese antropice de degradare. Materialul utilizat pentru delimitarea formelor de degradare este reprezentat de imagini aeriene ortorectificate şi georeferenţiate. Rezultatele studiului arată o bună comparabilitate dintre hărţile de distribuţie ale formelor de degradare obţinute terestru şi pe imagini aeriene. Variabilitatea spaţială a formelor de degradare este analizată prin metode ale geo-statisticii aplicate în ArcGIS 9.3.*
Cuvinte cheie: terenuri degradate, variabilitate spaţială

INTRODUCTION

The occurrence and development of the land degradation forms is linked to diverse geological, geomorphologic and vegetation conditions of the areas in which take place. An important aspect in the terrains vulnerability at the degradation phenomena is represented by the way of managing of the existing soil resources and the vegetation in those areas. Between the general land degradation forms, an important percentage is occupied by the erosion land sliding phenomena (Agurgo, 1996, Iacobescu et al., 2006, Nael et al., 2004). These phenomena are generally linked by torrential events and take place in areas that present high erosion susceptibility, areas differentially distributed in Suceava Plateau.

The researches objective is represented by the orthophotos usage opportunities analysis in the study of the spatial distribution of the Suceava Plateau degraded surfaces.

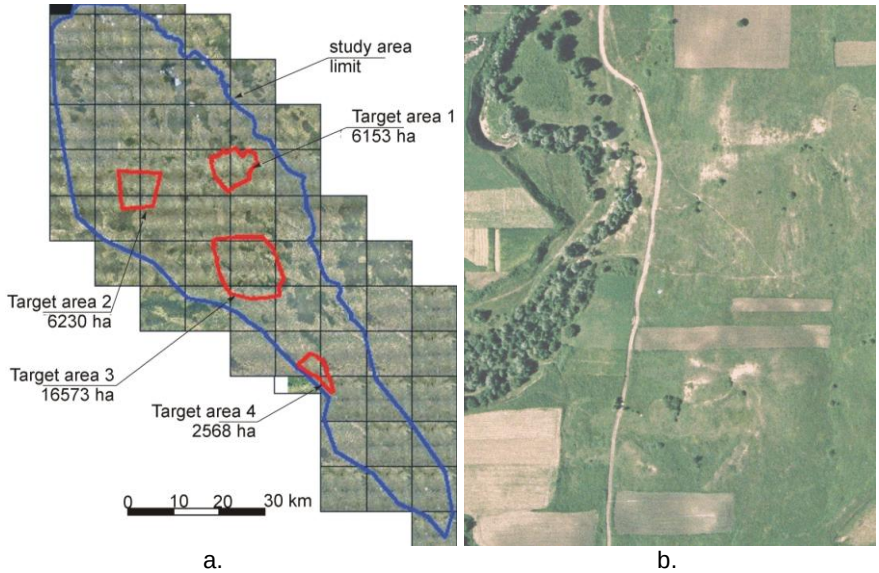
MATERIAL AND METHOD

The researches are located in Suceava Plateau (part which lies between Romania's North border, Moldova and Siret river, and Obcinile Bucovinei). The working model has been tested in four target areas, representative from the land degradation point of view, areas which sum up to 10 % of the total study area surface (fig.1.a): Suceava - Salcea (6153 ha), Ciprian Porumbescu (6230 ha), Preuteşti Buneşti (16573 ha) and Cristeşti (2568 ha).

The used *materials* are represented by *digital orthophotos* taken in 2004 – 2005 within the LPIS Programme (***L**and **P**arcel **I**dentification **S**ystem*). The images processing parameters are: 0,5 m spatial resolution, multispectral character, the spectral sensitivity domain – visible (fig. 1.b). The correspondence between the points in which the field observations were done and the images was accomplished by means of GPS technology, using Topcon GMS 2 GPS receiver.

The research methods are *observation* and *comparison*, applied in the field and at the office. Using these methods interactive photointerpretation keys were constituted, that were used afterwards in visual identification and mapping of land degradation affected terrains. The mapping was performed within *ArcGIS 9.3* software platform and verified in four target areas mentioned above (fig. 1.a).

The elementary units used in the mapping of degraded lands were differentiated based on the degradation forms that they occur in: *gullies, ravines* (coposed of origin, stable banks, relatively stable banks, talweg, forested areas), *landslides*, with breakage area, slide mass with marshes, *human induced degradations* (home and industrial waste heaps).



a. b.

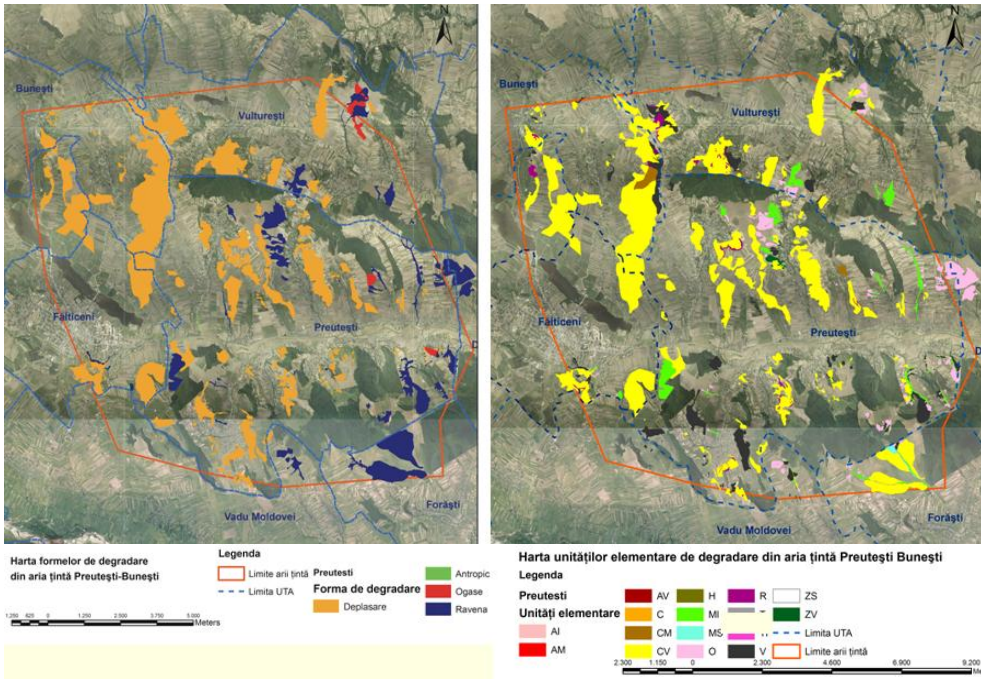
Fig. 1. a. Location of target areas for methodology calibration, b. fragment of *digital orthophoto*

The polygons resulted from digitization were overlapped on the administrative units limits (UTA). By interrogating the database, synthetic situations regarding the distribution of the degradation forms on the target area were obtained.

RESULTS AND DISCUSSIONS

The mappings from the target areas have been assembled in degraded lands distribution maps, lands identified on images, both by the type of land degradation (fig.2.a), and on the maps which contained the elementary units of the identified degradation forms (fig. 2.b). The predominant degradation types met in these areas are the gully erosion and the land slides, often in combined forms, which can be separated in erosion elementary units, to be dealt with separately in ecological reconstruction design (tab. 1). The highest percentages were obtained in Preuteşti Buneşti target area (17%) and Ciprian Porumbescu (15%).

By analyzing the distribution of degradation forms on the whole study area (fig. 3 and 4), one can notice a differentiation in the density of degradation areas (as a percent from non forested area) and in the location of the main degradation types. The highest land degradation percents occur in the central part of the Suceava Plateau, the land displacement areas having a high proportion.



a. b

Fig. 2. Land degradation type maps in Preuteşti - Buneşti area (a); with elementary degradation units identified (b)

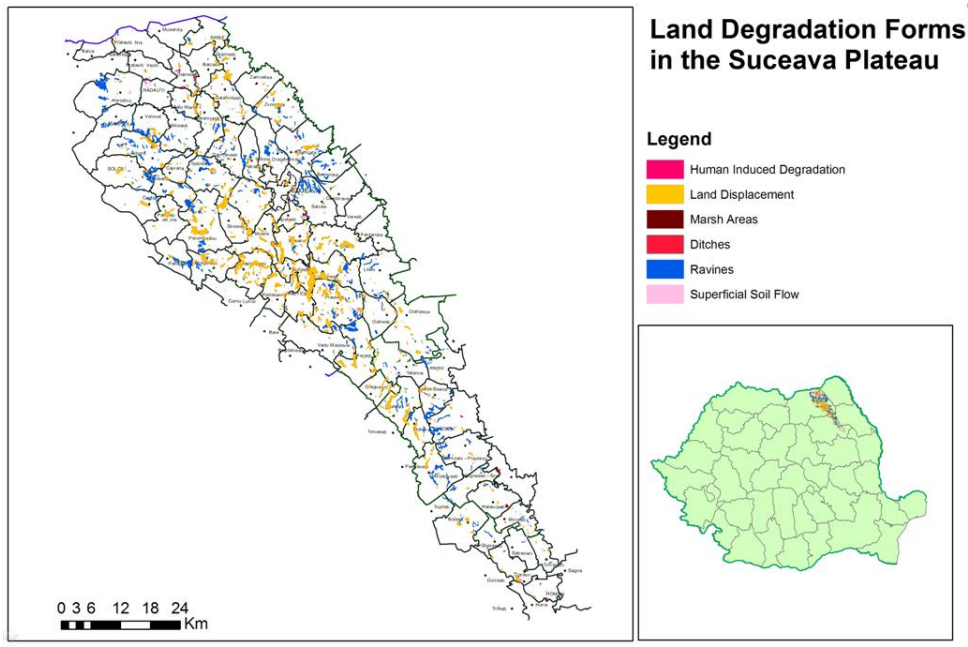


Fig. 3. Land degradation forms distribution in Suceava Plateau, mapped on digital orthophotos

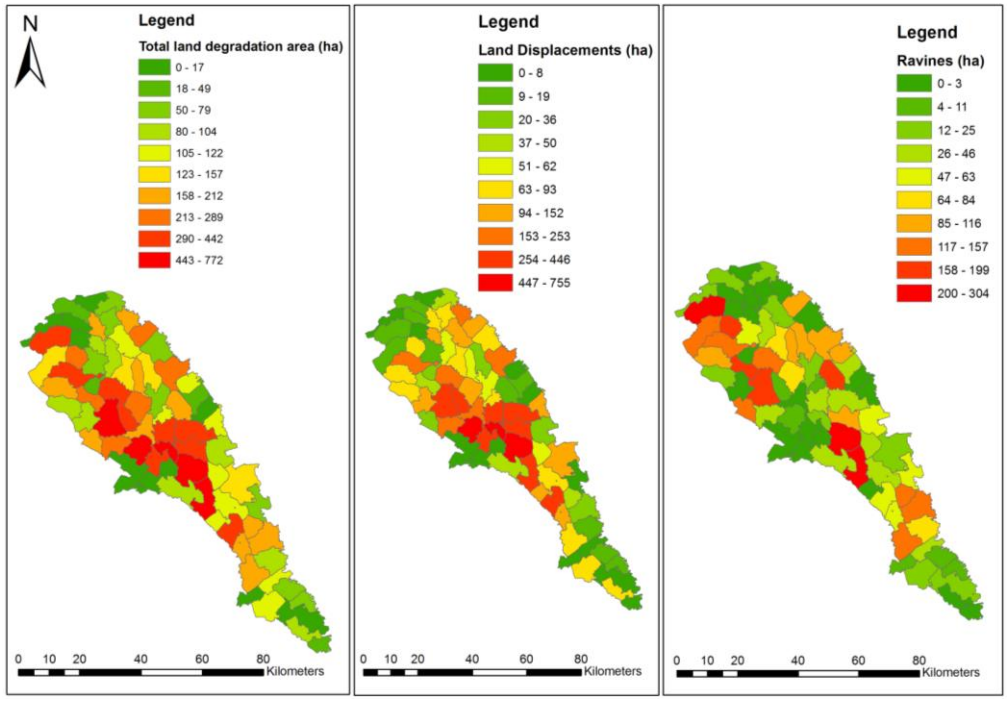


Fig. 4. Land degradation forms distribution in Suceava Plateau

Table 1

Area distribution on degradation types

Degradation type	Degraded areas in area … (ha)			
	Preuteşti Buneşti	Suceava	Ciprian Porumbescu	Cristesti
Human induced	67.49	20.14	4.43	0.90
Gullies	14.34		0.89	1.13
Ravines	1102.19	250.84	359.59	302.56
Land displacement	1654.85	40.95	544.92	72.49
Total	2838.87	311.94	909.82	377.08

The gully erosion forms are more uniformly distributed, occurring from North to South in all the study area.

The land degradation maps represent an important auxiliary in the decision system regarding the application of ecological reconstruction of affected areas. Aside the practical applicability, the maps have a special importance in the study of these phenomena, taking into account the high spatial resolution of the materials used and the digitization accuracy of the degradation forms.

CONCLUSIONS

1. The mapping of the land degradation on digital aerial images represents an alternative of analyzing this phenomenon on a broad scale, within an inventory repeatable on a five years basis.

2. The mapping method based on visual photointerpretation keys offers a satisfactory accuracy for the analysis of land degradation spatial distribution.

3. By separating elementary degradation units homogenous areas are separated, claiming similar ecological reconstruction methods.

4. Land degradation areas are differently distributed in the study area. The land displacement areas are concentrated in the central portion of the Suceava Plateau.

5. The integration of other elements regarding geological and geomorphologic conditions in analyzing the distribution of degradation forms on a broad scale can constitute a decision system regarding the management of ecological reconstruction works.

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