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2006-2012 LAND COVER AND USE CHANGES IN ROMANIA – AN OVERALL ASSESSMENT BASED ON CORINE DATA

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Abstract. Land cover and use changes are an important component of the global changes, and in relationship with their transitional dynamics reflect the impact of socio-economic transition. This study is aimed at exploring the land cover and use changes occurred during 2006-2012 in Romania with respect to their spatial distribution over the regions of development and main transitional dynamics. The results suggest that the main drivers of change are deforestation and urbanization, accounting for 3/4 of all changes, and that the most affected regions are the northwest, southwest, center and northeast ones. Overall, the findings suggest a continuation of the trends from the previous periods, characteristic to transition economies.

Introduction

As part of the 'global changes' (Dale *et al*., 2011), land cover and use changes are easier to assess and subject to lesser controversies than the other two components, climate changes and alterations of the energy flow, through the availability of geospatial data derived from satellite imagery (de Lima, 2005; Hagenauer and Helbich, 2012). In general, land cover reflects the biophysical coverage, while land use indicates the use of land by human communities (Jensen, 2000), or provides a more detailed classification of natural systems (Petrişor *et al*., 2010). In the European Union, CORINE Land Cover and Use data were freely offered by the European Environment Agency and the Copernicus program; however, they are subject to limitations including misclassification, changes in the classification schemes, and different resolutions from one period to another

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(Jansen, 2007; Pelorosso *et al*., 2009; Verburg *et al*., 2011; Petrişor *et al*., 2010, 2014).

Several similar studies were carried out in Romania at regional and national scales (Ianoş *et al*., 2011; Petrişor, 2012a, b, 2015a, b; Petrişor and Petrişor, 2015; Petrişor *et al*., 2010, 2014). Although their aims, focus and methodology were different, the common element is that land cover and use changes were assigned to transitional dynamics, which join several changes based on their common underlying cause.

The main transitional dynamics characteristic to Romania, identified by these studies, were few antagonistic phenomena: development and abandonment of agriculture, deforestation and forestation – consisting of afforestation and reforestation (Dutcă and Abrudan, 2010), but also of the colonization of abandoned agricultural sites by forest vegetation (Agnoletti *et al*., 2011; Blakesley, 2006; Petrişor *et al*., 2014; Van Uytvanck, 2009), urbanization and other minor causes, such as dams, draughts etc., characteristic to transition economies.

This study aims to explore the changes occurred in the last period (2006-2012) in Romania with respect to their spatial distribution, assessed in relationship with the regions of development and main transitional dynamics.

1. DATA AND METHODS

CORINE data are provided in a shape file format, usable by ArcView/ArcGIS. The projection is ETRS 1989 Lambert Azimuthal Equal Area L52 M10. In order to use the data and draw the maps, the data needed to be re-projected unto Stereo 1970 and clipped by the Romanian borders and limits of the regions of development (data owned by NIRD URBAN-INCERC).

The classification scheme is a mixture of the ones used in the previous studies (Ianoş *et al*., 2011; Petrişor, 2012a, b, 2015a, b; Petrişor and Petrişor, 2015; Petrişor *et al*., 2010, 2014), more appropriate for a general overview at the national scale; the following transitional dynamics were defined:

1. Development of agriculture – transformation of other level 1 classes into 'agricultural' and transformations within the level 3 'agricultural' class indicating the development
2. Abandonment of agriculture – transformations within the level 3 'agricultural' class indicating the abandonment of agricultural land
3. Forestation – transformation of other level 1 classes into forests, including the colonization of abandoned agricultural land by forest vegetation, and transformations of other level 3 ('natural') classes into forest; 'forests' are defined as CORINE classes 3.1.1 (coniferous forests), 3.1.2 (broadleaved

forests), and 3.1.3 (mixed forests), and other transformations within the same class indicating the forestation
4. Deforestation – transformations of forests (defined as above) in other level 1 classes, and other level 3 transformations within the same class ('natural') indicating the deforestation
5. Urbanization – transformation of other level 1 classes into 'urban' and transformations of level 3 ('urban') classes indicating the urbanization
6. Floods – transformation of other level 1 classes into 'wetlands' and 'waters'
7. Other – all other changes occurring sporadically (*i.e.*, damming, draughts, unidentified changes).

1. RESULTS AND DISCUSSION

Although the main focus of this study was to look at the most recent changes (2006-2012), it is noteworthy to present an overall look, compared to the other two periods. The changes tend to sum up lesser in time (3099 km^2 during 1990-2000, 766 during 2000-2006, and 720 during 2006-2012).

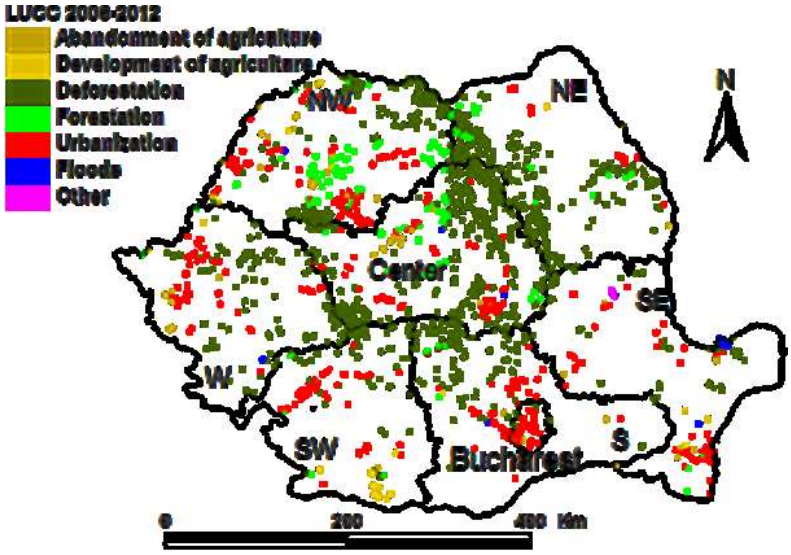

Fig.5. Spatial distribution of land cover and use changes in Romania during 2006-2012 by their transitional dynamic, based on CORINE data. The areas are enlarged by dilating their borders for a better visualization

For the recent changes, the overall spatial distribution is showed in Fig. 1. The image suggests that the main transitional dynamic is represented by deforestation, distributed around the Carpathians and especially at their limit of northeastern and northwestern regions of development, confirming the previous findings (Petrişor, 2012a; Petrişor *et al*., 2014, 2015b; Roman, 2009). The next one is urbanization, occurring around the large centers: Arad, Bucharest, Cluj-Napoca, Constanţa, Iaşi, Oradea, Sibiu and Timişoara (Grigorescu *et al*., 2012). In addition, forestation occurred especially in the northern part of the country, and massif floods are visible around Galaţi.

The results presented so far are based on a visual estimation; however, specific computations were performed, and their results are showed in Fig. 2 and Fig. 3. Fig. 2 shows the distribution of changes by transitional dynamics based on the total area affected, and confirms the finding according to which the main ones are deforestation and urbanization; the area affected by deforestation exceeds 50% of the total area, and the area affected by both of them totals approximately 75% of the total area.

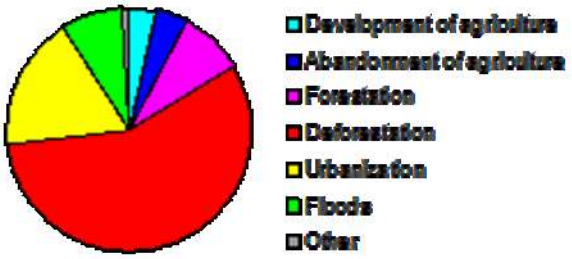

Fig.6. Distribution of land cover and use changes in Romania during 2006-2012 by their transitional dynamic, based on the total area affected

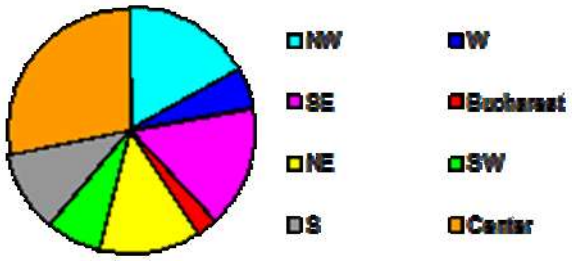

Fig. 3. Distribution of land cover and use changes in Romania during 2006-2012 by the regions of development, based on the total area affected

Fig. 3 shows the spatial distribution by region of development, indicating that the most affected regions are the northwest, southwest, center and northeast ones, totaling approximately 75% of the total area affected by land cover and use changes.

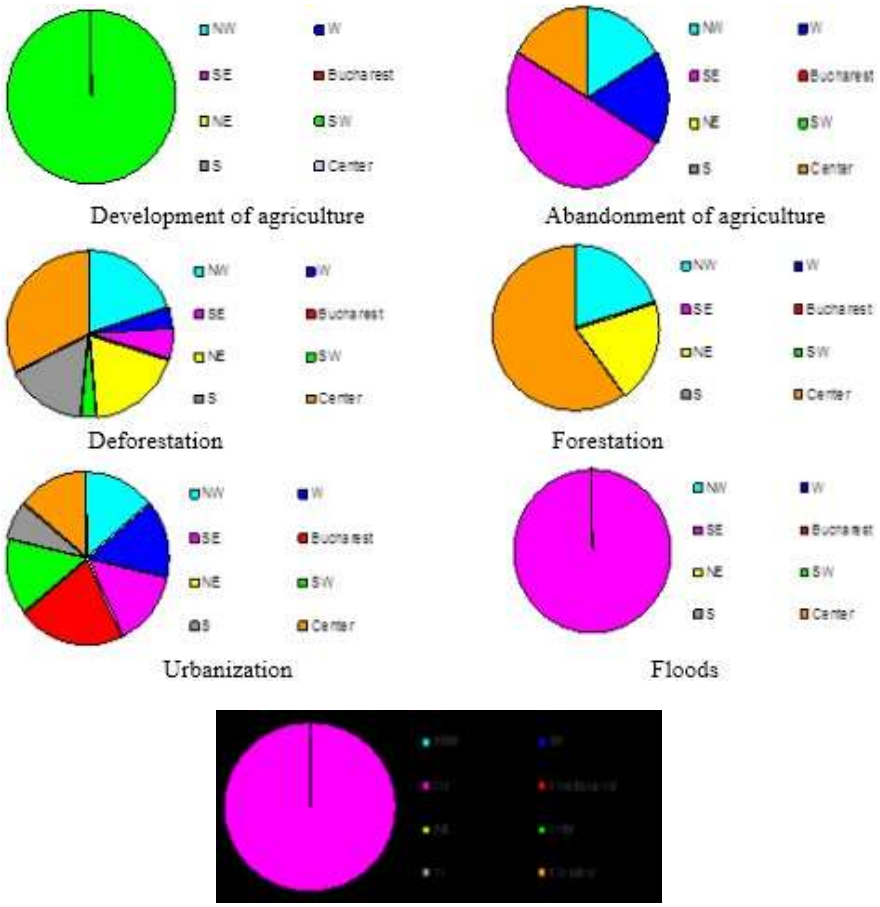

Fig. 4. Distribution of land cover and use changes in the Romanian regions of development during 2006-2012 by their transitional dynamic, based on the total area affected

The specific distributions are displayed in Fig. 4 and Fig. 5, form a double perspective. Fig. 4 looks at each transitional dynamic and tends to see which region was most affected by it; Fig. 5 looks at the influence of all transitional dynamics in each region. Fig. 4 identifies regions affected by a single transitional dynamic – *e.g.*, development of the agriculture in the southwest, and floods and other

phenomena in the southeast. In other regions, some transitional dynamics are dominating the others – forestation in the center and abandonment of the

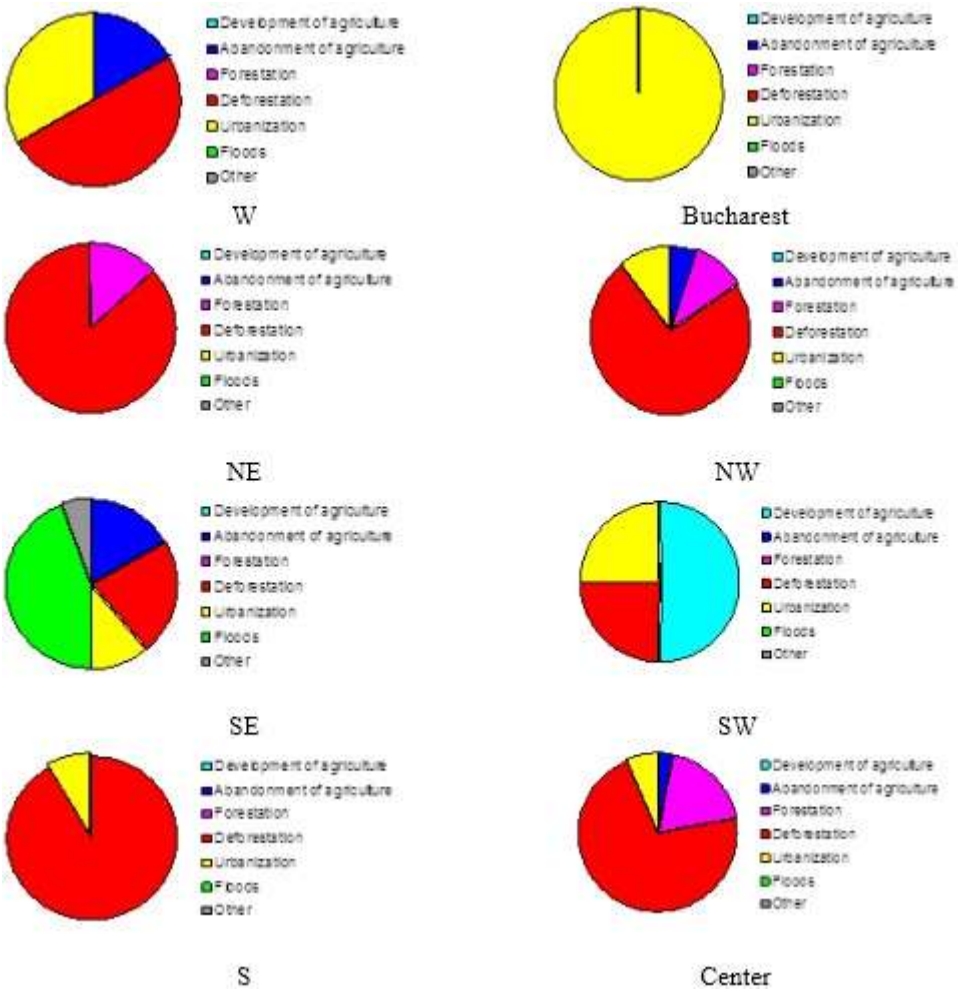

Fig. 5. Distribution of the main transitional dynamics determining land cover and use changes within the Romanian regions of development during 2006-2012, based on the share of areas affected per region

agriculture in the southeast. The latest can be also related to the draughts characteristic to the regions, which created additional obstacles to the agriculture (Dragotă *et al*., 2011; Păltineanu *et al*., 2007, 2009; Petrişor, 2015a).

Similarly, Fig. 5 identifies transitional dynamics which occur only in some regions (urbanization around Bucharest), or make up the largest share of a region (deforestation in the west, northeast, northwest, south, and center, development of agriculture in the southwest, and floods in the southeast).

Conclusions

The study aimed to explore the distribution of the land cover and use changes occurred during 2006-2012 in Romania by the regions of development and transitional dynamics. The results suggest that the main ones are deforestation and urbanization, affecting the mountain region and areas around the large cities. These findings are in line with the ones from the previous period and common to transition economies.

References

Agnoletti M., Cargnello G., Gardin L., Santoro A., Bazzoffi P., Sansone L., Pezza L., Belfiore N. (2011), *Traditional landscape and rural development: comparative study in three terraced areas in northern, central and southern Italy to evaluate the efficacy of GAEC standard 4.4 of cross compliance*, Italian Journal of Agronomy 6: 121-139.

Blakesley D. (2006), *Woodland Creation for Wildlife: a guide to creating new woodland for wildlife in Kent and East Sussex*, East Malling Research, Kent, UK.

Dale Virginia H., Efroymnson Rebecca A., Kline K. L. (2011), *The land use – climate change – energy nexus*, Landscape Ecology 26: 755-773.

de Lima M. V. N. (2005), *IMAGE2000 and CLC2000 Products and Methods*, Land Management Unit, Joint Research Centre, Institute for Environment and Sustainability, Ispra, Italy.

Dragotă Carmen, Dumitraşcu Monica, Grigorescu Ines, Kucsicsa G.. (2011), *The Climatic Water Deficit in South Oltenia Using the Thornthwaite Method*, Forum geografic. Studii şi cercetări de geografie şi protecţia mediului 10(1):140-148.

Dutcă I., Abrudan I. V. (2010), *Estimation of forest land-cover change in Romania, between 1990 and 2006*, Bulletin of the Transylvania University of Braşov Series II: Forestry, Wood Industry, and Agricultural Food Engineering 52:33-36.

Grigorescu Ines, Mitrică Bianca, Kucsicsa G.., Popovici Elena Ana, Dumitraşcu, Monica, Cuculici Roxana (2012), *Post-communist land use changes related to urban sprawl in the Romanian metropolitan areas*, Human Geographies 6(1):73-77.

Hagenauer J., Helbich M. (2012), *Mining urban land-use patterns from volunteered geographic information by means of genetic algorithms and artificial neural networks*, International Journal of Geographical Information Sciences 26(6): 963-982.

Ianoş I., Petrişor A.-I., Stoica Ilinca Valentina, Sârbu C. N., Zamfir Daniela, Cercleux Andreea Loretta (2011), *The different consuming of primary eco-energies and their degradation in territorial systems*, Carpathian Journal of Earth and Environmental Sciences 6(2):251-260.

Jansen Louisa J. M. (2007), *Harmonization of land use class sets to facilitate compatibility and comparability of data across space and time*, Journal of Land Use Science 1(2-4):127-156.

Jensen J. R. (2000), *Remote Sensing of the Environment. An Earth Resource Perspective*, Prentice Hall, Upper Saddle River, NJ, US.

Păltineanu C. Mihăilescu I. F., Seceleanu I., Dragotă Carmen, Vasenciuc Felicia (2007), *Aridity, draught, evaporation-transpiration and water demands of Romanian agricultural crops* [in Romanian], Ovidius University Press, Constanţa, Romania, 319 pp.

Păltineanu C. Mihăilescu I. F., Prefac Z., Dragotă Carmen, Vasenciuc Felicia, Nicola C. (2009), *Combining the standardized precipitation index and climatic water deficit in characterizing droughts: a case study in Romania*, Theoretical and Applied Climatology 97(3-4):219-233.

Pelorosso R., Della Chiesa S., Tappeiner U., Leone A., Rocchini D. (2011), *Stability analysis for defining management strategies in abandoned mountain landscapes of the Mediterranean basin*, Landscape and Urban Planning 103(3-4):335-346.

Petrişor A.-I. (2012a), *Dynamics of the environmental transformation processes during 1990-2006 in Romania reflected by land cover and use changes*, Present Environment and Sustainable Development 6(1):353-365.

Petrişor A.-I. (2012b), *Land cover and land use analysis of urban growth in Romania*, Human Geographies 6(1):47-51.

Petrişor A.-I. (2015a), *Land cover and land use changes reflecting the environmental impacts of declining economies. Case study: south-west development region, Romania*, Romanian Journal of Geography 59(1):29-39.

Petrişor A.-I. (2015b), *Using CORINE data to look at deforestation in Romania: Distribution & possible consequences*, Urbanism Architecture Constructions 6(1):83-90.

Petrişor A.-I., Grigorovschi M., Meiţă V., Simion-Melinte C.-P. (2014), *Long-term environmental changes analysis using CORINE data*, Environmental Engineering and Management Journal 13(4):847-860.

Petrişor A.-I., Ianoş I., Tălângă C. (2010), *Land cover and use changes focused on the urbanization processes in Romania*, Environmental Engineering and Management Journal 9(6):765-771.

Petrişor A.-I., Petrişor Liliana Elza (2015), *Assessing microscale environmental changes: CORINE vs. the Urban Atlas*, Present Environment and Sustainable Development 9(2):95-104.

Roman T. (2009), *The Forest of Romania: a Social-Economic's Dramma*, Theoretical and Applied Economics 6: 57-64.

Van Uytvanck J. (2009), *The role of large herbivores in woodland regeneration patterns, mechanisms and processes*, Research Institute for Nature and Forest, Brussels, Belgium.

Verburg P. H., Neumann Kathleen, Noll Linda (2011), *Challenges in using land use and land cover data for global change studies*, Global Change Biology 17(2):974-989.