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Florin Constantin Mihai, Liviu Apostol, Ana-Andreea Ghiurcă, Andreea  
Lămășanu, Alexandru Banica

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<sup>1,2,3,4,5</sup> “Alexandru Ioan Cuza” University of Iasi ,**Romania** \* - corresponding author

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## **ABSTRACT**

This paper proposes a spatial analysis of statistical data concerning the number and areas of rural dumpsites for local administrative units (LAU in Romanian's rural territory = communes) from 6 counties of North-East region using thematic cartography. Database created at local scale is correlated with demographic factors (eg population density) taking into account the various geographical conditions between these 6 counties (Neamt, Suceava, Botosani, Iasi, Bacau and Vaslui). Rural dumpsites have been identified by the county environmental authorities in 2008 and 2009, deadline for closure and rehabilitation being July 16, 2009. The large number of these sites reflect the lack of organized waste management system in rural territory. Sanitation services are still poorly developed in rural areas and the waste generated and uncollected are often disposed in open dumps or river banks (mainly in mountain areas). Geographic location of human settlements influences the disposal of waste, most of these dumpsites were located in their proximity. These bad practices are still present being revealed by field observations. Thus, demographic background (rural population share of total county population, population density at LAU level) and local geographical conditions (mountain, hill/plateau, plains/valley corridor) reflect the territorial disparities between counties (regional scale) and communes (local scale) regarding the geographical distribution of rural dumpsites.

**Keywords:** dumpsite, rural areas, spatial analysis, geographical conditions, territorial disparities

## **INTRODUCTION**

The current European regulations promoting the hierarchy of waste management inevitably involve a wealth of waste management practices tied to policies, institutional settings, financial mechanisms, technology selection, and stakeholder participation [1]. Also, analysis of policy effectiveness concerning waste management points out the existing gaps between EU countries [2]. The European Landfill Directive led to major changes in national policies on waste management particularly in EU newcomers revealed in following studies [3],[4],[5],[6] or in EU candidate countries [7],[8].

Implementation of EU acquis had a significant impact on waste disposal facilities from Romania. Primarily it made a schedule for closure of non-compliant urban landfills and secondly Romania has undertaken to close and rehabilitate the dumpsites from rural areas until July 16, 2009. This commitment is very difficult to follow under the conditions of partially access of rural population to sanitation services [3].

Uncontrolled waste disposal is still a current practice against environmental authorities efforts to limit this issue. This paper analyses the geographical distribution of rural dumpsites at regional scale (fig.1). The North-East Region consists of six counties (Bacău, Botoșani and Neamț, Suceava, Vaslui) there are 46 cities, 506 communes and 2436 villages. Among the eight regions of the country, it is the region with the largest area of 36,850 km<sup>2</sup>, representing 15.5% of the Romanian area, the largest counties being Suceava and Bacău and the most populated is Iași [9].

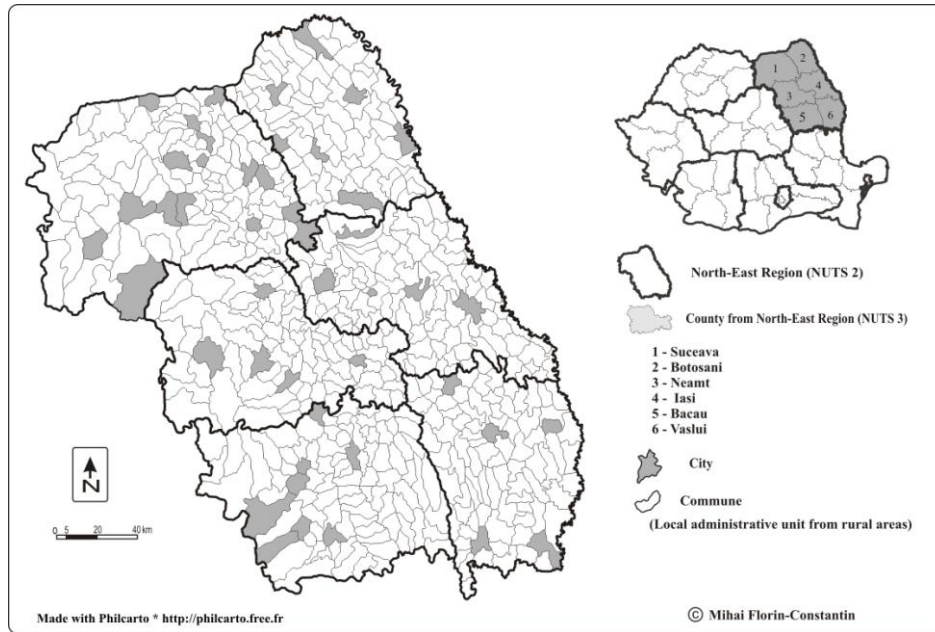


Fig.1. North-East Region- area of study

This region has a harmonious combination between all forms of relief: 30% mountainous area, 30% Subcarpathian hills (specific to Bacău, Neamț and Suceava counties) and 40% plains and plateaus (specific to Botoșani, Iași and Vaslui counties). Population is predominantly rural and most cities have less than 20,000 inhabitants. Also, the socio-economic context is less favorable compared to other regions of the country. These features of the territory are also reflected in current waste management issues.

## METHODS

It was conducted a database on the number and areas of rural dumpsites at commune level for the all 6 counties of North-East Region which include 506 communes. Commune is the local administrative unit in Romania's rural territory usually consisting of several villages in which one plays the role of administrative seat (local authorities) or even one village. It was calculated the number and areas of these dumpsites for each commune.

Data were provided by local environmental protection agencies. Local authorities had responsibility to close and rehabilitate these sites until July 16, 2009. It should be noted that on the one hand not all communes have reported such dumpsites (although organized waste collection services were lacking) and on the other hand for 13

communes could not be calculated population density due to incomplete data. Data on population of communes level were provided by the National Statistics Institute (INS) and refers to 2010. Areas of rural dumpsites (square meters) were correlated with population density from each commune. Thematic map (fig.3) was performed using on the one hand range colors method dividing population density of communes in 6 classes and on the other hand proportional circles method for absolute values (areas of dumpsites expressed in square meters). The proportional circles method was used for a comparative analysis of two absolute values such as number of dumpsites per commune and the number of villages that form a commune (fig.2). Those two maps are designed to highlight the geographical distribution of rural landfills taking into account demographic factors (population density) and also local geographical conditions in the context of a limited access of rural population to waste collection services.

## RESULTS AND DISCUSSION

Poor development of waste management services in rural areas from North-East Region led to open dumping being the easiest method to dispose waste generated and uncollected. Until 2009, local authorities from rural areas were not concerned in providing facilities for collection, transport and landfill of household waste. Usually communes in proximity of cities are served by waste collection services provided by private operators from cities. Poorer socio-economic conditions from rural territory of this region is reflected in the existence of a rudimentary waste management infrastructure. The budget of communes particularly those away from major cities of the county are insufficient to invest in the improvement of this infrastructure. New regulations requires local authorities to provide waste collection following July 2009. Field observations from Neamt County between September 2009-April 2010 revealed several dysfunctions in this regard. [3] PHARE and ISPA programs developed in North-East Region stipulate the development of waste management systems which includes towns and villages from neighborhood but their implementation is still ongoing. Regarding the ratio between the number of landfills at commune level and number of villages that form a commune it notice following trends (fig.2) :

- In the mountainous western half of the counties Suceava, Neamț and Bacău on the one hand the number of dumpsites is less than in the eastern half (dominant landscapes as Subcarpathian depressions and hills, plateau) and on the other hand number of sites from a commune in western half is much smaller than number of villages that form a commune, in other words are villages that did not report such dumpsites on their territory in the conditions of a limited access of local population to sanitation services.
- Botosani, Iași and Vaslui counties are overlapping the Moldavian Plateau, number of dumpsites is larger than the other three counties (especially to mountainous western half). Frequently, each village from a commune reported the presence of a waste disposal site and sometimes number of these sites exceeds the number of villages that form the commune. This explains the larger rural population especially in Iasi County. (tab.1)

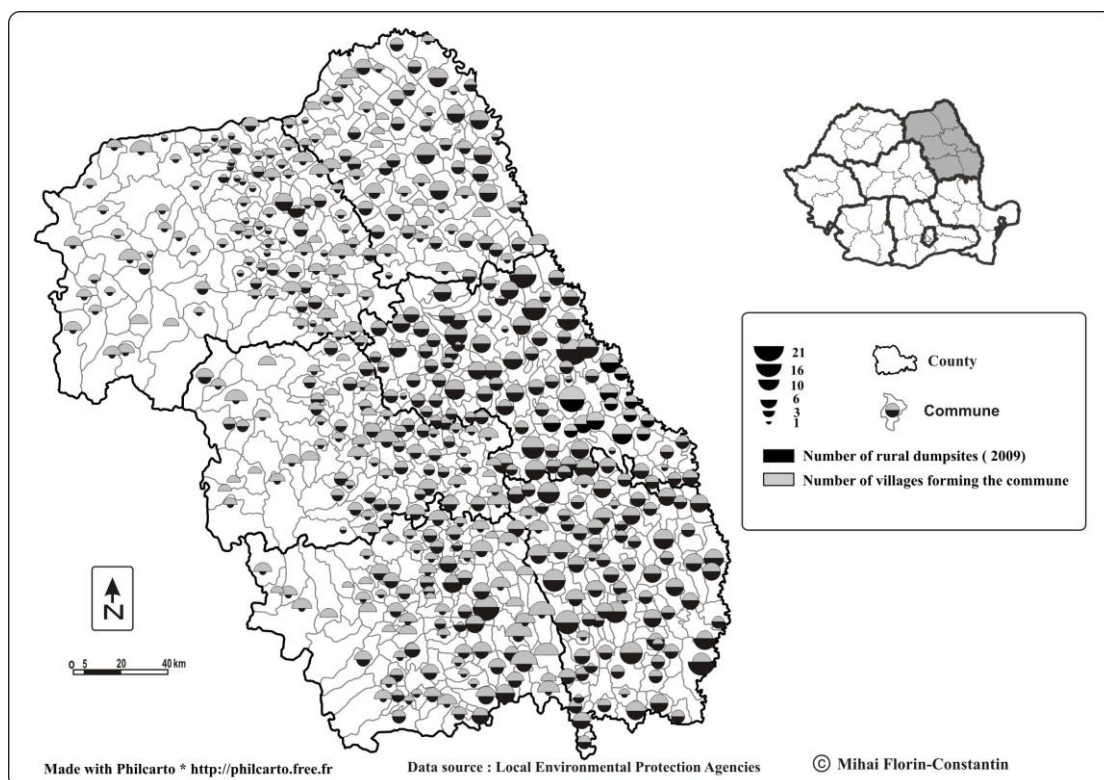


Fig.2 Geographical distribution of rural dumpsites ( number per commune)

Tab.1. Rural dumpsites in the context of limited acces to sanitation services

County	Rural pop. 2008	Served (%) by waste collection	Rural pop. unserved(nr.)	Nr. of dumpsites 2009	Surfaces (ha)
Suceava	403559	43.5	227898	136	73.04
Neamț	350675	10.4	314205	124	23.632
Bacău	392052	18.1	218078	195	40.39
Botoșani	263365	3.5	254148	184	36.201
Iași	434898	3.2	420974	454	108.54
Vaslui	266273	0	266273	389	43.8
North-East Region	2110822	14.5	1701576	1482	325.603

Data source : Bacău- Regional Environmental Protection Agency

Rural population density at commune level reflects the geographical conditions. Regarding the surfaces occupied by these dumpsites, disparities between western counties (Suceava, Neamț and Bacău) and eastern (Botoșani, Iași and Vaslui) are

obvious. In the mountainous western half of the counties Suceava, Neamț and Bacău population density is usually less than 50 inhab./sq.km and the surfaces of these dumpsites accumulated per commune are really low (< 1ha or 10,000 sq.m) and higher values are due to sawdust sites on the banks of rivers. Also, household waste generated and uncollected are uncontrollable disposed polluting mountain rivers and streams. Proximity of rivers to human settlements and lack of infrastructure for solid waste management favor this bad practice. Development of localities along the narrow valleys increase the vulnerability of rivers to illegal dumping. Summer floods carry the waste disposed downstream, these waste may accumulate behind the dams like those built on Bistrita river from Neamț County (Izvoru Muntelui, Vaduri, Pângărați, Bâta Doamnei). Development of localities in mountain depressions may mitigate the pressure on rivers because the waste can be disposed in the form of open dumps located in larger floodplains (or on terraces or other sites) being multiannual operational (in Suceava and Bacău counties) but still are vulnerable to stronger floods.

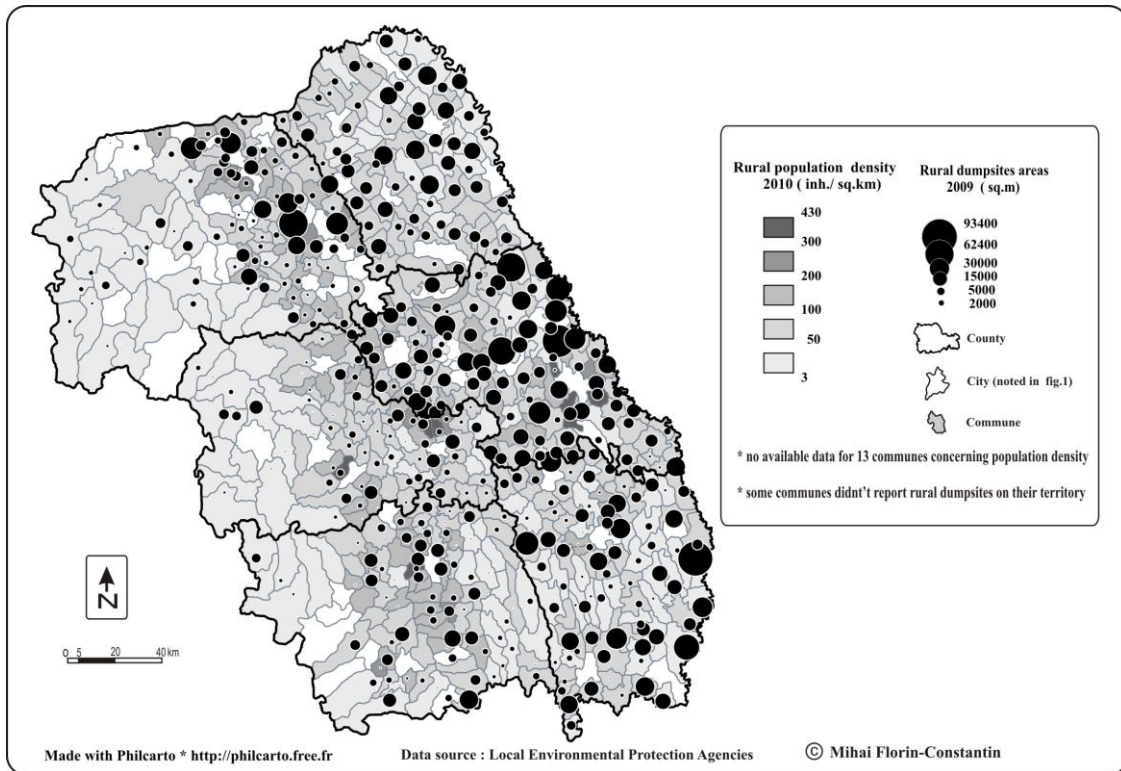


Fig.3 Geographical distribution of rural dumpsites areas at commune level from North-East Region

In counties that are overlapping Moldavian Plateau (Botoșani, Iași, Vaslui) due to landscape uniformity the disparities on number and surfaces of landfills are not so obvious in the territory of the same county (fig.3). However, in Vaslui County, there is a noticeable difference between north, south and east county where areas of these dumpsites are larger per commune compared to the center of county.

Communes frequently have densities over 50 inhab./sq.km and much higher in the proximity of large cities especially in Iași county (over 300 inhab./sq.km).

Geographical conditions, demographic context and lack of sanitation services have led to the disposal of household waste in open dumps. The large number of people but also villages that usually form a commune have led to a significant number of these

dumpsites occupying large surfaces compared to western counties from North-East Region. Furthermore, sanitation services from rural areas in 2008 were almost absent. However, it is observed some disparities between these three counties. Iasi county has the largest number of rural dumpsites and consequently the largest occupied areas from the North-East region but also it is the most populated. Only 3.5% of the rural population of this county had access to waste collection services in 2008, open dumping was a current practice in every commune and even village. Vaslui county is less populated, poor economic and social conditions favored the lack of sanitation services in rural territory (2003-2008), open dumps was the only option for waste management. Neither in urban areas situation is not favorable compared to other counties of the country [10]. The vulnerability of this county to illegal dumping in urban and rural areas is highest in North-East region. In Botoșani county, rural population access to sanitation services is insignificant thus encouraging uncontrolled waste disposal in open dumps like in the others two counties.

## **CONCLUSIONS**

Physical-geographical transition of Suceava, Neamț and Bacău counties is reflected in disparities concerning the distribution of rural dumpsites within the same county, while in eastern counties (Botoșani, Iași and Vaslui) this distribution is more uniform due to a more homogeneous landscape (Moldavian Plateau). Higher share of rural population with access to sanitation services, lower densities and waste disposal on rivers banks in mountain areas of western counties explains the smaller number and lower surfaces of dumpsites reported as opposed to eastern counties. On the other hand, the most populated counties such as Suceava and Iași have the largest number and surfaces of dumpsites than the other four counties together. Yet significant differences between these two counties highlights on the one hand the role of sanitation services in rural areas and on the other and the role of various geographical conditions from Suceava county in spatial analysis of these sites. North-East region are still facing the uncontrolled waste disposal due to a partial access of rural population to sanitation services damaging local environmental factors. Suceava and Bacău counties have some progress in the development of waste management facilities from rural areas while the Neamț county and eastern counties are still most vulnerable to illegal dumping.

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