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**Accessibility of waste collection services
in Romania: a multi-scale analysis in EU
context using thematic cartography**

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1. Accessibility of waste collection services in Romania: a multi-scale analysis in EU context using thematic cartography 2. L'accessibilità dei servizi di raccolta dei rifiuti in Romania: un'analisi multi-scala in contesto dell'UE utilizzando cartografia tematica.

4. Abstract

Low coverage of urban and rural population to waste collection services leads to various environmental threats caused by uncontrolled waste disposal. New EU regulations on waste management issues transposed into national laws have improved this sector, but, the population access to such services is still low compared to others new EU members. A multi-scale approach of this indicator is a necessary tool for a proper analysis of this environmental issue. The maps reveal that Romanian development regions (NUTS 2) have the lowest coverage rates at EU level in 2010. Furthermore, major disparities are reflected between Romanian counties in 2010. Thematic maps outline a comparative analysis at national and regional scale (Romanian counties & cities and communes of North-East Region) between urban vs rural areas in 2010. These geographical approaches are necessary for a better monitoring process of waste management sector.

5. Keywords : multi-scale analysis, waste collection services, disparities, thematic cartography, municipal waste,

6. Abstract in Italian :

La bassa copertura della popolazione urbana e rurale ai servizi di raccolta dei rifiuti porta a varie minacce ambientali causate da smaltimento incontrollato dei rifiuti. Nuovi regolamenti UE su questioni di gestione dei rifiuti recepite nelle legislazioni nazionali ha migliorato questo settore, ma, l'accesso della popolazione a tali servizi è ancora bassa in confronto ad altri nuovi Stati Membri dell'UE. Un approccio multi-scala di questo indicatore è uno strumento necessario per una corretta analisi della questione ambientale. Le mappe rivelano che sviluppo nelle regioni rumeno (NUTS 2) hanno le tariffe più basse di copertura a livello UE nel 2010. Inoltre, le grandi disparità si riflettono tra contee rumene nel 2010. Mappe tematiche delineano un'analisi comparativa su scala nazionale e regionale (contee rumene & città e comuni della regione di nord-est) tra le regioni rurali vs urbane nel 2010. Questi approcci geografici sono necessari per un migliore processo di monitoraggio della gestione dei rifiuti.

7. Keywords in Italian : analisi multi-scala, servizi di raccolta rifiuti, disparità , cartografia tematica, rifiuti municipali

1. Introduction

The non-compliant municipal waste management systems still create many environmental disturbances in the new EU Member States and the adoption of an efficient and sustainable management has become a priority for the EU. Solid waste management is a key component of public services which needs to serve the urban and rural municipalities in an efficient way in order to maintain a decent standard of public health (Marques e Simoes, 2008 ; Giusti, 2009). Major disparities between national and regional waste management systems are strongly related to demographic, geographic, social and economic features (Bianchini et al., 2011; Cifrian et al.,2012; Dahlen et al.,2007 Gellynck e Verhelst, 2007, Swami et al., 2011). Consumption patterns influence the municipal waste composition and the proper environmental awareness stimulates the separate collection and the implementation of best practices in this sector (Benitez et al., 2008, Sokka et al., 2010; den Boer et al., 2010) Nevertheless, some EU regions are not yet fully connected with waste collection services. In such cases, sustainable, regional and local waste management systems need to be improved. Spatial analysis of waste indicators at administrative territorial unit level is a proper tool in order to monitor this sector (D’Alisa et al., 2012; Mihai, 2013)

2. Waste collection coverage within EU-27 (NUTS 2)

Western Europe countries have full coverage of the population to waste collection services as shown in Table 1.

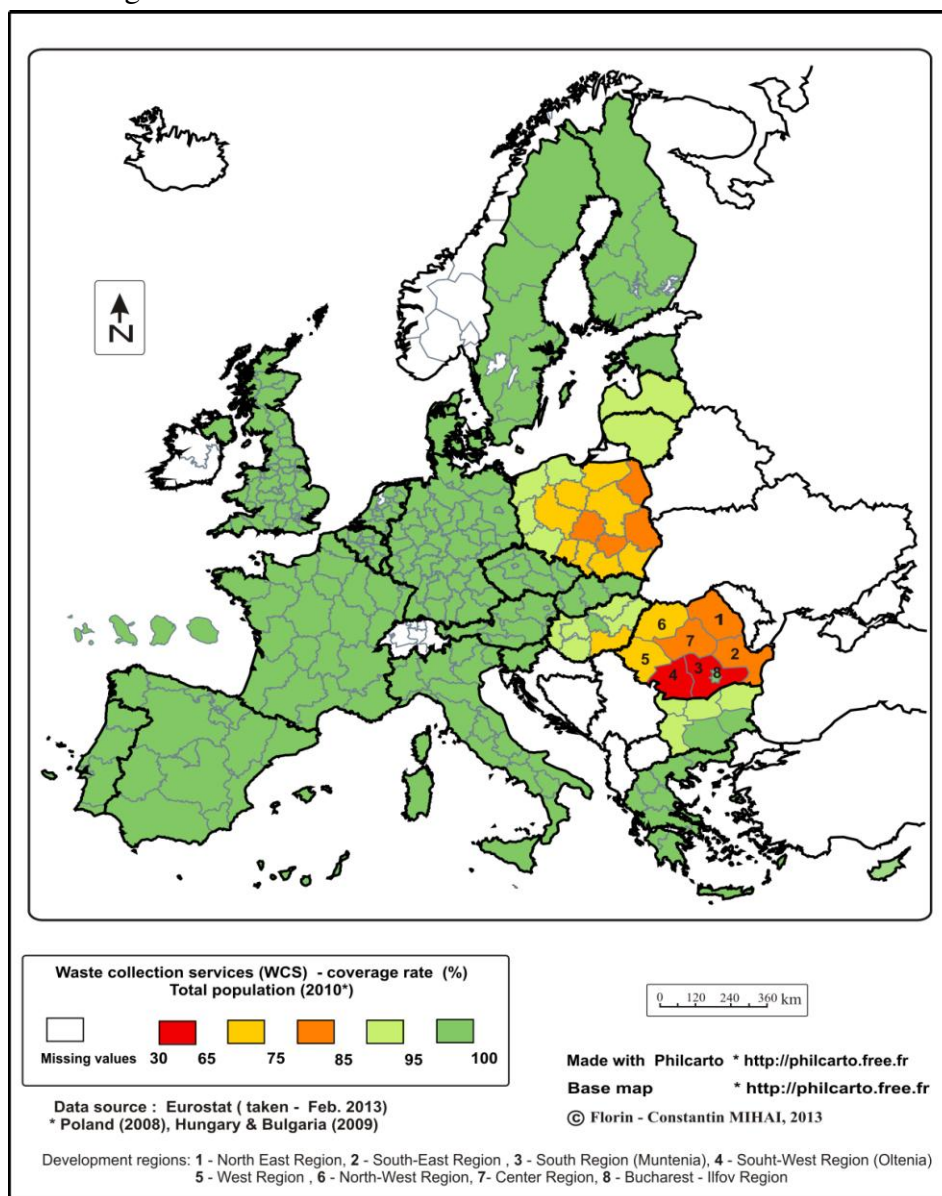
Table1- Share of population with access to waste management services in Europe

EU-28 Member State/ year –last available data	(%) pop. served by waste collection services	EU-28 Member State/ year –last available data	(%) pop. served by waste collection services
Austria 2004	100	Luxemburg 2003	100
Belgium 2003	100	Hungary 2009	92.2
Czech Rep. 2004	100	Greece 2003	100
Denmark 2003	100	Slovakia 2005	100
Finland 2004	100	Slovenia 2009	94.5
France 2005	100	Poland 2009	79.1
Germany 2004	100	Romania 2009	63
Bulgaria 2009	96.7	Malta 2009	100
Ireland 2005	76	Lithuania 2009	91
Italy 2005	100	Latvia 2009	85
Netherlands 2004	100	Estonia 2009	79
UK 2005	100	Cyprus 2008	100
Spain 2009	100	Croatia 2008	93
Portugal 2005	100	Sweden	100
Non-UE			
Albania	77	Macedonia	72
Georgia	60	Turkey	77
Montenegro	76	Iceland	100

Data source : OECD 2008, UNEP (2011) , Hoornweg e Bhada (2012), National Statistics

Regular waste collection services are provided for household waste and similar fractions such as wastes from the institutes, shopping centers or offices. Furthermore, some states have implemented an efficient separate collection system, both for the residential and business sector emerging a sustainable market in this field. Private capital has a significant share in various stages of waste management sector. Inter-municipal cooperation plays a key role for regional waste management systems which may include urban, metropolitan and rural municipalities. Disparities between North and South or East and West are determined by a different trend of socioeconomic levels as well as waste management policies adopted in recent decades (Mihai e Apostol, 2012). New EU Member States still have no full coverage of population access to waste collection services (Mihai, 2012), the lowest rates are encountered in rural areas (eg. Romania, Poland, Bulgaria, Hungary). These disparities are obviously at regional scale (NUTS 2), in case of the large countries with a significant share of the rural population such as Romania and Poland (see Figure1).

Figure -1 Coverage rate of waste collection services at NUTS-2 scale in EU-27



Data source: Eurostat (feb.2013)

Poor quality of waste management services are the main causes of environmental disturbances created by waste dumping. Globally, maybe 75% of waste generated is collected, leaving the remaining 25% unaccounted (Matthews, 2012). Uncollected wastes are burned or disposed on open dumps, rivers and streams polluting the surroundings. Even the coverage rate is 100 % in an urban area, perhaps only 80 % of the inhabitants actually benefit from waste collection services (Scheinberg et al., 2010).

Former communist countries of Europe have faced serious social and economic challenges in the transition period since 1990. Public administration has frequently ignored the municipal waste management issues due to the lack of proper funds. The major cities and peri-urban municipalities were covered by waste collection services compared to small towns and rural regions where poor facilities prevailed.

Implementation of the EU regulations in the new Member States it is difficult to achieve on this historical background. Waste collection systems in the Western and Northern Europe covered the entire population early as 2003-2004. Despite of this fact, the illegal dumping, fly-tipping, river and marine litter are still environmental threats in UK, Ireland, France, Italy, Spain, Portugal, Greece, Netherlands etc. Cleaning campaigns such as “Let’s do it “ point out such bad behaviors across all Europe.

New member states of the EU-27 are obliged to provide the expansion of these services and also to upgrade the existing waste management infrastructure. Also, the older EU members are facing the same transition from landfills to recycling and treatment facilities (Perkoulidis et al., 2010; Wolsink, 2010; Desmond, 2006). Full coverage of urban and rural regions is just a basic condition in order to fulfill the EU regulations.

One of the core issues in the field of solid waste collection is the failure to take account of the important differences between geographical regions, between nations, between cities and even within a city (Coffey e Coad 2010).

The mapping of waste indicators at different scales in Romania reveals regional and local inequalities in providing basic waste collection services between development regions (NUTS-2), counties, cities and communes.

3. Disparities between Romanian counties

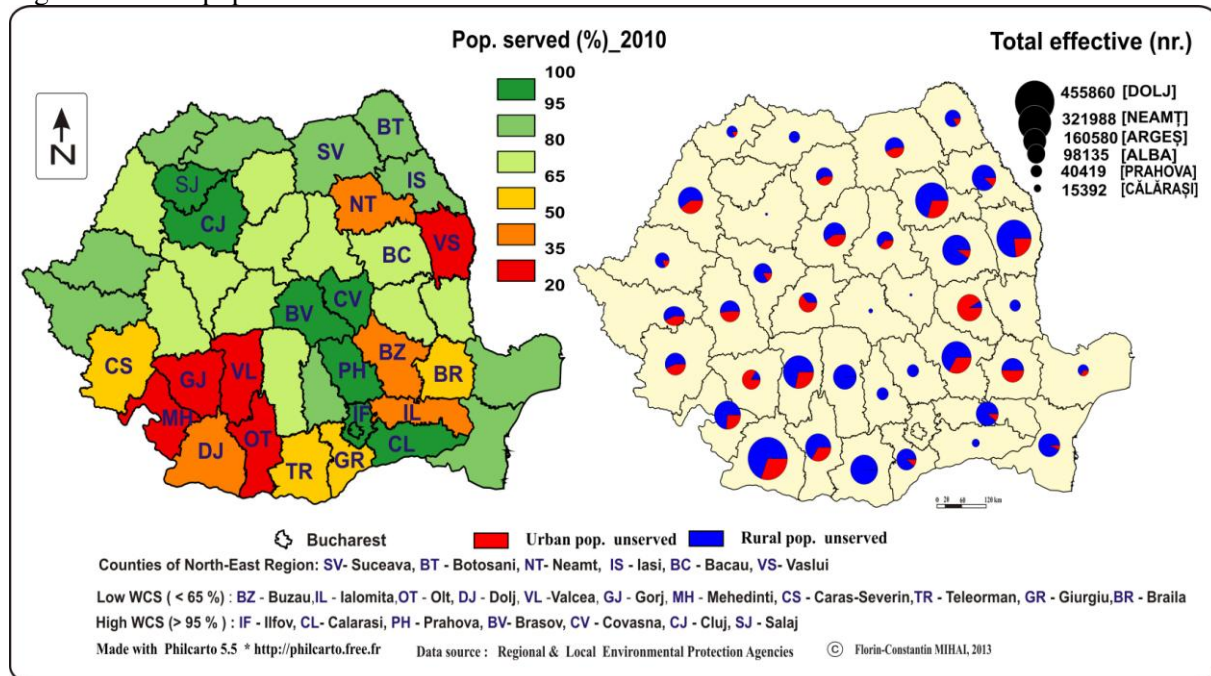
Romania is divided into 41 counties (“judete”) which correspond to NUTS 3 level (Nomenclature of Territorial Units for Statistics) and the municipality of Bucharest as the capital city. Each county is further divided into cities and communes (specific to rural areas) which correspond to NUTS 4 level. The *commune* is the lowest level of administrative subdivision which is made up by one rural municipality which may include other villages with no administrative responsibilities. Romania has eight development regions which correspond to NUTS 2 level, but with no legal basis (not included in the Constitution) or executive responsibilities.

The main purpose of these regions is to comply the EU standards in order to apply for structural funds, to support the regional development, to collect and monitor the regional statistics. North-East Region has six counties as follows: Suceava, Botosani, Neamt, Iasi, Bacau and Vaslui with 3.302.217 inhabitants in 2011 (16,41 % of national stable population. This area is a part of Moldavia historical region and cover an area of 36.850 kms and has borders with Rep. of Moldova in East and Ukraine in North.

Romanian population is not fully covered by waste collection services in 2010 and some counties have poor coverage rates below 65% being exposed to illegal waste disposal practices (open dumps, river dumping, backyard burning). Environmental authorities monitor the waste statistics at NUTS 2 & NUTS 3 scales, but data for NUTS 4 level (cities & communes) are scarcely seen. The data reported by waste operators which may serve several localities (city + communes) are not broken down per municipality, therefore, it is often difficult to perform a geographical analysis at this scale.

The poor access of population to formal waste collection services in 2010 is explained by the lack of proper waste management facilities in rural areas of Romanian counties (eg Vaslui, Neamt, Buzau, Dolj, Olt, Teleorman, Giurgiu, Mehedinti). These services from urban areas have a lower coverage (concerning the number of inhabitants served) than rural areas as follows: Vrancea, Gorj, Sibiu counties or similar values among urban & rural areas such as Braila and Hunedoara (see Figure 2).

Figure 2- Total population access to waste collection services in 2010



Data Source: Medius application _National and Regional Environmental Protection Agencies

The high number of inhabitants unserved by waste collection services (15.000 – 45.000 inhabitants per county) within several Romanian counties it explains the serious environmental threats caused by illegal waste disposal practices in the field.

Accuracy of data depends on the one hand, by the real residential population of cities and communes (without emigrants) and on the other hand, *by the veracity of reports made by waste operators and local authorities* ! Regional and local environmental reports reveal such data only at development region (NUTS2) or county levels (NUTS3). The partial sanitation fees collected by waste operators from urban residents may also explain the lower coverage rates for *urban population served* in official statistics.

Waste operators collect the waste generated and deposited into *community waste storages* of the main city, including for the inhabitants which does not pay the monthly fees. A low fee collection rate leads to poor quality services. Extension of waste collection services in urban and rural areas is a key objective of environmental policies in Romania followed by implementation of selective collection and recycling facilities. Romania has increased the total coverage rate from 51% in 2007 (EU adhesion) to 76 % in 2011 according to the National Statistics Institute. However, the National Environment Protection Agency database outlines that the South-West Region is the only region where total population coverage is less than 50 % in 2011 as follows : total (39,25 %) , urban (74,98 %) and rural (10.12 %) ! Romania must close all non-compliant municipal landfills until 16 July 2017 and all remote localities should be served by the new regional municipal waste management systems across the country ! The current major gaps between urban-rural areas makes more difficult to accomplish this target. The development of proper waste management services in tourism regions (particularly in Romanian protected areas) should be a priority in order to mitigate the potential impact of tourists. The old non-compliant sites are replaced by sanitary landfills (serving a large city or as regional site at county level) and by transfer stations equipped with sorting and/or composting facilities. This new approach should stimulate the recycling programs and to reduce the amounts of waste landfilled, particularly for biodegradable fraction in accordance with EU targets.

3. Coverage rates in urban and rural areas from North-East Region

This paper performs a geographic database for North-East Region in order to reveal a spatial analysis of waste collection rate in a multi-scale context. Public waste collection services were gradually leased to the private sector and major infrastructure investments (carried by EU funds) have improved their quality. The liberalization of this sector and new methodologies of waste statistics have led to significant oscillations in coverage rates of urban population access to waste collection services between the pre and post accession periods (Mihai et al., 2012, Mihai, 2013).

The reports on the status of environmental factors presents only aggregate data at the county level, which *cannot capture the local territorial disparities*. Extension of WCS from cities was accelerated by the transposition of *the EU acquis* into national regulations.

Most operators are based on these estimates and *not by the actual number of individual contracts concluded*. These inaccuracies have repercussions on *the real collection rate of stable population in 2010* (which in reality is higher than those resulting from waste statistics). The overvaluation of stable population (which includes the citizens working abroad) have most influenced the real level of coverage rates from urban areas of Neamt and Vaslui counties (Mihai, 2013). The administrative territorial unit of a city often includes the main city and suburbs localities.

The suburbs include rural municipalities which may not be served by waste operators these areas are often predisposed to illegal waste disposal practices. The collection rate is often calculated taking into account the whole population within the administrative territory of the city and therefore, there is no information for each suburban locality.

The waste collection is regularly provided for all major cities (> 50 000 inhabitants) compared to the poorer small towns with strong rural features (< 20 000 inhabitants). The remote villages within small urban administrative areas are frequently neglected by waste operators. Roznov city had no formal waste collection services until 2010, but new separate collection system has been operational since 2011 through a PHARE project. Several *communes* were declared towns in the period 2004-2007 even if they did not meet the criteria for urban infrastructure (including the existence of a formal waste collection system). These new urban areas led to significant changes regarding the share of rural and urban inhabitants from a total population of a county. The best example is the Suceava county where 8 communes without WCS had been declared cities in 2004 as follows : Broșteni, Cajvana, Dolhasca, Vicovu de Sus, Frasin, Liteni, Milisauti, Salcea which increased the percentage of urban population from 35% in 2001 to 43.4%. (LWMP Suceava, 2008).

The same situation was encountered across other counties such as Murgeni (Vaslui county), Podu Iloaiei (Iasi county), Roznov (Neamt county), Flamanzi, Bucecea, Stefanesti (Botosani county). Poor waste management systems were widespread in these new urban areas until 2009.

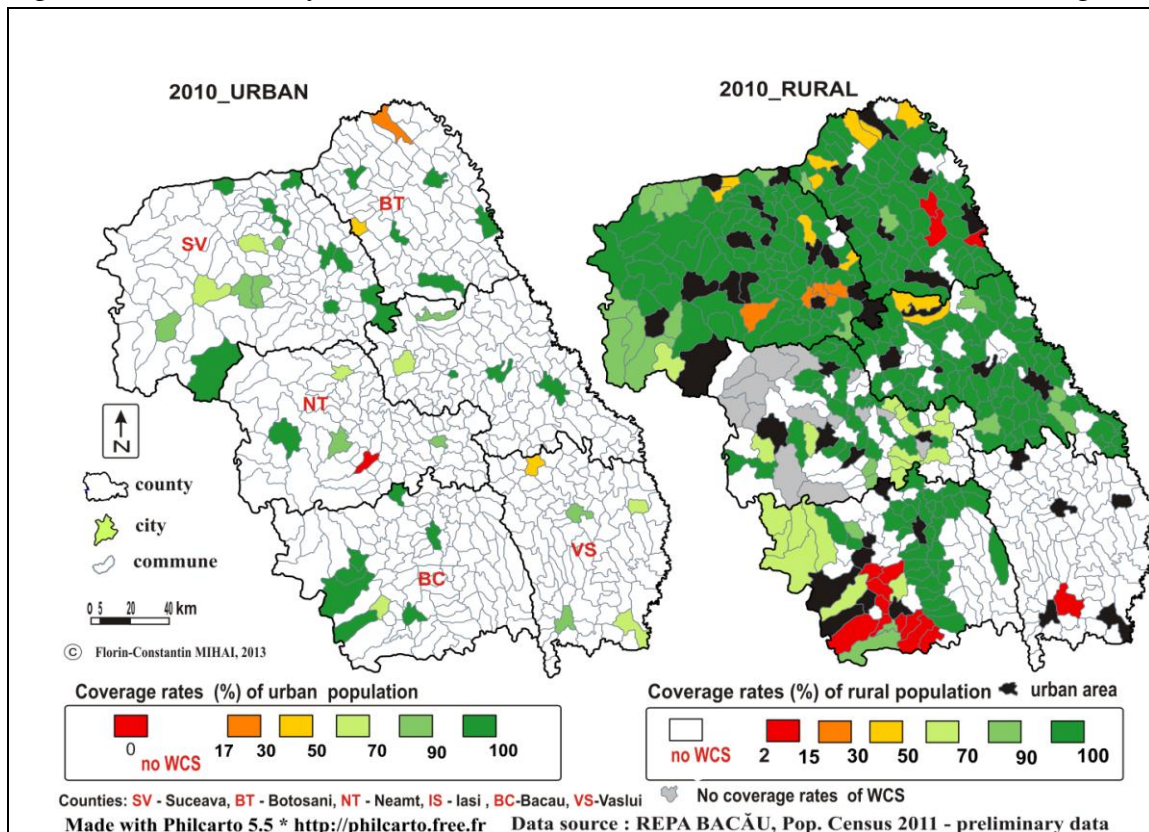
Local rural authorities have begun to set up their own sanitation services or to lease them to private operators from urban areas under the EU regulation pressure. The expansion of WCS from urban to rural areas is emerging in 2010 for several counties such as Suceava, Botosani and Iasi where coverage rates are frequently over 90 %.

The waste operator of Iasi city (“SC Salubris SA”) has significantly expanded his activity in rural areas, particularly after the closure of rural dumpsites in 2009, serving about 153 931 people from 43 communes. Waste operators from smaller towns have also expanded their services toward the surrounding localities. On the other side, some waste operators from Botosani county serve only rural localities such as “DEEA Cleaning Srl” (11 communes- 37 008 inhabitants), Pavra SRL (89361 inhabitants in 24 communes), “REGAN TRANS SRL Roma” (57 323 inhabitants, 16 communes) exceeding the share of urban operators. Significant increases from one year to another was recorded in Botosani county (rural coverage rate of 26.82% in 2009 increasing to 84.44% in 2010 !) and Iasi county (44.38 to 66.24% in 2010) according to the Regional Environmental Protection Agency Bacau. Traditional waste collection (mixed) prevails across the rural municipalities and the amounts of waste collected are transported to urban landfills in the proximity after the closure of rural dumpsites in July 2009.

The high coverage rate of rural population to WCS does not necessarily imply *an efficient waste collection system*. Separate collection is scarcely seen and illegal dumping is still widespread in the field. On the other side, coverage rates may be even higher in reality due to overestimation of stable population at the county level (National Institute of Statistics - data for 2010) caused by external migrations (people working abroad).

Furthermore, the lack of basic waste management services in rural territory of Vaslui county (exception Zorleni commune with 206 people served) encourages the illegal waste disposal practices in the study area as shown in Figure 3.

Figure 3 – Accessibility of urban and rural communities to WCS in North-East Region



The corridor valleys and *subcarpathian depressions* from the western region are best served by WCS unlike isolated Moldavian Plateau areas from Bacau and Neamt counties or critical situation from rural areas of Vaslui county.

Mountainous region of Suceava is better served by WCS which mitigates the local pressures on rivers than Bacau and Neamt counties (lower rates). Development of integrated waste management systems in major cities of counties from the study area (Iasi, Bacau, Piatra Neamt) has created a favorable framework for the extension of WCS in rural areas from the surroundings. This economic segment has known significant progress in a short period of time (2008-2010). Neamt county has a lower coverage rate in 2010 concerning the rural population access to waste collection services in official statistics, but the field trips reveal that several rural municipalities have set up their own sanitation services or contracted private waste operators. Such municipalities (the gray polygons) were not included in the statistical survey of National Environment Protection Agency (NEPA–“GD MUN” – statistics).

Urban waste operators have expanded their activities to peri-urban communes of Piatra Neamt city (SC Bratner Ecological Services SA), Roman city (SC Rossal SA) and Targu Neamt city (SC ECO TG Neamt).

The private sector is significantly emerging in the recent years. Accessibility of waste collection services is poor or non-existent in case of the remote regions to the cities (southeastern of county) or for those isolated from the main traffic roads plus some communes from the mountain region.

Major disparities are revealed in the case of the Bacau county between the western (mountain and subcarpathian sector) and eastern areas (overlap on Moldavian Plateau) due to socioeconomic differentiations across the county. Localities from Siret and Bistrita valleys (corridor sector) are crossed by important traffic roads (European and national roads) which allowed an easier extension of waste collection services from the Bacau city to the surroundings. The urban waste operator (SC SOMA SRL) serves 31 communes and the amounts of waste collected are disposed at the sanitary landfill located in “Nicolae Balcescu” commune. The mountainous western half of the Bacau county (urbanized area) allows an easier extension of waste collection services from the cities located on Trotuş valley toward the surrounding communes leading to a higher coverage rates among the upstream localities of Comanesti and Moinesti cities served by urban waste operators.

The development of these facilities has been possible due to the improving of waste management infrastructure through EU funded projects. The low coverage rates for some localities in 2010 outline the early stage of these services in the southwestern of the county where illegal waste disposal practices are inevitable. Remote communes from the main urban areas and also isolated from major traffic roads due to geographical features (located on subcarpathian hills and Moldavian Plateau) still have no access to formal waste collection services. The costs of waste collection and transport services are reflected in higher sanitation fees charged by private operators. Long distances from a village (waste generation source) until the disposal or recovery facility (such as sanitary landfills or transfer stations) are real challenges for local communities taking into account the affordability of low-income locals concerning the specific costs. Extension of sanitation services to these geographic regions will be possible through large-scale projects such as integrated municipal waste management systems financed by EU funds (SOP ENV).

The local authorities are obliged by law to provide waste collection for localities under their administration. Regional sanitary landfills are under construction as part of an integrated waste management system which supposes to cover all urban and rural communities within a county. Waste hierarchy of EU policy cannot be applied efficiently in Romania due to the low coverage rates of the population access to basic waste collection services and poor recycling and treatment options.

The full cover of WCS will be just a tiny step for a proper waste management system and it must be followed by a correct separate collection of waste streams (paper/carboard, plastics, glass, organic waste metal and aluminium cans) recycling centers, sorting and composting stations, environmental education, sustainable and competitive market in the waste management sector.

4. Conclusions

Spatial analysis of waste collection rate in a multi-scale context reveals national, regional and local inequalities in providing *basic waste collection services*. Regions of the large EU countries (such as Romania and Poland) are not fully covered by organized waste management services particularly in rural areas. Bad practices such as illegal dumping or backyard burning of wastes generated by rural communities are serious environmental threats. Thematic maps are useful tools in order to outline the territorial disparities between Romanian counties, cities and communes from North-East Region concerning the access of urban and rural population to WCS. Geographical analysis of waste indicators is imperative for a proper monitoring process of waste management sector. Spatial implications of this sector cannot be ignored any more in environmental studies, in national, regional and local waste management plans or environmental reports.

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