

Waste collection in rural communities: challenges under EU regulations; a case study of Neamt County, Romania

Mihai, Florin-Constantin

Preprint / Preprint

Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:

Mihai, F.-C. (2017). Waste collection in rural communities: challenges under EU regulations; a case study of Neamt County, Romania. *Journal of Material Cycles and Waste Management*, 1-20. <https://doi.org/10.1007/s10163-017-0637-x>

Nutzungsbedingungen:

Dieser Text wird unter einer CC BY-NC-ND Lizenz (Namensnennung-Nicht-kommerziell-Keine Bearbeitung) zur Verfügung gestellt. Nähere Auskünfte zu den CC-Lizenzen finden Sie hier:

<https://creativecommons.org/licenses/by-nc-nd/4.0/deed.de>

Terms of use:

This document is made available under a CC BY-NC-ND Licence (Attribution-Non Commercial-NoDerivatives). For more information see:

<https://creativecommons.org/licenses/by-nc-nd/4.0>

Preprint version - final publisher version can be found at :

<http://link.springer.com/article/10.1007/s10163-017-0637-x>

Waste collection in rural communities: challenges under EU regulations. A Case study of Neamt County, Romania

Florin Constantin Mihai^{1*}, (single author)

Department of Research, Faculty of Geography and Geology, “Alexandru Ioan Cuza” University of Iasi, B-dul Carol I, Nr. 20 A, RO-700505, Iasi, Romania

*Corresponding author : Email: mihai.florinconstantin@gmail.com ;

Abstract. The paper aims to examine the changes in the rural waste management sector at regional scale since the Romania adhesion to the EU in 2007. Traditional waste management based on the mixed waste collection and waste disposal often on improper sites prevailed in municipal waste management options of transitional economies across the globe. The lack of formal waste collection services in rural areas has encouraged the open dumping or backyard burning. The paper analyses the improvements and challenges of local authorities in order to fulfill the new EU requirements in this sector supported by data analysis at local administrative unit levels and field observations. Geographical analysis is compulsory in order to reveal the local disparities. The paper performs an assessment of waste collection issues across 78 rural municipalities within Neamt County. This sector is emerging in rural areas of Eastern Europe, but is far from an efficient municipal waste management system based on the waste hierarchy concept.

Keywords: waste collection, waste management, municipal waste, rural areas, EU,

Citation: Mihai FC (2017). **Waste collection in rural communities: challenges under EU regulations. A Case study of Neamt County, Romania . Journal of Material Cycles and Waste Management, DOI : 10.1007/s10163-017-0637-x**

1. Introduction

The rural waste management sector is poorly developed in low and middle-income countries compared to urban areas, even a significant share of the population lives in such regions. The rural waste management issues are less debated in the literature than urban areas due to the lack of proper data. There has been little discussion about this issue which focuses on a local scale using the data analysis in a geographical point of view. In this context, the paper seeks to provide a spatial dimension of the waste collection issue across rural areas. Open dumping is a complex environmental threat which is often widespread in rural regions across the developing countries due to the lack of formal waste management services. The illegal dumping of waste has occurred even in countries where waste management systems are better developed and cover almost all population as in Spain [1] or Italy [2]. Rural waste management sector is an emerging issue in developing and transitional countries across the world [3-5]. The landfill is far the main waste management option across new EU member states [6-7]. Reorganization of waste collection services, closure or the upgrade of non-compliant landfills, development of recycling centers are priorities in the case of new EU members [8-9]. The implementation of Landfill Directive 1999/31 is challenging even for older EU countries such as Greece [10]. The investments in the modernisation process of municipal waste management sector are expensive and CEE countries rely on EU funds [11-12]. Extension of waste collection towards less populated areas lead to a reduction of illegal dumping activities [13]. The changes of municipal waste composition varied differently among urban and rural households in the last decade which lead to different waste management options [14]. Rural areas of Eastern Europe were often ignored by waste management services until the implementation of the EU Landfill Directive. Recent studies pay attention to rural waste management issues from Poland [15-16], Romania [17] or from EU candidate countries such as Serbia [18] concerning illegal waste disposal practices, poor waste management facilities and future perspectives related to EU waste policy. The inter-municipal cooperation should be developed in order to combat the administrative and logistical inefficiency of rural areas with poor results in terms of separate collection and recycling activities [19]. Romania must upgrade the poor waste management facilities across rural municipalities. The paper examines the progress and the gaps of a new EU member in rural solid waste management sector.

2. Material and Methods

2.1. Study area

Neamt County is located in North-East Region of Romania, the Eastern border of EU. The population is 470776 inhabitants according to the last Population Census (2011), of which 301167 lives in rural areas and only 169599 people are residents in urban areas. The administrative territorial unit of this county includes 5 cities (Piatra Neamt - county capital, Roman, Targu Neamt, Bicaz, and Roznov) and 78 communes as shown in Fig.1.

The commune is the basic administrative unit for Romanian rural areas which may include one or more villages and where a single village play the role of the local administrative center. The landscape varies from mountain region in the western half to subCarpathian depression and hills in the center to corridor valleys (Moldova and Siret rivers) and the plateau region in the southeastern part of the county.

2.2 Data source and the geographic analysis

Raw data of waste streams (eg. amounts of mixed household waste collected, amounts of separately waste collected breakdown per waste fractions, number inhabitants served by waste of collection, waste collection facilities, frequency, and type of waste collection, sanitation fees) were collected from local authorities, waste operators and Environmental Protection Agency of Neamt County in order to calculate at commune level the main waste indicators. The analysis of quantitative data related to local geographical areas, demographic features and between rural municipalities is a difficult task. The paper analyzes the annual and monthly variations of the household waste stream in case of the five communes in order to outline the seasonal variations. The comparative analysis regarding the amounts of waste collected (2011-2012) reveals some oscillations within a commune or between rural localities served by the same waste operator. The accurate records of waste streams (mixed/separately collected, recovered and disposed) owned by the local authorities or waste operators are crucial in the analysis of key performance indicators, especially in a geographical context. The responses received from local authorities vary from case to case, some of them the are incomplete, inaccurate or local authorities have no such data. Most of the waste collection services are delegated to private operators and they also have no concrete data at the commune level because the data are mixed with other rural municipalities. Some of the waste operators refuse to share the waste statistics data. Therefore, the quality of the data varies from the one commune to another or between waste

operators. The majority of waste fractions data are volumetric estimations based on bin/containers volumes or according to the garbage compactor truck capacity.

There are no weighbridge systems at Roman and Targu Neamt landfills where most of the localities disposed their waste. Data submitted in tons are obtained based on volumetric estimations (the waste operator using a specific density of $0.4t/m^3$). The household waste is transported via a waste compactor truck (including waste fractions collected from population & economic agents). The quantitative and qualitative data are displayed by thematic maps which reveal on the one hand, the coverage rates of the rural population access to waste collection services and on the other hand, the current waste collection methods used by rural communities.

2.3 Governance of waste management sector

The closure of non-compliant urban landfill sites according to the calendar stipulated into Government Decision nr. 345/2005 [20] which transposed the EU Landfill Directive 1998/31 led to serious governance issues associated to waste management sector. The papers examines the implications of the landfills closure deadlines on rural municipalities of Neamt county such as: (i) 16 July 2009 - the closure of local dumps from rural areas and Bicaz city landfill (ii) 16 July 2012 - the closure of not-compliant landfills of Roman and Targu Neamt cities;

In 2014, the new regional sanitary landfill located in the Girov commune should be operational until the end of the year. In this context, the paper examines the garbage crisis (2014-2015) due to the legal issues debated in the regional mass media. Local details are provided for some communes in order to reveal the concrete difficulties encountering by local authorities in providing basic waste collection services.

3. Results and Discussion

3.1. The closure of wild dumps and non-compliant urban landfills

Local dumpsites, river dumping, and open burning were the main options for rural waste disposal until 16 July 2009. A little attention to this issue has been paid by rural municipalities till then, but environmental authorities have begun a better monitoring of the law enforcement. The calendar of urban landfills closure stipulated by G.D. nr.345/2005 [20] created several difficulties at the county level such as:

- (1) the obligation of local authorities to close and rehabilitate the rural dumpsites by 16 July 2009;
- (2) the local authorities are obliged to provide regular waste collection services across their administrative areas and to transport the wastes collected to urban landfills since the above deadline;

- (3) the non-compliant urban landfills (where these wastes could be disposed within the county) should be operational until 16 July 2009 (Bicaz) and 16 July 2012 (Roman & Targu Neamt);
- (4) poor budgets allocated to waste management sector, particularly in the case of rural communities.

The gap between the deadlines mentioned above and the implementation status of the new integrated solid waste management system at the county level led to serious issues in waste management sector during July 2012 and July 2015 (subsection 3.9).

3.2. The expansion of waste collection services (WCS) in rural areas

Rural waste management sector is in a full expansion process at national, regional and local levels in order to comply the targets assumed by Romania to EU. The waste collection companies prefer to serve dense urban centers with high population density and avoid sparsely populated rural areas with a lower-income population [21]. In Neamt county, most of the rural municipalities have a coverage rate over 70 % to waste collection services in 2012 according to Figure 2. The map also reveals the lack of such services in 7 communes and poor coverages (< 50 %) in Brusturi and Negresti communes. Waste operators have expanded their services towards rural areas after the closure of rural dumpsites in July 2009 compared to previous years [22]. This fact is visible year by year since 2009 due to the expansion of the private sector. In the first phase, urban operators have extended their activity in surrounding rural areas (SC Rossal SA Roman, SC Bratner Ecological Services Piatra Neamt, SC Romprest Service SA) then, the new waste operators came into the local market (SC Ave Huron SRL, SC Lemar Industries SRL, SC DDD Service SRL, SC Eurosas Trade SRL, SC Diana Service SRL). There are long distances between the collection point and landfill site, for example, wastes collected across Tazlău & Căndești communes are transported to Târgu Neamt city landfill. In other cases, the wastes collected from communes in the vicinity of Bacău County (Români, Podoleni) are disposed in the urban landfills of Buhuși or Bacău cities (Nicolai Bălcescu-sanitary landfill) which are located in the Bacău county. The coverage area of certain waste operators can be locally (e.g. SC Huron Ave-Bicaz Valley) or to overlap with a heterogeneous geographic region. For instance, SC Agmady SRL Durău collects the wastes from communes located in a mountain area (Ceahlău, Grinties, Farcașa, Hangu) or Moldavian Plateau (Bozieni, Oniceni). These wastes are collected from economic agents, local institutions or households. Most of the municipal waste collected across the county, during July 2009 – July 2012 were transported to old urban landfills of Târgu Neamt (see Figure 3) and Roman cities.

3.3 Alternatives for non-compliant landfills

Piatra Neamt, the capital city of Neamt county, has a modern waste management system supported by ISPA funds since 2007, but the sanitary landfill must accept only the garbage generated within the city. In this context, the peri-urban communes (Dumbrava Rosie, Girov, Garcina, Alexandru cel Bun) were forced to look for other alternatives with supplementary costs due to the transport. The investments achieved with pre-accession funds (PHARE-CES) had been implemented and new facilities (1 transfer station, 2 sorting plants) have been operational since 2011 in the county, serving the surrounding communes of Bicaz, Targu Neamt & Roznov cities. In order to avoid to the transportation of waste in other counties at higher costs, two temporary sites (dumps) were designed in the proximity of old landfills (Roman – 25 000 m³, Targu Neamt – 13 000 m³) in the summer of 2012. This temporary solution was an environmental compromise of local authorities because the new regional sanitary landfill was under construction and the old landfills should be closed until 16 July 2012. The residual waste collected (mixed fraction) from Roznov, Bicaz and surroundings communes were transported to Roman city landfill site. Furthermore, these two temporary sites are non-compliant with EU standards, pollute the surroundings and these has a limited capacity, serving three cities and dozens of communes. Basically, all the wastes disposed in these sites should be transported to the new regional sanitary landfill located in the Girov commune. This fact will imply supplementary costs for waste operators and local councils.

3.4. Lack or poor waste collection facilities

Seven communes (Doljești, Dulcești, Icusești, Pancesti, Poienari, Pastraveni, Bargaoani) were not covered by WCS in 2012 as shown in Fig.1, the wastes generated are disposed on improper sites (roadsides, riverbanks, pastures, creeks) or burnt by the inhabitants. The field observations revealed that waste dumping is still present and poor waste management services are implemented across several communes due to the lack of funds. Some inhabitants still refuse to pay the sanitation fees because the uncontrolled waste disposal is a cheap and convenient bad practice. Backyard burning or river dumping still occurs in the proximity of households, particularly in the mountain or sub-Carpathian sector of the county. Lack of appropriate infrastructure and improper location of collection points within a commune favor this bad practice. In this context, waste collection through "door to door" system may be more suitable. New regulations stipulate that the frequency of waste collection from community points should not exceed the following deadlines [23]: (1) in the warm season (April 1 to 30 September) daily from the central areas, catering

establishments, health facilities with beds, kindergartens, and nurseries and at most two days in other areas for biodegradable and residual fractions;

(2) in the cold season (October 1 to 31 March) within 3 days for all areas;

(3) once of 3 days in case of dry recyclables

Furthermore, waste collection through „door to door” system must be performed once per week for biodegradable and residual fractions and once per two weeks in case of dry recyclables. This system is commonly encountered in the rural areas and households districts of urban areas. The waste collection infrastructure varies from one community to another, depending on financial resources. For instance, in the case of the Trifești commune, the waste collection is carried from door to door in trash bags (household waste is taken by teams formed by individuals who benefit from the minimum income guarantee under Law 416/2001), transported by their own means or by tractor with trailer at the special collection point provided with containers. At this collection point, household wastes are transported by the waste operator (SC Rossal Roman SA) to the Roman city landfill.

Some localities (villages) are inaccessible and private waste operators do not consider economically profitable to serve all the villages within a commune, therefore, such local authorities need to provide the primary waste collection services. Thus, the household waste collected is transported to the collection center (administrative village) then carried out by the waste operator to the urban landfill site. In other cases, containers are spread across the commune where certain public locations are established (based on population density and households). Population performs the primary collection of mixed household waste which are further transported by the waste operator to the urban landfill site.

3.5 Separate waste collection services

The poor infrastructure and the few separate collection facilities across Romania reveal the early stage of waste management system in rural areas. The plastics and paper fractions are expected to increase in Romanian rural areas in the following years. This scenario is valid for other new EU members where source-separate collection must be improved in rural areas[14]. In 2012, the mixed waste collection through „door to door” system prevailed in rural communities (24) of Neamt County, followed by special collection points (13) or a mixed situation between these two options (11). Basically, there is no separate collection at source, no reuse or recycling facilities in these 48 communities (61.5 % of total) according to the Fig.4. The biowaste fraction of household waste is diverted from wild dumpsites via home composting (open piles) and animal feeding. The improvement of home composting

procedure in an organized manner will have a better result in terms of compost quality and net GHG's emissions if 70 % of biowaste is processed as a realistic scenario [24]. On the other side, the pre-accession funds helped the other rural communities to provide separate collection services. The construction of sorting station in Tasca commune (2400 t/yr) has introduced regular waste collection services in the mountain region of Bicz Valley covering one city (Bicaz) and six communes as follows: Tarcău, Tașca, Bicazu Ardelean, Bicaz Chei and Dămuc. Such services are provided by SC Ave Huron SRL which also operates the sorting plant. Waste collection from households is done either by "door to door" method using bags or bins or by collection points (containers –1,1 mc). Recyclables (paper/cardboard, plastic/PET, metal) are processed in sorting plant, the residual & household wastes are transported to the Roman city landfill. Before the sorting station, most of the rural communities were not served by an organized waste collection service favoring the waste dumping into Bicaz river and its tributaries. The Bicaz landfill had to be closed in July 2009 which complicated the situation in the region. The implementation of sorting station in Targu Neamt city has introduced the separate containers in the urban area and waste collection services in surrounding localities (the city plus Băltătești, Ghindăoani, Petricani, Brusturi, Drăganesti & Urecheni communes). The sorting station processes the paper/cardboard, PET bottles and plastics films collected from the population (almost 300 tons per year). The sorting band has a magnet for the metal fraction, and wastes are sorted manually by the workers. The processed recyclables are further sold to economic agents. The transfer station of Roznov city and separate waste collection facilities (plus Piatra Soimului, Borlești & Rădăuți communes) are operational in the southwestern part of the county. Special collection points are placed across villages 4 containers (1- paper/cardboard; 1- PET/plastics, 1- biowaste, 1-residual).

The collection of recyclables (from the commercial sector and/or households) was performed in other several communes in 2011-2012 as follows:

- Gherăești commune: PET/plastics are separately collected in special containers as 5.72 t in 2011 and 13.89 t in 2012.
- Farcașa commune: 124 m³ of plastics, 50 m³ of paper/cardboard; 12 m³ of wood in 2011; 136 m³ of PET/plastics, 54 m³ of paper/cardboard, 14 m³ wood in 2012; waste collection service is provided by SC Agmady SRL.
- Tupilași commune: 80 t of waste collected (in 2011) of which 0.8 tons of paper/cardboard, 0.5 t PET/plastics were separately collected; in 2012, 93.5 t of waste collected of which 1.33 t of paper/cardboard and 2.8 t PET/plastics were separately collected

- Tazlău commune (in 2012): 1.09 t of PET (six containers); 0,455 t of paper/cardboard; 0,003 t of metal (Al); 5 t of WEEE The SC Ecorec Recycling SRL recovers these recyclables

These recyclables are sent to recovery units (companies) by waste operators. Waste management services has experienced an emergent process between 2010-2012 when all municipalities (urban and rural) signed the inter-municipal association agreement "ECONEAMȚ" under the patronage of Neamt County Council which runs the project "Integrated Waste Management System in Neamt County".

Rural areas of Neamt county will be provided with waste collection platforms with residual (mixed fraction) and source-separated containers which are further discussed in subsection 3.8.

3.6 Waste collection costs

The costs of sanitation services (2009-2012) were supported by the local budget or by the population through annual or monthly fees. For instance, according to the Bahna Hall, the expenses of sanitation services (established by contract with SC ROSSAL SRL Roman) was carried from local budget as follows: 44679 lei in 2010 (44000 LEI = 10 000 EUR), 44407 in 2011 and 54066 lei in 2012 varying according to the amounts of waste collected (volumetric estimations) such as: 667/663/806 m³, with no separate accounts for population and economic agents.

The taxation system and sanitation fees vary from case to case (depending on the collection method, infrastructure, waste operator, transport, waste disposal site) for population/households and businesses as follows (source of data: local authorities)

- Brusturi - 4.11 lei inhab.month (4,4 lei = 1EUR), 12.48 lei for bin of 240 l/month (companies) in 2012 ;
- Drăgănești – 51 lei/m³ (2012);
- Urecheni – 2,4 lei.inhab.month ; 45 lei / month (economic agents) in 2012
- Alexandru cel Bun- 27.92 lei /household/month, 55,85 lei per economic agent/month (2012)
- Agapia - 5 lei / family / month (2009)
- Pângărați - 25 lei/household/bin of 240 l/month, 1,6 lei/inhab/month per eurocontainer 1,1 m³ (2010).
- Timișești -5 lei / family / month (15. 09.2009)

Partial coverage of waste management services implies a share of the population who do not pay these services. On the other hand, although the full population may be served, there are households who do not pay the charges for

services received and wastes are uncontrolled disposed into the surroundings. The awareness of population to such services plays a key role for the economic sustainability of this activity and local environmental protection.

3.7 Seasonal variation of household waste collected

Rural waste generation rates are much lower than in urban areas due to: the lower socio-economic conditions, poorer consumption power, a significant share of biodegradable wastes (such as food waste) may be recovered in households as compost or for livestock feed. The recyclables (paper /cardboard, plastic, metal, wood, glass) textiles or inert fractions (construction, demolition) are usually discharged in bags or containers. However, some organic fraction from gardens, agricultural sources or manure may be encountered in the mixed containers.

Per capita waste generation rates is frequently smaller than $0.3 \text{ kg.inhab.day}^{-1}$, but significant fluctuations may appear across several communes in the county $0,01 - 0,9 \text{ kg.inhab.day}^{-1}$ [25]. The most populated commune of the county, Sabaoani commune (9901 inhab in 2011), has a waste generation rate of $0.63 \text{ kg.inhab.day}^{-1}$ in 2009.

The waste management plans have a default value set to $0.4 \text{ kg.inhab.day}^{-1}$ for rural areas and of Romania and $0.9 \text{ kg.inhab.day}^{-1}$ for urban areas. Such fluctuations are also encountered in rural areas of emerging economies. As an example, in China, waste generation rates range from 0.25 to $2.1 \text{ kg.inhab.day}^{-1}$ [3]. Geographic and socio-economical features of municipalities influence the waste production per capita. For instance, in Greece, per capita municipal waste generation varies from $0.23 \text{ kg.inhab.day}^{-1}$ in East Zagorio (Epirus) to 3.59 in Vari (Attica) and the smaller rates ($< 0.8 \text{ kg.inhab.day}^{-1}$) characterized the small (1000-3000 inhabitants) and rural municipalities, particularly those located in mountain regions [26].

The comparative analysis (annual and monthly) regarding the amounts of waste collected reveals frequent oscillations within a commune or between rural localities served by the same waste operator (as shown in Figures 5 and 6.) There is a downward trend of household waste collected in the cold season (November-December-January-February) and a progressive trend in April-August. Monthly changes in 2011 are stronger than in 2012, but the latter case reflects a more homogeneous annual trend. Also, the amounts of waste collected in 2011 are lower with a maximum in July and August, in contrast to 2012 when the peak is from May to June. The oscillation of the amounts of waste collected within a commune is derived from the data accuracy, particularly in 2011. Major differences between communes may be explained by the demographic factor and by the coverage rate of waste collection services.

In the case of Brusturi commune, only 611 persons are reported to be served by the waste operator in 2011 and 624 in 2012, although the total population was 3852 inhabitants according to the Population Census in 2011. According to this data, only 50 % of the main village (Brusturi) is served by the waste operator in 2012 compared to full coverage (100 %) in the case of Draganesti (1382 inhab.), Baltatesti (4090 inhab.) and Ghindaoani (1807 inhab) communes. There is a significant increase of household waste collected in 2012 compared to 2011 in case of Brusturi commune (193 t.yr⁻¹ to 353 t.yr⁻¹) and Baltatesti commune (480 t.yr⁻¹ to 600 t.yr⁻¹), a relatively constant rate for Ghindaoani (170 to 176 t.yr⁻¹) and a decrease in case of Drăgănești (264 t.yr⁻¹ to 234 t.yr⁻¹). The monthly data of 2011 is not available for Urecheni commune, the amounts of waste collected in 2012 is 359 t.yr⁻¹. This variation also depends on the accuracy of data registered by the waste operator. The per capita waste generate rate range between 0.26 to 1.54 kg.inhab.day⁻¹ according to the Table 1. The total household waste collected (HSW) by the waste operator is divided by the number of population served by WCS which reflect the higher rates of Brusturi and Urecheni communes.

If the full population of Brusturi commune is served by WCS, the per capita generation rate will decrease to 0.253 kg.inhab.day⁻¹ in 2012 and 0.138 in 2011 based on actual data of HSW. The waste operator collected larger amounts of household waste than those generated by 624 persons reported, or such amounts are overestimated. The proper assessment of population served by WCS and the amounts of household waste collected is crucial in order to obtain reliable waste generation rates at commune level. Despite the fact the Baltatesti is the most populated commune among these 5 localities and on the other hand, it is a national touristic spa resort, the per capita generation rate is much lower than Brusturi commune. The tourism input could represent over 5 % of total waste generation rate within the commune [27]. There is a clear evidence that data reported for Brusturi commune are questionable.

The calculation and mapping of rural waste generation rates across the communes of a county have several challenges because the lack of basic waste statistics database broken down per local administrative levels [25]. Such statistics must be supported by experimental studies across rural municipalities.

3.8 Regional integrated waste management system

This major infrastructure project „Integrated Waste Management System in Neamt County”

aims the full coverage of county population to proper waste management services and it has several objectives such as (Source: <http://cjneamt.ro/smid/>):

- (1) Full coverage of rural population to residual waste collection via 3024 metallic containers (1.1 m³)
- (2) The expansion of source-separated waste collection schemes in urban and rural areas through collection points (plastic containers 1.1 m³) : 1 container for papers/cardboard; 1 – plastics and metals; 1- glass);
- (3) Separate collection of biowaste in urban areas (households areas) through plastic containers (240 l)
- (4) 52000 of individual composting units (240 l) for biodegradable waste covering 50 % of the rural population;
- (5) Building of 2900 waste manages platforms in rural areas where containers (residual / dry recyclables) will be located (other 154 in urban areas)
- (6) sorting station Cordun commune (in the vicinity of Roman city) – sorting station has a designed capacity 17000 t.yr⁻¹ for source-separated waste fraction such as paper, plastics, glass and metals . This station will serve Roman and 26 communes from south-east of county.
- (7) transfer station with compaction at Cordun - designed capacity 45 000 t.yr⁻¹ , the residual waste generated by Roman and 26 communes will be transported to the regional sanitary landfill site
- (8) transfer station at Tasca commune (in the proximity of Bicaz city) – 9000 t.yr⁻¹ will serve Bicaz city and rural communities from western part of the county
- (9) transfer station of Targu Neamt city - serving the urban area and surrounding communes
- (10) regional landfill site (located in the Girov commune – 27 ha) which will serve all localities in the county except Piatra Neamt city where a sanitary landfill is operational until 2017. The total capacity is 9 million of m³ shared by 3 cells , first – 980 000m³.
- (11) the full closure of non-compliant landfills from Bicaz, Targu Neamt and Roman cities.

The project costs is estimated to be 176.992.016 lei. The financial source is covered by European Regional Development Fund (80 %) Government Funds (18%) and 2 % (local budget). The project is implemented during February 2011 and June 2016. The county waste management system will integrate the previous waste management facilities implemented through Phare–CES such as sorting stations (Tasca commune and Targu Neamt city), transfer station (Roznov city) or ISPA funds (composting and sorting plants - Piatra Neamt city).

3.9 The local garbage crisis

The closure of non-compliant landfills with EU Directive 1999/31, according to the calendar established by the G.D nr. 345/2005, has created several dysfunctionalities of municipal waste management services across urban and rural municipalities during 2009-2014. Despite the fact the new regional sanitary landfill was finished in 2014, the tender process, which delegates the site to a waste operator, was contested by one participant to the court of justice, therefore, the integrated waste management system could not be operational. In this context, the County Council had to pay from the public budget the conservation and security of this facility until a legal waste operator is finally nominated to manage the site. In the meantime, the temporary sites were almost full of waste and further garbages generated by cities and rural communities have no place where to be disposed. This situation has severe implications for the local environment. Mass media reveals that some rural localities dispose their wastes on improper sites, even they have been fined by the local environmental guard. The transport of wastes is too expensive for local budgets of rural councils in order to dispose the garbage to landfills located in other counties. In March 2015, County Council decided to start the procedure for a public administration of Girov sanitary landfill as a temporary solution until a waste operator is nominated by the tender procedure. The landfill is operating from July 2015. This crisis highlights the gaps between the EU deadlines concerning the closure of non-compliant landfill sites (July 2012) and the construction of new waste management facilities in the field (November 2014) with no suitable alternatives in this period than two temporary dumps. Moreover, a court case prolonged this garbage crisis across 2015. In this context, the most of the municipal waste generated in the county (except Piatra Neamt city) have been disposed in the non-compliant sites during these 3 years. The lack of a coherent waste management policy and the bureaucracy between the EU Commission, Government, and local authorities lead to such situation.

4. Conclusions

This paper performs a depth analysis of rural waste management transition toward a sustainable system in the context of EU region (NUTS3) and it points out the local governance issues related to this sector.

The deadlines stipulated by G.D nr. 345/2005 for closure of wild dumps (16 July 2009) and non-compliant urban landfills (Targu Neamt, Roman – 16 July 2012; Bicaz – 16 July 2009) led to serious challenges in terms of waste collection, transportation and disposal of household waste across Neamt County which are highlighted in the paper (subsections 3.1-3.3 ; 3.9). Most of rural municipalities have a waste collection coverage over 70 %, but there are 7 communes with no such basic services in 2012. Mixed waste collection prevails in rural areas where „door to

door” collection system is frequently used. There is no separate collection at source, no reuse or recycling facilities in 48 rural municipalities. Some municipalities have implemented separate collection schemes via pre-accession funds (eg. Roznov city plus Borlesti, Piatra Soimului, and Rediu communes). Taxation system and sanitation fees vary from one municipality to another and private sector has expanded the waste management services towards rural areas since 2009. Seasonal variation of household waste generation (5 communes) reveals the main peak during the warm season (May- July) and the second one in October. The per-capita waste generation rates range between 0.26 -0.6 kg.inhab.day⁻¹, but an overestimation is observed in case of Brusturi commune due to the questionable raw data. The improvement of waste statistics (based on weighings) at commune level is imperative for future studies. The local garbage crisis led to disposal of household waste in two temporary dumps (Roman, Targu Neamt) and favored the illegal dumping practices across rural areas. The new regional integrated waste management system aims to cover all rural municipalities to proper waste management services. The regional sanitary landfill (Girov commune) , transfer stations (Tasca, Cordun, Targu Neamt and Roznov) will provide the disposal solutions for residual household waste collected among rural localities via waste collection platforms . Sorting stations (Piatra Neamt, Cordun, Tasca, Targu Neamt) , composting plants (Piatra Neamt city) and individual composting facilities will increase the recycling and reuse rate of biowaste and dry recyclables across the county. The rural solid waste management sector must be further analyzed in a geographical context in order to provide a holistic approach and to help the decision-makers to implement viable waste management policies related to local, regional and national features.

5. References:

1. Lucendo-Monedero AL, Jordá-Borrell R., Ruiz-Rodríguez F (2015) Predictive model for areas with illegal landfills using logistic regression. *Journal of Environmental Planning and Management* 58 (7):1309-1326 . doi: 10.1080/09640568.2014.993751
2. De Feo G, Cerrato F, Siano P, Torretta V (2013) Definition of a multi-criteria, web-based approach to managing the illegal dumping of solid waste in Italian villages. *Environmental Technology* 35:104-114. doi:10.1080/09593330.2013.816328
3. Zeng C, Niu D, Zhao Y (2015) A comprehensive overview of rural solid waste management in China. *Front. Environ. Sci. Eng.* doi 10.1007/s11783-015-0816-8

4. Taboada-Gonzalez P, Aguilar-Virgen Q, Ojeda-Benitez S, Armijo C (2011) Waste characteristic and waste management perception in rural communities in Mexico: a case study. *Environmental Engineering and Management Journal* 10(11): 1751–1759
5. Taghipour H, Amjad Z, Aslani H, Armanfar F, Dehghanzadeh R (2016). Characterizing and quantifying solid waste of rural communities . *J Mater Cycles Waste Manag* 18 (4): 790-797 doi:10.1007/s10163-015-0365-z
6. Dubravská M. (2014) Recycling of the MSW in the Slovak Republic . *Journal of Economic Development, Environment and People*, 3 (3) : 66-71
7. Gabršček AE, Išljamović S (2011). Communal Waste Management: Case study for Slovenia. *Management - časopis za teoriju i praksu menadžmenta*, 16 (60) : 35-41.
8. Stanic-Maruna I and Fellner J .2012. Solid waste management in Croatia in response to the European Landfill Directive. *Waste Management & Research* 30(8): 825– 838. doi: 10.1177/0734242X12444897
9. Szántó R (2011) Waste Management Facility Siting and Social Conflicts – the Case of Hungary In: Kumar S. (Ed.) *Integrated Waste Management - Vol I: 41-55* InTech . Available from:
<http://www.intechopen.com/books/integrated-waste-management-volume-i/waste-management-facilitysiting-and-social-conflicts-the-case-of-hungary>
10. Lasaridi K. (2009) Implementing the Landfill Directive in Greece: problems, perspectives and lessons to be learned. *The Geographical Journal*, 175 (4): 261–273. doi: 10.1111/j.1475-4959.2009.00342.x
11. Cudecka-Purina N. (2011) Evaluation of Financial Investment Effectiveness in Latvian Waste Management Regions. *Scientific Journal of Riga Technical University: Safety of Technogenic Environment* 1:14-20
12. Scheinberg A, Mol A.P.J (2010) Multiple modernities: transitional Bulgaria and the ecological modernisation of solid waste management. *Environment and Planning C: Government and Policy*. 28: 18-36.
doi:10.1068/c0926
13. Podgaiskyte V (2014) Waste management sector value changes in Lithuania along the last decade. *Procedia - Social and Behavioral Sciences* 110: 512 – 519. *Contemporary Issues in Business, Management and Education* 2013
14. Doležalova M, Benešova L, Zavodska A (2013) The changing character of household waste in the Czech Republic between 1999 and 2009 as a function of home heating methods. *Waste Management* 33(9): 1950–1957.

15. Malinowski M, Kopytko A.M. (2014). Assessment of segregated waste accumulation efficiency in selected suburban communities. *Polska Akademia Nauk, Oddział w Krakowie*, s. 6 (3), 1499–1512. doi: <http://dx.medra.org/10.14597/infraeco.2014.4.3.114>
16. Steinhoff-Wrzeźniewska A. (2015) The pilot study of characteristics of household waste generated in suburban parts of rural areas. *Journal of Ecological Engineering* 16 (2), 92–100, doi: 10.12911/22998993/1862
17. Mihai FC, (2015) Spatial distribution of rural dumpsites parameters in Romania. *Bollettino dell'Associazione Italiana di Cartografia* 154 , 93-101 doi: 10.13137/2282-472X/11830
18. Nenković-Riznić M, (2011) Socio-cultural models as an important element of the site selection process in rural waste management. *SPATIUM International Review* 26:1-6 , doi: 10.2298/SPAT1126001N
19. Poldnurk , J. (2015) Optimisation of the economic, environmental and administrative efficiency of the municipal waste management model in rural areas. *Resources, Conservation and Recycling* . 97: 55–65
20. Government Decision (G.D) nr.345 /2005 regarding the landfill of waste
21. UNECE (2012) Environmental Performance Reviews, Romania, Second Review
22. Mihai FC., Lămășanu A. (2013). Spatial analysis of dumpsites volumes from rural territory Case study: Neamț County, Romania. *Forum Geografic* 12 (1): 59-60. doi: 10.5775/fg.2067-4635.2013.063.i
23. Decree No. 82 of 9 March 2015 approving the framework-regulation regarding the sanitation services of localities [in Romanian]
24. Mihai, F.-C., Ingrao, C., (2016), Assessment of biowaste losses through unsound waste management practices in rural areas and the role of home composting, *Journal of Cleaner Production*
<http://dx.doi.org/10.1016/j.jclepro.2016.10.163>
25. Mihai FC, Oiste AM, Chelaru DA (2014) Rural waste generation : a geographical survey at local scale. 14th International Multidisciplinary Scientific GeoConference on Ecology, Economics, Education and Legislation SGEM 2014, Conference Proceedings, 1:585 – 593 doi: 10.5593/SGEM2014/B51/S20.080
26. Lasaridi KE, Rovolis A, Abeliotis K (2006) Waste management costs in Greece: spatial patterns and causal factors. *Environmental Economics and Investment Assessment* 98 : 55-64 *WIT Transactions on Ecology and the Environment*
27. Mihai, F.C., 2013, Tourism implications on local waste management. Case study: Neamț County, *Present Environment and Sustainable Development*, 7 (1): 214-221

Table 1. Waste collection data broken down per commune

Commune	Pop.2011 (Census) Inhab.	Pop. served	WCS (%)	HSW 2011 (t.yr ⁻¹)	HSW 2012 (t.yr ⁻¹)	WGR 2011 kg.inhab.day	WGR 2012 kg.inhab.day
Brusturi	3812	624	26.23	193	353	0.847	1.54
Draganesti	1382	1382	100	264	234	0.523	0.463
Baltatesti	4090	4090	100	480	600	0.321	0.401
Ghindaoini	1807	1807	100	170	176	0.257	0.266
Urecheni	3343	2499	74	no data	542		0.594

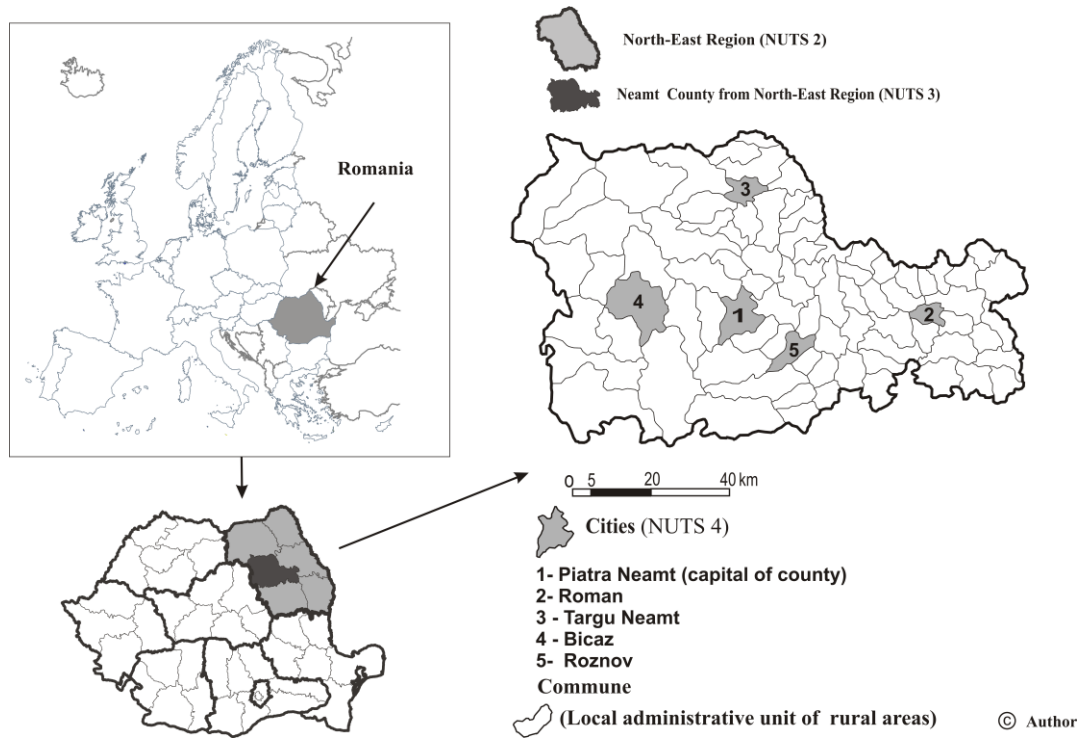


Fig.1 Geographical location of Neamt County and local administrative units

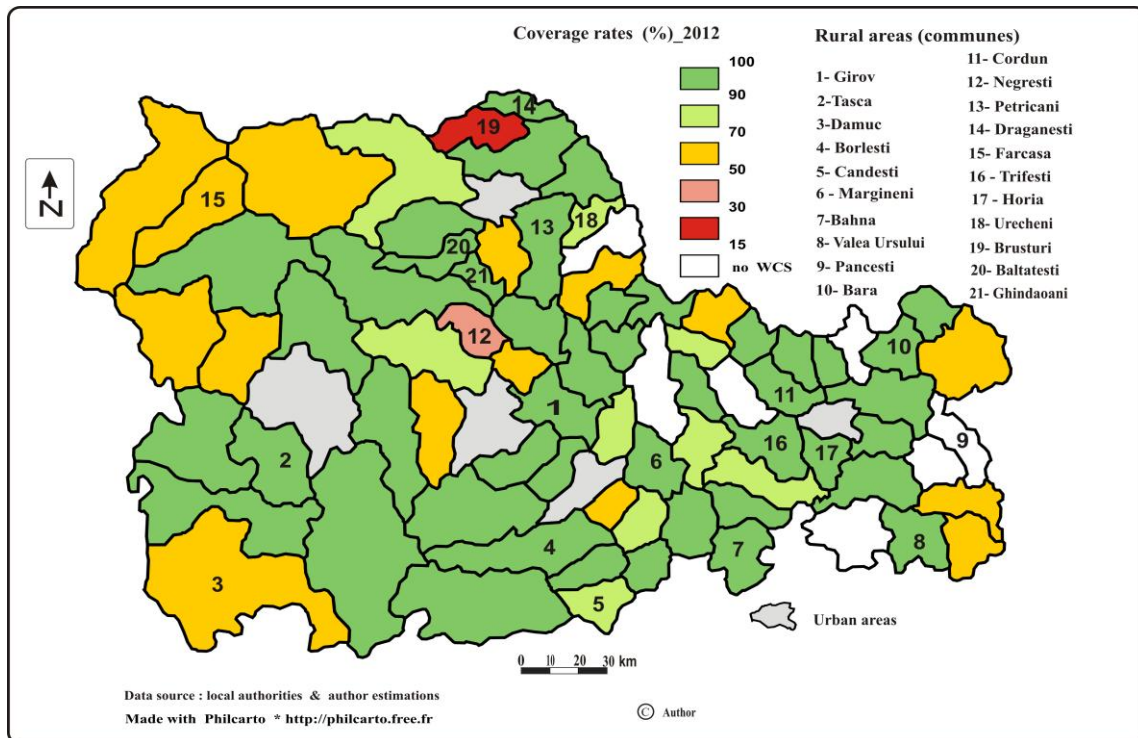


Fig.2 Coverage rates of waste collection services (reported & estimated data) at commune level in 2012. The numbers refer to the communes which are discussed in the paper and cover different geographical areas; not all communes can be labeled because will affect the map visibility.

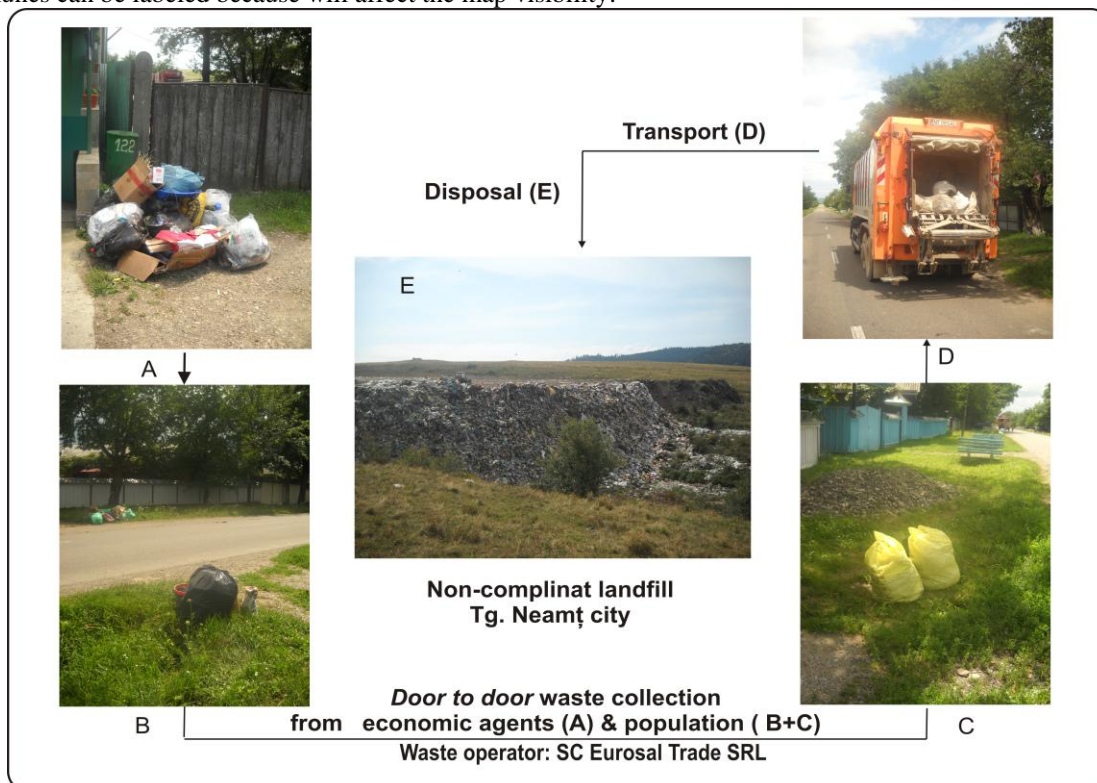


Fig.3 Mixed waste collection system in Petricani commune (2011)

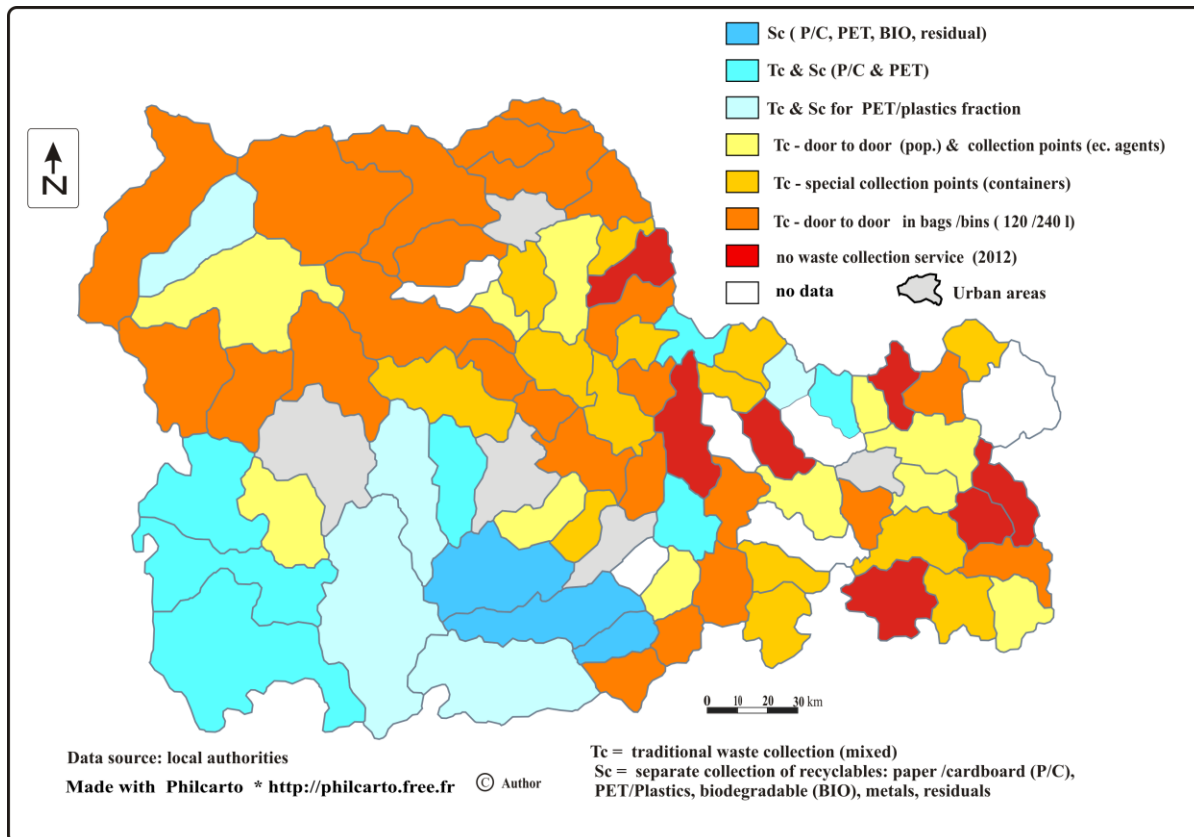


Fig.4 Waste collection facilities across rural municipalities (2011-2012)

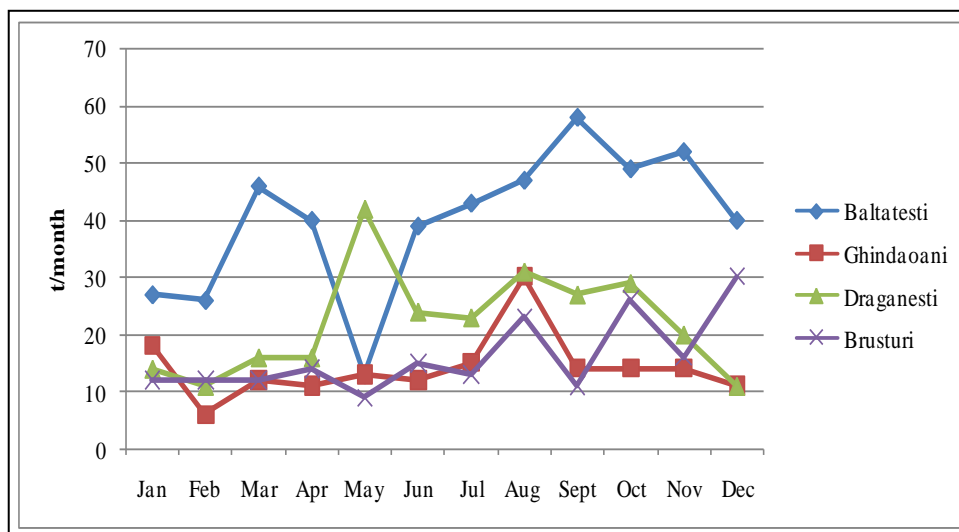


Fig.5 Household and similar waste monthly collected from communes in 2011

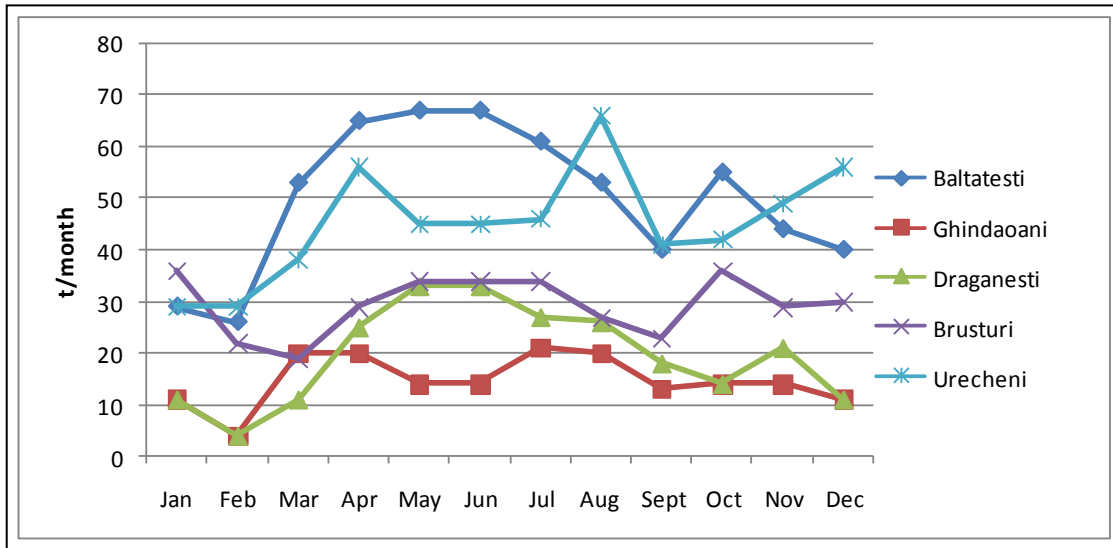


Fig.6 Household and similar waste monthly collected from communes in 2012