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ABSTRACT

This paper examines the current challenges in urban waste management systems under EU regulations for a newcomer state. Piatra Neamț is among the first Romanian cities which made the transition from a traditional to a modern waste management infrastructure through ISPA funds. These changes are poor reflected in rate of recyling and treatment so far according to analysis of waste streams. The paper performs a critical review of waste management services and also assesses the vulnerability to illegal dumping. Inappropriate sites of waste management facilities contribute to environmental pollution and urban landscape degradation. Comparative analysis between pre-accession period vs. current situation highlights one the one hand the improvements in this sector and on the other hand the difficulties to comply EU targets.

Keywords: waste streams, EU acquis, infrastructure, city, spatial issues .

INTRODUCTION

The traditional waste management systems based on mixed waste collection services and landfilling which prevails in most of EU newcomers states [1], are in contradictory to the EU acquis on waste management sector [2]. In this context, new waste management facilities is emerging in Romania according to EU regulations. Furthermore, the urban population is not fully covered by waste collection services favoring illegal dumping of waste (uncollected) particularly in small and midlle cities or in rural localities annexed to administrative territorial units (ATU) of cities [3],[4],[5]. The ISPA and PHARE projects were the main investments from pre-accesssion period in providing new integrated waste management systems from urban areas. The paper analyzes the impact of a such investement on local urban waste management system from Piatra Neamț. Recycling and waste recovery which dominate the waste management options in well-developped countries from EU-15 [6],[7] are in early stages in Romanian cities. Furthermore, the local authorities struggle to close the non-compliant landfills and to replace with sanitary sites or transfer stations. Local waste management plans should focus on sustainable options [8].

METHODS

The paper performs an analysis of main waste indicators at urban scale such as the coverage of waste collection services (WCS %), per capita waste generation (WG kg/per capita/yr), waste composition, separate collection (SC %), reycling and treatment rate (R&T %), landfilling (L %) during 2004-2010 period. Furthermore anual tendency of municipal waste collected (MWC t/yr) is completed by a monthly analysis for 2007-2011. The raw data were provided by Local Environmental Protection Agency of Neamț County, waste operators and local authorities. These waste indicators are not available at such scale in regional or national waste management plans or even for annually local environmental reports. Often, data are provided at regional scale (NUTS 2) or county level (NUTS 3) which are useless for a proper monitoring of waste indicators at administrative territorial units (ATU) such as cities or communes. The paper also examines the changes of waste management infrastructure between pre-accession (old infrastructure) and post–accession period (operational integrated waste management system since 2007). Quantitive estimation of Q_{wu} indicator (amounts of waste uncollected) made for urban areas [4] has the role to outilining the illegal dumping issue on local scale. Spatial implications of waste management facillities are examines according to local geographical conditions using GIS techniques.

RESULTS AND DISCUSSION

Waste collection services (or people which signed contracts) covered only 60-70 % of urban population during 2004-2010 despite of new operational urban waste management system since 2007. This fact are a major disadvantage for a proper performance of this modern waste management infrastructure and also lead to illegal dumping. It is noted that other rural localities ,without access to such services, inside the ATU of Piatra Neamț such as (Doamna, Văleni, Ciritei - 2,270 inhabitants in 2002) contribute to a lower overall percentage of the city. The evidence of waste operators or local authorities regarding the precisely number of inhabitants connected to these services are less reliable particularly for pre-accesion period (2004-2007). Also county statistics regarding the population of city (stable population which generate the wastes) may be overestimated due to inhabitants left to work abroad leading to a lower value of WCS rate than in reality. It should be noted that the WCS has become outsourced, associations of owners (which are not subordonated to local authorities) have signed their contracts with waste operators. These services were provided until 2007 by public sector respectively by “Salubritas” which had an old equipment for mixed waste collection and transportation. Often waste collection were made into large containers located in the proximity of blocks (4 floors) or special compartiments from ground floor of higher blocks (10 floors). These old collection points specific to traditional waste management systems were all replaced. This process started since 1999 when a pilot project supported by Danish Environmental Protection Agency was implemented for selective collection of household waste. The project provided 27 collection points in study area serving about 2200 people (nearly 2% of city population). Around 200 tonnes of recyclable waste (paper and cardboard, plastic and glass) was collected in every year (2000 & 2001) and recovery rate of these fractions was 80 % . [9].

Under the ISPA program, Piatra Neamț acquired the necessary equipment for 943 separate collection points respectively special containers (660 liters) in different colors such as green color for organic fraction , blue for glass and plastic fractions, brown color for paper and cardboard , black for residual waste (disposed into sanitary landfill). Waste operators market is still changing since 2007 and private sector prevailed this sector. Thus, during 2007-2009 Piatra Neamț has two private waste operators , one the one hand, Bratner Ecological Services for collection, transportation, treatment or disposal of household and similar waste and on the other hand, Romprest SA which collected the street and garden waste. In 2010, Bratner Ecological Services was the only waste operator in Piatra Neamt City until July 2011 where waste management services were divided. Thus, this operator is responsable for collection, transport and recycling activities and on the other side Rossal SA and Salubritas Association is responsable for landfilling operation. The private sector of waste management services from Romanian urban areas is emerging under EU regulations. Per capita household waste generation is a key indicator in the planning of efficient waste management system in a particular city. Household waste is only an important fraction of total municipal waste which includes others streams such as similar waste (economic agents & institutions), street & garden waste, construction & demolition. This indicator is calculated using following formula : Ig (kg/day) = Q_{hw} / P_s /365 , Q_{hw} - amounts of household waste collected, Ps – population served by WCS. The lack of weighing systems reflected the overestimated data on per capita of household waste generation between 2004-2006 vs 2007-2010. Volumetric estimations (m^3) and not reliable data about rate of WCS led to increase values of waste generation. Data for the period 2004-2010 are overestimated for all cities from Neamt County except Piatra Neamț who implemented through ISPA a weighing device at the entrance in the sanitary landfill. There is a clear reduction in household waste generation in the period 2004-2006 and a relatively constant trend from 2007 to 2010 (almost 1kg/per capita/day) due to improvement of quality data. These values are close to average indicator stipulated in waste management plans for urban areas (0.9 kg/per capita/day).

Tab.1. Waste indicators at urban scale during 2004-2010 (pre vs **post- accession**)

Indicators	2004	2005	2006	2007	2008	2009	2010
WCS (%)	60.8	61.06	64.25	**62.91**	**63.47**	**63.59**	**64.72**
HWSC (t/yr)	77982,1	55593,6	60372,18	**36910**	**47847.26**	**49725,96**	**37076,82**
WG kg/per/day	1.96	1.75	1.63	**0.89**	**0.98**	**0.9**	**0.97**
SC (%)	0.12	0.11	0,06	**38.09**	**21,9**	**25,98**	**38.36**
R&T (%)	0.037	0.092	0,068	**9.33**	**20,24**	**4,17**	**3.86**
L (%)	99.96	99,9	99,9	**88.74**	**79,75**	**95,8**	**88.22**
Q_{wu} t/yr estimates	12720.65	12692.54	11683.17	**12696.76**	**13995.37**	**12785.88**	**13316.17**

Raw data source: Neamț- Environmental Protection Agency, waste operators, Piatra Neamț City Hall

In the other cities, municipal waste is mixed collected beside household and street waste. Waste from municipal services (street & garden waste) have higher proportions in small cities (Târgu Neamț, Bicaz) than Piatra Neamț but there a new fraction occured (construction & demolition waste) due to separate collection of this waste stream. Recent studies on waste composition was made thought the Balkwaste Project [10] at regional scale (North-East Region). Waste samples were collected from Piatra Neamț city in order to determine the composition at county level. The result shows that the largest share of organic waste (65.4%) is typical for Neamț County compared to North-East region average (59.4 %) an for recycables [paper/carboad , glass,] the share is smaller than other counties. On the other side, these results highlighting the role of infrastructure development on municipal waste recovery by creating compost and sorting stations (existing since 2007 in the city of Piatra Neamț and transfer stations are recently put into operation in Târgu Neamț and Roznov cities). Based on monthly reports from the waste operator Bratner Ecological Services that develop their activity in Piatra Neamț city, it was carried out an analysis of monthly variation of municipal waste (selective and mixed) during 2007-2011, the data are more reliable because the waste collected and transported to the landfill site are weighed.

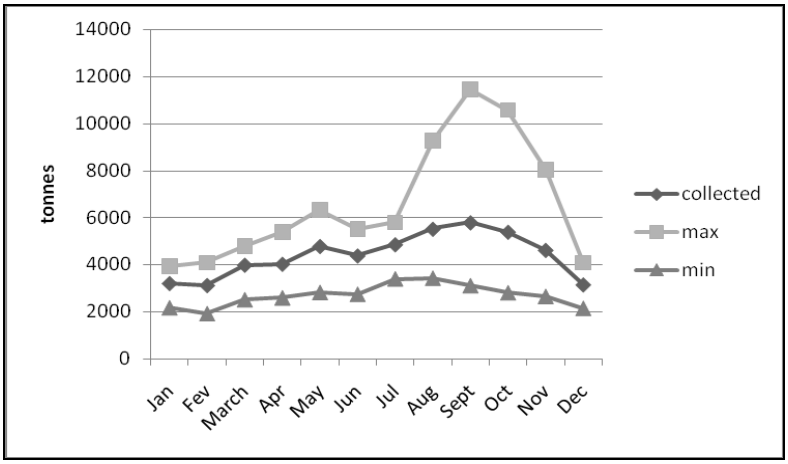

Fig.1 Monthly variation of muncipal waste (total fraction) collected

The graph outlining the seasonal differences of total municipal waste collected, low value during the cold period (November-April average value up to 4,000 tons collected) and higher in the warm season (May to September, average values between 4000-6000 tons collected). These differences are caused by biodegradable fraction that have the largest share in waste composition of municipal waste and higher consumption of population which is reflected in recyclables (plastic, paper/cardboard and glass). Winter supplies (vegetables, pickles, compotes, stews, vegetables, etc.) also contribute to increase of waste collected in September and October. Furthermore, significant differences between maximum and minimum quantities of waste collected overlaps to this interval. It should be noted that the maximum values occurred mainly in the first two years (2007-2008) since the new waste management system was put into operation. Thus, in these two years, the contribution of certain fractions such as construction & demolition waste was significantly (34,214.16 tonnes in 2008 compared to 2126.58 tons in 2010) reflected in the monthly averages. Demolition from the area of Bistrița dam (”Reconstrucție” area) and construction waste from new buildings (Nufărilor street, Văleni – annexed locality) contributed to an increasing amounts of this fraction which was separately collected and transported to the crushing plant (near the landfill site).

Minimum values are recorded especially in 2011 and also bring more reliable because these are not disturbed by certain exceptional values recorded during the first years of the new waste management system. There is a small amount of waste recycled and treated compared to landfilling since the new integrated waste management system is running despite the modern infrastructure implemented as shown in figure 2.

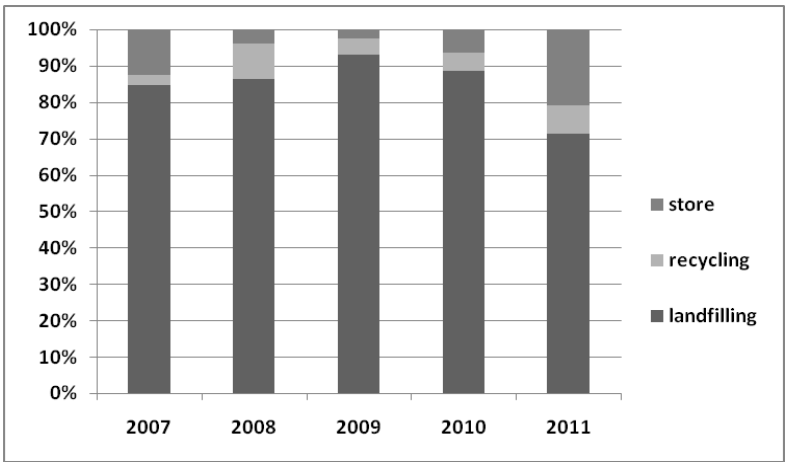

Fig.2 Municipal waste management (total fraction) since new system is operational

This infrastructure include a composting station for biodegradable waste (until 24 000 t/y) being operational 10 months per year due to climatic conditions, sorting station for recyclables (PET, paper, cardboard,) with two sorting lines, (mechanical and manual) the capacity is 3.4 tonnes/hour which means around 7000 tons/year and also, a crushing plant for construction and demolition waste (80 t/yr). This situation is explained by the fact the system was recently implemented and the population does not collect properly the recyclables according to bins or containers destination. To these, is added the lack of demand in the market segment of economic units that use recyclables in the production process which lead to high share of waste stock. Recycled amounts of waste come mainly from economic operators than population. In recent years, the number of economic operators specializing in the collection of recyclable streams (metal, paper/cardboard, PET) increased as a result of national programs which encourage this activity [11]. However, for certain waste types there are no viable options for recovery on national scale (eg glass). Separate collection rate (%) is still under 50 % reflecting the low values of R&T (<10 %) from study period except the 2008 year (21.8%). In this context, landfilling still prevails in waste management options despite of new operational facilities. Traditional period (2004-2006) did not support the waste hierarchy concept, furthermore it favored bad practices such as mixed collection or illegal dumping. The new integrated waste management system promotes the separate collections, recycling and treatment and less landfilling. Although landfilling is still a basic option in current waste management systems it should be noted that all old urban sites from Neamț county were closed (deadline JULY 2012) and replaced with sanitary ones (as for Piatra Neamț city) or transfer stations (Tg. Neamț, Bicaz) also, a new regional sanitary landfill is under construction in Girov commune. The sanitary landfill (two cells) from Piatra Neamț city is located in the proximity of the old site in order to use the existing infrastructure (road access, gate, buildings etc). Also, the new facilities (sorting and composting stations, crush plant) are inside the landfill perimeter or in the proximity. Geographically, the new site is located in lowland area of Bistrița river from Subcarphatian sector, in south- west of city in the range of Vânători locality.

This location is too close (50-250 m) from residential areas (households) and on the other hand from Bistrița river compared to the minimum distance recommended (at least 1km) as shown in buffer areas. The bad location of dumpsites lead to complex pollution of urban environment particularly in case of non-compliant landfills [12]. In order to mitigate the exposure to the floods, Bistrița river was recently dammed in the proximity of landfill site. The old industrial sector, wastewater treatment plant, non-compliant landfill in the proximity of this site contribute to an urban landscape degradation. Because the city is developped mainly on older terrace (higher altitude) the landfill site and surroundings are not highlighted in urban landscape. Still, the concentration of these facilities outlining these area as most susceptible to pollution from city.

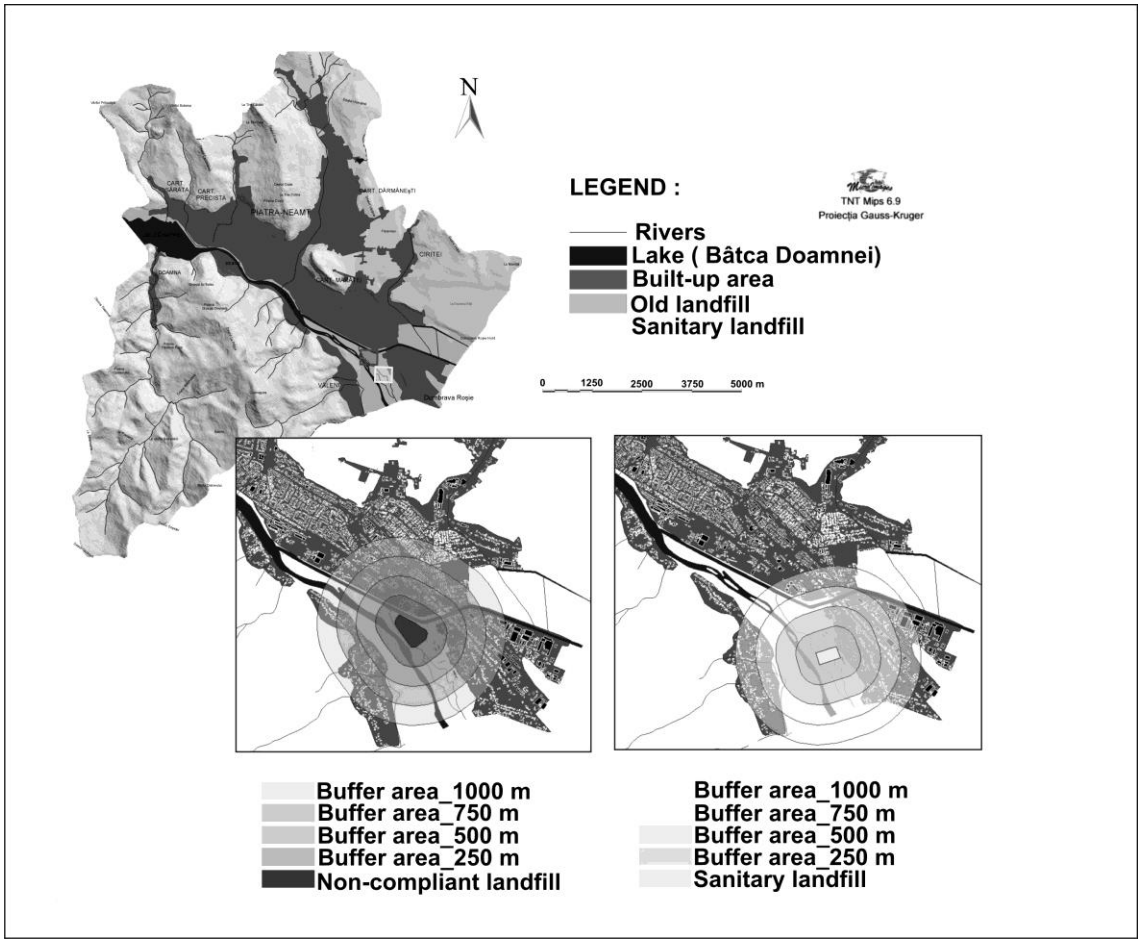

Fig.3 Spatial implications of urban landfills

Furthermore, illegal dumping of various waste is frequently in this area on both sides of Bistrița river. Amounts of waste uncollected (Q_{wu}) by waste operators are the main threats to pollution. High estimated values of Q_{wu} (over 12000 t/yr) at urban scale during 2004-2010 may suggest a high potential vulnerability to waste dumping but in reality most of these wastes are disposed in collection points. On the one hand, population "unserved'' benefit from these services without paying the fees which may lead to a low profitability and on the other hand, this indicator depend on accuracy data concerning the stable population per year and also by the number of inhabitants served by WCS.

The indicator is calculated according to following relation : $Q_{wu} = P_u * I_g$, , Q_{wu} = amounts of waste uncollected, P_u = population unserved, I_g = per capita waste generation (0,8 kg/ inhab. /day). Municipal waste management system must be continually adapted to the factors that favor urban development by implementing selective collection facilities, sorting and composting stations , crushing plant (construction and demolition waste) in order to support sustainable programs for waste recovery and to mitigate their generation .

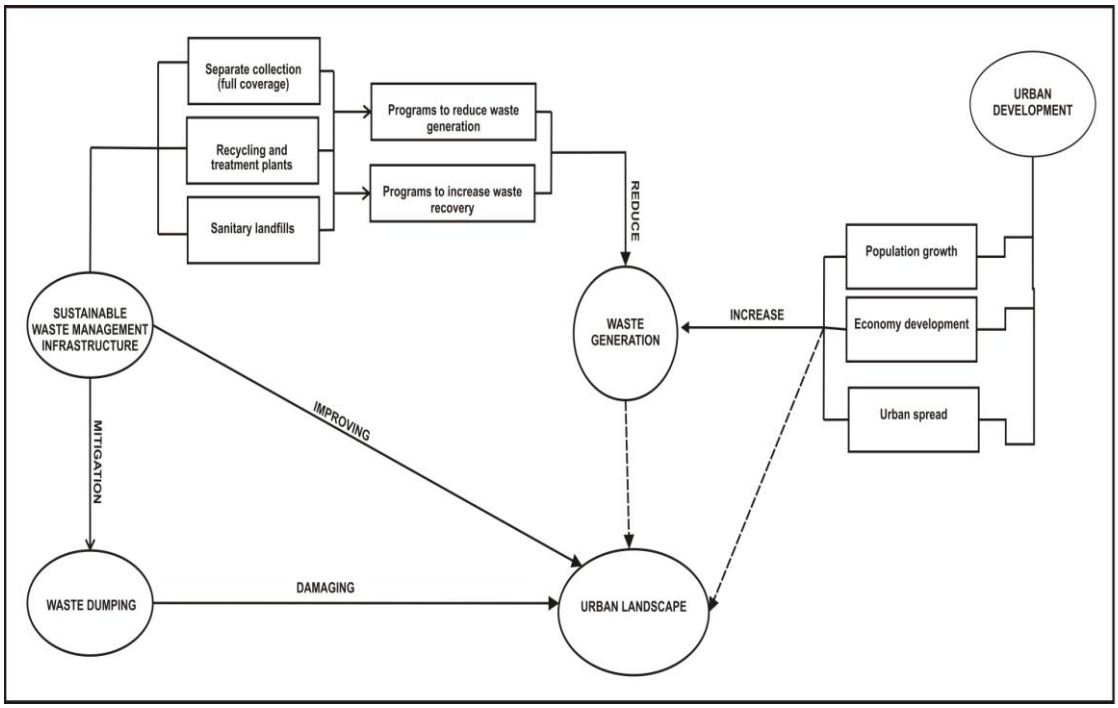

Fig.4 Systemic interactions between waste management system and urban landcape

This step reinforces the transition from a traditional to a sustainable waste management system which will eliminate the problem of illegal dumping protecting the urban environment. The responsibility and receptivity of citizens to such programs will play an important role in the sustainability of this process which finally will improve the quality of urban life.

CONCLUSIONS

The urban waste management transition from a traditional to a sustainable system may be more difficult and lengthy process than predicted in waste management plans. A new modern waste management infrastructure is operational since 2007 through ISPA funds but the rates of separate collection, recycling and treatment are still low. More clearly data regarding the waste flows and people connected to waste management services at urban scale are necessary for a more accurate assessment of muncipal waste management indicators. Landfilling prevails and current situation is unfortunately at the bottom of waste hierarchy concept but the results will improve in following years. However, the urban waste management system from Piatra Neamț has known significant improvements since 2007 compared to pre-accession period being a model at national scale.

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