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Waste management in public educational institutions of Bucharest city, Romania

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Abstract

The educational institutions represent the main components of sustainability promotion in our society. Waste management is one of the challenges that educational institutions have to face in accomplishing sustainability goals. In Bucharest, 457 educational institutions (pre-schools, primary and secondary schools, high schools, special schools) were analyzed using questionnaires. Questionnaires included items related with waste management inside the educational institutions: quantities, collection system characteristics (schedule, selective collection presence, temporary depositing place), responsible for management and influencing factors (total built surface, number of students and educational staff). The results show that most of educational institutions have deficiencies regarding waste management: 47% of the respondents don’t have sufficient information about the generated waste quantities and 49% don’t have waste selective collection systems implemented. Waste quantities generated in educational institutions does not depend on the number of students and the total built surface, but is influenced by the educational institution type. The findings illustrate the difficulty to promote realistic sustainable development actions plans without major changes in public educational institutions from Bucharest.

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1. Introduction

Educational institutions represent environmental degradation sources with a small direct influence on its quality [1]. Resource consumption and the externalities produced are reduced [2], their size depending

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on students/pupils and educational staff number, site and infrastructures technical characteristics (including buildings) and the institutional management [3, 4, 5, 6].

Waste management is one of the most important environmental aspects to be considered within educational institutions [7]. An integrated waste management system in particular, is one of the greatest challenges for higher educational [8, 9] as well as for pre-university educational institutes [10, 11]. The presence of waste educational programs and projects facilitates the improvement of knowledge and awareness concerning recycling and municipal waste [12].

Consistent and accessible recycling infrastructure must be in place and should provide proper knowledge of what is and what is not recyclable [13], all the actions being done with a minimum of inconvenience [14].

In Romania, the total public expenditure on education has decreased to 1.08% of GDP in 2011 compared to 5.4% in 2009 [15, 16, 17]. This important fund reduction limited the ability of educational institutions to respond to legislative measures (e.g. binding of selective collection) and to solve usual management problems like management of green areas, control of energy and water consumptions.

The decrease in funds allocated to educational institutions conducted, as an immediate consequence, to a reduction in the number of people responsible for maintenance and repairs and a decrease of the teachers interest in developing and engaging in new projects.

The funds decrease determined the educational institute’s principals to shift their attention more towards the teaching quality and less towards administrative aspects.

Environmental assessments in educational institutions in Bucharest have mainly focused on students and / or teachers perception of various urban ecosystem problems (e.g. poor waste management, green areas degradation) [18]. Waste management becomes a second place aspect, insufficiently studied and based not on a scientific premise, being supported just by local educational projects.

At the same time, starting from 2002, the Romanian National Government implemented the program *Croissant and Milk*. This program aims to support a healthy nutrition of pupils/students from primary and secondary educational units (I-VIII grade). The program consists in providing a daily lunch that includes milk or milk products and croissant. Despite the benefits of school lunch participation, just 10 to 60% of the students eat the products during school program [19]. This type of behaviour has a strong influence in waste quantities produced in primary and secondary educational institutes [20].

Assessment methods of the waste management in educational institutions and implicitly of the driving-forces of generated waste quantities are focused on qualitative evaluations (questionnaire, surveys) [4], [5, 8], estimations based on national standards [6, 7, 11] or prospective methods [13].

The objectives of this study are:

- to analyze the relation between the category of educational institution and the generated waste quantities;
- to determine the influence that the number of persons have in the generated waste quantities for each type of educational institution;
- to assess the importance of implementing waste management projects in raising the awareness of pupils, students and education staff, quantified through the number of institutions implementing selective collection.

2. Methodology

Bucharest had a spectacular evolution in urban development during the last 40 years, that generated the increase of the build-up area [21], reaching the value of 23787 ha in 2010. Major changes had been made as a result of the socialist policy regarding industrialization and important social modifications took place in social aspects. Although at a national level the tendency for urban population is to fall, Bucharest
is considered to be stable, with a small net in-migration [17]. From the total population of 1,944,367 inhabitants [22] about 14% are between 3-19 years old [18].

Public educational services represent 68% of the total educational opportunities (457 educational institutions), covering all levels of pre-university education. The highest number is represented by primary and secondary level, followed by pre-schools and high schools [16] (Table 1).

Table 1. Educational institutions by level and the corresponding number of pupils in Bucharest [16]

| Educational institutions                          | Number of public institutions | Number of private institutions | Number of pupils / students in public institutions |
|-------------------------------------------------|------------------------------|-------------------------------|-----------------------------------------------|
| Kinder gardens                                   | 154                          | 157                           | 45,536                                       |
| Primary and secondary schools                   | 177                          | 20                            | 108,804                                      |
| High schools                                    | 105                          | 15                            | 72,252                                       |
| Other categories (special schools and sports clubs) | 21                           | No data                       | 5,396                                        |
| Total                                           | 457                          | 192                           | 231,988                                      |

No data available regarding number of pupils/students in private educational institutions

The average number of teachers, auxiliary teaching staff and non-teaching staff in the educational institutions in Bucharest was in 2011 of 24.74 persons (68.8% teachers). The ratio of pupils/students to teachers for all pre-university levels registered a decrease since 2005, reaching a mean value of 14.1 in 2009. Nevertheless, the value is situated beneath the national ratio of 15.9 (pre-school not included) [17].

The study was applied in public educational institutions in Bucharest (Fig. 1). The survey started in September 2010 and ended in January 2011, during this period questionnaires were distributed using face-to-face interviewing with educational unit principals. As the interview was voluntary, 411 accepted to fill in the questionnaire. A number of 218 were containing all the information needed for the analysis.

The questionnaire included dichotomous (concerning waste recycling), nominal-polytomous (regarding frequency of waste collection from the classroom and by private collection services, educational level) and open questions (address, pupil number, educational staff number, generated waste volumes, environmental project participation). Romania’s present structure of pre-university education consists in four levels. The pre-primary level is corresponding to pre-school (3-7 years), the primary level of education (I-IV grade, 7-10 years), the lower secondary level or secondary school (V-VIII grade, 11-14 years) and the upper secondary level to high school (IX-XII grade, 15-19 years).

As the questionnaire was applied in different types of educational institutions, for the accuracy of the analysis, they were compressed in four groups: pre-schools (35% of total units), primary + secondary schools (36%), high schools (19%) and special schools (10 %). The special school category was created to integrate sport clubs and schools for persons with disabilities.

Non-parametric tests Kruskal – Wallis and Mann – Whitney were used for assessing the differences between educational institutions’ categories regarding generated waste volumes, generation coefficient and number of pupils/students [23], [24].

All descriptive statistical analysis, cross tabulations and non-parametric tests were the result of SPSS 13.0 for Windows. ArcGIS 9.3 was used in order to create the spatial database containing the educational institutions in Bucharest.

3. Results

The number of pupils/students per educational institution registered the lowest value in pre-schools (average = 253 pupils, range = 90-540 pupils), followed by primary + secondary school group (average = 605 students, range = 165-1500 students). The values encountered by high schools and special schools are
very close, with an average value of 757 students (range = 104-1276 students), respectively 756 students (range = 77-2200 students).

Fig. 1 Spatial distribution of public educational institutions in Bucharest

Almost the same tendency is kept in the case of number of educational staff, with an average value for all levels of education equal to 36.3 teachers (range = 4 -120 teachers).

The generated waste quantities (average=1668.63 kg; range = 200-9600 kg) were related to the educational institution type (Kruskal – Wallis $\chi^2(3) = 8.92, \ p=0.03$). Waste quantities produced by pre-schools (average = 1754.18 kg, ±1257.69) were significantly higher than the volumes produced by
primary + secondary school group (average = 1262.56 kg, ±1209.76). At the same time, compared to high schools (average = 2582.17 kg, ±2615.74) primary + secondary school group produce significantly lower waste volumes (Table 2). A Spearman’s rank correlation test equal to -0.03 determined that there is no relation between the number of pupils/students and the generated waste quantities (p=0.627).

Table 2 Relation between educational institution type and waste volumes

| Waste quantities(kg) | N  | Min | Max |
|----------------------|----|-----|-----|
| Pre-school vs.       | 77 | 200 | 5700|
| Primary+ Secondary   | 86.00 | 67.47 | 2202.00 | 0.008 |
| High school          | 58.99 | 61.86 | 1539.00 | 0.664 |
| Special school       | 52.62 | 40.82 | 645.00 | 0.089 |
| Primary + secondary vs. | 76 | 200 | 6000|
| High school          | 54.85 | 67.92 | 1242.50 | 0.047 |
| Special school       | 45.63 | 52.52 | 769.50 | 0.570 |
| High school vs.      | 42 | 200 | 9600|
| Special school       | 4800 | 34.50 | 28.66 | 377.50 | 0.232 |

The items marked with italic font represent statistically significant results

To determine the influence that the number of pupils/students and educational staff have in the generated waste quantities, a daily waste generation coefficient was calculated (kg/day for each person). The testes have demonstrated that the coefficient registered differences among each educational institution type (Kruskal – Wallis \( \chi^2(3) = 46.78, p<0.0001 \) and that pre-schools have a significantly higher generation coefficient than all other educational institutions (Table 3).

A Chi square-test was applied to see if the presence of waste selective collection is independent of educational institution type [25]. The result shows that the waste selective collection is another element of waste management that is influenced by educational institution type \( \chi^2(3) = 0.096, p = 0.99 \). At the same time, the presence of selective collection does not determine a statistically significant decrease of the waste quantities (Mann-Whitney U = 5321.00, p = 0.37).

Almost 30% of educational institutions have a cafeteria for serving lunch. The highest percentage is registered in pre-schools, there more than half serve a hot meal (53.25%), followed by special schools (31.82%) and high schools (23.08%). The lowest percentage is registered in primary and secondary schools (8.11%).

In 9% of the educational institutions the provided services include a dormitory. The type differs among educational institution: pre-schools and special schools have an afternoon program (8-18:00 or 8-19:00 during winter), while high schools offer a full time program.

Waste management in educational institutions from Bucharest refers to primary and secondary collection. Most of the educational institutions (63.90%) practice a daily waste collection from class rooms, while 30.24% prefer to collect once in two days. The rest of the institutions practice a more frequent collection (twice a day or during every break time).
66.34% of the institutions stated that they are disposing off the collected waste using private collection services twice or three times a week, 21.22% are disposing weekly, while the rest have other frequencies (daily, 1-2 times a month or when needed).

Table 3 Relation between educational institution type and waste generation coefficient

| Waste generation coefficient (kg/day for each person) | N  | Min | Max | Average | Mean rank variable 1 | Mean rank variable 2 | Mann-Whitney U | p    |
|-----------------------------------------------------|----|-----|-----|---------|---------------------|---------------------|----------------|------|
| Pre-school vs.                                       |    |     |     |         |                     |                     |                |      |
| Primary + secondary                                   | 77 | 0.01| 1.02| 0.25    |                     |                     |                |      |
| High school                                          |    |     |     |         | 99.83               | 52.55               | 1091.00        | <0.001|
| Special school                                       |    |     |     |         | 68.12               | 41.45               | 838.00         | <0.001|
| Primary + secondary vs.                              | 76 | 0.05| 0.36| 0.07    |                     |                     |                |      |
| High school                                          |    |     |     |         | 55.47               | 30.86               | 426.00         | <0.001|
| Special school                                       |    |     |     |         | 55.24               | 63.18               | 1293.00        | 0.224 |
| High school vs.                                      | 42 | 0.09| 0.58| 0.11    |                     |                     |                |      |
| Special school                                       |    |     |     |         | 48.53               | 50.59               | 790.00         | 0.763 |

The items marked with italic font represent statistically significant results

Selective collection of waste is registered in 50.7% of educational units, although the presence of this type of management is mandatory (Table 4).

Table 4 Number of educational institutions that have implemented selective collection

|                  | Presence | Primary + secondary | High school | Special school | % Selective collection |
|------------------|----------|---------------------|-------------|---------------|------------------------|
| Pre-school       | 37       | 39                  | 21          | 11            | 50.70%                 |
| Absence          | 38       | 37                  | 20          | 10            | 49.29%                 |

4. Discussion

The generated waste volumes in educational institutions in Bucharest are more influenced by the type of educational institution than by the number of pupils/students attending the classes. Pre-schools and high schools tend to produce more waste than all the other educational institutions. This fact is caused by the long program characterizing pre-schools (5-10 hours per day) and high schools (6-7 hours per day) which imply the fact that at least one meal has to be consumed during the school hours. Preparing the food in the cafeteria or contracting a catering service makes the waste quantity generated in pre-schools considerably higher compared with the one produced in other types of educational institutions. In the same time, the presence of dormitory function determines an increase in the waste quantities.

Waste quantity generated by educational institutions from Bucharest is similar to those in the European Union [6] and higher than the ones in Asian and African countries where they vary between 0.015-0.02 kg/pupil/day [26].
Other findings of the paper are that a low number of educational institutions are included in selective collection programs. Although 51% of the surveyed institutions stated that they have adopted a selective collection system, only a few have a functional one.

This trend is also sustained by the low increasing, in the last three years, (from 9.2% to 14.1%) of the school’s implication in waste management projects [27].

The difficulty in controlling the available data represents the main limitation of this study. This fact is due to the absence of a waste quantity monitoring system in the majority of educational institutions.

Future research will be focused on the integrated assessment of educational institutions’ impact on the environmental quality in human settlements. Analysis of the residents’ perception regarding the problems that educational institutions generate in the living areas nearby (noise, insecurity, etc.) will receive a special attention.

5. Conclusion

An efficient waste management is an emblem of the quality of educational services [8]. Even if the waste quantities are not very high, the projection of an inappropriate waste management in the internal and external environmental quality of the educational institutions and nearby areas is easily perceived. Also the waste management inside educational institutions is a model easily to multiply at an urban scale [9]. Thus, waste selective collection and educational projects related to waste management represent essential steps in promoting the sustainability concept [11]. Waste management plans need to be adapted to the characteristics and infrastructure of educational institutions in order to have the guarantee of success of sustainable development strategies.

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References

[1] Brasington D, Hite D. Demand for environmental quality: a spatial hedonic analysis. Regional Science and Urban Economics 2005; 35(1): 57-82.
[2] Dascalaki E, Sempetzoglou V. Energy performance and indoor environmental quality in Hellenic schools, Energy and Buildings 2011; 43(2-3): 718-727.
[3] Päivi M, Sever ML, Zeldin DC. Indoor allergens in school and day care environments, Journal of Allergy and Clinical Immunology 2009; 124: 185-192.
[4] Maddox, P., Doran, C., Williams, I.D., Kus, I. The role of intergenerational influence in waste education programmes: The THAW project. Waste Management 2011, 31(12): 2590-2600.
[5] Patel, N., Handu, P. Impact of Change in School Menu on Acceptability as Measured by the Plate Waste Method. Journal of the American Dietetic Association 2010, 110(9), A95.
[6] Buclet, N. Municipal waste management in Europe / European policy between harmonisation and subsidiarity. Springer, Berlin, 2002.
[7] Sales M.G.F., Delerue-Matos C., Martins I.B., Serra I., Silva M.R., Morais S. Waste management school approach towards sustainability. Resources, Conservation and Recycling 2006; 48(2): 197-207.
[8] de Vega C.A., Benitez S.O., Barreto M.E.R. Solid waste characterization and recycling potential for a university campus. Waste Management 2008; 28(1): S21-S26.
[9] Zhang N., Williams I.D., Kemp S., Smith N.F. Greening academia: Developing Sustainable waste management at Higher Education Institutions. Waste Management 2011; 31(7): 1606-1616.
[10] Getlinger, M. J., Laughlin C. V. T., Bell, E., Akre, C., Arjmandi, C. Food Waste is Reduced when Elementary-School Children Have Recess before Lunch. *Journal of the American Dietetic Association* 1996; 96(9): 906-908.

[11] Marlette, M. A., S. B. Templeton, Panemangalore, M. Food Type, Food Preparation, and Competitive Food Purchases Impact School Lunch Plate Waste by Sixth-Grade Students. *Journal of the American Dietetic Association* 2005; 105(11): 1779-1782.

[12] Grodzinska-Jurczak M, Bartosiewicz A, Twardowska A, Ballantyne R. Evaluating the Impact of a School Waste Education Programme upon Students', Parents' and Teachers' Environmental Knowledge, Attitudes and Behaviour. *International Research in Geographical and Environmental Education* 2003; 12(2): 106-122.

[13] Prestin A, Pearce KE. We care a lot: Formative research for a social marketing campaign to promote school-based recycling. *Resources, Conservation and Recycling* 2010; 54 (11): 1017-1026.

[14] McDougall, F., White, P. Integrated solid waste management: A life cycle inventory. Blackwell Science, Boston, 2007.

[15] EUROSTAT. *Expenditure on education as % of GDP or public expenditure*. http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_figdp&lang=en, accessed 06.12.2011.

[16] General School Inspectorate of Bucharest. *State of education*, Annual report, 2011.

[17] Nae, M., Turnock, D. The new Bucharest: Two decades of restructuring. *Cities* 2011; 28(2): 206-219.

[18] Nae M.M. *București – dezvoltare urbană și calitatea vieții*. Universitară Press, Bucharest, 2009.

[19] Arpinte, D., S. Cace. *Croissant and Milk - perceptions, attitude and efficiency*. Fundația pentru Recuperare, Integrare și Promovare Socială. ECHOSOC. Bucharest, 2009

[20] Marlette, M. A., Templeton, S. B. Food Type, Food Preparation, and Competitive Food Purchases Impact School Lunch Plate Waste by Sixth-Grade Students. *Journal of the American Dietetic Association* 2005; 105(11): 1779-1782.

[21] Ioja C, Rozyłowiç L, Pătroescu M, Nita MR, Vanau GO. Dog walkers’ vs. other park visitors’ perceptions: The importance of planning sustainable urban parks in Bucharest, Romania. *Landscape and Urban Planning* 2011; 103: 74-82.

[22] Ioja, C., Pătroescu, M., Nîță, M., Rozyłowiç, L., Ioja, A., Onose, D. Categories of residential spaces after their accessibility to urban parks – indicator of sustainability in human settlements, *Wseas Transactions on Environment and Development* 2009; 5(6): 307-314.

[23] Pallant, J. *SPSS survival manual : a step by step guide to data analysis using SPSS*. Allen&Unwin, Sidney, 2005.

[24] Erbay F., Ömeroglu E. Examination of pre-school educational environments in respect of some variables. *Procedia Social and Behavioral Sciences* 2009, 1(1) 42-45.

[25] Gotelli, N. J. A Primer of Ecological Statistics. Massachusetts U.S.A, Sinauer Associates, 2005.

[26] Cheremesinoff N.P. *Handbook of Solid Waste Management and Waste Minimization Technologies*. Elsevier: New York, 2002.

[27] EUROSTAT, 2011a *Thematic indicators - Progress towards the Lisbon objectives in education and training*. appssso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_th_pertch&lang=en, accessed 06.12.2011