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Waste management in the context of sustainable development: Case study in Romania

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Abstract

Sustainable development has become a central element in the work of national and international companies. From this perspective the focus is more and more on protecting the environment and society. So, waste management is a sensitive area for organizations. The present paper presents the situation of municipal solid waste management (MSW) in Romania, relative to EU requirements. Optimization of waste collection through source separation is mandatory, while the management based on waste land filling must be overcome. In this paper, some aspects are analyzed, related to the technologies used and the amounts collected in relation to the EU.

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1. Introduction

In the context of sustainable development, waste management is an activity that shapes the environmental protection. Sustainability has become the model of development adopted at international level, whereby both organizations and people act in accordance with the principles and its amendments. Since 1951 when the International Union for the Nature Conservation published the first report of a state on the global environment that is seeking reconciliation between economy and ecology and until present, the concept of sustainable development was shaped by the various interpretations. Currently, according to a study (Ivascu et al., 2014) most organizations associate sustainable development with environmental protection and with actions related to society. Environmental

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concerns are still intense. Organizations and municipalities develop intensive activities in this direction. At the beginning, emphasis was placed on selective waste collection (Brunner et al., 2015), currently there is intense concern for waste management and recycling. Human activities and those of organizations inevitably produce waste (Moraru et al., 2010). As analyzed territory is bigger the challenge of waste management is more complex (Lavee, 2007). Together with measures to reduce waste, waste management contributes significantly to the achievement of sustainable development.

This activity of waste management is complex and differently solved in European Union (EU). This paper analyzes the situation of Romania in correlation with international provisions. Research is structured in three directions: (1) the implications of Romania in sustainable development, (2) waste management, (3) evaluation of technologies used for waste management in Romania. The paper ends with conclusions and future research directions.

2. Waste management in Romania

2.1. Sustainable Development in Romania

Sustainable development is dealt with extensively in Romania. In a survey conducted in Romania, it was observed that most organizations (78.4%) associated sustainable development with activities for environmental protection, and 85.7% of these organizations are involved in social activities. Within this research there were involved 95 companies from Romania from the categories: micro (11), small (15), medium enterprises (34), large enterprises (27), and very large enterprises (8). The classification of the enterprise's size class was conducted in accordance with Law No. 346/2004, regarding the stimulation, the creation and growth of SMEs, as supplemented and amended, which establishes criteria for classifying enterprises (Official Gazette). Companies that exceed a category, in terms of number of employees, turnover or total assets are classified in the upper category when there is observed at least one of these limits.

The present research integrates elements of sustainability, risk assessment and international standards. The authors approach sustainable development in the four responsibilities of sustainability through their integration in the economic environment, with direct impact on the company. The study results are summarized in Table 1.

Table 1. Centralization of the data

Type	The implication of question	Affirmation answer
Risk	The existence of risk manager	63.3 %
	Risk monitoring	96.7 %
	Implementation of a tool	32.7 %
Standardization	Implementation of ISO 9000	96.3 %
	Implementation of ISO 14000	77.8 %
	Implementation of OSHAS18000	28.5 %
	Implementation of ISO 26000	7.4 %
	Implementation of ISO 27000	22.2 %
	Implementation of ISO 31000	42.6 %
Sustainability	The importance sustainable development	60.7 %
	Actions to protect the environment	78.4 %
	Social action	85.7 %
	Responsible programming of waste management	31 %
	Selective waste collection	65%
	Selective Technologies	7%

It is noted that a substantial fraction of the surveyed enterprises addresses the implications of sustainable development. Also, in most cases there was an overlap of the concept of sustainable development with environmental protection actions. Therefore, the organizations do not differentiate, yet strict environmental implications compared to the complexity of sustainable development of the enterprise (Mihaescu et al., 2008).

2.2. Waste management

In Romania, the policy on waste management (WM) must subscribe to European policy objectives relating to waste prevention and aims to reduce resource consumption and practical application of the waste hierarchy. In 2010, the EU member states produced over 252 million tons of MSW. This amount is representing around 502 kg per capita (Cruz et al., 2014). WM approach in EU (European Commission-Environment) is on three major directions:

- Waste prevention - an important factor in the development of national strategies directly related to production methods of organizations and lifestyle approach which should generate lower amounts of waste;

- Recycling and reuse - encouraging the recovery of a high level of material components, in particular by recycling materials.

- Improving final disposal and control of waste - in case the waste cannot be recovered, it must be removed in optimum conditions for environment and society health.

Actions for waste management are present in most organizations. For example, in the study (in a city representative of Romania) on 457 educational institutions (pre-schools, primary and secondary schools, high schools, special schools) it is shaping the image of waste management at educational level. 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).

In Romania (National Institute of Statistics), municipal waste collected per capita for the period 2003-2011 are shown in Figure 1. It is noted that in 2005 we generated the largest quantity of waste, namely 6,558,363 tons, followed by year the 2008 with 6,558,342 tons. Since 2008, the amount of waste considerably began to decline, reaching in 2011 4,553,300 tons. Further data after this year (2011) are not available online on the website of the National Institute of Statistics.
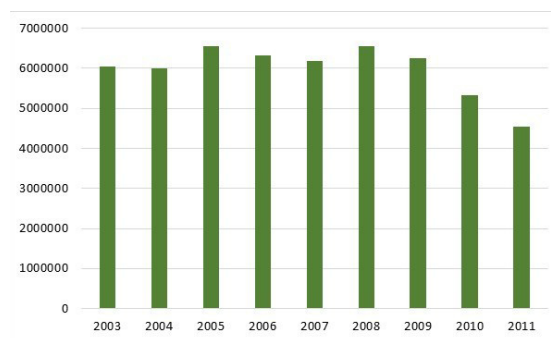

Fig. 1. Collected municipal waste (tons)

The distribution of the amount of waste per capita in Romania is presented in Table 2. The maximum amount of waste generated per capita is registered in 2008 and the smallest amount in 2011. It is noted that the proportion is maintained even if the number of inhabitants is taken into considered.

Table 2. Collected municipal waste per inhabitant (Source: INSS)

Indicator	2003	2004	2005	2006	2007	2008	2009	2010	2011
Quantity (tons)	6040230	6001200	6558363	6334491	6187943	6558342	6264778	5325808	4553300
Population (1st January)	21772774	21711252	21658528	21610213	21565119	21528627	21498616	21462186	19042936
Quatity/inhabitant (kg)	277	276	303	293	287	305	291	248	239

Municipal waste recycling rate is presented in Table 3. The industrial sector is the major element that generates waste in Romania and most polluting industry is mining (Cioca et al., 2015)

Table 3. Municipal solid waste collection and recycling rate (After Cioca et. al, 2015)

MSW (tons)	2006	2007	2008	2009	2010	2011
Collected	6,334,491	6,187,943	6,558,342	6,264,778	5,325,808	4,553,300
Recycled	40,945	65,741	72,110	100,455	296,342	331,622
MSW recycling rate	0.65%	1.06%	1.10%	2%	6%	7%

2.3. Technologies used in Waste management in Romania

At EU level, the generation of MSW has increased in parallel to the rapid industrialization, where the waste amount has recently grown with approximately 11% in 12 years and is expected to grow with 45% by 2020 (Ionescu et al., 2013). For this reason the technologies used in waste management must evolve with advanced technological support. In Romania there have been considerable efforts and significant investments were made to align with EU requirements, but the main way of waste disposing presently is storage. This action can be improved by the use of geographic information systems (GIS). There were developed a number of applications using GIS for different areas (Esmaili, 1972; Ghose et al., 2006; Karadimas et al., 2007). Among these applications, the study of complex systems of waste management, particularly placement waste management and disposal facilities was preferred direction for GIS applications. Currently, at international level, integrated GIS technology has been recognized as one of the most appropriate approach to automate planning and waste management (Karadimas et al., 2008). A tool that can be used in this process is Geographic Resources Analysis Support System (GRASS). In Romania, according to the Eurostat report (Eurostat, 2013), 99% of municipal waste collected is stored, and 1% are recycled. For this reason, the identification of suitable areas for waste storage using GIS technology represents a significant support in the direction of sustainable development of the country.

3. Result and discussions

Following the above analysis it can be concluded that in Romania MSW presents improvements, and is a priority in national development strategy. In outlining the strategy on waste management the following actions should be considered to achieve the objectives:

- The use of "clean technologies" in waste generating activities;
- Reduction / prevention of waste quantities by applying best practices for each field in which waste is generated;
- Capitalization through recycling, reuse and energy recovery;
- Elimination through landfills and incineration.

Waste Management properly adopted is a key element in ensuring an efficient use of resources and sustainable development of Romania. To fulfill the European objective, Romania has to make considerable efforts to increase

the recycling rate. It will require an exceptional effort from regional and national authorities in Romania in order to increase recycling to 50% by 2020, as required by the European Commission.

4. Conclusions

The evolution of Information Technology sector shows a decrease in costs and an improvement of the indicators relative to pollution. Certainly, the structural funds are a cornerstone in improving the situation in Romania and optimization of MSW. The analysis of the situation in Romania shows that the MSW has evolved, but this area is still faced with problems that can be addressed through well implemented strategies.

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