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Waste management sector value changes in Lithuania along the last decade

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Abstract

Waste management sector has negative aspects in public opinion as the pollution causing activity, but there is the other effect side of impact – an opportunity to reduce the environmental pollution regarding long term consequences. The waste management activity and sector by itself creates the value for the environment. The aim of the article is to present the results of critical analyze of sector value in relation to waste management; key waste management sector drivers – the waste generators. The article presents the research results of the waste management sector value changes in Lithuania along the last decade. Methodologies used for the research and presented in the article are the analysis and synthesis of scientific literature on critical review of waste management models used to be in Lithuania, statistical analysis, qualitative investigation of national policies influence to the results.

Keywords: waste management; impact value; Lithuania.

1. Introduction

Waste management system is very broad and scientifically researched on various aspects: content and functions, systems boundaries, modifications and properties, operating environment, waste management solutions, assessment methods and models (Žičkienė & Ruškus, 2001; Klang, Vikman, & Brattebo, 2003; Leonavičius, 2003; Morrissey & Browne, 2004; Husaini et al., 2007; Hung, Hwong-Wen, & Yang, 2007; Finnveden et al., 2007; Bivainis &

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Podgaiskyte, 2010). Waste management contribution to the sustainable development is proven and agreed by the scientists. Research goal is to investigate a municipal waste management development in Lithuania during the last decade and regarding sustainable development paradigm. During the research municipal waste management system impact value aspects were set and a data comparison in timeline perspective has been done. The timeline is set for the years 2000 – 2010, in accordance with data shortage, there was a black box for the data of some years, but the main tendencies could be defined.

2. Municipal waste management system

Waste management system is a complex, dynamic system, characterized by large number of stakeholders (therefore a society also), variety of types of waste generated (Costi et al., 2004, Bivainis & Podgaiskyte 2010). Inappropriate waste management is the most important factor in the formation of illegal landfills, breed of the parasites, and cause of unsanitary living conditions or contaminated drinking water, therefore disease breakthrough (Podgaiskyte, 2011). Properly organized and implemented waste management is determined to make a positive significant impact in general extent on natural environment, public health, and resource use. Nevertheless, changing lifestyles, consumption rates causes waste management technologies and methods development. Finally the waste management system changes, in ten years retrospective the Lithuanian municipal waste management system have changed the value.

Waste management as a specific activity and important state function have been formed gradually. Last century waste management concept had been limited by waste collection and disposal. As technology development increases the amount of waste and the intensification, the waste flow imposed the "optimisation" steps in a waste management system (Fig. 1).

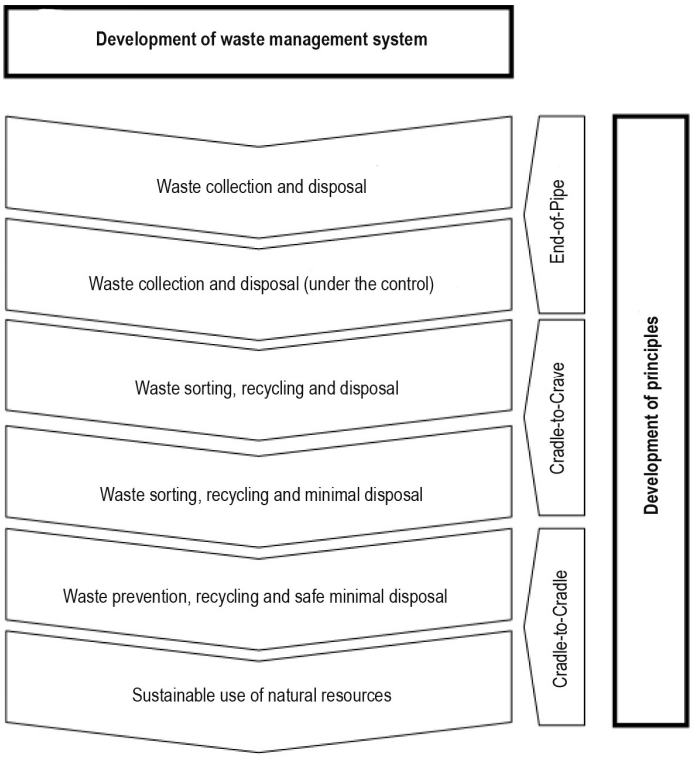

Fig. 1. Waste management system development. *Source:* prepared by author

The main purpose has evolved from "collect and remove" to "reduce the disposal of waste" (Boyle, 1989; Wilson 2002; Morrissey & Browne 2004). Changing concepts integrated the material sorting and recycling options to waste management systems and according to Morrissey and Browne (2004), during the 1990s, recycling and other waste management methods were being included in most municipal waste management models. Emergence of the sustainable development paradigm influenced the use of sustainable waste management concept of "integrated waste management" in the ninth decade of twentieth century. During this period, an issue of irreversibly depleting natural resource have been stated. The waste prevention matter was emphasized. Two main goals of the waste prevention are environment pollution prevention and the natural resource efficient use. It partly closes the recourse life cycle as the final disposed waste is potential resource by itself. During this period, the principle of "cradle to grave" developed to the new and wider concept of "cradle to cradle". It is likely that, although the current waste management and natural resource management systems are independent, the future of waste management is a natural resource management system.

3. Municipal waste management system assessment aspects

Scientists Morrissey and Browne (2010) state the sustainable municipal waste management system must be economically affordable, environmentally friendly and socially acceptable. Concept of sustainable development is based on three dimensional aspects of economy, social aspect and ecology. The scientists discuss the needs for the other aspects. In this context, Costi et al. (2010), Balkema et al., (2002), Finnveden et al. (2007b) provides discussions on additional aspects of technology, institutional, functional and normative. Technological aspect execution provides the information about the system efficiency, while the economic, environmental and social aspects provide information in relation to its effectiveness.

Results of scientific literature review show, that the economic measurements are usually expressed in a positive or negative results or effect in the monetary scale. In this case, the environmental and social estimates must be evaluated in monetary terms too. Monetary valuation methods according to Morrissey and Brown (2004) can be divided into two groups:

- to evaluate the costs in order to avoid a negative impact on society and the environment,
- to assess what is the willingness to pay for the environmental and social well-being.

The scientific literatures on the economic analysis of the proposed methods are cost-benefit analysis, investment analysis, impact assessment, life-cycle costs, etc. The main and the most economic method for the evaluation of environmental protection, sustainable development and waste management solutions in areas is cost-benefit analysis. Advantages of this method – the results are presented in a clear, easily measured and compared expression in total monetary value. Main negative aspect of the economic analysis methods is unsustainable balance between the different aspects (economic and/or environmental and/or social). A common task of economic analysis is cost minimization, but should be stated, the cost reduction is resolved by reducing or increasing pollution (emission) levels. Scientists accent the economic efficiency maximization as a key factor compared with other major environmental and social factors (Balkema et al., 2002; Morrissey & Browne, 2004; Finnveden, 2007a). Another problem with these methods is the decision maker factor, when evaluation of the system is fully dependent on the proposed evaluation system and the alternatives. Narrow profile system of different types of information, interests and parties offered conflicting objects can lead to a distorted and unbalanced score (Morrissey & Browne, 2004; Finnveden, 2007a; Pires, Martinho, & Chang, 2011).

A social aspect very often is called by socio-cultural aspect. Social aspect contains the public relations analyse in relation to the uncertainties and dependencies between the environmental and social aspects (Wilson, McDougall, & Willmore, 2001; Balkema, 2002; Hung, 2007). Hung, Ma and Yang (2007) in their work on sustainable aspect of evaluation of social analysis models divided into:

1) focus on the social factors,
2) focus on public participation in decision-making.

These factors describe the evaluation criteria such as social stability, personal morality, education level, public acceptance, involvement in the process rate. In scientific studies Hung, Ma, and Yang (2007) highlight that the public participates in the discussions, or about, to be informed and have a very small impact on decision outcomes.

This is the so-called consensus process. However, there is a lack of research on public participation as part of the decision-making process, so-called screening process, which sets out alternative solutions. In summary, public participation in decision-making mainly is researched as the problem scoping and active stage of the policy by the organization or offering to organize public meetings. Scientific literature shows that social analysis is based on peer review or public survey techniques.

Ecology aspect, or the natural environment, should be the basis for ensuring the long-term development of natural resources and emission reduction management. Anthropogenic activities directly affect and determine the long-term availability of natural resources, including living conditions. Waste management decided sustainable use of natural resources problems of waste generation phase, the negative environmental impact of the problems of waste management and efficient recovery with minimal energy loss, energy savings or energy benefits. Environmental sustainability refers in the environment to maintain the functionality of an existing way of life (Finnveden et al., 2007). Egocentric thinking the problem arises when you need to define or decide what the needs of the current generation threshold.

Environmental systems analyses human activities and their impact on the environment through the technical, economic, social and ecological systems interactions (Pires, Martinho, & Chang, 2011). Environmental aspects are assessed according to the environmental impact assessment categories:

- resource depletion;
- Greenhouse gas formation and global warming potential;
- ozone depletion;
- soil and water acidification;
- ecotoxicity;
- eutrophication processes;
- drought processes;
- landscape changes, etc.

The scientific literature offers a variety of methods for environmental impact assessment. The most popular methods are life cycle assessment, environmental impact assessment, ecological footprint, environmental management systems, material flow analysis, material flow accounting and strategic environmental assessment. The method offers a theory: 1) according to the research object, 2) under the effect of interest (Finnveden & Moberg, 2005; Finnveden 2007a). Great part of the methods used in environmental analysis is appropriate and adaptable to the analysis of the economic system, in cases where the methods understood as an economic – environmental friendly method of assessment.

Life cycle assessment – a method developed by the mass and energy balance, to evaluate the product or service life cycle of a different impact on the environment. The life cycle assessment methodology is structured and presented in the ISO 14000 family of standards documentation. The evaluation method is structured into four phases: 1) the purpose and scope, 2) inventory analysis, 3) exposure assessment, 4) interpretation of data.

Life cycle assessment – a tool used for environmental life-cycle assessment. The tool can determine not only the product but also the processes on a set of environmental factors. The main drawback of the method is the opportunity to assess the precise impact on the environment. Model evaluation results are often different from the results of the implementation of the system when the environmental conditions are changing (Environmental, 2013). The basic life-cycle assessment approach is intended – to identify potential environmental impacts that are irrelevant factors, unrelated to the environment.

The main disadvantage of the life cycle assessment – the need for large amounts of information, loss of data normalization, there is no possibility for economic (monetarily) assessment as assessment based on environmental and technological aspects of the relative (Morrissey & Browne, 2004).

Concluding, in coherence to the system and the uncertainties of environmental and social aspects in addition must be evaluated environmental and economic risks that must be must be balanced (Balkema et al., 2008; Finnveden et al. 2007b). Municipal waste management system should be oriented to the public welfare, human health and environmentally secure surrounding, sustainable use of natural resources, be economically feasible, independent and stable, considering the potential impact for future generations.

Sustainable development and waste management is two-way interface. Concept of sustainable development has influenced the development of the waste management system and formed the conceptual framework for waste

management goals, but on the other hand, effective, informed decisions relying on the waste management system can influence the global and local dimension of local or global sustainable development. Integrated waste management, based on the principle of cradle-to-cradle, through targeted, social, economic, environmental principles is one of the main conditions to ensure the sustainable use of natural resources, to reduce the negative impact on the natural environment, improve public health and quality of life.

4. Municipal waste management system assessment aspects

Research limits. In research the municipal waste management development and impact on environments have been investigated. The investigation aspects are based on sustainable development concept three main aspects, economy, ecology or natural environments and socio-culture. Investigation period –is the year of 2001-2010.

In Lithuania municipal waste management system is still under development (Strategic, 2008). The municipal waste definition differs from country to country, depending on point of view. The waste categories can be organized by:

- composition of waste;
- waste producer /source (activity the waste is produced from);
- waste properties.

Some countries municipal waste defines as waste generated only in households, alike others – include similar waste types from the commercial activities. In a research municipal waste is understood and analysed according to the concept of national regulations. The Law on Waste Management of the Republic of Lithuania (State Journal, 2002, No. 72-3016) sets out general requirements for waste prevention, accounting, collection, storage, transportation, utilisation, and disposal to avoid negative effects on human health and the environment, as well as the main guideline of organisation and planning of waste management systems. The concept of municipal waste set out in the Rules of Waste Management (State Journal, 2004, No. 68-2381; 2007, No. 11-461) while broadened boundaries set out in the list of waste. The municipal waste definition in a country is closer to the one, related to waste composition – all the waste similar to municipal waste, independently on source, are municipal.

The municipal waste management in Lithuania, as well as in EU, is based on the waste hierarchy, and the priority order in management legislation and policy is as following in prioritised order:

1. prevention;
2. preparing for re-use;
3. recycling;
4. other recovery, e. g. energy recovery; and
5. disposal.

Municipal waste generation in Lithuania during the period of the years of 2001–2010 is in average about 1.3 mln. t./year (Fig. 2), while the EU 27 average is about 9.432 mln. t./year. Average generation per capital is about 377 kg in year 2001 and 399 kg in a year 2010. The increase difference is 22 kg, the generation is stable – till 400 kg/cap. Comparing historic data for the period 2001–2010 on final consumption expenditure (Fig. 3) and waste generation, a linear relation can be stated. But on the other hand, the demographic data shows the negative curve (Fig. 4). Inhabitant reduction in Lithuania during the period of 10 years is about 10 per cent, from 3.486.998 to 3.141.976 mln. inhabitants, or 1.15 per cent annually. Concluding, the increase in waste generation is slow, but according to the population reduction, it is higher than the reduction of waste generated. With regards to the waste hierarchy the waste prevention is not implemented. The scientists discuss what a real goal of the prevention is, and what results could be expected, but there is no one opinion, as well as the waste management system is directly related to the economic issue and social/ cultural aspects of consumption society. An increase of waste generation is expected with regards to economy development. But there must be a limit in relation to environmental damages the consumption and waste generation can provide.

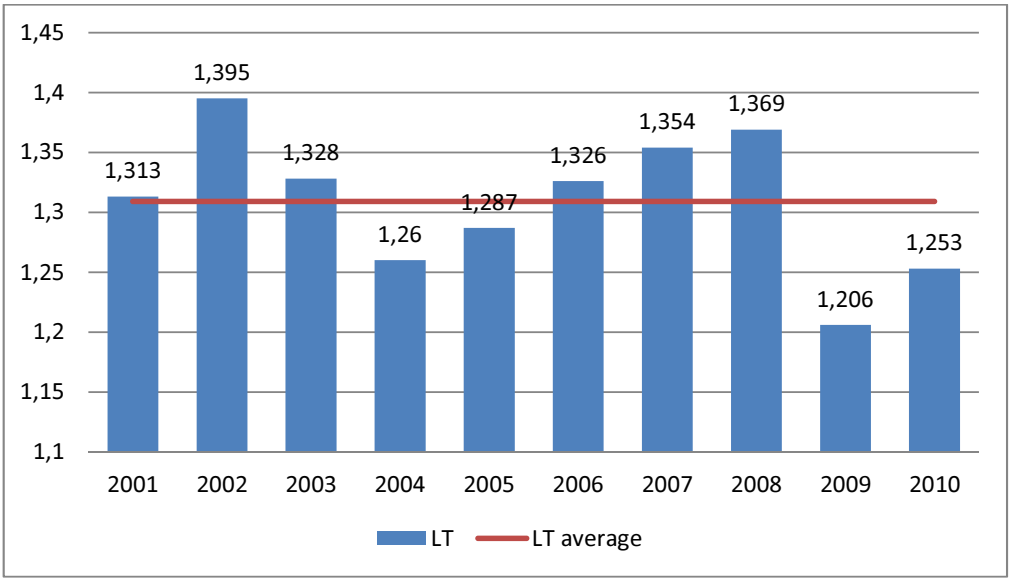

Fig. 2. Municipal waste generation in Lithuania in year 2001–2010, mln. t/year. *Source:* Eurostat

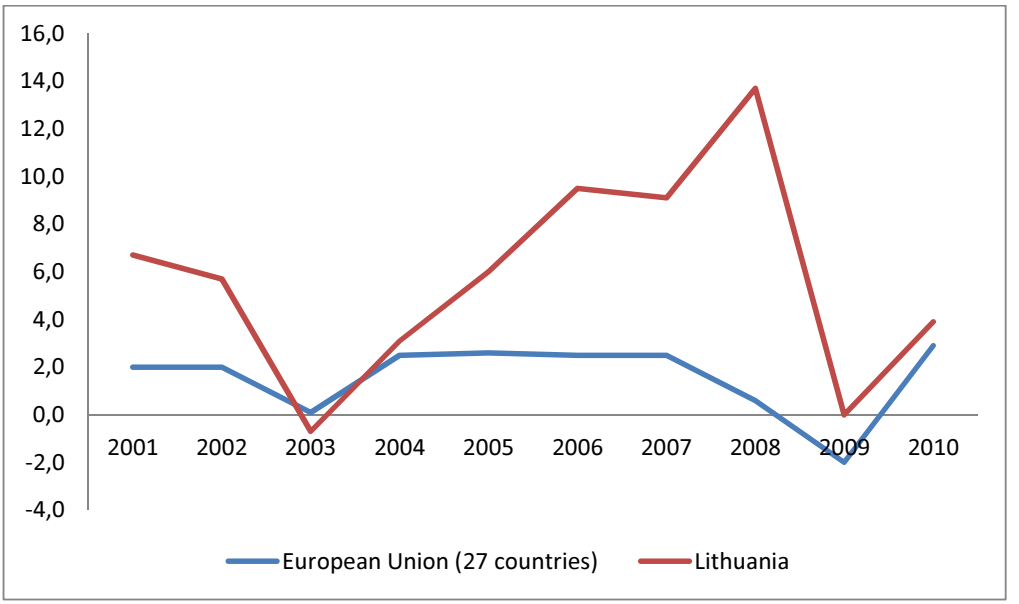

Fig. 3. Final consumption expenditure. *Y* axis – price index, percentage change on previous period, based on 2005 = 100 and the euro
Source: Eurostat

The waste management is one of service of general interest. According to the Strategic waste management plan (2008) accessibility to municipal waste collection service must be universal and used by 100 per cent of households. In a year 2012 the municipal waste collection service covered 94 per cent of households (Table 1). In rural areas the municipal waste collection service accessibility during the period 2005–2012 increased from 24 to 89 per cent.

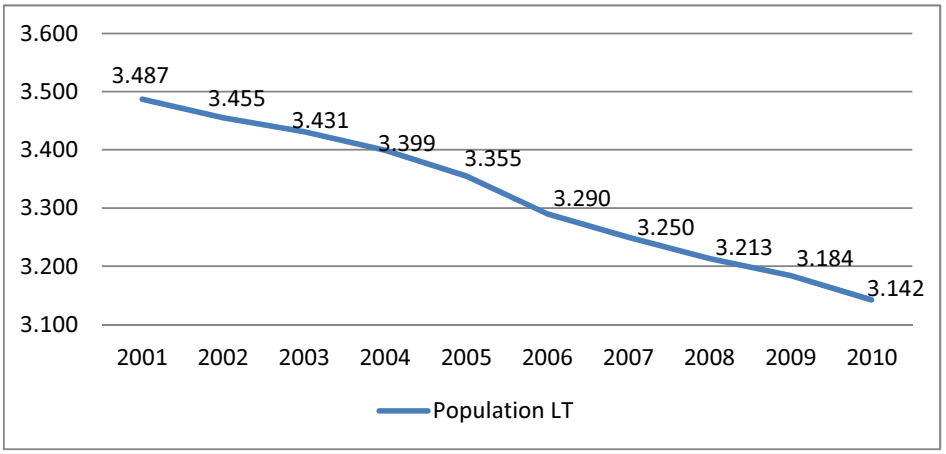

Fig. 4. Population rate (mln. inhabitants) in Lithuania during the year 2001–2010. *Source:* Eurostat

Still within the rural areas 11 per cent of households are not able to treat their own waste by the entire requirement and with the controlled impact on natural environment. Sudden change by increased service accessibility has been in 2008, when the requirement of general service has entered into the force by Strategic waste management plan (2008).

Table 1. Municipal waste collection rate in year 2005–2012. *Source:* Ministry, 2013; Environment, 2013

Year	Municipal waste collection rate, %				
	In cities with more than 100 000 inhabitants	In cities with 50 000–100 000 inhabitants	In cities with 500–3000 inhabitants	In cities with less than 500 inhabitants	In total
2005	84	57	42	24	72
2006	90	60	48	24	77
2007	90	60	56	30	80
2008	96	81	77	53	89
2009	96	88	84	66	91
2010	98	92	87	72	94
2011	97	91	90	79	94
2012	100	99	96	89	94

The decision of general interest service has determined the consequences of ecological, economical and social aspects. Economically there was an increase in municipal waste collection service. Research results, according to the local municipalities policies review, done by author, in average the price increased from 0 to 200 Litas/houshold per year. The overall waste collection service implemented “pollution pay” principle. The socio-cultural shock of the principle introduced empowered population for waste prevention. At the same the decision has the conscience on environmental thinking. After overall waste collection service have been implemented, have been reduced ownerless waste generation and illegal waste dumping sites.

5. Conclusions

Municipal waste management is a complex issue with impact on economic, environmental and social environments. The research results state the municipal waste management has been developed in Lithuania during the year 2001–2010.

1. The municipal waste management in Lithuania develops according to the sustainable development and waste hierarchy principles parcel. The waste management development is systematic and under the control, but the main goal of waste prevention is not achieved, municipal waste generation is increasing.
2. Fundamentals of "polluter pay", in essence, are implemented; the municipal waste collection service has reached the rate in average of 94 per cent of households, in rural areas – 89 per cents.
3. State policy and regulations for the municipal waste management allow and lead for the sustainable municipal waste management development, shortage in waste prevention shows there is no systematic approach including the methods and instruments for the key drivers – waste generators – participate effectively in municipal waste management system.
4. Concluding, the priority goal of waste prevention cannot be reached just by developing the waste management system. For the purpose the external drivers, such as culture, consumption should be incorporated and the economic, social, and other instruments should be set.

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