CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

FACULTY OF TROPICAL AGRISCIENCES

MASTER THESIS

System of Gathering and Utilization of Waste in Rural Areas of the Czech Republic

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Prague 6—Suchdol, 2013

DECLARATION

I hereby declare that I have written presented bachelor thesis "System of Gathering and Utilization of Waste in Rural Areas of the Czech Republic" by myself with help of the literature listed in references.

Prague 6—Suchdol, 1st April 2013

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ACKNOWLEDGEMENT

ABSTRACT

The diploma thesis is focused on the waste management system in seven municipalities in the Czech Republic. First, assessment of different legislation instruments which regulate and control waste management (also on the municipality level) has been done. In this respect the situation is the following: the Czech legislation allows the local governments to opt for one of the three systems of payment for waste. The three options imply: Local Fee, Fee by Act on Waste and Contractual form by Act on Waste. But not all of these systems motivate people to reduce, reuse or recycle.

Thesis compares the above systems of payment for waste and their influence on the quality of the environment. The comparison has been carried out on basis of data regarding the waste collection and financing which were collected from the seven municipalities at the end of 2012 and beginning of 2013.

The analysis of quantity of different types of waste per capita during the years 2007-2011 was conducted in relation with the demographic factors, location, types of legislation applied and attitude of the municipality management toward the environment. The survey also shows differences in the waste management in villages and towns as well as diverse attitudes of specific social groups toward the waste disposal.

Key words: Act on Waste, gathering, motivation, municipality, recycling, reduce, waste, waste handling

ABSTRAKT

Předložená diplomová práce se zabývá problematikou odpadového hospodářství obcí České republiky. Nejdříve bylo provedeno zhodnocení různých legislativních nástrojů, které umožňují kontrolu odpadového hospodářství na úrovni obce. V tomto ohledu je situace následující.

Česká legislativa umožňuje místním zastupitelstvům výběr ze tří systémů financování odpadového hospodářství. Tyto tři systémy zahrnují: Místní poplatek, poplatek dle zákona o odpadech a smluvní formu dle zákona o odpadech. Jak bylo zjištěno, ne všechny tyto systémy však v praxi podporují snižování odpadů či jejich recyklaci.

Práce porovnává výše uvedené tři systémy platby za odpad a jejich vliv na kvalitu životního prostředí. Srovnání bylo zpracováno na základě údajů o sběru odpadů a jejich financování, které byly shromažďovány přímo z obcí v letech 2012 - 2013.

Výzkum porovnává množství vyprodukovaného odpadu na osobu z let 2007- 2011. Výsledek je pak dáván do souvislostí s vnějšími faktory, které zahrnují demografické údaje, umístění, druh místní legislativy či postoj zastupitelstva obce vůči životnímu prostředí. Práce také odhaluje různorodé přístupy k odpadovému hospodářství v obcích či odlišné názory a chování různých sociálních skupin na zacházení s odpady.

Klíčová slova:

Motivace, nakládání s odpady, obec, odpady, recyklace, sběr odpadů, zákon o odpadech

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LIST OF ABBREVIATIONS

Coll. – Collection

CZK – Czech crown

EPA- US Environmental Protection Agency

EU- European Union

ISOH- Information system of the waste management

LCD- Liquid crystal display

MMW- mixed municipal waste

MSW – municipal solid waste

OECD- Organisation for Economic Co-operation and Development

PAYT- System Pay as you throw

PET- Polyethylene Tereftalat

UNECE - United Nations Economic Commission for Europe

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INTRODUCTION

Waste management plays one of the most important roles in the ecology of everyday life. People of the 21st century consumes as much as their finances allow. Customers buy the bargains in sales without considering the environmental impact of buying cheap and so usually low- quality goods. They buy excessive amount of clothes, shoes, tonnes of cheap furniture or food packed in metres of plastics without thinking about their ecological footprint.

The thesis aims are particularly monitoring the current situation in some municipalities in the Czech Republic via analysing the data of the collected waste. The attitude of different social groups was examined by the questionnaire.

The first part of the thesis describes the current situation in the Czech legislation concerning the waste management. The legislation generally reflects public opinion and necessity which is expressed in the three R (3R) approach: reduce – reuse – recycle.

The central body of the Czech Government which coordinates all the activities in the environmental system is the Ministry of the Environment of the Czech Republic.

The Ministry was initiator, submitter and is responsible body for the Waste Act (185/2001 Coll.) implementation and all the (connected) executive regulations further implemented. It is also the Waste Management Plan of the Czech Republic for 2003-2013 which was worked out and is implemented by the above Ministry – it forms the basis for all the regional and other waste management plans.

The legislation offers a range of options how to handle with municipal waste.

 Especially, each municipality is responsible for its own system of gathering and recycling of waste as well as for motivation of its inhabitants to behave environmentally friendly. The municipalities choose from three systems of financing their waste management. These are the Local tax, Fee by Act on Waste and the Contractual form by Act on Waste.

The thesis also targets the social motivation of the inhabitants toward the environmental protection and waste management. The projects which support the public motivation are demonstrated as examples of a partial solution. The general terminology and the system of waste handling and recycling is explained.

The starting (experimental) base of the thesis is hypothesis and objectives. They were set up in accordance with previous reference analysis and own author´s experience as well as experience of involved municipality and companies' officers.

It was presumed that the Act on Waste has more impact on environment quality than the Local Tax given by the local administration and bigger townships and communities have lower costs of waste management than the smaller ones. But also that the amount of waste per capita in bigger townships and communities is lower than that at smaller ones and that in townships and communities which apply Fee by Act on Waste system the inhabitants take more care on waste management (selection of waste) that in communities that apply the Local Tax.

On the above assumptions the objectives were formulated such as: survey on the quality of the environment by measuring the amounts of the waste generated in given area, monitoring of different types of the waste produced per capita, assessment of differences in waste management costs and evaluation of inhabitant´s motivation for responsible behaviour in the process of waste generation and gathering.

However the main objective of the thesis is to find out whether the influence of existing legislation has a positive impact on waste management at the municipality level. The thesis concludes by proving that the waste management system by Act on Waste is the most efficient (among other two alternatives) and positively motivates the inhabitants.

Demographic as well as economic factors influencing the amount of waste produced are studied in the research and collated with scientific literature.

It was found that waste management on the municipality level especially consists of a selection of a service company. On the other hand, the municipality can also partly influence the amounts and types of waste produced by motivating its inhabitants to reduce, reuse and recycle.

The presumption that the bigger municipalities generate less waste per inhabitant as well as they have lower expenses per inhabitant for waste management was also confirmed.

The above conclusions were possible thanks to the data collected through interviews with municipality representatives and service company employees. Inquires were conducted in seven municipalities - both bigger townships and smaller municipalities. By such a selection two groups of tested units were created.

Information of highest value was collected by questionnaire placed on web pages. The information made possible to examine the people´s attitude in environmental protection and waste management (as already mentioned). These facts were also put into conclusions and used for the recommendations formulation

The majority of collected data, the questionnaire as well as graphical elaboration of the results are connected in the Annex.

1. LITERATURE REVIEW

1.1. Czech Legislation

The institutions which deal with the environmental issues in the Czech Republic are divided into three groups- the legislative, judicial and the executive power.

The central body of the Czech Government which coordinates all the activities in the environmental system is the Ministry of the Environment of the Czech Republic. The ministry is the government agency responsible for the state environmental policy which includes: protection of: natural water, the air, agricultural lands, mineral resources, landscape and nature; the waste management, hunting and fisheries, management of the national parks, state ecology policies etc.

The Ministry is responsible for the Waste Act (185/2001 Coll.) and all the executive regulations which sets the rules for the waste treatment, gathering of waste, waste utilization, waste administration etc. The Ministry also creates the Waste Management Plan of the Czech Republic for 2003-2013 which forms the basis for all the regional and other waste management plans. The plan is compiled in order to meet the strategic objectives of reducing specific waste production regardless of the level of economic growth, maximum use of waste as a replacement for primary natural resources and minimizing negative impacts on human health and the environment in waste. In practices, the government is planning to support e.g. the changes in the production processes towards the low waste technologies or to substitute the dangerous materials in production, create conditions for the system of the returnable packaging, support the positive waste management changes at all the levels of the public administration, fulfil the environmental programme for the public etc. The overall goal is to lead the Czech waste management towards the EU environmental plan[1]

The bodies which are obliged to form the waste management plan are the regions and these originators of the waste who produce more than 10 tones of the dangerous waste per

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[1] RNDr. Ambrozek v. r.Ministr životního prostředí: Nařízení vlády č. 197/2003 Sb., o Plánu odpadového hospodářství České republiky, Změna: 473/2009 Sb., 2003

year or more than 1000 tonnes of other waste per year. The content of the waste management plan is given by the regulation no. 383/2001 Coll.[2]

"In order to be able to assess the waste management plans responsibly and to obtain data for administrative and inspection work, records are kept as part of waste management; they provide detailed data on waste production and treatment in compliance with EU regulations. The information obtained is crucial for further waste management planning, legislative work, and for the ministerial advisory bodies, including the Czech Republic Waste Management Board, composed of leading experts from all government departments as well as the non-governmental sector."[3]

The other institutions involved in the environmental issues are The Czech Environmental Inspectorate (CEI) who is an "expert executive body within the state administration charged primarily with supervision in the area of environmental legislation enforcement" [4] or the State Environmental Fund of the Czech Republic who deals mainly with the subsidies issues. The other state governmental level is formed by regional and municipality bodies which play an important role in local environmental protection. Finally there are the nongovernmental organizations of different legislation forms dealing either with an exact problem at the given place (e.g. o.s. Zdravé životní prostředí Praha – Běchovice) or with the overall issues as the organization Greenpeace or Tereza who educates children in environmental behaviour.

1.2. Municipality regulations

The municipality is the basic unit of the territorial government by the Czech constitution. The municipalities with extended powers (municipality III) perform the state administration of the highest level in terms of the education, agriculture, culture, finances etc. but also the environmental protection. These municipalities are in charge of the waste management, quality of the water in the area, define and monitor local ecologic stability, supervise the nature and landscape protection, fine the environmental offences, apply

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[2] Citing the sites: Středočeské odpady [online], http://www.stredoceske-odpady.cz/?sid=3d05184a4692d61ea8af1f1e54b53a50&lang=cz&uzel=108 11/2/2013

[3] Citing the sites: Ministerstvo životního prostředí ČR [online], http://www.mzp.cz/en/waste 16/2/2013

[4] Citing the sites: Česká inspekce životního prostředí [online], http://www.cizp.cz/lang/l2 3/3/2013

opinions on the zoning and regulation plans. This level of local government has the most important influence in the environmental protection.[5]

1.2.1. Regulation under § 17a of the Act on Waste

This regulation sets the system of the gathering, collection, transportation, classification, reuse and removal of the municipal solid waste within given area of the municipality. The basis of the regulation also determines the price and the method of charging for municipal waste. This regulation is binding on all natural persons having their permanent residence or living in the municipality falling.

Mixed municipal waste is collected in the plastic or metal containers of the volume from 110 to 1100 litres. The waste removal is then secured by the authorized company at least once per week. The municipal waste produced by the holiday cottage residents is held in the special plastic sacks (of the volume 60l or 110l) sold at the municipal office.

The bulk waste as well as the hazardous waste is gathered separately into huge metal containers of volume from 9 to 25 m^3 which must be arranged by the municipal authorities at least twice per year.

The recyclable components of the municipal waste are gathered into special coloured containers divided – blue for the paper, green and white for the glass and yellow for the plastics. These containers are usually located together at strategic public places. The minimum periodicity for the recyclable waste removal is once per week for the paper and plastic containers and once per month for the glass containers.

The municipality sets the height of the municipal fee which is produced within its area. All the fees for waste are the revenues of the municipality and it is mainly used for the financing of the local waste management system. The municipality is in charge of administration of the fees given by the act no 337/1992 Coll.

The natural person obligated to pay the municipal fee is everyone who produces municipal waste at the given municipality. The payer is usually the owner of the property who´s duty is to pay the right price on time. The fee rate is calculated every year by the

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[5] Soukupová, Jana & kolektiv: Ekonomika životního prostředí, Brno: Masarykova univerzita 2011, ISBN 978-80-210-5644-2

presumed expenditures for the whole municipal waste management system. The fee depends on the number and the volume of the dust bins.

The municipalities are competent to find out what happened with the waste produced by their inhabitants. They are also obliged to solve the problems with the illegal dumps.

1.3.   System of financing local waste management

1.3.1. Amendment to Act No. 275/2002 Coll.

Beginning January 1, 2003 the amendment of the law brought he right to choose between three systems of financing local waste management.

The municipality is the originator of municipal waste produced in its territory, which has its origins in the work of individuals.

The main purpose of the amendment to the Waste Act was to give municipalities a choice between different forms of collecting payments for municipal waste from individuals. The municipalities can choose between **local fee** (§ 10b of the Act on Local Fees), **the fee by Act on Waste** (§ 17a of the Act on Waste) and **contractual form** (§ 17, paragraph 5 of the Act on Waste). Each of these options has advantages and disadvantages and it is up to the village itself, in order to evaluate them all and eventually opted for a system that will be the most suitable for the citizens. After the entry into force of Act No. 185/2001 Coll. many municipalities have adopted local fee for municipal waste. But they were also communities (and among them also some surprisingly large towns - Plzen, Karlovy Vary), which still remained in contractual forms of payment. There are even some villages whose disposal of municipal waste is paid entirely from its own budget without any contribution from individuals.Various forms of payment cannot be combined (one form of implementation of the law automatically excludes any other), e.g. to introduce the community such as local tax, it must apply to all individuals in the community and not as part of the municipality to collect the payment of contractual form.

1.3.2. Local tax under the Act on Local Fees

The advantage of local tax for municipal waste according to § 10b of the Act on Local Fees is that it clearly defines a person taxpayer, as a natural person who is residing in the municipality pursuant to Act No. 133/2000 Coll. respectively a natural person who has owned the building designated or used for individual recreation, which does not have a

permanent residence reported no physical person (charging the "per capita"). Thanks to this fact, the municipality doesn´t have to find out if and how much of the waste is produced by each inhabitant. The administration of taxes is clear and easy as it follows the Act on Tax Administration which under this provision regulates, inter alia administration (any) charges that are receiving municipal budgets and § 13 of the Act on Local Fees.[6]

The fact that the Act on Local Fees defines a person taxpayer may be also its biggest drawback, since the criterion of permanent residence is a formal criterion that may ultimately fail in many cases reflecting the actual state (and thus the actual production of municipal waste). Another disadvantage – mainly in bigger towns- is the high costs of the tax administration

The fee consists of a lump sum of 250 CZK per person who has the permanent residence in the municipality per year, and second part of the fee up to 250 CZK per person per year based on the actual costs of the village (based on the expenditures of the previous year). For unoccupied vacation property the owner pays in one amount as a resident person. If the person obligated to pay the tax fails to pay the required fee in time or in the correct amount, the fee payment may increase unpaid fees by up to 50%. [7]

1.3.3. The fee by Act on Waste

The fee for municipal waste according to § 17a of the Act on waste compared to the local tax, much more closely reflects the actual state of things- production of municipal waste by individuals in the municipality. The payer of the fee is any natural person whose activities created municipal waste. Flip side of this benefit is that the community in the administration and collection of this fee can get into a situation where people will need in the fee proceedings prove that municipal waste is actually produced and in what quantities.

Maximum fee determined by the estimated eligible costs by the municipality based on rules of municipal waste management, distributed to individual taxpayers by the number and volume of containers for storing waste per individual property or the number of users flats with regard to the level of classification of the waste, and the fee may be reflected as expenses associated with the lease of containers for storing waste, while local tax under the

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[6] Citing the sites: JURISTIC [online], http://spravni.juristic.cz/174304/clanek/j_obce.html, 1/3/2013

[7] Citing the sites: EPRAVO [online]   http://www.epravo.cz/top/clanky/spravni-pravo/povinnost-obcanu-obce-platit-poplatky-za-odpady-15616.html, 28/2/2013

Act on local Fees is a fee for "operation of the system for collection, transport, sorting, recovery and disposal of municipal waste." Containers intended for storing sorted municipal waste generally will not "fall on the individual property." On the other hand, the charge under § 17a of the Act on Waste Act has given a firm upper limit rate.

Administration fee for municipal waste according to § 17a of the Act on Waste requires lower costs, as part of the duties associated with the collection of the fee is transferred to the payer, which is the owner of the property where there is municipal waste, while tax payer divides the tax to individual taxpayers and if the taxpayer fails to pay the fee on time or in the correct amount, the payer shall notify this to the village. [8]

1.3.4. Contractual form by Act on Waste

In comparison with the other two paying methods the contractual form of the municipal fee seems the least beneficial. As it is based on the contract between the municipality and the residents, it mainly depends on the good will of the inhabitants who produce the waste that they will volunteer to come to the municipal office and ask for the contract them.

Without such cooperation, the municipality has no other way to get any waste fees unless it changes its waste tax system.

In case the resident doesn´t pay the waste tax, the municipality has to submit the case to the court. On the other hand, administration of this system is easy (for example, municipality can use a simple stamp system) and clear.

As we can see, all forms of payment for municipal waste have their "pros" and "cons" and we can hardly say that this or that form is clearly better than others.

1.4.   Role of the citizens in the environmental protection in the municipality

Active involvement of key groups and citizens is one of the fundamental principles of sustainable development. For public participation at the national level the main instruments are the legislative measures, but also "soft tools" as Jarmila Beránková stated in her book Ekonomika životního prostředí. The soft tools are represented by e.g. the referendum, the

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[8] Citing the sites: JURISTIC [online], http://spravni.juristic.cz/174304/clanek/j_obce.html, 1/3/2013

role of ombudsman, the possibility of the criticizing role of the inhabitants at the local level etc.

The possibility and the degree of involvement of the public is given by two factors- the interest of the inhabitants in the activities in the given area and the willingness of the local autonomy to cooperate with the inhabitants. The main principle in the local cooperation is the awareness based on the joint dialogue and communication.

The knowledge of the attitudes of the inhabitants can be gathered by formal or informal way as the public meetings, by the public meeting, social research or initiation of the social groups. The inhabitants participate in the municipality decision making in different ways as choosing from the given options or express their views and agreement or disagreement with the planned changes or by presenting their own ideas.

Another important aspect of the cooperation in the municipality is the good relationship and the faith in the local autonomy.[9]

The overall rules of the environmental cooperation between authorities and the public are stated in the Aarhus Convention.

1.4.1. Aarhus Convention

"The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters was adopted on 25 June 1998 in the Danish city of Aarhus at the Fourth Ministerial Conference as part of the "Environment for Europe" process. It entered into force on 30 October 2001.

The Aarhus Convention establishes a number of rights of the public with regard to the environment. The Parties to the Convention are required to make the necessary provisions so that public authorities (at national, regional or local level) will contribute to these rights to become effective. The Convention provides for:

- The right of everyone to receive environmental information that is held by public authorities ("access to environmental information"). This can include information on the state of the environment, but also on policies or measures taken, or on the state of human health and safety where this can be affected by the state of

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[9] Soukupová, Jana & kolektiv: Ekonomika životního prostředí, Brno: Masarykova univerzita 2011, ISBN 978-80-210-5644-2

the environment. Applicants are entitled to obtain this information within one month of the request and without having to say why they require it. In addition, public authorities are obliged, under the Convention, to actively disseminate environmental information in their possession;

- The right to participate in environmental decision-making. Arrangements are to be made by public authorities to enable the public affected and environmental non-governmental organisations to comment on, for example, proposals for projects affecting the environment, or plans and programmes relating to the environment, these comments to be taken into due account in decision-making, and information to be provided on the final decisions and the reasons for it ("public participation in environmental decision-making");

- The right to review procedures to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general ("access to justice"). " [10]

1.4.2. Forms of the participation in influencing the quality of the environment

One of the basic forms of the public participation is the participation in governmental decision-making. In practice it comes to deciding about activities which directly or indirectly influence the environment as the territorial planning, building of the new industries, entering of the new products on the market etc. Every citizen has a right to stand up and submit comments on given issue.

Main group of the tools for influencing the quality of the environment falls under the wings of the business sector. Each company can choose the direction towards healthy environment by introduction new eco-designs, eco-labels on their products, monitoring and targeting, product life cycle assessment, clean production, environmental benchmarking etc. which regulates company´s industrial impact.

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[10] Citing the sites: European commission, Environment [online], http://ec.europa.eu/environment/aarhus/, 4/3/2013

1.4.3. Prevention of the waste production

The good which was produced yesterday, customers buy today will be disposed tomorrow. Every citizen of the Czech Republic produces 1.7 m^3 of the communal waste which presents 0.3 m^3 ^{or} in the landfill or 441 kg per person. [11]

The Czech legislation is the word prevention stated mainly in the Waste management plan from 2003 where it is stated as one of the strategic goals- "lowering of the specific production of waste independently to level of the economic growth". The Waste Act (185/2001 Coll.) also states that "primary originator of the waste has to prevent the generation of waste, the amounts of waste as well as the hazardous properties when producing any goods". In 2008 Czech legislation legitimized the hierarchy of the waste management where the place is taken by prevention, then the reuse, recycle, then energetic use and at the end is the land filling.

There are two types of prevention of the waste generating: At first there are the measures which reduce the amount of the waste produced which means the *quantitative prevention.* The result would be less of waste which mean that the economy consumes less of the natural resources. The area doesn´t need new landfills or combustion units. The typical example of such quantitative prevention is the composting.

The measures which reduce the ecological risks of waste are called *qualitative prevention.*

The volume of the waste remains the same but it has lower impact on the human health and it contains less harmful materials.[12]

"According to Eurostat, each European produces on average 502 kg of waste per year (2010). The importance of waste prevention is nowadays fully recognized and generally considered as a priority within EU, as well as national and regional authorities' waste management strategies and plans." [13]

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[11] Benešová, L.; Černík, B; Doležalová, M.; Havránková, V.; Kotoulová, Z.; Marešová, K.; Slavík, J.: Komunální a podobné odpady, Frýdek-Místek ENZO, 2011, ISBN 978-80-901732-1-7

[12] Hnutí Duha, Prevence odpadů: Rady a zkušenosti se snižováním produkce odpadů v obci, 2012, ISBN 978-80-86834-44-3

[13] Citing the sites: Pre-waste [online], http://www.prewaste.eu/prevention-policies/item/55-what-is-waste-prevention?.html, 3/3/2013

"Our production and consumption lead to large quantities of waste. An important element in work on eco cycles is therefore sustainable waste management. Articles that circulate in society contain large quantities of different materials. Many are energy demanding to produce and contain substances that exist in limited quantities. It is therefore necessary that we manage joint resources in a long term manner to achieve sustainable cycles in society. Many articles additionally contain substances that are toxic or hazardous and should not be released into the environment. This necessitates phasing out the most harmful substances and handling correctly those substances that continue to be used."[14]

The eco-cycle strategy includes prevention of waste, change in the consumer´s behaviour and patterns, efficient production methods with emphasis on the recycled materials and energy consumed. "At the same time it is important to reduce adverse effects in the forms of emissions of methane gas from the landfills and carbon dioxide from combustion as well as emissions of heavy metals and organic environmental pollutants. The key is to increase the material recovery of waste" [15]

Anyone can take part in the prevention process by changing little habits in everyday life. By consuming and throwing away less, people will reduce the need to handle, treat, and dispose of waste. Some of the everyday life steps can be: Purchasing durable, long-lasting materials, using products that are free of toxic materials, reducing the amount of packaging, conserving water and energy, implementing in process of recycling etc.

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[14] Citing the sites: United Nations, Sustainable development [online],
http://sustainabledevelopment.un.org/dsd_aofw_ni/ni_pdfs/NationalReports/sweden/WasteManagement.pdf, 5/3/2013

[15] Citing the sites: UN- Sustainable development [online]
http://sustainabledevelopment.un.org/dsd_aofw_ni/ni_pdfs/NationalReports/sweden/WasteManagement.pdf, 5/3/2013

1.4.4. Programmes supporting waste minimization

1.4.4.1. Strategy on the prevention and recycling of waste (European Commission 2005)

"This strategy sets out guidelines for European Union (EU) action and describes the ways in which waste management can be improved. The aim of the strategy is to reduce the negative impact on the environment that is caused by waste throughout its life-span, from production to disposal, via recycling. This approach means that every item of waste is seen not only as a source of pollution to be reduced, but also as a potential resource to be exploited.

The strategy aims to limit waste production, but it does not include an overall waste-prevention target because these do not necessarily lead to improvements in the environment. Certain techniques used to reduce the volume of waste are actually more polluting than others, even if using those means greater reductions in volume.

The main focus of the strategy for preventing waste production is on reducing the environmental impact of waste and products that will become waste. In order to be effective, this impact must be reduced at every stage of a resource's life-span. Applying the instruments set up under existing Community legislation, such as disseminating best available techniques or eco-design of products, is therefore an important factor in achieving this.

The strategy also offers a coordinated framework for specific national actions. Under the new proposal for a framework Directive on waste, the Member States are therefore required to develop programmes to prevent waste production. These programmes include specific prevention targets to be implemented at the most appropriate level and which must be made public." [16]

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[16] Citing the sites: Europa.eu [online],

http://europa.eu/legislation_summaries/environment/sustainable_development/l28168_en.htm, 5/3/2013

1.4.4.2. OECD Waste prevention and minimization programme

"The OECD work programme on waste minimisation began in 1994. The initial step was to compile information on existing policies and tools for waste minimisation in OECD countries. The second phase of the OECD Waste Minimisation Programme focused on the development of a common understanding of waste minimisation and its components (strict prevention, reduction at source, product re-use, recycling, and, when appropriate, energy recovery). This work resulted in a series of OECD publications covering specific waste streams, tools and policy approaches. During the third and final phase of the project, the OECD focused its efforts more squarely on the prevention component of waste minimisation. Since waste are generated throughout the life of economic activities, this phase of work added a resource flow perspective to the initial waste minimisation approach and will comprise waste prevention policy design, target setting, implementation and evaluation. The overall aim of this phase was to develop a Reference Manual on Strategic Waste Prevention." [17]

1.4.4.3. Hnutí Duha - Improving Waste Prevention in V4 Countries

"Current debate limits waste management to dilemma "land filling or incineration", forgetting the other options – waste prevention, reuse and recycling. The aim of the project is to develop previous successful V4 project further and build awareness about the waste prevention option among politicians, businesses and civic society in V4 countries in line with objectives of EU Waste Framework Directive." [18]

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[17] Citing the sites: OECD [online], http://www.oecd.org/env/waste/wastepreventionandminimisation.htm, 7/3/2013

[18] Citing the sites: Hnutí Duha [online], http://www.hnutiduha.cz/temata/improving-waste-prevention-v4-countries, 7/3/2013

1.4.4.4. Pre waste project (European Regional Development Fund)

"The Pre-waste project has developed a consistent and comprehensive approach to help local and regional authorities to prevent waste generation. In particular, Pre-waste will deliver:

- guidelines for planning, implementing and monitoring regional waste prevention policies
- 20 best examples of waste prevention actions implemented in the European Union by local or regional authorities, along with other good practices
- a web tool allowing the assessment of waste prevention actions' efficiency and monitoring."[19]

1.4.4.5. Tereza Association

Tereza Association is a nongovernmental non-profit organization fostering environmental education at schools in the Czech Republic. It delivers its programs to over 90.000 children participants a year. It focuses on environmental education for primary and secondary schools all over the Czech Republic and support schools and teachers with programs, trainings and materials and helps them provide better environmental education for their pupils and students. Their methodological approaches range from outdoor, experiential and project learning to constructivist pedagogy.[20]

1.5.   General Terminology

Waste - any movable thing which the owner disposes of or intends to dispose
Trash- dry discards
Garbage – wet discards
Refuse- both trash and garbage
Rubbish – all refuse plus construction and demolition debris [21]

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[19] Citing the sites: Pre waste [online], http://www.prewaste.eu/contacts.html, 7/3/2013

[20] Citing the sites: Sdružení Tereza [online], http://www.terezanet.cz/english.html, 7/3/2013

[21] Vail, Benjamin J.; Litter on the shores of Bohemia, Brno: Masaryk University press, 2011,
 ISBN 978-80-210-5733-3

Municipal solid waste (MSW) - all waste generated within the municipality by the activities of the physical persons and commercial establishments. The MSW also includes waste produced by the cleaning of the public areas of the municipality as well as the bio waste produced by the park and cemetery keeping.

Characteristics of Municipal solid waste (MSW)

The properties of municipal solid waste can be defined from several aspects. When concerning the manner of the waste treatment the critical point is the technological benefits.

From this point of view, the important characteristics measured are: the properties of the material for the recycle, characteristics for the biological degradability, energetic use etc. The main characteristics of MSW are: quantity, granulometric and material composition, moistness, caloric value and contents of selected substances and elements.

The amount of the MSW produced is usually given in tones per year. The composition of the MSW is find out by the combination of the methods as net analysis or manual sorting. Those analysis investigate the MSW composition in different types of the development as housing development, block of houses, mixed development, residential, urban or countryside and in different time periods.[22]

Municipal waste = mixed municipal waste + recycled waste + bulk waste + hazardous waste

Municipal solid waste division:
1. Household waste
2. Bulk waste
3. Recyclable fractions of the MSW
4. Hazardous fractions of the MSW
5. Street sweepings
6. Organic waste
7. Packaging

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[22] Benešová, L.; Černík, B; Doležalová, M.; Havránková, V.; Kotoulová, Z.; Marešová, K.; Slavík, J.: Komunální a podobné odpady, Frýdek-Místek ENZO, 2011, ISBN 978-80-901732-1-7

8.   Mixed municipal waste

9.   Other municipal waste similar to household waste

10.   Waste similar to mixed municipal waste [23]

   1) Household waste – is the waste produced by the households and by the activity of the cleaning the public areas of the house complexes.

   The waste management company EKO-KOM stated the composition of the household waste in its annual report from 2008 as given: Village households (mainly family houses): 0.4% hazardous waste, 0.7% Tetra pack, 2.6% metals, 3.4% textiles, 6.9% glass, 10.1% plastics, 11.3% paper, 18.6% organic waste and 46% other waste

   Households mainly in the blocks of houses: 0.7% hazardous waste, 0.9% Tetra pack, 2% metals, 5% textiles, 9.2% glass, 13.7% plastics, 18.8% paper, 20.7% organic waste and 29% other waste. Table 1 shows the ratio of different types of waste in te household waste.

Table 1 EKO-KOM a.s.: Sborník odpady a obce, Praha 2011

Separate commodities in the household waste of CR			
commodity	*weight %*	*kg/inhabitant/year*	*t/year*
Paper	16.10%	41.9	438 701
Plastics	12.30%	32.1	335 701
Glass	6.80%	17.6	184 456
Tetra pack	1.10%	3	30 918
Metals	3.50%	9.2	96 669
Organic waste	21.60%	56.3	589 207
Textiles	5.40%	14	146 259
Mineral waste	1.00%	2.5	26 000
Hazardous waste	0.40%	1	10 746
Combustible waste	7.90%	20.6	215 348
Electro waste	0.40%	1	10 167
Screenings up to 40mm	23.50%	61.2	640 416
Total		*260.4*	*2 724 588*

[23] Balner, Petr; Mojžíš, Josef; Lochovský, Martin; Drahovzal, Pavel; Kratochvíl, Petr; Kotoulová, Zdenka; Černík, Bohumil; Vrbová, Martina: Hospodaření s odpady v obcích, Praha : Ekokom a.s., 2009, ISBN 987-80-254-6019-1

2) Bulk waste – is part of the household waste and similar waste which is bigger than 1.1m3.

3) Recyclable fractions of the MSW- are classified fractions of the MSW which can be reused. These are specified in the Catalogue of waste by numbers:

a. *200101- paper and/or board*
b. *200102- glass*
c. *200103- minute plastic objects*
d. *200104- other plastics*
e. *200105- minute metal objects (tins)*
f. *200106- other metals*
g. *200107- timbre*
h. *200108- organic waste*
i. *200110- clothes*
j. *200111- textiles*
k. *200122- spray vessels*
l. *200124- electro technical waste*
m. *200305- car wrecks* [24]

4) Hazardous waste - waste included in the list of hazardous waste, set out in the implementing regulation and any other waste exhibiting one or more of the hazardous properties listed in Annex 2 to the Act on Waste. These are divided:

a. *200109 – oils and/or fats*
b. *200112- colour paintings, glues, resin*
c. *200113- dissolvent*
d. *200114- acids*
e. *200115- hydroxides*
f. *200116- detergents*

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[24] Černík, Bohumil;Kotoulová, Zdena; Mrázek, Pavel: Systém nakládání s odpady v obcích, Praha 1998, ISBN 80-7212-051-4

g. *200117- photo chemicals*

h. *200118- drugs*

i. *200119- pesticides*

j. *200120- galvanic cells*

k. *200121- objects with mercury*

l. *200123- objects with fluoro chluoro hydrocarbons*

5) Street sweepings- little fractions gathered by the street sweeping as well as the refuse from the public street bins.

a. *200303 – street sweepings*

b. *200302- waste from the markets*

c. *200203- other non compostable waste*

6) Organic waste – biological waste from parks, cemeteries and other public places as well as from the gardens of natural persons which can be disposed of by the anaerobic or aerobic decomposition. (200201 compostable waste)

7) Packaging – is the product of any material which should protect, hold, present or help with manipulation the good. This type of waste includes the returnable packaging.

8) Mixed municipal waste - fraction of municipal waste that remains after sorting of paper and cardboard, glass, plastics, biological, bulky and hazardous waste from municipal waste. [25]

a. *200301- mixed municipal waste*

b. *200304- sludge from septic tank and cesspools, waste from chemical toilets*

c. *200399- other municipal waste*

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[25] Černík, Bohumil;Kotoulová, Zdena; Mrázek, Pavel: Systém nakládání s odpady v obcích, Praha 1998, ISBN 80-7212-051-4

9) *Other municipal waste similar to household waste*- waste gathered from the municipal properties etc.

10) *Waste similar to mixed municipal waste*- waste similar to mixed municipal waste but produced by the legal persons and companies within the given community

Recyclable waste- material or other reusable items culled from municipal waste, these components are paper and cardboard, beverage cartons, glass, plastic / PET bottles /, biological waste from households (common kitchen waste)

Scrap yard – object or the lot determined for the waste disposal which is operated by the competent person and within the legal rules.

Write- offs – the whole car or parts of the car which was capable to transfer people, animals or goods on the roads and became the trash.

Waste management – activity aimed at prevention of waste genesis, waste disposal and then the consequent care of the place where the waste is kept as well as the overall official control.

Waste disposal – waste gathering, waste concentration, collection, purchase, separation, transport, storage, treating, exploitation and removing.

Waste gathering – waste concentration from the municipalities by the authorized legal person in order to handover for reusing or waste disposal.

Waste separate collection- activity which aims to separate the chosen fractions of waste in order to their reusing or disposal. The most common separation is the waste sorting system aimed for the waste recycling. [26]

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[26] Balner, Petr; Mojžíš, Josef; Lochovský, Martin; Drahovzal, Pavel; Kratochvíl, Petr; Kotoulová, Zdenka; Černík, Bohumil; Vrbová, Martina: Hospodaření s odpady v obcích, Praha : Ekokom a.s., 2009, ISBN 987-80-254-6019-1

Reverse consumption- the obligation to take back used goods, stated as dangerous waste, in order to reuse the components or dispose them. In the Czech Republic the obligation to take back used oils, electric accumulators, galvanic cells and batteries, discharge tubes, fluorescent tube, tires, electric machines from households and write- offs is applied.

Waste treatment- is any activity which changes the physics, chemical or biological properties of the waste (including the waste separation) in order to simplify the transport, usage, and disposal or in order to lower its volume or hazardous materials.

a) *Biological waste treatment*- controlled action of biologically active components to change the properties of the waste as lowering the volume of the hazardous fractions, lowering the amount of the pathogen biological agents which causes the infection etc.

b) *Physicochemical waste treatment*- evaporation, calcinations, drying, change of the pH, change of the chemical composition, dehydration, filtration, solidification etc.

c) *Mechanical waste treatment*- change of the waste composition, mainly separation of different types of materials [27]

Recycling- "is the process of re-using a given product (beyond its intended use), or producing a new product from a recyclable material. " [28]

Figure 1 Examples of recycling logo, Logoblink 2013[29]

[27] Balner, Petr; Mojžíš, Josef; Lochovský, Martin; Drahovzal, Pavel; Kratochvíl, Petr; Kotoulová, Zdenka; Černík, Bohumil; Vrbová, Martina: Hospodaření s odpady v obcích, Praha : Ekokom a.s., 2009, ISBN 987-80-254-6019-1

[28] Citing the sites: Energy ideas [online],   http://www.clean-energy-ideas.com/energy_definitions/definition_of_recycling.html, 26/1/2013

[29] Citing the sites: Logoblink [online], http://logoblink.com/44-recycle-logos/ 26/1/2013

Recycling logo- helps to identify the recyclable products. It usually shows the symbol with a percentage inside which identifies a product made from recyclable material. " [30] Different types of recycling logo are shown in Figure 1.

The figure was originally designed by Gary Anderson from USA who won the student´s competition of designs that symbolize the recycling process in September 1970. He says that the logo shows a Mobius strip to symbolize continuity within a finite entity."[31]

Energetic use of the waste- use of the waste as a fuel for the energetic industry

Waste composting- the aerobic process in which the micro and macro organism causes the decomposition of the biological waste and so form the waste into compost. "Mature compost is a stable material with content called humus that is dark brown or black and has a soil-like, earthy smell. It is created by: combining organic waste (e.g., yard trimmings, food waste, manures) in proper ratios into piles, rows, or vessels; adding bulking agents (e.g., wood chips) as necessary to accelerate the breakdown of organic materials; and allowing the finished material to fully stabilize and mature through a curing process." [32]

The composting process- the most important steps in the composting process include:

- *Feedstock and nutrient balance-* Proper balance of "green" organic materials which contain large amounts of nitrogen, and "brown" organic materials which contain large amounts of carbon but little nitrogen.
- *Particle size-* Grinding, chipping, and shredding materials increases the surface area on which the microorganism can feed. Smaller particles also produce a more homogeneous compost mixture and improve pile insulation to help maintain optimum temperatures.

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[30] Citing the sites: Energy ideas [online],   http://www.clean-energy-ideas.com/energy_definitions/definition_of_recycling.html, 26/1/2013

[31] Citing the sites: Logoblink [online], http://logoblink.com/wp-content/uploads/2008/03/recycling_symbol_garyanderson.pdf, 18/2/2013

[32] Citing the sites: EPA [online], http://www.epa.gov/region9/organics/ad/index.html, 22/2/2013

- *Moisture content*- Microorganisms living in a compost pile need an adequate amount of moisture to survive. Water is the key element that helps transports substances within the compost pile and makes the nutrients in organic material accessible to the microbes.

- *Oxygen flow*- Turning the pile, placing the pile on a series of pipes, or including bulking agents such as wood chips and shredded newspaper all help aerate the pile. Aerating the pile allows decomposition to occur at a faster rate than anaerobic conditions.

- *Temperature*- Certain temperatures promote rapid composting and destroy pathogens and weed seeds. If the temperature does not increase, anaerobic conditions (i.e., rotting) occur. [33]

Anaerobic digestion- "Anaerobic digestion is a process where microorganisms break down organic materials such as food scraps, manure and sewage sludge in the absence of oxygen. Anaerobic digestion produces biogas and a solid residual. Biogas, made primarily of methane and carbon dioxide, can be used as a source of energy similar to natural gas. The solid residual can be land applied or composted and used as a soil amendment. The benefits of anaerobic digestion include renewable energy generation, greenhouse gas emissions reduction, and waste diversion."[34]

Landfill – Landfill, dump or tip is a place where the waste is disposed. It should be well planned with regard to the location, operation, design, and monitoring to ensure the environmental regulations and safety. The biggest threats of the landfills include the contamination of the underground water and the streams and destroying the environmentally sensitive areas. Many new landfills collect potentially harmful landfill gas emissions and convert the gas into energy by the cogeneration unit.

Cogeneration unit – is the device for energy recovery of landfill gas, which draws gas from the landfill body and adds it to the internal combustion engine that drives a generator to produce electricity. The generated electricity is passed through a transformer to the

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[33] Citing the sites: EPA [online], http://www.epa.gov/compost/basic.htm, 22/1/2013

[34] Citing the sites: EPA [online], http://www.epa.gov/region9/organics/ad/index.html, 22/1/2013

distribution network. Otherwise the gas would escape into the air and contaminate the ozone layer.[35]

1.6. Recycling

The basic stone of recycling is the general knowledge how to sort the waste. Municipalities differ in the types of materials they sort, but the basic division is the same for the whole country. Even though the containers at the recycling nests are usually of just 3-5 types, people can sort many more materials and take them away to the scrap yard or to the special recycling centre. Several companies have already realized how important is the implementation of the "green" policies Some of those can be tracked for example by the special recycling bins in their stores (see Figure 3) or by the environmentaly friendly packaging etc.

Basic division of materials:

Asbestos – three types of asbestos- white, blue and brown. Asbestos is a hazardous waste which includes fibres which can be easily breathed in and then causes cancer. Asbestos is usually part of e.g. adhesives, pipe insulations, textured wall surfaces, heat resistant fabrics etc. "Today, there are technologies to recycle asbestos into harmless silicate glass using thermal decomposition at very high temperatures. This can then be turned into stoneware and ceramic products of various types." [36]

Batteries - All waste batteries are classified as hazardous waste which must be recycled.

- *Alkaline:* Even though the most popular type of disposable battery - alkaline no longer contains mercury, these batteries can be recycled to recover steel and zinc.
- *Carbon zinc:* Though less popular now because of their inefficiencies in extreme temperatures, these are still relatively cheap to

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[35] Citing the sites: ASA group [online], http://www.asa-group.com/cs/Ceska-republika/Novinky/Nova-kogeneracni-jednotka-v-Unanove.asa, 1/2/2013

[36] Citing the sites: Eco life- Recycling [online], http://www.ecolife.com/recycling/hazardous/how-to-recycle-asbestos.html, 10/3/2013

make and therefore some are still in circulation. They can be recycled to recover zinc through retail drop-off and mail in programs.

- *Silver oxide:* Known most for their use in things like hearing aids, watches, calculators, and the like, these button batteries contain mercury and should always be recycled.
- *Zinc-air:* Similar to other button batteries, these are made with zinc and are resistant to self-discharging unless exposed to air. They can be recycled with other disposable batteries.

The most environmentally friendly batteries are the rechargeable and reusable ones.

Building materials

Metal, wood, glass, concrete etc. such waste can be thrown in the architectural salvage yards which may resell some of it or some of the materials can be reused (bricks, doors, windows, plumbing, electrical, millwork, tile, cabinets, lumber, flooring, etc.)

Clinical waste

In the UK, the company Knowwaste developed a programme which recycles the used nappies, dirty diapers and other absorbent sanitary products.

"Within an air controlled and clean working environment, we take delivery of the materials in a dedicated receiving bay. Utilising autoclave advanced thermal treatment technology, the waste material is sterilised, separation commenced and moisture released. At this stage the super absorbent polymers are collapsed and rendered inert.

There follows further sort and separation of plastics and fibres and removal of contaminants. The plastics continue through granulation and multiple- washing stages before being bagged for shipment in flake form. These flakes can then be used, or pelletized to be used, in new products such as plastic components or as an ingredient in composite materials replacing concrete and steel. The fibres can be used for industrial cardboard tubing and fibre-based construction materials. 95 % of the material input is treated with the remaining solids sent to the sewer." [37]

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[37] Citing the sites: Know waste [online], http://www.knowaste.com/process, 11/3/2013

Other clinical waste has to be handled with attention in special bins as it becomes hazardous for humans health as well as a toxic pollutant. Clinical waste is recycled by specialist companies who normally pass clinical waste through a sterilisation plant and then into an autoclave which essentially heats and shreds the materials and finally separates into different fractions such as plastics, organics and so on.

Composting

Composting can divert as much as 30% of household waste away from the garbage can which includes: hay, wood ashes, cardboard, cowpeas, coffee grounds, egg shells, flowers, feathers, fruit and vegetable peels, leaves, newspaper, leather, wood etc...

During composting, microorganisms from the soil eat the organic (carbon containing) waste and break it down into its simplest parts. This produces a fiber-rich, carbon-containing humus with inorganic nutrients like nitrogen, phosphorus and potassium. The microorganisms break the material down through aerobic respiration, and require oxygen that they get from the air you introduce when you turn the material in the compost bin. The microorganisms also require water to live and multiply. Through the respiration process, the microorganisms give off carbon dioxide and heat temperatures within compost piles can raise as high as 38 to 66 degrees C. If the compost pile or bin is actively managed by turning and watering it regularly, the process of decomposing into finished compost can happen in as little as two to three weeks (otherwise, it may take months). 38

Compost adds nutrients to your plants and helps retain moisture in the soil. Composting introduces beneficial organisms to the soil. Microscopic organisms in compost help aerate the soil, break down organic material for plant use and ward off plant disease. Good for the environment. Composting offers a natural alternative to chemical fertilizers.

Electrical Equipment

As with any e-waste challenge, it is important to choose an ethical recycler that promotes safe and fair methods for recycling your electronic waste. The bulk of all e-waste is sent overseas where the components are dismantled (sometimes smashed apart) by people (often children) without proper personal protection making less than 25 cents an

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[38] Citing the sites: The City of St. Luis [online], http://home.howstuffworks.com/composting1.htm, 11/3/2013

hour. 39 Heavy metals are particularly harmful to the environment because they accumulate through the food chain and can cause serious health effects in humans. Other items are also potentially damaging such as plasticizers which can leach into the soil caused toxicity in wildlife.

Another crucial aspect is the saving of the raw materials from the electronics. As EPA stated in its article "For every million cell phones we recycle, 35 thousand pounds of copper, 772 pounds of silver, 75 pounds of gold, and 33 pounds of palladium can be recovered. Recycling one million laptops saves the energy equivalent to the electricity used by more than 3.500 US homes in a year." 40

LCDs, computers, monitors, cartridges, iPods, mobile phones, televisions etc. all these unused valuables consist of many types of materials, including plastic, glass, metal, and many harmful chemicals and heavy metals (like mercury, cadmium, and lead). Almost all computers contain brominates flame retardants (BFRs) which are serious environmental hazards. All this e-equipment can be easily repaired and reused or resold. Then there are several organisations as e.g. Centrum recyklace elektroniky by Pražské služby a.s. which take back used electronics as well as you can dispose it at the municipal scrap yard.

Glass

The glass is divided into three colours: green, brown and clear. The recycling process (which can be as fast as 30 days) of glass has several steps:

- *"Crushing:* Once it arrives at the local recycling facility, the glass is sorted and washed again, and things like metal lids and food waste are removed to ensure that it's in the best condition it can be. It is then sent to a crushing machine where it is broken down into small gravel-like pieces called cullet.

- *Contaminant removal:* As the cullet travels down a conveyor belt, magnets will remove metals and air current help to remove things like paper labels and other lightweight items to further refine the finished product.

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[39] Citing the sites: Eco Life [online], http://www.ecolife.com/recycling/electronics/how-to-recycle-printer-ink-cartridges.html, 11/3/2013

[40] Citing the sites: EPA [online], http://www.epa.gov/epawaste/conserve/materials/ecycling/donate.htm, 11/3/2013

- *Melting:* Finished cullet is then packaged up and sold to manufacturers as a raw material. It is then taken to a production facility where it is melted down at much lower temperatures than would be required to make glass from raw materials. During the melting phase, any remaining labels are burned off. The melted cullet is then formed into new products just as it would be when the glass was originally formed from sand and limestone.

- *Production:* Recycled glass can be made into many new products, including fibre glass insulation, ceramic tiles, beach sand, and glass for picture frames, sand-blasting material, and even reflective paint for street lines." [41]

The basic and the most eco-friendly glass handling is the returnable packaging which can be used mainly for beverage production (beer, wine, lemonades, juices etc.). The most expensive aspect is unfortunately the system of collection.

Metals

Metal is usually separated into 2 groups: aluminium (as drink cans) and steel (as food cans). The recycling process includes waste sorting, burning as the material division, cutting and briquetting of the metals and then sending the pieces into concentrator where it is re-melted in 1700 degrees C.

"Recycling scrap metal reduces greenhouse gas emissions and uses less energy than making metal from virgin ore. The amount of energy saved using various recycled metals compared to virgin ore is up to: 92 % for aluminium, 90 % for copper, 56 % for steel. Recycling one ton of steel conserves 2.500 pounds of iron ore, 1.400 pounds of coal and 120 pounds of limestone. Recycling a ton of aluminium conserves up to 8 tons of bauxite ore and 14 megawatt hours of electricity." [42]

Reusing of the precious metals became a good business. As an example we can name one of the biggest companies in the Czech Republic- SAFINA, a.s. who buys materials with

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[41] Citing the sites: Eco Life [online], http://www.ecolife.com/recycling/glass/glass-recycling-process.html, 11/3/2013

[42] Citing the sites: About- Environment [online], http://environment.about.com/od/recycling/a/metal-recycling.htm, 11/3/2013

precious-metal and non-ferrous-metal content, electronic waste with precious-metal content as well as broken pieces to come from jewellery manufacture, coins, etc. and produces new dental materials or jewellery.

Paints and oils

Waste such as paint, paintbrushes, car oil and oil filters have to be carefully disposed of. Paint is an enormous waste problem as it belongs to hazardous waste. It has toxic ingredients and corrosive, volatile and reactive attributes as well as it contains heavy metals. Most of the municipal scrap yards would accept or especially paints can be kept for future or offered for donating.

As an excellent example of paint reusing is the "Community RePaint schemes, which collect reusable, leftover paint and re-distribute it to individuals, families, communities and charities in need, improving the wellbeing of people and the appearance of places across the UK. In 2012 the Community saved 387.495 litres of paint, donated by householders and businesses, going to waste" [43]

Recycling of oils is proceeded in three steps. The first step is sedimentation, followed by filtration and removal of moisture from the oil by centrifugation or vacuum device (humidity increases acidity destroy additives in the oil). The most important step is recycling filtration impurities. These recycled oils are used for oil for heating, as the basis of machining emulsions, or as a basis for the less powerful lubricating oil.[44] Recycled cooking vegetable oils are primarily reused in food production and subsequently utilized as a component of fuel.

Paper

Paper can be recycled 4-6 time which saves the water and air pollution as well as every tonne of the recycled paper saves up to 14 trees (5m3 of timbre). European paper industry promised to recycle 66% of the overall production in 2010 and it fulfilled its mission. Paper is separated in several subgroups by the way of recycling: Books, Notebooks, phonebooks, magazines, tetra pack, cardboard, and milk cartoons. Recycled paper is then used for many secondary products as notebooks, envelopes, cartoons, leaflets,

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[43] Citing the sites: Community Repaint [online] http://www.communityrepaint.org.uk/, 11/3/2013

[44] Citing the sites: Community Repaint [online], www.recyklace.unas.cz, 11/3/2013

serviettes, toilette paper etc. 90% of the newspapers are printed on recycled paper as well as 90% of corrugated boxes are made of recycled fibre. In New Zealand, the scientists developed new technology of producing the mulch mats intended for use in agriculture or in horticultural production, which prevents the growth of weeds and retain moisture. [45]

Textiles

Figure 2 Containers for textiles and shoes

More than 70% of the humans on earth rely on second hand clothing for their wardrobes. There are many better options that to throw away the old clothes: e.g. donating or swapping clothes, reusing the fabrics or finally it can be left in special textile banks at recycling centres. The recycling container is sown in Figure 2.

The fabrics are shredded into "shoddy" fibres and blended with other selected fibres before being reprocessed into new items. The fibres can also be compressed for mattress production or to make filling material for car insulation, roofing felts, loudspeaker cones, panel linings and furniture padding. Some companies are creating new pieces of clothing from scraps of old clothes. An example of the fashion company H&M can be showed. H&M will become the first fashion company to launch clothing collecting initiative worldwide beginning in February 2013 at all its 48 markets. Customers at H&M, the world's second biggest fashion chain, will be able to hand in used garments from any brand. "The customers can save natural resources and contribute to reduced environmental impact by avoiding textile waste as well as they will get a 15% discount for their next purchase. This might be the right time to ask how sustainable these programs actually are, especially if they also encourage consumers, directly or indirectly, to buy new items."[46]

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[45] Citing the sites: Biom [online] Kozáková, Radka:Výroba a použití mulčovacích folií z recyklovaného papíru, http://biom.cz/cz/odborne-clanky/vyroba-a-pouziti-mulcovacich-folii-z-recyklovaneho-papiru, 23/3/2013

[46] Citing the sites: Magazine Triple Pundit: Raz Godelnik: H&M Launches First Global Clothing Collection Recycling Program[online], http://www.triplepundit.com/file-library/Commit_LeaveBehind_booklet_forWeb.pdf 11/12/2012

2.   Hypothesis and Objectives

2.1.   Hypotheses

1. The Fee by the Act on Waste has got more impact on environment quality than the Local Tax given by the local administration;

2. Bigger townships and communities have lower costs of waste management than the smaller ones;

3. Amount of waste per capita in bigger townships and communities is lower than that at smaller ones;

4. In townships and communities which apply Fee by Act on Waste system the inhabitants take more care on waste management (selection of waste) that in communities that apply the Local Tax.

2.2.   Objectives

1. Survey on the quality of the environment by measuring the amounts of the waste generated in given area

2. Monitoring of different types of the waste produced per capita

3. Assessment of differences in waste management costs

4. Evaluation of inhabitant´s motivation for responsible behaviour in the process of waste generation and gathering.

Figure 3 Example of the recycling nest in Psáry, Dolní Jirčany, 2013

3.   Methodology

3.1.   Data collection

Data regarding the waste generation and collection were collected during three months in years 2012- 2013. The research included seven municipalities of different sizes:

Horažďovice- Plzeňský region, district Klatovy

Horoměřice- Středočeský region, district Praha- západ

Mnichovice- Středočeský region, district Praha- východ

Jílové u Prahy- Středočeský region, district Praha- západ

Psáry- Středočeský region, district Praha- západ

Říčany- Středočeský region, district Praha- východ

Statenice- Středočeský region, district Praha- západ

Location of the municipalities was chosen incidentally around Prague with one exception of Horažďovice in South Bohemia. The choice assumed that Horažďovice showed some externalities.

Time period of the collected data included years 2007 – 2011. Unfortunately data from the year 2012 was not available as most of the municipalities process the waste management results in the first quarter of the next year (2013).

The addressed municipalities were asked personally and by email to fill out several questions regarding their waste management system and to send the results from years 2007-2011.

The results were divided as: mixed municipal waste, plastics, glass, tetra packs, organic, bulk, dangerous or other waste generation which is separated in given area. Similar division was applied for the economic overview with the emphasis on the revenues from the inhabitants as well as other incomes from the waste. Each year was calculated separately.

Each municipality keeps records about waste management in different way. Some of the municipalities did not find records older than 5 years as the previous local government threw them away. Waste managers choose their own way how to handle with the waste data, so some of the records were written in hand, some were obligatory basic numbers which are sent to Ministry of the Environment and to Czech Statistical Office, some elaborate tables with all precise data. Town Jílové u Prahy refused to provide any financial

documentation as it was the business secret even though the waste management records should be published for public. In general most of the villages were very helpful. The missing information or data from former years were obtained due to companies EKOKOM, a.s., RUMPOLD-P s.r.o. and Regios a.s.

Data regarding demographic and housing development information was brought by Czech statistical office from the section of the census. Location and the distance to the landfills were calculated by Google Maps.

The social motivation and general meaning about waste management was surveyed by the public questionnaire "Production of waste in households" (see par.3.3).

3.2. Data analysis

Data were processed by statistical tabular and graphical methods.

Data collected from seven municipalities were ordered by the same parameters into the tables. The parameters included years and the types of the waste. Each type of the waste was then calculated into tone per capita so that all the villages could be equally compared.

Main criteria compared included demographic details as population growth in 5 years, prevailing education and age as well as the housing development of the area, the applied waste law and height of the waste fee (see Table 2). Three municipalities apply the system of waste management by the Act on Waste and four municipalities by Local Tax.

Horažďovice- Local Tax

Horoměřice- Local Tax

Mnichovice- Act on Waste

Jílové u Prahy- Local Tax

Psáry- Act on Waste

Říčany- contractual form by Act on Waste

Statenice- Local Tax

Next criteria focused on the system of the waste gathering. The main details collected compared the distance between the recycling nests[47], number of the nests, types of the containers and how many inhabitants of the given municipality uses 1 recycling nest. Another factor which plays a big role in the municipality waste gathering is the service company and the distance to the landfill or the sorting unit. Most of the villages hire just

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[47] recycling nest = 1 unit of the recycling containers which usually consists of bins for plastic or PET, glass and paper

one company which deals with all the waste types. These municipalities which run their own scrap yard contracts more companies which specialize in exact type of the waste e.g. hazardous waste, for the electro waste, tires, organic waste etc.

Data regarding the waste generation were compared and formed into the graphs to show the development in time (see Annex). The growth and decline of the ratio of different types of waste were contrasted by the trend lines count for each municipality.

Student´s t test was applied when testing two sets of data to determine if the averages of two samples are significantly different.

The purpose of the research is to prove that the municipalities which apply the payment system for waste by Act on Waste (Group 2) differ from these municipalities who apply the Local Tax system (Group 1). The data used in the test come from the totals per 5 years per capita in each municipality. There are included 5 types of the waste: mixed municipal, paper, plastics, glass and dangerous waste. The data regarding other waste were not complete so the test would be distorted.

1. $H_0 = \mu_1 = \mu_2$: Selection of measured amounts of waste from Group 1   and Group 2 come from a statistical file.
2. $H_A = \mu_1 \neq \mu_2$: Selection of measured amounts of waste from Group 1 and Group 2 do not come from a statistical file (the amounts of waste are of different sizes).

Testing of the probability that both selections come from the same file:
   o If the probability is small ($p < 0,05$) the H_0 is rejected and H_A is verified.
   o If $P > \alpha$ the H_0 cannot be rejected, if $P < \alpha$ the H_0 can be rejected
   o If t belongs to the critical region of , H_0 can be rejected
   o The mean of both groups will with high probability differ. The test will prove if it differs enough so that H_0 can be rejected.

3.3.   Questionnaire

The **social motivation** and general meaning about waste management was examined by the public questionnaire "Production of waste in households". The questionnaire was randomly spread between respondents of any age or location via internet as well as in person. The questionnaire was responded by 145 volunteers in February and March 2013.

The questionnaire included 4 general questions regarding social background and 7 questions regarding waste disposing (see Annex 1). The questions were formulated in easily understandable way. Questionnaire was filled by 145 respondents.

Questions regarding waste management in households were testing:

- Whether people recycle household waste
- Basic awareness about waste generation
- Knowledge about system of payment for waste

4.   RESULTS AND DISCUSSION

4.1.   Horažďovice

Town Horažďovice is situated in South Bohemia in Plzeňský region, district Klatovy. The settlement can be divided in halves to family houses and to the block of flats.

The population slowly declines from 5729 inhabitants (2007) to 5578 (2011). Detailed demographic data description is in Annex 2. The predominant age groups by the Czech Statistical Office are the same in all seven municipalities divided in groups 0-14 and 30-39 years. The prevailing finished education in Horažďovice is secondary without graduation.

The government of Horažďovice apply the Local tax under the Act on Local Fees.

The inhabitants pay CZK 600 per capita per year. The town also runs local scrap yard as well as the 1100 l containers for the organic waste situated on 10 places around the city. The containers for the bulk waste are available only after Christmas for the Christmas trees. The inhabitants use 27 recycling nests which are stated on the town´s web site. One nest is used by approximately 207 people. Horažďovice sort: paper, glass, plastics, tetra pack and organic waste. The table with the summary of the sorting information is connected in Annex 2. The service company Rumpold- P s.r.o. which operates in town transports the mixed communal waste to landfill in Chrást u Březnice (43km), plastics to sorting unit in Sušice (20km) and the organic waste to composting unit in Svaté Pole u Březnice (58km).

The website of the town encourages inhabitants to behave ecologically as well as informs in detail about all the waste management activities held in the area.

4.2.   Horoměřice

The village Horoměřice is situated at the West outskirt of Prague in the Středočeský region, district Praha – západ.

Horoměřice is mainly formed by new modern housing which consists of 769 family houses and 72 blocks of flats.

Population of the village has grown from 2515 inhabitants in 2007 to 3335 inhabitants in 2011, which is caused by the modern trend of moving from the city towards the suburbs. The age groups 0-14 and 30-39 prevails in the local population. The most frequent finished education is secondary with graduation.

The waste management in the municipality is run by the system of local tax. Every inhabitant should pay CZK 480 per year. The municipality keeps local scrap yard which runs 5 containers for the bulk waste and 1 for the organic waste and a scrap yard for the hazardous waste which is opened once a week.

Local government runs 13 recycling nests which include 53 containers for paper, plastic, glass and tetra pack. Each recycling nest serves 257 inhabitants.

The black dumps around the village appear usually 2-3 times per year and the offender is found in half of the cases.

Company Regios a.s. (A.S.A.) operates in Horoměřice and collects all types of the waste and transports those 6km to landfill and the sorting unit in Úholičky.

The list of the recycling nests is published on the village´s web pages.

4.3.   Jílové u Prahy

Town Jílové u Prahy, situated in Středočeský region, district Praha- západ, looks down to the valley of river Sázava. The municipality is mainly formed of the 972 villas and family houses and two housing estates with 85 blocks of flats.

The population of Jílové u Prahy slowly grows (3688 inhabitants in 2007, 4222 inhabitants in 2011). The predominant finished education is secondary.

Figure 4 Land fill in Jílové u Prahy

The waste management system is performed by the local tax in the amount of CZK 500 per capita per year or per recreational property. The municipality owns landfill situated in the town boundary operated by the company AVE (see Figure 5) which also collects all types of waste in the town. AVE transports paper and plastics waste to sorting unit Kovošrot Praha, glass to AMT Příbram which produces foam glass and tetra pack to company Pražské služby. From 2010 Jílové u Prahy also runs own scrap yard.

The map of the recycling nests is not available. Town runs 35 recycling nests which include 141 containers. Each recycling nest serves 121 inhabitants.
Webpage of the municipality does not show the location of the recycling nests or any other information regarding waste management with the exception of the scrap yard.

The waste manager of Jílové u Prahy was the only one from all the municipalities included in the research who refused to publish the financial situation regarding the waste management in the town. The business secret was stated as a reason. In all the six other villages the waste management is a public matter and anyone can be informed about the activities and prices in the community.

4.4. Mnichovice

Town Mnichovice is situated along the river Mnichovka in Středočeský region, district Praha – východ. The municipality mainly consists of 1049 family houses and villas and 16 blocks of flats predominantly built at one housing estate (see Figure 6).

The population of the community grew in years 2007 and 2008, but from the year 2009 it stagnate around a number of 3050 inhabitants (2009 – 3043, 2010- 3065, 2011- 3069 inhabitants). The prevailing finished education is secondary with graduation and most frequent age group 0-14 years and 30-39 years. Mnichovice runs local company

Figure 5 Land fill in Jílové u Prahy

Veřejné služby Mnichovice which deals with the sewage as well as with the sorted waste and metal waste. The recycled waste is brought to sorting unit in Benešov

The mixed communal waste is gathered by company A.S.A. and transported 36 km to the land fill in Radim. The containers for the bulk and hazardous waste are arranged twice per year **by the municipality. The hazardous waste is then erased by company Marius Pedersen a.s.**

Mnichovice run only 5 recycling nests which include bulk metal container for paper, PET and glass. Since 2011 Mnichovice sorts also the plastics. One recycling nest serves to 614 inhabitants. This fact shows that the sorting facilities are undersized in relation to distance from the households as well as to types of waste sorted. The capacity of the containers would be sufficient if they were taken out very frequently.

The waste management system in the municipality is financed by the fee by Act on Waste. The bin of 240 l cost 2550 CZK in 2011. The price has grown from CZK 2170 in 2007 by CZK 380.

Waste manager in Mnichovice was very helpful and even though all the data were written and counted in hand it was precise and neat. The only odd fact is that the data regarding the waste management are kept only back to the year 2005. The web site of the town does not show any information about waste management.

4.5. Psáry

The village Psáry expands on wide area in Středočeský region, district Praha – západ. The village has quickly expanded in past 10 years. It is formed by 1036 family houses and 12 blocks of flats at one housing estate.

The number of local residents has grown from 2750 (2007) to 3331 inhabitants in (2011). In general the number of inhabitants is higher as many people have their residency at other place. The prevailing education is secondary with graduation. Population is mainly formed by age group 0-14 years and 30-39 years.

Psáry has applied payment system of fee by Act on waste. The municipality runs own scrap yard which is opened twice per week and it is situated in the middle of the village. The cost based on regular every week basis of 110l bin costs CZK 2145. The service is provided by Rumpold-P, s.r.o. which takes the waste 53 km to the land fill Kamenné Žehrovice. The community sort glass, paper, plastics, electro waste and tetra pack (see Figure 4).Textile containers are available in neighbouring Jesenice (2km). The municipality also offers the collection of the organic waste by Rumpold-P, s.r.o. The customers can hire or buy the brown bin of volume 140l or 240l which is then collected on every week basis. The 140l bin costs CZK 1024 per season (April- October).

The municipality runs 15 recycling nests which include 87 containers. Each recycling nest serves to 222 residents.

Waste management of the village is chaotic and based just on every year official duties. The data are kept without system and can be partly found only back to year 2006. The data stated in the thesis were partly found due to helpful managers in EKO-KOM, a.s. and Rumpold-P, s.r.o. Web site of the village informs about the scrap yard and about the terms of the waste gathering times. Any motivation or instructions about recycling or so is not available.

Table 2 Description of sorting in the municipalities

			SORTING IN MUNICIPALITIES	
Name	Recycling nests	Inhabitants using 1 recycling nest	Company operating in the municipality	Landfill
Horažďovice	27	207	Rumpold - P, s.r.o.	Chrást u Březnice
Horoměřice	13 (53 bins)	257	Regios (A.S.A)	Úholičky
Jílové u Prahy	35(141 bins)	121	AVE	Jílové u Prahy
Mnichovice	5	614	A.S.A , Veřejné služby Mnichovice	Radim
Psáry	15 (87 bins)	222	Rumpold - P, s.r.o.	Kamenné Žehrovice
Říčany	72	187	Marius Pedersen a.s.	Radim
Statenice	7 (31 bins)	180	Regios (A.S.A)	Úholičky

4.6. Říčany

The biggest municipality compared – town Říčany is situated 15km from the Prague´s outskirt. The settlement is composed of 3255 family houses and then several housing estates formed by 159 blocks of flats.

The population of Říčany has grown from 11957 (2007) to 13450 residents (2011). The prevailing finished education in the municipality is secondary with graduation and predominant age groups are same as in the other municipalities 0-14 and 30-39 years.

The town finance its waste management using the contractual fee by Act on Waste in an amount CZK 2520 per 120l bin.

The municipality runs the scrap yard. Up to the year 2010 the municipality organised 4 times per year bulk waste containers and from year 2011 only twice per year 31 containers.

The service company Marius Pedersen, a.s. transports the mixed communal waste 36 km to the land fill in Radim. Paper waste is brought 20km to sorting unit Papkov s.r.o. in Prague 10. The plastics are transported 50 km to AVE in Benátky nad Jizerou. Tetra packs is recycled by Pražské služby in Prague which is pictured in Figure 8. Glass waste is brought 72 km to AMT Příbram and metal waste travels to Kovošrot in Prague.

The town solves approximately 15 black dumps per year but usually just once is found the originator. Last year the offender was found due to help of the local inhabitants and he got a fine of CZK 12 000. Unfortunately the case that the offender is found is unique.

The town runs 72 recycling nests of plastics, paper, glass and tetra- pack.

A recycling nest serves to 187 residents.

The waste manager of Říčany is very helpful and organised. All the data are precise and kept in neat tables etc. The local website informs inhabitants about the system of payment for waste and the scrap yard. Unfortunately there is not many information about sorting of waste.

Říčany has also engaged in the Operational programme of the Environment of European union which focuses on the composting of household waste. The town is giving out 300 household composters of 800l volume as pictured in Figure 7.

Figure 6
Composter 800l

4.7. Statenice

The village Statenice is situated in the West outskirt of Prague. The community is formed mainly by 475 family houses- most of them built lately- and only 6 blocks of flats.

Since 2007 (832 residents) the population has grown by more than a third (1261 residents in 2011).

The most frequent finished education in the community is university one and the predominant age groups are - the same as in other villages- 0-14 and 30-39 years.

The village´s waste management is financed by the local tax. Every inhabitant should pay CZK 600 per year.

The local government arranges twice per year 25- 30 containers for bulk waste on 13 stations as well as twice a year the containers for the hazardous waste. The inhabitants use 7 recycling nests which include 31 containers. Each recycling nest serves to 180 inhabitants. The village plans to spread the sorting types as well as the number of recycling nests. The community can use a container for old textiles.

The service company operating in the municipality is Regios, a.s. which belongs to ASA group and transports the waste 6 km to landfill and sorting unit in Úholičky. The

Figure 7 Sorting unit of Pražské služby, a.s.

organic waste is brought to composting unit Jena.

The black dumps appear often but the offender is usually unknown. The biggest black swamp lately was the one of building waste which cost the village more than CZK 100 000 to solve.

The waste management is not very well stated on the local website neither the motivation for the inhabitants to sort the waste. The mayor of Statenice is very helpful and it seems that the village plans to expand the sorting types as well as the number of containers.

4.8. Comparison of waste production differences in the municipalities

4.8.1. Comparison by the waste produced

When comparing average generation of mixed municipal waste in two groups of the municipalities large differences were found (see Table 3). Group of municipalities using the payment system of Local tax produced in years 2007-2011 in average 322 kg of mixed municipal waste per capita per year. Group of municipalities which apply the system of payment by Act on Waste produced only 219 kg. The research showed that the municipalities using Local Tax produce 47% more waste than the other villages.

When comparing these average results other facts and factors have to be taken into consideration.

Ambiguous fluctuations in some years can be explained by the trend of moving outside from Prague, but keeping the residency in the city. This fact causes higher amounts of waste produced, but at the same time it does not increase the population number in given area. This factor influences mainly villages: Horoměřice, Statenice, Psáry and Jílové u Prahy.

The graph in Figure 9 also shows that people living in the towns- Mnichovice, Říčany and Horažďovice- produce in average the least of the municipal waste. The villages located in the outskirts of Prague and Jílové u Prahy showed out the highest values.

The highest production of the mixed municipal waste was found in Jílové u Prahy. This fact raises the question why would inhabitants of Jílové produce the highest amount of the waste when they have to live right next to the land fill. The first answer which occurs is

that the land fill is owned by the town and operated by the company AVE (which looks after collection of waste in the town) and so there might not be any intention to lower the amount of mixed communal waste produced and so the costs for the waste... But as Jílové u Prahy did not provide any information regarding finances due to "business secret" it is hard to prove the speculation.

Table 3 Comparison of average production of mixed municipal waste

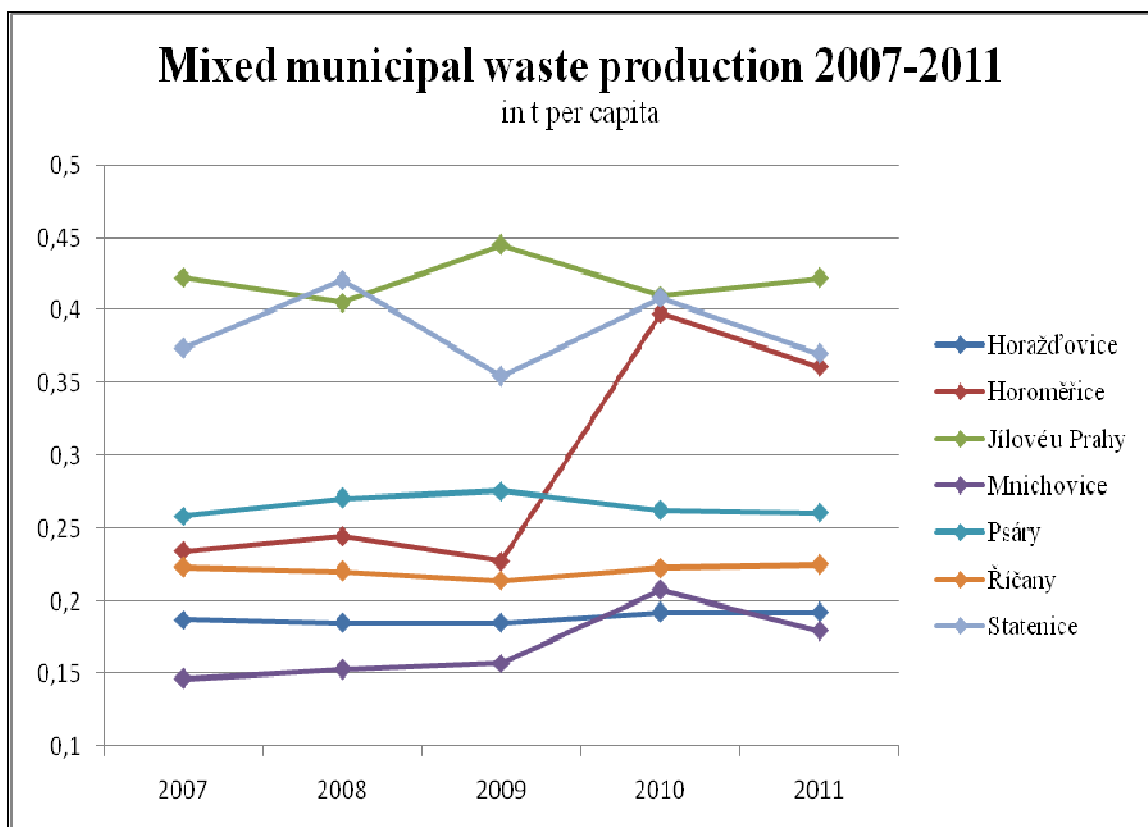| Average production of mixed communal waste			
Local Tax:	*kg*	*Fee by Act on Waste/ contractual form:*	*kg*
Horažďovice	188		
Horoměřice	293	Mnichovice	169
Jílové u Prahy	421	Psáry	266
Statenice	386	Říčany	221
Average per 5 years	322	*Average per 5 years*	219

Figure 8 Mixed municipal waste production in 2007-2011

4.8.2. Recycling

In general, the highest amounts of sorted waste appeared in municipalities: Říčany and Psáry. The lowest amounts were found in Horažďovice and Jílové u Prahy. The graphs of all types of waste with yearly data are connected in Annex 3.

No connection was found when comparing numbers of inhabitants using a recycling nest with the amounts of waste sorted.

Mnichovice and Horažďovice showed the lowest production off majority of waste types and highest proportion of the organic waste which can be caused by several factors as:

- o Family houses predominates in those municipalities- inhabitants grow their own plants and keeps animals
- o Inhabitants live in more modest way due to lower incomes
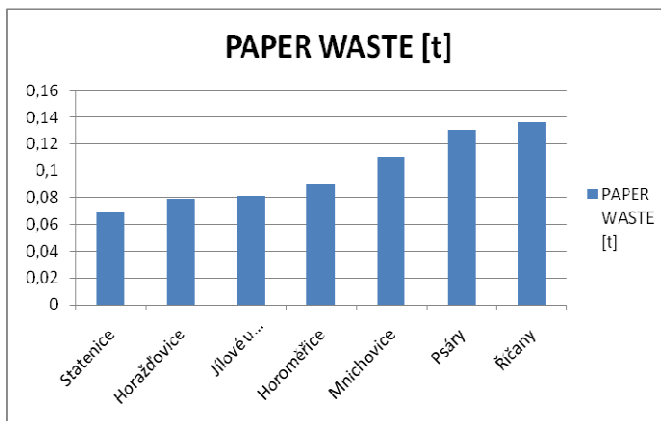- o People burn part of the waste

Figure 9 Production of paper waste per capita per 5 years (2007-2011)

When comparing the sorting trends in figures 10, 11, 12 and 13 in each municipality separately, we can see that in Horažďovice the ratio of the mixed municipal waste declines. The only sorted waste which grows fast is the organic and bulk waste.

This fact shows the succes of the local policy of numerous containers for organic waste located aroud the town. The rest of the sorted types of waste remain very similar every year.
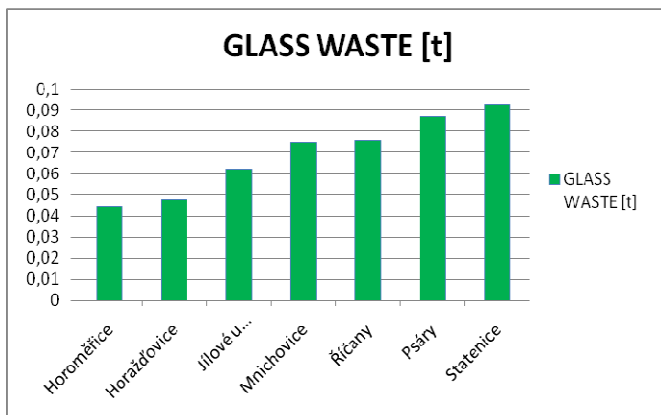

Figure 10 Production of glass waste per capita per 5 years (2007-2011)

The most alarming fact regarding village **Horoměřice** is that the ratio of the mixed municipal waste has risen from 55% to 70% during years 2007- 2011.

The ratio of bulk and paper waste has fallen and ratio of the plastics and

organic have risen. This fact can be

50

caused by changes in the overall production as more and more of the plastics are used for packaging than paper.
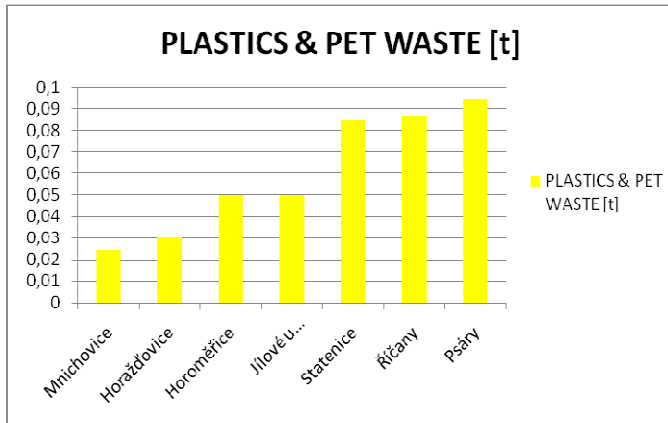

Figure 11 Production of plastic and PET waste per capita per 5 years (2007-2011)

In the case of town **Mnichovice** the small growth (of 8%) in ratio of mixed municipal waste is observed. On the other hand high growth of sorting plastics appeared after installation of the containers for plastics instead of just PET.

Small decline in ratio of mixed municipal waste was observed in **Psáry**. In the same time the ratio of organic waste has grown since the introduction of brown bins and regular collection by service company Rumpold- P, s.r.o.

Říčany has proved the best waste management strategy by the drop of the ratio of mixed municipal waste from 78% (2007) to only 50% (2011). The involvement in EU environmental project has brought success in growth of the ratio of the organic waste.
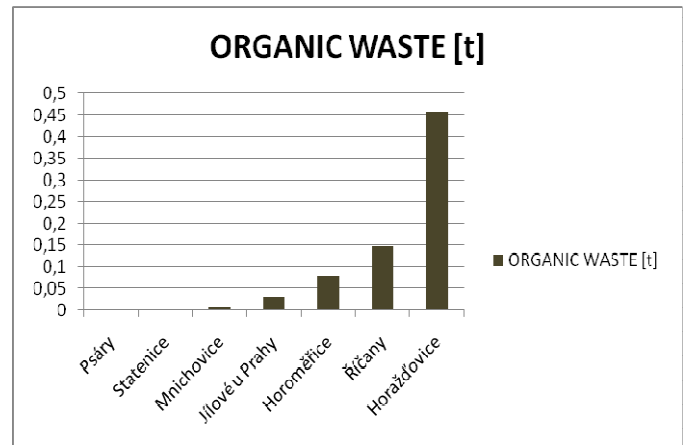

Figure 12 Production of bio waste per capita per 5 years (2007-2011)

The village **Statenice** has undergone a wide change in waste management as the ratio of the paper and glass waste rose five times and plastics waste three times between years 2007-2011. The ratio of mixed municipal waste dropped by 11%.

4.8.3. Comparison of the expenses

The data regarding all the expenses for the municipal waste were collected from the local Waste managers. The elaboration of the results appeared to be significantly different in every village. Some communities divide the final numbers to numerous entries and some show only a few figures. When looking up the contributions from EKO-KOM a.s., who pays back the fees for the recycled materials, only Horoměřice and Mnichovice stated

some numbers in years 2007-2010. Other villages with the exception of Jílové u Prahy showed the contributions only in 2011.

In table 4, the waste management expenses for mixed communal, recycled and dangerous waste were calculated per capita per year 2011. In the case of these 7 municipalities the direct proportion cannot be seen. In general the towns proved that they have lower expenses for the waste management. On the other hand it is hard to compare those towns with villages know for their immigration wave from Prague (and keeping residency in the city).

Table 4 Expenses count per capita in 2011

WASTE MANAGEMENT EXPENCES IN 2011 PER CAPITA		
Name	**Population**	**CZK**
Statenice	1 261	750
Mnichovice	3 069	730
Psáry	3 331	823
Horoměřice	3 335	833
Jílové u Prahy	4 222	N/A
Horažďovice	5 578	629
Říčany	13 499	688

Table 5 Distance from the municipality to the landfill

DISTANCE TO THE LANDFILL		
Name	**Landfill**	**Distance [km]**
Horažďovice	Chrást u Březnice	43
Horoměřice	Úholičky	6
Jílové u Prahy	Jílové u Prahy	1
Mnichovice	Radim	35
Psáry	Kamenné Žehrovice	53
Říčany	Radim	36
Statenice	Úholičky	6

Another interesting factor which was supposed to influence the expenses – distance to the landfill- did not show any effect. When comparing Psáry with the farthest distance to the landfill Kamenné Žehrovice (53 km) and Horoměřice with one of the closest distance (Úholičky, 6 km) it is seen that the expenses almost do not differ.

From the ecological point of view, the villages, which would like to keep low ecological footprint should consult not just the prices for the waste collection and disposal, but also the distance to the land fill. An example of Psáry shows the dilemma of transporting waste 53km when having the closest land fill 10km away...

Figure 13 Comparison of generation of mixed municipal waste per two households: Full trash can belongs to family of 2 adults and 2 children, half empty trash can belongs to family of 5 adults and a child (same location, 5/4/13)

4.8.4. Student´s t test

Group 1 (municipalities which apply the payment system by Local Tax) was compared with Group 2 (municipalities which apply system by Act on Waste) as stated in Table 6 and 7.

The data used in the test come from the totals per 5 years per capita in each municipality. There are included 5 types of the waste: mixed municipal, paper, plastics, glass and dangerous waste.

$H_0 = \mu_1 = \mu_2$: Selection of measured amounts of waste from Group 1 and Group 2 come from a statistical file.

$H_A = \mu_1 \neq \mu_2$: Selection of measured amounts of waste from Group 1 and Group 2 do not come from a statistical file (the amounts of waste are of different sizes).

The overall results showed that the villages of Group 1- those which apply Local Tax system- produce 47% more of the mixed municipal waste. This fact is reflected in the results of the sorted waste. In all categories of the sorted waste the average production is higher in Group 2 – villages which apply Fee by Act on Waste.

The average results proved that the inhabitants of municipalities which apply the fee by Act on Waste: Mnichovice, Psáry and Říčany produce less mixed municipal waste and more of recycled waste, which means that they in general more sort.

The total amounts of produced waste are compared in tables in Annex 2.

The t test showed the fact that the amount of data collected for the research were insufficient for statistical testing. The only one t test which showed the fact that groups belong to two different populations was t test of paper waste.

Results - Mixed municipal waste

The villages which apply Local Tax generated in average by 0.518 t of mixed municipal waste per 5 years more than villages which apply the Fee by Act on Waste.

The t test showed that the Group 1 and Group 2 do not differ and so they come from the same population. On the other hand a big difference of 104 kg (in average per capita per year) is appreciable. It is obvious that the amount of data collected were insufficient for the statistical testing.

Table 6 Calculation of the Student´s t test (I.)

STUDENT´S t TEST (Sum of waste/each municipality/5 years)		
	Mixed municipal	**Paper**
Two-tailed P value	0.1771	0.0026
The mean of Group One minus Group Two equals	0,517947356	-0.045767387
t	1.5706	5.5747
Degrees of freedom	5	5
Standard error of difference	0.33	0.008
Group 1 (4 Municipalities- Local Tax)		
Mean	1.61105260	0.08022069
SD (standard deviation)	0.52105982	0.00851770
SEM (standard error of the mean)	0.26052991	0.00425885
Group 2 (3 Municipalities- Act on Waste)		
Mean	1.09310524	0.12598808
SD	0.24249090	0.01341771
SEM	0.14000219	0.00774672
$H_0 = \mu_1 = \mu_2$ X $H_A = \mu_1 \neq \mu_2$		
Significance level **α=0,05**	t≠W	t=W
If **P>α** the H0 cannot be rejected	P>α	P<α
If **P<α** the H0 can be rejected	$t_{(5)}$ =1.5706	$t_{(5)}$= 5.5747
Critical region **W= (-∞;-2,015) U (2,015; ∞)**	The groups do not differ	There ARE 2 different groups

Results – Paper waste

The inhabitants of Group 2 generated 53% more of paper waste (per capita per year) than those from Group 1. The inhabitants of Group 2 produced 9kg of paper waste per year more than those from Group 1.

The testing showed that the groups come from two different populations.

Results – Glass waste

The means of both groups showed the average difference of 11% which means that Group 2 produced by 3.5 kg of glass waste per capita per year more.

By the t test, both groups belong to the same population. This fact seems to be caused by insufficient amount of data collected.

Results – Plastic waste

The t test discovered no difference in Group 1 and Group 2 so that the municipalities come from the same population.

Villages which apply Local Tax system generated less plastic waste than villages from Group 2. The difference was 3 kg per capita per year.

Results - Dangerous waste

The data given in the testing were statistically wrong. The result of the counting came out as statistical error. The t test could not be count due to big differences in the values as well as small amount of data collected. The municipalities apply different systems of collection of dangerous waste and it seems that they also count the annual results in different way.

In general, the Group 2 generated more dangerous waste than Group 1. The difference was big 1.3 kg per capita per year (50% more than Group 1).

Table 7 Calculation of the Student´s t test (II.)

STUDENT´S t TEST (Sum of waste/each municipality/5 years)			
	Glass	**Plastic**	**Dangerous**
Two-tailed P value	0.246	0.5471	0.0803
The mean of Group One minus Group Two equals	-0.0176208	-0.0148565	-0.0063193
t	1.3137	0.6454	2.1884
Degrees of freedom	5	5	5
Standard error of difference	0.013	0.023	0.003
Group 1 (4 Municipalities- Local Tax)			
Mean	0.0616362	0.05370639	0.0064569
SD (standard deviation)	0.0219822	0.02278001	0.00464094
SEM (standard error of the mean)	0.0109911	0.01139000	0.00232047
Group 2 (3 Municipalities- Act on Waste)			
Mean	0.07925697	0.06856289	0.01277631
SD	0.00679872	0.03863308	0.00185174
SEM	0.00392524	0.02230482	0.00106910
$H_0 = \mu_1 = \mu_2$ X $H_A = \mu_1 \neq \mu_2$			
Significance level $\alpha = 0.05$	t≠W	t≠W	t=W
If **P>α** the H0 cannot be rejected	P>α	P>α	P>α
If **P<α** the H0 can be rejected	$t_{(5)}$= 1.3137	$t_{(5)}$= 0.6454	$t_{(5)}$= 2.1884
Critical region **W= (-∞;-2.015) U (2.015; ∞)**	The groups do not differ	The groups do not differ	Error- not enough data

4.8.5. Social research – questionnaire

The questionnaire "Production of waste in households" was published in March 2013 via internet as well as spread in person to respondents of any age or location. The original version of the questionnaire translated in English is in Annex 1.

The questionnaire was answered by 145 respondents.

The questionnaire included 4 general questions regarding social background and 7 questions regarding waste disposing, recycling and financing.

Approximately three quarters of respondents were women (75.86%) and a quarter of men (24.14%). Most of the respondents (51.72%) belonged to the age group 16-31 years. The other age groups (32-47, 48-63, 64+ years) were divided equally (15.86% each) with the exception of age group (0-15 years) which was represented by 0.69%.

The question regarding residency showed the ratio of 52.41% of people living in the blocks of flats and 45.52% living in the family houses. Only 3 (2.07%) cases lived somewhere else.

Most of the respondents finished university education (51.72%), second group of 32.41% finished secondary education with graduation. People with other education were divided in ratio: secondary education 8.28%, higher specialized school 6.21% and basic education 1.38%.

134 respondents (92.41%) sort the household waste and only 11 respondents (7.59%) do not recycle. 126 respondents recycle paper, 118 respondents sort glass, 112 people sort plastics and 105 PET. 73 queried sort electro waste, 51 people tetra pack, 50 respondents sort textiles and 43 people sort metals. Only 32.64% of all respondents sort organic waste.
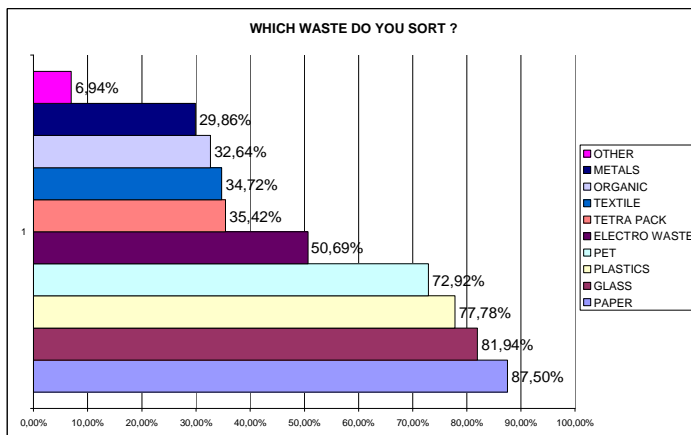

Figure 14 Questionnaire - Which types of the wastes do you sort?

10 people sort other than stated materials. Some people do not know what is included in each sorting category as few people wrote down leaves or wood in category "other" even though it belong to category "organic waste".

Most of the respondents were surprised by questions regarding the payment for waste and the system of payment in their municipality. Many respondents do not know that they pay for the waste.
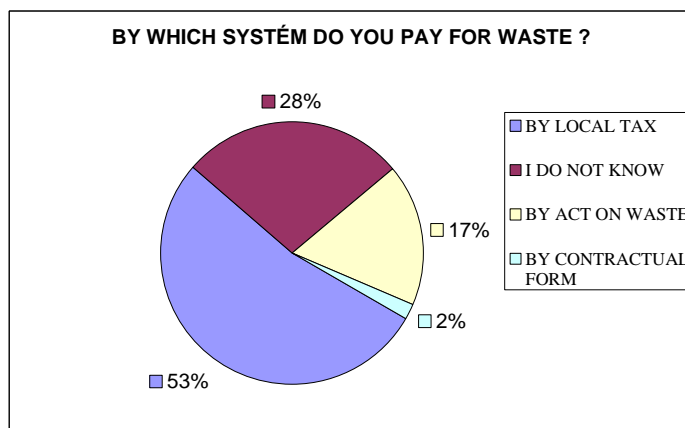

Figure 15 System of payment the fee for waste management

As the Figure 16 shows, the most of the respondents (53%) pay for the waste by local tax. 17.24% finance the waste management by the fee by Act on Waste and 2.07% by contractual form. Less than a third of asked - 27.59% (40 queried) - do not know how they pay for the waste.

When asking about the fee for the waste, most of the queries (56.55%) answered they pay between CZK 400-700 per person/year. Second dominant group of answers was "I do not know" (31.03%) and the last group of 12.41% answered they pay more than CZK 700 per person/year.

Majority of respondents (55.17%) have the closest recycling nest up to 100m from their house. 36.55% carry the sorted waste 200-400m from their home and 6.9% have recycling nest more than 500m away. Two respondents did not know where the containers are.

By the information system ISOH (Info Systém Odpadového Hospodářství), the production of mixed communal waste is slowly diminishing. The average generation of waste per capita per year was 401 kg in 2006.[48]

The questionnaire showed the general knowledge of the respondents about the average production of waste. 64.83% answered similar amount of 400kg per capita per year.

21. 38% recon they produce around 50kg of communal waste and 13.79% of respondents chose answer 1000kg per capita per year.
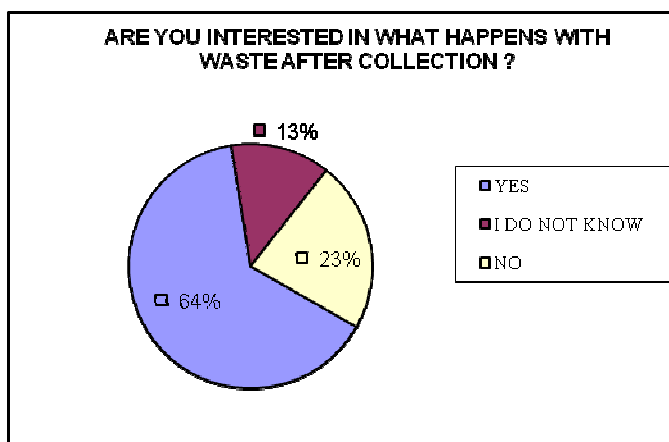

Figure 16 Question showing the interest in the waste treatment

waste disposal and recycling system.

The last question was formulized to find out about interest in the ecology of the respondents. The Figure 17 shows that the majority – 64.14% - answered they are interested what happens

with the waste after collection. 22.76% was not interested and 13.1% did not know.

This fact in general says that two thirds of the respondents are interested in the

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[48] Citing the sites: Komunalní odpad, [online], http://www.komunalniodpad.eu/?str=produkce, 29/3/2013

4.8.5.1. Comparison of two systems of payment for the municipal waste

Respondents who pay for the waste by fee by Act on Waste (25):

- 56% live in the block of flats
- 44% live in family houses
- 88% sort waste, 12% do not sort waste
- **48% pay for waste CZK 400-700 per person/year**
- **36% pay more than CZK 700 per person/year**
- 16% do not know how much they pay for the waste
- 52% suggest they produce around 400kg of municipal waste per year
- **24% think they generate around 1000kg of municipal waste per year**
- 24% suggest they produce around 50kg of municipal waste per year
- **68% of asked is interested in what happens with waste after disposal**

Respondents who pay for the waste by Local tax (77):

- 51% live in the block of flats
- 49% live in family houses
- 94.81% sort waste, 5.19% do not sort waste
- **76.62% pay for waste CZK 400-700 per person/year**
- **10.39% pay more than CZK 700 per person/year**
- 12.99% do not know how much they pay for the waste
- 68.83% suggest they produce around 400kg of municipal waste per year
- **11.69% think they generate around 1000kg of municipal waste per year**
- 19.48% suggest they produce around 50kg of municipal waste per year
- **48% of asked is interested in what happens with waste after disposal**

The comparison found interesting facts showing that the system of payment by Local Tax seems to be more efficient. Local Tax system shows higher ratio of people who sort the waste, higher ratio of people who are aware of producing 400 kg of municipal waste per capita/year and less people who do not know how much they pay for the waste disposal system. The comparison shows similarities in the residency factor, but it reveals that the system of Local Tax is cheaper per person.

On the other hand, people who pay for waste by system by Act on Waste show more interest in ecology.

4.8.5.2. Comparison of the residents who live in the blocks of flats and those who live in family houses

Respondents who live in the block of flats (69):

- 92.11% sort waste, 7.89% do not sort waste
- 52.63% pay for waste CZK 400-700 per person/year
- 13.16% pay more than CZK 700 per person/year
- **34.21% do not know how much they pay for the waste**
- **73.68% inhabitants have the recycling nests up to 100m from their home**
- 26.32% inhabitants have the recycling nests 200-400m from their home
- **15% people sort organic waste**
- 63.16% of asked is interested in what happens with waste after disposal

Respondents who live in the family houses (79):

- 92.42% sort waste, 7.58% do not sort waste
- 52.12% pay for waste CZK 400-700 per person/year
- 12.12% pay more than CZK 700 per person/year
- **25.76% do not know how much they pay for the waste**
- **33.33% inhabitants have the recycling nests up to 100m from their home**
- 48.48% inhabitants have the recycling nests 200-400m from their home
- **54.55% people sort organic**
- 65.15% of asked is interested in what happens with waste after disposal

Differences in sorting habits were not found between people living in the family houses and those living in the block of flats.

People living in the family houses are more aware of how much they pay for the waste management and sort organic waste 40% times more often than residents of the blocks of flats.

People living in the flats have in general shorter way to the recycling nest (up to 100m).

4.8.5.3. Comparison of female and male respondents

Women (110)

- **93.3% sort waste, 6.36% do not sort**

- **26.36% do not know by which type of payment system they pay the fee for waste**

- 31.82 do not know how much they pay for the waste per year

- 62.73% thinks they produce 400 kg per capita/year

- 68.18% is interested in what happens with waste after disposal

- **18.18% is not interested in what happens with waste after disposal**

- 13.64% does not know if they are interested in what happens with waste after disposal

Men (35)

- **88.57% sort waste, 11.43% do not sort**

- **31.43% do not know by which type of payment system they pay the fee for waste**

- 28.57% do not know how much they pay for the waste per year

- 71.43% thinks they produce 400 kg per capita/year

- 51.43% is interested in what happens with waste after disposal

- **37.14% is not interested in what happens with waste after disposal**

- 11.43% does not know if they are interested in what happens with waste after disposal

When comparing male and female population it is seen that women are generally more interested in sorting and the further procedures of the waste after collection.

Women are also more aware of the payment system applied in their municipality but on the other hand men know better about amount they pay for the waste.

Men possess better estimation of amount of waste generated per year.

In the research the indecisive behaviour is seen when deciding about responsibility towards the ecology in both groups – women (13.64%) and men (11.43%).

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

On basis of literature analysis, interviews with involved municipal officers and company employees and own surveys the following conclusions have been formulated. First, the conclusions on hypotheses are further indicated – they are either confirmed or rejected in accordance to the gained knowledge or/and experimental results.

5.1.1. Hypotheses assessment

1. The first hypothesis was approved. Fee by the Act on Waste has got more impact on environment quality than the Local Tax given by the local administration. This fact was proved by comparison of the amount of waste produced. The Fee by Act on Waste forces people to produce less waste and more sort.

2. The second hypothesis was approved. Bigger townships and communities have lower costs of waste management than the smaller ones. The hypothesis was proved by counting the average waste management expenses per year per capita.

3. The hypothesis "Amount of waste per capita in bigger townships and communities is lower than that at smaller ones." cannot be proved or falsified as the collected data are not sufficient. There is an extreme value of town Jílové u Prahy which changes the general prediction. There would have to be more data collected from villages from the countryside to prove or falsify this hypothesis.

4. The last hypothesis "In townships and communities which apply Fee by Act on Waste system the inhabitants take more care on waste management (selection of waste) that in communities that apply the Local Tax." is approved as the ratio of sorted waste in communities which apply Fee by Act on Waste is by 5.7% higher than in communities that apply the Local Tax.

5.1.2. Other Conclusions

1. When comparing nation-wide data (count from data of the Czech Statistical Office from 2011) with two groups of municipalities it was found that, Group 2 - municipalities with Fee by Act on Waste - generate less communal waste and also the ratio of the sorted waste (32.2%) is higher. The Group 1 (municipalities with Local Tax) generates by 118 kg of communal waste more than the nation-wide average from year 2011 and the ratio of the sorted waste is 26.5% of the communal waste.

   The Group 1 - **municipalities with Local Tax -** produced in average (per capita per year):
   - 438 kg of communal waste *(vs. national average of 320kg)*
     - 322 kg of mixed municipal waste *(vs. national average of 233kg)*
     - 116 kg of sorted waste *(vs. national average of 46 kg)*

   The Group 2 - **municipalities with the Fee by Act on Waste** - produced in average (per capita per year):
   - 323 kg of communal waste *(vs. national average of 320kg)*
     - 219 kg of mixed municipal waste *(vs. national average of 233kg)*
     - 104 kg of the sorted waste *(vs. national average of 46 kg)*

2. From the financial point of view, the system of the fee by Act on Waste or contractual form is favourable when there are four and more people living together in a household otherwise the fee by Act on Waste gets too expensive (unless the village offers different sizes of the dust bins and choice of regularity of the waste collection).
   System of the Local Tax requires more administrative work as the fee is paid per capita and it depends on the good will of the inhabitants that they come forward the payment; on the other hand it is more lenient to sales for e.g. disabled people.

3. In general the towns proved that they have lower expenses for the waste management. On the other hand it is hard to compare those towns with villages known for their ambiguous fluctuations in some years which are explained by the trend of moving outside from Prague, but keeping the residency in the city.

4. There is no dependence between price of the waste service and the distance to the land fill. On the other hand the municipalities should think about the ecological impact of the transport of the communal waste. The dependence between economic situation in years 2007-2011 and generation of communal waste was not proved.

5. It was monitored that the waste management on the municipal level is not well advertised as a third of queried people did not know how much they pay for waste and by which system (Local Tax, Fee by Act on Waste or Contractual form).

6. When comparing the good will to sort waste it was found that female population sort by 6% more than male. The type of finished education did not show any dependence on the sorting habits. Women showed more interest in the waste treatment than men.

7. It is complicated to find out credible data from more municipalities as the system of gathering data from the waste management differs in every municipality. History of the reports has been in many cases kept just few years - until the election of new local government. Even though there is a duty to send waste management data to Czech Statistical Office, the waste managers of many villages keep the records in chaotic way.   The Student´s t test showed the fact that the amount of data collected for the research were insufficient for statistical testing. The only t test which showed that the groups belong to two different populations was t test of paper waste- it is for sure that the results from the seven municipalities cannot be applied for the whole population of the Czech Republic but it can show some interesting facts.

5.2. Recommendations

The above conclusions offer ground for formulation of recommendations which could contribute to improvements of the local waste management. It is because seven municipalities compared in the survey showed different attitudes to waste management. Some of them are involved in European environmental projects and try to reduce the amount of communal waste, but some of them just do not care about any waste management innovations.

1. **Sale of the sacks** for the PET bottles or plastics in general, for tetra- pack, glass and metals which would be collected from households by the service company on regular basis

2. **Implementation of system PAYT** (pay as you throw). This system should offer choice from different sizes of the dust bins as well as choice of the periodicity of collection. An example of towns- Hustopeče nad Bečvou or Rozsochy - shows that special tokens which are hung out on the dust bin when the household wish to collect it can be employed. People buy the tokens for CZK 68 and so they can regulate how often the dust bin will be emptied.

3. **Intense environmental education and motivation** organised by the municipality:
   a. Especially in schools, as children should accustom to the ecological way of thinking from the early childhood.
   b. The environmental enlightenment could be organised also in local businesses, at the public festivals etc.
   c. By publishing environmental issues in the local newspapers, on the public places (shops, containers, by leaflets etc.) and at the local websites.
   d. Enlightenment of the behavior which causes contamination of the underground waters or air pollution caused by burning plastics etc.

4. **Arranging containers for the organic waste or the composting units** in the housing estates. Several towns participate in programmes in spreading of the composting units. An example from the book "Prevence odpadů" by Hnutí Duha - Brumov-Bylnice is shown as an inspiration. Local government distributed composting units into 36% of households and the amount of the mixed municipal waste lowered by 1000 t in the given year.

REFERENCES

Bibliography

- Ambrozek, Libor v. r. Ministr životního prostředí. Nařízení vlády č. 197/2003 Sb., o Plánu odpadového hospodářství České republiky, Změna: 473/2009 Sb.,Praha: Ministerstvo životního prostředí, 2003.

- Balner, Petr; Černík, Bohumil; Drahovzal, Pavel; Kotoulová, Zdenka; Kratochvíl, Petr; Lochovský, Martin; Mojžíš, Josef; Vrbová, Martina. Hospodaření s odpady v obcích. Praha: Ekokom a.s., 2009. ISBN 987-80-254-6019-1.

- Bateman Ian J.; Powell Jane C.; Turner R.Kerry. Waste management and planning. Cheltenham: Edward Elgar, 2001. ISBN 1-84064-217-3.

- Benešová, L.; Černík, B; Doležalová, M.; Havránková, V.; Kotoulová, Z.; Marešová, K.; Slavík, J. Komunální a podobné odpady. Frýdek-Místek: ENZO, 2011. ISBN 978-80-901732-1-7.

- Canterbury, Janice L. Pay As You Trow: Lessons Learned About Unit Pricing of Municipal Solid Waste. DIANE Publishing, 1996. ISBN 0-7881-3175-3.

- Černík, Bohumil;Kotoulová, Zdena; Mrázek, Pavel. Systém nakládání s odpady v obcích. Praha, 1998, ISBN 80-7212-051-4

- Dubanská, V.; Tomášková, V. Platby za komunální odpad podle zákona č. 185/2001 Sb., o odpadech a změně některých dalších zákonů, ve znění pozdějších předpisů. In Jak (ne)platit za domovní odpad. Praha 2007,ISBN 80-245-0638-6

- Hnutí DUHA. Prevence odpadů: Rady a zkušenosti se snižováním produkce odpadů v obci. Hnutí DUHA. 2012. ISBN 978-80-86834-44-3.

- Půbalová, Monika. Domácí ekologie, odpadové hospodářství. České Budějovice:Vysoká škola evropských a regionálních studií, 2012. ISBN 978-80-87472-30-9.

- Slavík, Jan et al. Poplatkové systémy v obcích – rizika a příležitosti pro odpadové hospodářství. Praha: IREAS, 2009. ISBN 80-6598-136-1

- Soukupová, Jana et al. Ekonomika životního prostředí. Brno: Masarykova univerzita, 2011. ISBN 978-80-210-5644-2

- Vail, Benjamin J. Litter on the shores of Bohemia. Brno: Masaryk University press, 2011. ISBN 978-80-210-5733-3.

Internet sources

- Citing the sites: About- Environment [online], http://environment.about.com/od/recycling/a/metal-recycling.htm, 11/3/2013

- Citing the sites: ASA group [online], http://www.asa-group.com/cs/Ceska-republika/Novinky/Nova-kogeneracni-jednotka-v-Unanove.asa, 1/2/2013

- Citing the sites: Česká inspekce životního prostředí [online], http://www.cizp.cz/lang/l2, 3/3/2013

- Citing the sites: Community Repaint [online], http://www.communityrepaint.org.uk/, 11/3/2013

- Citing the sites: Eco Life [online], http://www.ecolife.com/recycling/electronics/how-to-recycle-printer-ink-cartridges.html, 11/3/2013

- Citing the sites: Eco Life [online], http://www.ecolife.com/recycling/glass/glass-recycling-process.html, 11/3/2013

- Citing the sites: Eco life- Recycling [online], http://www.ecolife.com/recycling/hazardous/how-to-recycle-asbestos.html, 10/3/2013

- Citing the sites: Energy ideas [online], http://www.clean-energy-ideas.com/energy_definitions/definition_of_recycling.html, 26/1/2013

- Citing the sites: EPA [online], http://www.epa.gov/compost/basic.htm, 22/1/2013

- Citing the sites: EPA [online], http://www.epa.gov/epawaste/conserve/materials/ecycling/donate.htm, 11/3/2013

- Citing the sites: EPA [online], http://www.epa.gov/region9/organics/ad/index.html, 22/2/2013

- Citing the sites: EPRAVO [online], http://www.epravo.cz/top/clanky/spravni-pravo/povinnost-obcanu-obce-platit-poplatky-za-odpady-15616.html, 28/2/2013

- Citing the sites: Europa.eu [online], http://europa.eu/legislation_summaries/environment/sustainable_development/l28168_en.htm, 5/3/2013

- Citing the sites: European commission, Environment [online], http://ec.europa.eu/environment/aarhus/, 4/3/2013

- Citing the sites: Godelnik, Raz: H&M Launches First Global Clothing Collection, Magazine Triple Pundit,Recycling Program[online], http://www.triplepundit.com/file-library/Commit_LeaveBehind_booklet_forWeb.pdf 11/12/2012
- Citing the sites: Hnutí Duha [online], http://www.hnutiduha.cz/temata/improving-waste-prevention-v4-countries, 7/3/2013
- Citing the sites: JURISTIC [online], http://spravni.juristic.cz/174304/clanek/j_obce.html, 1/3/2013
- Citing the sites: Know waste [online], http://www.knowaste.com/process, 11/3/2013
- Citing the sites: Komunalní odpad, [online], http://www.komunalniodpad.eu/?str=produkce, 29/3/2013
- Citing the sites: Kozáková, Radka:Výroba a použití mulčovacích folií z recyklovaného papíru, Biom [online], http://biom.cz/cz/odborne-clanky/vyroba-a-pouziti-mulcovacich-folii-z-recyklovaneho-papiru, 23/3/2013
- Citing the sites: Logoblink [online] http://logoblink.com/44-recycle-logos/ 10/3/2013
- Citing the sites: Logoblink [online], http://logoblink.com/wp-content/uploads/2008/03/recycling_symbol_garyanderson.pdf, 18/2/2013
- Citing the sites: Math Planet [online], http://www.mathplanet.com/education/algebra-2/quadratic-functions-and-inequalities/standard-deviation-and-normal-distribution, 31/3/2013
- Citing the sites: Ministerstvo životního prostředí ČR [online], http://www.mzp.cz/en/waste, 16/2/2013
- Citing the sites: OECD [online], http://www.oecd.org/env/waste/wastepreventionandminimisation.htm, 7/3/2013
- Citing the sites: Pre-waste [online], http://www.prewaste.eu/prevention-policies/item/55-what-is-waste-prevention?.html, 3/3/2013
- Citing the sites: Recyklace u nás [online], www.recyklace.unas.cz, 11/3/2013
- Citing the sites: Sdružení Tereza [online], http://www.terezanet.cz/english.html, 7/3/2013

- Citing the sites: Středočeské odpady [online], http://www.stredoceske-odpady.cz/?sid=3d05184a4692d61ea8af1f1e54b53a50&lang=cz&uzel=108, 11/2/2013

- Citing the sites: Students t test [online], http://studentsttest.com/, 31/3/2013

- Citing the sites: The City of St. Luis [online], http://home.howstuffworks.com/composting1.htm, 11/3/2013

- Citing the sites: UN- Sustainable development [online], http://sustainabledevelopment.un.org/dsd_aofw_ni/ni_pdfs/NationalReports/sweden/WasteManagement.pdf, 5/3/2013

ANNEXES

LIST OF ANNEX

ANNEX 1

QUESTIONNAIRE

PRODUCTION OF WASTE IN THE HOUSEHOLDS

1) **SEX**
o Female
o Male

2) **AGE**
o 0-15
o 16-31
o 32-47
o 48-63
o 64 +

3) **PLACE OF RESIDENCE**
o Block of flats
o Family house/ villa
o Other

4) **EDUCATION**
o Basic
o Secondary
o Secondary with graduation
o Higher specialized school
o University

5) **DO YOU SORT THE WASTE?**
o No
o Yes

6) **IF SO, WHICH KIND OF THE WASTE DO YOU SORT?** Paper - Plastics/ PET - Glass -
Tetra pack - Organic - Metals – Electro waste - Textiles - Other

7) **DO YOU PAY FOR THE WASTE BY:**
o Local tax
o Act on waste fee
o Contractual form of the waste fee
  o I do not know

8) HOW MUCH DO YOU PAY FOR THE WASTE COLLECTION PER YEAR?
o   CZK 400-700
o   CZK 1000- 2500
o   I do not know

9) HOW FAR FROM YOUR HOUSE ARE THE RECYCLING CONTAINERS?
o   Up to 100m
o   200- 400m
o   More than 500m
o   I do not know

10) HOW MUCH OF THE MUNICIPAL WASTE DO YOU THINK YOU GENERATE?
o   50 Kg
o   400 Kg
o   1000 Kg

11) ARE YOU INTERESTED IN WHAT HAPPENS WITH THE WASTE AFTER DISPOSAL?
o   Yes
o   No
o   I do not know

ANNEX 2

TABLES

Table 8 Demographic data

DEMOGRAPHIC INFORMATION							
Name	**Population**					**Predominant Age [years]**	**Prevailing education**
	2007	*2008*	*2009*	*2010*	*2011*		
Horažďovice	5 729	5 686	5 676	5 650	5 578	0-14, 30-39	Secondary
Horoměřice	2 515	2 675	2 975	3 091	3 335	0-14, 30-39	Secondary with graduation
Jílové u Prahy	3 688	3 756	3 968	4 125	4 222	0-14, 30-39	Secondary
Mnichovice	2 628	2 736	3 043	3 065	3 069	0-14, 30-39	Secondary with graduation
Psáry	2 750	2 947	3 096	3 268	3 331	0-14, 30-39	Secondary with graduation
Říčany	11 957	12 388	13 118	13 450	13 499	0-14, 30-39	Secondary with graduation
Statenice	832	932	1 038	1 118	1 261	0-14, 30-39	University

Table 9 Housing development

HOUSING DEVELOPMENT				
Name	**Municipality**	**Family houses**	**Blocks of flats**	**Other buildings**
Horažďovice	Town	1078	165	23
Horoměřice	Village	769	72	13
Jílové u Prahy	Town	972	85	32
Mnichovice	Town	1049	16	11
Psáry	Village	1036	12	12
Říčany	Town	3255	159	43
Statenice	Village	475	6	9

Table 10 Waste management in the municipalities

WASTE MANAGEMENT			
Name	**Applied waste law (2011)**	**Fee (CZK)**	**Scrap yard**
Horažďovice	local tax	600/ person	YES
Horoměřice	local tax	480/ person	YES
Jílové u Prahy	local tax	500/ person	YES
Mnichovice	fee by Act on Waste	1750/ 120l	NO
Psáry	fee by Act on Waste	2145/120l	YES
Říčany	contractual form by Act on Waste	2520/ 120l	YES
Statenice	local tax	600/person	NO

Table 11 Types of sorted waste in each municipality

SORTING OF WASTE							
Name	**Sorting units**						
	Glass	*Electro*	*Paper*	*PET*	*Plastic*	*Organic*	*Tetra pack*
Horažďovice	x		x	x	x	x	x
Horoměřice	x		x	x	x		x
Jílové u Prahy	x	x	x	x	x		x
Mnichovice	x		x	x			
Psáry	x	x	x	x	x		x
Říčany	x		x	x	x		x
Statenice	x		x	x			

Table 12 Genration of the mixed municipal waste 2007-2011

GENERATION OF THE MIXED MUNICIPAL WASTE per capita [t]						
Municipality	**2007**	**2008**	**2009**	**2010**	**2011**	**Total 2007-2011**
Horažďovice	0.1873	0.1848	0.1850	0.1926	0.1925	0.942
Horoměřice	0.2345	0.2449	0.2276	0.3982	0.3614	1.467
Jílové u Prahy	0.4230	0.4057	0.4450	0.4099	0.4225	2.106
Mnichovice	0.1465	0.1531	0.1573	0.2078	0.1796	0.844
Psáry	0.2585	0.2707	0.2761	0.2629	0.2607	1.329
Říčany	0.2234	0.2205	0.2141	0.2228	0.2253	1.106
Statenice	0.3739	0.4212	0.3551	0.4088	0.3703	1.929

Table 13 Generation of sorted waste

GENERATION OF THE PAPER WASTE per inhabitant [t]						
Municipality	**2007**	**2008**	**2009**	**2010**	**2011**	**Total 2007-2011**
Horažďovice	0.0150	0.0160	0.0155	0.0147	0.0177	0.079
Horoměřice	0.0138	0.0211	0.0211	0.0187	0.0156	0.090
Jílové u Prahy	0.0182	0.0144	0.0163	0.0150	0.0177	0.082
Mnichovice	0.0315	0.0278	0.0165	0.0181	0.0170	0.111
Psáry	0.0245	0.0300	0.0330	0.0215	0.0219	0.131
Říčany	0.0279	25.8207	25.9560	28.7420	0.0263	80.573
Statenice	0.0047	0.0117	0.0138	0.0180	0.0216	0.070

GENERATION OF THE GLASS WASTE per inhabitant [t]

Municipality	2007	2008	2009	2010	2011	Total 2007-2011
Horažďovice	0.0098	0.0084	0.0092	0.0097	0.0106	0.048
Horoměřice	0.0079	0.0084	0.0081	0.0095	0.0105	0.044
Jílové u Prahy	0.0101	0.0106	0.0116	0.0095	0.0200	0.062
Mnichovice	0.0220	0.0172	0.0126	0.0096	0.0133	0.075
Psáry	0.0193	0.0153	0.0169	0.0193	0.0163	0.087
Říčany	0.0140	0.0143	0.0157	0.0149	0.0166	0.076
Statenice	0.0103	0.0201	0.0187	0.0222	0.0213	0.093

GENERATION OF THE PLASTIC WASTE per inhabitant [t]

Municipality	2007	2008	2009	2010	2011	Total 2007-2011
Horažďovice	0.0065	0.0062	0.0056	0.0058	0.0061	0.030
Horoměřice	0.0059	0.0097	0.0112	0.0127	0.0104	0.050
Jílové u Prahy	0.0068	0.0071	0.0141	0.0120	0.0099	0.050
Mnichovice	0.0031	0.0028	0.0012	0.0077	0.0095	0.024
Psáry	0.0174	0.0180	0.0188	0.0194	0.0212	0.095
Říčany	0.0177	0.0144	0.0147	0.0182	0.0214	0.086
Statenice	0.0051	0.0149	0.0151	0.0243	0.0256	0.085

ANNEX 3

GRAPHS

Table 14 Comparison of mixed municipal waste production
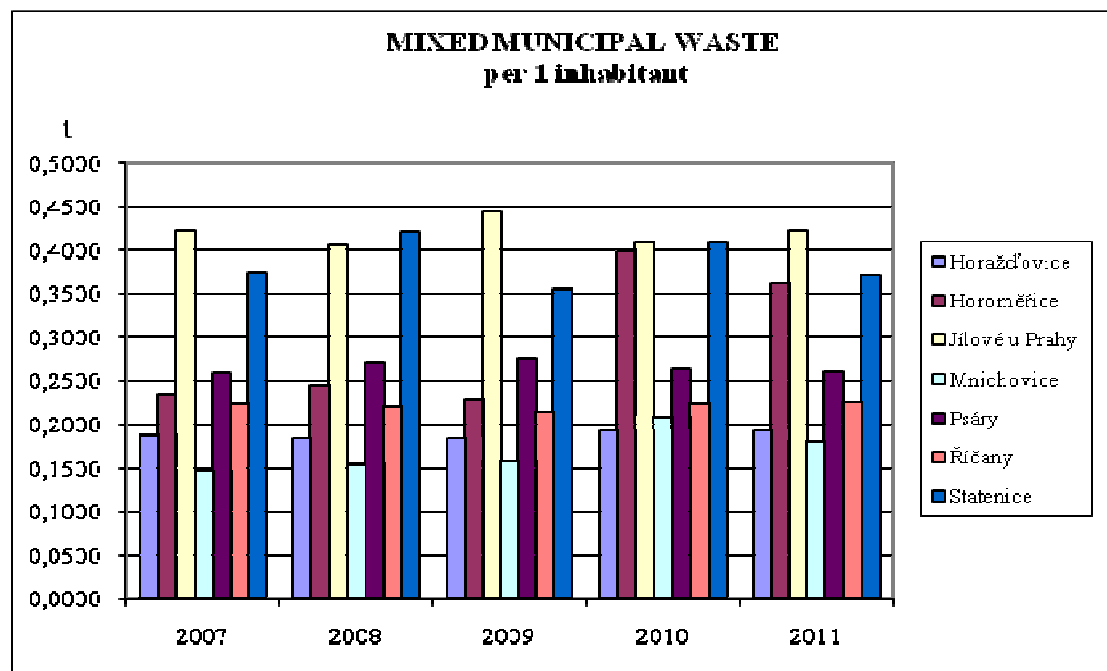
Table 15 Comparison of paper waste generation
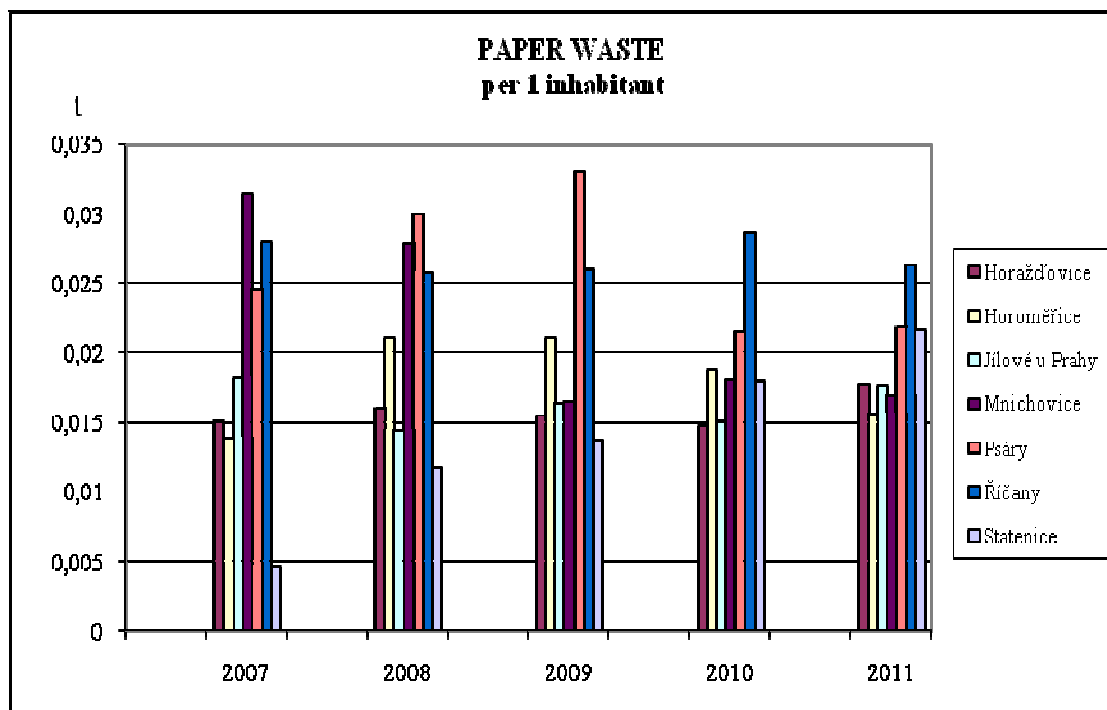
Table 16 Comparison of glass waste generation

GLASS WASTE
per 1 inhabitant
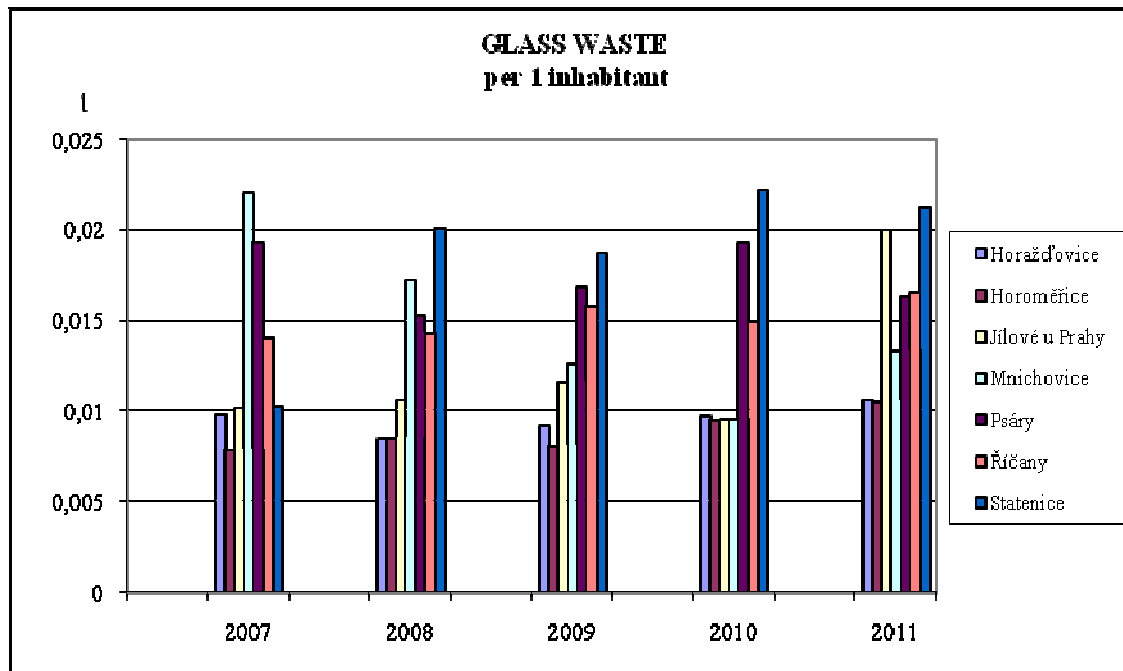
Table 17 Comparison of plastic waste generation

PLASTIC WASTE
per 1 inhabitant
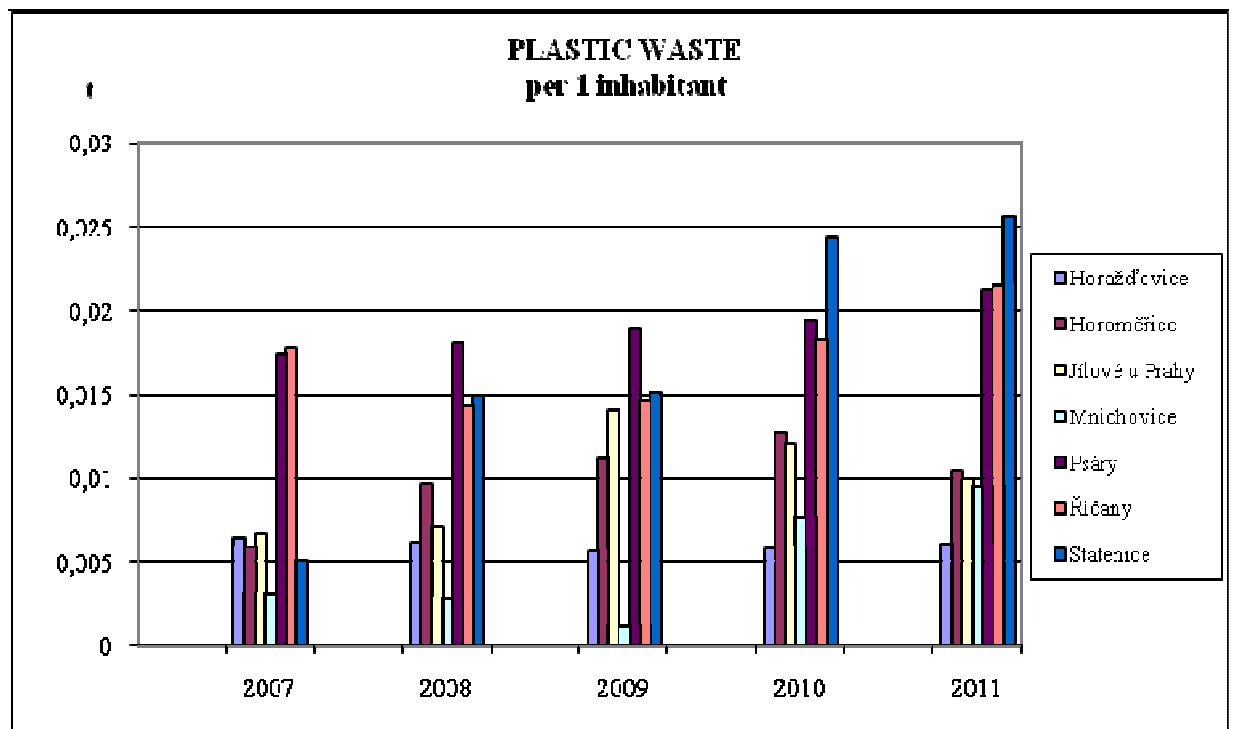
Table 18 Comparison of dangerous waste generation
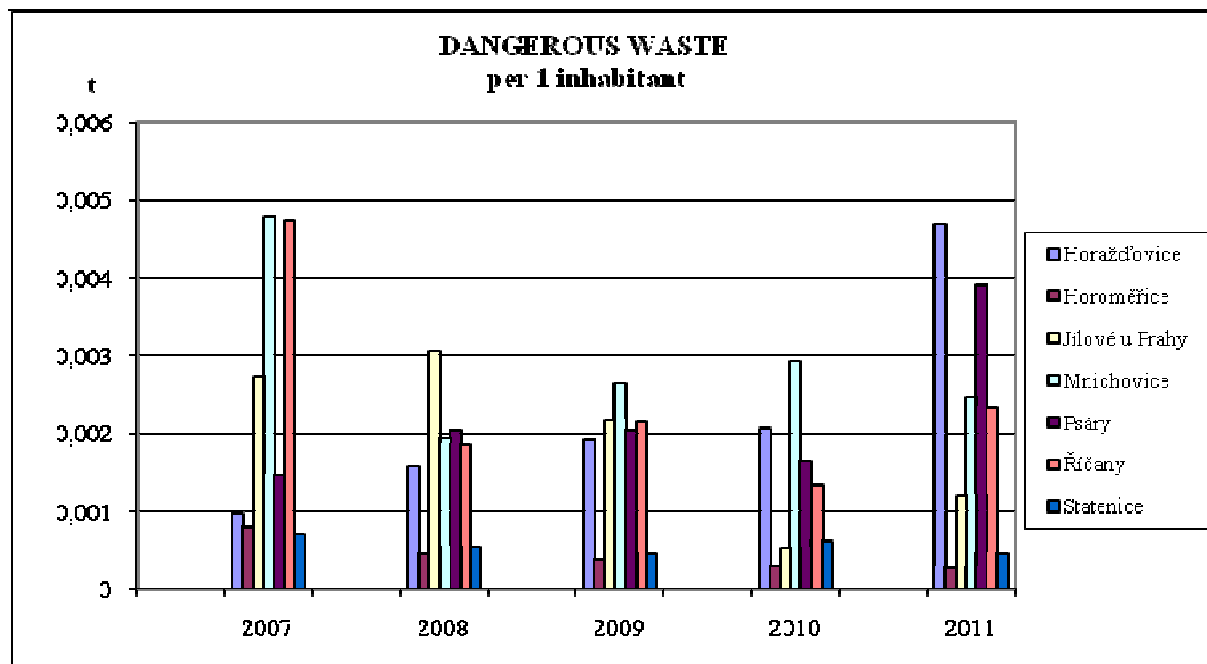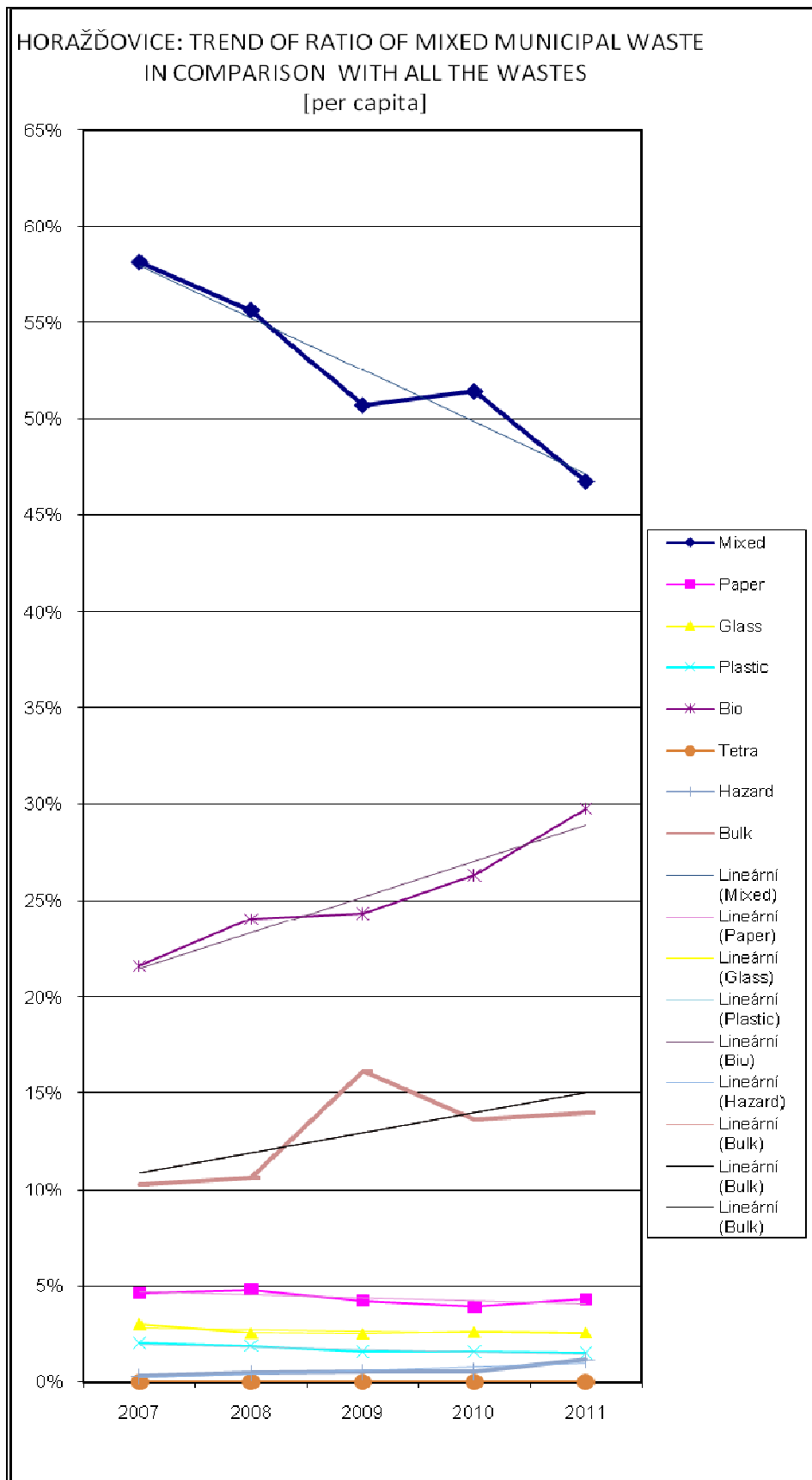
Figure 17 Trend of mixed municipal waste in Horažďovice
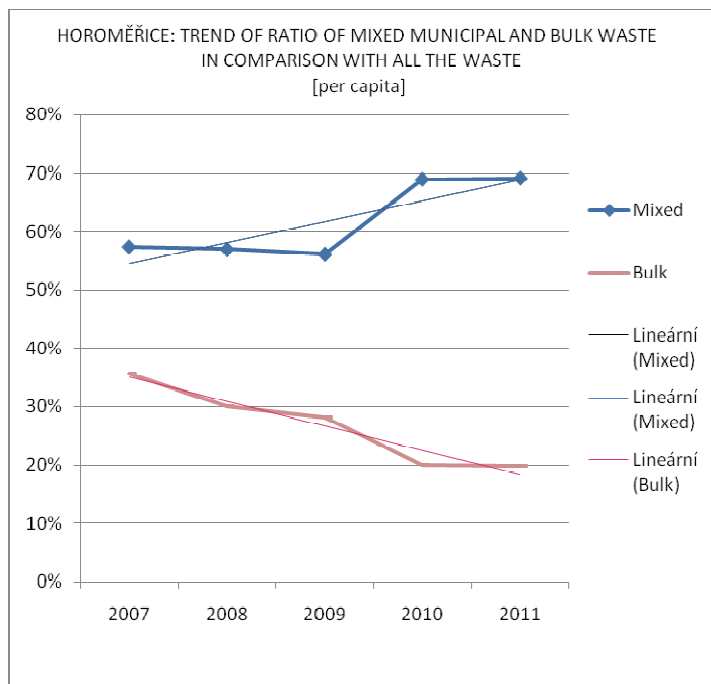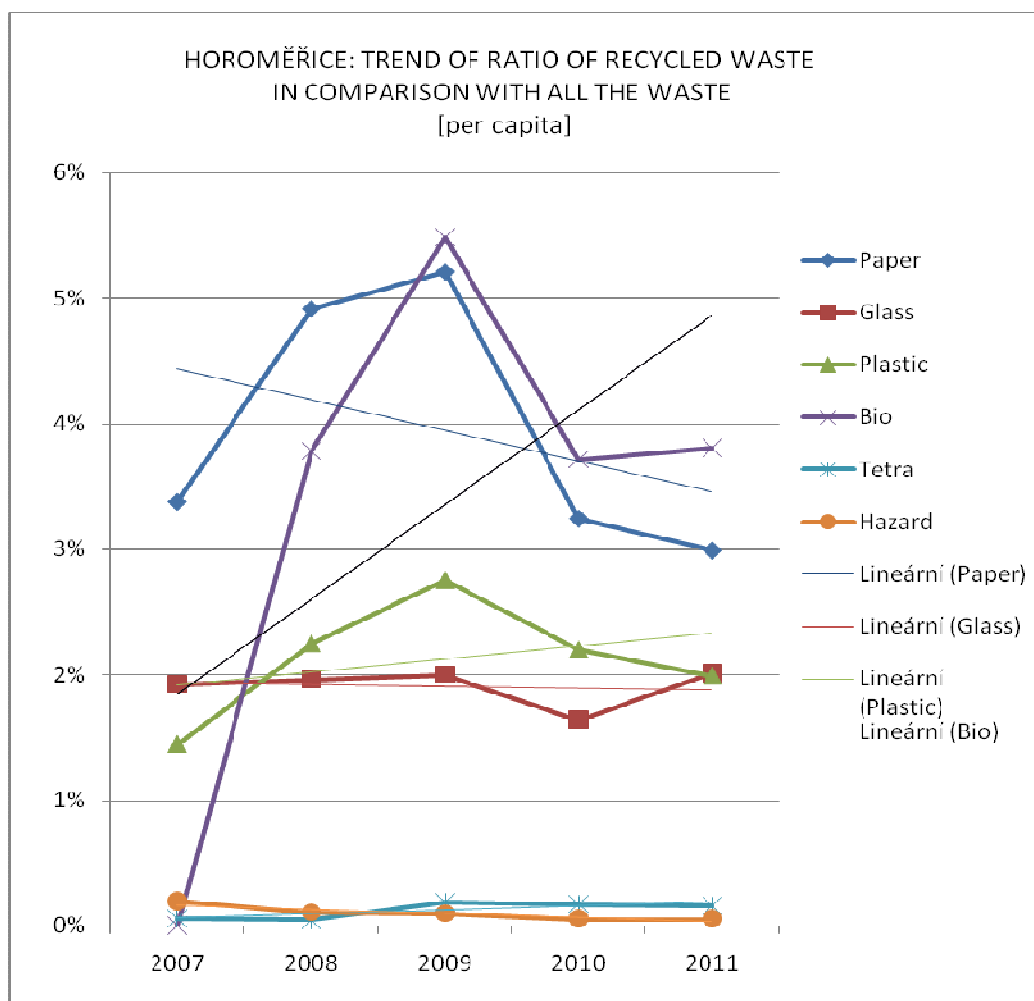
Figure 18Trend of mixed municipal and bulk waste in Horoměřice

Figure 19Trend of sorted waste in Horoměřice
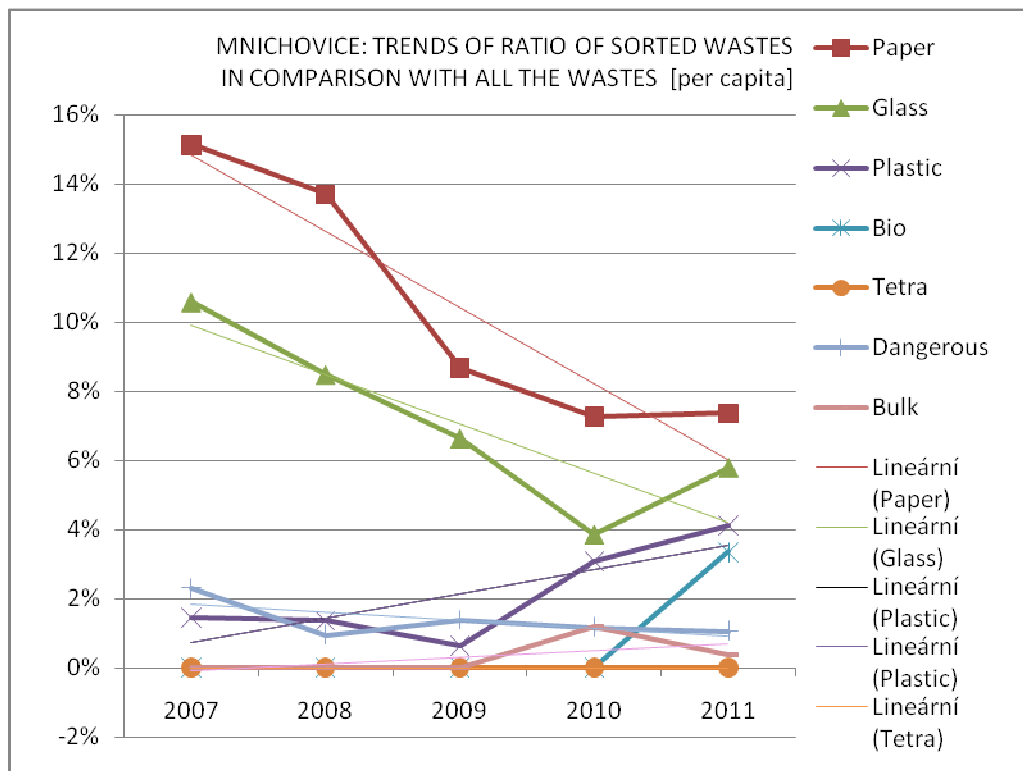
Figure 20 Trend of sorted waste in Mnichovice
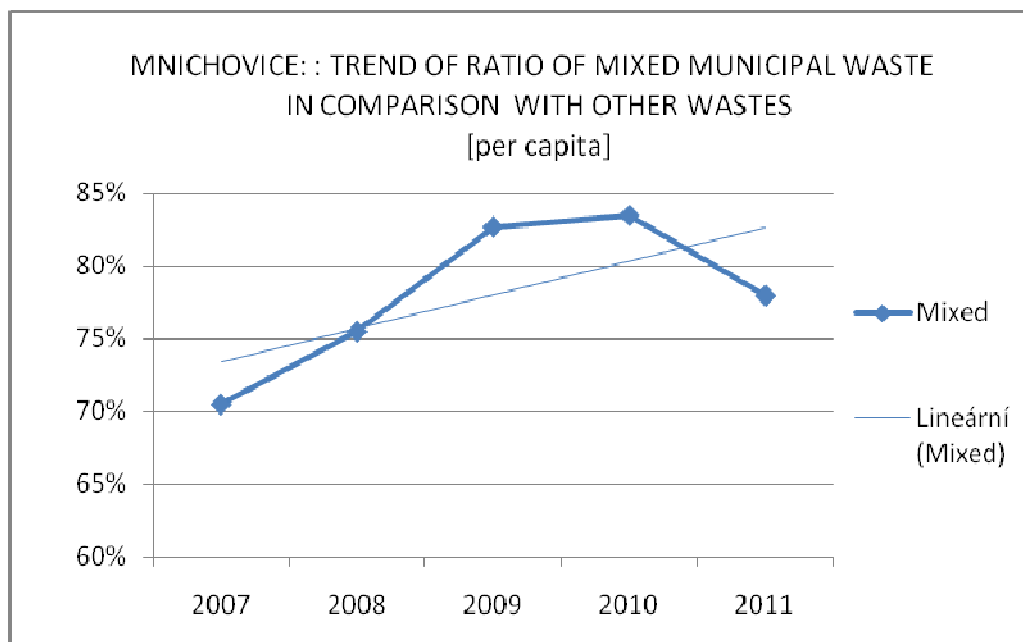
Figure 21 Trend of mixed municipal waste in Mnichovice
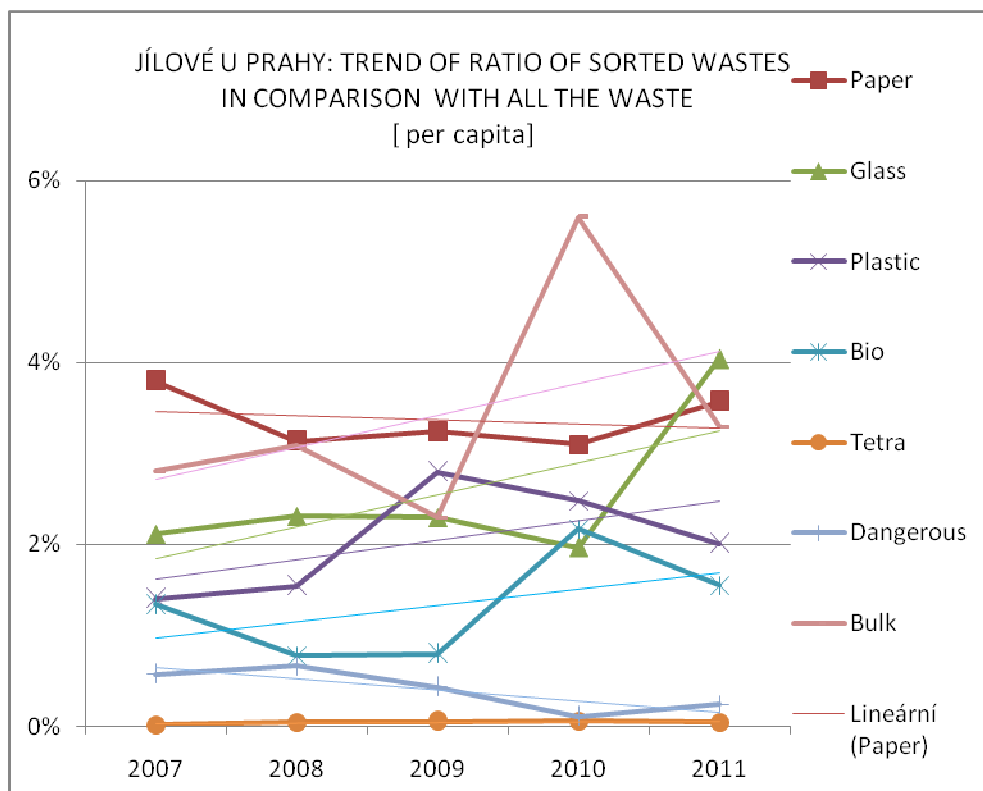
Figure 22 Trend of sorted waste in Jílové u Prahy
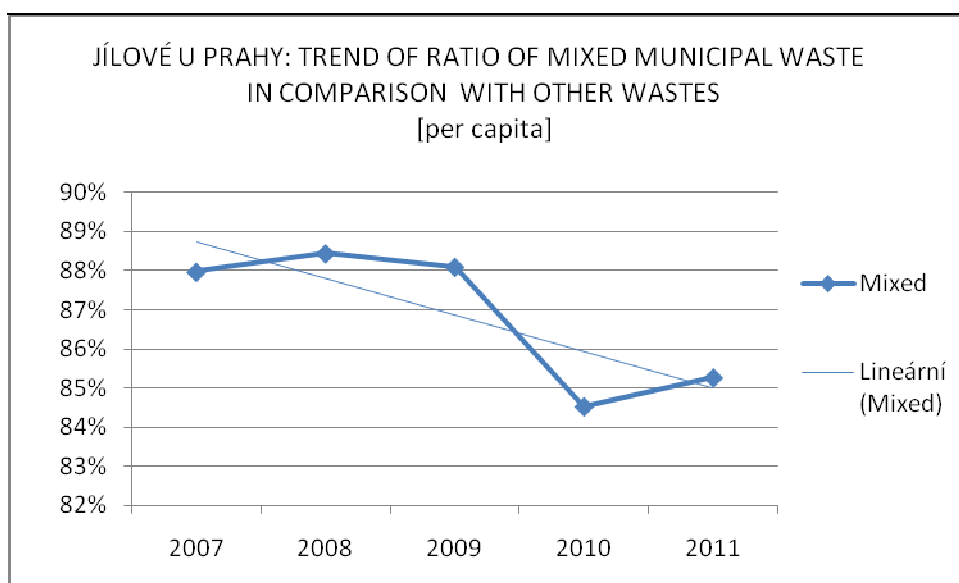
Figure 23 Trend of mixed municipal waste in Jílové u Prahy
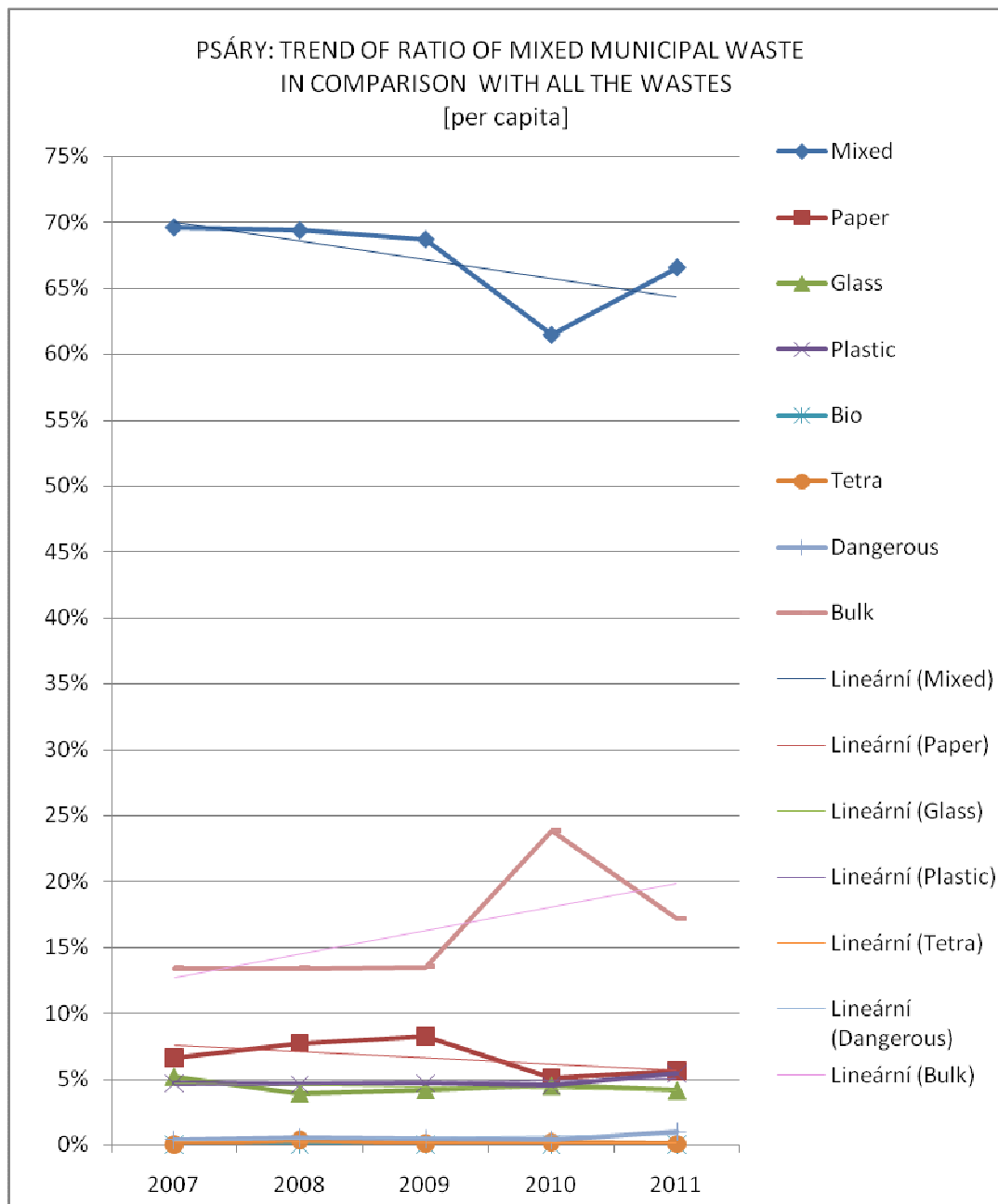
Figure 24 Trend of the mixed municipal waste in Psáry
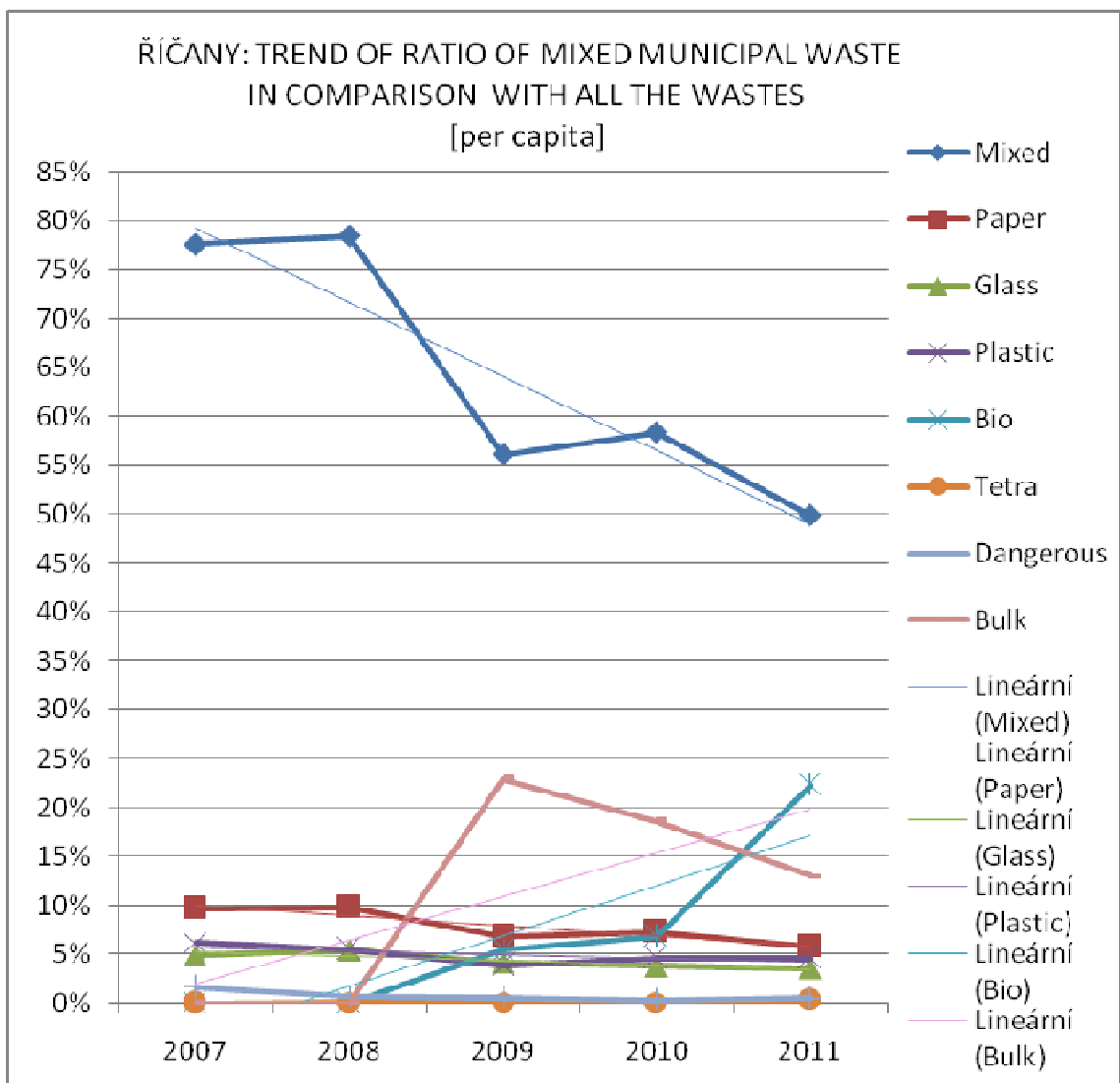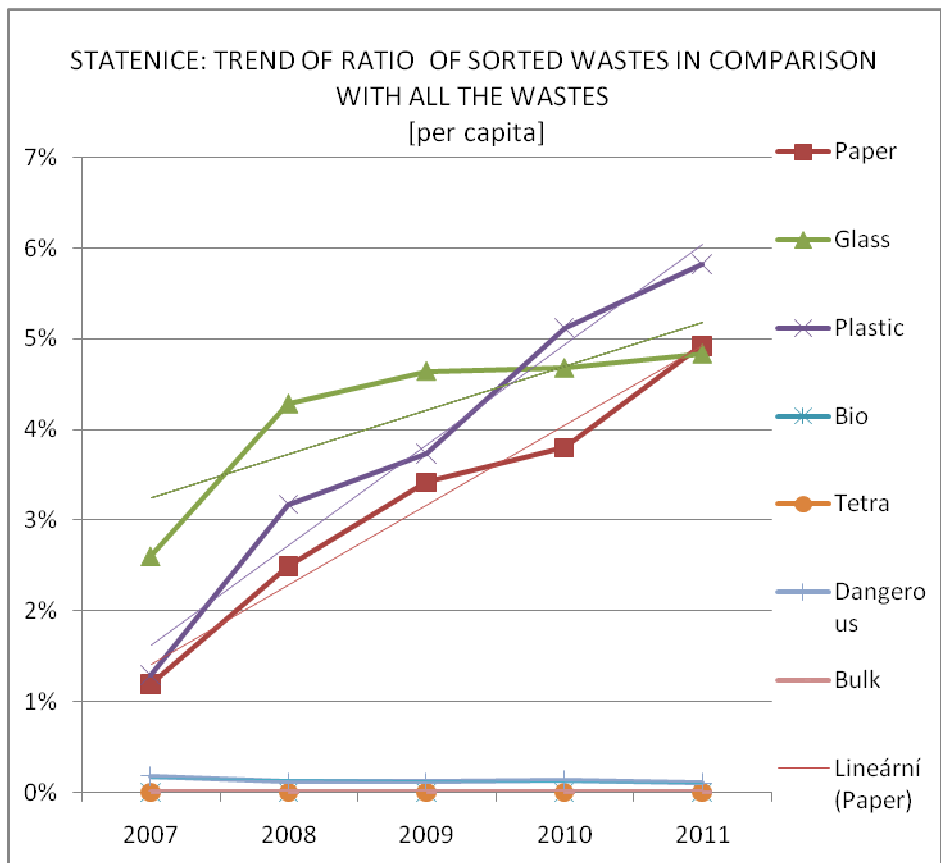
Figure 25 Trend of the mixed municipal waste in Říčany
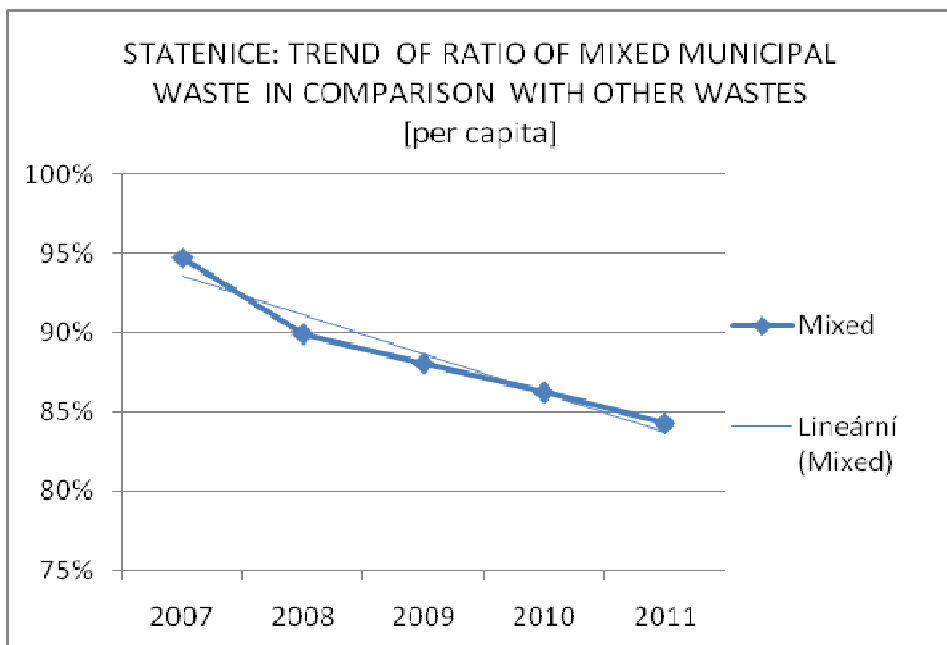
Figure 26 Trend of the sorted waste in Statenice
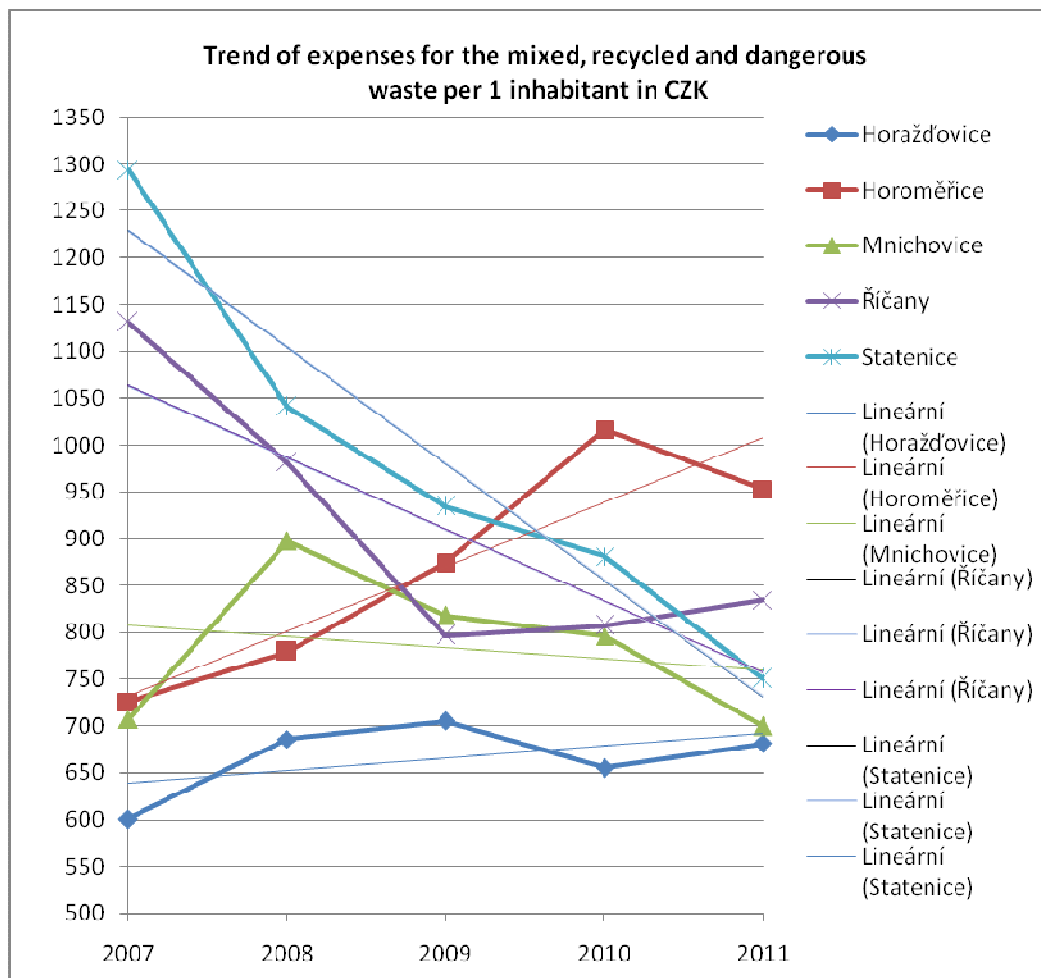

Figure 27 Trend of the mixed municipal waste in Statenice

Figure 28 Trends of expenses for mixed municipal waste