

# RETAIL FOOD WASTE MANAGEMENT

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## Abstract

Food losses and waste are substantial on the global level. With the aim to achieve efficient management of food losses, it is necessary to find out the root causes, the locations of their origins, effects and efficacious activities aimed at minimising them. Identifying areas is of quite significant for improving cost effectiveness, efficiency in resource use and future activities directed at "optimization" of food losses. Food is lost throughout the food supply chain. This paper focuses on the research of root causes, effects and treatments of losses in the retail sector as a stage of the food supply chain. By minimizing the food losses and waste, and by using the modern technologies in addition to other means, performances of the modern retail sector can be improved substantially.

**Keywords:** food value chain, root causes, cost effects, waste, technology.

## 1. INTRODUCTION

Owing to its huge significance, a growing number of both theoretical and practical research papers and studies are, as of lately, being dedicated to the problem of food losses and waste. This problem is being researched and explored according to respective geographic areas (regions and countries), throughout the entire food value chain, according to the individual causes of food loss and waste generation, respective food categories, according to the food waste treatment and according to some other relevant issues. Within the context of the problem in our focus and for the sake of providing a complete picture, food thefts are being analysed as well as an aspect of food loss, and these are, as of lately and within the context of the economic downturn, quite pronounced or frequent in almost all the countries internationally. A separate and significant question that the researchers explore is the impact of the modern technologies on food losses and waste optimization through the entire food supply chain, including the retail sector.

This paper focuses on the importance and specific aspects of food loss and waste management in the retail sector. Retail is treated as a special, quite significant and indispensable element in the food value chain. Certain share of food losses and waste occur within the food retail sector, as well. With the aim to minimise these losses and waste, including the food theft, retail sector allocates significant resources and invest these in modern technologies, such as the Radio Frequency Identification (RFID).

## 2. LITERATURE OVERVIEW

There are numerous dissertations and studies on the issue of food losses and waste management on all the organizational levels. Key questions to be explored by the researchers in theoretical works include the significance of food losses and waste on the international level and per individual countries; root causes of food losses and waste across different sectors of the food value chain; detailed analysis of the problem of food losses and waste in each individual member of the food value chain; importance of food losses and waste per individual categories of food; global problem of food theft; food waste management and treatment, and impact of the modern technologies on efficiency in food losses and waste management throughout the food value chain. Information and knowledge derived through research of relevant literature and works in this paper are used as the fundamental basis for thorough theoretical and practical research work that would include the accounting aspect of this problem as well, on the complexity and specific nature of the food losses and waste in the retail sector. Based on this, guidance is formulated for efficient food losses and waste management as an important factor of performance in the retail sector.

With relation to the literature, the following fact should additionally be particularly mentioned here: individual empirical studies were produced using different research methodology for the issue of food losses and waste throughout the food value chain, including the retail sector. This fact additionally complicates or reduces potential for comparing empirical data in all their relevant aspects and makes it quite difficult to reach a valid conclusion (within the context of the problem under consideration in this paper) with the view to improve comprehensive business performances in the food retail sector.

## 3. HYPOTHESES, RESEARCH METHODOLOGY AND EMPIRICAL DATA

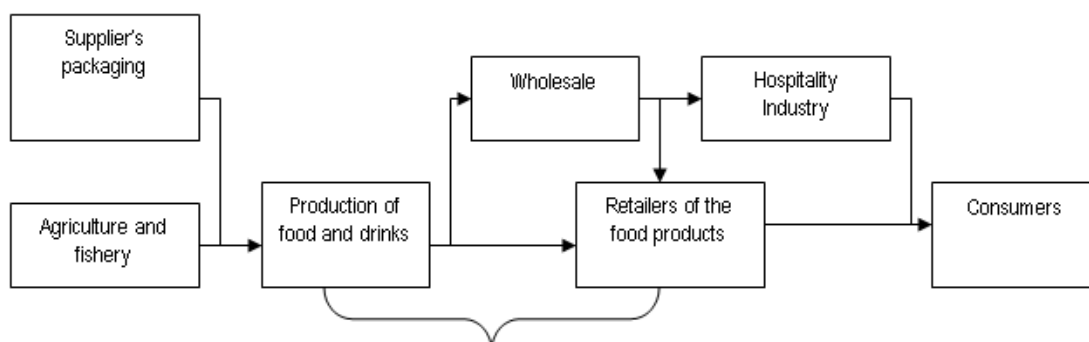
Problem under consideration in this paper – that of food losses and waste in the retail sector, is quite prevailing, significant and complex, that it can be observed and/or researched by using different hypotheses. Nevertheless, this paper focuses on the following two key and interrelated hypotheses: the First Hypothesis (H1) – food losses and waste are now becoming a factor of growing importance for the

total performances of the modern retail sector; the Second Hypothesis (H2) – with improved and more efficient management, and with the support from the modern technologies, food losses and waste can be significantly reduced and thus in turn, the overall performance levels in the retail sector can be improved. Fundamental research methodology for the above hypotheses is the comparative analysis of relevant empirical data according to all their relevant aspects. With the aim to achieve as detailed and complex processing of the observed issue as possible in this paper, comparative analysis has been supported with research of theoretical studies, literature and norms, as well as with the relevant accounting methodology. In addition to these, the method of case analysis has been used in this paper as well, from the current practice in Serbia.

Analysed empirical data were collected from various sources, such as the literature, Institutes, Environmental Agencies, and so on. Individual pieces of primary data were processed in the manner that is in line with the adopted research hypotheses and methodology applied in this paper, within the context of the problem under consideration.

#### 4. FOOD VALUE CHAIN

All the companies operating within all the respective stages of the food value chain have significant economic and social parts to play, even in the developing countries. These companies are important actors in the creation of sustainable value of the national economy and in the overall employment numbers. As of lately, a significant increase in the retail food sale has been noted. Thus, for example, according to some estimates, global food sale in 2013 will amount to USD 4.6 trillion, and, according to the World Bank projections, demand for food will increase by 50% in 2009 - 2030 (Mena et al. 2011). These pieces of data highlight the importance of efficient food value chain management, including the retail sector. Figure 1 contains an illustration that presents the food and drinks supply chain.



The main steps in focus of this Study

FIGURE 1 - FOOD AND DRINK SUPPLY CHAIN

Source: Mena et al. (2011)

According to some estimates, approximately 40% of the produced food is lost and/or wasted in individual stages of food supply chain on the international level. The retail sector in the developed countries accounts for food losses in the food supply chain with approximately 5% (Ericsson et al. 2012).

## 5. GLOBAL IMPACT OF FOOD LOSSES AND WASTE

The problem of food losses and waste internationally and per individual regions is additionally reflected in the fact that different methodology approaches are used in individual studies and thus these studies essentially present heterogeneous and differing results (Parfitt et al. 2010). Nevertheless, all these studies unanimously come to the same conclusion: food losses worldwide are substantial. According to some recent estimates of the United Kingdom Government, approximately 30% of food worldwide is lost or wasted even before it reaches the end consumer, across different sectors of the food supply chain. Some other studies, however, indicate that the food loss levels are much higher and range up to 50%. If observed within the context of the food value chain, more than 30% of all food losses is generated during processing, in transportation, retail and consumption (that is, in the consumer's kitchen) (according to: BSR, March 2011, Waste Not, Want Not: An Overview of Food Waste). According to some estimates, 1,400 calories are wasted per capita each day on the global level (kcal/capita) (Beretta et al. 2013).

If observed on the global level and per individual regions, food losses and waste levels are quite high. Figure 2 presents data on food losses and waste per individual regions internationally.

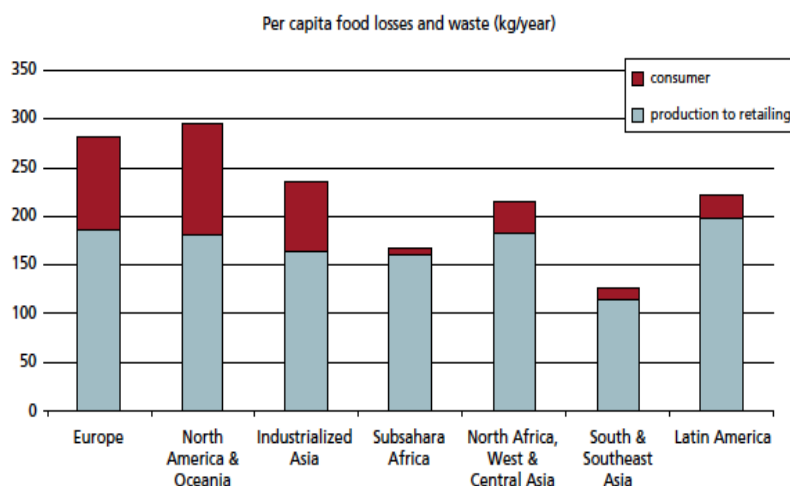


FIGURE 2. FOOD LOSSES AND WASTE INTERNATIONALLY, PER CAPITA (IN KG/ANNUALLY)  
Source: FAO, 2011

Thus, on the international level, as presented in the above Figure, food losses and waste levels are considerable. The issue of food losses is much more pronounced in the industrialized than in the underdeveloped countries. The main causes of food losses and waste in the high-income countries are overproduction and, if observed across individual sectors in the food supply chain, these are predominant in food production and consumption sectors. Food waste per capita in food production sector in Europe and in the North America ranges between 95 and 115 kg on the annual level, while in the impoverished South these amount to only 6 to 11 kg (according to FAO, 2011). Much of the food waste in the low-income countries occurs due to the poor infrastructure (such as the food processing technology used and poor transport infrastructure).

Carbon dioxide (CO<sub>2</sub>) emission, as the most prevalent greenhouse gas, is among the prominent root causes of food losses. According to the Greenpeace Report, food production industry accounts for the generation of up to 30% of the total emission levels of exhaustion gasses internationally on the annual level. In 2006 in the United Kingdom, food production, retail sector and household sector had the joint share of 27% in the greenhouse gasses' emission within the entire food supply chain, where the individual share of the retail sector amounted to 6% (WRAP, March 2010, Waste arising in the supply of food and drink to households in the UK, Final Report).

In the United States, 34 millions of tons of food waste is generated each year, and these make up 14% of the total municipal solid waste stream, where 97% of the food wasted and/or lost is disposed of in the landfills. Food waste per capita in the United States increased by approximately 50% since 1974, and it now amounts to more than 1,400 calories per person per day or 150 billion of calories on the annual level (BSR, March 2011, Waste Not, Want Not: An Overview of Food Waste).

Food waste shares in individual sectors of the food value chain in Canada is as follows: in the agricultural production: 9%; in food packaging/processing sector: 18%; in transportation/distribution sector: 3%; in the retail stores: 11%; in food service/HRI hotels/restaurants/institutional food "outlets": 8%; and in household sector: 51% (Gooch et al., 2010). Food losses in production and processing sectors, and especially in consumption sector, are much higher than in the retail sector (Mary et al. 2011).

According to the estimates for Europe, food losses on the annual level amount to approximately 280 kg per capita annually (kg/capita/a). Total amount of food waste in the European Union (in 27 EU Member States) is estimated to have reached the level of 89 Mt, or 179 kg per capita on the annual level.

The issue of food losses has been specially regulated in the European Union (EU Council Directive Waste 75/442/EEC [91/156/EEC]). According to the EU acquis, food loss is defined as "any substance or object ... which the holder discards, intends to discard or is required to discard". In the European Union Member States (EU - 27) losses in the food supply chain, exclusive of the agricultural production, range between 50 kg (in Greece) and more than 500 kg (in the Netherlands), or on the average 180 kg per capita on the annual level (in 27 EU Member States). Estimated food loss in Germany ranges between 8 and 14 millions of tons on the annual level (or 100 to 188kg per capita, calculated for the population of 82 millions) (Beretta et al. 2013). Food losses in the consumption sector are the principal contributors to such high food loss levels (with 42%) (Beretta et al. 2013).

In Great Britain, retailers and wholesalers generate approximately 1.7 millions of tons of food waste on the annual level (Weber et al. 2011). In 2008, losses in food and drink in the individual sectors of the food supply chain in the Great Britain amounted to (in percentages of the total loss): production - 27.2%; distribution - 0.5%; retail sector - 7.6% and households - 64.7% (WRAP, March 2010, Waste arisings in the supply of food and drink to households in the UK, Final report). The biggest waste of food is thus generated in the consumption sector.

As shown in the Figure 3 per individual sectors of the food supply chain in the European Union, both food consumption and generation are responsible for substantial food losses.

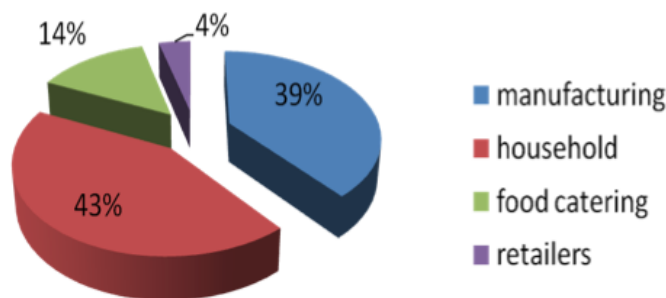


FIGURE 3 - FOOD WASTE ACROSS THE FOOD VALUE CHAIN IN THE EUROPEAN UNION

Source: Segré, A. and Gaiani, S. (June 26, 2012), Transforming food waste into a resource Last Minute Market - a Win-Win Case Study, (Diapositiva 1 - Brussels Development Briefings)

Estimated total food losses in the retail and wholesale sectors in the Nordic countries are presented in Table 1.

TABLE 1 - ESTIMATED TOTAL FOOD LOSSES IN THE RETAIL AND WHOLESALE SECTORS IN THE NORDIC COUNTRIES

Denmark	Average amount of food waste per shop amounted to 165-562 kg/millions DKK turnover (diverging with shop size and type). Based on a three weeks' survey of 24 shops within five categories of retail shops (Ettrup & Bayer, 2002).
Denmark	Average amount of food waste per shop is 200 kg per week. The total generation of food waste from the retail sector is estimated to 40,000 – 46,000 tons per year (Miljøstyrelsen, 2002).
Finland	65,000 – 75,000 tons (including retail and wholesale) per year. Estimations are based on interviews within a special research project (ForMat project).
Norway	43,000 tons per year in the retail sector. Data measured in a number of shops and aggregated to the national Norwegian level.
Sweden	83,000 tons in 2008 for the retail sector. Calculated based on waste factors analysis (Background data was Avfall Sverige 2008).

Source: Initiatives on prevention of food waste in the retail and wholesale trades, IVL report B1988, June 2011

Data presented in the above Table shows that there are significant food losses in the Nordic countries in the retail and wholesale sectors. Food losses differ per individual stores, if observed by the size thereof. Thus, for example, estimated food losses in Sweden in 2008 amounted to the following values for the retail and for the wholesale sector: supermarkets 74,000 tons jointly for the retail and for the wholesales sectors – small stores 9,500 tons. Food losses are thus much higher in the large than in the small stores, which is a logical fact in itself (Initiatives on prevention of food waste in the retail and wholesale trades, IVL report B1988, June 2011).

## 6. ROOT CAUSES OF FOOD LOSSES IN THE RETAIL SECTOR

There are different root causes for food losses among individual sectors of the food value chain. Primary causes of food losses in distribution and wholesale are: storage, packaging, handling and stock management. Significant root causes for food losses in the retail sector are: knowledge, order batch sizes, storage, labelling, packaging, handling, stock management and required quality of products.

Food losses and waste generate considerable environmental impact. In 2009 in Italy, the environmental impact of the retail food waste per individual categories in food supply chain was as follows: agriculture – EUR 10,008,424,720; processing industry - EUR 1,178,207,218; and the retail sector - EUR 1,512,000,000 (Segré, A., Transforming food waste into a resource Last Minute Market and the Italian case study) (<http://www.isekiconferences.com/docs/Presentations/10%20Segre.pdf>).

The impact food losses and waste on the carbon dioxide emission levels in the retail sector is significant. This is corroborated by data for food retail sector in Italy that is presented in Table 2.



TABLE 2 - RETAIL FOOD WASTE ENVIRONMENTAL IMPACT IN ITALY, 2009

	Environmental impact on the fruit and vegetable waste in the retail sector		
	Carbon footprint (equivalent to kg of CO <sub>2</sub> )	Water footprint (m <sup>3</sup> of water)	Ecological footprint (m <sup>3</sup> global)
Per kg	0.080	0.7	3.7
Total	8,436,640	73,820,600	390,194,600
	Environmental impact of the meat waste in the retail sector		
	Carbon footprint (equivalent to kg of CO <sub>2</sub> )	Water footprint (m <sup>3</sup> of water)	Ecological footprint (m <sup>3</sup> global)
Per kg	4.449	5.8	38
Total	9,787,800,000	127,600,000	83,600,000

Source: Segré, A., Transforming food waste into a resource Last Minute Market and the Italian case study (<http://www.isekiconferences.com/docs/Presentations/10%20Segre.pdf>)

In the United States of America, in supermarkets, restaurants and convenience stores 27 millions of tons of food are wasted on the annual level, which is the cash equivalent of EUR 28.6 billion, or USD 41.9 billion. Additional food waste in the consumer sector amounts to 25.9 millions of tons. With the sales levels ranging from 50% to 60% for the perishable goods in the supermarkets, according to some estimates loss levels of 5% to 7% in the perishable goods are caused by poor management. Costs of thefts and food losses in the retail sector can amount up to 4% of the total revenues. Only 0.75% of the 4% of the lost revenues can be recovered through promotions (Weber et al. 2011).

Improved management efficiency can result in significant positive impact on the reduction of food waste in the supermarkets. This was corroborated by data for supermarkets in Italy, which is presented in the Table 3.

TABLE 3 - IMPACT OF THE MANAGEMENT EFFICIENCY IMPROVEMENTS ON FOOD WASTE LEVELS IN SUPERMARKETS IN ITALY

Year	Tons	In EUR
2005	92.4	251,466
2006	61	161,339
2007	49.9	203,613
2008	53	197,928

Source: Segré, A. and Gaiani. S. (June 26,2012), Transforming food waste into a resource Last Minute Market - A Win-Win Case Study, (Diapositiva 1 - Brussels Development Briefings)

## 7. FOOD WASTE IN STORES

In the United States of America, estimated total food waste in stores in 2008 amounted to 43 billions of pounds, which was equivalent to 10% of the total food supply in the retail sector. Estimated annual waste of fruit and vegetable in supermarkets in the United States of America is 15 billion of US dollars.



In 2005 and 2006, average annual waste of fresh fruit and vegetables is 11.4% and 9.7% respectively, where the waste per individual products ranges from 0.6% (for maize) to 63% (mustard cabbage) (WRAP, 2010). Significant savings can be achieved with the reductions in food waste.

A research that was carried out on a sample of six large grocery retailers (that make up 25% of the total number of 122 stores within the Willy:s retail chain) in Sweden has shown that the food waste amounted to 4.3% of the delivered quantity of food. Breakdown of losses in the retail stores, per individual stages of goods flow, is as follows: pre-store food waste (delivered goods were not received, but rejected by the store at delivery) - 3.01%; recorded in-store waste - 0.99%; unrecorded in-store waste 0.3%, and missing quantities of food 1.1%. There is a positive correlation between the unrecorded in-store waste and the total waste, which is indicative of the potential for efficient reduction of fruit and vegetable losses by recording. Substantial amounts of rejected goods based on complaints at delivery constituted the main cause of waste and losses, since such pre-store waste was significant. To achieve this in the specific, observed case, and with the aim to reduce food waste in fruits and vegetables in the retail chain, focus should be placed on efficient pre-store deliveries (Eriksson et al. 2012).

## 8. FOOD LOSSES PER INDIVIDUAL CATEGORIES OF FOOD SUPPLY CHAIN

Food losses differ among individual categories. Relations between food generation and food losses are presented in percentages in Table 4 per individual observed categories calculated collectively for USA, Canada, Australia and New Zealand.

TABLE 4 - CONSUMPTION AGAINST FOOD WASTE PER INDIVIDUAL CATEGORIES (PERCENTAGE CALCULATED COLLECTIVELY FOR USA, CANADA, AUSTRALIA AND NEW ZEALAND)

Category	Losses	Consumption
Grain products	38%	62%
Seafood	50%	50%
Fruits and vegetables	52%	48%
Meat	22%	78%
Milk	20%	80%

Source: Gunders, (2012)

In the developed countries, food waste per individual categories is as follows: salad 50%, bread 33%, fruit 25% and vegetables 20% (BSR, March 2011, Waste Not, Want Not: An Overview of Food Waste). Thus, with the reduction in food waste, significant positive financial and economic effects can be achieved on the global level.

Food waste differs per individual categories within the food supply chain. Food waste per individual categories of food supply chain for North America is presented in the Table 5.

TABLE 5 - NORTH AMERICAN FOOD LOSSES PER INDIVIDUAL FOOD CATEGORIES AT EACH STEP IN THE SUPPLY CHAIN

	Production losses	Postharvest, handling and storage losses	Processing and packaging losses	Distribution and retail losses	Consumer losses (includes out-of-home consumption losses)
Grain products	2%	2%	10%	2%	27%
Seafood	11%	0.5%	5%	9.5%	33%
Fruit and vegetable	20%	3%	1%	12%	28%
Meat	3%	2%	4%	4%	12%
Dairy products	3%	0.25%	0.5%	0.25%	17%

Source: Gunders, (2012)

According to data presented in the above Table, losses per individual categories of food in distribution and retail sector in North America range from 0.25% (for milk) to 12% (grain products). Waste of fruits and vegetables is quite higher in production (20%) than in the distribution or retail sector (12%). Generally speaking, in almost all the observed categories of food, waste in the distribution and retail are lower than in the production and even more so than in the consumption sector.

Similar to the waste and losses per individual categories of food within the food supply chain in North America are the waste and losses in other countries. Thus, for example, as presented by the data in the Table 6, food waste in Switzerland in the retail sector range from 4% (for bread and pastry) to 11% (for fresh vegetable). Food losses and waste in the retail sector are much lower than those in the agricultural production or consumption. The reason for this lies in the fact that the rate of utilization of modern technologies and work flow organization in the retail sector is quite high in Switzerland. This is the case with the retail sector in other countries as well, especially among the countries with the developed market economies.

TABLE 6 - LOSSES PER INDIVIDUAL CATEGORIES OF FOOD SUPPLY CHAIN IN SWITZERLAND

	Agricultural production	Postharvest handling and trade	Processing	Food service industry	Retail sector	Private households
All categories of food	13	2	31	5	4	45
Fresh vegetables	42	5	0	2	11	40
Bread and pastries	21	0	41	2	4	32
Eggs	18	0	0	9	9	64

Source: Beretta et al. (2013)

Average estimated waste and losses of fresh fruit and vegetable in supermarkets in the United States of America in 2006 amounted to 8%, while the waste and losses in fresh meat, poultry and seafood were less than 4.5% of the sale per capita (Jean C. Buzby, Hodan Farah Wells, Bruce Axtman, and Jana Mickey, Supermarket Loss Estimates for Fresh Fruit, Vegetables, Meat, Poultry, and Seafood and Their Use in the ERS Loss-Adjusted Food Availability Data United States Department of Agriculture, Economic Research Service, Economic Information Bulletin Number 44 March 2009) (According to: BSR, March 2011, Waste Not, Want Not: An Overview of Food Waste). In spite of the fact that the stock management has seen significant improvements in the recent past, losses have nevertheless remained on quite high levels.

The impact of packaging with the privately owned brand label on efficient food losses' management is becoming more and more prominent. The share of privately owned brands in percentage of the total sales of food in 2011 amounted to the following presented shares for the individual retailers: Aldi 12%; Asda 55%; Co-op 55%; Lidl 7%; M&S 98%; Morrisons 57%; Ocado 48%; Sainsbury's 56%; Tesco 56%; Waitrose 55%; or 56% on average. If observed per individual food categories, average shares of privately owned brands (with their respective retailers) range from 25% (cooked sauce) to 99% (apple) (WRAP, June 2012: Helping Consumers reduce Food Waste - A Retail Survey 2011).

Both the EU and the UN have repeatedly requested and appealed for the reductions in food waste and losses of up to 25% by 2025 (according to: "Joint Declaration against Food Waste"). In the United Kingdom, the Government has laid down a Programme entitled "Waste and Resources Action Programme" (WRAP) aimed at achieving reductions of food losses throughout the food supply chain. In compliance with this Programme, a campaign entitled "Love Food - Hate Waste" was launched in 2007; the campaign lasted until January 2009, and contributed to the reduction in food waste and consecutively in savings of EUR 337 million, or USD 493 million (Weber et al. 2011).

## 9. THEFTS IN FOOD RETAIL

Among the causes for the retail losses of goods, food included, is theft. In 2011, total costs of thefts on the global level in the retail sector amounted to USD 119,092 billion, which makes up 1.45% of the global sales in the retail sector (Centre for Retail Research - Global Retail Theft Barometer 2011). As of lately, and coupled with the world economic recession, the impact of food thefts is on the rise on the global level. This fact is highlighted by data presented in Table 7.

TABLE 7 - FOOD THEFT PER INDIVIDUAL CATEGORIES IN THE RETAIL SECTOR ON THE GLOBAL LEVEL, FOR 2011 (AVERAGE THEFT RATE)

	Globally	North America	Latin America	Asia / Pacific	Europe
Cheese	3.09%	2.76%	2.96%	1.39%	3.90%
Fresh meat	2.79%	3.60%	3.80%	1.83%	2.35%
Sweets and chocolates	2.78%	3.60%	2.99%	1.74%	2.45%
Luxury cooked meat	2.74%	2.86%	3.20%	1.65%	2.94%
Alcoholic beverages/drinks/whiskey	2.47%	2.95%	2.85%	1.84%	2.25%
High quality seafood/fish	2.46%	2.28%	2.31%	2.21%	2.70%
Baby formula/baby products	2.33%	3.10%	3.20%	1.36%	1.95%
Spices	2.02%	1.97%	2.58%	1.18%	2.27%

Source: Centre for Retail Research - Global Retail Theft Barometer 2011

According to data in the above Table, food thefts are smallest in the Asia/Pacific Region, if compared against the other (observed) regions internationally. On the global level, thefts recorded per individual categories of food range from 2.02% (for spices/vanilla), to 3.09% (for cheese). In Europe, food thefts range from 1.97% (for baby products) to 3.90% (for cheese), and its levels are almost the same as the theft levels recorded on the global level.

## 10. FOOD AND PACKAGING LOSSES IN THE RETAIL SECTOR IN SERBIA

There are no special records on total food losses or on the food losses in the retail sector in Serbia. Data on food losses and waste is available only through analyses of the annual reports of individual companies operating in the retail sector. For illustration purposes, data on losses in goods of the "Banat" a.d. Nova Crnja Company for 2010 and 2011 is presented in Table 8.

TABLE 8 - LOSSES IN GOODS, "BANAT" A.D. NOVA CRNJA COMPANY

Indicators	For 2011	For 2010
Losses / Business profit	1.46%	2.87%
Expenditures for write-offs of stocks of materials and goods/ Business profit	0.34%	1.09%
Losses / Business profit	0.14%	0.31%
Expenditures for write-offs of stocks of materials and goods/ Business profit	0.03%	0.12%

Note: Calculations performed by the Author  
Source: Annual reports

Data from the above Table shows that the losses in business profit generated by deficient goods in 2011 in the observed Company amounted to 1.46%, and that the losses generated by expenditures for write-offs of stocks of materials and goods amounted to 0.34%. In the same year, losses in business profit from shortages and lacking goods amounted to 0.14%, and losses from write-offs of stocks of materials and goods amounted to 0.03%. When compared with the previous year, the observed Company achieved slight reduction in both the lacking goods and in expenditures for write-offs of stocks of materials and goods.

Due to the fact that there is no adequate statistical records, analyses of the food losses and/or waste in the retail sector in Serbia are quite difficult to perform. Such data is indirectly available from the analysis of the estimated waste from the commercial and institutional sectors. Projected amounts of waste from the commercial and institutional sectors in Serbia (presented in thousands of tons on the annual level) for 2010, 2014 and 2019 are 367, 418 and 490 thousands of tons respectively. (Waste Management Strategy for 2010-2019, RS Official Gazette, No. 29/2010). Estimated share of waste from the commercial and institutional sectors in total waste for 2014 is 4.08% (Calculation performed by the Author, based on data presented in "Waste Management Strategy for 2010-2019", RS Official Gazette, No. 29/2010).

In addition to the food waste treatment, significant efforts are being made in Serbia to achieve environmentally friendly product packaging and/or in packaging waste treatment. Thus, for example, in 2012, the Tetra Pak Company announced its efforts to achieve environmentally sustainable product packaging by 2020 as a part of its predefined objectives in environmental protection, through the exclusive use of the renewable materials and by leaving the minimum environmental footprint with zero waste. Such strategy implies focus on three key areas: environmental impact, sustainable products and recycling. Last year, this Company opened its first recycling plant in Serbia (In Store, May 2013; [www.instore.rs](http://www.instore.rs)).

Estimated amount of waste generated from product packaging on the annual level in Serbia is 334.500 tons (see Table 9 and Figure 4). Its share in the total amount of communal waste is approximately 14%. The shares of individual types of waste in the total estimated waste on the annual level is as follows per individual waste types: for glass packaging: 27%; for plastic packaging: 26%; for paper/cardboard: 34%; for composite packaging: 5%; for aluminium packaging: 2%, and for the packaging made of iron: 6%. In the overall breakdown of the estimated amount of waste generated from product packaging in Serbia, glass packaging has the biggest share (that of 27%), followed by the plastic packaging (of 26%) and preceded by the paper/cardboard packaging (with 34%), which, taken as an aggregate share, amounts

to 87% of the total waste generated from product packaging. There is no adequate system for management of waste generated from product packaging in Serbia. Bearing in mind the growing amounts of waste from product packaging based on the rise in the share of non-recyclable product packaging, it is by all means necessary to invest efforts in improvements of the existing system in the future period.

TABLE 9 - ESTIMATED PACKAGE WASTE LEVELS IN SERBIA

Waste type	Quantity, in ton per year
Glass packaging	90.000
Plastic packaging	88.000
Paper/cardboard packaging	115.000
Composite packaging	17.300
Aluminium packaging	5.200
Packaging made of iron	19.00
Total	334.500

Source: Agency for Environmental Protection, 2009. According to: "Waste Management Strategy for 2010-2019", RS Official Gazette, No. 29/2010

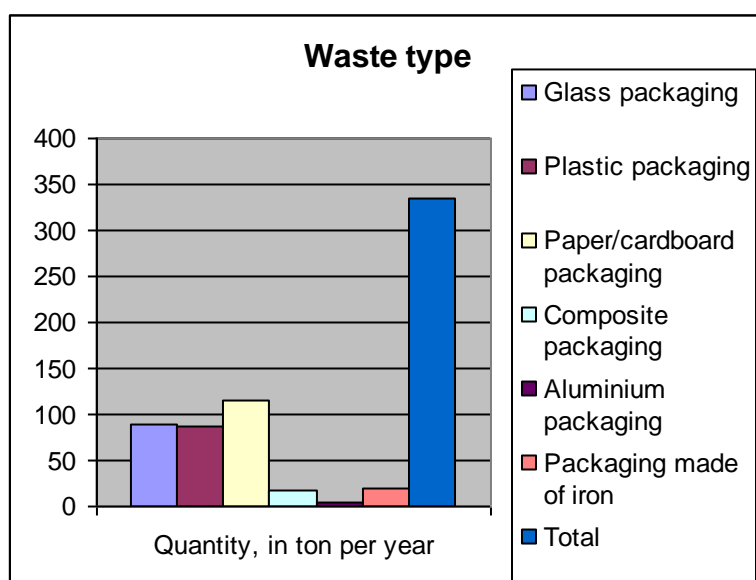


FIGURE 4 - BREAKDOWN OF THE ESTIMATED AMOUNTS OF WASTE GENERATED FROM PRODUCT PACKAGING IN SERBIA

Note: Figure produced by the Author

Source: Table 9

Delhaize Group is the leading retailer in Serbia, operating under the business name of "Delhaize Serbia". To a large extent, this Company purchases perishable goods and products and it is thus reasonable to expect that it generates significant losses and waste of food. Table 10 contains breakdown of Delhaize Group revenues of relevance for the problem observed in this paper.

TABLE 10 - BREAKDOWN OF DELHAIZE GROUP REVENUES (AS A PERCENTAGE OF REVENUES)

	In 2012	In 2011	In 2010
Retail revenues			
- Food - perishable	40.0%	37.9%	40.0%
- Food – non-perishable	35.6%	36.1%	35.5%
- Non-good products	13.4%	15.0%	13.8%
Total revenues from the retail business	89.0%	89.0%	89.3%
Revenues from the wholesale	11.0%	11.0%	10.7%
Total revenues	100.0%	100.0%	100.0%

Source: Annual Reports and Statements for 2012

Despite the fact that no special records are being maintained, growing and frequent thefts of all goods, including food, are evident in Serbian retail sector. This fact contributes to significant total amounts of losses in food in the retail sector in Serbia.

From the accounting point of view, natural losses in goods in the retail sector in Serbia, inclusive of food thefts, are treated as operational expenses up to the amount of the purchase price of such goods. Such accounting and booking treatment provides for accurate calculations of the average rate of differences in prices (or margin), as the key indicator of operational profitability in the retail sector (Lukić, 2011; Lukić, 2013a, b).

## 11. CONCLUSIONS

Food losses and waste are global phenomena with environmental and social impact through energy use in food production; food disposal by the retailers, food waste and losses in households and energy use for disposal of wasted food. Food is wasted and lost throughout the entire food value chain, including in the retail sector. Food waste and losses in the retail sector is, in principle, less than in the food production and consumption sectors. Greater reliance on and use of modern technologies and improved efficiency in organization of work flow have produced positive impact on these (recorded) amounts of food waste and losses in the retail sector that makes a separate stage in the food value chain.

Retail food waste and losses have become huge problem not only in the developed, but in the developing countries and in the countries in transition process as well; this is, for example, the case with Serbia as well. Specific and unrelenting consumers' demands for complete and varied and diverse offer of food are also reflected on the retailers' overstocking, and have become quite difficult and complicated to justify from the ethical and social point of view. The environmental and economic impact of such consumers' demands has become increasingly prominent and measurable.



Significant factors in food waste and losses throughout the food value chain, including the retail sector, are the carbon dioxide emissions that produce the greenhouse effect, management efficiency and the use of modern technologies (Enterprise Resource Planning – ERP system, Radio Frequency Identification - RFID). By improving the efficiency of control over these factors, significant impact can be exerted on minimization of food waste and losses in the retail sector today. This will certainly exert positive impact on the overall performance of the retail sector as well.

With the aim to achieve as efficient retail food loss and waste management as possible, it is necessary to develop and apply unified methodology for monitoring, analysis, planning and supervision. This especially applies to the case of Serbia. The final effect of achieving this will be reflected in the improved comparability of data, as a necessary prerequisite for minimising of food losses and waste in the retail sector.

## REFERENCES

- Berreta, C. et al. (2013). "Quantifying food losses and the potential for reduction in Switzerland". *Waste Management*, 33 (3): 764-773.
- BSR, (March 2011). *Waste Not, Want Not: An Overview of Food Waste*. Centre for Retail Research - *Global Retail Theft Barometer 2011*. Department of Agriculture, Economic Research Service, Economic Information Bulletin Number 44: 20.
- Eriksson, M. et al. (2012). "Food losses in six Swedish retail stores: Wastage of fruit and vegetables in relation to quantities delivered". *Resources, Conservation and Recycling*, 68: 14-20.
- Gooch, M. et al., (2010). *Food Waste in Canada*. Value Chain Management Centre, George Morris Centre.
- Gunders, D. (August 2012). "Wasted: How America Is Losing Up to 40 Percents of Its Food from Farm to Fork to Landfill". *NRDC Issue Paper*, IP:12-06-B. *Initiatives on prevention of food waste in the retail and wholesale trades* (June 2011). IVL report B1988.
- Jean C. Buzby, Hodan Farah Wells, Bruce Axtman, and Jana Mickey, (March 2009). "Supermarket Loss Estimates for Fresh Fruit, Vegetables, Meat, Poultry, and Seafood and Their Use in the ERS Loss-Adjusted Food Availability Data". United States.
- Lukic, R. (2011). *Evaluation of Business Performance in the Retail Sector* ("Evaluacija poslovnih performansi u maloprodaji"). Faculty of Economics (Ekonomski fakultet, Beograd), Belgrade.
- Lukic, R. (2013a). *Accounting in Trade Companies* (Računovodstvo trgovinskih preduzeća). Faculty of Economics (Ekonomski fakultet, Beograd), Belgrade.
- Lukic, R. (2013b). «Sustainable Cost Management in Retail». *Review of International Comparative Management*, 14 (2): 268-280.
- Mary K. Muth, Shawn A. Karns, Samara Joy Nielsen, Jean C. Buzby, and Hodan Farah Wells, (January 2011). "Consumer-Level Food Loss Estimates and Their Use in the ERS Loss-Adjusted Food Availability Data". USDA ERS, Technical Bulletin No. (TB-1927): 123.

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- Mena, C. et al. (2011). "The causes of food waste in the supplier - retailer interface: Evidences from UK and Spain". *Resources, Conservation and Recycling*, 55 (6): 648-658.
- Parfitt, J. et al., (2010). "Food waste within food supply chain: quantification and potential for change to 2050". *Philosophical Transactions of The Royal Society B*, 365: 3065-3081.
- Segré, A. (2012). Transforming food waste into a resource Last Minute Market and the Italian case study (<http://www.isekiconferences.com/docs/Presentations/10%20Segre.pdf>).
- Segré, A. and Gaiani. S. (June26, 2012). *Transforming food waste into a resource Last Minute Market - a win-win case study*, (Diapositiva 1 - Brussels Development Briefings).
- Waste Management Strategy for 2010-2019 (Strategija upravljanja otpadom za period 2010.-2019. godine)*. RS Official Gazette, No. 29/2010.
- Weber, B. et al. (2011). *The Challenge of Food Waste*, Planet Retail.
- WRAP, (June 2012). *Helping Consumers reduce Food Waste - A Retail Survey 2011*, Final report.
- WRAP, (March 2010). *Waste arising in the supply of food and drink to households in the UK*, Final report.