



## FOOD WASTE REDUCTION AS A CHALLENGE IN SUPPLY CHAINS MANAGEMENT

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**ABSTRACT. Background:** Sustainability has been an area of growing concern and attention for companies, especially operating on a global scale, that more and more often develop strategies of sustainable supply chain management (SSCM). The sustainability of the food supply chains management is a global challenge demanding implementation of innovative solutions based on the triple bottom line concept of best practices. The paper is devoted to the food waste problem, that occurs in all parts of the value chains. It is important to notice that the further down the value chain, the more costly it becomes in social, economic and environmental perspectives. The purpose of this paper is to explore the food waste problem at a supply chain level and present how companies can cope with the challenge of food waste reduction in the light of the framework of SSCM.

**Methods:** The paper is based on a desk research. The authors conducted a review of recent literature, reports of international and national institutions, conference presentations, materials provided by companies and other Internet sources. As a result of the materials analysis, a plethora of initiatives aiming to reduce waste is investigated considering activities developed by different groups of stakeholders.

**Results:** The authors characterized the specificity of the food waste reduction as a multidimensional problem and challenge in the development of both scientific research as well as business practices within SSCM.

**Conclusions:** Food waste management is an important challenge in the global economy as well as in the contemporary business in the light of sustainable development requirements. Generally, a spectrum of international, national and local initiatives, including legal acts and voluntary programs, has been developed to reduce food waste. Similarly, different supply chain practices have been advanced so far to decrease food waste and enhance sustainability. The authors advocate that four supporting facets of sustainability (strategy, culture, risk management, transparency) are an integrated part of SSCM in the food industry. Certainly, food waste management requires system thinking and responsible involvement of all parties, especially public authorities, NGOs, business operators as well as individuals, based on common goals and collaborative actions.

**Key words:** food supply chain, food waste, waste management, best practice, retail operations, sustainability.

### INTRODUCTION

The achievement of a balance between economic, environmental and social effects is a long-term objective to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs [World Commission on Environment and Development 1987]. Sustainability has been an area of growing concern and attention for companies, especially operating on a global

scale, that more and more often develop strategies of sustainable supply chain management. The sustainability of the food supply chains management is a global challenge demanding development and implementation of innovative practices by all entities within value chains. There are several serious problems for the food sector sustainable growth, among others such as rapid increase of populations and their food consumption or changing consumer demand patterns, but on the opposite side, climate change, competition for resources, including

the limited availability of arable land and natural resources for food production or the scale of malnutrition in developing countries [Dani 2015]. In this perspective, food waste represents a critical problem and is gaining more and more attention among stakeholders in both public and private sectors.

Food waste refers to any food discarded despite being appropriate for human consumption, whether or not after it is kept beyond its expiry date or left to spoil [FAO 2013]. The UN Sustainable Development Goals target to halve per capita global food waste by 2030. The EU circular economy package sets the objective to reduce food waste by 30% till 2025 and by 50% till 2030. Mena et al. outlined three root causes of food waste, namely: megatrends, natural constraints and management factors [Mena et al. 2011]. Furthermore, determinants of food loss and waste might be divided into two basic types: factors that occur along a food supply chain and factors that come from the surroundings of a food supply chain.

The purpose of this paper is to explore the food waste problem at a supply chain level and present how companies can cope with the challenge of food waste reduction in the light of the framework of SSCM. A plethora of initiatives aiming to reduce waste is investigated illustrating the activities developed by different groups of supply chains stakeholders. The specificity of the food waste reduction is characterized as a multidimensional challenge.

## METHODS

The method used in this paper is a desk research. Firstly, it relates to the analysis of scientific papers originating from different journals published within the period 2013-2018. Authors based on the leading research databases which are EBSCOhost Online Research Databases, Emerald Insight and Web of Science. The following search terms were used: food waste, food waste management, food supply chain and food supply chain management. This action allows authors to concentrate mainly on food waste reduction within supply chain management field. The

most relevant scientific papers taken into account within the analysis considered definitions of “food waste” or “food loss” according to reports provided by different international (especially the Food and Agriculture Organization of United Nations – FAO) and national institutions (e.g. in Denmark, UK or Poland). As a result, the second research path was focused on their analysis, which allows to define the terms and identify the most recent data and initiatives regarding food waste management. The third desk research path concentrated on searching and analysis of case studies presenting practices within food supply chain management. The main sources of the knowledge were companies’ professional reports, presentations and materials as well as direct interviews with logistics managers during conferences or seminars, that allowed to discover business practices and discuss lessons learned. Although the problem of food waste reduction has been gaining much attention in recent years, end-to-end supply chain practices are still not widely analysed and described. The authors concentrated their attention on the sustainable supply chains to fill this gap.

## FOOD WASTE: AN ECONOMIC, ENVIRONMENTAL AND SOCIAL PROBLEM

Before addressing specific practices in food waste reduction and tailored solutions developed within food supply chains management, it will be helpful to outline the scale and character of food waste problem. According to the FAO, “food loss” is defined as the decrease in quantity or quality of food available for consumption throughout the different segments of the supply chain [FAO 2015]. It includes also a physical food loss. Food waste is a part of food loss, however not clearly distinguished. Both of the terms “food loss” and “food waste” are nevertheless maintained in a regular communication [FAO 2014]. From a broad perspective, “food waste” might be considered as “all food that for any reason is taken out of the supply chain it was originally linked to” [Batista et al. 2015] or as “the removal from the food supply chain of food which is still fit for human consumption, done either by choice or after the food is

spoiled or expired due to poor stock management or neglect” [Rezaei and Liu 2017].

First of all, ensuring curtailing of food loss and waste is one of the most significant determinants of food security in the world. Based on the FAO data, the enormous scale of the problem is evident. Around 30% (about 1.3 billion tons per year) of food production for human consumption is lost or wasted globally [FAO 2017b]. Moreover, World Resources Institute indicates that globally, food worth 1 trillion USD is lost or wasted each year throughout the entire supply chain. According to the Polityka Insight Report, 88 million tons a year are wasted in the EU countries [Sipiński 2018]. In Poland, 9 million tons of food waste per year (247 kg per person) occur throughout the supply chain from farms to final consumers [Greenpeace Polska 2017]. Poland occupies the 5th position in the EU regarding the value of the estimated cost of food waste, that amounts to 14 billion EUR (143 billion EUR in the EU, 850 billion EUR worldwide) [Business Insider Polska 2017, Sipiński 2018].

Besides the economic effect, Greenpeace Polska highlighted the environmental impact, namely waste of water, which amounts to 1.72 billion m<sup>3</sup>, and CO<sub>2</sub> emissions, that achieve the level of 22.77 million tons annually [Greenpeace Polska 2017]. In comparison, 170 million tons of CO<sub>2</sub> are emitted in the EU each year in connection with food supply chain that is wasted. Reducing food loss and waste might be helpful to improve ecological safety in terms of resources limitations [Kwasek et al. 2016]. Especially, reducing food waste through prevention, re-using and recycling can be a key part of a climate change strategy to reduce greenhouse gas emissions.

Furthermore, the social problem of global hunger should be also emphasized. According to the FAO data, in the period from 2014 to 2016 there have been nearly 795 million undernourished people in the world, mostly in developing countries (about 98%) [FAO 2017a], while globalization in certain regions contributed to the occurrence of food overproduction. The statistics indicate that if just ¼ of the food currently lost or wasted globally could be saved, it would be enough to

feed 870 million hungry people in the world [Vaqué 2015].

Facing the problem of food waste at a supply chain level, requires the perspective of organizational sustainability, that consists of three components: economic, environmental and social performance. This approach corresponds to the concept of the triple bottom line, that balances the just mentioned dimensions and determines development of sustainable (good and best) practices in supply chains. According to Carter and Rogers [2008], “sustainable supply chain management” is defined as “the strategic, transparent integration and achievement of an organisation’s social, environmental and economic goals in the systematic coordination of key interorganisational business processes for improving the long-term economic performance of the individual company and its supply chains”. Furthermore, there are four other aspects of sustainability [Carter and Rogers 2008], that should be highlighted, namely:

- risk management – the ability of a firm to understand and manage its economic, environmental and social risks in the supply chain;
- transparency – reporting to stakeholders, engaging them and using their feedback and input to both secure buy-in and improve supply chain processes;
- strategy and culture – the integration of an organization’s sustainability initiatives, its core business strategy and organizational culture.

All of them will be discussed in the article taking into account the challenge of food waste reduction.

## **REDUCING WASTE IN FOOD SUPPLY CHAIN MANAGEMENT**

Waste management is currently a rising challenge for food supply chains managers, who are faced with a negative influence of food waste and search for improvement possibilities in this sphere. The need of waste management in the context of supply chain management is underlined by the Waste

Framework Directive, which determines the framework for collection, transport, recovery and disposal of waste [Defra 2014]. It is also worth mentioning the global perspective of such initiatives, like The Consumer Goods Forum, a network of some 400 retailers, manufacturers, service providers and other stakeholders across 70 countries with combined sales of EUR 3.5 trillion, that has published the Food Waste Resolution and promised to halve the food waste within their own retail and manufacturing operations by 2025 versus a 2016 baseline [Consumer Goods Forum 2015]. Various other initiatives within the food industry have been established, like e.g. the Food Waste Reduction Alliance in the US, the Waste and Resource Action Programme in the UK, the Retailers' Environmental Action Programme in Europe with waste reduction as the most important objective or the ECR Europe Shrinkage & On-shelf Availability Group developing a complex strategy, called "sell more, waste less", based on improving the performance of operations (especially in retail) simultaneously by reducing food waste, increasing freshness and/or increasing sales. Strategic and operational interventions can be prioritized across national, regional and industry levels in food waste reduction [Irani and Sharif 2016].

Global food waste occurs at each of the stages in supply chain management, namely within agricultural production, post-harvest handling and storage, processing, distribution and final consumption. Food waste happens across the supply chain, including all entities – farms, manufacturers, retailers, consumer-facing business like restaurants or catering services as well as individual consumers. Following the approach presented by Batista et al., there is a differentiation among the five general types of waste in the food sector [Batista et al. 2015]:

- Processing waste – all inedible materials generated from the production process such as stems, leaves, bones, excess animal fat, spoiled food, spillages, contaminated products due to poor handling or processing failure;
- Wastewater – water at the end of food processing or cleaning processes, which usually carries dirt or debris;

- Packaging waste – different sorts of food packages that may be disposed along the way through the supply chain;
- Non-conformity waste – all edible products generated in the production process that have not achieved conformity with specifications of quality, consistency, flavor, aroma, size, shape etc., predetermined by organization downstream the supply chain;
- Overproduction waste – food that meets industry specifications but has not been scrapped because it no longer has a customer.

Food waste hierarchy prioritizes actions to prevent food waste and handle surplus food in the most sustainable way [Papargyropoulou et al. 2014, Batista et al. 2015, Hermsdorf et al. 2017]. On the one hand, prevention is the most desirable option at the first stage of the hierarchy, on the other hand, disposal is the least desirable option and constitutes the last level. On the re-use level, surplus food can be used for human consumption through e.g. donating these items to charitable organizations such as food banks or social supermarkets [Hermsdorf et al. 2017]. Recycling is good practice in using food as animal feed or composting material in agriculture sector. On the recovery level, surplus food might be used for energy generation. Finally, food items not used on other levels, must be disposed.

The food supply chain entities and their possible main activities in waste management are presented in Table 1. It should be stressed that supply chain managers face a challenge how to monitor the food waste amount at all stages of value creation process.

Food waste reduction might be analyzed according to different types of possible actions, considering legislative, social and business issues. In Poland, the first act taking into account in details how to counter food waste was prepared in 2016 and accepted by the Polish Senate in March 2018. Currently, it is proceeded further by the Polish Sejm. According to a draft law on combating food waste, food business operators who manage a store with a sales area bigger than 250 m<sup>2</sup> will be obligated to sign an agreement to

provide free of charge the dedicated non-governmental organization with food surplus for social objectives, there is also announced

the possibility to introduce charges for food waste or penalties for not signing the just mentioned agreement [Polish Sejm 2018].

Table 1. Supply chain entities and their possible activities in food waste reduction

Actors in supply chain	Main activities	Possible waste management activities
final consumer	Consumption and utilization	<ul style="list-style-type: none"> <li>- transfer of non-consumed food to the bank of food</li> <li>- national consumption (according to the date of use)</li> </ul>
	Storage	<ul style="list-style-type: none"> <li>- maintenance of appropriate conditions of food storage (temperature, humidity, insolation, etc.)</li> <li>- standardized date labels for food expiration</li> </ul>
	Buying	<ul style="list-style-type: none"> <li>- buying list (manual and electronic)</li> <li>- menu planning and shopping apps in smartphones</li> </ul>
wholesaler, retailer, transporters and open market dealers	Selling	<ul style="list-style-type: none"> <li>- promotional campaign of food waste management</li> <li>- discounts for short-dated products</li> <li>- information about the quantity of product required to selected recipe for identified number of people, different recipes for the rest of quantity</li> <li>- information about the condition of product's storage</li> <li>- range re-examining and consolidation, including deleting slow-moving tail products that are highly substitutable</li> <li>- in-store production (perishables nearing the end of their life can be transformed into a ready-to-eat product in store)</li> <li>- optimization of handling of the best before dates</li> <li>- offering products with longer life on sale in stores</li> <li>- offering smaller packs and reducing multi-buy promotions</li> <li>- differentiation of on-shelf availability for slow-moving and fast-moving items</li> <li>- increase of the product's shelf life with one day</li> </ul>
	Transporting	<ul style="list-style-type: none"> <li>- correct preparing of loading, security of shipment and unloading</li> <li>- delivery of the right volume into stores at the right time</li> <li>- unpacking items in the distribution center and ship products in smaller quantities to stores</li> </ul>
	Storing	<ul style="list-style-type: none"> <li>- maintenance of appropriate conditions of food storage (temperature, humidity, insolation, etc.)</li> <li>- systematical service of warehouse</li> <li>- inventory management in terms of dates and food quality</li> <li>- management of warehouse (according to FEFO and pick to zero method)</li> <li>- cross-docking for selected suppliers</li> </ul>
	(Re)packing	<ul style="list-style-type: none"> <li>- maintenance of appropriate conditions of (re)packing (temperature, humidity, insolation, etc.),</li> <li>- eco-labelling</li> </ul>
	Buying	<ul style="list-style-type: none"> <li>- collaboration with local suppliers (local sourcing)</li> <li>- base of trusted suppliers, control and evaluation of current suppliers</li> <li>- quality control of products and suppliers</li> <li>- collaborative forecasting</li> <li>- electronic data interchange</li> <li>- safety stock management</li> <li>- effective store replenishment improvement (giving the right information, training and incentives to the store managers, engaging the employees who replenish the shelves, rotating correctly)</li> </ul>
suppliers, manufacturers	Selling the products	<ul style="list-style-type: none"> <li>- discounts for products with short date of use</li> <li>- make-to-order flows management</li> </ul>
	Transporting	<ul style="list-style-type: none"> <li>- correct preparing of loading, security of shipment and unloading</li> <li>- safe transport conditions</li> </ul>
	(Re)packaging	<ul style="list-style-type: none"> <li>- maintenance of appropriate conditions of (re)packing (temperature, humidity, insolation, etc.)</li> <li>- eco-labelling</li> </ul>
	Storage	<ul style="list-style-type: none"> <li>- maintenance of appropriate conditions of food storage (temperature, humidity, insolation, etc.)</li> <li>- systematical service of warehouse</li> <li>- raw material inventory management in terms of dates and food quality</li> </ul>
	Production	<ul style="list-style-type: none"> <li>- production with the longest date of use possible</li> <li>- collaborative forecasting and demand planning</li> <li>- using after-production rest to produce another product</li> <li>- continuity of production</li> <li>- adherence to production principles and norms</li> </ul>
	Growing and buying raw material	<ul style="list-style-type: none"> <li>- selection of raw material suppliers</li> <li>- continuous control of raw material quality</li> </ul>

Source: own elaboration based on ECR Europe 2018; Jones et al. 2005, Hermsdorf et al. 2017, Liljestrand 2017, Heisig et al. 2017, Kaipia et al. 2013, Aschemann-Witzel et al. 2017.

Analyzing the best practice from abroad, two perspectives can be observed. The first one, represented by leader of food waste prevention - Denmark, bottom-up initiative based on commitment of non-profit organizations and the cooperation with government administration and distributors [Halloran et al. 2014]. An organization Stop Spild Af Mad (Stop Wasting Food) through different actions, such as: urging supermarkets to sell imperfect-looking products or products which had been close to their use-by-date, educating consumers by cooking books, workshops at schools. In Denmark there are shops selling food past its best before date or in damaged packaging, ensured by national legislation. Danish retailers mostly have ceased promotional actions like “cheaper big packages” or “buy two get three”, “two of the price of one” and have changed merchandising policies by separating shelves with cheaper products approaching their best before date, or fail to meet standards in other ways. The cooperation between retailers and non-profit organizations is significant in waste reduction, e.g. Unilever and Stop Spild Af Mad have encouraged HoReCa clients to take home leftovers by offering them special bags [Stop Spild Af Mad 2018]. Furthermore, since 2016 The Ministry of Environment and Food had substituted initiatives aiming to reduce waste food, such as educational activities at schools and individual consumers, which gave the stimulus to responsible behavior. As a result, between 2011 and 2017 food waste by Danish households fell by 8% per person.

The second perspective of possible food waste actions represents a British government initiative. In 2000 the UK government founded the Waste & Resources Action Programme (WRAP) to promote sustainable waste management. Its campaign, called “Love Food, Hate Waste” launched in 2007, is focused on educating individual consumers and changing their habits in everyday food waste reduction actions. WRAP plays an important role in food waste management by focusing on cooperation in supply chains, involving retailers representing 93% of the grocery shop market, with Tesco as a leader. The WRAP representatives encourage and stimulate different stakeholders to take actions through

different agreements and commitments, such as [WRAP 2018]:

- The Courtauld Commitment, which aims to improve resource efficiency and reduce the carbon impact of the UK grocery sector, involving manufacturers, retailers and households;
- The Hospitality and Food Service Agreement, which supports the whole sector – hotels, hospitals, schools and restaurants – in reducing waste, recycling more and saving money;
- The Federation House Commitment, which delivers water savings of 7.4 million m<sup>3</sup> – equivalent to 2 965 Olympic-size swimming pools from 2007 to 2012.

## **GOOD PRACTICES IN FOOD SUPPLY CHAIN – CASE STUDY OF TESCO**

Tesco is a company that develops waste management practices within end-to-end supply chain management, taking into account a strategic objective to help halve global food waste, farm to fork, by 2030 [Tesco 2018a]. The global retailer explores the approach based on the following stages: identify source of waste, measure waste, set targets and act through innovations development. There are 4 main actions that have been developed so far, namely: no food that is safe for human consumption will be wasted inside the UK operation by the end of 2017, to halve food waste in Tesco’s own operations by 2030, to work in partnership with suppliers to halve food waste in supply chains by 2030 and to help halve household food waste in the markets where Tesco has retail operations by 2030 [Tesco 2018a]. The powerful role of food retailer as a leader in socially responsible behaviors to lower food waste is prominent [Devin et al. 2018]. Tesco is one of the global retailers that publish food waste data in different countries of its operations: in the UK, Ireland, Czech Republic, Hungary, Poland and Slovakia.

The methodology used for waste measuring by Tesco is in accordance with the Food Loss and Waste Accounting Standard (FLW Standard), that defines food waste as “any

food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)". Accordingly, food donated to charities or sent to animal feed and the packaging waste are not considered to be food waste. The scope of this calculation covers food waste arising only from Tesco depots and stores in Central Europe (Czech Republic, Hungary, Poland and Slovakia) and had been used to calculate the total tons of food wasted in Central European operations in the full Tesco financial year 2017/18, from 26th February 2017 to 24th February 2018 inclusive. Waste arising at Tesco suppliers' sites and from third party counters in Tesco stores is not included into calculation [Tesco 2018c]. In 2017/2018 Tesco reduced the total level of food wasted in Central Europe from 1.6% to 1.2% of all food sales. Company presents several reasons for this fact, such as: improving forecasting and ordering, increasing compliance with stock and waste routines in the stores, prioritizing the rollout of the surplus food redistribution scheme across Central Europe, improving the food donation process to food bank partners and animal feed [Tesco 2018b]. Producers applied also FLW Standard, for example Nestle in its dairy supply chain [Tostivint et al. 2017].

Awareness of food waste that does not directly affect a firms' profit can be increased by multi-stakeholders cooperation [Derqui et al. 2016]. It is a high importance to improve communication and to raise a new appreciation for food among all stakeholders of supply chain in order to develop more sustainable food system [Göbel et al. 2015]. The British retailer has announced a partnership with its 24 largest food suppliers (representing GBP 17 billion worth of sales) considering the achievement of the sustainable development goal to halve food waste by 2030 [Slow 2017]. The company AMT Fruit is one of the strategic suppliers involved strongly in the cooperation. It delivers fruits adequately to the demand in a smart way to minimize fruits waste. Moreover, the company supplies surplus products to FareShare – the UK's largest food redistribution charity. Approximately 20% of

the waste reduction is achieved through the supplier's FareShare donations. AMT Fruit has decreased its operational waste overall by 30% during last 18 months, mainly due to more direct deliveries from Spain to Tesco depots in the UK [Searle 2017]. Additionally, many of Tesco's suppliers aim at waste reduction through the initiative "Perfectly Imperfect", which spotlights the role of production process. Conscious and well informed customers can buy product of high quality but not a perfect look. Consumer acceptance of suboptimal food before and after purchase increases [Rohm et al. 2017]. Buying non-ideal food brings benefits both to consumers, suppliers and farmers, who can offer more crop to retailers. In Poland the following products are offered as perfectly imperfect: potatoes, carrots, beetroot, apples, avocados, ginger, seasonally pears and paprika [Tesco 2018d].

Food banks cooperating with Tesco and its suppliers publish data regarding results of the collaborative food waste management. From the perspective of this group of NGOs, the following important benefits have been achieved so far: more and more food for charities, getting wider range of products, improvement of the donation process, implementation of donation in all eligible stores, cooperation on legal issues of the mandatory donation, possibility to learn from Tesco about food safety and hygiene, learning PR and marketing of the saved food, e.g. in the Czech Republic, food volume of 2 180 t was re-distributed by 14 food banks, supporting 470 charities and more than 96 000 beneficiaries in 2017 [Ruzickova 2018].

One of the technologies used by Tesco to redistribute surplus food is the FoodCloud platform working well in UK and Ireland. It is helpful to manage the cooperation between stores and different charity institutions and food banks following very simple steps: a store uploads a description of the food that it cannot sale using in-store scanner or smartphone app, local agencies or charities linked to the store through the platform receive a notification that food is available for collection, the organization responds accepting the food and collects it [FoodCloud 2018].

## DISCUSSION

Based on the results of literature review and presented case study, the authors would like to discuss the most important findings regarding the framework of SSCM developed by Carter and Rogers (2008). It is clear, that the food waste reduction is an important problem covering dimensions of the triple bottom line concept, including economic, social and environmental issues, and demanding implementation of the strategy of SSCM. The most desirable strategic purpose is to manage food waste within end-to-end supply chain management. As was mentioned in Table 1, each link of the food value chain might contribute to reduce or even prevent food waste. Facing this problem requires supply chain strategies oriented towards the food waste reduction through integration and synchronization of efforts between engaged parties and stakeholders. Furthermore, the organizational culture should be based on the values and ethics of collaborative relationships. Generally, the collaboration development between companies and their stakeholders is a priority, that should be strongly supported by transparency being driven by the information exchange and communication. The systematic monitoring with the usage of a coherent measuring system of food waste amount is essential and recommended. On the one hand, it can be improved through the implementation of digital technologies, including e.g. mobile technologies or cloud computing. On the other hand, there is a serious problem to report food waste in both research and business practice, because of the lack of common definitions and methodology of its measurement. Transparency includes not only measuring and reporting of food waste, but also active engaging of supply chains' entities and stakeholders to continuously improve business processes.

Tesco, as a global retailer, is constantly developing the strategy of SSCM and waste measurement methodology. The company collaborates with other supply chain partners to prevent food waste and deliver more value for the company's stakeholders. It improves transparency within supply chain by using digital technologies, as the example of the Tesco app illustrated. The company

encourages other retailers to do the same step towards sustainability, because it helps to achieve higher visibility within supply chains and ensure information desirable to meet legal requirements outlined in regulations.

It should be finally underlined that firms must not only manage the short-term causes and effects of the food waste problem, but also the long-term risk factors like e.g. food security, natural resources scarcity or biodiversity loss. In this regards, the development of the SSCM strategies depends highly on the legislative issues. As the examples of Denmark and the UK proved - waste management requires system thinking and responsible involvement of public authorities based on common goals and collaborative actions for food waste reduction. The deliberative coordination and integration of legislative, social and business actions are necessary to achieve food waste reduction successfully.

## CONCLUSIVE REMARKS

Food waste management is an important problem in the global economy as well as in the contemporary business in the light of sustainable development requirements. The presented data and case study of Tesco indicate that the strategy "waste less" is an imperative towards sustainability in food supply chains management. There are many activities that organizations can engage in which positively affect the food waste reduction and achieve economic, environmental and social benefits within the triple bottom line concept. Their implementation is possible and expected on today's market. The development of good and best practices in the food industry based on the framework of SSCM takes into account interrelationships among strategy, culture, transparency and risk management.

Finally, the authors hope that the findings are inspiring and motivating for the supply chains business partners and their stakeholders to search for excellence in food waste reduction to achieve long-term sustainable goals. The intension of the authors is to focus their attention on the development of strategies and practices in food waste management in



further research, especially considering benchmarking and transferability of food reduction initiatives across countries.

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## REDUKCJA MARNOTRAWSTWA ŻYWNOŚCI JAKO WYZWANIE W ZARZĄDZANIU ŁAŃCUCHAMI DOSTAW

**STRESZCZENIE.** Wstęp: Zrównoważony rozwój zyskuje coraz większą uwagę i istotność w działalności przedsiębiorstw, w szczególności w skali globalnej, znajdując odzwierciedlenie w strategiach zarządzania łańcuchami dostaw. Wdrożenie koncepcji zrównoważonego rozwoju w zarządzaniu łańcuchami dostaw żywności stanowi globalne wyzwanie wymagające zastosowania innowacyjnych rozwiązań bazujących na koncepcji triple bottom line w rozwoju najlepszych praktyk biznesowych. W artykule przedstawiono problem marnotrawstwa w łańcuchach dostaw żywności. Warto odnotować, że koszty związane z marnotrawstwem żywności w wymiarze ekonomicznym, społecznym i środowiskowym rosną w dół łańcucha dostaw. Celem artykułu jest zbadanie problemu marnotrawstwa żywności w perspektywie łańcucha dostaw oraz prezentacja, w jaki sposób przedsiębiorstwa mogą sprostać wyzwaniu jego redukcji, w świetle koncepcji zarządzania zrównoważonym łańcuchem dostaw.

**Metody:** Przeprowadzono analizę źródeł wtórnych, w tym publikacji z baz naukowych, raportów międzynarodowych i krajowych instytucji, prezentacji konferencyjnych, materiałów udostępnionych przez przedsiębiorstwa i innych źródeł internetowych. W rezultacie ich analizy, zaprezentowano inicjatywy mające na celu redukcję marnotrawstwa rozwijane przez różne grupy interesariuszy.

**Wyniki:** W artykule scharakteryzowano specyfikę problemu redukcji marnotrawstwa jako wyzwania mającego wiele wymiarów zarówno w rozwoju badań, jak również praktyk biznesowych w zakresie zarządzania łańcuchami dostaw w świetle koncepcji zrównoważonego rozwoju.

**Wnioski:** W świetle wymagań zrównoważonego rozwoju, zarządzanie marnotrawstwem żywności jest ważnym wyzwaniem zarówno w globalnej gospodarce, jak również we współczesnym biznesie. Dotychczas rozwinięto wiele międzynarodowych, krajowych i lokalnych inicjatyw, w tym aktów prawnych i dobrowolnych programów, mających na celu redukcję marnotrawstwa żywności. Podobnie, wdrożono różnorodne praktyki w łańcuchach dostaw, by zredukować marnotrawstwo i wzmacniać efekty zrównoważonego rozwoju. Autorzy wskazują, iż elementy wspierające wdrożenie koncepcji zrównoważonego rozwoju, jak strategia, kultura organizacyjna, transparentność i zarządzanie ryzykiem, są istotne także w rozwoju strategii łańcuchów dostaw żywności. Z pewnością, zarządzanie marnotrawstwem żywności wymaga podejścia systemowego i odpowiedzialnego zaangażowania interesariuszy: w szczególności władz publicznych, organizacji pozarządowych, przedsiębiorstw, jak również konsumentów, bazującego na wspólnych celach i działaniach opartych na współpracy.

**Słowa kluczowe:** łańcuch dostaw żywności, marnotrawstwo żywności, zarządzanie marnotrawstwem, najlepsza praktyka, handel detaliczny, zrównoważony rozwój

## DIE REDUKTION DER VERSCHWENDUNG VON NAHRUNGSMITTELN ALS EINE HERAUSFORDERUNG IM LIEFERKETTENMANAGEMENT

**ZUSAMMENFASSUNG. Einleitung:** Die nachhaltige Entwicklung gewinnt in wirtschaftlicher Betätigung von Unternehmen immer wieder an Beachtung und Relevanz, insbesondere im globalen Ausmaße, indem sie ihre Widerspiegelung in Managementstrategien von Lieferketten findet. Die Einführung der nachhaltigen Entwicklung im Lieferkettenmanagement von Nahrungsmitteln stellt eine globale Herausforderung dar, die die Anwendung von innovativen, auf das Konzept von triple bottom line gestützten Lösungen bei der Implementierung der besten Business-Praktiken erfordert. Im vorliegenden Artikel wurde die Problematik der Verschwendung von Nahrungsmitteln in Lieferketten projiziert. Es sei hier hervorzuheben, dass die mit der Verschwendung von Nahrungsmitteln in wirtschaftlicher, sozialer und ökologischer Hinsicht verbundenen Kosten abwärts der Lieferkette zu wachsen. Das Ziel des Artikels ist es, das Problem der Verschwendung der Nahrungsmittel aus der Perspektive der Lieferkette zu erforschen und die Art und Weise der Reduzierung dieser negativen Erscheinung in den betreffenden, daran interessierten Unternehmen angesichts der Managementkonzepte für die nachhaltige Lieferkette darzustellen.

**Methoden:** Es wurde eine Analyse von Sekundärquellen, darunter Veröffentlichungen in wissenschaftlichen Datenbanken, Berichterstattungen von in- und ausländischen Einrichtungen, Konferenzmaterialien, Materialien aus Unternehmen und andere Internet-Quellen, durchgeführt. Im Ergebnis deren Analyse wurden einige Vorhaben, die eine Reduktion der Nahrungsmittel-Verschwendung zum Ziel haben und von unterschiedlichen Gruppen von Interessenten entwickelt werden.

**Ergebnisse:** Im Rahmen des vorliegenden Artikels charakterisierte man die Eigenart der Problematik der Reduktion der betreffenden Verschwendung als einer Herausforderung, die viele Dimensionen, sowohl in der Entwicklung von Forschungen als auch von Business-Praktiken im Management von Lieferketten angesichts der nachhaltigen Entwicklung, hat.

**Fazit:** Angesichts der Anforderungen hinsichtlich der nachhaltigen Entwicklung stellt das Management der Verschwendung der Nahrungsmittel eine wichtige Herausforderung, sowohl in der globalen Wirtschaft als auch im gegenwärtigen Business, dar. Bisher leitete man viele internationale, inländische und lokale Initiativen, darunter gerichtliche Regelungen und freiwillige Programme ein, die eine weitgehende Reduktion der Verschwendung der Nahrungsmittel zum Ziel hatten. In ähnlicher Weise wurden verschiedenartige Praktiken in die Wege geleitet, um die Verschwendung zu reduzieren und Effekte der nachhaltigen Entwicklung zu stärken. Die Autoren weisen darauf hin, dass die die Einführung des Konzeptes der nachhaltigen Entwicklung unterstützenden Elemente wie: Strategie, organisatorische Kultur, Transparenz und Risikomanagement auch für die Entwicklung von Strategien der Lieferketten von Nahrungsmitteln relevant sind. Sicherlich verlangt das Management der Verschwendung der Nahrungsmittel ein systematisches Herangehen und ein verantwortliches Engagement seitens der Interessenten: insbesondere seitens öffentlicher Behörden, Nichtregierungsorganisationen, Unternehmen sowie der Verbraucher, wobei gemeinsame Ziele und die auf die Zusammenarbeit gestützten Aktivitäten realisiert werden müssten.

**Codewörter:** Lieferkette von Nahrungsmitteln, Verschwendung von Nahrungsmitteln, die beste Praktik, Einzelhandel, nachhaltige Entwicklung

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