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Food Waste Generation in Europe

Reasons, Scale, Impacts, and Prevention Strategies

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The reduction of food waste is seen as an important lever for achieving global food security, freeing up finite resources for other uses, diminishing environmental risks and avoiding financial losses. Although the estimates of global losses along the food chain are based on highly uncertain data, there is no doubt that considerable amounts are at stake. In its roadmap for a resource-efficient Europe, the European Commission has set the target to halve the generation of food waste by 2020. The present paper gives an overview on the scale, reasons, and impacts of food wastage in Europe and addresses prevention measures under discussion. The authors conclude that up to now, mainly soft instruments like awareness campaigns, round tables and information platforms have been implemented, whereas more rigorous approaches like amendments to EU regulations and financial incentives have been circumvented.

Die Reduzierung der Lebensmittelverschwendung gilt als ein wichtiger Hebel zur Sicherstellung der Welternährung, zur Freigabe begrenzter Ressourcen für andere Nutzungen, zur Verringerung von Umweltbelastungen und zur Vermeidung finanzieller Verluste. Auch wenn die Abschätzung der globalen Verluste entlang der Lebensmittelkette auf einer höchst unsicheren Datenbasis beruht, besteht kein Zweifel, dass es um beträchtliche Mengen geht. In ihrer Roadmap für ein ressourceneffizientes Europa hat die Europäische Kommission das Ziel festgelegt, die Lebensmittelabfälle bis zum Jahr 2020 um die Hälfte zu reduzieren. Der vorliegende Artikel gibt einen Überblick über das Aufkommen, die Gründe und Auswirkungen der Lebensmittelverschwendung in Europa und behandelt Vermeidungsmaßnahmen, die in der aktuellen Debatte eine wichtige Rolle spielen. Der Artikel kommt zu dem Ergebnis, dass bislang hauptsächlich „weiche“ Instrumente wie Aufklärungskampagnen,

Runde Tische und Informationsplattformen implementiert wurden, während rigorosere Ansätze wie Änderungen im europäischen Lebensmittelrecht und finanzielle Anreize bis jetzt weitgehend unberücksichtigt blieben.

1 The Relevance of the Food Waste Issue for Global Food Security

The Food and Agriculture Organization of the United Nations estimates that the demand for food will increase by 65 percent until 2050, driven by population growth, accelerated prosperity, and changing consumption patterns (FAO 2012, p. 37). Rising population combined with shifting dietary preferences will exert increasing pressure on global food supply. Thus, yield gains in agriculture are seen as crucial to ensure future food security.

There are identifiable and known opportunities to enhance yields, but there are also several factors having the potential to obstruct progress: The area available for agriculture will be reduced due to environmental degradation, stresses related to global warming, restrictions imposed by nature conservation, and competition with other land use demands such as the production of biofuels, urbanisation, and leisure needs. Increased competition for water resources will reduce the quantities available for irrigation to improve crop yields. Energy costs, particularly for fossil fuels, are likely to rise substantially with growing demand and reduced availability of easily exploitable sources. This will scale up the energy costs for the production of fertilisers and pesticides (IMECHE 2013). Although solutions to these issues may emerge over time, it would be prudent to pursue, in parallel to increased food production, a range of alternative approaches that can help to meet the future demand. One of these approaches is to make better use of the food already available with the current production and to implement measures to reduce wastage (FAO 2013).

It is estimated that roughly one third of the food produced for human nutrition gets lost or wasted globally, which amounts to approximately 1.3 billion tonnes per year (Gustavsson et al. 2011). Food is lost or wasted throughout the entire supply chain, from initial agricultural production up to final household consumption. In low-income

countries food is lost mostly during the early stages of the supply chain as a result of limited harvesting techniques, inadequate storing and cooling facilities, difficult climate conditions, poor infrastructure, insufficient processing, packaging and marketing systems (FAO 2013; Meyer et al. 2013, p. 167). In medium- and high-income countries food losses occur to a significant extent at the consumption stage and are related to a lack of coordination between different actors in the supply chain as well as to consumer behaviours and the fact that people simply can afford to waste food (Grethe et al. 2011). On a per capita basis, much more food is wasted by households in industrialised countries than in developing ones. The FAO estimates that the per capita food waste by consumers in Europe and North America is 95–115 kg/year, while this figure in Sub-Sahara Africa and South/Southeast Asia is only 6–11 kg/year (Gustavsson et al. 2011).

2 About the Career of the Topic “Food Waste”

The topic “food waste” is currently up to date, but not a brand new issue. In the course of time the subject has already been addressed several times, whenever people recognised that food security is at risk. In the 20th century it first appeared during the First World War. Posters of the United States Food Administration called on households for a

Fig. 1: Poster of the awareness campaign “Don’t waste food” initiated by the US Food Administration during the First World War



Source: U.S. Food Administration. Educational Division. Advertising Section, 01/15/1918–01/1919

sparing and responsible handling of food out of loyalty to their own soldiers and the hungry in Europe (Fig. 1). As can be seen from figure 2, the tips for avoiding food waste given a hundred years ago are almost the same as those provided to consumers nowadays. In the following years the topic disappeared from the political agenda due to economic recovery and increasing prosperity.

In the 1970s and 1980s the issue came back. While the solidarity with the fighting troops and the starving people in Europe was the focus during the period of the First World War, the trigger now was the development debate and the hunger in the Third World. At the first World Food Summit in 1974 the reduction of postharvest losses in emerging and developing countries was identified as a key element to combat hunger. Worldwide losses were estimated at 15 percent and in 1974 the target was set to halve this amount by 1985 (Parfitt et al. 2010). To this end, the FAO launched a “Special Action Programme for the Prevention of Food Losses” in 1977. Due to its purely technical nature the programme was not successful (Meyer et al. 2013, p. 168). In the late 1990s international organisations such as the FAO took up the subject again and initiated various activities and forums. However, a monitoring of the progress was almost impossible due to a lack of data.

Since 2002 activities in this field have increased again. The issue has gained further impor-

tance in the context of the current debate on food security for a growing world population against the background of limited agricultural land and increasing meat consumption. It is subject of both research as well as policy initiatives in many European and non-European countries. One possible reason for the current boom may be people’s rising environmental consciousness and changing values in the Western World. Another reason could be increased food prices after the food crisis in 2008 which raised awareness for the unequal access to food. However, it is doubtful whether this will lead to behavioural changes since the economic consequences of shortages are barely significant for rich countries. Although the current debate started bottom-up (in Germany for example the discussion was triggered by the TV documentary “Frisch auf den Müll” and the film “Taste the waste” by Valentin Thurn, see project description in this edition), the issue was later on picked up by governments which organised round tables and discussion platforms in many European countries.

3 Data Availability and Liability

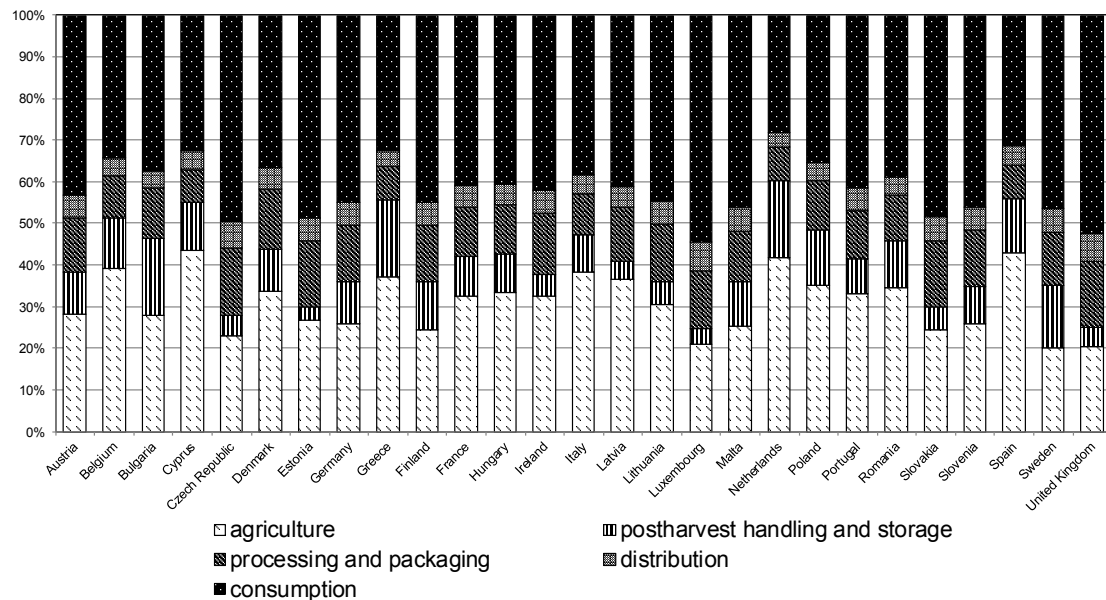
The implementation of prevention measures to combat food waste requires an understanding of the scale and pattern of wastage. This in turn depends on the availability of reliable data on food waste generation. There are two studies dealing with pan-European data: one carried out by the Bio Intelligence Service (BIOIS) on behalf of the European Commission (BIOIS 2010) and the other one carried out by the Swedish Institute for Food and Biotechnology (SIK) commissioned by the FAO (Gustavsson et al. 2011; Gustavsson et al. 2013).

For the BIOIS study a mixture of data was used, compounded of EUROSTAT, national studies and extrapolations by BIOIS. All figures are seen as approximate estimates representing best available data. Nevertheless, one can doubt whether they correctly reflect the true quantity of food waste. EUROSTAT data are submitted by individual Member States, but there is no standardised methodology for the collection and processing of data. Furthermore, EUROSTAT includes both food waste and by-products that are either reused or recycled in the category “animal and vegetal waste”. In contrast to BIOIS,

Fig. 2: Poster of the awareness campaign “Don’t waste food” initiated by the US Food Administration during the First World War



Source: U.S. Food Administration, between 1914–1918

Fig. 3: Share of the different stages of the food chain on total food waste in the EU-27

Source: Own calculations

the SIK study uses FAOSTAT data for food production and utilisation, which feed into a mass flow model. Due to the fact that all stages of the food chain are modelled in a consistent manner, food losses at a specific stage of the food chain directly influence the input data of all succeeding stages. This avoids conflicts resulting from the use of data from different sources. However, also this approach has some restrictions which limit the liability of the results. The percentages of food losses for the individual stages of the supply chain set by SIK are in most cases averages over all European countries and thus do not consider country-specific differences (HLPE 2014, p. 26).

Figure 3 shows the contributions of the single stages of the supply chain to total food waste across the EU-27. The figure is based on calculations carried out by ITAS (Bräutigam et al. 2014) applying FAOSTAT data from 2006 and the methodology provided by SIK.

In accordance with the findings of other studies ITAS calculations indicate that the household sector is one of the most significant contributors to total food waste. In contrast to the prevailing opinion that losses at the stage of primary production in developed countries are negligible, ITAS calculations further show that also the first

step of the food chain makes a substantial contribution to total food waste in Europe.

Besides the pan-European studies, there is a large number of national studies across Europe. Research as well as political activities and social initiatives mainly originate from Northern, Central, and Western European countries, and a few from the South; research activities in Eastern Europe are scarce. National surveys are available for Sweden, Finland, Norway, Denmark, the Netherlands, Germany, France, Austria, Switzerland, Italy, Portugal, Catalonia/Spain, and Greece; the main focus is on food waste generation at household level. The UK has a leading role in Europe by virtue of the Waste and Resources Action Programme (WRAP) which is funded by the British government. On behalf of WRAP different reports on the scale and patterns of food wastage in the UK were published, concerning various stages of the supply chain.

In general, national studies are deemed to be based on more intensive research and thus provide more robust data. However, due to different definitions of the term “food waste”¹, the use of different metrics and the lack of standards for data collection, the comparability is restricted and the results vary greatly even for the same research subject (HLPE 2014, p. 28 et seqq.). For analys-

ing households' wastage behaviours the available studies use a variety of methods like online surveys, interviews, kitchen diaries, waste composition analyses, and calculations based on statistical data on food supply or municipal waste. Some studies cover all kinds of food waste including the non-edible parts of food items, others are focused on "avoidable food waste", that means products that are still fit for human consumption at the time of discarding or products that would have been edible if they had been eaten in time.

In addition to the disparate data stock there are also knowledge gaps regarding the various disposal routes. Food items that are discarded via municipal waste (from households, supermarkets, restaurants) can hardly be traced back and quantified since they are not recorded separately. Alternative disposal routes of households like composting, feeding to animals, and disposal via sewer are difficult to assess. Not all stages of the food chain are equally well studied. There is quite comprehensive research on household food waste for a variety of countries, while data on food waste generated in agricultural production, manufacturing, wholesale and retail as well as in the catering industry are scarce and highly controversial.

4 Reasons That Lead to Food Being Wasted

Food losses can arise at every stage of the food supply chain. On the level of agricultural production, losses in industrialised countries occur due to bad weather conditions, sorting out because of rigorous quality standards, and market prices that do not justify the expenses of harvesting. In food manufacturing and processing, losses result from washing, peeling, slicing and boiling, during process interruptions, or when products are sorted out as not suitable. In distribution (wholesale and retail), losses emerge due to packaging defects, non-compliance with food safety requirements, exceeding of expiry dates, inadequate stock management, logistical constraints, and marketing strategies. At the stage of final consumption, losses arise due to consumer preferences, wrong purchase planning, incorrect interpretation of expiry dates, inadequate storage, cooking of oversized meals, and lack of knowledge about how to re-

use leftovers (HLPE 2014, p. 35 et seq.; IMECHE 2013; BCFN 2012).

Apart from these everyday causes for food losses, there are also societal trends which promote the wastage of food. In the last decades the food chain has become longer and progressively complex due to market globalisation and increasing migration of population from rural to urban areas. This includes larger distances between producers and consumers, longer cold chains, and more intermediaries. Consumer expectations regarding the variety of choices and the growing demand for meat, fruit, vegetables, and other easily perishable products further enhance the risk of losses (BCFN 2012). The behaviour of city dwellers concerning food is significantly different from that of country dwellers. Based on waste analyses, Obersteiner and Schneider (2006) found that the amount of food in the garbage bin of city dwellers is much higher than in rural areas.

Several studies reveal that the wastage of food tends to augment with rising prosperity. Even in countries with a low to medium average income the upper classes have wasteful lifestyles concerning food (HLPE 2014, p. 47; Parfitt et al. 2010). In addition, the world market prices for food constantly decreased over the last century and have only slightly increased since the first decades of the new century. As a consequence, the expenses for food represent an ever shrinking part of European families' spending. While an average household at the beginning of the 20th century had to spend more than half of its disposable income for food, the share is now between less than 10 percent (Luxembourg, Austria, United Kingdom) and up to 20 percent (Estonia, Latvia) across EU-27 (Gerstberger/Yaneva 2013).

The rising number of single households increases the amount of food being wasted. Single households show the highest waste rates per capita, since an efficient supply of small households is more challenging compared to larger households (Quested et al. 2013; Koivupuro et al. 2012). Young people produce more food waste than older people. Reasons are that they are less experienced in the planning and preparation of meals and eat less often at home with the possible consequence that the groceries purchased will not be consumed in time (Göbel et al. 2012; BIO-

IS 2010; Cox/Downing 2007). In contrast to the immediate post-war generation, younger people were not necessarily trained to a high regard for food and did not experience austerity and food rationing. It can be assumed that the young generation of today will continue to retain the same attitudes to food also in their older ages. Thus, the problem of food wastage is likely to become worse in the future (Parfitt et al. 2010).

A third trend which has an impact on the handling of food is the increasing employment of women. Schneider (2008) concluded from waste analyses and surveys that those persons with a full time job dispose of more food. Multiple burdens due to work and family reduce the time available for shopping and make daily food purchases more difficult. As a result, larger quantities are bought which have to last the whole week, increasing the probability that certain food items will be disposed of unused. Different studies attest that the amount of food waste depends on shopping frequency. Households that purchase food more often usually produce less food waste than households that purchase food more seldom (Williams et al. 2012; Lyndhurst et al. 2007).

5 Impacts of Food Waste Generation

Given the fact that over one billion people suffer from malnutrition, wasting food is primarily seen as an ethical issue. Although the estimates of global losses along the food chain are fraught with considerable uncertainties, there is no doubt that significant quantities are at stake that would be sufficient, seen purely mathematically, to curb global hunger (Kreutzberger/Thurn 2011). Critics of such simple extrapolations argue that our unused food cannot be made available to the hungry. Thus, a reduction in the share of discarded food at one side will not automatically lead to equivalent supply on the other side. Critics further emphasise that people in poor countries suffer from hunger because they either do not produce food in sufficient quantity and quality or their purchasing power does not allow buying foodstuffs. Reducing food waste in rich countries would hardly modify these two roots of malnutrition (HLPE 2014, p. 35 et seq.; Koester 2012). This reasoning is well founded. Nevertheless, it can be expected

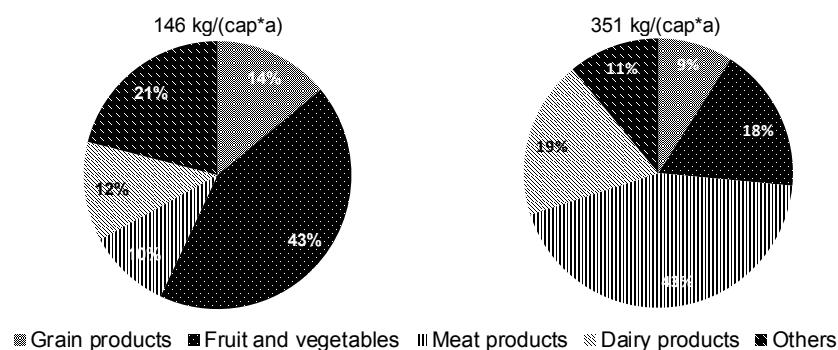
that the careless handling of food in rich countries increases the demand for food, which leads to higher prices on the world market. Higher food prices would further weaken the purchasing power of poor people in developing countries.

Wasting food means losing not only life-supporting nutrition, but also scarce resources like land and water. Calculations of Noleppa and von Witzke (2012) have shown that already a halving of the avoidable food losses in Germany might save 1.2 million hectares of agricultural land. The German land footprint for nutrition would be reduced from 2,300 m² to 2,000 m² per capita, corresponding to a decrease of about 13 percent. By importing agricultural commodities from emerging and developing countries to Europe, production sites are taken abroad. As the demand for agricultural products is continuously growing and the improvement of land productivity is limited, land conversions occur in terms of deforestation of tropical rain forests, crop cultivation instead of natural grasslands, and extension of farmland at the expense of protected areas. This type of land conversion is accompanied by the release of CO₂ which was previously bound as carbon in soils and biomass.

Similarly to the land footprint, the prevention of food losses would reduce the water footprint. According to a study of the WWF (Sonnenberg et al. 2009) the total water consumption in Germany amounts to 5,288 liters per capita and day, of which 3,904 liters are consumed in the form of agricultural goods. Only 41 percent of the water which is used for the growing of arable crops comes from domestic sources, whereas 59 percent are imported. That means the local water resources are saved at the expense of the producer countries. This is particularly problematic as a certain share of imported products comes from arid areas with unfavourable hydrological conditions. Artificial irrigation is used to an increasing extent for the cultivation of crops in arid areas. This practice stresses natural water resources and provokes conflicts with other water users.

Complementary to the saving of resources, an efficient handling of food would reduce agricultural emissions. According to estimates of BIOIS (2010), food wastage in Europe is responsible for the release of at least 170 million tonnes of CO₂-eq which is broadly equivalent to 1.9 tonnes of CO₂-

Fig. 4: Annual per capita volume of total food waste (left), broken down to food groups, and the corresponding carbon footprint (right), including the upstream steps of the food supply chain²



Source: Göbel et al. 2012, p. 105

eq per ton of food waste. These calculations include all stages of the life cycle of a product; from cultivation through harvesting, processing, packaging, transportation, storage, and sale up to household consumption. Each stage of the life cycle adds its own emissions in terms of greenhouse gas emissions, acidification, and photochemical oxidation (BIOIS 2013). Thus, one ton of food waste in the household (i.e. at the last stage of the chain) causes much higher environmental costs than one ton of food waste in the manufacturing sector.

The environmental impacts of food wastage will be further exacerbated by future population growth combined with changing dietary habits. Due to increasing prosperity in developing countries, the per capita caloric intake from meat consumption is set to rise by 40 percent by mid-century (IMECHE 2013). The production of animal-based products (meat, dairy products) requires significantly more resources than the production of grain-based foodstuff. According to estimates of the FAO, the total global amount of food wastage occupied almost 1.4 billion hectares in 2007, equal to about 28 percent of the world's farmland. The major contributions to land occupation came through meat and milk (78 percent), whereas their share in total food waste was only 11 percent globally (FAO 2013).

The same relation applies to the carbon footprint of food. Figure 4 illustrates the carbon footprint of different food groups along the food chain, referring to annual per capita food waste in Germany. The left pie chart shows that fruit

and vegetables contribute most to the total amount of food waste in Germany. Although meat products are wasted least, the carbon footprint is almost three times higher than the one of fruit and vegetables (right pie chart). Koivupuro et al. (2012) came to similar results for Finland.

In addition to negative environmental impacts, food wastage causes significant monetary losses. Available data on economic losses primarily refer to households.

The British WRAP study "Waste arisings in the supply of food and drink to households" (Lee/Willis 2010) estimates that the households in the UK throw away 5.3 million tonnes of food per year, corresponding to an economic value of £12 million (approximately €13.79 million)³. For Germany it was calculated that 21 percent of the food purchases are discarded by households (6.6 million tons per year). This is equivalent to 80 kg of food waste per person and year with an economic value of €310 (Cofresco 2011). The estimates of the costs are hardly comparable because there are significant differences in survey methods, underlying food prices, and reference values. Nevertheless, the figures illustrate that food waste is accompanied by considerable economic losses for the individual consumer. Similar to the ecological costs, the economic losses are highest for meat products due to higher producer prices, even though meat products are wasted to a far less extent (FAO 2013; Qusted/Johnson 2009).

6 Assessing Prevention Measures

Considering the extent of losses and the associated social, environmental, and economic impacts, the reduction of food wastage is seen as crucial to improve global food security. In the current national and international debate a wide range of approaches to encourage the different players along the supply chain to a responsible handling of food has been submitted and, partially, already

implemented (an overview is provided by Priefer et al. 2013, p. 91 et seqq.; Reisch et al. 2013). The following measures are deemed to be particularly useful and capable to achieve long-term gains.

All available studies agree on the fact that information and education are prominent measures to influence consumers' behaviour (inter alia: Lipinski et al. 2013; Hanss/Böhm 2013; Quested/Parry 2011). Awareness campaigns like the British "Love food hate waste", the French "Qui jette un œuf, jette un bœuf" and the German "Zu gut für die Tonne", to name just a few, aim to draw consumers' attention to the issue of food wastage and to increase their regard for food. They instruct consumers on the proper handling of food by providing tips on shopping, shelf life, storage, preparation, and recovery of leftovers. Awareness campaigns should be tailored to different target groups, in close cooperation with retailers and the hospitality sector, using various media. To be efficient, consumer education has to start at infancy. Thus, all Member State should include the topic of a sparing use and careful handling of food into school curricula (BIOIS 2011).

Consensus also exists that the lack of reliable data hampers a successful fight against food waste. To overcome this obstacle, an agreed and binding definition of the term "food waste", which differentiates between avoidable and unavoidable food waste and by-products, should be provided within the EUROSTAT framework. Furthermore, the methods used by the Member States for the collection and calculation of data on food waste generation, should be standardised. In order to facilitate monitoring, the separate collection of food waste generated at all stages of the food supply chain should be introduced, whether voluntary or mandatory. It is among the tasks of the ongoing European FUSIONS project to elaborate recommendations on this issue (<http://www.eu-fusions.org/>).

Legal requirements for the prevention of risks to consumers' life and health, which are anchored in various EU regulations, may conflict with the ambition to avoid food waste. Strict norms for the tolerable contamination of food, Maximum Residual Levels for pesticides and veterinarian medicines as well as hygienic rules concerning the

packaging and storage of easily perishing goods are seen as significant drivers promoting the discarding of edible food (Marthinsen et al. 2012; Waarts et al. 2011). Thus, the current regime of food safety regulations should be reviewed in order to identify provisions that are not mandatory to protect human life, but lead to unnecessary food waste. Further research is required to decide where limits may be revised without decreasing food safety. The current system of food labelling is regarded as another legal barrier to a responsible handling of food. Consumer surveys in various Member States revealed that there is considerable confusion about expiry dates and the differences between "best before" and "use by" dates. Thus, the revision of existing regulations on food labelling should be considered in order to improve the definiteness and visual presentation of expiry dates. In addition, the European legislator should think about the setting of new best before dates according to the true shelf life of products. The initiative of the Netherlands and Sweden (FAZ 2014) to abolish the expiration dates for stable food is a first step in this direction.

There is broad consensus that the careless handling of food is not least a consequence of its low market value. Thus, many experts consider economic instruments as particularly promising to recuperate consumers' regard for food. Against this background, EU Member States should review their tax regulations in order to remove all incentives that may encourage the wastage of food. Some experts like the German Scientific Advisory Board on Agricultural Policy (Bauhus et al. 2012) call for the elimination of the reduced Value-Added Tax rate (VAT rate) on groceries representing an indirect subsidisation of food. Any social hardships, caused by tax harmonisation, should be offset by targeted governmental income support, which could be financed from additional tax revenue. Other experts, mainly from environmental groups, suggest introducing different VAT rates according to the environmental impacts of food items. Higher taxes on meat, dairy products, and convenience food could be compensated by lower taxes on fruit and vegetables.

Economic incentives to reduce food waste in the business sector are also discussed. Taxes and fees on waste treatment like landfill or incinera-

tion taxes escalate the total costs of waste handling and thus they can stimulate waste prevention, although their original purpose was to move waste away from landfills towards recovery and recycling (EEA 2013; BIOIS 2012). When using taxes on waste treatment as a tool to avoid food waste, certain requirements have to be met. Firstly, a separate collection of food waste, both in households and in commercial enterprises (mainly in the retail and hospitality sector) should be introduced mandatorily. Secondly, the tax rate must be high enough to create a sufficiently strong incentive for waste minimisation. Thirdly, the existing provisions of financial support for energy from waste in Europe should be revised in order to identify incentives that run contrary to the objective of food waste prevention. It may lead to conflicting incentives, if legislators would on the one hand impose high taxes for the treatment of food waste and on the other hand subsidise the production of energy from waste (Priefer et al. 2013, p. 132).

Even if all possibilities to combat food waste would be exploited, a certain amount of surplus food would still persist. Food redistribution programmes organised by retailers and caterers are a proven tool for the efficient use of this surplus to the benefit of economically deprived people. It should be checked if the European food law needs an amendment in line with the US American “Good Samaritan Act” in order to limit the liability of donors and charity organisations that redistribute surplus food. Without any amendment to European food law, they may be driven to discard non-marketable goods in order to avoid liability (Planchenstainer 2013; Lipinski et al. 2013).

7 Outlook

Most of the prevention measures implemented by governments up to now are soft instruments like awareness campaigns, round tables and information platforms. This is, firstly, because such measures are easy to implement and, secondly, because it is obvious that the exchange of information can contribute considerably to combat food wastage. Estimations by WRAP have shown that avoidable food waste in British households was reduced by 18 percent within five years primarily due to public awareness campaigns (Quested/

Parry 2011). More rigorous approaches like the abolishment of the reduced VAT rate on groceries or amendments to EU regulations on food safety have not yet been realised because it is expected that they would evoke protest by citizens and the relevant stakeholders. Apart from a lack of acceptance, little is known about their effectiveness to reduce food waste. In addition to measures which are exclusively designed on food waste reduction also a change of social framework conditions can help to meet the objective. This includes an improved compatibility of career and family, marketing systems which establish a closer link between producers and consumers, and a change of dietary patterns. Although a reduced consumption of meat products would not scale down the total amount of food waste, it would considerably decrease the environmental impacts.

Notes

- 1) Up to now, there has been no commonly accepted definition of the terms “food loss” and “food waste”, neither in European and national legal frameworks nor in the scientific literature. The available studies are working mostly with their own definitions narrowed down to their field of investigation. The main differences arise in the question where the border between “avoidable” and “unavoidable” food waste runs, whether non-edible parts of foodstuff belong to food waste and whether food that was originally dedicated to human consumption, but gets out of the supply chain, is considered as food waste, even if it is brought to a non-food use.
- 2) The calculations of Göbel et al. 2012 are based on data compiled by MTT Agrifood Research Finland and data from the Statistical Yearbook 2011 of the German Federal Ministry of Agriculture. The proportion of food waste for different product groups was adopted from the WWF study (Noleppa/von Witzke 2012). The category “others” refers to data on fish, eggs, oils and fats, sugar, and confectionery.
- 3) Exchange rate on 01/05/10: £ 1 corresponds to € 1.1490.

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