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Food Waste Along the Food Chain

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Comments are welcome and may be sent to tad.contact@oecd.org.

Abstract

FOOD WASTE ALONG THE FOOD CHAIN

by

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Reducing food losses and food waste is attracting growing public attention at the international, regional, and national levels, and is widely acknowledged to contribute to abating interlinked sustainability challenges such as food security, climate change, and water shortage. However, the pattern and scale of food waste throughout the supply chain remains poorly understood, despite growing media coverage and public concerns in recent years.

This paper takes stock of available data on food waste and explores policies related to food waste in OECD countries.

Keywords: agricultural losses, food loss, food waste, food waste reduction, grain storage, municipal solid waste, food value chain, data, policy information

JEL classification: Q180, Q530, Q580

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Executive Summary

This paper is one part of a response to increased awareness of, and interest in, reducing unnecessary waste in the food system. Its aim is to take stock of food waste statistics that currently exist and to explore existing policies related to food waste.

Data and policy information were collected from public sources and subsequently validated through bilateral contacts with experts in order to improve the information base. This exercise helped identify a number of methodological issues, the most important being the absence of a commonly agreed definition of food waste.

The Fourth OECD Food Chain Analysis Network Meeting (20-21 June 2013) offered an opportunity to discuss and improve the data and identify policy issues relevant to food waste. Bringing together stakeholders from the food sector, the Network helped to validate available data on food waste and offered a platform for dialogue between policy communities, business, academia and others with an interest in reducing food waste. Actions by both the private and public sectors require a better understanding of the magnitude of food waste and of its causes.

Data availability on food waste and loss generated at household level is relatively good across OECD countries and time. Very little is known about food waste in the primary, the manufacturing and related services sectors (covering both distribution and out-of-home eating).

Legal frameworks covering food waste exist in most countries. However, these frameworks address waste management in general and in most cases are not specifically adapted to food. As food waste attracts increased public attention, increased regulatory activity to address this issue might be expected.

When emphasis shifts from waste management to improving the overall resource and economic efficiency of food production and use, there is greater scope to widen the network of agencies and stakeholders involved. This includes involving the private sector that directly influences the amount of discarded food prior to household consumption, including through voluntary standards.

While there are many regional and international initiatives that endeavour to define, measure and reduce food waste is a positive indication of the momentum around food waste prevention and reduction, close coordination across initiatives is necessary to avoid yielding multiple and incompatible outcomes, and instead contribute to a more coherent and evidence based understanding.

1. Introduction

Reducing food waste[1] and increasing resource use efficiency in the food chain has received growing attention at the international, regional and national levels. In 2010, Ministers of Agriculture requested the OECD to explore ways to reduce food waste in the food chain and in 2011 the OECD Green Growth Strategy identified reducing food waste as a means to increase the available food supply and to reduce pressures on resources and the climate.

This paper responds to this interest; it takes stock of available data on food waste and explores policies related to food waste in OECD countries. Secondary information sources were supplemented by a one-time survey questionnaire on food waste.[2] Furthermore, views from public and private sector representatives engaged in reducing food waste throughout the food supply chain were solicited in a dialogue on food waste hosted by the OECD Food Chain Analysis Network in June 2013.

The paper is structured as follows. Section 2 provides an overview of global and regional food waste estimates. Section 3 provides the preliminary OECD food waste dataset. Section 4 provides an overview of the policy related to food waste. Section 5 concludes.

Why reduce food waste?

Food waste is seen as an obstacle to achieving food and nutrition security for the millions of undernourished around the world. Furthermore most societies attach an ethical and moral dimension to food waste. Although, reducing food waste in medium and high income countries may not directly help tackle food insecurity in low income countries, it reduces competition on limited water, land and biodiversity resources; making these resources available for other uses. Edible food that would otherwise be wasted could be redistributed to food insecure populations in local communities in medium and high income countries, and in low income countries alike.

The consumption of water resources and land used for the production of uneaten food remains a challenge to the environment. Food waste is also a major component of waste going into municipal landfills, a significant source of methane. According to the FAO report in 2013, food that is produced but not eaten is responsible for adding 3.3 billion tons of greenhouse gases to the planet's atmosphere that makes up food wastage as the third top emitter after the United States and China (FAO, 2013).

A third incentive is economic. Reducing food waste can increase the efficiency of the food supply chain and bring economic benefits, including lower costs for businesses and lower prices for consumers. Business examples exist where innovative production

1 In the absence of a consensus on the distinction between food waste, food wastage or food loss, this document uses the term food waste unless specifically reporting the other designations. More detailed information on issues relating to definitions is provided in Section 2 and Box 1 of this document.

2 An *ad hoc* questionnaire was added to the Annual Quality Assurance exercise of the "OECD reference data for environmental indicators", which was carried out under the auspices of the OECD Working Party on Environmental Information (WPEI) of the Environment Policy Committee in October 2012.

methods turned what would have otherwise been wasted into inputs to new products.[3] In other cases, the food manufacturing industry or the retail sector is prepared to pay for the removal of surplus food that would be otherwise wasted. New businesses are created that collect, handle and deliver this surplus to food banks.[4] Social innovation plays and important role in initiating such social economy businesses.

The importance of reducing food waste in order to increase the efficiency of the food supply chain from the social, environmental and economic points of view was repeatedly raised by participants in the OECD Food Chain Analysis Network in June 2013.[5]

Attempts have been made to analyse the effects of reducing food waste using a partial equilibrium model (Rutten, 2013).[6] Standard economic theory suggests that reducing food waste could increase supply and shift the supply curve right, lowering prices and increasing consumption overall. Alternatively, reducing food waste could decrease demand and consumption, thereby decreasing quantities and prices. Very little is known about the impact of changes in levels of food waste on welfare gain or loss or on the magnitude of the impact of price levels on food waste. The task becomes more complex, and is ultimately an empirical matter, as evaluating the impacts on welfare gain or loss is significantly influenced by data availability on food waste, elasticity of demand and supply, and trade-off between consumers, producers, food commodities and others.

Rising world population, combined with increasing incomes and shifting dietary preferences continue to exert pressure to increase global food supply. There is a potential to provide more food by eliminating waste, while simultaneously freeing up land, energy and water resources for other uses. Finding these opportunities, however, requires understanding the pattern and scale of food waste throughout the supply chain, the incentives and disincentives directed to businesses and consumers, and the policy and regulatory framework on food waste.

2. Global and regional food waste estimates

What is food waste?

To date there are no agreed definitions of "food waste", "food wastage" or "food loss" (Box 1). "Food losses can be qualitative, such as reduced nutrient value and undesirable changes to taste, texture, or colour, or quantitative as measured by decreased weight or volume" (Buzby and Hyman, 2012). In some cases, food waste is used as a subset of food loss, or *vice versa*.

3 For example, Provalor is a Dutch firm that has patented industrial processes that extract pulp, colouring and juice from vegetable rejects. These are used either directly (juice or soups) or as input to the food industry (colouring and vegetal thickeners).

4 One example of such a business is Allwin, a business operating in Sweden on private funds. It collects food that would otherwise be discarded from retailers and the food industry and provides it to non-profit organisations that distribute food to the needy.

5 The programme of the 4th Meeting of the Food Chain Analysis Network is available on the meeting website together with material presented at the meeting (http://www.oecd.org/site/agrfcn/4thmeeting20-21june2013.htm).

6 More recently the OECD-FAO Aglink-Cosimo model has been applied to assess market effects of reducing food loss and waste, see TAD/CA/APM/WP(2014)35/FINAL.

Box 1. Discussions on a possible reference definition of food loss and food waste

Finding a commonly agreed definition is key to measuring food waste in a consistent way across sectors and countries. A number of initiatives are currently on-going that attempt to achieve consensus on such a definition, some from different perspectives and with different foci. While the multiplicity of these initiatives is a positive indication of the momentum on food waste prevention and reduction they should not compromise future by yielding incompatible results.

As part of the Save Food initiative, the FAO has endeavoured to develop a "reference" definition for food waste and food loss. The definitions below have been circulated as possible starting points:

Food Loss and Waste refer to the decrease in mass (quantitative) or nutritional value (qualitative) of food - edible parts - throughout the supply chain that was intended for human consumption. Food that was originally meant for human consumption but which gets out the human food chain is considered as food loss or waste, even if it is then directed to a non-food use (feed, bioenergy).

Food Loss refers to food that during its process in the food supply chain gets spilled, spoilt or otherwise lost, or incurs reduction of quality and value, before it reaches its final product stage. Food loss typically takes place at production, postharvest, processing and distribution stages in the food supply chain.

Food Waste refers to food that completes the food supply chain up to a final product, of good quality and fit for consumption, but still does not get consumed because it is discarded, whether or not after it is left to spoil. Food waste typically (but not exclusively) takes place at retail and consumption stages in the food supply chain."

In a collaborative initiative called "Creating a sustainable food future" (Lipinski et al.), the UNEP together with the World Resources Institute have used food loss as "food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting, or otherwise gets lost before it reaches the consumer" while food waste refers to "food that is of good quality and fit for human consumption but that does not get consumed because it is discarded - either before or after it spoils".

One dimension of the EU-wide FUSIONS[7] initiative currently underway is to assess food waste quantities and trends in food waste prevention and reduction within the EU27 by establishing a standard approach on definitions of food waste, including the preparation of a handbook.

There is no clear consensus on some of the concepts used in these definitions. A few examples are described below:

- The distinction between food loss and food waste has been used to characterise withdrawal of food from the supply chain that occurs either at or before final consumption, or alternatively, allows a distinction between what is considered as evitable or inevitable withdrawal.
- "Edible" food is not a concept that applies uniformly through time and across countries. Business practices, private standards, regulatory and food safety frameworks differ across countries and influence food waste generation in varying degrees. Furthermore, changes in food consumption behaviour and innovation in production processes contribute to moving the border line separating edible and inedible food.

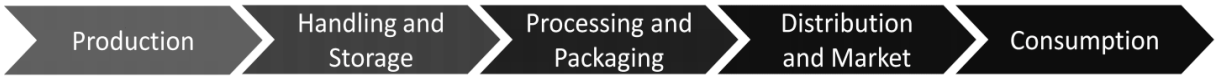
7 FUSIONS (Food Use for Social Innovation by Optimising Waste Prevention Strategies) aims to achieving a more resource efficient Europe by significantly reducing food waste. It has established a European Multi-Stakeholder Platform to generate a shared vision and strategy to prevent food loss and waste across the whole supply chain through social innovation. The project runs for four years, from August 2012 to July 2016. It is funded by the European Commission Framework Programme 7 (as described in http://www.eu-fusions.org/)

- Although most commodities are destined either to food or to other use at production, it may be the case that the final use of some agricultural commodities be determined at the end of the production process and in light of market conditions. This is the case for example for some commodities that can be used indifferently as input to feed or biofuels.

In cases where health and diet are the focus, food intake is preferred to food consumption; this is relevant to food waste in so far as food intake in excess of reference levels is considered as waste. However estimation methods of food intake and food consumption serve different purposes, generally related to public health and diet. This is the reason why results cannot be used in the context of food waste.

The causes of food loss and waste and their occurrence along the value chain are also discussed in a collaborative piece by the UNEP and WRI (Lipinski et al., 2013).

Figure 1. Food loss and waste along the value chain



Definition				
During or immediately after harvesting on the farm	After produce leaves the farm for handling, storage, and transport	During industrial or domestic processing and/or packaging	During distribution to markets, including losses at wholesale and retail markets	Losses in the home or business of the consumer, including restaurants/caterers
Includes				
Fruits bruised during picking or threshing	Edible food eaten by pests	Milk spilled during pasteurization and processing	Edible produce sorted out due to quality	Edible products sorted out due to quality
Crops sorted out post-harvest for not meeting quality standards	Edible produce degraded by fungus or disease	Edible fruit or grains sorted out as not suitable for processing	Edible products expired before being purchased	Food purchased but not eaten
Crops left behind in fields due to poor mechanical harvesting or sharp drops in prices	Livestock death during transport to slaughter or not accepted for slaughter	Livestock trimming during slaughtering and industrial processing	Edible products spilled or damaged in market	Food cooked but not eaten

Source: Based on Lipinski et al., 2013.

Food waste and loss are sometimes classified into two broad categories – avoidable and unavoidable. For industry, avoidable food waste includes damaged stocks and products that have not been used. Food waste occurs for a number of reasons, including over-purchasing, poor preparation, and inadequate storage, and excessive serving sizes. While avoidable food waste could be prevented (for example through better planning), unavoidable food waste consists of unsellable or inedible food. Available technology and economic efficiency also contribute to determine the distinction between avoidable and unavoidable food waste. Examples of unavoidable food waste are fats, bones and skins of meat, eggshells, and fruit and vegetable peels (Table 1). However, usage and meaning of the terms avoidable, unavoidable, edible and inedible are subject to interpretation and are not universally accepted. Furthermore these notions evolve through time, cultures and culinary habits.

Table 1. Illustration of edible-avoidable and inedible-unavoidable household food waste
An example used in the United Kingdom

Edible food waste	
Avoidable food waste	Food that is thrown away that was, at some point prior to disposal, edible (e.g. slices of bread, apples, meat)
Inedible food waste	
Unavoidable food waste	Waste arising from food preparation that is not, or has not been, edible under normal circumstances (e.g. bones, egg shells, pineapple skins)

Source: WRAP (2009) Household Food and Drink Waste in the United Kingdom.

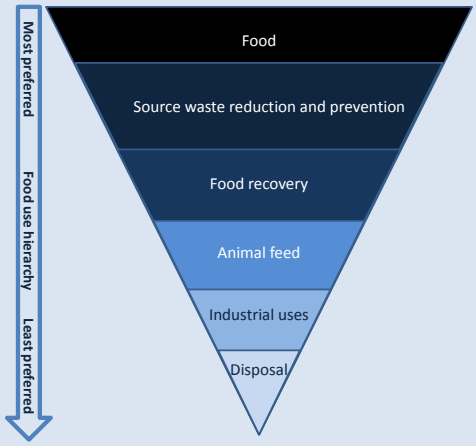
In addition to the various definitions, different methodologies and activities in the food chain add to the complexity of quantifying food waste. For example, food waste can be expressed in caloric equivalents, weight, volume or value, all depending on the specific question to be addressed. When different sectors of the food chain are combined, it is extremely difficult to compare data due to differences in scope. For instance, one study (Statistics Canada, 2009) uses a caloric evaluation of food waste for the food chain as a whole, while another study (Buzby et al., 2011), limits the scope to the retail and consumer levels, and evaluates the amount and value of specific commodities.

The differences are often caused by the fact that information is collected and reported by different institutions. Waste management in the food chain involves stakeholders from many areas (Box2). These can be different government areas (agriculture and food safety, consumer health, waste management, environment, etc.), the private sector (food industry and waste processors), international and regional organisations, academia, and non-governmental organisations. Each institution has its own data collection objectives and priorities and thus different methodologies and targets for estimating food waste and loss.

Box 2. The food recovery hierarchy

The waste hierarchy represents a classification of waste management options in increasing order of their environmental impact, starting from the least negative environmental impact at the top of the pyramid, These include; source reduction, feeding hungry people (food banks), animal feed, industrial uses, composting, and discard through incineration or landfill with no recovery of materials or energy. The latter are the most negative options from the economic and environmental point of view (Figure 2). Energy recovery receives growing attention; this is the case for anaerobic digestion of wet biomass waste including food waste in countries such as the United Kingdom and Japan. The complexity of food waste data is partially driven by different type of data generated for different waste management issues which involve different stakeholders.

Figure 2. Food use hierarchy



Source reduction and prevention	Preventing food waste before it is created
Food recovery	Feeding hungry people Donating fresh, wholesome food to those in need
Animal feed	Feeding safe, fresh scraps to animals like pig farms
Industrial uses	Rendering fats, oils, and grease and turning it into products or energy
Disposal	End-of-life treatment with no valorisation.

Source: Adapted from multiple sources including United States' EPA

Quantifying food waste at aggregated global and regional levels

Discussions of food waste have been given significant visibility since the FAO published estimates in 2011 that about 1.3 billion tons or a third of all food produced for human consumption is wasted. The report quantifies food waste along the supply chain at global and regional level. The report finds that whereas food is wasted mostly during the earlier stages of the supply chain, such as production and processing in low-income countries, more food is wasted in the later stage of supply chain, such as consumption in medium and high income countries. On a per-capita basis, consumers in Europe and North-America waste food between 95 and 115 kg/year, while this figure in Sub-Saharan Africa and South/Southeast Asia ranges between 6 and 11 kg/year (FAO, 2011).

To calculate these estimates, the FAO study classifies the regional groups into two income groups. Loss coefficients, estimated on the basis of existing data and literature or based on assumptions when data gaps were to be filled, are then assigned to each country group, by commodity group (cereals; roots and tubers; fruit and vegetables; oilseeds and pulses; meat; fish and seafood; milk; and eggs), and by activity in the food supply chain (agricultural production; postharvest handling and storage; processing and packaging; distribution; and consumption). The amount of food waste is then estimated by applying these coefficients to production volumes (FAO, 2011).

The report suggests that the causes of food waste and loss in low-income countries are mainly connected to insufficient farmers training, to the lack of technology and infrastructural limitations such as harvesting techniques, storage and cooling facilities, transportation, and packaging and marketing systems. In medium and high income countries, by contrast, lack of coordination between different actors in the supply chain, as well as consumer behaviour, are the main causes of food waste. Nonetheless, both in low-income countries and in medium and high income countries food is wasted throughout the supply chain from initial agricultural production to the final consumer.

The method was subsequently expanded to estimate the environmental impact of food waste, while disaggregating further the countries into seven groupings and the FAO published in 2013 a report "Food wastage footprint: Impacts on natural resources" that analyses the impacts of global wastage from an environmental perspective. Key findings of the report include that the direct economic cost of food wastage of agricultural products (excluding fish and seafood) is about USD 650 billion, equivalent to the GDP of Switzerland. (FAO, 2013)

The EC Preparatory Study on Food Waste across the EU27 which was led by the Bio Intelligence Service is another important attempt to estimate food waste at regional level. The report quantifies food waste along the supply chain in 27 EU member countries, while excluding the agricultural sector from its scope. Unlike the FAO studies, the study was based on the quantification of food waste for each country and used Eurostat data relevant to food waste. The report estimated the generation of food waste in the EU at around 89 million tons per year or 179 kg per capita, in which households are the largest contributors, at 43 per cent of the total (Table 2). However the exclusion of the agricultural sector altogether, combined with the lack of reliable information from the manufacturing industry and food services sectors are important limitations to the results (EC, 2011).

Table 2. Waste amounts in EU27

Sector	Mt of food waste/year	Kg per capita
Manufacturing	35	70
Households	38	76
Retail/Wholesale	4	8
Food service	12	25
Total	89	179

Source: Preparatory Study on Food across the EU27 (EC, 2011)

The current Eurostat data collection and reporting covers waste generation and management. In the classification used since 2010 and reported on the Eurostat website, none of the several categories of waste that could relate to food waste represent food waste *per se*, as the dataset is not intended to this use.

National EU member states statistics are another source of data on food waste. Definitions of food waste and methods of calculation vary across EU member states and these countries may use different methodologies to collect and publish food waste data. National waste statistics of EU member states sometimes include other vegetal waste or tobacco, which may cause significant discrepancies if used as a proxy for food waste.

Furthermore data is lacking for many member states and sectors in the categories that could help inform food waste. These differences are additional limitations to EU cross country comparisons or aggregation.

3. The OECD food waste dataset

The scope of the OECD work covers all activities in the food supply chain in its entirety, from farm to fork. When available, food waste data, classified according to the UN International Standard Industrial Classification system, or other compatible systems such as the Statistical Classification of Economic Activities in the European Community, were used to collect and compare data. This broad approach was adopted in order to include all available information.

Two separate paths for data collection were followed. Data was collected from government and academic websites to capture available quantification of food waste. Simultaneously and building on an existing survey, an *ad hoc* request for information on food waste was sent to the members of the OECD Working Party on Environmental Information (WPEI) of the Environment Policy Committee. The *ad hoc* request covered simple questions on the tonnage of food waste generated and on the treatment and disposal method. Eighteen countries responded to the survey, many pointing to existing case studies or research, some to report lack of information and on-going efforts to quantify food waste with results expected in the medium term. The food chain analysis network meeting discussed data issues and allowed to improve the information base.

With regard to the early stages of the food supply chain, it must be noted that experts are sceptical of any national aggregate data that would quantify food waste on the farm on the grounds that any food products that would not be harvested for any reason, including economic efficiency, would not be reported and therefore not captured by national statistics. Few academic studies have explored this important area, Felfel, Gooch and Marenick (2011) estimated this number to represent on average 5% of food waste produced in Canada in 2009, however wide discrepancies are noted between crops.

This stocktaking exercise revealed that little is known on waste generated in the food industry and the retail sector. Further investigation showed that this information is identified as business sensitive and the only business level data collection exercise known that covers manufacturing and retail businesses is carried out by the United Kingdom's WRAP under the auspices of the Courtauld Commitment, that was launched in 2005 as a voluntary agreement aimed at improving resource efficiency and reducing waste within the United Kingdom's grocery sector. The Commitment is now in its third phase and signatories have expanded beyond the retail sector to food manufacturers (WRAP, 2013).

For the agricultural policy maker it would be important to distinguish food waste by commodity grouping, such as grains, meats, dairy, fruits and vegetables, in order to tailor policy instruments that would be pertinent to the relevant sector or commodity. This may be meaningful in the early stages of the food chain as well as for commodities that reach the final consumer in their unprocessed form. However, once commodities are combined in the process of food preparation, it is more complex to differentiate the share of food wasted by each commodity group.

An accurate reporting of food waste by economic activity and commodity groupings would allow a more thorough understanding of individual country food waste generation patterns, thus allowing tailor made approaches.

Box 3. Reducing and recycling food waste in Korea

The Korean government has implemented food waste management policies focusing on reducing waste generation and recycling food waste as organic resources.

From 1995, the government started to collect food waste separately from other municipal wastes. In 1998, the Food ***Waste-to-Resource Plan*** was established and took comprehensive measures to reduce discharge of food waste by more than 10% and recycle more than 60% of the discharged food waste as resources until 2002. Under the ***Feed Control Act*** (revised in March 2001), all feed manufacturers should register to produce and distribute animal feed, and manufacturing processes including heating temperature were introduced to enhance the safety of feed using food waste. In addition, under the ***Fertilizer Control Act*** (revised in March 2003) it became necessary to register as a fertilizer manufacturer to produce and distribute by-product fertilizers using food waste. Landfill of food waste is prohibited since 2005.

With the ***Enforcement Decree of the Waste Control Act*** (revised in 2004), it became mandatory to report the status of food waste recycling facilities and to receive regular inspection for maintaining the performance of the facilities. Also, the criteria of installation of the facilities became enhanced to improve the quality of the by-products. To promote food waste recycling, KRW 161 billion (USD 144 million) was provided to install 128 recycling facilities and to develop recycling technology between 1996 and 2011. As a result, 95.3% of food waste generated (12 905 ton/day) was recycled as animal feed and compost in 2011.

Encouraged by the positive result of the policy, the government decided to step forward. In February 2010, the ***Master Plan for Food Waste Reduction*** was announced, and this new policy placed even greater emphasis on reducing food waste generation and its linkage to the green growth strategy. The strategy has four main components: 1) Incentive; introducing a volume-based food waste fee system; 2) Method; tailored to dischargers of the food waste; 3) Operation; easy to do in daily life; 4) Participation; governance driven by private sector.

The most important measure in this plan is that the levy is borne by dischargers. The government aimed to extend the volume-based system to all of the 144 local governments in urban area by 2013. Before the plan of 2010, local governments imposed a food waste fee either as a fixed charge or free of charge. As this flat-rate or cost-free food waste collecting system was inefficient to reduce the waste amount and was unfair to households which discharges small amount of waste, the government developed a new intelligent method, the Radio Frequency Identification (RFID) system, imbedded IT technology.

The RFID system is a collecting system that identifies the discharger by an electronic card or tag, charges the fee according to the waste volume and collects information through internet. A pilot program introducing the RFID system in 60 000 households in seven local governments started in 2010 and expanded to 490 000 households in 28 local governments in 2012. At the same time, local governments that did not participate in the pilot program could use two different systems which are not based on actual volumes collected: a) the prepaid chip or sticker system that a discharger buys to attach to his food waste container for it to be picked up or b) the standard plastic garbage bag system which a discharger buys and uses for food waste exclusively, the latter will phase out by June 2015.

According to the Ministry of Environment, based on the monitoring of the performance of the pilot RFID system from January to May in 2012, on average, 25% of food waste has been reduced. If this result could be generalized, an average household could save KRW 188 000 (USD 168), considering that a representative household spends about KRW 3.8 million (USD 3400) on groceries and that 20% of those groceries, that is to say KRW 753 000 (USD 674) were wasted in 2011. Although a wide variation in the year-on-year change was noted between local governments, from a minimum 3% to a maximum 40%, the Ministry positively evaluated the trend as significant.

In the case of Gimcheon city that adopted the RFID in January 2012, 40% of the food waste has been reduced and the amount of the waste collection fee paid by household also has been reduced to one third. The Ministry evaluates the system is now in its stabilizing stage without any side effects such as complaints from the residents or illegal disposal behaviour. Based on a satisfaction survey on RFID carried out in 2011, 75% of the residents responded that the volume-based waste fee system helped reduce food waste and only 8% answered that adapting to the new system was not easy.

Encouraged by the positive results, over forty local governments volunteered to apply the RFID system in 2014. The Ministry announced a plan to provide national funding until the end of 2013 to support local governments in the transition to RFID. The RFID system will be scaled up and spread across the country this year while some errors on the measuring equipment that caused inconvenience to residents during the pilot phase are fixed. The Ministry and local governments cooperate closely to take measures in accordance with the guidelines dealing with civil complaints distributed early 2012. At the same time, local governments are expected to complete amending the ordinance to be able to implement volume-based food waste fee system and to lay groundwork by the end of this year.

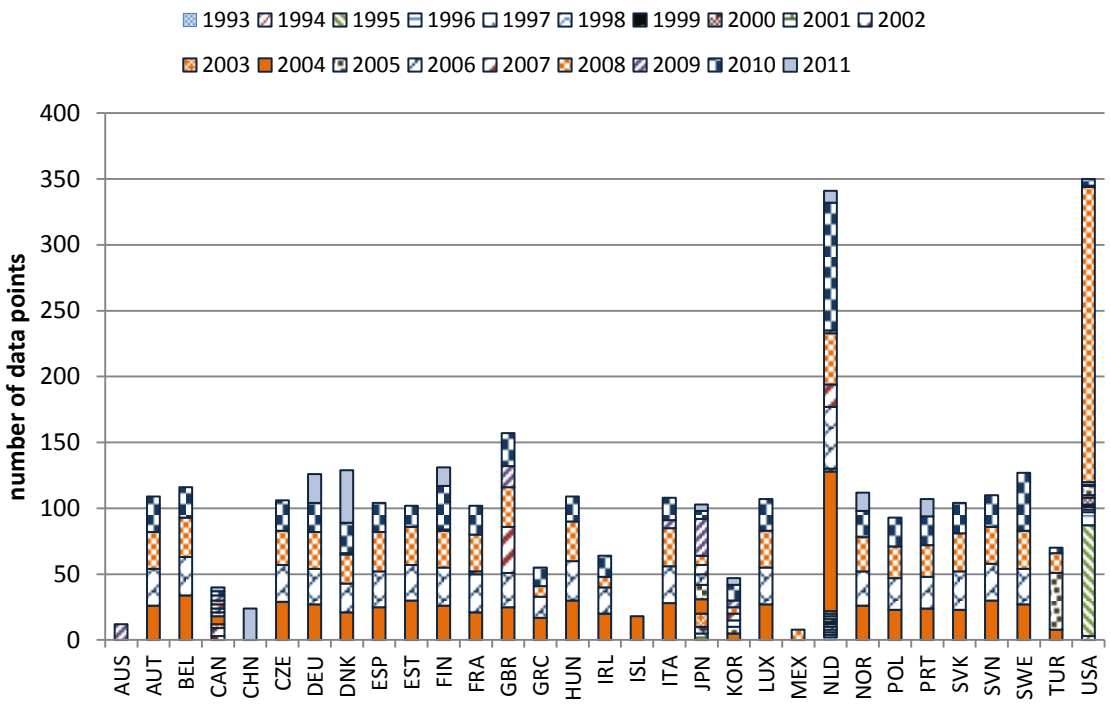
Source: Ministry of Environment of Korea, and Ministry of Agriculture, Food and Rural Affairs of Korea.

Monetary value and weight are the most common units used to report food waste. These are often elaborated as percentages to offer a synthetic indicator allowing for comparisons across time and geographic units. Aggregating the weight of food waste across commodities raises comparability issues that could be overcome by using caloric equivalents. However, it should be noted that few reports have used this measurement unit unless they focus on health and dietary issues. Attempts to measure the impact on resources and the environment are also on-going. They will contribute valuable information to the debate on how to improve resource efficiency in the food chain when their results are validated and published (FAO, 2013).

National sources of data include consumer and household surveys, business registers, reports on municipal solid waste collection. Depending on the source and the purpose of the collection exercise, it may be less practical to isolate food waste, but some encouraging initiatives are reported in member countries that will help improve the quality of food waste data. For example, a pilot exercise is being implemented in urban areas of Korea to organise a separate collection of household food waste in municipal waste collection (Box 3). This allows for a more precise capturing of data on food waste generated by households. Data at local and sub-national levels are sometimes available and may be useful to explore.

The information gathered was organised according to the main dimensions described above. Each value is classified according to the i) definition used, ii) economic activity, iii) commodity grouping, and iv) measurement unit as well as v) year and vi) country, and region, when data is at sub national level. Source and additional metadata are included when available.

Figure 3. Food waste dataset coverage



Source: Food waste dataset, OECD as of October 2013.

The database contains approximately 2 100 data points, for 31 countries. Categories of waste data reported by the European Statistical Office, Eurostat, that are considered to be relevant to food waste are included to supplement national food waste statistics for EU countries, although they do not offer an exact match. Of the 24 countries for which Eurostat waste data is used, it should be noted that Eurostat is the only source identified for 12 countries. For the remaining 12 European countries, food waste statistics are available on a national basis with different scopes or coverage in addition to Eurostat waste data that has been included as a proxy (Figure 3). These have been included in the database after consultation with members. It should be noted that the coverage of the waste data available at Eurostat expands beyond EU membership and includes Iceland, Norway and Turkey. Also worth noting is an in-depth data collection initiative launched by Eurostat on a voluntary basis and to improve the knowledge base on food waste. This exercise should substantially improve the capacity to inform on the scope and nature of food waste generation in participating countries. In order to serve as a useful tool for monitoring food waste reduction through time in the EU and in order to capitalise the improved reporting capacity at national level that this exercise has enabled, it would be important that the in-depth data collection exercise be repeated at a regular frequency.

Differences in coverage and measurement are major obstacles to comparability of food waste statistics. As the database stands today, it includes data classified in over 150 different ways (combining definition, commodity coverage and measurements units). There are cases where detailed levels of commodity breakdown are reported, for example in Australia, the Netherlands and the United States.

Table 3. Measurement units used

%	kg/week
kcal/cap	kg/capita
kg	kg/household
tonnes	kg/capita/week
10^6 kg	kg/household/week
10^6 pounds	g/capita/day
10^4 tonnes	10^6 national currency
10^6 tonnes	10^9 national currency
tonnes/day	national currency
tonnes/40 weeks	national currency/capita
kg/day	national currency/household

As was expected from the results of an initial literature review, food waste generation at household level is the most frequently reported variable with fairly good coverage through time. The method used to gather the dataset introduces a bias; as the dataset attempts to capture all available information; a snowball effect is inevitable when household food waste has been cross referenced and taken up in many academic pieces, leading to repetitions. This is notably the case in the dataset coverage of the Netherlands. Tables 3 and 4 provide an overview of the coverage of food waste data at household level for year 2010 as currently available in the dataset. The tables highlight the wide range of variables and the multiplicity of measurement units. They are presented here to illustrate and underline the need for continued harmonisation.

Table 4. Overview of food waste variables at household level – 2010

Variable	Occurrences
Animal and mixed food waste	33
Animal and vegetal waste	42
Discarded foodstuff: bread	1
Discarded foodstuff: convenience food	1
Discarded foodstuff: fruits and berries	1
Discarded foodstuff: home cooked	1
Discarded foodstuff: meat fish and eggs	1
Discarded foodstuff: milk produce	1
Discarded foodstuff: tinned goods and other non-perishable foods	1
Discarded foodstuff: vegetables	1
Food and other municipal solid waste	1
Food loss	3
Food loss and food waste	1
Food loss and food waste (minimum - weight basis)	2
Food loss and food waste disposed through residual waste	1
Food loss and food waste disposed through sink and toilet (liquid food waste)	1
Food loss and food waste in purchased food [min. % = (weight food loss and food waste/total weight food purchased)]	1
Food loss and food waste: vegetal, fruit and garden waste	1
Food loss disposed through residual waste (weight)	1
Food loss disposed through residual waste in total food loss disposed [% = (weight food loss disposed through residual waste)/(weight total food loss)]	1
Food loss disposed through sink and toilet (liquid food waste) (weight)	1
Food loss disposed through sink and toilet in total food loss disposed [% = (weight food loss disposed through sink and toilet)/(weight total food loss)]	1
Food loss in purchased food [% = (weight food loss)/(weight purchased food)]	1
Food loss in residual waste	1
Food loss in total food waste and loss [% = (weight unavoidable food loss)/(total weight food loss and food waste)]	1
Food loss in total food waste of loss disposed [% = (weight food loss)/(total weight food loss and food waste)]	1
Food loss in total residual waste [% = (weight food loss)/(weight residual waste)]	1
Food loss: vegetal, fruit and garden waste	1
Food loss: vegetal, fruit and garden waste [% = (weight food loss)/(weight Vegetal, Fruit and Garden Waste)]	1
Food loss: vegetal, fruit and garden waste in total food loss disposed [% = (weight food loss disposed through vegetal, fruit and garden Waste)/(weight total food loss)]	1
Food waste	59
Food waste (weight %)	1

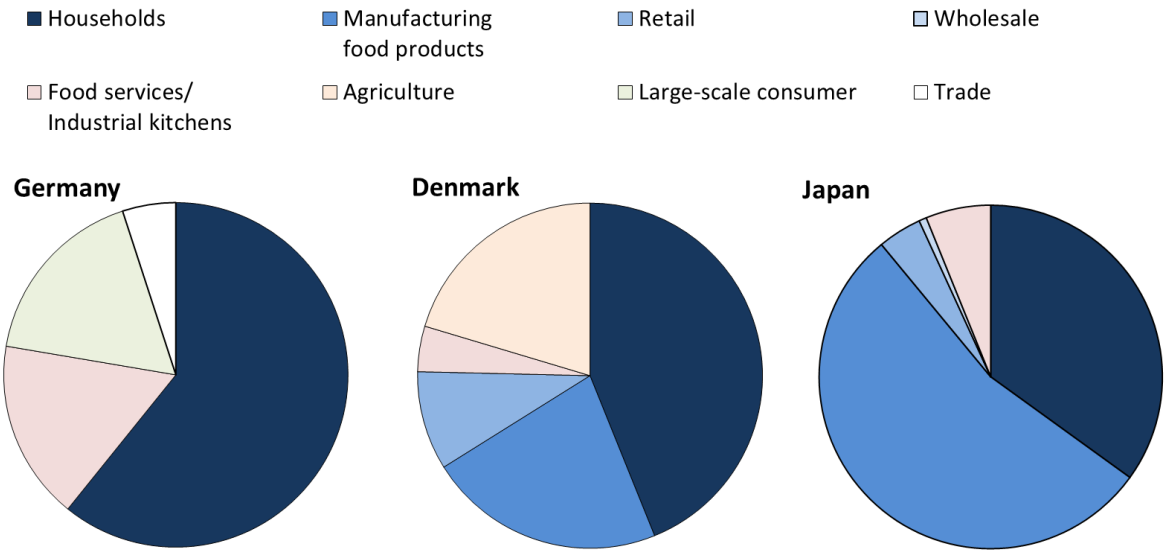
Variable	Occurrences
Food waste and food loss in total purchased food [% = (weight food waste and food loss)/(weight purchased food)]	1
Food waste disposed through residual waste (weight)	1
Food waste disposed through sink and toilet (liquid food waste) (weight)	1
Food waste disposed through sink and toilet (liquid food waste) [% = (weight waste disposed through sink and toilet)/(total food waste)]	1
Food waste disposed through vegetal, fruit and garden waste	1
Food waste disposed through vegetal, fruit and garden waste (weight %)	1
Food waste in million Euros (Minimum estimated)	1
Food waste in purchased food [% = (weight food waste and food loss)/(weight purchased food)]	1
Food waste in residual waste	1
Food waste in total 'food waste and loss' [% = (weight food waste)/(total weight food loss and food waste)]	1
Food waste. maximum (weight basis)	1
Food waste: avoidable	4
Food waste: avoidable (average weight)	5
Food waste: edible	1
Food waste: unavoidable	1
Food waste: unavoidable (average weight)	3
Vegetal municipal waste	2
Vegetal waste	38
Vegetal, fruit and garden waste	1

Source: Food waste dataset, OECD as of October 2013.

Beyond the fact that food waste generated by households has received considerable attention throughout most OECD countries, the data collected provides a basis, although incomplete and scattered, for comparisons across economic activities for a same country. Available data suggests that food waste generated in other parts of the food supply chain is significant and should receive adequate attention (Figure 4). Therefore, better knowledge of the food manufacturing and key services sectors (distribution and out-of-home eating) would be needed in order to adopt policy responses that would have greatest impact.

In a context of scarce information, case studies on specific stages of the food value chain have been used to extrapolate missing information. A recent study carried out in Germany for the Federal Ministry of Food Agriculture and Consumer Protection evaluated food waste generated in the agricultural sector to 1 to 2 million tons (Johann Heinrich von Thünen-Institut et al., 2013). A survey approach was used in the People's Republic of China to collect information on food waste generated in the food services sector (Liu, 2014).

Figure 4. Selected examples of food waste by economic activity



Note: Coverage and definitions differ across countries. The graphs are not intended for cross country comparison.

Source: OECD Food waste dataset, adapted from: a. University of Stuttgart (2012) for data for Germany in 2011; b. Concito (2011) for data for Denmark combining years 2004 and 2011; and c. the Statistics Department of the MAFF, Japan (2013) for Japan in 2011 for all activities except Households where 2010 data were used. The data include by-products from the processing industry.

4. The policy context of food waste

This section provides an overview of the policy environment relating to food waste in a number of selected countries with the aim to identify possible best practices. The information was collected from government and academic websites for several countries (Australia, Denmark, the EU, Finland, France, Ireland, Japan, Korea, New Zealand, Norway, Sweden, Switzerland, the United Kingdom and the United States). When possible the information collected was verified by the country concerned. Government strategies and actions on food waste that were reported at the OECD Food Chain Analysis Network meeting regarding Finland, the Belgian province of Flanders, France, Japan, Portugal, Spain, Sweden and the United States were also included.

Government strategies and actions on food waste

Consumer health and food safety are often at the centre of regulators' attention, perhaps contributing to a tension between the obligation to ensure food safety and the desire to reduce food waste. The law for the promotion of recycling in Japan illustrates the fact that, under certain conditions, food waste is used as an input to the feed processing industry, thus diverting to a productive use food that would otherwise be lost. The potential for consumer and food safety regulations to contribute to the reduction of food waste exists; it should be further explored and exploited.

Attention has been focused on waste generated by households and at consumer level, as these may be more reactive and likely to yield results faster. Many awareness raising initiatives are targeted at consumers (Table 5). These initiatives are implemented in a number of different ways but their common objective is to raise public awareness on the issue of food waste and to communicate through media campaigns in order to change the behaviour of each consumer so as to reduce food waste. For example, some countries have put in place pedagogical actions specifically targeted to youth, sometimes through virtual communities or through more classical classroom education at school.

Table 5. Strategies and actions on food waste by different entities

	Collaboration among different stakeholders and public private partnerships
	Denmark
Awareness raising initiatives	European Union
Belgium	Finland
Canada	France
Denmark	Japan
European Union	Norway
Finland	Poland
France	Portugal
Germany	Switzerland
Ireland	United Kingdom
Japan	United States
Korea	**Data collection and improvement initiatives**
Norway	Belgian province of Flanders
Poland	Denmark
Portugal	European Union,
Spain	Eurostat
Sweden	Finland
Switzerland	France
United Kingdom	Japan
United States	Norway
	Poland
	United Kingdom
	United States

Source: OECD Inventory of policies as of October 2013.

Actions aimed to improve collaboration among different stakeholders are also starting to generalise in many countries. As the food supply chain becomes increasingly complex, collaboration among the various stakeholders along the food supply chain, such as manufactures or catering services, wears increased importance to reduce food waste. Governments have a role to play in facilitating this collaboration and providing an enabling environment. For example, the Good Samaritan Act that is in place in the United States and several European countries, including Italy and Poland, protects food donors

from liability, thus supporting donations of food fit for human consumption to food banks. In some countries food discarded is exempt from VAT while such an exemption does not apply to food donated, thus providing an economic incentive for businesses to discard rather than donate.

Different sets of EC regulations relate to food waste in the European Union. Their implementation by Member states has shown a great degree of variation, highlighting the flexibility that exists within the European Union. The General Food Law Regulation lays down definitions, principles and obligations covering all stages of food and feed production and distribution. The Waste Framework Directive provides the general framework of waste management requirements and sets the basic waste management definitions for the EU. It identifies legally binding minimum targets for recycling and recovery rates and sets landfill diversion targets. These two sets of legislation influence the generation of food waste, but more importantly discriminate possible uses of food waste. The EU animal by-products regulation lays down health rules as regards animal by-products and derived products not intended for human consumption. Another key component of EU frameworks that influence food waste is the Roadmap to a Resource Efficient Europe that identifies reducing food waste as an area for action. The roadmap sets targets for 2050 and foresees intermediate evaluation in 2020.

The government of Germany has set up an information portal that offers consumers information and tips about shopping, storage and processing of food. Similarly a web page was set up as part of the Danish "Charter on reduction of food waste". Signatories of the Charter commit to a number of concrete and short term initiatives to reducing food waste. French government actions on food waste include consumer information and knowledge improvement of legal framework for food donation. Training in agricultural high schools and the hotel and catering schools will also be undertaken. In the United Kingdom, Love Food Hate Waste, managed by the WRAP and backed with Government funding, aims at raising awareness, in partnership with retailers, manufacturers, local governments and communities.

In Norway, the food-industry-led ForMat brings together food processors, retailers and suppliers in the private sector with civil society and government to analyse and minimise food waste along the value chain. In Poland, the Alliance for Rational Use of Food gathers representatives of research, public administration and food producers and distributors as well as food banks under the auspices of the Ministry of Agriculture and Rural development.

A working team composed of manufacturers, wholesalers and retailers was set up in Japan to review and improve its business practices in order to reduce food waste. A partnership with sector stakeholders such as food banks to facilitate reuse and recycling of food is developed in Spain. A similar setup was used in France to prepare the National pact to fight against food waste (MAAF, 2013), and in Switzerland to prepare the action plan on Green Economy, that addresses food waste among other (BLW, 2013).

These initiatives are sometimes short-lived and may lack long term vision, furthermore their impact on reducing food waste remains unknown as, with few exceptions, these actions tend to lack ex-post evaluation, and the impact of each activity on reducing food waste in the short or long term remains unknown. One exception is the WRAP that regularly publishes targets as well as estimates of food waste reduction achieved.

Governments also play a key role in the production of official statistics and, compared to awareness raising and collaborative actions going on in a growing number of countries, initiatives on the collection of data on food waste are much less widespread. Primary data collection on food waste tends to be on an *ad-hoc* basis as one-off projects within a limited time frame and not on a continuous basis. In the absence of reliable measurement and historical benchmarks it may prove difficult to evaluate the evolution of food waste generation. However a number of initiatives exist that aim to improve data availability and quality. The United Kingdom's WRAP recently published data on food waste in the manufacturing and retail sectors. Sweden conducts studies of food waste in primary production. Also under the leadership of Sweden, a Nordic project with Denmark, Norway and Finland will quantify the resource efficiency issues associated to food waste in agriculture and food industry The Belgian province of Flanders maps food waste in industry and France published in 2011 data on food waste in the retail and the catering sectors. Postharvest Food Losses at the Retail and Consumer Levels in the United States were published in 2014 (Buzby et al., 2014).

Characteristics of legal framework on food waste

Unlike the government strategies and actions that centrally focus on food waste *per se*, legal frameworks cover waste in general and are not specifically addressing food. Although many OECD countries have identified food waste as a very important issue, the legal frameworks in place tend to focus on waste rather than on food or food waste. This is the case for example in:

- Australia: National Waste Policy: Less Waste, More Resources
- Finland: Waste Act
- Germany: Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal
- Korea: Wastes Control Act
- New Zealand: Waste Minimisation Act
- Scotland: Waste Regulations

This is not the case in Japan where food waste is the central focus of the *Law for the Promotion of Recycling and Related Activities for the Treatment of Cyclical Food Resources* (Food Waste Recycling Law) which aims both at preventing and reducing food waste. It also promotes recycling food waste into animal feed and fertilisers as well as energy recovery.

In Ireland, the Waste Management (Food Waste) Regulations of 2009 outline the requirements for the catering sector in relation to management of food waste, including segregation and processing. While the Household Food Waste Regulation promotes the segregation and recovery of household food waste. The regulation directs source-segregated household food waste to composting, and to other forms of treatment, and imposes obligations on waste collectors as well as on households.

General objectives of the framework legislation

The fact that food waste is considered within the broader context of waste in many countries is also backed up by the objectives of these frameworks. In most cases, the

primary laws provide general guidance to the ministry, local governments and other stakeholders which apply to all types of waste generated and processed. Food waste is implicitly included in various objectives that countries stipulate for waste such as:

- avoiding the generation of waste, reducing the amount of waste for disposal;
- managing waste as a resource; promoting the sustainable use of natural resources; promoting recycling food waste into animal feed and fertilisers as well as recovering heat or energy from food waste by food-related businesses;
- ensuring that waste treatment, disposal, recovery and re-use is undertaken in a safe, scientific and environmentally sound manner; preventing hazard and harm to human health posed by waste and waste management; protecting the outdoor environment against pollution and reducing existing pollution and waste;
- contributing to the reduction in greenhouse gas emissions, energy conservation and production, water efficiency, and the productivity of the land; preventing environmental disturbance by promoting effective energy use in products;
- ensuring efficient waste management systems; preventing littering;

Some countries prioritise different objectives in their waste frameworks. The German Act for Closed Substance Cycle Waste Management of 2012 transposes the five steps hierarchy, as foreseen in the Waste Framework Directive (2008/98/EC). According to this hierarchy, "waste must, firstly, be avoided, this must be accomplished especially by reducing its amount and noxiousness, and must, secondly, be prepared for re-use, thirdly be subjected to substance recycling fourthly be otherwise recovered , i.e. used to obtain energy (energy recovery) and lastly be disposed". The law for the promotion of recycling in Japan stipulates the hierarchy for waste treatment starting by source reduction and waste treatment in decreasing priority order: use of food waste for feed, heat recovery, and reduction in weight by drying.

Different instruments are used to achieve these objectives such as charges for waste disposal and treatment (landfill and incineration); Pay-as-you-throw systems; and Producer responsibility schemes:

- a ban on landfill of waste or levies collected on all waste disposed of in landfills to support local governments, communities and businesses in their efforts to reduce the amount of waste. Korea, Norway and Sweden ban landfill of organic waste. It should be noted that organic waste includes food waste among other components. The United Kingdom imposes a tax on landfill of biodegradable waste which drives-up gate fees to landfills. Korea also started to charge residents based on the volume or weight of their food trash as part of efforts to reduce processing costs and save money (Box 3);
- separate or segregated collection. In the case of Scotland, the waste regulations that will come into force in January 2014 specifically address food waste by imposing food businesses operating in non-rural areas a separate collection and by prohibiting disposal of food waste into public drains and sewers. In Ireland the catering sector as well as households are obliged to segregate food waste in non-rural areas;
- mandatory reporting or recycling of waste imposed on certain groups, such as landfill operators, to improve the quality of information on waste minimisation. Japan imposes mandatory reporting and sets targets of food waste recycling for food manufacturers, food wholesalers and food retailers. These businesses are required to meet each target set by the

regulation. In France waste generators above a certain size would be obliged to separate and recycle waste. The coverage of generators obliged to participate should expand every year;

- delegation of waste minimisation to territorial authorities; and
- constitution of independent advisory bodies on waste minimisation issues. This is the case in the United Kingdom with the WRAP.

Regulations implementing framework legislations are established by relevant institutions. They may limit the volume of food waste, set recycling ratios, impose certain waste treatment methods, collect land filling fees, and set the number of landfill facilities when landfill is allowed, etc. The most commonly declared goal of these food waste management programs is to reduce the volume of food waste. Countries have set national targets regarding food waste relevant to their policy objectives. Sweden's national target is that half of the food waste from households, shops and restaurants needs to be separated and treated biologically and that 40 % are handled for energy recovery. The United Kingdom set the biodegradable municipal waste target as 35% of that produced in 1995 by 2020 in compliance with the EU wide target on landfill.

Ministry in charge and related agencies

While the framework legislation covering food waste is placed under the responsibility of the Ministry of Environment in most countries, waste management is generally operated under the responsibility of local governments and municipalities because waste collection, management and recycling services are provided at the local level. The government coverage of food waste can become complex and vague, when it deals with different aspects of food waste issues. For instance, data collection on food waste can be conducted at central government or local level. Establishing capacity for waste management and delivering information is a major role for local governments. Collecting data and information, imposing fees or levies on the related services is also typically regarded as a part of local administration.

The Ministry of Agriculture or Economy oversees farming activities or the food industries that generate food waste while the Ministry of Environment regulates waste management. The Ministry of Economy decides on taxation issues relating to donation of food that would otherwise be wasted. The sanitary standard of food can be regulated under the Ministry of Health, whereas the standard of label or expiration dates of food can be regulated under the Food Safety authority. These separations in responsibility for managing food waste, and possible conflicts of interest between government bodies can lead to the lack of coordination for policy implementation, monitoring and enforcement on food waste reduction. A whole of government view should be developed to efficiently tackle the food waste issue.

Hence, there is greater scope to enlarge the network of agencies involved in food waste management when the emphasis shifts from "managing food waste" to "improving overall efficiency of food use". Because this broadens the subject to include economic, moral and social impact, the ministries in charge of environment, agriculture, health, sanitary issues, natural resources and education are implicated in one way or the other in the food waste debate. In some countries, these institutions have been brought together in special boards or advisory committees focused on food waste to develop a more comprehensive approach.

Business-business (B2B) and public-private collaboration

It is important to note at this stage that some potential causes of food waste do not directly result from regulation but from business practices and private standards, sometimes set at much higher levels than those set by government. For example the "best before" date printed on food products is not set by regulation but rather the result of industry practice that seeks to adapt to business liability constraints. (Broad Lieb, 2013) The food processing industry determines the date so as to ensure the best gustative quality of products. Similarly it is business practice in the retail sector that determines shelf life of a product. A large retail company in the United Kingdom reports that 80 million litres of milk were saved by prolonging by one-day the shelf life of milk in their stores. In some countries it is business practice to indicate delivery date and return date on packaging. In a B2B initiative in Japan food companies set up a working team to review their business customs leading to excess stock and return products. A pilot project relaxing "delivery date" was launched with the aim to reduce the food waste of industry.

While the public sector has an important role in providing guidance in reducing food waste, the role of private sector in food waste reduction and management cannot be ignored. The private sector is engaged to reduce food waste throughout the food supply chain through various initiatives such as innovation (e.g., technologies, packages, production processes), company initiatives and consumer education via social media and other platforms (BIAC, 2013). In Poland, the Federation of Polish Food Banks has an active role in food waste reduction initiatives, such as educational campaigns directed to consumers and industry and food recovery as well as research and knowledge improvement. In the United States, the Food Waste Reduction Alliance brings together business groups from the food industry, the food retail sector and the food service industry to reduce food waste generated, increase food donation and recycle and divert food waste from landfill. Such initiatives have a potential to complement public efforts on reducing food waste but the challenge for the public sector is to foster a partnership between the public and private sector with the right enabling policy conditions.

National campaigns such as consumer education campaigns on reading "use by", "expiration" or "best before" date labels can help change consumer behaviour but these initiatives cannot be fully effective without having an active participation from the private sector (Broad Leib, 2013). It is necessary to reduce food waste not by individual companies but by the whole food industry. Therefore collaboration between the public and the private sector is already happening in some countries. As part of the FAO Save Food initiative[8], actions at the regional and national levels such as multi-stakeholder and inter-ministerial working groups are encouraged; for example a High-Level Multi-Stakeholder Consultation on Food Losses and Food Waste in Asia and the Pacific Region took place in August 2013 under the auspices of the APEC and the FAO.[9]

The EU retail agreement on waste has a specific chapter on food waste by which food retailers commit to carry out awareness raising initiatives. Specific themes have been identified (advice on food handling, storage and use, information on the "use-by" and "best before" and innovative marketing tools). These initiatives will be monitored in terms of number of campaigns and number of persons reached. Similar agreements have been developed in a number of countries including France, Ireland and Spain.

8. http://www.save-food.org.

9. http://www.fao.org/fileadmin/templates/rap/files/news/Final_Communique.pdf.

New businesses emerge, often social economy businesses initiated through social innovation, typically connecting retail and food businesses to food banks. A frequent example is of businesses that offer job opportunities to unemployed persons to collect food otherwise wasted either to distribute or sell at lower than market prices.

A number of government supported international initiatives targeted to improving the efficiency of the food supply chain in developing countries also have identified the reduction of food waste as an efficient way forward. The conference "Towards sustainable food systems" is one such initiative, organised as part of the FAO/UNEP Sustainable Food Systems Programme (SFSP) and supported by the Government of Switzerland. The SFSP emphasised the importance of food loss and waste management and recycling and the need to mobilise all stakeholders in industrialised, emerging and developing countries.

5. Conclusion

Overall, and compared to other stages along the food chain, data availability on food waste generated at household level is relatively good across OECD countries and time, however the quality of data suffers from the methodological challenges related to its collection. Insufficient coverage of other areas of the food supply chain does not allow an informed view of where most food waste occurs. The results of the OECD data gathering exercise that has been validated for public availability illustrates these facts.

Challenges remain with regards to data and definitions. Data are rarely reported on a regular basis through national statistical offices; and are either reported by different ministries or academic researchers using different measurement methodologies and definitions.

In order to establish a reliable food waste dataset, an important first step is to develop a common methodological framework for food waste data estimation. Whether food waste should be measured by its economic value, its volume, its weight, wet or dry, its caloric content is being discussed. There is a strong need to develop commonly agreed definitions of food waste and of the system boundaries of the food supply chain.

In most countries, the legal frameworks on waste influence food waste. However, these frameworks cover waste in general and are not specifically adapted to food. Notwithstanding, many countries are now beginning to implement government actions focusing on raising awareness and collaboration among stakeholders, including the private sector. This has the potential to yield positive outcomes even in the short term.

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