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 **Foresight**

Foresight Project on Global Food and Farming Futures

Synthesis Report C7: Reducing waste

This Report has been commissioned as part of the UK Government's Foresight Project on Global Food and Farming Futures. The views expressed are not those of the UK Government and do not represent its policies.

Contents

C7.1	Introduction	3
C7.2	What counts as food waste?	3
C7.3	Accurate quantification of food waste is challenging	4
C7.4	Post-harvest losses in the food supply chain	6
C7.5	Losses in food processing and retail losses	9
C7.6	Food waste from consumers	11
C7.7	Conclusions: the greatest potential for food waste reduction	14
	References	18

About this Report

This Report has been commissioned as part of the UK Government's Foresight Project on Global Food and Farming Futures and forms one of a set of 13 'Synthesis Reports' synthesising the evidence base of over 80 independent reviews commissioned by the Project. For the Final Project Report and a map of all the Foresight Project publications please see the project CD or website at www.bis.gsi.gov.uk/foresight.

C7 Reducing waste

C7.1 Introduction

Increasing the primary production of food is only one of the many strategies that will be required to feed nine billion people sustainably and equitably by 2050. The challenge is to achieve optimal results right across the food system. This requires that substantial inefficiencies across the entire food supply chain – from the farm gate to the point of consumption – are addressed. Estimates suggest that as much as half of all food grown is lost or wasted before and after it reaches the consumer¹, although there are significant uncertainties and gaps in our understanding of losses in the food supply chain across the globe. In low-income countries, where infrastructure for storage and supply are often inadequate, food losses are greatest in early post-harvest stages, whereas in high-income countries, the greatest losses are usually incurred by the consumer. Rising affluence and dietary transition, particularly in the BRIC countries (Brazil, Russia, India and China), is likely to increase future demand for more perishable foods and, as a consequence, increase consumer waste.

Reductions in food waste contribute to a more sustainable food system by allowing more efficient production and reduced consumer demand. By factoring in a reasonable target for the reduction of food waste, the increase in primary production needed over the next 40 years would be considerably less in order to meet the estimated 70% increase in demand². Increased production efficiency through waste reduction would therefore help relieve some of the pressure to increase the land area used for agriculture. Reduction of food waste also has significant potential to reduce greenhouse gas emissions³ and other pressures on the environment, including water stress and soil degradation, as environmental burdens at successive stages are reduced. Taken together, the direct and wider benefits of food waste reduction add weight to its importance and priority. The evidence presented in this Report, although not fully quantified in some aspects, indicates that concerted interventions by governments, the private sector and consumer organisations have significant potential to influence rapid change in food production and consumption through the prevention of food waste at all stages of the food supply chain.

C7.2 What counts as food waste?

Food waste can be defined as edible material intended for human consumption that is discarded, lost, degraded or consumed by pests between harvest and reaching the consumer⁴. This definition, which includes food that is fit for humans but intentionally used as animal feed^{5,6}, spans the entire food supply chain. Post-harvest loss is often used to describe losses between harvest and the onward supply of produce to markets, and equates broadly with waste in the 'food supply chain', a term generally used to describe post-harvest processing and the large retail sectors in high-income countries and, increasingly, in emerging economies. The food supply chain encompasses all those activities that help ensure the delivery of finished products to the consumer from the primary producer. Such activities can include processing, storage, transport and distribution, manufacturing, and wholesale and retail. The capture and discard of fish stocks that are not intended for consumption and therefore not landed and marketed also need to be considered, a loss that is not normally included in post-harvest accounting of food waste. The parallel situation in agricultural systems involves losses that occur when crops are not harvested and ploughed back into the soil. As with fish by-catch and discards at sea, these 'in-field' losses cannot be accurately quantified, as material is not regarded as 'waste' in the same way as losses in the post-harvest stages. Consumer losses encompass food wasted from activities in the domestic setting (purchasing behaviour,

1 Lundqvist et al. (2008)

2 See Project Report C1 (Annex E refers)

3 See Project Report C1 I (Annex E refers)

4 FAO (1981)

5 Stuart (2009)

6 A broader definition of food waste also encompasses food eaten by humans beyond their biological need. This is difficult to measure, and therefore not considered here.

food storage, meal planning and preparation, over-portioning and using leftovers) and within the food hospitality sector once food has been procured for consumption.

For some foods (ingredients and/or products) that cannot be or are not sold to consumers, options such as redistribution via charitable organisations, reprocessing into other food products, or sale to consumers as 'lower grade' products keep them out of the waste stream. Where food waste cannot be prevented, options for obtaining value from food waste need to be considered. These may include diversion into animal feed or recovery options (anaerobic digestion and composting). In the context of this Report, these last options are still considered 'food waste' as the resulting benefits are generally small compared with the value of the original food product.

C7.3 Accurate quantification of food waste is challenging

In general there is a dearth of data on food waste at all stages of the food supply chain, and estimates from different systems and during different growing seasons vary widely. Food waste can occur at every stage from the grower's field, or pond, market yard or fishing net through post-harvest handling, pack houses, processors, transporters, wholesale, retail or catering outlets to storage, preparation and consumption at home (see Table C7.1). The contexts for food waste vary widely in different localities, and cultures, even within a single country. Except for unusual events, such as floods, major pest infestations or process failures, growers, supply chain participants and consumers may have limited awareness of the scope and scale of the waste losses that they incur. Losses may be considered to be routine and tolerable features of their activities, particularly where little transparency exists in downstream supply chains.

Because food is comparatively cheap, businesses in food supply chains may not value the potential financial and other benefits of better management of food losses and may not record them accurately, or may be unwilling to make them public. Businesses may also be wary of measures to reduce consumer waste if this is seen to affect overall demand. In addition, food that does not meet retailer, manufacturer or consumer standards may not be recorded as waste, even if this is the ultimate consequence. Consumers commonly misreport possible negative aspects of their food choices, attitudes or behaviours. Measurement of consumer waste after purchase, whether in food service or domestic settings, is especially difficult, and relies on detailed sampling of small numbers of individuals or households⁷, waste compositional analysis, and modelling of losses from case studies. A distinction between 'avoidable' and 'unavoidable' food waste (inedible discards such as fruit stones and bone) is necessary in order to estimate the lost nutritional value within total food waste. Despite these problems, the evidence indicates that losses are generally substantial and, to varying degrees, avoidable.

Table C7.1: Generic food supply chain and examples of food waste

	Stage	Examples of food waste/loss characteristics
1	Harvesting – handling at harvest	Edible crops left in field, ploughed into soil, eaten by birds and/or rodents, timing of harvest not optimal: loss in food quality Crop damaged during harvesting/poor harvesting technique Out-grades at farm to improve quality of produce or meet quality standards
2	Threshing	Loss through poor technique
3	Drying – transport and distribution	Poor transport infrastructure, loss due to spoiling/bruising
4	Storage	Pests, disease, spillage, contamination, natural drying out of food

⁷ WRAP (2008)

	Stage	Examples of food waste/loss characteristics
5	Processing	
5a	Primary processing – cleaning, classification, de-hulling, pounding, grinding, packaging, soaking, winnowing, drying, sieving, milling	Process losses Contamination in process causing loss of quality
5b	Secondary processing – mixing, cooking, frying moulding, cutting, extrusion	Process losses Contamination in process causing loss of quality
6	Product evaluation – quality control: standard recipes	Product discarded/out-grades in supply chain Destructive testing
7	Packaging – weighing, labelling, sealing	Inappropriate packaging damages produce Grain spillage from sacks Attack by rodents
8	Marketing – publicity, selling, distribution	Damage during transport: spoilage Poor handling in wet market Losses caused by lack of cooling/cold storage
9	Post-consumer – over- or inappropriate purchasing, storage, preparation, portioning and cooking	Buying more than is needed (packsize availability, in-store promotions etc.) Plate scrapings and surplus food cooked and not used Poor storage/stock management in homes: discarded before serving Poor food preparation technique: edible food discarded with inedible Food discarded in packaging: confusion over 'best before' and 'use by' dates
10	End of life – disposal of food waste/loss at different stages of supply chain	Food waste discarded may be separately treated, fed to livestock/ poultry, mixed with other wastes and landfilled

Source: DR20

C7.4 Post-harvest losses in the food supply chain

There are a number of important factors that determine the extent of losses post harvest in the food supply chain that are discussed below in the context of low- and high-income countries and emerging economies. The primary drivers of post-harvest losses are poverty, lack of investment in basic storage facilities and lack of basic infrastructure or transport to enable food to reach local or regional markets. These are discussed in detail below, particularly in the context of low-income countries. Three other global drivers are also influential:

- **Urbanisation and the contraction of the agricultural sector.** The proportion of the world's population employed in agriculture has declined in recent decades, and 50% of the world's population now live in urban environments. This figure is expected to rise to 70% by 2050⁸. Rapid urbanisation has created the need for extended food supply chains to feed urban populations. For these to be efficient, countries need improvements to roads, transportation and storage and marketing infrastructure to keep food affordable for lower income groups. How these extended supply chains develop has implications for food waste globally, now and in the future.
- **Dietary transition.** The growth of household incomes, particularly in emerging economies, is associated with a decline in consumption of starchy food staples and diversification of diet into fresh fruit and vegetables, dairy, meat and fish. The shift towards vulnerable, shorter shelf-life items is associated with greater food waste coupled with greater demands placed on agriculture in terms of land and inputs to production⁹. This 'nutritional transition' varies by country and culture. For example, in India there is less demand for animal feed compared with China, where the demand for meat and poultry is increasing rapidly.
- **Increased globalisation of trade.** International trade in processed foods accounts for 10% of the total processed food sold¹⁰. Globalisation may open up opportunities for agricultural exports while representing a threat to development of internal markets through competition from inexpensive imports of higher quality than can be produced locally. Linked to trade liberalisation, multinational chains have become a driving force in the rapid growth of supermarkets in many transitional economies¹¹.

Low-income countries

The quality of preparation, storage and transport infrastructure is the primary cause of losses in the early stages of the food supply chain. These losses are partly a function of the technology available in a country, as well as the extent to which markets have developed for agricultural produce. The development of post-harvest infrastructure closely reflects how urbanised a country is and how diverse the diets of its citizens are (see Figure C7.1). In many low-income countries, most of the rural poor rely on short food supply chains with limited post-harvest infrastructure and technologies, leading to substantial losses of food after harvest. Grain is lost from spillage, poor separation and drying, contamination and consumption by rodents, insects and fungal and bacterial diseases. If stored long enough under poor conditions, it may become inedible, even though grain is normally regarded as non-perishable¹². Extended food supply chains providing food for urban populations are likely to involve many intermediaries between growers and consumers, which may limit the potential for growers to receive higher prices (unless there is investment in local processing capacity) and decrease the incentive to grade produce or provide suitable storage infrastructure and transit packaging. Farming is mostly small scale with varying degrees of involvement in local markets and a rapidly diminishing proportion of subsistence farmers who neither buy nor sell food staples¹³. Interventions within these systems are focused on improving their technical capacity to reduce losses, increasing their efficiency and reducing the labour intensity of the technologies that are used¹⁴. Attempts to reduce post-harvest losses will need to take account of cultural and financial implications of any innovations in post-harvest technologies. In years with food surpluses the prices received for goods will be low. One option is to store grain surpluses for lean years, but suitable

8 United Nations (2008)

9 Lundqvist et al. (2008)

10 United Nations (2002)

11 DR20 (Annex E refers)

12 DR20 (Annex E refers)

13 Jayne et al. (2006)

14 DR20 (Annex E refers)

storage facilities may be lacking. Investment and engineering skills are needed to provide solutions and there are many examples of relatively simple technologies that can provide effective solutions. For example, a Food and Agriculture Organization (FAO) project provided simple effective sealed storage drums for grain farmers in Afghanistan and elsewhere, dramatically reducing post-harvest food losses¹⁵.

Estimates of post-harvest grain losses from a variety of Asian, African and South American countries typically range from 10% to 25%¹⁶, with extremes as high as 80%¹⁷; 13–15% is quoted as the Asian average¹⁸, although it has been suggested that post-harvest losses are sometimes overestimated¹⁹. This partly relates to the difficulty of deriving 'typical' loss estimates for a crop and region, when limited data from field measurements may relate to specific local research objectives and extreme values (rather than averages) may be mistakenly extrapolated to estimate losses from an entire country or region²⁰. The losses for perishable crops, by their nature, are higher than those for grains²¹, with data from low-income countries available for a limited range of fresh fruit and vegetables. Estimates for Egypt²², Venezuela²³ and a number of Asian countries²⁴ are typically in the range of 30–40%. Globally it is estimated that approximately one-third of all fresh fruit and vegetables produced is lost before it reaches consumers²⁵.

Fish and shellfish, unless kept alive as for some specialised markets, are also highly perishable, and the combination of poor harvest²⁶ and post-harvest handling and the lack of ice commonly lead to significant loss in quality and in some cases complete spoilage. Traditional supply chains, particularly in tropical zones, still have only limited access to or use of ice, and commonly rely on salting, drying and/or smoking of products near to landing sites to reduce perishability. However, nutritional quality is often much reduced and is further compromised in long supply chains with poor handling and storage. A further constraint is that, during seasonal peak catches, there may be insufficient capacity to handle the products. This is particularly the case for migratory fish where changing patterns of distribution lead to fish being landed in areas with limited infrastructure. Where fish meal and oil reduction facilities are available, some value may be retrieved. In other instances, 'trash fish' may be fed to animals or used for aquaculture. According to FAO²⁷, post-harvest losses in small-scale fisheries can be among the highest in the entire food system, and spoilage losses alone are estimated at 10–12 million tonnes per year; some 10% of the total aquatic production.

Looking to the future, the predicted increase of the global urban population to 75% of the total in 2050, which is expected to be concentrated in low-income and emerging economies, is likely to extend food supply chains and increase post-harvest food losses²⁸. However, infrastructural improvements, particularly dry and cold storage facilities, pack houses, roads, ports, telecommunications and power supplies, all have the potential to counteract such developments.

Emerging economies and high-income countries

In emerging economies and high-income countries, post-harvest food supply chains have a closer integration of growers, suppliers, processors, distribution systems and markets, ensuring greater economies of scale, competitiveness and efficiency. Development of more industrialised food supply chains can also result in growth in the food processing sector²⁹. In medium- and high-income countries,

15 FAO (2008)

16 DR20 (Annex E refers)

17 Phan and Nguyen (1995)

18 Grolleaud (2002)

19 DR20 (Annex E refers)

20 Tyler (1982)

21 DR20 (Annex E refers)

22 Blond (1984)

23 Guerra et al. (1988)

24 Rolle (2006)

25 DR20 (Annex E refers)

26 Estimates of discards of fish vary widely as there are a number of different ways of measuring these losses. One estimate for the period 1992–2001 indicates that yearly average discards are around 7.3 million tonnes; see FAO (2005).

27 FAO (2005)

28 United Nations (2008)

29 In some BRIC countries, public sector investment is being considered to accelerate this process. For example, in India the government is discussing an 'evergreen revolution', which will involve the build-up of food processing units; see DR20 (Annex E refers).

it has often been argued that the centralised processing of food leads to better resource efficiency and less waste overall. Further losses are associated with the cosmetic quality standards that retailers apply to fresh fruit and vegetables, which can reduce the volume of marketable and edible food reaching consumers. This trend is increasingly being counterbalanced by the growing influence of retailers and manufacturers in agricultural development groups³⁰, crop sustainability groups and sustainable agriculture initiatives³¹, which are all bringing about improvements in growing practices and the reduction of post-harvest losses.

Supermarkets are the dominant intermediary between farmers, food manufacturers and consumers in high-income countries. Even in emerging economies, supermarkets are the main vehicle for providing diversified diets for the expanding middle classes and the urban poor. These developments are almost entirely dependent on foreign direct investment, and show high growth rates in Eastern Europe, parts of Asia and Latin America³². The nature and pace of these developments is influenced by the extent to which retailers bypass existing markets and traditional wholesalers to secure produce of the required standard and volume. Export quality assurance, the quality standards set by supermarkets and the procurement systems are also influential. Many of the issues identified in food supply chains in emerging economies are similar to those in high-income countries, such as payment terms that discourage small growers and systems for demand forecasting, order planning and replenishment that sometimes lead to overproduction and waste³³. However, there are lessons that might be learned from industrialised countries. For instance, in the UK, the introduction of contractual penalties for non-delivery of order volumes, residual shelf-life product take-back clauses and poor demand forecasting were estimated to have a combined influence that drove 10% overproduction and higher levels of wastage in the UK food supply chain³⁴.

In high-income countries, advanced infrastructure applied to temperate agricultural systems supplying grain have significantly reduced post-harvest losses, and, under favourable conditions, these are often well below 3%. However, for perishable crops, the losses are significant: for fruit and vegetables at the farm retail stage, losses have been estimated to be 2–23% in the USA³⁵ and 9% in the UK³⁶. However, these estimates exclude produce 'out-graded' at the farm in response to quality and cosmetic standards specified by retailers. It has been claimed that as much as 20–40% may go to waste in the UK³⁷ but evidence from recent detailed supply chain mapping suggests much lower losses for most types of fresh fruit and vegetables³⁸. In commercial fishing, the use of on-board ice and freezing equipment has considerably reduced losses, though quality may be impaired over long fishing trips.

30 Meat Trade News Daily (2010)

31 Murray (2010)

32 Reardon et al. (2007)

33 See DR20 (Annex E refers) for a more detailed discussion of the development of food supply chains in low-income countries and emerging economies.

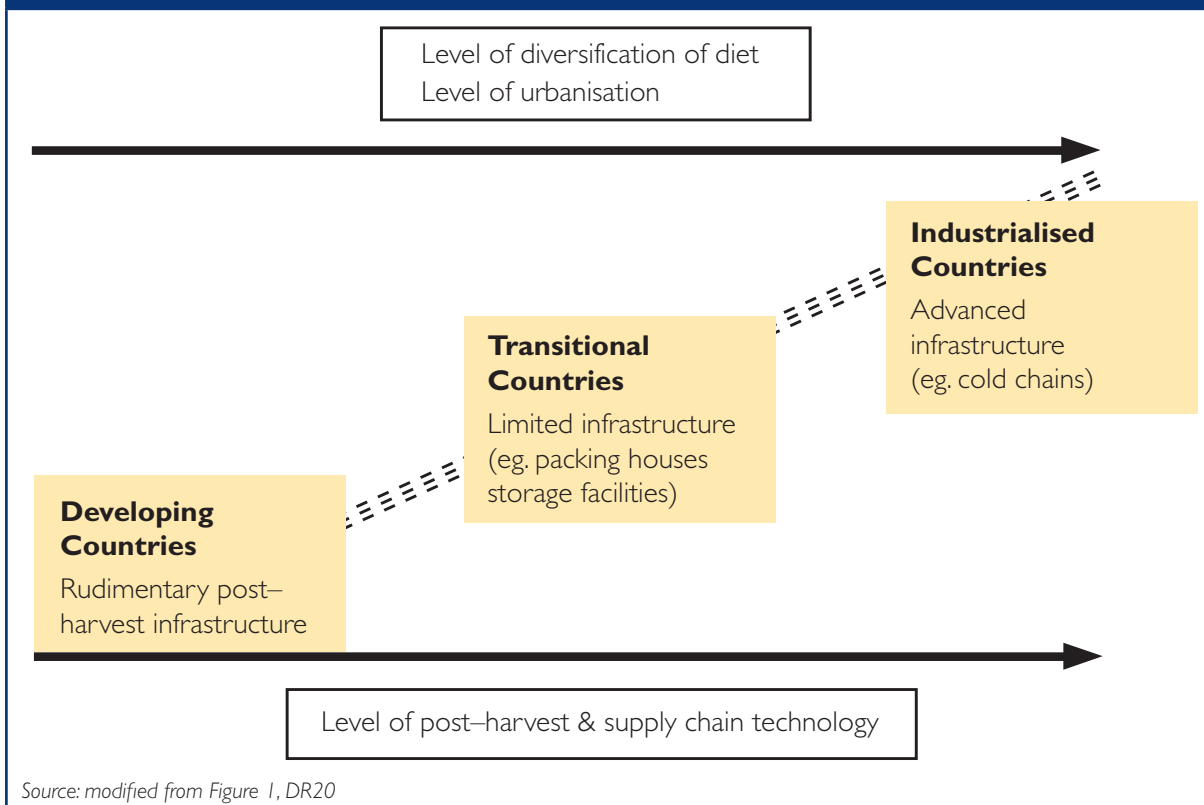
34 Defra (2007)

35 Kader (2005)

36 Garnett (2006)

37 Stuart (2009)

38 WRAP (in press)-b

Figure C7.1: Schematic development of post-harvest infrastructure of the food supply chains

C7.5 Losses in food processing and retail losses

In high-income countries where waste figures are available, total food losses in food processing and retailing can be estimated. Results for the UK indicate that the losses can be very substantial. Much of this waste is diverted into waste treatment options (e.g. anaerobic digestion and composting) and by-product markets, such as animal feed. About 22% of the total UK food and drink waste of 16 million tonnes per annum (which includes all supply chain and consumer sources) is associated with food processing, distribution and retail³⁹. The food and drink manufacturing and processing sector produces an estimated 3.2 million tonnes of food waste per annum⁴⁰. A further 2.2 million tonnes of by-products (not included in the 3.2 million tonnes), are diverted into animal feed⁴¹. Surveys of waste production have identified that a large proportion of manufacturing by-products originate from meat and poultry, fresh fruit and vegetables, and the beverage sectors. There are few published specific data for total food losses incurred by retailers. The US Department of Agriculture (USDA) Economic Research Service found that annual US supermarket losses for 2005 and 2006 averaged 11.4% for fresh fruit, 9.7% for fresh vegetables, and 4.5% for fresh meat, poultry and seafood⁴². Overall, losses in food processing, distribution and retail largely consist of by-products and unsold prepared food products. Mass-balance studies conducted at food and drink manufacturing sites in the UK suggested that about 16% of raw materials were wasted within processes.

39 Communication with WRAP

40 Communication with WRAP

41 WRAP (2010)

42 Buzby et al. (2009)

Table C7.2: Estimates of food and drink waste arising in the UK by sector

Sector	Food and drink waste arising (million tonnes)	Solid food waste sent to landfill (million tonnes)	Notes
Household	8.3	5.1	7.0 million tonnes of food and 1.3 million tonnes of drink
Food manufacturing	3.2	0.55	An additional 2.2 million tonnes, not included in 3.2 million tonnes, consists of by-products sent to animal feed
Retail and distribution	0.37	0.23 (disposed, but not all landfilled)	
Other sources, including hospitality sector and schools	4.0	Fate not fully quantified	
Total	16.0	7.0	

Source: WRAP 2009 and WRAP 2010, with current WRAP estimates for 'Other sources' (unpublished data).

While there have been notable gains in distribution efficiency and control of product quality within the UK supply chain, these trends have brought about other forms of wastage⁴³. Over 7,000 food manufacturers supply a small number of large retailers in the UK. The retailers have developed to serve the consumer demand for choice and quality at the lowest cost, increasing their control over supply chains and market margins. To ensure availability of supply at required specifications, food producers will often overproduce to avoid financial, contractual or market access-related penalties of being unable to supply. For manufacturers of supermarkets' own brands, packaged surplus production cannot be sold elsewhere and becomes waste. A bigger problem for growers, manufacturers and retailers in working together are the changes that can occur between preliminary and final order volumes. Poor demand forecasting, order planning and replenishment systems, or the impact of changing weather, increasingly test the food supply chain's ability to respond to constantly changing consumer behaviour. The example illustrated in Box C7.1 is a fairly typical scenario for products that consumers buy at short notice such as fresh produce and barbecue foods. It is indicative of consumer expectations in high-income countries that they will be able to buy what they want when they want and that successful retailers will meet their demand.

Box C7.1: Responding to consumer demand for lettuces in the UK: towards better demand forecasting

A UK retailer places a provisional order of 100 units of lettuce for the May Bank Holiday Saturday delivery. The weather forecast on the preceding Monday indicates that a heat wave is possible at the weekend and the retailer doubles the order to 200 units. Trucks are dispatched from Spain with the additional lettuce, but en route the weather forecast changes again and the order is cut back to a final order of 100 units. The supplier is then left with the additional lettuce, which is highly perishable. This problem can be particularly protracted given the time it takes to grow produce. On average a lettuce takes around 12 weeks to grow, and yet order volumes can vary dramatically and on a daily basis. Some retailers are now recognising the fundamental challenge arising from the time it takes to grow something and the likely consumer demand levels for that crop when it is harvested. For example, Marks & Spencer in the UK is working towards a demand-forecasting, order-planning and replenishment information technology (IT) platform that will ultimately allow it to assess consumer demand and make inventory decisions in real time while considering both inter-day and intra-day stocking⁴⁴. Of course, unpredictable variations in demand will still influence over- and under-ordering.

43 DR20 (Annex E refers)

44 Quantum Retail (2010)

At the retail and distribution stage, the most recent estimate for the UK suggests that the losses are relatively small at 366 kilotonnes per annum, 2.6% of the total food waste⁴⁵. Small grocery stores produce proportionately more waste than large supermarkets, as the former tend to be used by consumers for top-up shopping, which makes demand unpredictable.

Although the food sector is adept at reusing and treating the majority of food waste that arises⁴⁶, the greatest environmental benefits are likely to accrue through reduction in inputs per unit of product supplied into higher-grade food uses⁴⁷. With real food prices on a downward trend over the past 50 years, there is less economic incentive for food supply chain businesses to implement waste prevention measures and improve utilisation efficiencies through reduced by-product flows⁴⁸. If real food prices rise significantly in the future (as suggested by the modelling in Project Report C4), commercial incentives to reduce waste, particularly towards the primary end of the food chain, would be strengthened.

C7.6 Food waste from consumers

With the historically low cost of food in high-income countries the proportion of disposable income spent on food has declined. As prices have fallen, the choice of food available to consumers has grown, particularly with respect to more perishable foodstuffs. The combination of low prices, the greater proportion of perishable foodstuffs purchased and modern lifestyles provides little incentive for some to reduce food waste⁴⁹. Other influential drivers of the extent of consumer food waste in high-income countries include the growth in single-person households, the reduction in skills and confidence in food preparation and handling and the decline, until recently, of the proportion of disposable income spent on food.

The falling cost of food and tight control over growers has made it possible to raise the quality standards for fresh fruit and vegetables to the point at which wholesome food is discarded for cosmetic blemishes, contributing to the 'out-grading' at the front end of the supply chain described earlier. Many consumers in high-income countries now expect high-quality food with a good appearance to be readily available at low cost. In addition, consumers who might over-purchase to guarantee that they have sufficient quantity and diversity of choice available in the home (or have been incentivised by multiple purchase discounts or by potential savings on larger product packs) will throw away food they no longer want. This tendency has been exacerbated by declining home economics skills and a poor understanding of, and lack of confidence in, date marks⁵⁰ that are applied to food products. Evidence suggests that this confusion is leading to consumers unnecessarily wasting perfectly good food⁵¹.

The scale and timing of the change can be readily seen in the UK. Studies before the Second World War showed that between 1% and 3% of food was wasted in the home⁵². This had grown to around 6% in 1982, depending on the season⁵³, but by 2008 as much as 25% of purchased food was found to be wasted in the home⁵⁴. In other high-income countries the scale of food waste in the home has been found to be similar, ranging from 15% to 25% in, for example, the USA^{55,56} and Australia⁵⁷. Difficulties of measurement suggest that the scale of consumer food waste in high-income countries is probably underestimated. For example, some studies⁵⁸ have measured only food waste that is collected by local

45 WRAP (2010)

46 C-Tech Innovation Ltd (2004)

47 For example, WRAP estimates that for every tonne of household food waste prevented 4.3 tonnes of CO₂ equivalent emissions are avoided, whereas for every tonne of food waste diverted from landfill to anaerobic digestion around 1 tonne of CO₂ equivalent emissions are avoided.

48 Hazell and Wood (2008)

49 DR20 (Annex E refers)

50 'Use by' and 'best before' dates are date marks legally required under EU legislation for particular food products, and relate respectively to food safety or quality. Stock control dates such as 'display until' and the now rarely-used 'sell by' date are intended to be used by retailers for stock management and control purposes.

51 DR20 (Annex E refers)

52 Cathcart and Murray (1939)

53 Osner (1982)

54 WRAP (2008)

55 Griffin et al. (2009)

56 Jones (2003)

57 Morgan (2009)

58 DR20 (Annex E refers)

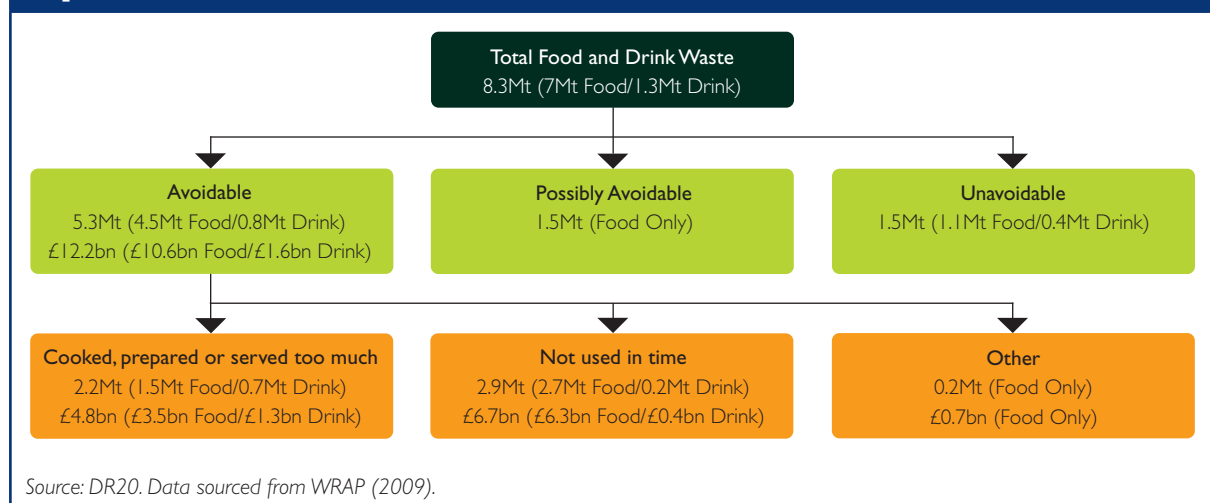
authorities and excluded food waste that is composted in the home, fed to pets or poured down the drain. Household food and drink waste in the UK, at 8.3 million tonnes, makes the largest single contribution to total UK food and drink waste⁵⁹, but food waste arising from other consumer sources is also significant. A further 2.4 million tonnes is estimated to arise from the hospitality and contract catering sectors across the UK⁶⁰. The total weight of food wasted is about one-third of the total food purchased (excluding drink); the majority of this is avoidable/edible (see Figure C7.2).

A small number of in-depth studies in the UK, USA and Australia have considered why high-income countries waste so much food in the home. Leaving aside the low cost of food as a primary driver, they highlight a complex array of underlying consumer attitudes, values and behaviours towards food and how varying degrees of food knowledge affect individual's propensity to waste food. These studies attribute most of the avoidable waste to two factors:

- Too much food was prepared and cooked in the home, a growing problem as the knowledge of how to use leftovers has declined, or food was prepared badly and discarded.
- Food was discarded because it had visibly spoiled or smelled or tasted bad, but also because, although it appeared palatable, it had passed date marks. Although consumers are right to discard food that has passed dates relating to food safety such as 'use by' dates, consumers are also interpreting other date marks such as 'best before', which actually indicate the period in which food is of optimum quality, as meaning that food is unsafe to eat thereafter.

From these studies WRAP⁶¹ has classified different categories of household food waste in the UK according to whether or not it could be avoided (see Figure C7.2). Avoidable waste is defined as food thrown away that was edible prior to disposal, possibly avoidable as it is food that some people would eat but others would not, or food that could be eaten if prepared in a specific manner; unavoidable waste is defined as waste from food preparation that was not edible under any normal circumstance.

Figure C7.2: Classification of UK household food and drink waste by avoidability, reason for disposal and economic value. Mt, million tonnes.



Most studies that have sought to identify the main food types wasted find that it is the most perishable food items that account for the highest proportion. Fresh fruit and vegetables are usually among the most-wasted items, followed by other perishables such as bakery and dairy products, meat and fish⁶². A recent survey in the UK suggests that 15% of all the food and drink purchases that could have been eaten were wasted in 2008, but with significant variations between food groups⁶³. WRAP's analysis, shown in Figure C7.3, suggests that as much as 5.3 million tonnes of food and drink waste generated by UK households could be avoided and 18% (1.5 million tonnes) possibly avoided.

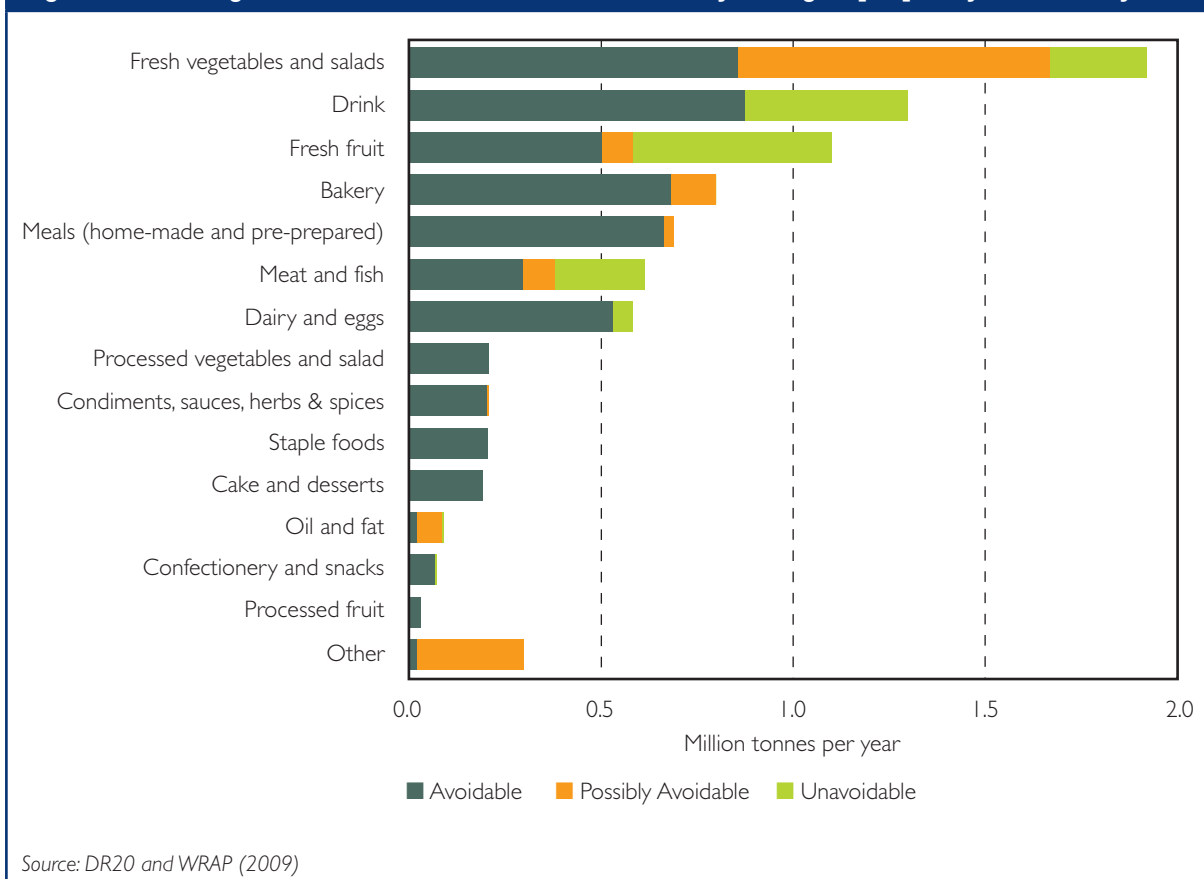
59 DR20 (Annex E refers) and WRAP (2009)

60 WRAP (in press)-a

61 WRAP is the Waste and Resources Action Programme in the UK. See <http://www.wrap.org.uk/>.

62 For further details, see DR20 (Annex E refers).

63 Defra (2010)

Figure C7.3: Weight of food and drink waste in the UK by food group, split by avoidability

Far fewer data are available on wastage in the food service sector, though in countries where eating out is becoming more common, this form of waste is likely to be increasing. The limited data available suggest that 20–30% of food is wasted in schools in the USA⁶⁴, and 20% in food service institutions in Sweden⁶⁵. Cultural factors, such as displaying wealth by leaving food uneaten, or eating only specific parts of banquet food, will also influence wastage.

As yet there are few robust published data on the scale of consumer food waste in low-income countries and emerging economies. In general this issue has received little attention from non-governmental organisations and governments. However, a conclusion from a recent Foresight workshop on global food waste prevention⁶⁶ was that the scale of consumer waste appears to be lower overall, but approaching that of high-income countries in the more affluent communities, particularly in China and Brazil. In much poorer communities, there is typically a wider range of outlets for discarded food, and these cultures commonly permit the most hungry and destitute people to obtain leftover food scraps. The net loss to human consumption can therefore be lower, albeit with higher safety risks, particularly if water used for food preparation is insanitary. For consumers in low-income countries and emerging economies the signs are that, with growing affluence, they are moving towards the waste pattern of high-income countries. There seems no reason to think that, as wealth increases in countries in economic transition, they will not follow the same change in the pattern of wasting more food. The drivers of high-income waste patterns are already there: increasing urbanisation, the development of retail chains raising the standards of produce required, rapid increases in demand for more perishable foods and the decline in the expenditure on food as a proportion of total income.

64 Getlinger et al. (1996)

65 Engstrom and Carlsson-Kanyama (2002)

66 W4 (Annex E refers)

C7.7 Conclusions: the greatest potential for food waste reduction

Halving global food waste by 2050 is considered to be a realistic target, in view of the evidence reviewed by this Report. It is also an important step towards securing food for the likely global population of nine billion people within that timescale. Further increases in primary production on a sufficient scale will be challenging to deliver and put further pressure on the environment and compromise other ecosystem services⁶⁷. If the current global figure of 30% waste is assumed, this would reduce the food required by 2050 by an amount approximately equal to 25% of today's production⁶⁸.

On this basis, it can be argued that global efforts to reduce waste should be given much higher priority. Currently there is insufficient research and support given to this area, with less than 5% of the funding for agricultural research allocated to post-harvest systems⁶⁹. A global objective to reduce losses in the global food supply chain and by consumers would help to rebalance priorities, but this would need to be supported by a systematic benchmarking of current losses, given the paucity of data behind current global loss estimates.

There are three particular reasons for making global food waste reduction a priority:

- Some estimates suggest that waste could account for around 50% of all of current food production⁷⁰ – notwithstanding difficulties in measuring it accurately. Reduction of post-harvest waste in low-income countries and consumer waste in high-income countries offer the greatest potential gains.
- Waste is set to grow substantially in real terms as production increases to meet future demand and as incomes rise – notably in the BRIC countries – and diets become more diversified.
- Addressing waste would contribute to wider policy agendas that are critical for the future: increasing production; improving sustainability; reducing pressure on land use and freshwater resources; and reducing greenhouse gases. This would require continued commitment by governments to deliver real change, including recognition that some aspects of the problem require interventions that run contrary to prevailing market forces.

A strategic target would benefit strongly from high-level political support (at the international level), and be championed by a major international body. This is because many different stakeholders would need to come together to tackle the very different levels and types of waste in different sections of the food chain in different parts of the world.

The following proposals are considered to have particular promise in bringing about a reduction in food waste and contributing to greater sustainability in food production and supply. They are divided into wider policy goals and actions across the food supply chain: those aimed specifically at consumers and the public; further actions for retailers, manufacturers and the food service sectors (in addition to the general supply chain measures); actions in low-income countries; and further work and research.

Wider policy goals and actions across the food supply chain

- **Setting of policy goals by governments in high-income countries and emerging economies for the reduction of food waste as a contribution to a global objective of reducing food waste by 50% by 2050.** The UK has played a pioneering role in developing initiatives to address food waste at all stages of the food supply chain. A number of other high-income countries have recognised the significance of this issue and have taken action. The Nordic countries and the Netherlands have set reduction targets in the short to medium term at a level that, if replicated in all high-income countries, would make the 50% food waste reduction target possible before 2050 in those countries. In the case of the Netherlands an intermediate target of 20% has been set for 2015⁷¹. **For the UK a medium-term aspiration within the region of 10–15% reduction by 2015 would be quite achievable and give direction to voluntary agreements and work on food waste from consumers.**

67 Royal Society (2009)

68 This estimate is intended only to be indicative. It assumes that total waste in the food chain is reduced from an estimated 30% down to 15%. It also assumes that without waste reduction, food production would need to increase by around 70% by 2050, as broadly suggested in Chapter 3.

69 Kader (2003)

70 Lundqvist et al. (2008)

71 Ministry of Agriculture, Nature and Food Quality (2009)

- **Stimulation of gains in resource efficiency and reduction in food waste across food supply chains in high-income countries and emerging economies.** This could be achieved through the extension of voluntary agreements with retailers and international food and drink manufacturers to bring about gains in resource efficiency across the whole supply chain. Food waste is a useful indicator of resource inefficiencies within supply chains, but it is a subset of the more complex set of issues that define their wider sustainability. This agenda requires engagement with the retail food and drink sectors and could be driven through the establishment of voluntary agreements to extend the scope of agricultural extension services or through the agricultural development and crop sustainability groups of the major retailers. This has the potential to improve food quality and safety and increase volumes of marketable food that meet the buying, quality and cosmetic standards of the retailers. Under responsibility deals industry fora could be established to tackle food products with the highest, or most environmentally damaging, wastage rates. These sustainability fora could also be adapted to collect more consistent and up-to-date food loss and wastage data, carry out supply chain resource mapping, benchmark company and supply chain performance and share good practice.
- **Supply chain resource maps.** Working with the food processing and retailing sectors to establish resource maps that illustrate the volume of food lost or wasted at different stages of supply chains in different countries. This builds on the pioneering work being undertaken by WRAP in the UK for fresh fruit and vegetables, meat and poultry, fish and pre-prepared meals. This will improve the availability of up-to-date data and allow for benchmarks to be set, monitored and improved.
- **A review of historic regulations that appear to drive unintended food waste.** For example, in the UK: regulations that restrict or hinder redistribution of donated food from manufacturing and retail sources into 'food banks' for human consumption; a removal of restrictions on the onward sale of unfertilised hatchery eggs to retailers and consumers; more flexibility in the regulations on the repackaging of partially damaged products in store (e.g. where one egg in a box of 12 is damaged or where one soft drinks can is damaged in a multi-pack of eight); a further review of the Animal By-products Regulations, particularly in relation to Category 3, Catering wastes and their potential use in animals feeds under low-risk conditions.
- **Support EU and international strategies to reduce fisheries by-catch and discards.** This includes changes in quota settings from fish landed to total fish caught, discarding bans on on-vessel catch monitoring, better design and operation of fishing gear, improved use and value of all fish landed, and development and application of national and fishery sector by-catch indicators and targets, within a context of improved fisheries management, including where relevant allocated rights.
- **Spreading best practice.** For example, a project in the Netherlands involving modest funding shows how waste in the supply chain from food processing through to the home can be significantly reduced by a combination of education and simple technology.

Actions in low-income countries and donor support for waste reduction

- **Greater investment in storage, packing and transport infrastructure within low-income countries by national governments and the donor communities.** Relatively low-cost interventions that have large benefits in food waste reduction include: basic packaging for transport of fresh produce; innovation in low-technology storage to reduce grain losses on small farms; simple cool chain options that are not fuel intensive. These investments could potentially increase the income of those in the food chain, including growers, particularly if they enable access to more valuable markets. However, the evidence shows that active domestic or international markets and effective local policies for upgrading activities and standards are crucial to achieving success^{72,73}.
- **Connecting smallholder growers in low-income countries to urban/regional and international food chains, possibly linked also with various forms of ethical trading, may well offer the best chance of success⁷⁴.** This includes the use of communications technology (mobile phones in particular) for improving market information and access to other important information (e.g. weather forecasts, locally appropriate crop varieties, agricultural good practice), allowing producers to make better planting, harvesting and supply decisions, meet market requirements and avoid or at least reduce

72 FAO (2003)

73 Kader (2005)

74 For example, the Common Code of the Coffee Community, the Fairtrade scheme and even the investments China is making in African and Brazilian farming to ensure their future food needs.

seasonal gluts and higher wastage rates, and linking artisanal fishers and aquaculturists, whether as individuals or communities, with improved resource management to improve consistency and quality of supply and provide better returns on investment.

- **Targeting of overseas aid to encourage small growers to produce better quality produce for local and regional markets.** This is in a similar way to the United Nations World Food Programme 'Purchase for Progress' initiative, which includes the provision of guaranteed contracts, agricultural extension services and crop insurance to supply to local communities, a social safety net, and food aid from local rather than international sources. Such measures help to reduce post-harvest losses as they encourage investment in post-harvest infrastructure and reduce price fluctuations.
- **Encourage training in the sciences relevant to food storage and distribution issues in low-income countries through dedicated programmes and bursary schemes.** This should include the training of people to support the planning and maintenance of the more advanced post-harvest and food supply chain technologies needed to feed growing urban populations.

Further actions for retailers, manufacturers and the food service sectors

- **Productive recycling of surplus food deemed as not premium quality.** This should follow a preference hierarchy of food redistribution (through schemes such as the UK's Fareshare), used as a component of animal feed or as a source of energy through anaerobic digestion. Waste food used in this way would then make a positive contribution to the global food and energy balance, rather than producing greenhouse gases from landfill.
- **Improvements in demand forecasting.** The expanded use of information technology in food supply chains can be applied to improvements in forecasting of retailer demand and order planning and replenishment to avoid over-production. Such innovations have the potential to shift the balance of the contractual risk of food supply between the retailer and food manufacturer.
- **The development and use of cheap, mass-produced sensor technology that can detect spoilage in certain perishable foods.** This is highly likely within the next four decades, and may have the potential to replace some current date marks and provide a more accurate indicator of freshness or spoilage, which could help reduce waste. Currently a family household in a developed country such as the UK could save up to £680⁷⁵ a year by managing their food better.
- **In food service sectors, campaigns to reduce waste could be initiated for both the supply businesses and the large firms that they serve.** This includes voluntary agreements to reduce food waste with those catering companies supplying the public sector (hospitals, educational institutions, prisons, local and central government)⁷⁶.

Actions to reduce consumer waste and for public education

- **Continued activity aimed at raising awareness of food waste issues among consumers, while also making it easier for consumers not to waste.** Initiatives could follow the approach developed by WRAP in combining simple messages that point to actions that consumers can adopt to reduce food waste and draw attention to cost savings in so doing. The consumer-facing work developed in the UK has been at the forefront of work aimed at the reduction of food waste, and the approach has been incorporated into initiatives in other high-income countries. In making it easier not to waste food, innovations in packaging design, greater consistency in labelling (for example, date stamps and advice on cooking, storage and home freezing) and better design of domestic refrigeration all have a role to play. Approaches to addressing consumer food waste in emerging economies are also increasingly necessary, with work already under way in Brazil⁷⁷.
- **Urgent review of home economics skills and education in schools and colleges in high-income countries to improve in-home food storage, preparation and cooking skills and improve professional practice.** There is a need to counteract the steady loss of home economics skills in the home (meal planning, food preparation and storage, combining leftovers and other ingredients to create new meals) and improve the level of professional training in food retailing and food service and raise awareness of the issue of food waste.

75 WRAP (2009)

76 W4 (Annex E refers): example of Sodexo and Chinese/Brazilian initiatives in waste workshops.

77 W4 (Annex E refers)

Further work and research

- **Further research to improve the evidence base.** Although a start has been made in understanding consumer waste in high-income countries, many important issues remain to be addressed. For example: the root causes and volumes of food waste in the hospitality sector; in-home food waste versus food wasted when eating out in high-income countries; examination of the supply chain characteristics/technologies most likely to reduce food losses through the food supply chain; the role of locally grown food in developing local communities; and longitudinal research to test the impact of behavioural change on food waste reductions.
- **Development of a global benchmarking network to estimate food losses, with priority given to emerging economies.** Many of the data available on losses have not been collected systematically and few measurements are contemporary. If progress is to be made towards a global benchmark for food waste, more empirically based loss estimates are required. Such an undertaking would require strong leadership across international agencies with an interest in food security and development issues. Given the wide variability of food supply chains, it would be unrealistic to gather data from a representative sample of the global food supply chains. A more targeted approach has a greater chance of success, with priority assigned to those systems likely to experience higher wastage rates and focused at the most critical supply chain stages, such as farm to distribution centre for fresh produce in emerging economies. Selected supply chain segments should be monitored to establish how changes in technology and infrastructure have influenced losses. A similar approach to the resource mapping of the supply chain developed in the UK could be adopted.

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