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Resources on:

Addressing Food Waste in Times of Crisis¹

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Addressing Food Waste in Times of Crisis¹

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¹This Reader is not intended to exhaustively cover the issue of the challenges facing ACP Small island economies, but to provide some background information and selected information resources, focusing on the implications for rural development. The Reader and most of the resources are available on <http://brusselsbriefings.net>

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1. Context

Food production must clearly increase significantly to meet the future demands of a growing and more affluent world population. Considering the number of people starving worldwide - 925 million in 2010² - and the growing population - 9 billion people by 2050 - the subject of food losses and waste has become one of utmost concern.³ It is also a critical issue due to its links to agriculture, food security, trade, energy and environment and the complex causes, effects, actors involved and sectors affected.⁴ The exact causes of food losses and waste vary in low-income and medium- and high-income countries and largely depend on the specific conditions and local situation in each country.⁵ In this context, it is necessary to increase awareness of the economic, social and environmental challenges related to food losses and waste, and to emphasize the importance of respecting food through responsible consumer behavior and changes in attitudes to food.⁶ Given that many smallholder farmers in developing countries live on the margins of food security, a reduction in food losses could have an immediate and significant impact on their livelihoods.

In low-income countries where poverty and limited household income are widespread, less food is wasted at the consumer level than in medium- and high-income countries due to the awareness of food insecurity. Consumers often buy smaller amounts of food products and plan meals more, while abundance and higher incomes lead to the opposite in medium- and high-income countries.⁷

Although the problem of losses and waste is different in developed

and developing countries, we have chosen to look at both trends under the umbrella of wasting food in times of crisis and scarcity.

1.1. Examples of Initiatives to Address Food Waste and Food Losses

a) At the Global Level

When the Food and Agricultural Organization (FAO) was established in 1945 the reduction of food losses was within its mandate. In 1974, the reduction of food losses was first identified by the World Food Conference as being part of the solution to address world hunger and FAO resolved to bring about a 50% reduction in postharvest losses by 1985. A Special Action Program for the Prevention of Food Losses was established by the FAO with a focus on technological solutions to reduce losses in durable grain. The scope of the work broadened in the early 1990s, when it began to include roots, tubers and fresh fruits and vegetables (FFVs). However, poor adoption rates for interventions led to the recognition that a purely technical focus was inadequate for solving problems within the sector and a more holistic approach was developed.⁸

Recently, Lundqvist et al. (2008) have called for action to reduce food losses 'from farm to fork' and again advocated a 50% reduction in postharvest losses to be achieved by 2025. Benchmarking global estimates of postharvest and post-consumer losses would require extensive

data to be collected to provide a systematic analysis across different types of supply chain and produce, to reflect varying levels of development, technology and food culture.

FAO: SAVE FOOD campaign

The SAVE FOOD campaign was established in 2011, as a Global Initiative on Food Losses and Waste Reduction, aiming to reduce the estimated 1.3 billion tonnes of food that are lost or wasted every year, valued at nearly one trillion US dollars. The initiative aims to cut food losses and boost sustainability and currently has over 50 partners. FAO continues to call on companies and organizations, both in the private as well as non-profit sectors, to join the SAVE FOOD initiative to contribute to developing new technologies, better practices, coordination and investments in infrastructure - in the areas ranging from food production to consumption.

b) At the European Level

European Parliament Resolution to Halve Food Wastage in the EU

In January 2012, the European Parliament called in a resolution for urgent measures to halve food waste by 2025 and to improve access to food for EU citizens in need. Indeed, up to 50% of edible and healthy food gets wasted in EU households, supermarkets, restaurants and along the food supply chain each year, while 79 million EU citizens live beneath the poverty line and 16 million depend on food aid from charitable institutions. The current waste in EU27 is 89 million tonnes per year (179 kg per capita). Members of Parliament have called for a more coordinated strategy that combines EU-wide as well as national

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measures to improve the efficiency of the food supply and consumption chains and to urgently tackle food wastage. Emphasis is being put on awareness-raising and education to better inform the public on how to prevent wasting food, better labeling by distinguishing between sell-by and use-by dates, promoting the availability of different package sizes, and increasing the responsibility of catering companies to use local produce and redistribute leftover food to poorer people or food banks.⁹

EU Fisheries Discards Ban

For the first time in four decades, the wasteful practice of throwing away healthy and edible fish at sea will come to an end in Europe, in a partial victory for environmental campaigners who have viewed a discards ban as the key step to preserving fish stocks. Indeed, more than 1 million tonnes of healthy fish are annually thrown back dead into the sea by fishermen. However, the date for this ban to come into force is still in question among environmental groups who fear that its implementation may be too late to save certain species. A ban on discarding certain types of fish, such as mackerel and herring, is likely from 2013, while a ban for other species under pressure, such as cod, haddock and sole, may not be fully implemented until 2010. Greenpeace has claimed that this demonstrates a stubborn resistance to change tack and leaves the EU fisheries reform hanging in the balance. However, Maria Damanaki, the EU fisheries chief, stated that the plans to implement the ban should be seen as a compromise and a step forward in the right direction.¹⁰

Stop Wasting Food

Stop Wasting Food is a non-profit consumer movement against food waste. In Denmark alone, food worth 2,15 billion EUR is wasted every year. *Stop Wasting Food* was founded by Selina Juul in 2008 and has since earned the support of several thousands of Danish consumers, Members of the Danish Parliament, Members of the European Parliament, top chefs and Michelin restaurants, as well as leading Danish food personalities. The movement aims to raise public awareness on food waste through campaigns, publicity, press, discussions, debates, events and other information channels, and to minimize food waste among consumers. *Stop Wasting Food* also inspires consumers to act locally, for example by donating edible surplus food to shelters for homeless people.¹¹

Last Minute Market

The Italian initiative, *Last Minute Market* (LMM), seeks to enhance the redistribution of unsold goods to charitable organizations in the country. LMM developed from a research project within the Faculty of Agriculture of the University of Bologna in 1998. LMM offers services to enterprises and institutions, in order to prevent and reduce waste production at its origin, including promoting the management of surplus food in innovative ways, reducing costs for the disposal of waste and improving linkages among companies, public institutions and the community.¹²

Love Food Hate Waste

Love Food Hate Waste aims to raise awareness of the need to reduce food waste and encourage citizens

to take action. It demonstrates that through certain simple practical everyday action in households it is possible to waste less food, which will ultimately decrease economic losses and benefit the environment. *Love Food Hate Waste* is an initiative by WRAP (Waste and Resources Action Programme) in England, Scotland, Wales and Northern Ireland to help businesses and individuals reap the benefits of reducing waste, develop sustainable products and use resources in an efficient way.¹³

c) Initiatives to Reduce Post-harvest Losses in Africa

African Development Bank

The African Development Bank (AfDB) with the support of FAO has been helping the Rwandan government to restore and improve the Rwandan fisheries sector within the project 'Inland Lakes Integrated Development and Management Support Project' (PAIGELAC). Through training in fisheries management and improving fishing techniques, the aim is to support the provision of fisheries infrastructures (such as cold storage and ice making machines at selected sites), reducing post-harvest losses and increasing the value of the fish landed.¹⁴

In 2008, the AfDB also implemented a 3-year project to scale up the rural infrastructure necessary to reduce post-harvest losses (PHL) and expand agro-processing by: a) constructing or rehabilitating 22,100 km of feeder roads, 820 market facilities and 5,412 storage facilities b) working with partners (FAO, UNIDO, NEPAD and IIRRI) to develop a specific PHL Strategy for

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Africa with the target of reducing 0.5% of post-harvest losses per year c) using bank interventions in Technical and Vocational Training to target the strengthening of human capacity in the area of post-harvest management and food technology in relevant programs.¹⁵

AfDB's Agriculture and Agro-Industry Department (OSAN) began the process of developing a Post-harvest Losses Programme (PHLP) in 2009, in order to enable countries to achieve supply-chain efficiencies through targeted investments in rural infrastructure, post-harvest and agro-processing technologies to contribute to reducing PHL, improving food availability and enhancing product quality in a sustainable manner.¹⁶

The Gambia Artisanal Fisheries Development Project was established in 2009 with one of the aims being the improvement of infrastructure and access to inland fishing, in order to reduce PHL through the availability of potable water, cold storage and better hygiene standards.¹⁷

African Union Commission

In July 2011, the African Union Commission (AUC) signed a Memorandum of Understanding (MoU) with FAO on reducing post-harvest losses. The MoU defined the areas of cooperation between the two bodies to support regional capacity in reducing post-harvest losses, and reducing food and nutrition insecurity. The objective of the project is to fill gaps through training of regional institutions, national government officials and development agencies in designing

policies, strategies and investment programs that target the reduction of PHL as well as identify and implement country-level PHL reduction projects and the use of PHL assessment methodologies and assessment tools. The program will continue until 2014 with total indicative costs of US\$ 1,7 million.¹⁸

The Learning Alliance Approach

The learning alliance approach has been applied to postharvest research projects, in order to encourage joint work between research organizations, development agencies, policy makers and private businesses who contribute to identifying, sharing and adapting good practices in research and development. The Post-Harvest Innovation Learning Alliance (PHILA) was established to boost cooperation among organizations and individuals with post-harvest interests to address the underlying post-harvest problems confronting many poor households. It was active in Tanzania and Zimbabwe and addressed relevant postharvest issues. Information and reports on specific case studies were shared among the team members. However, the project timeframe was not long enough to go beyond these achievements.¹⁹

d) Initiatives to Reduce PHL in the Pacific

Post-harvest treatment of fresh produce in the Pacific usually consists of moistening green vegetables, in order to preserve their freshness while they are displayed at the market, as cooling storage facilities are mainly owned by exporters, importers and supermarkets and are not available

for domestic marketing purposes. Packaging in the island countries is basic, using traditional materials, such as baskets woven from coconut fronds. Farmers generally do not use materials for packing fresh produce when selling on local markets, as the material for this is expensive. The general consideration for post-harvest handling of produce is very low, and farmers and retailers often lack the information on post-harvest handling of fresh produce, proper packaging, transportation and storage of produce before sale. This leads to exposure to considerable damage and a shorter shelf life for fresh produce.

Samoa was one of the first leading islands to develop the post-harvest sector in fresh produce through the fruit tree development program, which started in 1987. In other Pacific islands, such as the Cook Islands, post-harvest issues have been generally addressed indirectly in the context of quarantine protocols, such as the adaptation of the High Temperature Forced-Air Cooling unit, used in the Cook Islands, Tonga, Fiji and New Caledonia as a post-harvest quarantine disinfestations treatment against fruit flies for fresh produce.²⁰

The Papua New Guinea National Agricultural Research Institute (NARI) has emphasized the importance of improving post-harvest activities, including product handling, cool chain arrangement, storage, packaging, quality management, food hygiene and safety, in order to preserve and enhance the quality and value of Papua New Guinea's agricultural commodities (root and tuber crops,

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vegetables, fruits and nuts, tree crops, livestock products and feeds). NARI suggests processing root and tuber crops for chips, flour, bread, as well as avoiding losses of fruits and vegetables by processing them into fruit juices, concentrates, jams, chutneys and other products. The options for processing rice and cereal grains are flour and canned or frozen goods, and peanuts and soybeans can be processed into spreads and vegetable oil. A popular crop in Papua New Guinea is vanilla, which can be processed into extracts and powder for the food, perfumery and medical industries. Strong emphasis has also been put on research and development, in order to develop techniques to avoid losses, quality deterioration and wastage during handling, transportation, storage,

marketing, ensuring product safety and improving health and nutrition.²¹

e) Initiatives to Reduce PHL in the Caribbean

A project was implemented from 1986 – 89 with FAO assistance in Antigua and Barbuda, Barbados, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago with the objective of reducing PHL of horticultural produce at the country level, particularly for produce entering inter-island trade. This was to be done by improving harvesting, handling shipping and marketing of horticultural produce, creating a core of public and private-sector personnel with knowledge of post-harvest handling activities for

horticultural produce, identifying and preparing national projects geared to better post-harvest handling of agricultural produce, improving facilities for the preparation and storage of produce, and producing training materials on improved post-harvest handling of produce.²²

The Caribbean island of Jamaica has a long history of utilizing herbs and spices for the preservation of food, which improves the shelf-life of meat, fruits and vegetables and reduces PHL. Other opportunities exist in processing exotic products, such as chutneys, sauces and beverages. Furthermore, there is a strict quality-control regime of herbs, in order to prevent microbiological contamination of herbs and spices.²³



2. The Scale of Food Waste

Postharvest losses refer to the measurable quantitative and qualitative food loss in the postharvest system and comprise interconnected activities from the time of harvest to crop processing, marketing and food preparation, up until the final decision by the consumer to eat or discard the food. The term 'food loss' can be defined as any reduction in food available for human consumption taking place in the food chain from the moment of harvest until the moment of consumption.²⁴ At later stages of the food supply chain, the term 'food waste' is applied and generally relates to behavioral issues and a deliberate discarding of edible food.²⁵

Crop losses usually occur due to pests and natural hazards, along with food waste in storage, distribution, marketing and at the HH level.²⁶ It is important to distinguish between perishable and non-perishable

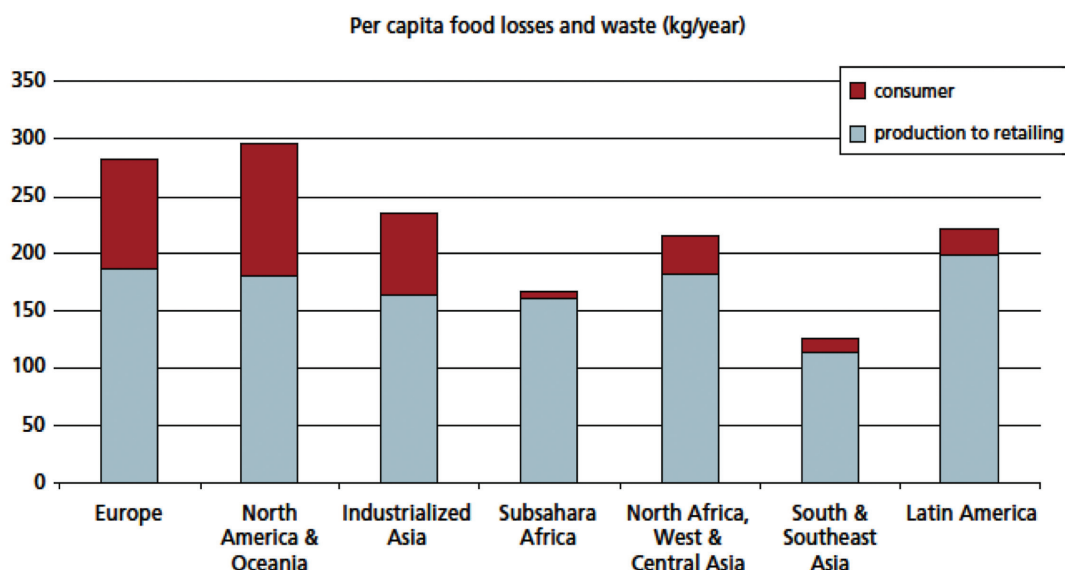
food stuffs because the causes and rates are different for both. For non-perishable food crops, grain losses occur due to physical losses (spillage, consumed by pests) or a loss in quality.²⁷ For perishable crops, losses can occur during handling or storage, with the largest losses occurring for fresh fruit and vegetables (percentage, volumes, financial, energy).²⁸

Estimates relating to the scale of global food waste vary, yet there is consensus that waste is substantial.²⁹ Overall, on a per-capita basis, much more food is wasted in industrialized countries than in developing countries. It is estimated that the per capita food waste by consumers in Europe and North-America is 95 - 115 kg/year.³⁰ In the EU, the total food loss of both avoidable and inevitable food is estimated at 89 million tonnes per year, with households (43%) and

the food industry (39%) taking the largest share of food loss.³¹

Not only is edible food discarded that could feed the many people who need it, but the rate of loss could save consumers and manufacturers tens of billions of dollars each year. Consumers and retailers are responsible for minimizing food waste, but it is manufacturers, who are being squeezed by high raw material prices and low retail costs, that stand to gain most by establishing greater operational efficiencies, in order to decrease unnecessary waste. Of course, a certain amount of waste in the food stream is unavoidable, for instance waste caused by weather and crop deterioration. However, the impetus is on minimizing waste, especially considering that reducing food waste would significantly contribute to reducing serious environmental problems.³²

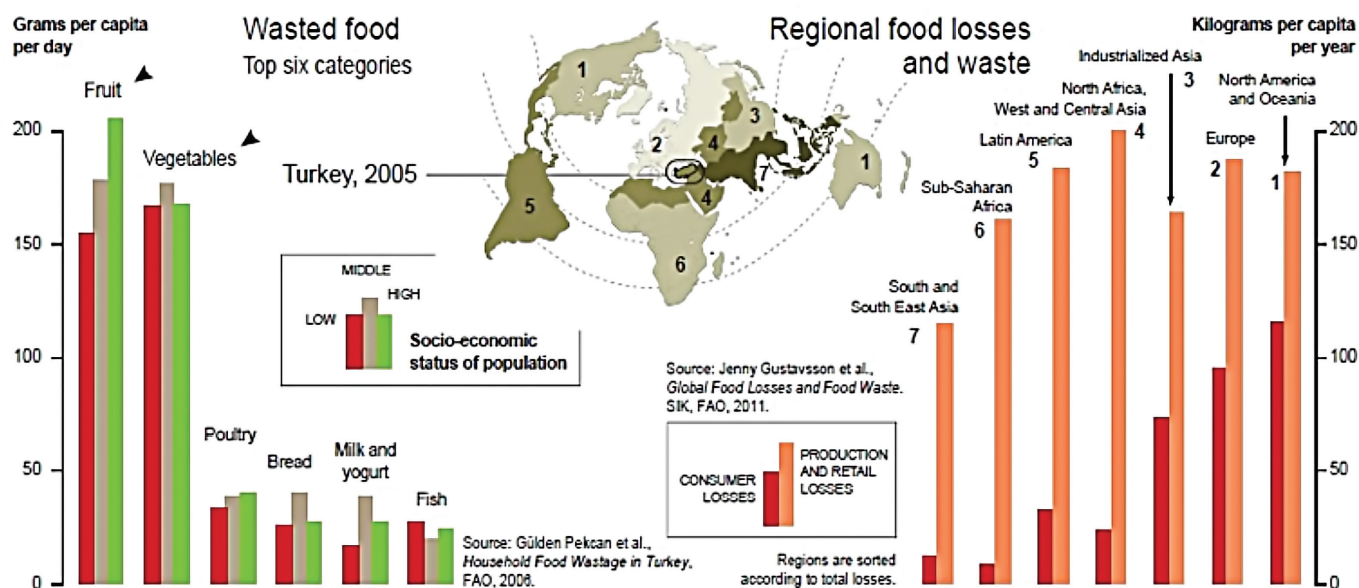
Figure 1: Per-Capita Food Losses and Waste at consumption and pre-consumption stages



Source: FAO, Global food losses and food waste, 2011

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Figure 2: Global Food Losses and Waste



Source: Secretariat of the Basel Convention, Vital Waste Graphics 3, 2012

2.1. In High-income Countries

In the United States, where the food supply is the most varied and abundant,³³ 30% of all food is thrown away each year, worth US\$48.30 billion (EUR32.5 billion). It is estimated that almost half of the water used to produce this food goes to waste. Depending on the industry, losses at the farm level are approximately 15 – 35%. The retail sector experiences high rates of loss at around 26%, while supermarkets only lose about 1%. Overall losses amount to around US\$90 – 100 billion per year.³⁴ It is estimated that about half of the water used to produce this food also goes to waste. Losses of FFVs have been estimated to range from 2% to 23%, depending on the commodity, with an overall

average of about 12% losses between production and consumption sites.³⁵

In the US and Britain, studies have concluded that a quarter of food from shops is wasted with salads being on the top of the list (half of all salads). One-third of bread, a quarter of fruit and a fifth of vegetables are all wasted. In the US this amounted to 43 million tonnes of food in 1997; in Britain 4 million tonnes in 2006.³⁶

In the United Kingdom alone, households waste an estimated 6.7 million tonnes of food every year, around one third of the 21.7 million tonnes purchased. This means that approximately 32% of all food purchased per year is not eaten. Most of the food waste (4.1 million tonnes or 61%) is avoidable and could be eaten if it were

better managed. Approximately 14 megatonnes of food and drink are wasted, of which 20% is associated with food processing, distribution and retail. Household food waste makes the largest single contribution. Surveys have also identified that a large proportion of waste originate from the meat, poultry, FFVs and beverage sectors.³⁷

In the Netherlands, €2 billion worth of food and food ingredients is wasted annually in the food chain; during harvesting or processing, upon storage, and in retail distribution. In Sweden, approximately 50% of food is lost and wasted in the food supply chain.³⁸

Overall in the European Union, total food loss is estimated at 89 million tonnes per year, with households



(43%) and the food industry (39%) taking the largest share of food loss.³⁹

2.2. Significance of BRIC countries in Global Food Waste

The four BRIC (Brazil, Russia, India, China) countries account for over a quarter of the world's land area and more than 40% of the world's population. The economic emergence of the BRICs will have unpredictable consequences on the global environment and patterns for food supply until 2050. Over recent years, BRIC countries have been the major influence on changing food production and consumption patterns in the world economy.

In India, losses for cereals and oil seeds are much lower, about 10–12%, according to the Food Corporation

of India. Some 23 million tonnes of food cereals, 12 million tonnes of fruits and 21 million tonnes of vegetables are lost each year, with a total estimated value of 240 billion Rupees.⁴⁰

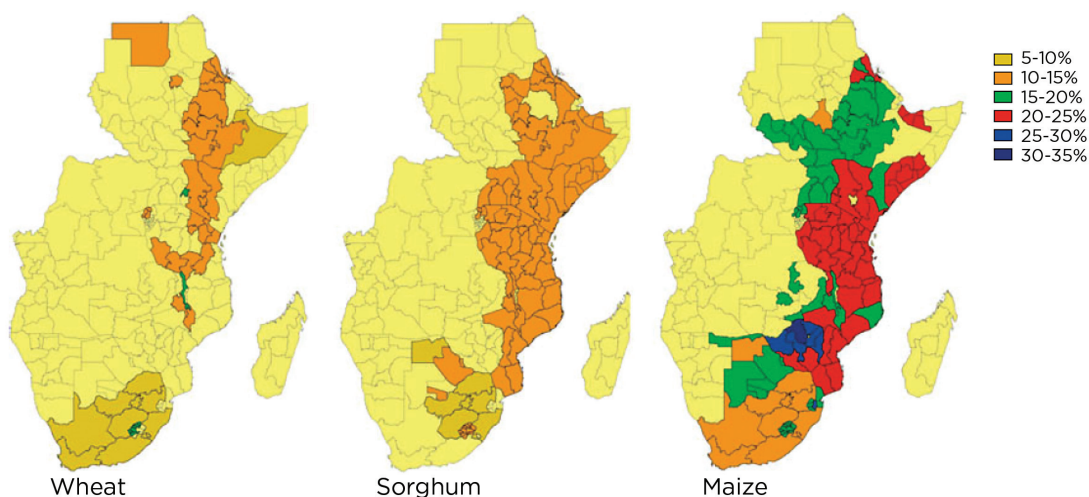
The current situation relating to PHL in China provides comparable data to Brazil for both fresh produce and grains. Estimates range from 15–20% of grain supplies, equivalent to 75 to 100 million tonnes per annum. In BRIC nations, where transport infrastructure is not as developed as OECD countries, storage and distribution are more relevant. OECD countries can operate on a just-in-time delivery policy, where transport infrastructure is developed fully to accommodate short-term variations in demands for food. China was given as an example of a country where the transport infrastructure is not as efficient compared to other nations and therefore requires more efficient storage systems. Here poor

distribution infrastructure is a driver of storage.⁴¹

2.3. In Low-income Countries

In low-income countries, food is mainly lost during the early and middle stages (production to processing stages) of the food supply chain (FSC); much less food is wasted at the consumer level.⁴² Crop losses usually occur due to pests and natural hazards, along with food waste in storage, distribution, and marketing and at the household level.⁴³ For non-perishable food crops, grain losses occur due to physical losses (spillage, consumed by pests) or a loss in quality.⁴⁴ For perishable crops, losses can occur during handling or storage, with the largest losses occurring for fruit and vegetables.⁴⁵

Figure 3: Estimated % cumulative post-harvest weight loss from wheat, sorghum, maize for countries in East and Southern Africa for 2007



Source : APHLIS Africa. Africa Post Harvest Losses Information System, 2011

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In many African countries, the PHL of food cereals are estimated at 25% of the total crop harvested. For some crops, such as fruits, vegetables and root crops, being less hardy than cereals, PHL can reach an estimated 50%. In East Africa and the Near East, economic losses in the dairy sector due to spoilage and waste are estimated to average as much as US\$90 million/year. In Kenya, each year around 95 million liters of milk, worth around US\$22.4 million, are lost. Cumulative losses in Tanzania amount to about 59.5 million liters of milk each year, over 16% of total dairy production during the dry season and 25% in the wet season. In Uganda, approximately 27% of all milk produced is lost, equivalent to US\$23 million/year.⁴⁶

Data relating to post-harvest losses in the Caribbean is not widely available. While inter-island trade in fresh produce is significant, and has provided a source of revenue to small-scale farmers, it is characterized by inadequate infrastructure relating to market information, produce preparation and packing facilities, packaging materials, sea transport and wholesale facilities in the importing islands. As a result, PHL tend to be high with estimates at around 20 - 50%.⁴⁷

The post-harvest constraints faced by Pacific Island countries are mainly found in the areas of transportation and packaging, quality control, pests and diseases. Factors including post-harvest training and research, organic farming, processing and quarantine are issues that need to be considered, in order to improve the development of the export of fresh produce.⁴⁸

2.4. How are Food Losses and Waste measured?

Estimates suggest that as much as half of all food is lost or wasted before and after it reach the consumer.⁴⁹ However, the evidence base available, which is used to benchmark global food waste, is poorly developed at all stages of the FSC in both industrialized and least developed countries (LDCs).⁵⁰

PHL estimates date mainly from the 1970s and 1980s, and therefore do not take account of the rapid changes in the global economy and FSCs that have occurred over the last 20-30 years, especially with respect to BRIC and transitional economies. This is particularly the case for estimates of losses relating to FFVs, dairy, meat and fish supply chains. There is also a general lack of field measurements underpinning the available post-harvest loss estimates and poor referencing of the climatic, technological and cultural factors contributing to particular estimates, leading to inappropriate extrapolation to a wider picture. At the post-consumer stage, loss estimates are mostly limited to OECD countries, using different estimation methodologies, terminologies and units of measurement, making comparability difficult to achieve.⁵¹

The accurate measurement of PHL is a complex problem, even within the defined boundaries of a single crop/food type, locality, level of technology and season. The causative and interlinked factors in losses for different crop types in different environments

are extremely varied. Agricultural systems and their associated FSCs contain many intervening human variables that cannot be easily controlled for in research design, as well as exogenous factors that may influence loss estimates.

For areas at risk from changing patterns of rainfall and dry seasons as a result of climate change, it will become increasingly challenging to define 'typical' conditions to which loss estimates relate. There is an urgent need to improve and standardize the methodologies for loss assessment, to justify with greater certainty the development and introduction of measures designed to reduce losses in a cost effective way.

Challenges in measuring food losses and waste are due to the following factors:

- Food waste studies that have been published until now are heterogeneous and difficult to compare. Among the contemporary methodologies that are used to quantify food waste are: (i) Weighing food waste in households (ii) Using kitchen diaries to monitor food waste and consumer behavior (iii) Archaeological excavations of landfill sites to determine historical levels of food waste⁵² (iv) Using statistical models relating to population metabolism and body weight⁵³ (v) Estimating the environmental impact of food waste, including the embodied GHG emissions or wasted water.⁵⁴
- There are no harmonized methods available for measuring food

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waste.⁵⁵ Generally, estimations of PHL are not very reliable, particularly because most often it is unknown what was there at the outset. Indeed, most estimates are only approximates, especially in LDCs.⁵⁶ Data pertaining to geographical food losses is also unreliable. PHL of grain in developing countries are suspected to be overestimated, as most of the PHL data for developing countries was collected over 30 years ago. Furthermore, extensive data on food waste is still unknown for

the BRIC economies.⁵⁷ There are major data gaps in the knowledge of global food losses and waste and further research into this area is urgently needed.⁵⁸

- Measurements of food loss or waste are only based on products that are directed to human consumption and exclude waste directed to a non-food use, such as feed and bio-energy, and parts of products that are not edible.⁵⁹ In developing countries it is typical that agricultural produce and residues are used

for different purposes at the farm level, for feed, bioenergy and soil amelioration.⁶⁰

- Many of the studies on which current estimates are based date back to the mid-1970s or before, despite the significant changes in the food marketing systems that have been made since then, including innovations in food processing, technology and unprecedented growth in the foodservice sector.⁶¹

3. Causes of food losses and waste

Food is lost or wasted at all stages of the FSC, from the initial agricultural production to the final household consumption.⁶² While food waste and loss vary by region and by stage in the FSC, we can say that overall food losses in low-income countries occur in the production, storage and distribution stages of supply chains, as opposed to the consumption stage in medium- and high-income countries.

Food losses and waste are problems in every part of the world. However, there are differences in causes, effects and stages at which losses and waste occur among low-income countries and medium- and high-income countries. Indeed, there is a link between income level and the stage of loss in the food supply chain with richer countries experiencing a higher loss at the end of the chain, while poorer countries mainly

encounter loss at the beginning of the chain.⁶³ Due to more and more of the world’s population leaving agricultural areas and moving to urban centers, the FSC has become longer and more complex in terms of distribution, supply systems and geographical distances between production and consumption.⁶⁴

Figure 4: Losses in the FSC



Source : Foresight Project, The Government Office for Science of UK, 2010

Limited data suggests that losses are much higher at the immediate post-harvest stages in low-income countries and higher for perishable foods in medium- and high-income countries. The main difference between the two is that FFVs infrastructure losses are greater in low-income than in medium- and high-income countries.⁶⁵

3.1. In Low-income Countries

Food losses in low-income countries mainly occur due to a lack of appropriate storage and an inadequate distribution system. At the middle stage of the supply chain, food is lost during processing, wholesale and retail.⁶⁶ Food losses and waste mainly occur due to financial, managerial and technical limitations in food production and post-harvest processing techniques, storage and cooling facilities in difficult climatic conditions, infrastructure, packaging

and marketing systems,⁶⁷ as well as other factors including high insect infestations, unwanted microbial growth, injuries and blemishes due to improper handling or transportation, as along with high temperatures and humidity during growth and harvesting.⁶⁸

The largest PHL occur on or near the farm, where the initial choice of crop type and variety and the success of harvesting and consolidation methods are fundamental in keeping losses low.⁶⁹ In many African countries, the PHL of food grains are estimated at 25% of the total crop

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harvested and up to 50% for other crops, such as fruits, vegetables and root crops.⁷⁰ Depending on the crop, approximately 15 – 35% of food may be lost in the field due to poor agricultural techniques and

other factors, including droughts, flooding and pests. Another 10 – 15% is lost during processing, transport and storage due to a lack of modern facilities, trucks and access to refrigeration.⁷¹ Another cause of

PHL is the damage caused to crops during handling, for example grains may be scattered, dispersed or crushed⁷²

Box 1: Economic Losses in the Dairy Sector in East Africa and the Near East

Economic losses in the dairy sector are a result of spoilage and waste and are estimated at US\$90 million per year. In these hot and humid climates perishable food items are extremely vulnerable, especially without adequate storage and transport facilities.

- Kenya: around 95 million liters of milk are lost each year, worth around US\$22.4 million
- Tanzania: about 59.5 liters of milk are lost each year, over 15% of the total dairy production during the dry season and 25% in the wet season
- Uganda: approximately 27% of all milk produced is lost, worth around US\$23 million per year

Source: Lundqvist et al., *Saving Water: From Field to Fork*, 2008

Contrary to medium- and high-income countries, the majority of waste in low-income countries has financial causes, rather than behavioral, particularly in relation to storage facilities and infrastructure. For instance, grain is often heaped on the ground and merely covered with a sheet, enabling easy access for rodents.⁷³ Losses could be reduced by constructing sturdy silos and providing more refrigeration facilities, both of which are expensive.⁷⁴ A variety of different storage structures are available according to the scale of operation and may either be open to air exchange or airtight (hermetic). Hermetic stores by themselves prevent pest damage. Grains can be stored in sacks of various types on both a small and large scale. For medium- or long-term storage, hermetic sacks may be used when benefits outweigh

costs. In other situations, traditional mud stores (as well as more modern plastic or metal silos) may significantly reduce the PHL of smallholders.⁷⁵

3.2. In Middle and High-income Countries

In middle and high-income countries, food is wasted to a significant extent at the consumption stage, with food usually being discarded in spite of its suitability for human consumption.⁷⁶ Processing, distribution and retailing are also responsible for the amount of food losses. Over-ordering of stock, cosmetic imperfections (weight, size, shape and appearance) and other issues contribute to food waste.⁷⁷ Furthermore, higher 'appearance quality standards' by supermarkets

for fresh products have led to a rise in food waste.⁷⁸ Increasingly strict rules and labeling of food due to consumers' increasingly high standards and expectations have resulted in a large part of the food supply being unsold or withdrawn from the food supply chain. Expiration dates are also a leading cause of food wastage and are often considered as 'safety dates'.

The extent of waste is partly a reflection of prices: food is cheap enough for consumers to not worry about wasting it.⁷⁹ As reported by the United Nations Environmental Programme (UNEP), food waste is responsible for several environmental problems that range from the wasteful use of chemicals, such as fertilizers and pesticides to more fuel being used for the transportation and production of chemical inputs, and even more rotting food creating

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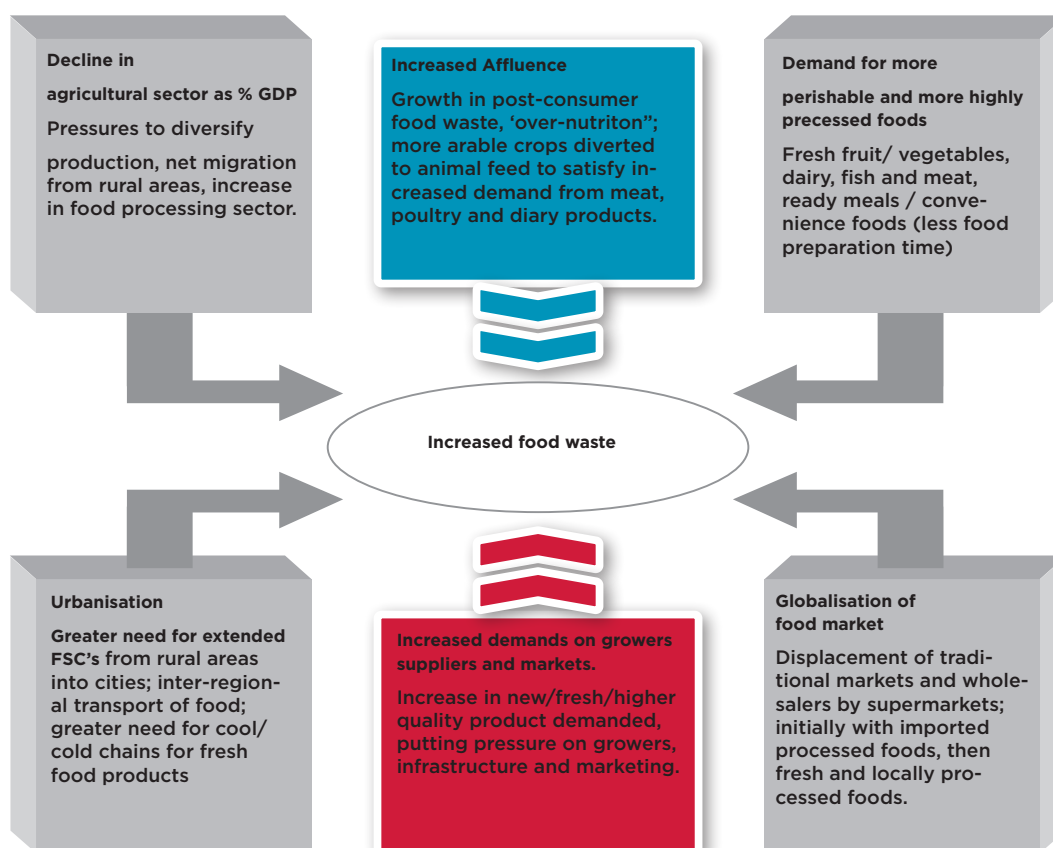
methane - one of the most harmful greenhouse gases that contribute to climate change.

In medium- and high-income countries, food losses often occur in the later stages of the food supply chain due to transportation losses during processing, poor temperature management, trimming scraps.⁸⁰ Most food losses occur at the consumer level than from the actions of retailers.⁸¹ In households, waste occurs due to spoiled food, expiration dates, leftovers

from meals and a general lack of carelessness or knowledge about correct storage conditions and shelf lives of different food products as well as poor planning of grocery shopping, cooking and the limited availability of smaller packaging sizes.⁸² Food merchandizing has also changed with greater emphasis on coupons, discount offers and super-sizing or portions, leading consumers to increase their expectations of serving sizes and buying more than they need.⁸³ The discard of edible food in retail, food services and

households is the biggest problem in these countries.⁸⁴ Significant losses in the first segments of the food chain in the rich countries depend on what food is being produced, for instance, quite significant volumes of food are lost and wasted in the US, losses at the farm level are about 15 – 35%, depending on the industry.⁸⁵ Generally, the widespread use of mechanization and cold chain technologies keep on-farm PHL lower than those in low-income countries.⁸⁶

Figure 5: Factors influencing food waste in BRIC/transition economies



Source: Foresight Project on Global Food and Farming Futures Science, 2010



3.3. Consumer Behavior, Appearance Quality Standards and Consumer Attitudes

One of the main causes of food loss and waste in medium- and high-income countries is a result of consumer behavior. Consumers' demands in medium- and high-income countries for a variety of food, animal products, FFVs and other sensitive and perishable food items have led to a higher risk of losses and waste of food.⁸⁷ The increasing preference for animal food items, FFVs tends to shorten the durability of food and increase losses and waste.⁸⁸ Livestock products, fish and FFVs lose value very quickly without proper refrigeration.⁸⁹

Higher 'appearance quality standards' from supermarkets for fresh products

have also led to increased food waste.⁹⁰ Produce is rejected by supermarkets at the farm gate if it does not comply with the rigorous quality standards relating to weight, size, shape and appearance of crops because supermarkets often believe that consumers will not buy food that does not have the expected weight, size or appearance. Increasingly strict rules and labeling of food along with consumers' increasingly high standards and expectations lead to a large part of the food supply being unsold or withdrawn from the FSC.

Furthermore, other concerns, including public health, environmental and ethical issues are becoming more and more important in the FSC. With consumers increasingly concerned about food safety and demanding high quality fresh produce, more and more food is being thrown away in spite of its suitability for consumption.⁹¹

These consumer choices are influenced by moral, normative,

emotional and social factors.⁹² One of the most important reasons for food waste at the consumption level is the fact that the population can afford to waste food due to its abundance. In both the US and the EU, the last decades have seen an increase in the amount of food available per person in retail and restaurants.⁹³ Other drivers in medium- and high-income countries are the composition of households – an ageing population and the growth in single-person households lead to more food waste.⁹⁴

What is needed is increased public awareness and education on these issues, in order to change consumers' attitudes towards food.⁹⁵ Education or exhortation might make a difference, but the extent of waste is partly a reflection of prices: food is cheap enough for consumers not to worry about wasting it, and prices seem unlikely to rise by enough to change that attitude.⁹⁶

4. Environmental Impact of Food Losses and Waste

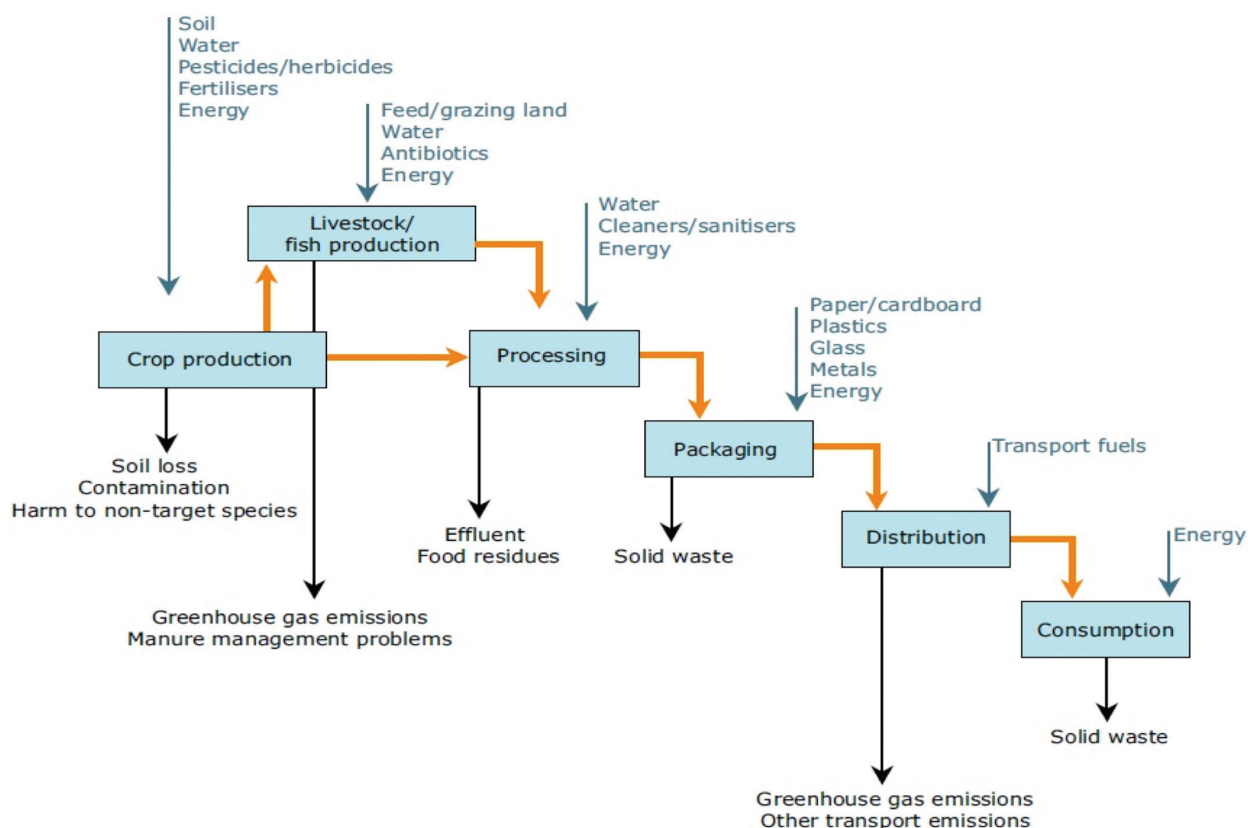
It is important to consider that food production is resource intensive and has significant environmental consequences. Food is, on average, responsible for about one fourth of the climate impact of private consumption and approximately one third of other environmental impacts.⁹⁷ The later food is wasted in the supply chain, the larger the environmental impact. In particular, food waste is largely generated by

FFVs, fermentation, dairy, meat, and seafood industries.

It is clear that the impact of food waste is not only financial, as food waste contributes to excess consumption of freshwater and fossil fuels, which along with methane and CO₂ emissions from decomposing food, impacts global climate change.

As reported by UNEP (2009), food waste is responsible for several environmental problems ranging from the wasteful use of chemicals, such as fertilizers and pesticides to increased fuel use for transportation and the production of chemical inputs, and the creation of methane through rotting food - one of the most harmful greenhouse gasses (GHGs) that contributes to climate change.⁹⁸

Figure 6: Food life-cycle chain



Source: UNEP, Forum on Sustainable Agri-Food Production and Consumption, 2011

The reduction of food waste has a large potential to reduce the environmental impact related to food production and consumption, increase

the efficiency of the use of resources in the food chain, and improve food security by increasing the amount of food available for human consumption.

Demand for fresh produce, meat, fish and dairy will increase in BRIC/transition countries over the foreseeable future, placing even



greater demands on the environment and promoting higher rates of food wastage. For instance, the growth in annual household demand in India for high value perishable products between 2000 and 2020 is likely to equate to a doubling in demand for meat, fish and eggs. Such rapid growth in demand is likely to increase food wastage unless there are significant improvements in the supply chain improvements following these propositions.

In the case of Brazil - a major global food producer - deforestation and land use changes associated with agriculture account for over 70% of greenhouse gas emissions of this country.⁹⁹ If the food produced is not consumed, the tremendous impact on the environment has been unnecessary. The livestock sector is by far the single largest anthropogenic user of land. According to the FAO (2006), grazing occupies 26% of the Earth's terrestrial surface, while feed crop production requires about one third of all arable land.¹⁰⁰

In recent decades global appetite for meat has exploded, driven by industrialized and BRIC countries and their growing demand for goods. Animal products tend to have the worst environmental impacts, as producing them requires the most amounts of resources - mainly chemical fertilizer, feed, fuel, pesticides and water - and pound for pound, they generate more polluting manure. It also generates GHGs and large amounts of wastewater that pollute groundwater, rivers, streams and ultimately, the ocean. According to recent studies, about 20% of edible meat gets thrown out without being consumed.¹⁰¹

Food wastage is also water wastage.

It is important to remember that agriculture is the largest human use of water. Mexican agriculture - for example - accounts for 77% of the total water use in the country.¹⁰² Agricultural practices need to be targeted to also reduce the wastage of water, given that large quantities of water are used to produce the food that is lost.

Food waste now accounts for more than one quarter of the total freshwater consumption and uses more than 300 million barrels of oil per year.¹⁰³ Moreover, increasing amounts of wasted food come from countries where water is scarce, meaning that the food discarded has a huge hidden impact on the depletion of valuable water resources across the world. An estimated 1.4 billion people already live in areas where there is not enough water available to meet cover the needs of the population, let alone the needs of aquatic ecosystems.¹⁰⁴ Water will continue to be a key constraint to food security, unless we change the way we think and act about the whole chain, from production to consumption.

Food production has become increasingly dependent on energy derived from fossil fuels. Today, industrial agriculture consumes fossil fuels for several purposes such as fertilizer production, farm equipment and processing, packaging and transportation. There is a critical need to recover and recycle nutrients from organic waste streams and use them as productive inputs of organic fertilizer. Enormous quantities of valuable organic nutrients could be recovered from intensive livestock farming, food processing sites,

municipal green wastes, and human sewage wastes in both rural and urban communities.

Although transportation-related emissions do not vary widely among different types of food, transportation accounts for a much higher fraction of the overall footprint of vegetable proteins because they have significantly lower emissions overall. Increasing demand for non-seasonal food and exotic food in industrialized countries is leading to a large increase in the distance of travel from the farm to tables, known as 'food miles'. In the UK, for example, the annual amount of food moved by heavy goods vehicles has increased by 23% since 1978.¹⁰⁵ On top of that, transport of food by air has the highest CO2 emissions per tonne, and is the fastest growing method of transport.

CO2 emissions

Globally, agriculture and food production combined are responsible for the generation of around 20% of all GHGs.¹⁰⁶ This is approximately the same amount as the industry sector but higher than the transport sector. Therefore, agriculture has an inevitable impact in relation to both the production of the GHGs responsible for climate change and in relation to the alleviation of the effects of climate change.

The major GHGs produced by agriculture are Carbon dioxide (CO₂), Methane (CH₄), and Nitrous Oxide (N₂O). All forms of agriculture generate CO₂, while CH₄ is primarily a product of livestock and N₂O a consequence of the use of nitrogen fertilizers in arable agriculture. Both

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CH₄ and N₂O are more damaging than CO₂, which is why the GHGs impact of agriculture is so high. Lamb, beef, cheese, pork and farmed salmon generate the most amounts of GHGs.¹⁰⁷

Methane is 23 times more potent than CO₂ as a greenhouse gas.¹⁰⁸ According to Lundqvist (2008), livestock production alone accounts for approximately 18% of total global GHG emissions. While beef and lamb generate comparable amounts of methane and require similar quantities of feed, lamb generates more emissions per kilo in part because it produces less edible meat relative to the sheep's live weight.

Chickens generate no methane and have far fewer emissions during production, but processing is more energy- and water-intensive than other meat processing. Meat, eggs and dairy products that are certified organic, humane and/or grass-fed are generally the least environmentally damaging.¹⁰⁹

The vast amount of food going to landfills makes a significant contribution to global warming. Wasted food, most of which is sent to landfills, contributes to global warming because each metric tonne of food scraps generates 4.5 times the amount of CO₂. Indeed, the increase of wasted food is

responsible for 10% of the GHGs emitted by wealthy countries, such as the UK and the US¹¹⁰

WRAP has mapped food waste along the FSC for selected foods in the UK, with goal of developing recommendations for improving supply chain management. The organization also aims to reduce packaging waste and consumer food waste by carrying out research, disseminating information on best practices and promoting awareness. WRAP estimates that if food were not discarded in this way in the UK, the level of greenhouse gas abatement would be equivalent to removing 1 in 5 cars from the road.¹¹¹



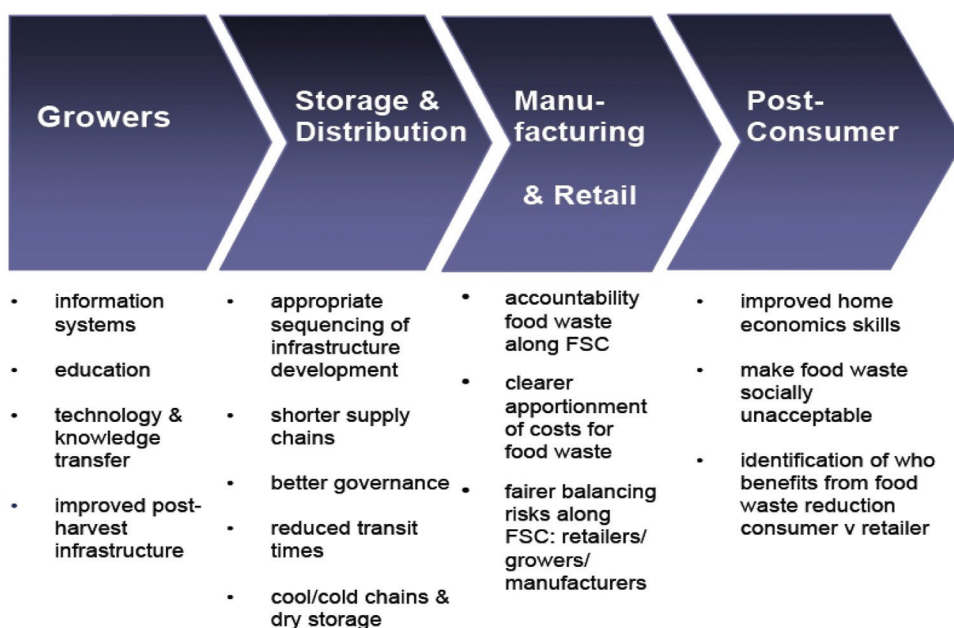
5. What are the Options to Preventing and Minimizing Food Losses?

As stated by the European Commission, good waste management begins with the prevention of waste.¹¹² Food loss reduction strategies should take into account the various sectors that are strongly interrelated, for instance, investing in storage and cold chain

infrastructure alone is not enough to be effective. Instead, investments should be made in improving road networks, transportation, electricity supplies and communication, as well as post-harvest handling of drying, cleaning, grading, packing or otherwise conditioning of the

products to be stored. Furthermore, investment in storage structures should be accompanied by the provision of advice and training on design, ownership and proper management.

Figure 7: Key areas for action to reduce food losses and waste



Source : Foresight Project, The Government Office for Science of UK, 2010

Developing and industrialized countries face different challenges and solutions must be envisaged according to their possibilities and needs. In low-income countries, measures should foremost have a producer perspective, for example by improving harvest techniques,

farmer education, storage facilities and cooling chains.¹¹³ Drivers for change also include more widespread education of farmers relating to the causes of PHLs, and more effective value chains that provide sufficient financial incentives at the producer level,

opportunities to adopt collective marketing and better technologies supported by access to microcredit, and the public and private sectors sharing the investment costs and risks in market-orientated interventions.¹¹⁴

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In industrialized countries, on the other hand, solutions at the producer and industrial level would only be marginal if consumers continue to waste at the current levels. Consumer households need to be informed and change their behavior, which causes the current high levels of food waste.¹¹⁵

5.1. In Middle- and High-income Countries

a) Increasing incentives and penalties

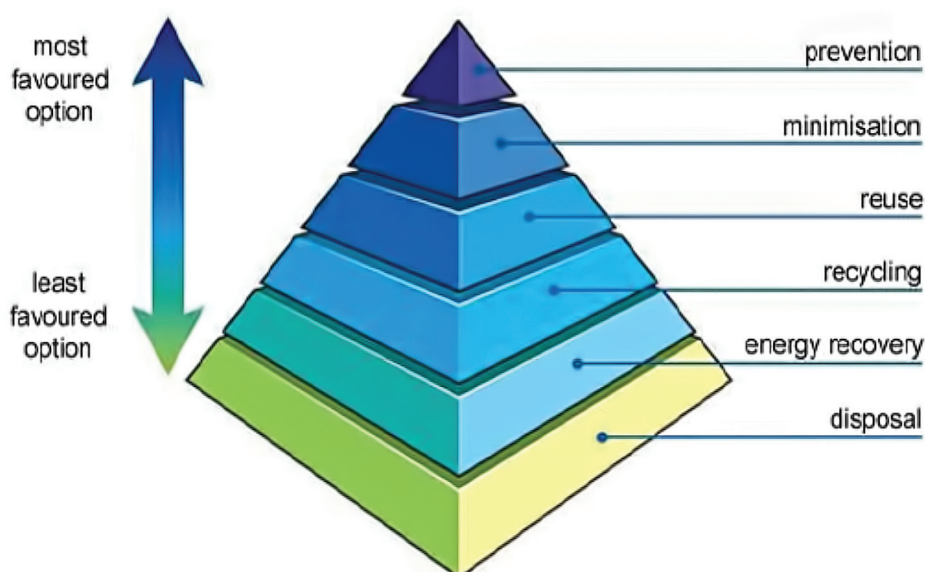
At present, there is no financial incentive for supermarket retailers to reduce current waste levels in neither BRIC or OECD countries. This

is because the alternative of reducing waste may be more expensive than simply disposing of excess supply – in part because the environmental impacts of food waste have not been internalized; and because in these countries food is still relatively plentiful and sufficient to meet consumer needs. With a growing global population and dietary transition in BRIC countries, the opportunity costs of wasting food will increase over time.

To effect change in the retail part of the value chain, economic incentives around waste must be addressed, so that the economic drivers behind producing and wasting more food are reversed. This may require greater accountability for waste, with waste producers held legally or financially responsible for its

generation. Better waste legislation or information - with a threat of legal sanctions or exposure to consumers where necessary - may push retailers to reduce waste. Voluntary agreements to reduce food waste, such as the Courtauld Commitment in the UK, may provide an alternative to regulation. This agreement between major UK supermarkets and WRAP aims to reduce household waste by working with companies to map packaging waste growth and begin delivering absolute reductions in packaging waste. More than 35 major retailers, brands and distributors signed the Courtauld Commitment in March 2005, representing 92% of the UK grocery market. Since 2005, the stakeholders have met annually to assess progress, share best practices and develop further initiatives.¹¹⁶

Figure 8: Courtauld Commitment's most favored options



Source : WRAP, Courtauld Commitment, 2012

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The political emphasis on farmers/suppliers to increase production can be shifted into a more sustainable focus by increasing the availability of food through waste reduction. Improved forecasting by suppliers and retailers has an important role to play in reducing waste at the food manufacturing and retail stages. Presently, insufficient pressure is being put on suppliers and retailers to forecast demand and supply accurately. The opportunity to increase incentives to undertake forecasting accurately has the potential to reduce waste significantly. The UK and the Netherlands have created financial

incentives to test forecast models in order effectively to reduce waste through the adoption of improved forecasting methodologies and information systems.

Most consumers in developed countries have weak financial incentives to minimize food waste because they have access to an abundance of inexpensive, readily available food. In the US, over a period of approximately 80 years (1929–2008), food expenditure by families and individuals as a share of disposable personal income decreased from 23.4 to 9.6%.¹¹⁷ In general, most consumers in the

US do not appear to be concerned about food waste and this may also be true in other developed countries. If consumers were better informed about the amount and value that they waste annually, including its share relative to their household's budget, they would potentially waste less. The WRAP study found that the average household in the UK throws out £480 (US\$745) of food and drink each year. In an earlier study by WRAP, almost 0.70 of the 284 households that kept 1-week diaries of their discarded food were subsequently committed to discarding less food.¹¹⁸

Box 3: Examples of incentives to reduce food waste

Fiscal policy can encourage cooperation amongst farmers as well as improve infrastructure and access to extension services. Fiscal incentives should be provided to encourage successful farmers to grow more food in developing countries and to engage with the markets (for instance through preferential tax treatment). However, fiscal incentives may prove to be problematic and can lead to negative behavior.

Market incentives provide an alternative to fiscal incentives: for instance, the establishment of the Fair-Trade brand can create incentives to engage farmers in cooperatives and community-based farming.

Various pricing mechanisms can impact the type of storage and distribution undertaken. Pricing mechanisms include percent of crop share, market price, input price and these determine the type of storage. As an example, historically, tea was purchased through an auctioning system which required storage.

Although greater storage of produce may be driven by consumers, in order to overcome periods of potential shortages (such as during periods of civil unrest), in the longer term, governments may be a main driver as a measure to maintain country stability. China may be seen as an example, which has stored strategic reserves, in order to maintain country stability. Storage increases shelf-life and encourages access to the market at different points and can be used to stabilize prices or as a food security measure.

Source: Foresight Project, The Government Office for Science of UK, 2010

Governments also have incentives to monitor landfill use and promote efficient means of reducing the amount of waste that goes to landfills to limit their costs and decrease risks to the environment, such as the production of methane and leachate (a mixture of liquid

waste, organic degradation by-production and rain water).¹¹⁹

b) Liaising with Charity Organizations

In industrialized countries, errors during processing lead to final

products having the 'wrong' weight, shape or appearance, or damaged packaging, without affecting the safety, taste or nutritional value of the food. In a standardized production line these products often end up being discarded. Both commercial and charity organizations could

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arrange for the collection and sale or use of discarded 'sub-standard' products that are still safe and of good taste and nutritional value.¹²⁰

In the US, the largest supermarket chains and many other companies provide food to charitable organizations. The US business environment is favorable towards food redistribution, because there are tax incentives to do so, there is legal protection from Good Samaritan laws and it can help improve corporate image.¹²¹ Companies are penalized for generating excess agricultural production and food waste as they must pay for its disposal in landfills or by incineration. Governments have incentives to monitor landfill use and promote efficient means of reducing the amount of waste that goes to landfills, in order to limit their costs and to decrease risks to the environment, such as the production of methane gas, which has been linked to climate change, and leachate (a mixture of liquid waste, organic degradation by-products and rain water), which has the potential to contaminate groundwater. In the US, there is increased interest in diverting food and other organic wastes away from landfills. Future diversion will be governed by incentives such as climate change mitigation policies and landfill organics bans.

c) Increasing Awareness and Information Campaigns

Consumers and all other actors in the food chain need to be informed about food waste and its environmental and economic impacts, and of the easily applicable and effective prevention methods.¹²² Campaigns to highlight the extent of waste and the financial benefits of reducing it are needed. A product with better quality or an improved shelf life, which comes as a result of alternative processing or preservation techniques, may reduce food wastage, while simultaneously lowering the costs of distribution, as well as minimizing energy usage during processing and transport.

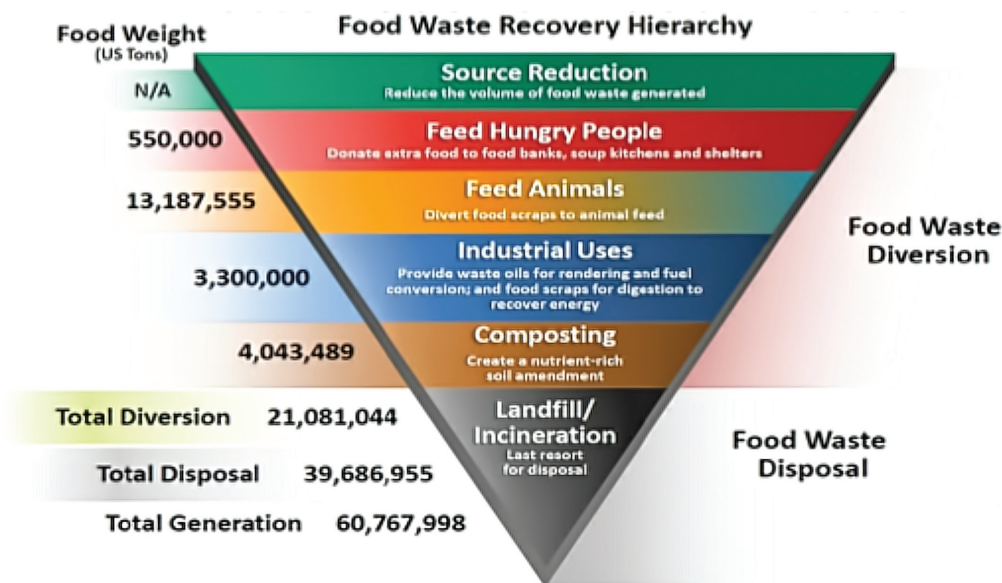
Cultural shifts in the ways consumers value food, which can be promoted through education, increased awareness of the FSC and food waste's impact on the environment, have the potential to reduce waste production. Consumer education campaigns should increase knowledge and awareness of appropriate portion sizes, food purchasing skills, meal planning, use of left-over, food safety, food discard behavior and interpretation of sell-by or use-by dates¹²³ Improved food labeling and better consumer understanding of labeling and food storage also have the potential to reduce food waste.¹²⁴

There is a need to raise public awareness about food waste: in the UK and Brazil, where data have been collected on post-consumer food waste, the indications are that consumer awareness is low. For many consumers where behavioral data have been collected, the act of throwing away food is an unconscious act – they often do not realize that they are throwing away food, and have little or no awareness of doing so. Food waste campaigns have emphasized the cost of food waste to Brazilian consumers (an approach also tried in the UK by WRAP): for instance, avoidance of 20% of a household's food waste would result in a monthly economy of US\$32.¹²⁵

Economic arguments can be used to motivate individual consumers to reduce food waste. Simple logic dictates that if households purchase food with more foresight (having planned their meals and checked their food stocks at home) and manage their food stocks better, then they will save money and be able to diversify their shopping basket and 'trade up' to better quality food. Point of purchase and on-pack information on storing and portioning food and food date labels can help consumers to reduce food waste – as many consumers are unaware of difference between 'use by' and 'best before' dates, and waste food unnecessarily.



Figure 9: Better use for Food Waste



Source: Earl-Torniainen P., Tackling Food Waste, 2012

5.2. Innovations to Reduce Post-consumer Food Waste in Households

a) Launching Innovative Partnerships for Research

Research and reliable loss estimates for the different foods and stages in the postharvest chain are needed to identify where food waste can be minimized efficiently. More research is also needed on how agricultural policies (for example output-based subsidies) might promote over-production and thus increase food waste and whether other policies could provide useful incentives to reduce food waste.¹²⁶ Research is being conducted on the role of packaging in prolonging the shelf life of food products and reducing

their wastage as well as the use of food that is no longer fit for human consumption as animal feed or as a source of energy through processes such as anaerobic digestion.

Thus, the impetus is on public and private efforts to make better use of available food supplies by recovering food safe for consumption that would otherwise be wasted.¹²⁷

WRAP encourages leading retailers, brand owners and their supply chains to identify collaborative approaches towards reducing the amount of food and packaging waste that ends up in the household bin and ultimately in landfill.

One industrial purpose being explored in the US, the UK and other developed countries, is the use of anaerobic digestors to take

feedstock, food and agricultural waste and wastewater plant biosolids to produce biogas and other valuable outputs (e.g. compost material). However, digestors need a continuous supply of materials to remain profitable and there is some concern that this could divert food from feeding programs.

b) Innovative Packaging and Distribution

The greatest potential for the reduction of food waste in the developed world lies with retailers, food services and consumers. Innovative technology throughout the FSC, in both developed and developing countries, particularly in packaging, contributes to improving shelf-life for perishable foods and semi-prepared meals.¹²⁸

Active and intelligent packaging technologies can extend product

shelf-life and help reduce wastage by clarifying the suitability of a product for consumption. The reduction of packaging waste has become a major issue for consumers and society and is the subject of much lobbying and government initiatives. Active and intelligent packaging introduces new perspectives for the packaging of food, such as the concept of intentional migration of substances, for example preservatives and antioxidants from packaging into food.

Industrialized countries have extensive and effective cold chain systems to prolong product shelf-life, and more sophisticated management and new technologies continue to improve the efficiency with which food is brought into stores, displayed and sold. Just-in-time production and the use of computerized stock control have dramatically decreased the volume of stock within the food chain, which has driven down costs.¹²⁹

In some countries, suppliers currently have an incentive to oversupply in order to guarantee that retail demand is met: this situation acts as a disincentive to reduce waste. In order to effectively tackle food waste these economic incentives must be changed. A side effect will also be to free up land that can be used for other effective and sustainable uses.¹³⁰ In the developing world, the transfer of existing technologies and the spread of good practice, linked to market-led investment, have the greatest potential to reduce food waste across the FSC.¹³¹

5.3. In Low-income Countries

In low-income countries, food may be lost due to premature harvesting. Poor farmers sometimes harvest crops too early due to food deficiency or the desperate need for cash during the second half of the agricultural season. At the grower stage, changes are needed to encourage farmers to reduce waste at the production end of the value chain. Given that many smallholders in LDCs live on the margins of food security, a reduction in food losses could have an immediate and significant impact on their livelihoods.

a) Facilitating Access to Information and Training

At the grower stage, the highest priority areas include the development of locally appropriate information systems and education, technology and knowledge transfer and access to improved post-harvest infrastructure, particularly in the case of smallholders, facilitating better access to markets and a greater diversity and quality of products.

Exchanging information can play a major role in reducing PHLs, an example being APHLIS (African Post Harvest Losses Information System) – a network of local experts in East and Southern Africa, backed up by a database and postharvest loss calculator, that together facilitate the estimation by province of annual PHLs for the cereal grains of the countries of Eastern and Southern Africa.¹³²

Interventions in low-income countries must focus on training and upgrading technical capacity to reduce losses, increase efficiency and reduce labor intensity of the technologies that are employed.¹³³ Poor storage facilities and lack of infrastructure are major causes of PHL. Fresh products like fruits, vegetables, meat and fish straight from the farm or after the catch can be spoiled in hot climates due to a lack of infrastructure for transportation, storage, cooling and markets.

A better dissemination of research results would be useful as well as an increased access to market information.

The use of Information and Communication Technologies (ICTs) and mobile phones, in particular, could help improve market information and allow producers to make better decisions about timely supply to markets, avoiding or at least reducing seasonal gluts.

b) Organizing Small-scale Farmers and Promoting Collective Marketing

Small resource-poor farmers can be organized in groups to produce a variety of significant quantities of cash crops or animals, through which they can receive credit from agricultural financial institutions or advance payments from buyers of the produce. Cooperation among farmers could reduce the risk of overproduction by allowing surplus crops from one farm to solve a shortage of crops on another. Market incentives, fiscal incentives, consumer pressure, and education



have to be targeted, in order to promote significant changes.¹³⁴

In storage and distribution systems, there is a need for shorter supply chains with fewer intermediaries and with food processing facilities closer to growers and end-markets (adding more economic value locally and improving the quality and durability of food). Investment in new, appropriate technology to reduce post-harvest waste and to upgrade storage facilities and cooling chains¹³⁵ should be a priority before encouraging producers to increase productivity.

Suitable market institutions need to be developed and promoted to enable marketing groups and individuals to best respond to market demand. Collective

marketing can take various forms and for grains may include inventory credit schemes and Warehouse Receipt Systems to accelerate the efficient removal of the crops from the farmer into safe centralized storage. Successful markets depend on a consistent supply of produce of better quality and this can be achieved by adopting and adapting improved technologies that also lower PHLs.

c) Up-scaling Infrastructure and Improving Control Management

Without management controls, it is estimated that pathogen, pests or weed species have the potential to inflict pre-harvest yield losses ranging from 44-54% in wheat, 64-80% in rice, 58-75% in maize, 73-80% in potatoes and 49 - 69% in soybeans, just to make some

examples. Even with controls - globally - losses average 28% in wheat, 37% in rice, 31% in maize, 40% in potatoes and 26% in soybeans.¹³⁶

The postharvest systems of LDCs need considerable investment to create more formal markets and improve their performance to a point where PHLs can be substantially reduced. Some of these improvements need to take the form of public 'goods', including infrastructure, such as the development of networks of all-weather feeder roads, in order for crops to reach markets - a problem that has been especially acute in Africa where transport costs can be five times those in Asia.¹³⁷

Box 2: Reducing Post Harvest Losses in Sub-Saharan Africa

Crop varieties: grain varieties with better postharvest characteristics should be developed. It is important to strive for grain varieties that have greater resistance to damage from insect pests and fungi. However, to date, little progress has been made despite many years of research. Genetic transformation may offer opportunities, but this may not be acceptable in many SSA countries.

Harvesting: use of mini-combine harvesters may offer opportunities to farmer groups to reduce labor requirements and gather a full harvest. The costs of the technology are high, so the benefits may only apply where the crop is sufficiently valuable, for example in SSA's expanding rice industry. Currently, in most situations it is unlikely that changes can be made to traditional smallholder harvesting methods.

Drying grain: use of various drying equipment reduces physical losses and potential contamination with mycotoxin. The type of equipment employed depends on the scale of farm production; tarpaulins can be used to cover small quantities of grain in damp weather, whereas larger quantities may be put into drying cribs or processed in various types of mechanical dryers. Mechanical dryers would be more appropriate for farmer groups than for individuals.

Threshing, shelling, and winnowing of grain: use of mechanized rice threshers/winnowers and maize shellers can speed up postharvest operations and deliver improvements in grain quality and quantity. These may be hand powered or motor driven and have become more relevant as labor shortages increase. Access to motor-driven equipment would need to be through farmer groups or supplied as part of contract farming arrangements.

Source: The World Bank/FAO, Missing Food, 2011

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d) Improving Post-harvest Handling, Processing and Storage

Although natural disasters played a significant part, in 2010 losses associated with poor post-harvest technologies were estimated to account for between 25 – 50 million tonnes per year, a similar level to those caused by natural disasters.¹³⁸

Reducing postharvest food losses must be an essential component of any strategy in developing and industrialized countries to make more food available without increasing the burden on the natural environment. Investing in post-harvest technologies to reduce food losses could significantly increase the food supply in Sub-Saharan Africa.¹³⁹

Knowledge and technology transfer of effective storage and distribution systems to farmers result in increases in profits without increasing production. In years with food surpluses, the prices received for goods will be low. One option is to store surplus for lean years, but there may not be suitable storage facilities. Thus, investment and engineering skills are strongly needed.

Research conducted in several countries in Africa demonstrated that irradiation can potentially be used to reduce high PHLs of products, such as roots and tubers, dried meat and fish; ensure microbiological safety of spices and dried vegetable seasonings; and to

control insect infestation of fresh and dried fruits for export.¹⁴⁰

e) Addressing Waste Disposal

As urbanization continues to take rise, the management of solid waste is becoming a major public health and environmental concern in urban areas of many developing countries. Solid waste management is an enormous task in developing nations all over the globe due to factors like poverty, population explosion and a lack of proper funding by the government. Disposal methods, such as incinerators, landfill, pyrolysis and gasification, are efficient but have negative impacts on the environment and also pose a threat to public health.¹⁴¹

Disposal (land-filling, incineration with low energy recovery) is defined as the worst environmental option by the European Commission. Land-filling invokes major environmental risks such as emissions of GHGs and pollution of soil and groundwater and withdraws valuable resources (for example compost, energy) irrevocably from economic and natural cycles. Land-filling also violates the guiding principles of EU waste and sustainable resource management policy, notably the 'waste hierarchy'.¹⁴² Decomposing waste releases dust, smog odors and toxic gases, including ammonia and hydrogen sulfide, which degrade air quality and can cause

itching, dizziness and discomfort to workers and nearby residents.¹⁴⁴

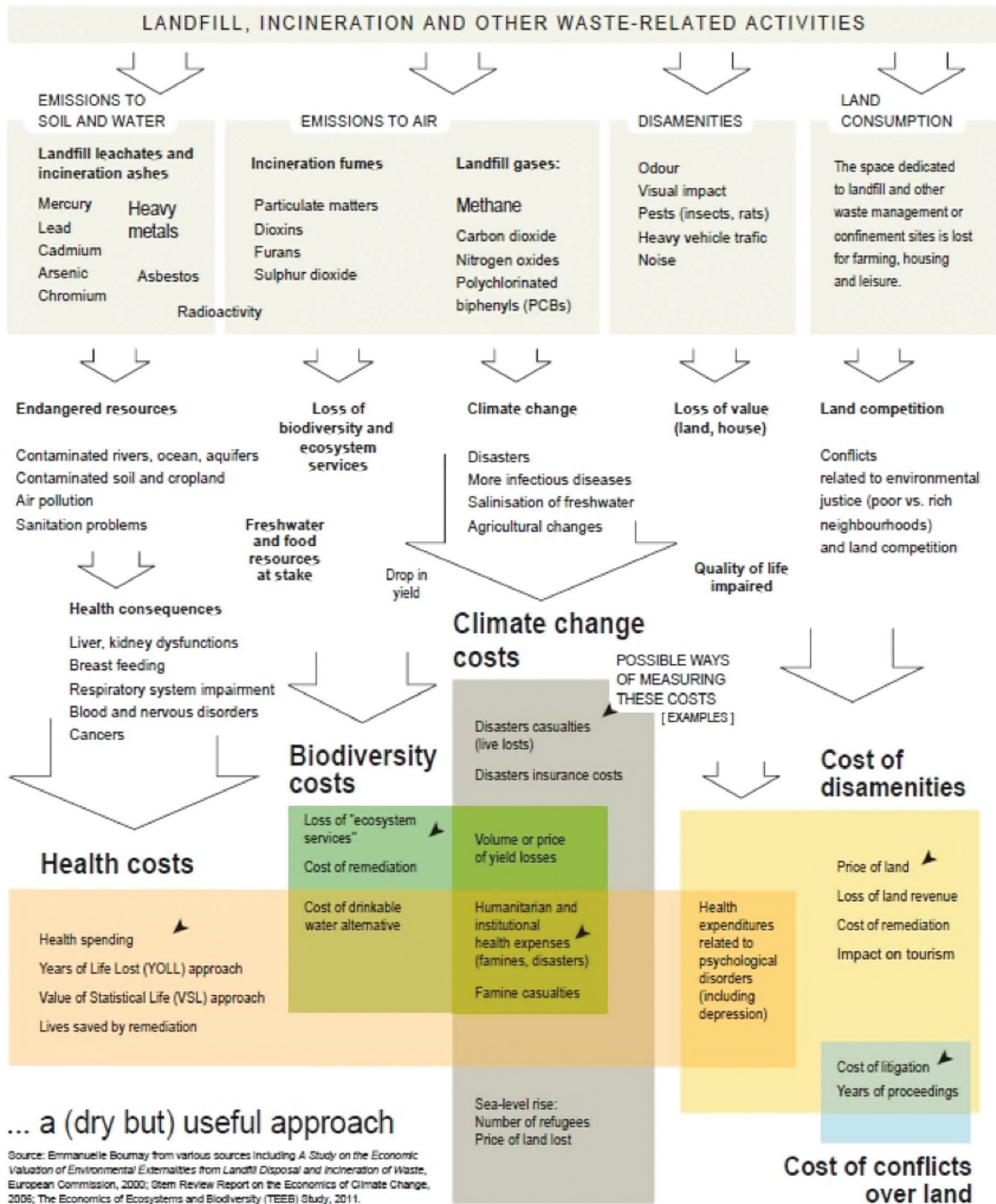
In some developing countries, reducing waste may be more expensive than simply disposing of excess supply - in part because the environmental impacts of food waste have not been internalized, and because in OECD and BRIC countries food is still relatively sufficient to meet the needs of consumers.¹⁴⁴

While composting provides an alternative to landfill disposal of food waste, it requires large areas of land; produces volatile organic compounds (smog precursors), which are released into the atmosphere; and consumes energy. Consequently, better recycling alternatives to composting food waste should be explored. Anaerobic digestion has been successfully used for many years to stabilize municipal organic solid wastes, and to provide beneficial end products, that is, methane gas and fertilizer.¹⁴⁵

Some political solutions in industrialized countries may include the taxation of foods with the highest waste to increase their income elasticity, increasing the cost of and taxes on waste disposal (particularly food by-products and food waste), developing private and public sector partnerships to jointly reduce food waste and sharing responsibility to reduce waste.¹⁴⁶

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Figure 10: Waste external costs



Source: Secretariat of the Basel Convention, Vital Waste Graphics 3, 2012, p. 24



6. Challenges Ahead and Policy Options

With a growing global population and changing dietary needs the opportunity costs of wasting food will increase over time. In order to incentivize change in the retail part of the value chain the economic incentives of waste must be addressed. Increasing the cost of and taxation on waste disposal, particularly food by-products and food waste, could lead to a reduction of food waste. This may, however, provide adverse incentives for illegal dumping.

Priorities for reducing post-consumer food waste include public education campaigns for better management of food (improving home economics skills) and to make food waste socially unacceptable. It has been agreed that careful messaging to consumers, in order to avoid 'nanny state' messages is an important method (using a mixture of humor with a bit of guilt) and that campaigns will need to consider cultural sensitivities.

The nature of the retail supply chain will change, with more sales being conducted over the internet and more centralized (and possibly shared) distribution systems, resulting in less waste in both OECD and BRIC/transition countries. Conversely, an increase in choices combined with an increase in the scale of food supply will create larger format supermarket chains, with enormous waste management challenges.

For LDCs, there is a wide range of priority areas for further research efforts but key among these must be studies on the implications of climate change for on-farm PHLs and options for smallholder adaptation, and the

development of an authoritative approach to cost-benefit analysis for postharvest interventions, in order to guide policy-making and the efficient use of resources.

There are a number of emerging themes in improving supply chain information management and logistics that feature in the platforms under development by major European retailers, that could help to reduce food waste and losses in those countries whose FSCs are moving towards the developed world 'supermarket model'. Examples under development in the UK include Sainsbury's Real Time Supply Chain system,¹⁴⁷ Morrisons' Evolve Programme (which involves upgrading warehouse management and supply chain systems) and Marks and Spencer's 'Q' platform (a system with improved demand forecasting, order planning, replenishment and merchandising and promotions management systems).¹⁴⁸

These systems have a number of common features that have potential to reduce waste. They use IT systems to link electronic point-of-sale (EPOS) data and shared (retailer/supplier) stock inventory data to demand forecasting, ordering and stock replenishment systems. The objective in linking these systems is to generate in-day sales data to inform buying decisions, improve the accuracy of stock control measures, improve product availability rates (without the need for over-ordering), and to extend the lead time on orders placed with suppliers. This, in turn, provides suppliers with more time to fulfill orders and avoids pre-emptive over-production, which is a common practice in the industry,

due to high contractual penalties for partial or total non-delivery of orders.

A further innovation that improves inventory control is the use of **stock tracking technologies** like radio frequency identification (RFID) tags and labels. These allow for stock to be identified and inventoried when it enters a radio field at any point in the supply chain, rather than requiring line of sight, as is the case with bar code systems. RFID technologies are already being widely applied to supply chain management from farm to market in different countries. For instance, in Thailand, these systems are used specifically to assess rice FSC loss in storage and transport phases and to improve the traceability from paddy through milling to the packaging plant.¹⁴⁹ The system has permitted integration of data on Good Agricultural Practice (harvesting, drying, paddy packing and storage) with information on transport and milling stages. For improved stock control of fresh produce, smart labels have been developed that include time and temperature indicators (TTIs), providing a more realistic assessment of the residual shelf life and quality of food products.

Looking forward, it would be beneficial for developed countries to **provide national estimates of food waste and information** on where to target resources, in order to decrease food waste efficiently. For LDCs, there is a wide range of priority areas for further research but key among these must be conducting studies on the implications of climate change for on-farm PHLs and options for smallholder adaptation, and the development of an authoritative

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approach to cost-benefit analysis for postharvest interventions, in order to guide policy making and the efficient use of resources.¹⁵⁰

LDCs need considerable investment to create more formal markets and improve their performance to a point where PHLs can be substantially reduced. Some of these improvements need to take the form of public 'goods' including infrastructure, such as the development of networks of all-

weather feeder roads so that crops can get to the market.¹⁵¹

Governments should improve the infrastructure for roads, energy and markets. Subsequently, private sector investments can improve storage and cold chain facilities as well as transportation. For many commodities in industrialized countries, food loss has declined in recent decades and new loss-reducing technologies are under development.¹⁵²

With new technological improvements waste along the human food supply chain could be used as a substitute for cereal in animal feed. The available cereal from such alternatives and efficiencies could potentially feed all of the additional 3 billion people expected by 2050. At the same time, this would support a growing green economy and greatly reduce pressures on biodiversity and water resources.¹⁵³



Selected Resources (English And French)

En italique les documents disponibles en français

African Development Bank

African Development Bank Group. 7 July 2008. The African Food Crisis Response (AFCR).

<http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/The%20Africa%20Food%20Crisis%20Response.pdf>

African Development Bank Group. March 2009. The Gambia Artisanal Fisheries Development Project.

<http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/AR%20En%20gamb1.pdf>

Mohamedou E.I., June 2011. UNCTAD's Annual Session of the Trade and Development Commission: Supply Chains in Africa. Trade and Development Commission (Third session).

http://archive.unctad.org/sections/wcmu/docs/c13rd2011_mohamedou_item5_en.pdf

African Union

African Union. 2011. African Union Signs Memorandum of Understanding with Food and Agriculture Organization of the United Nations. Press Release No. 067/2011.

<http://www.au.int/en/sites/default/files/MOU-%20AUC-FAO%20110705-f.pdf>

Articles

Barnett A. 11 January 2011. Adding Value to Jamaican Herbs and Spices: Reducing Postharvest Losses and Expanding Market Opportunities.

<http://knowledge.cta.int/en/Dossiers/Demanding-Innovation/Reducing-Postharvest-Losses-A-Challenge-for-the-Scientific-Community/Articles/>

[Adding-value-to-Jamaican-herbs-and-spices-reducing-postharvest-losses-and-expanding-market-opportunities](#)

Devitt T. 21 July 2005. World land use seen as top environmental issue. University of Wisconsin-Madison. <http://www.news.wisc.edu/11357>

Humphries J. 24 June 2010. Developing active and intelligent packaging. NGF Next Generation Food. <http://www.nextgenerationfood.com/news/developing-active-and-intelligent-packaging/>

MacKenzie D. 21 November 2009. Feeding the Nine billion. http://www.monsanto.com.au/_pdfs/media_coverage/2009/feeding_the_9billion.pdf

Neave S. 19 July 2009. How ending food waste would help the environment. HELIUM. <http://www.helium.com/items/1119510-global-food-waste-and-its-effect-on-the-environment>

Roels K., van Gijsegem D. November 2011. Loss and waste in the food chain. <http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>

Defra

Defra. May 2001. Future trends on waste generation and resource efficiency in the food chain: A scoping study. A report from Defra. Department for Environment, Food and Rural Affairs of the United Kingdom. http://www.brooklyndhurst.co.uk/future-trends-in-resource-efficiency-and-waste-generation-in-the-food-chain-_157

Defra. May 2007. Report of the Food Industry Sustainability Strategy Champion's Group on Waste (CGW). Department for Environment, Food and Rural Affairs of the United Kingdom. <http://archive.defra.gov.uk/foodfarm/policy/foodindustry/documents/report-waste-may2007.pdf>

Defra. 2010. Background to the Government Review of Waste Policy in England 2011. Department for Environment, Food and Rural Affairs of the United Kingdom. <http://archive.defra.gov.uk/corporate/consult/waste-review/100729-waste-review-background.pdf>

Defra. 2011. Food Statistics Pocketbook 2011. Department for Environment, Food and Rural Affairs of the United Kingdom. <http://www.defra.gov.uk/statistics/files/defra-stats-foodfarm-food-pocketbook-2011.pdf>

Morely N., Bartlett C. 17 July 2008. Mapping Waste in the Food Industry. Defra and the Food and Drink Federation. Department for Environment, Food and Rural Affairs of the United Kingdom. http://www.fdf.org.uk/publicgeneral/mapping_waste_in_the_food_industry.pdf

European Commission

European Commission. 18 May 2010. Communication from the Commission to the Council and the European Parliament on future steps in bio-waste management in the European Union. Brussels. http://www.ab.gov.tr/files/ardb/evt/1_avrupa_birligi/1_6_raporlar/1_3_diger/environment/comm_future_steps_in_

Resources on: Addressing Food Waste in Times of Crisis

[bio_waste_management.pdf](#)

European Commission. 28 October 2010. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a better functioning food supply chain in Europe, Brussels.

http://ec.europa.eu/economy_finance/publications/publication16061_en.pdf

European Commission. 2010. Being wise with waste: the EU's approach to waste management. European Union. Publications Office of the European Union, Luxembourg.

<http://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf>

Rembold F., Hodges R., Bernard M., Knipschild H. and Léo O. 2011. The African Postharvest Losses Information System (APHLIS). European Commission, Joint Research Centre, Institute for Environment and Sustainability. Publications Office of the European Union, Luxembourg. <http://publications.jrc.ec.europa.eu/repository/bitstream/11111111/15877/1/lbna24712enc.pdf>

Smith A., Brown K., Ogilvie S., Rushton K. and Bates J. July 2001. Waste Management Options and Climate Change. Final report to the European Commission, DG Environment. Publications Office of the European Union, Luxembourg. http://ec.europa.eu/environment/waste/studies/pdf/climate_change.pdf

FAO

Burden J., Wills R.B.H. 1989. Prevention of post-harvest food losses: Fruits, vegetables and root crops: A Training

Manual. Food and Agriculture Organization of the United Nations, Rome.

<http://www.fao.org/docrep/T0073E/T0073E00.htm>

FAO. 1994. The role of agriculture, forestry and fisheries in the sustainable development of small island developing states. Paper prepared by FAO on the occasion of the United Nations Global Conference on the Sustainable Development of Small Island Developing States. Food and Agriculture Organization of the United Nations, Rome.

<http://www.fao.org/docrep/T3384e/t3384e00.htm>

FAO. 2006. Livestock's long shadow. Environmental issues and options. The Livestock, Environment and Development (LEAD) Initiative and Food and Agriculture Organization (FAO) of the United Nations. <ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e00.pdf>

FAO. 2009. How to Feed the World in 2050. High-level Expert Forum. Food and Agriculture Organization of the United Nations, Rome.

http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

FAO. 2010. The State of Food Insecurity in the World: Addressing food insecurity in protracted crises. Food and Agriculture Organization of the United Nations, Rome.

<http://www.fao.org/docrep/013/i1683e/i1683e.pdf>

FAO. 2011. Food Loss Reduction Strategy. Food and Agriculture Organization of the United Nations. http://www.fao.org/fileadmin/user_

[upload/ags/publications/brochure_phl_low.pdf](#)

Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. Study conducted for the International Congress SAVE FOOD! Food and Agriculture Organization of the United Nations, Rome.

<http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>

Kader A.A. and Rolle R.S. 2004. The Role of Post-Harvest Management in Assuring the Quality and Safety of Horticultural Produce. Food and Agriculture Organization of the United Nations, Rome.

<http://www.fao.org/docrep/007/y5431e/y5431e00.htm>

López Camelo A.F. 2004. Manual for the Preparation and Sale of Fruits and Vegetables. From Field to Market. Food and Agriculture Organization of the United Nations, Rome.

<http://www.fao.org/docrep/008/y4893e/y4893e00.htm#Contents>

Niggli U., Fließbach A., Hepperly P. and Scialabba N. April 2009. Low Greenhouse Gas Agriculture: Mitigation and Adaptation Potential of Sustainable Farming Systems. FAO, Rev. 2 - 2009.

<ftp://ftp.fao.org/docrep/fao/010/ai781e/ai781e00.pdf>

Foresight Project

Foresight. 2010. Land Use Futures: making the most of land in the 21st century. Executive Summary. The Government Office for Science, United Kingdom.

http://www.bis.gov.uk/assets/foresight/docs/land-use/luf_

Resources on: Addressing Food Waste in Times of Crisis



[report/8614-bis-land_use_futures_exec_summ-web.pdf](#)

Foresight. 2010. Expert Forum on the Reduction of Food Waste. Foresight Project on Global Food and Farming Futures. The Government Office for Science, United Kingdom.

<http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/workshops/11-608-w4-expert-forum-reduction-of-food-waste>

Foresight. 2011. The Future of Food and Farming: Challenges and choices for global sustainability. Final Project Report. The Government Office for Science, United Kingdom.

<http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/11-547-future-of-food-and-farming-summary>

Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. Foresight Project on Global Food and Farming Futures. Journal of Agricultural Science. Cambridge University Press.

<http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>

Parfitt J., Barthel M. 2011. Global food waste reduction: priorities for a world in transition. Foresight Project on Global Food and Farming Futures. Science review: SR56. The Government Office for Science, United Kingdom.

<http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-588-sr56-global-food-waste-reduction-priorities>

Government agencies

Gray D.M.D. March 2008. Anaerobic Digestion of Food Waste - Final Report. U.S. Environmental Protection Agency (EPA) Region 9. East Bay Municipal Utility District, United States.

<http://www.epa.gov/region9/organics/ad/EBMUDFinalReport.pdf>

Ministère de l'Agriculture, de l'Alimentation, de la Pêche, de la Ruralité et de l'Aménagement du Territoire. 2001. Pertes et Gaspillages Alimentaires. Marges de manœuvre et verrous au stade de la remise directe au consommateur (distribution et restauration) et en restauration collective. Rapport final.

http://alimentation.gouv.fr/IMG/pdf/Pertes-gaspillages_RAPPORT270112_cle02c35d.pdf

Ministry of Agriculture, Nature and Food Quality. 2010. Fact Sheet: Food Waste in the Netherlands.

http://www.hetInVloket.nl/portal/page?_pageid=116,1640321&_dad=portal&_schema=PORTAL&p_file_id=2001236

Roels K. and van Gijsehgem D. November 2011. Loss and Waste in the Food Chain. Department of Agriculture and Fisheries, Division for Agricultural Policy Analysis, Brussels.

<http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>

Samuelu L. Post-harvest Challenges and Opportunities in the Pacific Island Region. Ministry of Agriculture, Forests, Fisheries and Meteorology, Samoa.

[http://www.egfar.org/egfar/lfm/gphi_documents/02_Region_specific_documents/D_Asia_and_the_Pacific_Islands_\(APAARI\)/02_Background_Documents/01_General_issues/D-1-](http://www.egfar.org/egfar/lfm/gphi_documents/02_Region_specific_documents/D_Asia_and_the_Pacific_Islands_(APAARI)/02_Background_Documents/01_General_issues/D-1-)

[003-D3_Ph_in_Pacific_Islands.pdf](#)

The Scottish Government. June 2009. Food Affordability, Access and Security: Their Implications for Scotland's Food Policy. A Report by Work Stream 5 of The Scottish Government's Food Forum.

<http://www.scotland.gov.uk/Resource/Doc/277447/0083291.pdf>

International agencies

EEA. 2001a. Indicator Fact Sheet Signals 2001 - Chapter Waste. Generation of waste from households. European Environmental Agency, Copenhagen.

<http://www.eea.europa.eu/data-and-maps/indicators/waste-generation-from-household-and/generation-of-waste-from-households>

IAEA. May 2002. Study of the impact of food irradiation on preventing losses: Experience in Africa. International Atomic Energy Agency (IAEA). Proceedings of a final Research Co-ordination Meeting held in Pretoria, South Africa, 20-24 September 1999. IAEA-TECDOC-1291.

http://www-pub.iaea.org/MTCD/Publications/PDF/te_1291_prn.pdf

Ogawa H. 2000. Sustainable Solid Waste Management. WHO Western Pacific Regional Environmental Health Centre (EHC), Kuala Lumpur, Malaysia.

<http://www.gdrc.org/uem/waste/swm-fogawa1.htm>

Secretariat of the Basel Convention. 2012. Vital Waste Graphics 3. Secretariat of the Basel Convention prepared by Zoë Environment Network and GRID-Arendal.

<http://www.grida.no/publications/vg/>

Resources on: Addressing Food Waste in Times of Crisis

Publications, conferences and reports

Fabech B., Hellstrøm T., Henrysdotter G., Hjulmand-Lassen M., Nilsson J., Rüdinger L., Sipiläinen-Malm T., Solli E., Svensson K., Thorkelsson A.E., Tuomaala V. 2000. Active and Intelligent Food Packaging. A Nordic report on the legislative aspects. Norden. TemaNord 2000:584
http://www.norden.org/da/publikationer/publikationer/2000-584/at_download/publicationfile

Food Ethics Council. October 2008. Food Distribution: An Ethical Agenda. Institute of Food Research, United Kingdom.
<http://www.ifr.ac.uk/waste/Reports/Food-Ethics-Council-fooddistribution.pdf>

Hamerschlag K. July 2011. Meat Eater's Guide to Climate Change and Health. Environmental Working Group.
http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf

Hubert B., Rosegrant M., van Boekel M.A.J.S. and Ortiz R. 2010. The Future of Food: Scenarios for 2050. Crop Science Society of America 50:S-33-S-50. doi: 10.2135/cropsci2009.09.0530
<https://www.crops.org/story/2010/feb/fri/the-future-of-food-scenarios-for-2050>

Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts. HENVI Seminar Series. Food and Environment - Sustainable food cycle.
<http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>

Khoo H.H. et al. 2009. Food waste conversion options in Singapore: Environmental impacts based on an LCA perspective. Science of the Total Environment. doi:10.1016/j.scitotenv.2009.10.072
<http://www.sciencedirect.com/science/article/pii/S0048969709010547>

Lundie S. and Peters G.M. 2005. Life cycle assessment of food waste management options. Journal of Cleaner Production 13, 275-286.
<ftp://cee.ce.cmu.edu/wharriga/Public/Composting%20Data/composting/comp,%20landfill,%20drain%20GHG%20Energy.pdf>

Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain. Stockholm International Water Institute (SIWI) Policy Brief.
http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf

Morgan G., Robertson K. March 2011. Waste Not, Want Not: An Overview of Food Waste. BSR.
http://www.bsr.org/reports/BSR_Waste_Not_Want_Not_An_Overview_Food_Waste.pdf

Muller A. April 2009. Benefits of Organic Agriculture as a Climate Change Adaptation and Mitigation Strategy for Developing Countries. Environment for Development, Discussion Paper Series.
<http://www.ifr.ac.uk/waste/reports/benefitsoforganicagriculture.pdf>

Mutambuki K., Ngatia C.M., Mbugua J.N. 2010. Post-harvest technology transfer to reduce on farm grain losses in Kitui district. Kenya Agricultural Research Institute National Agricultural Research Centre.

NARI. 2006. Potential of Post-Harvest Research and Development in PNG. Newsletter Number 1. National Agricultural Research Institute, Papua New Guinea.
http://www.nari.org.pg/sites/default/files/narinius/2006/NN_vol9_No1_2006.pdf

Scott Kantor L., Lipton K., Manchester A. and Oliveira V. 1997. Estimating and Addressing America's Food Losses. Economic Research Service/USDA. Food Review 17: 2.
<http://www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf>

Sidik M. 1996. The role of technological transfer to strengthen food security in the ASEAN region. Proceedings of the 7th International Working Conference on Stored-product Protection - Volume 2.
<http://bru.gmprc.ksu.edu/proj/iwcssp/pdf2/7/1877.pdf>

Segrè A., Gaiani S., Falasconi L., Bapst G., Coates T., Connett P., Lundqvist J., Juul S., Pagliara C. 2010. Joint declaration against food waste.
http://www.lastminutemarket.it/media_news/wp-content/uploads/2010/12/JOINT-DECLARATION-FINAL-english.pdf

Stevenson S. Values-Based Food Supply Chains: Strategies for Agri-Food Enterprises-of-the-Middle. Agriculture of the Middle.
<http://www.agofthemiddle.org/papers/valuechain.pdf>

Resources on: Addressing Food Waste in Times of Crisis



Stuart T. 2009. *Waste: Uncovering the Global Food Scandal*. 1st American ed. <http://www.tristramstuart.co.uk/>

Taiwo A.M. 2011. *Composting as A Sustainable Waste Management Technique in Developing Countries*. Research Article. Journal of Environmental Science and Technology, 4: 93-102. <http://scialert.net/fulltext/?doi=jest.2011.93.102&org=11>

The Worldwatch Institute. 2011. State of the World - Innovations that Nourish the Planet. <http://www.worldwatch.org/sow11>

Research

Buysman E. April 2009. Anaerobic Digestion for Developing Countries with Cold Climates. Utilizing solar heat to address technical challenges and facilitating dissemination through the use of carbon finance. Faculty of Environmental Sciences, University of Wageningen. <http://www.wecf.eu/download/2009/EricBuysman-AnearobicDigestionforDevelopingCountrieswithColdClimates-June2009-MasterThesis-Final.pdf>

Cook D.C., Fraser R.W., Paini D.R., Warden A.C., Lonsdale W.M. et al. 2011. Biosecurity and Yield Improvement Technologies Are Strategic Complements in the Fight against Food Insecurity. PLoS ONE 6(10): e26084. doi:10.1371/journal.pone.0026084 <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0026084>

Garnett T. September 2008. Cooking up a storm: Food, greenhouse gas emissions and our changing climate.

Food Climate Research Network. Centre for Environmental Strategy, University of Surrey. http://www.fcrn.org.uk/sites/default/files/CuaS_web.pdf

Godfray H.C.J., Crute I.R., Haddad L., Lawrence D., Muir J.F., Nisbett N., Pretty J., Robinson S., Toulmin C. and Whiteley R. 2010. The future of global food system. Philosophical Transactions of The Royal Society, B 2010 365, 2769-2777. <http://rstb.royalsocietypublishing.org/content/365/1554/2769.full>

Hall K.D., Guo J., Dore M., Chow C.C. 2009. The Progressive Increase of Food Waste in America and Its Environmental Impact. PLoS ONE 4(11): e7940. doi:10.1371/journal.pone.0007940 <http://www.plosone.org/article/info:doi/10.1371/journal.pone.0007940>

Jackson T. January 2005. Motivating Sustainable Consumption: a review of evidence on consumer behavior and behavioral change. A Report to the Sustainable Development Research Network. Centre for Environmental Strategy, University of Surrey. <http://www.c2p2online.com/documents/MotivatingSC.pdf>

Jones T.W. 2006. Using Contemporary Archaeology and Applied Anthropology to Understand Food Loss in the American Food System. Bureau of Applied Research in Anthropology, University of Arizona. http://www.ce.cmu.edu/~gdrgr/readings/2006/12/19/Jones_UsingContemporaryArchaeologyAndAppliedAnthropologyToUnderstandFoodLossInAmericanFoodSystem.pdf

Kader A.A. 2005. Increasing Food Availability by Reducing Postharvest Losses of Fresh Produce. Department of Pomology. University of California. <http://ucce.ucdavis.edu/files/datastore/234-528.pdf>

Kosseva M.R. 2009. Chapter 3 - Processing of Food Waste. Advances in Food Nutrition Research Volume 58, 2009, pages 57-136. UCD School of Chemical & Bioprocess Engineering, College of Engineering, Mathematical & Physical Sciences, University College Dublin, Belfield, Dublin 4, Ireland. <http://www.sciencedirect.com/science/article/pii/S1043452609580035>

Mazar N. and Zhong C.-B. 2009. Do Green Products Make Us Better People? Green Products and Ethical Behavior. In Press at Psychological Science, University of Toronto. <http://www.rotman.utoronto.ca/facbios/file/Green%20Products%20Psych%20Sci.pdf>

Millstone E. and Lang T. 1 October 2008. The Atlas of Food - Who Eats What, Where, and Why. University of California Press. <http://www.ucpress.edu/book.php?isbn=9780520254091>

Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains: Quantification and Potential for Change to 2050. Philosophical Transactions of The Royal Society, B 365: 2065. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>

Research Institutes

Beddington J., Asaduzzaman M., Clark M., Fernández A., Guillou M., Jahn M.,

Resources on: Addressing Food Waste in Times of Crisis

Erda L., Mamo T., Van Bo N., Nobre C.A., Scholes R., Sharma R., Wakhungu J. 2012. Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark. http://ccafs.cgiar.org/sites/default/files/assets/docs/climate_food_commission-final-mar2012.pdf

Karl-Heinz E., Haberl H., Krausmann F., Lauk C., Plutzer C., Steinberger J.K., Müller C., Bondeau A., Waha K., Pollack G. 2009. Eating the Planet: Feeding and fuelling the world sustainably, fairly and humanely – a scoping study. Commissioned by Compassion in World Farming and Friends of the Earth UK. Institute of Social Ecology and PIK Potsdam. Vienna: Social Ecology Working Paper No. 116. http://www.foe.co.uk/resource/reports/eating_planet_report2.pdf

United Nations

United Nations. 4 August 2011. The Right to Food. Note by the Secretary-General. UN General Assembly, Sixty-sixth session, Item 69 (b) of the provisional agenda. http://www.ohchr.org/Documents/Issues/Food/A.66.262_en.pdf

UNDESA. 2007. Small-Scale Production and Use of Liquid Biofuels in Sub-Saharan Africa: Perspectives for Sustainable Development. United Nations Department of Economic and Social Affairs. http://www.un.org/esa/sustdev/csd/csd15/documents/csd15_bp2.pdf

UNEP. 2010. Assessing the Environmental Impacts of

Consumption and Production: Priority Products and Materials. A Report of the Working Group on the Environmental Impacts of Products and Materials to the International Panel for Sustainable Resource Management. Hertwich E., van der Voet E., Suh S., Tukker A., Huijbregts M., Kazmierczyk P., Lenzen M., McNeely J. and Moriguchi Y. <http://www.unep.org/civil-society/Portals/59/Documents/SCP-Assessment-of-Env-Impact-of-SCP.pdf>

UNEP. 2011. The Global Outlook on SCP Policies. United Nations Environmental Programme. <http://www.unep.fr/shared/publications/pdf/DTIx1387xPA-GlobalOutlookonSCPPolicies.pdf>

UNEP. 2011. Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication – A Synthesis for Policymakers. United Nations Environmental Programme. http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_synthesis_en.pdf

UNEP-EEA. 2007. Sustainable consumption and production in South East Europe and Eastern Europe, Caucasus and Central Asia. Joint UNEP-EEA Report on the opportunities and lessons learned. EEA Report No. 3/2007. European Environment Agency, Copenhagen. http://www.eea.europa.eu/publications/eea_report_2007_3

Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis – the Environment's Role in Averting Future Food Crises. A UNEP Rapid Response Assessment. UNEP. United

Nations Environment Programme, GRID-Arendal. http://www.unep.org/pdf/FoodCrisis_lores.pdf

World Bank

The World Bank/FAO. April 2011. Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa. The World Bank. Report No. 60371-AFR. http://siteresources.worldbank.org/INTARD/Resources/MissingFoods10_web.pdf

WRAP

WRAP. 2008. The food we waste. Food waste report. Waste and Resources Action Programme, United Kingdom. <http://www.ns.is/ns/upload/files/pdf-skrar/matarskyrsla1.pdf>

WRAP. November 2009. Meeting the UK climate change challenge: The contribution of resource efficiency. Executive Summary. Waste and Resources Action Programme, United Kingdom.

http://www.wrap.org.uk/sites/files/wrap/AC_Exec_Summary_WEB_2.pdf

WRAP. 2009. Courtauld Commitment Factsheet. Best Practice Factsheets in preparation for Waste Prevention Guidelines. Waste and Resources Action Programme, United Kingdom. http://ec.europa.eu/environment/waste/prevention/pdf/Courtauld_Commitment_Factsheet.pdf



Websites (English And French)

En italique les sites en français

African Development Bank Group. May 2012. Inland Lakes Integrated Development and Management Support Project (PAIGELAC) in Rwanda.

<http://www.afdb.org/en/news-and-events/article/inland-lakes-integrated-development-and-management-support-project-paigelac-in-rwanda-9192/>

APHLIS Africa. Africa Post Harvest Losses Information System. eRAILS is developed by FARA.

<http://www.erails.net/FARA/aphlis/aphlis/Home>

DEFRA. Department for Environment, Food and Rural Affairs, United Kingdom.

<http://www.defra.gov.uk/>

Eastern Africa Farmers Federation.

<http://eaffu.org/eaffu/>

European Parliament. 2012. Parliament Calls for Urgent Measures to Halve Food Wastage in the EU.

<http://www.europarl.europa.eu/news/en/pressroom/content/20120118IPR35648/html/Parliament-calls-for-urgent-measures-to-halve-food-wastage-in-the-EU>

FAOStat.

<http://faostat.fao.org/>

Feeding the 5000. Food Waste Facts.

<http://www.feeding5k.org/food-waste-facts.php>

Food Chain Sustainability Special Interest Group.

<http://www.ifr.ac.uk/waste/index.htm>

Food navigator. US waste half its food.

<http://www.foodnavigator-usa.com/Business/US-wastes-half-its-food>

Fresh Produce Exporters Association of Kenya.

<http://www.fpeak.org/>

GRO – Green Recycled Organics.

<http://www.gro-holland.com/>

IGD. Efficient Consumer Response (ECR) Programme. IGD The food and grocery experts, UK.

<http://www.igd.com/index.asp?id=1&fid=5&sid=43>

Last Minute Market Association.

<http://www.lastminutemarket.it/>

Love Food Hate Waste.

<http://www.lovefoodhatewaste.com/>

Natural Resources Institute. University of Greenwich.

<http://www.nri.org/>

NNEC. Energy & Agriculture.

http://www.newenergychoices.org/index.php?page=EA_Intro&sd=no

Olivier de Schutter. United Nations Special Rapporteur on the Right to Food.

<http://www.srfood.org/>

Stop Wasting Food.

<http://www.stopspildafmad.dk/inenglish.html>

TED. Food Matters. TED Radio Hour. A cornucopia of TEDTalks about food.

<http://ht.ly/b2ALi>

Tristram Stuart.

<http://www.tristramstuart.co.uk/>

Wageningen University.

<http://www.wur.nl/UK/>

WRAP (Waste and Resources Action Programme).

<http://www.wrap.org.uk/>

Articles

EurActiv. EU news and policy debates. Eating green? Food, drinks and the environment.

<http://www.euractiv.com/consumers/eating-green-food-drinks-environment-links dossier-504448>

FAO. 13 June 2012. FAO partners, urge greater Push to Reduce Food Losses and Waste.

<http://www.fao.org/news/story/en/item/147427/icode/>

FAO. 2012. *Empreintes des pertes/gaspillage alimentaires.*

<http://www.fao.org/nr/sustainability/pertes-et-dechets-alimentaires/fr/>

Harvey F. 22 March 2012. Throwing food away sends world's scarce water gushing down the plughole. The Guardian.

<http://www.guardian.co.uk/environment/2011/mar/22/binning-food-wastes-lots-of-water>

Harvey F. 13 June 2012. Fishing discards practice thrown overboard by EU. The Guardian.

<http://www.guardian.co.uk/environment/2012/jun/13/fishing-discards-ban-eu>

Le Monde. 22 Mai 2012. Alimentation: la

Resources on: Addressing Food Waste in Times of Crisis

chasse au gaspi est lancée. Le Monde.
<http://alternatives.blog.lemonde.fr/2012/05/25/alimentation-la-chasse-au-gaspi-est-lancee/>

PRANA. 20 Mai 2011. *Pertes et gaspillages alimentaires : le FAO tire la sonnette d'alarme.*
<http://pranabio.wordpress.com/2011/05/20/pertes-et-gaspillages-alimentaires-le-fao-tire-la-sonnette-d%E2%80%99alarme/>

Sainsbury's. 11 June 2010. Sainsbury's tests new technologies to trim food waste. Business Green.
<http://www.businessgreen.com/bg/news/1801748/sainsburys-tests-technology-trim-food-waste>

Stuart T. 6 January 2007. The scandal of Britain's free food. The Guardian.
<http://www.guardian.co.uk/environment/2007/jan/06/waste.pollution1>

Stuart T. 11 May 2012. Food redistribution is a win-win solution for food waste. The Guardian.
<http://www.guardian.co.uk/sustainable-business/food-waste-redistribution-sustainable-solution>

Sustainweb. Sustainable Food. Seven principles of sustainable food.
<http://www.sustainweb.org/sustainablefood/>

The Economist. 24 February 2011. Waste not, want not. Special Report: Feeding the World.

<http://www.economist.com/node/18200694>

The Guardian. Overconsumption. Environment Section of The Guardian, UK.
<http://www.guardian.co.uk/environment/overconsumption>

UNEP. World Food Supply.
<http://www.grida.no/publications/rr/food-crisis/page/3565.aspx>

Vidal J.. 26 April 2012. World Needs to Stabilize Population and Cut Consumption, says Royal Society. The Guardian.
<http://www.guardian.co.uk/environment/2012/apr/26/earth-population-consumption-disasters>



Acronyms

ACTESA	Alliance for Commodity Trade in Eastern and Southern Africa
ADF	African Development Fund
AfDB	African Development Bank
AGRA	Alliance for the Green revolution in Africa
APHLIS	African Post Harvest Losses Information System
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AU	African Union
AUC	African Union Commission
AVRDC	The World Vegetable Center
BRIC	Brazil, Russia, India, China
CAADP	Comprehensive African Agriculture Development Programme
CGIAR	Consultative Group on International Agricultural Research
CORAF	West and Central African council for agricultural research and development
DCs	Developing Countries
EAGC	Eastern Africa Grains Council
EC	European Commission
EPOS	Electronic Point-of-sale
FAO	Food and Agriculture Organization of the UN
FARA	Forum for Agricultural Research in Africa
FFVs	Fresh Fruits and Vegetables
FSC	Food Supply Chain
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
HH	Household

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ICTs	Information and Communication Technologies
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute for Tropical Agriculture
ILRI	International Livestock Research Institute
IRRI	International Rice Research Institute
IWM	Integrated Waste Management
LDCs	Least Developed Countries
MoU	Memorandum of Understanding
NARI	National Agricultural Research Institute (Papua New Guinea)
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organization
NRI	Natural Resources Institute (UK)
OECD	Organization for Economic Cooperation and Development
OSAN	African Development Bank's Agriculture and Agro-Industry Department
PAIGELAC	Inland Lakes Integrated Development and Management Support Project
PHILA	Post-Harvest Innovation Learning Alliance
PHL	Post-harvest Losses
PHLP	Post-harvest Losses Program
PHS	Post-harvest System
PPP	Public- private partnership
RECs	Regional Economic Communities
RFID	Radio Frequency Identification
SADC	Southern African Development Community

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SCP	Sustainable Consumption and Production
SSA	Sub-Saharan Africa
TTI	Time and Temperature Indicators
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNIDO	United Nations Industrial Development Organization
WB	World Bank
WFP	World Food Program of the United Nations
WRAP	Waste and Resources Action Program
WRS	Warehouse Receipt System

Glossary

Bio-waste

Garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, as well as comparable waste from food processing plants. The term does not cover forestry or agricultural residue and should not be confused with the wider term 'biodegradable waste', which includes other biodegradable materials, such as wood, paper, cardboard, and sewage sludge.¹⁵⁴

Carbon Footprint

This term refers to the total amount of greenhouse gas emissions generated by a product, an event or an individual.¹⁵⁵

Food Loss (FL)

The term 'food loss' can be defined as any reduction in food available for human consumption taking place in the food chain from the moment of harvest until the moment of consumption.¹⁵⁶ 'Food loss' is a subset of PHL and represents the part of the edible share of food that is available for consumption at either the retail or consumer levels but not consumed for any reason.¹⁵⁷ It refers to the decrease in food quantity or quality, which makes it unfit for human consumption.¹⁵⁸ It is important to note that not all food that is lost is suitable for consumption¹⁵⁹, such as banana peels or skins from vegetables.

Food Supply Chain (FSC)

A food supply chain (FSC) is 'a network of food-related business enterprises through which food products move from production through consumption, including pre-production and post-consumption activities'. Links that are typical in the FSC are Inputs → producer → distributor → wholesaler → retailer → consumer.¹⁶⁰ The food supply chain connects three important sectors of the economy – agriculture, the food processing industry and the distribution sectors'.

Food Waste (FW)

At later stages of the FSC, the term 'food waste' is applied and generally relates to behavioral issues. 'Food waste' is the subset of food loss that is potentially recoverable for human consumption and can be divided into two categories – **avoidable** (edible or edible before spoilage/damage) and **unavoidable** (inedible food material like vegetable peels, bones, etc.)¹⁶³ A more clear definition of food wastage refers to the 'deliberate discarding of food that is fit to be eaten.'¹⁶⁴

Post-Harvest Losses (PHL)

The term 'postharvest loss' (PHL) refers to the measurable quantitative and qualitative food loss in the postharvest system and comprises interconnected activities from the time of harvest to crop processing,

marketing and food preparation, to the final decision by the consumer to eat or discard the food. Losses of quantity (weight or volume) and quality (altered physical condition or characteristics) can occur at any stage in the postharvest chain. Economic loss can also occur if the produce is subsequently restricted to a lower value market.¹⁶⁵

Post-Harvest System (PHS)

Both FSC and 'post-harvest system' (PHS) have the same meaning in literature. However, the term 'post-harvest loss' is more often used to describe agricultural systems and the onward supply of produce to markets, while FSC is more associated with industrialized countries, where post-harvest processing and large retail sectors are important features.¹⁶⁶ The post-harvest system encompasses a sequence of activities and operations that can be divided into two groups. Technical activities: harvesting, field drying, threshing, cleaning, additional drying, storage, processing; and economic activities: transporting, marketing, quality control, nutrition, extension, information and communication, administration and management (FAO, 2002).

Water Footprint

This term refers to the total volume of freshwater used to produce goods or services.¹⁶⁷



Footnotes

- 1 This Reader is not intended to exhaustively cover the issue of food waste and food losses but to provide some background information and selected information resources, focusing on the implications for rural development. The Reader and most of the resources are available on <http://brusselsbriefings.net>
- 2 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 3 Roels K., van Gijsegem D. November 2011. Loss and waste in the food chain. <http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>
- 4 Ministry of Agriculture, Nature and Food Quality. 2010. Fact Sheet: Food Waste in the Netherlands. http://www.hetlnvloket.nl/portal/page?_pageid=116,1640321&_dad=portal&_schema=PORTAL&p_file_id=2001236
- 5 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 6 Vidal J.. 26 April 2012. World Needs to Stabilise Population and Cut Consumption, says Royal Society. The Guardian. <http://www.guardian.co.uk/environment/2012/apr/26/earth-population-consumption-disasters>
- 7 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 8 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 9 European Parliament. 2012. Parliament Calls for Urgent Measures to Halve Food Wastage in the EU. <http://www.europarl.europa.eu/news/en/pressroom/content/20120118IPR35648/html/Parliament-calls-for-urgent-measures-to-halve-food-wastage-in-the-EU>
- 10 Harvey F. 13 June 2012. Fishing discards practice thrown overboard by EU. The Guardian. <http://www.guardian.co.uk/environment/2012/jun/13/fishing-discards-ban-eu>
- 11 Stop Wasting Food. <http://www.stopspildafmad.dk/inenglish.html>
- 12 Last Minute Market Association. <http://www.lastminutemarket.it>
- 13 <http://www.wrap.org.uk/> and <http://england.lovefoodhatewaste.com/content/uk-media-resources>
- 14 African Development Bank Group. May 2012. Inland Lakes Integrated Development and Management Support Project (PAIGELAC) in Rwanda. <http://www.afdb.org/en/news-and-events/article/inland-lakes-integrated-development-and-management-support-project-paigelac-in-rwanda-9192/>
- 15 African Development Bank Group. 7 July 2008. The African Food Crisis Response (AFCR). <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/The%20Africa%20Food%20Crisis%20Response.pdf>
- 16 Mohamedou E.I., June 2011. UNCTAD's Annual Session of the Trade and Development Commission: Supply Chains in Africa. http://archive.unctad.org/sections/wcmu/docs/cl3rd2011_mohamedou_item5_en.pdf, pp. 11 - 15
- 17 African Development Bank Group. March 2009. The Gambia Artisanal Fisheries Development Project. <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/AR%20En%20gamb1.pdf>, p. 8
- 18 African Union. 2011. African Union Signs Memorandum of Understanding with FAO. <http://www.au.int/en/sites/default/files/MOU-%20AUC-FAO%20110705-f.pdf>
- 19 The World Bank/FAO. April 2011. Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa. http://siteresources.worldbank.org/INTARD/Resources/MissingFoodsIO_web.pdf, p. 42
- 20 Samuelu L. Post-harvest Challenges and Opportunities in the Pacific Island Region. [http://www.egfar.org/egfar/lfm/gphi_documents/02_Region_specific_documents/D_Asia_and_the_Pacific_Islands_\(APAARI\)/02_Background_Documents/01_General_issues/D-1-003-D3_Ph_in_Pacific_Islands.pdf](http://www.egfar.org/egfar/lfm/gphi_documents/02_Region_specific_documents/D_Asia_and_the_Pacific_Islands_(APAARI)/02_Background_Documents/01_General_issues/D-1-003-D3_Ph_in_Pacific_Islands.pdf), p. 6
- 21 NARI. 2006. Potential of Post-Harvest Research and Development in PNG. http://www.nari.org.pg/sites/default/files/narinus/2006/NN_vol9_No1_2006.pdf, pp. 1 - 2
- 22 FAO. 1994. The role of agriculture, forestry and fisheries in the sustainable development of small island developing states. <http://www.fao.org/docrep/T3384e/t3384e00.htm>
- 23 Barnett A. 11 January 2011. Adding Value to Jamaican Herbs and Spices: Reducing Postharvest Losses and Expanding Market Opportunities. <http://knowledge.cta.int/en/Dossiers/Demanding-Innovation/Reducing-Postharvest-Losses-A-Challenge-for-the-Scientific-Community/Articles/Adding-value-to-Jamaican-herbs-and-spices-reducing-postharvest-losses-and-expanding-market-opportunities>
- 24 Roels K., van Gijsegem D. November 2011. Loss and waste in the food chain. <http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>
- 25 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>, p. 3067
- 26 UNEP. 2011. Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication. http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_synthesis_en.pdf, pp. 36 - 37
- 27 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>, p. 3069
- 28 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 29 Morgan G., Robertson K. March 2011. Waste Not, Want Not: An Overview of Food Waste. http://www.bsr.org/reports/BSR_Waste_Not_Want_Not_An_Overview_Food_Waste.pdf, p. 1
- 30 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 31 Roels K., van Gijsegem D. November 2011. Loss and waste in the food chain. <http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>
- 32 Food navigator. US waste half its food. <http://www.foodnavigator-usa.com/Business/US-wastes-half-its-food>
- 33 Scott Kantor L., Lipton K., Manchester A. and Oliveira V. 1997. Estimating and Addressing America's Food Losses. <http://www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf>, p. 2
- 34 Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis - the Environment's Role in Averting Future Food Crises. http://www.unep.org/pdf/FoodCrisis_lores.pdf, p. 32
- 35 Ibid., p. 30
- 36 The Economist. 24 February 2011. Waste not, want not. Special Report: Feeding the World. <http://www.economist.com/node/18200694>
- 37 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>, p. 3067
- 38 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Waste in the Food Chain. http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf, p. 25
- 39 Roels K., van Gijsegem D. November 2011. Loss and waste in the food chain. <http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>
- 40 UNEP. World Food Supply. <http://www.grida.no/publications/rr/food-crisis/page/3565.aspx>
- 41 Foresight. 2010. Land Use Futures: making the most of land in the 21st century. Executive Summary. http://www.bis.gov.uk/assets/foresight/docs/land-use/luf_report/8614-bis-land_use_futures_exec_summ-web.pdf, pp. 26 - 28
- 42 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 43 UNEP. 2011. Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - A Synthesis for Policymakers. http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_synthesis_en.pdf, pp. 36 - 27
- 44 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 45 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 46 Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis - the Environment's Role in Averting Future Food Crises. http://www.unep.org/pdf/FoodCrisis_lores.pdf
- 47 FAO. 1994. The role of agriculture, forestry and fisheries in the sustainable development of small island developing states. <http://www.fao.org/docrep/T3384e/t3384e00.htm>
- 48 Samuelu L. Post-harvest Challenges and Opportunities in the Pacific Island Region. [http://www.egfar.org/egfar/lfm/gphi_documents/02_Region_specific_documents/D_Asia_and_the_Pacific_Islands_\(APAARI\)/02_Background_Documents/01_General_issues/D-1-003-D3_Ph_in_Pacific_Islands.pdf](http://www.egfar.org/egfar/lfm/gphi_documents/02_Region_specific_documents/D_Asia_and_the_Pacific_Islands_(APAARI)/02_Background_Documents/01_General_issues/D-1-003-D3_Ph_in_Pacific_Islands.pdf), p. 11

Resources on: Addressing Food Waste in Times of Crisis

- 49 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain. http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf
- 50 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 51 Ibid.
- 52 Jones T.W. 2006. Using Contemporary Archaeology and Applied Anthropology to Understand Food Loss in the American Food System. http://www.ce.cmu.edu/~gdr/reading/2006/12/19/Jones_UsingContemporaryArchaeologyAndAppliedAnthropologyToUnderstandFoodLossinAmericanFoodSystem.pdf
- 53 Hall K.D., Guo J., Dore M., Chow C.C. 2009. The Progressive Increase of Food Waste in America and Its Environmental Impact. <http://www.plosone.org/article/info:doi/10.1371/journal.pone.0007940>
- 54 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain. http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf
- 55 Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts, <http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>, p. 8
- 56 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>, p. 3
- 57 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>, p. 3065
- 58 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 59 Ibid.
- 60 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain, http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf, p. 5
- 61 K Scott Kantor L., Lipton K., Manchester A. and Oliveira V. 1997. Estimating and Addressing America's Food Losses, <http://www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf>, p. 3
- 62 Roels K., van Gijsegem D. November 2011. Loss and waste in the food chain. <http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>
- 63 Ibid.
- 64 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork
- 65 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains.
- 66 Foresight. 2010. Land Use Futures: making the most of land in the 21st century. Executive Summary, http://www.bis.gov.uk/assets/foresight/docs/land-use/uf_report/8614-bis-land_use_futures_exec_summ-web.pdf, p. 3.
- 67 Ibid.
- 68 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork
- 69 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>, p. 4.
- 70 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork
- 71 Morgan G., Robertson K. March 2011. Waste Not, Want Not: An Overview of Food Waste, http://www.bsr.org/reports/BSR_Waste_Not_Want_Not_An_Overview_Food_Waste.pdf, p. 2.
- 72 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 73 The Economist. 24 February 2011. Waste not, want not. Special Report: Feeding the World. <http://www.economist.com/node/18200694>
- 74 Ibid.
- 75 The World Bank/FAO. April 2011. Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa, http://siteresources.worldbank.org/INTARD/Resources/MissingFoods10_web.pdf, p. 32.
- 76 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 77 The Worldwatch Institute. 2011. State of the World - Innovations that Nourish the Planet. <http://www.worldwatch.org/sow11>
- 78 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 79 The Economist. 24 February 2011. Waste not, want not. Special Report: Feeding the World. <http://www.economist.com/node/18200694>
- 80 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 81 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>, p. 4.
- 82 Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts, <http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>, pp. 6, 12.
- 83 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 84 Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts, <http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>
- 85 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain, http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf, p. 24.
- 86 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 87 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 88 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain, http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf
- 89 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, p. 3. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 90 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 91 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain, http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf
- 92 Jackson T. January 2005. Motivating Sustainable Consumption: a review of evidence on consumer behaviour and behavioural change, p. 105. <http://www.c2p2online.com/documents/MotivatingSC.pdf>
- 93 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 94 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3067. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 95 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 96 The Economist. 24 February 2011. Waste not, want not. Special Report: Feeding the World. <http://www.economist.com/node/18200694>
- 97 Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts, p. 21. <http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>
- 98 Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis - the Environment's Role in Averting Future Food Crises. http://www.unep.org/pdf/FoodCrisis_lores.pdf
- 99 Beddington J., Asaduzzaman M., Clark M., Fernández A., Guillou M., Jahn M., Erda L., Mamo T., Van Bo N., Nobre C.A., Scholes R., Sharma R., Wakhungu J. 2012. Achieving food security in the face of climate change. http://ccafs.cgiar.org/sites/default/files/assets/docs/climate_food_commission-final-mar2012.pdf

Resources on: Addressing Food Waste in Times of Crisis



- 100 FAO. 2006. Livestock's long shadow. Environmental issues and options. <ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e00.pdf>
- 101 Hamerschlag K. July 2011. Meat Eater's Guide to Climate Change and Health, p.4. http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf
- 102 FAOStat, 2010 <http://faostat.fao.org/>
- 103 Hall K.D., Guo J., Dore M., Chow C.C. 2009. The Progressive Increase of Food Waste in America and Its Environmental Impact. <http://www.plosone.org/article/info:doi/10.1371/journal.pone.0007940>
- 104 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain. http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf
- 105 UNEP-EEA. 2007. Sustainable consumption and production in South East Europe and Eastern Europe, Caucasus and Central Asia, p. 60. http://www.eea.europa.eu/publications/eea_report_2007_3
- 106 Garnett T. September 2008. Cooking up a storm: Food, greenhouse gas emissions and our changing climate. http://www.fcrrn.org.uk/sites/default/files/CuaS_web.pdf
- 107 Hamerschlag K. July 2011. Meat Eater's Guide to Climate Change and Health, p.4. http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf
- 108 Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis - the Environment's Role in Averting Future Food Crises, p. 32. http://www.unep.org/pdf/FoodCrisis_lores.pdf
- 109 Hamerschlag K. July 2011. Meat Eater's Guide to Climate Change and Health, p.4. http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf
- 110 Stuart T. 2009. Waste: Uncovering the Global Food Scandal. <http://www.tristramstuart.co.uk/>
- 111 Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis - the Environment's Role in Averting Future Food Crises, p. 32. http://www.unep.org/pdf/FoodCrisis_lores.pdf
- 112 European Commission. 2010. Being wise with waste: the EU's approach to waste management. European Union, p. 13. <http://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf>
- 113 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste, p. 15. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 114 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 115 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste, p. 15. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 116 WRAP. 2009. Courtauld Commitment Factsheet. Best Practice Factsheets in preparation for Waste Prevention Guidelines. http://ec.europa.eu/environment/waste/prevention/pdf/Courtauld_Commitment_Factsheet.pdf
- 117 Scott Kantor L., Lipton K., Manchester A. and Oliveira V. 1997. Estimating and Addressing America's Food Losses. <http://www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf>
- 118 WRAP. 2009. Courtauld Commitment Factsheet. http://ec.europa.eu/environment/waste/prevention/pdf/Courtauld_Commitment_Factsheet.pdf
- 119 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 120 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste, p. 12. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>, p. 12
- 121 Foresight. 2010. Expert Forum on the Reduction of Food Waste. Foresight Project on Global Food and Farming Futures. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/workshops/11-608-w4-expert-forum-reduction-of-food-waste>
- 122 Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts. <http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>
- 123 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, p. 8. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 124 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3079. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 125 Foresight. 2010. Expert Forum on the Reduction of Food Waste. Foresight Project on Global Food and Farming Futures. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/workshops/11-608-w4-expert-forum-reduction-of-food-waste>
- 126 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 127 Scott Kantor L., Lipton K., Manchester A. and Oliveira V. 1997. Estimating and Addressing America's Food Losses. <http://www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf>
- 128 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains., <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>, p. 3079
- 129 Foresight. 2010. Land Use Futures: making the most of land in the 21st century. Executive Summary, pp. 26-28. http://www.bis.gov.uk/assets/foresight/docs/land-use/luf_report/8614-bis-land_use_futures_exec_summ-web.pdf
- 133 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3079. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 134 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3068. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 135 Gustavsson J., Cederberg C., Sonesson U., van Otterdijk R., Meybeck A. 2011. Global Food Losses and Food Waste. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- 136 The World Bank/FAO. April 2011. Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa. http://siteresources.worldbank.org/INTARD/Resources/MissingFoods10_web.pdf
- 138 The World Bank/FAO. April 2011. Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa. http://siteresources.worldbank.org/INTARD/Resources/MissingFoods10_web.pdf
- 140 Hamerschlag K. July 2011. Meat Eater's Guide to Climate Change and Health, p. 7. http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf
- 141 Gray D.M.D. March 2008. Anaerobic Digestion of Food Waste - Final Report. <http://www.epa.gov/region9/organics/ad/EBMUDFinalReport.pdf>
- 143 Foresight. 2010. Expert Forum on the Reduction of Food Waste. Foresight Project on Global Food and Farming Futures. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/workshops/11-608-w4-expert-forum-reduction-of-food-waste>
- 144 Ibid.
- 145 Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis - the Environment's Role in Averting Future Food Crises, p. 19. http://www.unep.org/pdf/FoodCrisis_lores.pdf
- 146 EurActiv. EU news and policy debates. Eating green? Food, drinks and the environment. <http://www.euractiv.com/consumers/eating-green-food-drinks-environ-links dossier-504448>
- 147 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, p. 2. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 148 Scott Kantor L., Lipton K., Manchester A. and Oliveira V. 1997. Estimating and Addressing America's Food Losses. <http://www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf>
- 149 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3066. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 150 Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts, p. 5. <http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>
- 151 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, p. 2. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 152 EurActiv. EU news and policy debates. Eating green? Food, drinks and the environment. <http://www.euractiv.com/consumers/eating-green-food-drinks-environ-links dossier-504448>

Resources on: Addressing Food Waste in Times of Crisis

- 153 Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., Kaltenborn B.P. (Eds). 2009. The Environmental Food Crisis - the Environment's Role in Averting Future Food Crises, p. 19. http://www.unep.org/pdf/FoodCrisis_lores.pdf
- 154 European Commission. 18 May 2010. Communication from the Commission to the Council and the European Parliament on future steps in bio-waste management in the European Union. http://www.ab.gov.tr/files/ardb/evt/1_avrupa_birligi/1_6_raporlar/1_3_diger/environment/comm_future_steps_in_bio_waste_management.pdf
- 155 EurActiv. EU news and policy debates. Eating green? Food, drinks and the environment. <http://www.euractiv.com/consumers/eating-green-food-drinks-environ-links dossier-504448>
- 156 Roels K., van Gijsegem D. November 2011. Loss and waste in the food chain. <http://lv.vlaanderen.be/nlapps/docs/default.asp?id=2647>
- 157 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, p. 2. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 158 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3066. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 159 Scott Kantor L., Lipton K., Manchester A. and Oliveira V. 1997. Estimating and Addressing America's Food Losses. <http://www.ers.usda.gov/publications/foodreview/jan1997/jan97a.pdf>
- 160 Stevenson S. Values-Based Food Supply Chains: Strategies for Agri-Food Enterprises-of-the-Middle, p. 1. <http://www.agofthemiddle.org/papers/valuechain.pdf>
- 161 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3066. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 162 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, p. 2. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 163 Koivupuro H.K. 19 October 2011. FOODSPILL - Food Wastage and Environmental Impacts, p. 5. <http://www.helsinki.fi/henvi/yvv/esitykset/Koivupuro.pdf>
- 164 Lundqvist J., de Fraiture C. and Molden D. 2008. Saving Water: From Field to Fork - Curbing Losses and Wastage in the Food Chain, p. 22. http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf
- 165 Hodges R.J., Buzby J.C. and Bennett B. 2010. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use, p. 2. <http://www.bis.gov.uk/assets/foresight/docs/food-and-farming/science/11-561-sr15-postharvest-losses-and-waste>
- 166 Parfitt J., Barthel M. and Macnaughton S. 2010. Food Waste within Food Supply Chains, p. 3066. <http://rstb.royalsocietypublishing.org/content/365/1554/3065.full>
- 167 EurActiv. EU news and policy debates. Eating green? Food, drinks and the environment. <http://www.euractiv.com/consumers/eating-green-food-drinks-environ-links dossier-504448>