

## **Economic Commission for Europe**

### **Steering Committee on Trade Capacity and Standards**

#### **Working Party on Agricultural Quality Standards**

##### **Specialized Section on Standardization of Fresh Fruit and Vegetables**

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###### **SDG 12 and sustainable practices: Food loss and food waste**

### **Code of Good Practice for reducing losses in fruit and vegetable trade**

The following document was prepared by the working group on food loss led by the delegation of Sweden. It was circulated among delegations and sent for comments to private sector operators.

Losses and waste of food products<sup>1</sup> have received increased attention in the last years as it leads to waste of resources and thus an increased impact on environment and climate. Due to the perishable nature of many fruits and vegetables, losses and waste of this group of products is high. There is therefore much to gain from measures that reduce losses and waste. In addition to reduced environmental and climatic impact, there is also a considerable potential for economic gains. According to estimates, investments in measures that reduce losses and waste in food give an estimated 14-fold return<sup>2</sup>. Hence, there is a clear business case for the companies involved.

Fruit and vegetables are—sold internationally, nationally, regionally and locally are frequently traded over large distances and involve a number of actors. Reducing waste and losses requires care, attention and cooperation along value chains, whether global or local.

The Code of Good Practice for reducing losses in fruit and vegetable trade sets out a number of activities and measures along the value chain with the aim of reducing losses and waste. Trade standards for agricultural produce elaborated by the United Nations Economic Commission for Europe (UNECE) have contributed to facilitating trade for over 50 years. This Code of Good Practice is intended to complement this work and help maintain quality along the supply chains to prevent and reduce food loss. It is

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<sup>1</sup> Food loss is defined as “the decrease in quantity or quality of food”. Food waste is part of food loss and refers to discarding or alternative (non-food) use of food that is safe and nutritious for human consumption along the entire food supply chain, from primary production to end household consumer level. Food waste is recognized as a distinct part of food loss because the drivers that generate it and the solutions to it are different from those of food losses. (FAO, 2014).

<sup>2</sup> Hanson, C., and P. Mitchell. 2017. The Business Case for Reducing Food Loss and Waste. Washington, DC: Champions 12.3.

aimed at strengthening the work on reducing food waste and associated costs that is already an important part of the sustainability work carried out by many companies. Many measures during production will influence quality and shelf life. The scope of this Code covers measures that help prevent food loss and waste at the various stages before the fruit and vegetables reach the consumer level, i.e. from harvest to retail.

The Code of Good Practice consists of three distinct chapters which focus on the three major segments of the fruit and vegetable supply chain. The chapters can be used separately.

The aim of this Code is to provide a number of recommendations that can contribute to reducing waste of fruit and vegetables when traded, from harvest to retail level.

### **Recommendations on Good Practices for three major segments of the fruit and vegetable value chain**

The Code of Good Practice looks at the potential of reducing food loss from the following supply chain participants:

- Producers;
- Buyers and traders [Traders and wholesalers, sales departments of retail chains]
- Retailers.

## **Producers**

### **Producers adhering to the Code of Good Practice undertake the following**

- ***Ensure that production is planned and adjusted to demand, in terms of both quantity and quality***

It is important that production meets market demand. It means planning the produced volume to the expected demand, at different times, of a species, variety, size, colour, and quality as well as price level. It is also important to consider maturity stage at harvest, expected shelf-life and type of product, for example if it is a climacteric or non-climacteric type of fruit<sup>3</sup>. *Harvesting at the right stage of maturity is particularly important for tropical fruit (e.g. mangoes), as direct contact of immature fruit with more mature fruit can cause physical damage and quality losses. Harvesters should therefore be trained on how to harvest produce items at the right stage of maturity.*

On a local market, the direct contact between producer/seller and buyer will give the producer valuable information on the buyers' preferences and demands. In longer value chains, stretching over country borders or even continents, good communication along the chain will help convey important information on market demand to producers located far away from the final market.

Trade standards, which have been elaborated with important input from the market, are commonly agreed descriptions of the quality expected of products sold as Class Extra, I or II and therefore provide valuable information on quality requirements. There may

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<sup>3</sup> A climacteric fruit is a fruit with a clear continuing ripening stage when many characteristics of the fruit change, for example fruit texture which becomes softer, content of sugar and aroma substances, increased respiration rate and production of ethylene. Non-climacteric fruit lack this stage. A list of climacteric and non-climacteric fruit is found in annex I.

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also be more detailed and often more stringent requirements in the specifications from the buyer.

By collecting information on market demand and planning production based on the quality standards and specifications, producers reduce the risk of products remaining unsold at the farm, of products being rejected upon arrival at wholesale level or of not being chosen by the consumer and therefore remaining unsold at retail level.

Collecting market information, using crop estimation tools as well as training in grading according to trade standards can therefore contribute to decreasing losses. Advisory services can support this kind of work.

- ***Use the best possible harvest methods for product quality and shelf life.***

Products can easily be damaged during harvest without careful handling and ensuring the correct equipment is used properly. All mechanical impact on products, cuts, bruises, tearing, breakages etc. will reduce product quality, shorten storage life and shelf life, and increase waste.

If products are harvested manually, it is important to train staff to handle products carefully. When products are cut, sharp, disinfected knives or scissors that cut through a thin layer of cells will give a better result than blunt edges damaging a greater area in the cutting zone. Furthermore, by for example, having a lining in boxes, bins and harvest bags will minimize damage to products.

*Soft-skinned fruit is particularly sensitive to signs of physical damage, such as cuts, bruises and scratches. The careful handling at harvest and adherence of staff to personal hygiene are important, as studies have shown that even protruding fingernails can easily cause damage to soft-skinned fruit, and therefore reduce quality and increase waste. Using gloves when harvesting sensitive fruit can also help.*

For mechanical harvest, it is important to choose equipment that does not damage products. The choice of equipment depends on price and financial resources but can have a major impact on the results. The quality of the harvested product will also be influenced by the way the equipment is used or the experience and the skills of the driver of a harvester. *Raising awareness and training staff in correctly using the appropriate harvest equipment and methods for product quality will contribute to decreasing losses.*

- ***Harvest products at the best appropriate conditions***

The time of the day and weather conditions at harvest can influence post-harvest quality of products. An early harvest while products are still cool from the night and before the sun is high and temperatures have risen is likely to limit water losses and reduce rate of senescence (i.e. the ageing of the fruit and vegetables) . Leafy products and other products with a high surface to volume (like broccoli) that easily lose water are those that will benefit most from this. The shorter the normal shelf-life of a product the greater the benefit. Higher temperatures will also speed up the ripening process.

Sunshine, high temperatures and wind will increase water losses and speeds up the ageing of products. Products should therefore be taken to a storehouse as soon as possible using a means of transport that minimizes damage and maintains the quality of

the products in the best possible way. While still in the field, products need to be protected from sun, wind, rain, dust and other factors affecting the quality, *by for example being placed in covered containers or under a tree or in a shed*. Humid weather makes fruit more water saturated (high turgor pressure) and this in turn makes them bruise more easily. For many fruits, harvesting in humid weather conditions should be avoided if possible.

- ***Ensure that products that are not fit for long storage are delivered as soon after harvest as possible***

Delivering products after harvest to warehouses or cooling facilities without delay will decrease waste throughout the distribution chain and at consumer level.

Products that are normally not fit for long-term storage after harvest have a limited shelf-life. The length of this shelf-life depends on the climatic conditions in which products are harvested, transported, graded, packed, distributed, stored and displayed. Temperature has the greatest effect, but humidity and air circulation are also important factors. The “age” of a product is largely determined by temperature and time. The shorter the time from harvest to retailer, the better the quality and the longer the shelf-life at both retail and consumer level. A shorter distribution time will also reduce food waste at all distribution stages and at consumer level.

Although a large share of food waste takes place at consumer level, it should be noted that part of the waste at consumer level is caused by too little shelf-life remaining when products reach consumers.

- ***Cool products – where appropriate - to their correct temperature as soon as possible after harvest and keep the products at the appropriate temperature until delivered***

Sub-optimal cool or cold chain processes and management cause a considerable share of food losses. The single most important factor for retaining product quality after harvest is temperature<sup>4</sup>.

There is thus much to gain from a rapid and efficient cooling of products after harvest. The higher the temperature is at harvest and the more sensitive products are, the greater the gain from cooling. This however only refers to products that are not chilling sensitive.

Products that contain a lot of air, for example leafy vegetables like lettuce, take a long time to cool. Certain cooling techniques like forced air and vacuum cooling speed up the cooling process and reduces the risk that the interior of pallets remains uncooled after harvest cooling.

Products with a large surface to volume ratio, for example leafy vegetables and broccoli, easily lose water during harvest cooling. All products, but these in particular, benefit from high air humidity during cooling to prevent products from rapidly losing water.

Subtropical and tropical products develop chilling injuries when kept at lower, though non-freezing, temperatures. Attention should therefore be paid to appropriate storage temperatures ensuring that products sensitive to chilling are not subjected to temperatures below those that may cause chilling injury. (See annex II for recommended lowest storage temperatures).

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<sup>4</sup> Temperature has a direct effect on shelf-life by affecting respiration rate, the rate with which carbohydrates in a product are converted into carbon dioxide and water. In for example asparagus, respiration at 20° C is 10 times higher than at 0° C. Temperature also has an indirect effect by affecting air humidity, ethylene production and effect of existing ethylene.

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- ***Choose packaging that protects products properly during transport and distribution, while balancing the cost and quantity of packaging material and taking into account buyer requirements***

Packaging is often chosen in a dialogue between seller and buyer. The wish to fill packages and thereby use space in storage and transportation efficiently should be weighed against the risk of causing product damage when packages are put on top of each other in a pallet. *The careless stacking of boxes during storage and transportation can easily lead to extra losses, especially, when dealing with soft-skinned fruit which is more likely to suffer from visible and latent damage.*

Packages must be of a quality, strength and characteristic to protect the produce during transport and handling. Clean materials should be used to protect the produce from foreign matter such as leaves, sand or soil, which could cause a negative impact on the produce and its presentation. A visible lack of cleanliness in several packages could result in the goods being rejected. *Bruising caused by vibrations during the transport and distribution can be minimized by using appropriate packaging as well as such simple things as proposedly inflated vehicle tyres.*

For products that bruise easily, the use of trays should be considered. For many products, modified atmosphere may extend shelf-life and reduce waste.

- ***Follow the principles of Good Hygienic and Manufacturing practices***

The principles of the Good Hygienic Practices (GHP) and Good Manufacturing Practices (GMP) help to reduce food losses caused by factors such as physical and microbial contamination. It is highly recommended to proceed in accordance with these principles at all stages from harvest to retailer.

- ***Find outlets for products that would not be harvested due to oversupply***

Weather conditions may cause more products than planned to be ready for harvest at the same time. These products meet buyer quality requirements but face a saturated market.

Alternatives that can be considered may include:

- Reduce the price. In some countries, electronic market places for unsold/ surplus products are being developed.
- Increase the amount of produce sold to the processing industry (if relevant for the product in question and if such an industry exists)
- Donate products to charity (see Guidelines<sup>5</sup>)

- ***Find alternative outlets for products not meeting buyer's quality requirements***

Not meeting buyers' requirements should of course be avoided. A continuing dialogue with buyers is therefore important to know clearly what the buyer expects but also to increase the buyer's knowledge and understanding regarding certain defects.

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<sup>5</sup> EU Food Donation Guidelines provides valuable advice see:  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2017:361:FULL&from=EN>

On many markets, especially with large retailers, buyers mainly demand Class I products. Class II products are however subject to the same requirements on good eating quality as Class I products, but the allowance for defects is larger. Products that today are marketed as so-called ugly fruits/vegetables can largely be accommodated within the quality requirements and tolerances of Class II. For Class II products to be harvested and traded, they need to fetch a higher price than is the case today. If demand for Class II increases, and these products fetch a higher price, the share of products that can be sold for human consumption would increase.

In addition, the following alternatives are examples that can be considered:

- Increase the amount of produce sold to processing industry (if relevant for the product in question and if such an industry exists) and repurpose
  - Develop new products (carrot and broccoli paste for cooking are examples)
  - Find alternative outlets, new markets or destinations
  - Donate products to charity (see guidelines<sup>6</sup>)
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- ***Measure the amount of produce that is wasted and specify the major causes of the waste***

Companies in food production that understand the causes of food waste and measure it have a greater capacity to reduce waste at the source. This implies that most companies acknowledge there is a problem, measure the loss, identify hotspots and manage the food losses through targeted interventions. Companies that regularly measure waste can identify more easily the hotspots for this waste (where it happens) and review the results to start a learning process. This is an important tool for finding measures that lead to reduced waste. The results can be used for future planning but also for the implementation of measures related to handling, temperatures, transport, logistics etc. Apart from the aspect of reducing waste there is a strong business incentive to carry out this work since money spent on reducing waste is reported to give an estimated 14-fold return on the money spent<sup>7</sup>.

## **Buyers and traders [Traders and wholesalers, sales departments of retail chains]**

**Traders and whole-sellers adhering to the Code of Good Practice undertake the following**

- ***Ensure that ordered volumes of products are planned and adjusted to demand, in terms of both quantity and quality***

Planning and adjusting ordered volumes to demand ensures that products can be delivered to retailers without unnecessary delay. Products that arrive at retail level with a larger part of their shelf-life remaining will be fresher and thus have a better quality leading to reduced waste of these products at retail level and at consumer level.

Demand for products is not constant but varies with for example weather, season, holidays and celebrations. Some of these can be foreseen whereas others are

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<sup>6</sup> EU Food Donation Guidelines provides valuable advice see:

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2017:361:FULL&from=EN>

<sup>7</sup> Hanson, C., and P. Mitchell. 2017. The Business Case for Reducing Food Loss and Waste. Washington, DC: Champions 12.3.

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unpredictable, thereby making planning more difficult. An efficient chain from harvest to retailer requires market knowledge and careful planning.

Planning involves estimating sales volumes of different products, but also for example trade types, varieties, sizes, quality categories, colour categories and level of maturity/stage of ripeness. Good communication along the distribution chain will help coordinate market demand with supply.

- ***Improve logistics to shorten time from harvest or packing to retail***

An efficient logistics' chain that reduces the time from producer or packer to retailer is important for ensuring a larger share of a perishable products' shelf-life is retained for retail and consumer levels. Such efficiency reduces quality losses and waste. An efficient logistics' chain has no more stops and reloading points than necessary. Stops are short and reloading quick. At reloading points, a strict "first-in – first-out" principle is applied.

- ***Cooperate to establish unbroken cool chains at the appropriate temperature for respective products***

Sub-optimal cold chain processes and management cause a considerable share of food losses. Shelf-life is highly influenced by temperature deviations during transport and storage. An appropriate temperature shall be kept all the time from harvest to retail. The money and effort put into cooling products to the appropriate temperature is quickly lost if products are kept at too high temperatures later in the chain. A good dialogue along the distribution chain shall therefore include discussions on how to establish an unbroken cold chain.

Temperature is one of the most important factors for retaining product quality during distribution. It increases shelf-life by affecting respiration rate and thereby the ageing of the fruit and vegetables.

There is thus much to gain in terms of reduced waste and improved quality from keeping products in appropriate climate conditions throughout distribution and retail. The higher the temperature is and the more sensitive products are, the greater the gain from an unbroken cool chain. For example, lettuce has an estimated shelf-life of up to 12 days at zero degrees Celsius but only two days at 20 degrees; leek and cauliflower may be stored over 40 days at zero degrees but only two days at 20 degrees. This only refers to products that are not chilling sensitive (see Annex II).

Subtropical and tropical products develop chilling injuries when kept at low, though non-freezing, temperatures. Attention should therefore be paid to appropriate storage and transport temperatures to ensure that chilling sensitive products are not subjected to temperatures below those that may cause chilling injury (link to Annex II).

The cool chain should be established from harvest and retained all the way through retail, including, where possible, during display for the consumer.

- ***Place orders and/or change orders in good time to allow for products to be carefully harvested, handled and cooled before dispatch***

Producers need to be given sufficient time to be able to cool products to the appropriate temperature and to sort and pack according to specifications given. If orders are placed or changed shortly before time of dispatch, producers may have to send products that are not properly cooled. This will reduce the shelf-life of the products. It may also lead

to sorting and packing having to be done too quickly to allow for careful handling and for quality assurance to be carried out properly.

- ***Avoid the cancellation of orders close to planned dispatch of products from packer/producer***

When orders of perishable products are cancelled with short notice and close to dispatch, it is difficult to find a new buyer for these products. As a result, these products are often wasted.

The reason behind late cancellations is often that market demand for a product, at a given time, is lower than when the buyer originally placed the order. Products may therefore still be wasted even if the order is kept. In these cases, the buyer should consider measures to promote the sale of these products.

The negative impact of a cancellation will be particularly severe if an order is cancelled for example after a producer has opened a cold store or a Controlled Atmosphere (CA) store and removed the products from the storage room. Once a CA store has been opened, the fruit has to go into the distribution chain.

- ***Place orders for fruit only when there is information that they have reached their proper maturity, by agreement and communication between producers, traders and retailers***

Produce needs to have reached an appropriate stage of development and maturity to have good eating quality and shelf-life. This should be respected.

Consumers may be very eager to buy products when these first appear on the market at the beginning of the season. They may also be willing to pay quite a high price for these first products. It may therefore be tempting to sell products as early in their season as possible. If, however, products are marketed before they have reached the appropriate level of maturity, they may not be able to mature and ripen into a product with good eating quality, but remain hard and tasteless. These immature products will then, most likely, be thrown away by the consumer and the (disappointed) consumer may avoid buying this product again for some time.

The different varieties of many fruits, for example apples and pears, mature and ripen at different times and should therefore be marketed at different times. It is important that each variety is placed on the market at the appropriate time with respect to harvest and storage period to avoid low eating quality and products being wasted. The best way to avoid this is to have a good communication with producers and respect the advice given by them.

- ***Define clear specifications that will prevent food loss and avoid interventions, by agreement and communication between producers, traders and retailers***

Specifications should be clearly elaborated, in a dialogue with producers, in such a way that they avoid causing unnecessary waste.

For example, such specifications might require trimming products to the exact same size to fit a specific consumer package. This kind of intervention is not related to quality and will lead to waste.

Products are also trimmed to remove or reduce parts that are dry or damaged, such as the outer leaves of lettuce or headed cabbage, or parts that are usually not eaten, such as the green leaves of cauliflower.

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These kinds of requirements might need to be reviewed, become obsolete over time and could be phased out to avoid unnecessary food loss.

- ***Check the ordered products at arrival by:***

- applying an agreed inspection procedure such as for example the OECD guidelines on quality inspection (not to be applied at retailer stage) (link to appendix) [Note: these guidelines are under development at the time of writing]
- setting up a control protocol specifying the defects and the percentage of non-conforming products
- communicating complaints/ claims to the seller in a report format and within a reasonable time after products have arrived at the buyer's premises
- Establish, if possible, the likely reason for the non-conformity.

Rejection of products at wholesale level with reference to products not fulfilling the requirements that have been agreed by buyer and seller is a major cause of waste.

The added difficulty is that buyers and sellers do not always agree on whether products are in conformity. When the complaint is fair, and is justified by photos and additional supporting evidence, common agreement is facilitated. Similar incidents and further waste can then be avoided in the future.

In obvious cases, for example if all products are dirty or overripe, it may not be necessary to apply an agreed control method. Instead, photographs may suffice to communicate the extent of non-conformity to the seller. Products may be judged by the buyer to not be in conformity because the tolerances set out in the standards have been exceeded. When such non-conformity is not excessive and the complaint less easy to see from a photograph, a common control method needs to be agreed and applied to produce a repeatable control result. With an agreed control method, the buyer can establish the percentage of products with different defects and communicate the result to the seller. The communication of non-conformity is a difficult topic, as can the understanding between the two parties concerned. Using a commonly agreed control/inspection method can also avoid products being rejected erroneously.

To guarantee a reliable and repeatable inspection result, the OECD for example, has developed an inspection method to be used for conformity controls of fresh fruits and vegetables. The method defines the number of boxes in a sample, depending on the size of the lot, that needs to be taken randomly and inspected and the method of inspection, for products in consumer packages and for products loose in the package (link to OECD guidelines on quality inspection).

The buyer should use a control protocol that specifies the percentage of products with different defects as found in the control that has been made.

The control and the results should be communicated to the seller within a reasonable time. Depending on how sensitive products are and how they are kept and handled after arriving at the buyer's premises, they may lose quality quite quickly. Control results are therefore only a valid judgement of the quality of delivered products if made in connection to the arrival of these products at the buyer's premises. What is judged to be "a reasonable time" will vary depending on the product and how it is stored and handled after arrival. High risk areas and their controls should be defined in contracts in advance.

When products are found not to meet specifications, and this is communicated to the dispatcher, there should be a reference to the likely reason behind the nonconformity as this will help the involved actors to take measures to avoid this problem in the future. If for example products show symptoms of chilling injury and there has been a known deviation from the appropriate temperature during transport, this is very important information to those involved.

- ***Find alternative outlets for products that cannot be sold on the intended market***

Even with the most careful planning, there will always be, at some time and for various reasons, products that cannot be sold to the intended buyer. Companies in the fruit and vegetable trade should therefore have in place alternative outlets and uses for products that cannot be placed on the intended market and/ or sold to the intended buyer.

The following alternatives are examples that might be considered:

- Reduce price and sell as
  - Category II (if applicable)
  - For home processing
  - To be consumed soon
- donate to charity (see guidelines<sup>8</sup>)

- ***Measure the amount of produce that is wasted and specify the major causes***

Companies in food production that understand the causes of food waste and measure it have a greater capacity to reduce waste at the source. This implies most companies acknowledging there is a problem, measure the loss, identify hotspots and manage the food losses through targeted interventions. Companies that regularly measure waste can identify more easily the hotspots for this waste (where it happens) and review the results to start a learning process. This is an important tool for finding measures that lead to reduced waste. The results can be used for future planning but also for the implementation of measures related to handling, temperatures, transport, logistics etc. Apart from the aspect of reducing waste there is a strong business incentive to carry out this work since money spent on reducing waste is reported to give an estimated 14-fold return on the money spent<sup>9</sup>

## **Retailers**

**Retailers and retailer chains adhering to the Code of Good Practice undertake the following**

- ***Ensure that ordered volumes are planned and adjusted to demand, in terms of both quantity and quality***

The longer the time it takes from harvest to retailer until products are sold, the greater the loss of quality and the greater the waste, both at retail level and at then at consumer level. Planning and adjusting ordered volumes to demand ensures that products can be sold to consumers without being kept in shop storage or in display longer than

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<sup>8</sup> EU Food Donation Guidelines provides valuable advice see:

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2017:361:FULL&from=EN>

<sup>9</sup> Hanson, C., and P. Mitchell. 2017. The Business Case for Reducing Food Loss and Waste. Washington, DC: Champions 12.3.

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necessary. This will retain quality and reduce waste. The longer the time from harvest to retailer and the more time that passes until the product is sold to the consumer, the greater the loss of quality and the risk for waste generation, at retail as well as at consumer levels.

Demand for products is not constant but varies with for example weather, season, holidays and celebrations. Some high-demand periods can be foreseen whereas others are unpredictable, thereby making planning more difficult. Ensuring a steady flow of products through the shop requires market knowledge and careful planning.

Planning involves estimating sales volumes of different products, but also for example trade types, varieties, sizes, quality categories, colour categories and level of maturity/stage of ripeness. Campaigns promoting the sale of one product may also influence the sales volumes of other, similar products. Good communication with the supplier and/or distribution centre will help coordinate market demand with supply.

A “first-in – first-out” approach of the stock will contribute to minimizing wastage.

- ***Define clear specifications that will prevent food loss and avoid interventions, by agreement and communication between producers, traders and retailers***

Specifications should be clearly elaborated, in a dialogue with producers, in such a way that they avoid causing unnecessary waste.

For example, such specifications might require trimming products to the exact same size to fit a specific consumer package. This kind of intervention is not related to quality and will lead to waste.

Products are also trimmed to remove or reduce parts that are dry or damaged, such as the outer leaves of lettuce or headed cabbage, or parts that are usually not eaten, such as the green leaves of cauliflower.

These kinds of requirements might need to be reviewed, become obsolete over time and could be phased out to avoid unnecessary food loss.

- ***Place orders for fruit only when there is information that they have reached their proper maturity, by agreement and communication between producers, traders and retailers***

Produce need to have reached an appropriate stage of development and maturity to have good eating quality and shelf-life. This should be respected.

Consumers may be very eager to buy products when these first appear on the market at the beginning of the season. They may also be willing to pay quite a high price for these first products. It may therefore be tempting to sell products as early in their season as possible. If, however, products are marketed before they have reached the appropriate maturity, they may not be able to mature and ripen into a product with good eating quality but remain hard and tasteless. The consumer will then, most likely, throw these products away and the (disappointed) consumer may avoid buying this product again for some time.

The different varieties of many fruits, for example apples and pears, mature and ripen at different times and should therefore be marketed at different times. It is important that each variety is placed on the market at the correct time to avoid low eating quality that leads to products being wasted. The best way to avoid this is to have good communication with producers and respect the advice given by them.

- ***Control products and make complaints/ claims within a reasonable time after products have arrived at the buyer's premises. Buyer and seller should have a common agreement on criteria and method for controls and claims.***

Rejection of products at wholesale level with reference to products not fulfilling the requirements of a quality standard or the requirements that have been agreed by buyer and seller is a major cause of waste.

The added difficulty is that buyers and sellers, do not always agree on whether products are in conformity. When the complaint is fair, and is justified by photos and additional supporting evidence, common agreement is facilitated. Similar incidents and further waste can then be avoided in the future.

In obvious cases, for example, if all products are dirty or overripe, non-conformity is easy to establish. Photographs usually suffice to communicate the extent of non-conformity to the seller. In less obvious cases, there may be a need for a more thorough check. Buyer and seller should have a common agreement on methods for controls and claims and also how claims are communicated and what documentation it should be based on.

The control and the results should be communicated to the seller within a reasonable time. Depending on how sensitive products are and how they are kept and handled after arriving at the buyer's premises, they may lose quality quite quickly. Control results are therefore only a valid judgement of the quality of delivered products if made in connection to the arrival of these products at the buyer's premises. What is judged to be "a reasonable time" will vary depending on which product it is and how it is stored and handled after arrival. Areas considered high risk and likely to cause problems should be defined in the contracts or otherwise by a common agreement between buyer and seller.

- ***Store and display products in the shops at the appropriate, product specific temperature***

Sub-optimal cold chain processes and management cause a considerable share of food losses. Shelf-life is highly influenced by temperature deviations during transport and storage. An appropriate temperature shall be kept all the time from harvest to retail. The money and effort put into cooling products to the appropriate temperature is quickly lost if products are kept in too high temperatures later in the chain.

Temperature is the most important factor for retaining product quality during distribution. It increases shelf-life by affecting respiration rate and thereby the ageing of the fruit and vegetables. Temperature also has an effect on the nutritional content of products.

There is thus much to gain in terms of reduced waste and improved quality from keeping products in appropriate climate conditions throughout distribution and retail. The higher the temperature is and the more sensitive products are, the greater the gain from an unbroken cool chain. For example, lettuce has an estimated shelf-life of up to 12 days at zero degrees Celsius but only two days at 20 degrees, leek and cauliflower may be stored over 40 days at zero degrees but only two days at 20 degrees. This however only refers to products that are not sensitive to chilling (see Annex II).

Subtropical and tropical products develop chilling injuries when kept at low, though non-freezing, temperatures. Attention should therefore be paid to ensure that chilling sensitive products are not subjected to temperatures below those that may cause chilling injury (link to list).

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At retail level, products shall be stored and displayed at their appropriate, product specific temperature to retain the visible quality, the keeping quality, the nutritional quality and to reduce waste. When possible, there should be different temperature zones to accommodate the different temperature requirements of products. The volume of products displayed at unfavourable temperatures should be limited to avoid shortening shelf-life.

Retailers with no cooling facilities may prolong shelf-life by covering the fresh produce overnight with wet cloth or tissues.

- ***Handle products carefully and take measures to reduce the risk of products getting bruised***

Bruising causes a lot of damage, not least at retail level. It reduces quality and often leads to products being wasted. Products are bruised when they are transferred from boxes into display but also when consumers squeeze and choose. Products that are packed individually on trays in the packages (boxes) will be less bruised if displayed for sale in these boxes.

Products should be handled as carefully as possible when transferred into display. It is therefore of utmost importance that staff are instructed well and fully understand the consequences of not handling carefully. Retailers should also consider measures that limit the damage caused by careless consumers, such as limiting the volume displayed at the same time and thereby the number of times each product is scrutinized by a consumer until finally chosen.

- ***Store and display products in the shops appropriately***

At retail level, products shall be stored and displayed appropriately, considering product specificities and the facilities available. In addition to temperature, retailers should take into consideration other aspects of the presentation of the produce that are important to retain the visible quality, the keeping quality, the nutritional quality and to reduce waste. Products should be presented in such a way that:

- a negative impact of climacteric fruit on other produce is minimized,
- adequate humidity is maintained.

- ***Avoid campaigns encouraging consumers to buy more than they can eat.***

Campaigns such as “buy three pay for two” encourage consumers to buy more products than they may be able to consume, thus increasing waste at consumer level. There may be good intentions behind such campaigns such as increasing consumption for health reasons or helping producers sell a sudden overproduction caused by a period of hot weather. In these cases, it is however better to decrease the price per piece or weight.

It is also worth considering that when consumers are encouraged to buy more of a certain product, this may quite likely decrease sales of other similar products, i.e. a campaign for pears may lead to decreased sales volumes of apples. Thus, the turnover time for apples in the display may increase and so may the waste of apples.

Therefore, in the long run, a stable volume and price decreases waste.

- ***Find ways to use or sell damaged or suboptimal products.***

Even with the most careful planning, storage and handling, there will always, for various reasons, be products that cannot be sold as originally intended or at the price

intended. Retailers should therefore be equipped with an elaborate range of alternatives for selling or giving away these products

- Reduce price and sell as
  - Category II (if applicable)
  - For home processing
  - To be consumed soon
- Process to juices, jams, smoothies etc.
- New products (can be developed by research)
- Give to charity (see guidelines<sup>10</sup>)

- ***Measure the amount of produce that is wasted and specify the major causes of the waste***

Companies that understand the causes of food waste and measure it have a greater capacity to reduce waste than companies not making this effort. Companies that regularly measure waste, identify the specific causes for this waste and hold discussions on the results start a learning process that is an important tool for finding measures that reduces waste. The results can be used for future planning but also for measures related to handling, temperatures, transport, logistics etc. Apart from the aspect of reducing waste there is a strong economic incentive to carry out this work since money spent on reducing waste is reported to give an estimated 14-fold <sup>11</sup>return on the money spent.

**Retailers buying directly from producers should in addition undertake the following**

- ***Improve logistics to shorten time from harvest or packing to retail***

Fresh fruit and vegetables have a limited shelf-life. It is therefore important that the time from harvest to retail, or for long term stored products from packing to retail, is as short as possible. The longer the time from harvest to retailer, the greater the loss of quality and the greater the share of waste, both at retail level and at consumer level. A strict “first-in – first-out” principle should be applied also at retail level.

- ***Cooperate to establish unbroken cool chains, at the appropriate temperature for respective products***

An appropriate temperature shall be kept at all times from harvest to retail. The money and effort put into cooling products to the appropriate temperature is quickly lost if products are kept in too high temperatures later in the chain. Therefore, a good dialogue by all participants along the distribution chain shall include discussions on how to establish an unbroken cool chain.

The cool chain should be established from harvest and retained all the way through retail, including, where possible, during display for the consumer.

- ***Place orders and/or change orders in good time to allow for products to be carefully harvested, handled and cooled before dispatch***

Producers need to be given sufficient time to be able to cool products to the appropriate temperature and to sort and pack according to specifications given. If orders are placed

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<sup>10</sup> EU Food Donation Guidelines provides valuable advice see:

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2017:361:FULL&from=EN>

<sup>11</sup> Hanson, C., and P. Mitchell. 2017. The Business Case for Reducing Food Loss and Waste. Washington, DC: Champions 12.3.

or changed shortly before time of dispatch producers may have to send products that are not properly cooled. This will reduce the shelf-life of the products and increase waste. It may also lead to sorting and packing having to be done too quickly to allow for careful handling and for quality assurance to be carried out properly.

- ***Avoid the cancellation of orders close to planned dispatch of products from packer/producer***

When orders of perishable products are cancelled with short notice and close to dispatch, it is difficult to find a new buyer for these products. As a result, these products are often wasted.

The reason behind late cancellations is often re that market demand for a product, at a given time, is lower than when the buyer originally placed the order. Products may therefore still be wasted even if the order is kept. In these cases, the buyer should consider measures to promote the sale of these products.

The negative impact of a late cancellation will be particularly severe if an order is cancelled for example after a producer has opened a cold store or a Controlled Atmosphere (CA) store and removed the products from the storage room. Once a CA store has been opened, the fruit has to go into the distribution chain.

**Annex I.**

**Classification of fruit, based on their respiratory behaviour, into climacteric and non-climacteric fruit.**

| <b>Climacteric fruit</b> | <b>Non-climacteric fruit</b> |
|--------------------------|------------------------------|
| Apple                    | Blackberry                   |
| Apricot                  | Cacao                        |
| Avocado                  | Carambola                    |
| Atemoya                  | Cashew apple                 |
| Banana                   | Cherry                       |
| Biriba                   | Coconut                      |
| Blueberry                | Cranberry                    |
| Bitter melon             | Cucumber                     |
| Breadfruit               | Date                         |
| Cantaloupe               | Dragon fruit                 |
| Cape Gooseberry          | Eggplant                     |
| Cherimoya                | Grape                        |
| Chiku                    | Grapefruit                   |
| Corossol sauvage         | Java Plum                    |
| Durian                   | Jujube                       |
| Ferioja                  | Langsat                      |
| Fig                      | Lemon                        |
| Guava                    | Lime                         |
| Honeydew melon           | Longan                       |
| Jackfruit                | Loquat                       |
| Japanese pear            | Lychee                       |
| Jujube                   | Okra                         |
| Kiwifruit                | Olive                        |
| Mammee apple             | Orange                       |
| Mango                    | Pea                          |
| Mangosteen               | Pepine                       |

|               |                        |
|---------------|------------------------|
| Muskmelon     | Pepper                 |
| Nectarin      | Pineapple              |
| Papaw         | Pitaya                 |
| Papaya        | Pomegranate            |
| Passion fruit | Prickly pear           |
| Peach         | Rambutan               |
| Pear          | Raspberry              |
| Persimmon     | Rose apple             |
| Plantain      | Star apple             |
| Plum          | Strawberry             |
| Quince        | Summer squash          |
| Rambutan      | Surinam cherry         |
| Sapodilla     | Tamarillo              |
| Sapote        | Tree tomato            |
| Soursop       | Tangerine and mandarin |
| Sweetsop      | Watermelon             |
| Tomato        |                        |

Sources: Kader, A.A.2002. *Postharvest technology of horticultural crops*. University of California, Publication 3311; Kays, S.J. and Paull, R.E. 2004. *Postharvest biology*. Exon Press, Athens, GA, USA.

## Annex II.

**Classification of fruit and vegetables based on their sensitivity to chilling injury, i.e. injuries caused by low but non-freezing temperatures, and recommended lowest storage temperature..**

| <b>Chilling sensitive fruits</b> | <b>Lowest storage temperature</b> |       |
|----------------------------------|-----------------------------------|-------|
|                                  | °C                                | °F    |
| Atemoya                          | 13                                | 55    |
| Avocado, var Hass                | 3-7                               | 37-45 |
| Banana                           | 13-15                             | 56-59 |
| Breadfruit                       | 13-15                             | 55-59 |
| Carambola                        | 9-10                              | 48-50 |
| Cherimoya                        | 13                                | 55    |
| Cranberry                        | 2-5                               | 35-41 |
| Cucumber                         | 10-13                             | 50-55 |
| Dragon fruit                     | 10                                | 50    |
| Durian                           | 4-6                               | 39-42 |
| Feijoa                           | 5-10                              | 41-50 |
| Guava                            | 5-10                              | 41-50 |
| Jackfruit                        | 13                                | 50    |
| Jujube                           | 2.5-10                            | 36-50 |
| Lemon                            | 10-13                             | 50-55 |
| Lime                             | 9-10                              | 48-50 |
| Litchi                           | 1-2                               | 34-36 |
| Longan                           | 4-7                               | 39-45 |
| Lychee                           | 1-2                               | 34-36 |
| Mandarin                         | 4-7                               | 40-45 |
| Mango                            | 13                                | 55    |
| Mangosteen                       | 13                                | 55    |
| Melon, canary                    | 10                                | 50    |
| Melon, cantaloupe                | 2-5                               | 36-41 |
| Melon, casaba                    | 7-10                              | 45-50 |
| Melon, crenshaw                  | 7-10                              | 45-50 |
| Melon, Honey dew                 | 5-10                              | 41-50 |

|                                      |   |   |
|--------------------------------------|---|---|
| Melon, persian                       | 7-10                                      | 45-50                                       |
| Olive                                | 5-10                                      | 41-50                                       |
| Orange                               | 3-9 (dry areas),<br>0-2 (humid regions)   | 38-48 (dry areas),<br>32-36 (humid regions) |
| Papaya                               | 7-13                                      | 45-55                                       |
| Passion fruit                        | 10  | 50  |
| Pepino                               | 5-10                                      | 41-50                                       |
| Pepper, sweet and chili              | 7-10 (sweet),<br>5-10 (hot)               | 45-50 (sweet),<br>41-50 (hot)               |
| Pineapple                            | 7-13                                      | 45-55                                       |
| Plantain                             | 13-15                                     | 56-59                                       |
| Pomegranate                          | 5-7.2                                     | 41-45                                       |
| Prickly Pear                         | 5   | 41  |
| Rambutan                             | 12  | 54  |
| Sapodilla                            | 15-20                                     | 59-68                                       |
| Sapote                               | 3 -20                                     | 38 -68)                                     |
| Squash                               | 7-10 (summer),<br>12-15 (winter)          | 45-50 (summer),<br>54-59 (winter)           |
| Tamarind                             | 2-7                                       | 36-45                                       |
| Tamarillo                            | 3-4                                       | 37-40                                       |
| Tomato                               | 10-13 (Mature-green),<br>8-10 (Firm-ripe) | 50-55 (Mature-green),<br>46-50 (Firm-ripe)  |
| Watermelon                           | 10-15                                     | 50-59                                       |
|                                      |   |   |
| <b>Chilling sensitive vegetables</b> |   |   |
| Basil                                |   |   |
| Beans, green or snap                 | 10  | 50  |
| Bitter gourd                         | 4-7                                       | 40-45                                       |
| Cassava                              | 10-12                                     | 50-54                                       |
| Cucumber                             | 0-5                                       | 32-41                                       |
| Eggplant                             | 10-13                                     | 50-55                                       |
| Ginger                               | 10-12                                     | 50-54                                       |
| Luffa gourd                          | 13  | 55  |
| Okra                                 | 10-12                                     | 50-54                                       |
| Peppers                              | 7-10                                      | 45-50                                       |
| Potato                               | 10-15 (early crop),<br>4-12 (late crop)   | 50-59 (early crop),<br>40-54 (late crop)    |
| Pumpkin                              | 12-15                                     | 54-59                                       |
| Sweet potato                         | 13-15                                     | 55-59                                       |
| Taro                                 | 7-10                                      | 45-50                                       |
| Yam                                  | 15  | 59  |
|                                      |   |   |
| <b>Non-chilling sensitive fruits</b> |   |   |
| Apple*                               | -1.1                                      | 30.0  |
| Apricot                              | -0.5-0                                    | 31-32                                       |
| Asian pear                           | 1   | 34  |
| Blackberry                           | -0.5-0                                    | 31-32                                       |
| Blueberry                            | -0.5-0                                    | 31-32                                       |
| Cloudberry                           | 0   | 32  |
| Cherry                               | 0 (sour),<br>-1-0 (sweet)                 | 32 (sour),<br>30-32 (sweet)                 |
| Coconut                              | 0-2                                       | 32-36                                       |
| Cranberry                            | 2-5                                       | 35-41                                       |

|  |                                   |                            |
|--|-----------------------------------|----------------------------|
| Currant, black, red, white               | -0.5-0                            | 31-32                      |
| Date                                     | -18-0                             | 0-32                       |
| Dewberry                                 | -0.5-0                            | 31-32                      |
| Elderberry                               | -0.5-0                            | 31-32                      |
| Fig                                      | -0.5-0                            | 31-32                      |
| Gooseberry                               | -0.5-0                            | 31-32                      |
| Grape                                    | -0.5-0,<br>-1- (-) 0.5 (American) | 31-32,<br>30-31 (American) |
| Kiwifruit                                | 0                                 | 32                         |
| Loganberry                               | -0.5-0                            | 31-32                      |
| Loquat                                   | 0                                 | 32                         |
| Nectarine*                               | -0.5-0                            | 31-32                      |
| Peach*                                   | -0.5-0                            | 31-32                      |
| Pear                                     | -1.5 – 0.5 (European)             | 29-31 (European)           |
| Persimmon*                               | 0                                 | 32                         |
| Plum*                                    | -0.5-0                            | 31-32                      |
| Prune                                    | -0.5-0                            | 31-32                      |
| Quince                                   | -0.5-0                            | 31-32                      |
| Raspberry                                | -0.5-0                            | 31-32                      |
| Strawberry                               | 0                                 | 32                         |
|  |                                   |                            |
| <u>Non-chilling sensitive vegetables</u> |                                   |                            |
| Artichoke                                | 0,<br>-0.5-0 (Jerusalem)          | 32,<br>31-32 (Jerusalem)   |
| Asparagus                                | 2.5                               | 36                         |
| Beans, lima                              | 5-6                               | 41-43                      |
| Bean sprouts                             | 0                                 | 32                         |
| Beet                                     | 0                                 | 32                         |
| Bok Choi                                 | 0                                 | 32                         |
| Broccoli                                 | 0                                 | 32                         |
| Brussels sprouts                         | 0                                 | 32                         |
| Cabbage                                  | 0                                 | 32                         |
| Carrot                                   | 0                                 | 32                         |
| Cauliflower                              | 0                                 | 32                         |
| Celeriac                                 | 0                                 | 32                         |
| Celery                                   | 0                                 | 32                         |
| Chevril                                  | 0                                 | 32                         |
| Chinese cabbage                          | 0                                 | 32                         |
| Cilantro                                 | 0-1                               | 32-34                      |
| Collard                                  | 0                                 | 32                         |
| Coriander                                | 0                                 | 32                         |
| Corn, sweet                              | 0                                 | 32                         |
| Dandelion                                | 0-2                               | 32-36                      |
| Dill                                     | 0                                 | 32                         |
| Endive                                   | 0                                 | 32                         |
| Fennel                                   | 0-2                               | 32-36                      |
| Garlic                                   | 0                                 | 32                         |
| Ginger                                   | 13                                | 55                         |
| Ginseng                                  | 0                                 | 32                         |
| Horseradish                              | -1-0                              | 30-32                      |
| Kale                                     | 0                                 | 32                         |
| Kohlrabbi                                | 0                                 | 32                         |
| Leek                                     | 0                                 | 32                         |

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|                |     |       |
|----------------|-----|-------|
| Lettuce        | 0   | 32    |
| Mizuna         | 0-2 | 32-36 |
| Mushrooms      | 0   | 32    |
| Onion          | 0   | 32    |
| Parsley        | 0   | 32    |
| Parsnip        | 0   | 32    |
| Peas           | 0-1 | 32-34 |
| Radish         | 0   | 32    |
| Rhubarb        | 0   | 32    |
| Rocket salad   | 0   | 32    |
| Rutabaga       | 0   | 32    |
| Salsify        | 0   | 32    |
| Savory         | 0   | 32    |
| Sorrel, French | 0-2 | 32-36 |
| Spinach        | 0   | 32    |
| Sprouts        | 0   | 32    |
| Swiss chard    | 0   | 32    |
| Turnip         | 0   | 32    |
| Watercress     | 0   | 32    |

Sources: Kader, A.A.2002. *Postharvest technology of horticultural crops*. University of California, Publication 3311; Kays, S.J. and Paull, R.E. 2004. *Postharvest biology*. Exon Press, Athens, GA, USA.