

Review

Food waste within food supply chains: quantification and potential for change to 2050

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Food waste in the global food supply chain is reviewed in relation to the prospects for feeding a population of nine billion by 2050. Different definitions of food waste with respect to the complexities of food supply chains (FSCs) are discussed. An international literature review found a dearth of data on food waste and estimates varied widely; those for post-harvest losses of grain in developing countries might be overestimated. As much of the post-harvest loss data for developing countries was collected over 30 years ago, current global losses cannot be quantified. A significant gap exists in the understanding of the food waste implications of the rapid development of 'BRIC' economies. The limited data suggest that losses are much higher at the immediate post-harvest stages in developing countries and higher for perishable foods across industrialized and developing economies alike. For affluent economies, post-consumer food waste accounts for the greatest overall losses. To supplement the fragmentary picture and to gain a forward view, interviews were conducted with international FSC experts. The analyses highlighted the scale of the problem, the scope for improved system efficiencies and the challenges of affecting behavioural change to reduce post-consumer waste in affluent populations.

Keywords: food waste; post-harvest loss; consumer waste

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Review article

Bioconversion of food waste to energy: A review



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ABSTRACT

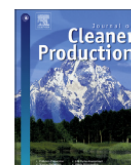
According to Food and Agricultural Organization (FAO), one third of food produced globally for human consumption is lost along the food supply chain. In many countries food waste are currently landfilled or incinerated together with other combustible municipal wastes for possible recovery of energy. However, these two approaches are facing more and more economic and environmental stresses. Due to its organic- and nutrient-rich composition, theoretically food waste can be utilized as a useful resource for production of biofuel through various fermentation processes. So far, valorization of food waste has attracted increasing interest, with biogas, hydrogen, ethanol and biodiesel as final products. Therefore, this review aims to examine the state-of-the-art of food waste fermentation technologies for renewable energy generation.

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Review

Current options for the valorization of food manufacturing waste: a review

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ABSTRACT

The production of food waste covers all the food life cycle: from agriculture, up to industrial manufacturing and processing, retail and household consumption. In developed countries, 42% of food waste is produced by households, while 39% losses occur in the food manufacturing industry, 14% in food service sector and remaining 5% in retail and distribution. Increasingly, industrial ecology concepts such as cradle to cradle and circular economy are considered leading principle for eco-innovation, aiming at “zero waste economy” in which waste are used as raw material for new products and applications. The large amount of waste produced by the food industry, in addition to being a great loss of valuable materials, also raises serious management problems, both from the economic and environmental point of view. Many of these residues, however, have the potential to be reused into other production systems, through e.g. biorefineries. The present work focuses on the use of food waste coming from food manufacturing (FWM). Through extensive literature review, the authors present feasibility and constraints of applying industrial symbiosis in recovering waste from food processing, focusing on recycling (excluding energy recovery) of the solid and liquid waste from food processing industry. The main uses of functional ingredients derived from this transformation are presented and discussed, highlighting mainstream sectors of application, e.g. in the nutraceutical and pharmaceutical industry.

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Food waste generation and industrial uses: A review



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ABSTRACT

Food waste is made up of materials intended for human consumption that are subsequently discharged, lost, degraded or contaminated. The problem of food waste is currently on an increase, involving all sectors of waste management from collection to disposal; the identifying of sustainable solutions extends to all contributors to the food supply chains, agricultural and industrial sectors, as well as retailers and final consumers. A series of solutions may be implemented in the appropriate management of food waste, and prioritised in a similar way to waste management hierarchy. The most sought-after solutions are represented by avoidance and donation of edible fractions to social services. Food waste is also employed in industrial processes for the production of biofuels or biopolymers. Further steps foresee the recovery of nutrients and fixation of carbon by composting. Final and less desirable options are incineration and landfilling. A considerable amount of research has been carried out on food waste with a view to the recovery of energy or related products. The present review aims to provide an overview of current debate on food waste definitions, generation and reduction strategies, and conversion technologies emerging from the biorefinery concept.

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Effectiveness of the food recovery at the retailing stage under shelf life uncertainty: An application to Italian food chains



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ABSTRACT

Food losses represent a significant issue affecting food supply chains. The possibility of recovering such products can be seen as an effective way to reduce such a phenomenon, improve supply chain performances and ameliorate the conditions of undernourished people.

The topic has been already investigated by a previous paper enforcing the hypothesis of deterministic and constant Shelf Life (SL) of products. However, such a model cannot be properly extended to products affected by uncertainties of the SL as it does not take into account the deterioration costs and loss of profits due to the overcoming of the SL within the cycle time. Thus the present paper presents an extension of the previous one under stochastic conditions of the food quality. Differently from the previous publication, this work represents a general model applicable to all supply chains, especially to those managing fresh products characterized by uncertain SL such as fruits and vegetables. The deterioration costs and loss of profits are included in the model and the optimal time at which to withdraw the products from the shelves as well as the quantities to be shipped at each alternative destination have been determined. A comparison of the proposed model with that reported in the previous publication has been carried out in order to underline the impact of the SL variability on the optimality conditions. The results show that the food recovery strategy in the presence of uncertainty of the food quality is rewarding, even if the optimal profit is lower than that of the deterministic case.

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The value of food waste: An exploratory study on retailing

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ABSTRACT

Retailers are increasingly concerned with the sustainability of their business. Food waste is a major sustainability issue: 90 million tons of food are wasted in the EU every year. The production of much of this waste is directly linked to the food chain operations, included those performed at the retail stage. The literature on food waste has mainly focused so far on the quantification of the total food lost along the supply chain. However, the stage of retail has long been neglected. This paper attempts to partly fill this research gap, with the aim of measuring the extent of food waste in retailing as well as its environmental, social and economic value. To do so, we analyse the results of a food waste recovery project held in an Italian supermarket and, by drawing on the data collected in this case study, we perform an evaluation of the value of the food wasted. The results show that the extent of food waste in retailing is certainly considerable, both in terms of quantity and economic value. Moreover, we found evidence that it may be greatly reduced, with a significant limitation of its environmental impact and, through the mechanism of recovery, it may even generate social benefits. Despite the many limitations of such preliminary research, the results provide useful information for retailers aiming to develop strategies against food waste in the context of improving the sustainability of their business.

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An environmental analysis of options for utilising wasted food and food residue



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ABSTRACT

The potential environmental impact of wasted food minimisation versus its utilisation in a circular bioeconomy is investigated based on a case study of Ireland. The amount of wasted food and food residue (WFFR) produced in 2010 was used for business-as-usual, (a) and four management options were assessed, (b) minimisation, (c) composting, (d) anaerobic digestion and (e) incineration. The environmental impacts Global Warming Potential (GWP), Acidification Potential (AP) and Eutrophication Potential (EP) were considered. A carbon return on investment (CROI) was calculated for the three processing technologies (c–e). The results showed that a minimisation strategy for wasted food would result in the greatest reduction of all three impacts, -4.5 Mt CO₂-e (GWP), -11.4 kt PO₄-e (EP) and -43.9 kt SO₂-e (AP) compared to business as usual. For WFFR utilisation in the circular bioeconomy, anaerobic digestion resulted in the lowest environmental impact and best CROI of -0.84 kg CO₂-e per Euro. From an economic perspective, for minimisation to be beneficial, 0.15 kg of wasted food would need to be reduced per Euro spent.

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Review

Food waste prevention in Europe – A cause-driven approach to identify the most relevant leverage points for action



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ABSTRACT

The reduction of food waste is seen as an important lever for ensuring food security and diminishing environmental burdens. In context of the forthcoming revision of the European Waste Directive the EC is planning to commit its Member States to reduce their food waste by 30% until 2025. To reach this ambitious objective effective prevention measures have to be implemented. This requires detailed knowledge on drivers and reasons for food waste generation along the food supply chain and the 'hotspots of wastage'. The paper provides information on these two topics. Main drivers for food waste generation are process- and market-based standards, non-compliance with food safety requirements, exceeding of expiry dates, marketing standards or logistic constraints, but also consumer preferences and societal trends like growing prosperity, declining food prices, rising number of single households and increasing employment of women. As surveys and calculations indicate, the highest waste rates in Europe occur at the first stage (primary production) and the last stage (household sector) of the supply chain. The paper further presents a set of policy options on European and national level which are considered most promising to prevent food waste. The selection is based on a thorough literature review, reflecting also the results of a stakeholder workshop held in November 2014. The analysis reveals that most of the prevention measures implemented in the EU Member States up to now are soft instruments like awareness campaigns, round tables, networks and information platforms. In addition to this soft instruments, the paper advocates for the introduction of more rigorous approaches like the abolishment of subsidies on food, amendments to EU regulations and economic incentives. Further research is required to assess the impacts and efficacy of economic and regulatory instruments.

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Review

Processing- and product-related causes for food waste and implications for the food supply chain

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ABSTRACT

Reducing food waste is one of the prominent goals in the current research, which has also been set by the United Nations to achieve a more sustainable world by 2030. Given that previous studies mainly examined causes for food waste generation related to consumers, e.g., expectations regarding quality or uncertainties about edibility, this review aims at providing an overview on losses in the food industry, as well as on natural mechanisms by which impeccable food items are converted into an undesired state. For this, scientific literature was reviewed based on a keyword search, and information not covered was gathered by conducting expert interviews with representatives from 13 German food processing companies. From the available literature, three main areas of food waste generation were identified and discussed: product deterioration and spoilage during logistical operations, by-products from food processing, and consumer perception of quality and safety. In addition, expert interviews revealed causes for food waste in the processing sector, which were categorised as follows: losses resulting from processing operations and quality assurance, and products not fulfilling quality demands from trade. The interviewees explained a number of strategies to minimise food losses, starting with alternative tradeways for second choice items, and ending with emergency power supplies to compensate for power blackouts. It became clear that the concepts are not universally applicable for each company, but the overview provided in the present study may support researchers in finding appropriate solutions for individual cases.

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