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Zusammenhänge zwischen Lebensmittelabfällen und Lebensmittelsicherheit entlang der Wertschöpfungskette

Liens entre le gaspillage alimentaire et la sécurité des aliments le long de la chaîne d'approvisionnement

Luiza Toma, Cesar Revoredo-Giha, Montserrat Costa-Font and Bethan Thompson

Reducing food loss and waste (FLW) results in economic, socio-ethical and environmental improvements and delivers into a majority of the United Nations' Sustainable Development Goals (SDGs). The most documented FLW aspects relate to the resulting environmental footprint. The Food and Agriculture Organisation's well-known statement highlights the significance of FLW: 'if food wastage were a country, it would be the third largest [GHGs] emitting country in the world' (FAO, 2015). The direct economic cost of FLW (agricultural products excluding fish and seafood) has been estimated as equivalent to Switzerland's GDP (FAO, 2013). The socio-ethical dimension of FLW is typically referred to in the context of nutrition. It is seen as a missed opportunity to improve food security, where unequal access to food in less developed parts of the world accentuates the moral implications of food wasted in higher income countries. The literature provides worrying FLW estimates, portraying a predominantly inefficient use of resources within agri-food chains and at national and global levels.

FLW may be caused by a myriad of interrelated socio-economic and environmental factors between the different stages of the agri-food chain; and therefore with cumulative impacts (HLPE, 2014). Among the key factors, food safety issues, whether actual or perceived, often have a direct relationship with FLW. In the remainder of this paper, we concentrate on food safety related causes of FLW. The focus is on the dairy sector where food safety issues have a relatively high impact, with some references to the case of fruit and vegetables.

> "Une meilleure coordination est nécessaire entre les politiques visant le gaspillage alimentaire et les politiques de sécurité sanitaire concernant les réglementations en matière d'étiquetage, grâce à un meilleur équilibre entre les preuves scientifiques et le principe de précaution."

Rapid technological developments to improve food safety have enabled accurate assessment of quality beyond subjective means such as appearance, aroma and taste. These changes have been prompted by a range of factors: ongoing concerns about the need to protect consumers from hazards to food safety; changing food supply patterns serving an increasingly affluent and sophisticated demand; scientific evidence of the linkages between diet and health; and the continuously evolving regulatory framework. From the passing of effective laws against food adulteration during the mid-19th century to the present day, food legislation has focussed on setting the minimum food safety standards acceptable to society.

Food losses and safety at farm and processing levels

Many of the causes of food losses in primary production are related to food safety concerns. Dairy farmers, for example, may dispose of milk deemed unfit for human consumption due to unacceptably high concentrations of antibiotic residues after treatment for animal diseases such as mastitis. However, in some cases this milk will remain in the food chain as farmers may redistribute it for animal consumption, for example by feeding it to calves. This may still have food safety implications as antimicrobial residues in milk fed to calves may be partly the cause of the high prevalence of *Escherichia coli* bacteria reported in dairy calves (Brunton *et al.*, 2012). Antimicrobials used in the rearing of food producing animals account for two thirds of the total use of antimicrobials in the European Union.

Food losses on farm may also occur in order to avoid transmission into the human food chain of zoonotic diseases through products such as milk and raw meat. The UK legislative framework for

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Food loss and waste represent the decrease in quantity or quality of food along the food supply chain, where *food losses* occur from harvest/slaughter/catch up to, but not including, the retail level, while *food waste* occurs at the retail and consumption levels (FAO, 2019).

zoonoses control, implemented in food safety, public health, and health and safety at work regulations, involves largely effective control measures at slaughter and processing levels; however an increase in infection control measures on-farm is recommended. Complementary to regulation, farmers' uptake of preventative (e.g. biosecurity) and control (e.g. vaccination, medication) measures to mitigate zoonotic diseases on-farm can impact the safety of the whole supply chain (Toma *et al.,* 2015); and subsequently the amount of food losses on livestock farms and beyond the farmgate.

In the fruit and vegetable sector a number of factors can lead to high losses pre-farmgate, for example where retailers reject fruits and vegetables affected by pest-induced diseases.In some cases produce may be safe for human consumption, for example where only inedible parts such as swede skin are affected. Thus many losses occur due to perceived rather than actual food safety issues, or simply for cosmetic concerns (Beausang *et al.*, 2017).

Figure 1 illustrates the linkages between food safety and FLW at farm level and beyond farmgate in the dairy supply chain. Monitoring of food safety along the chain is regulated through risk-based monitoring programmes and quality control programmes (e.g. Hazard Analysis Critical Control Points - HACCP). However, food safety hazards can still occur, for example, via mycotoxins present in EU imports of feed or through suboptimal livestock disease control on farm (Asselt *et al.*, 2016), which may lead to FLW.

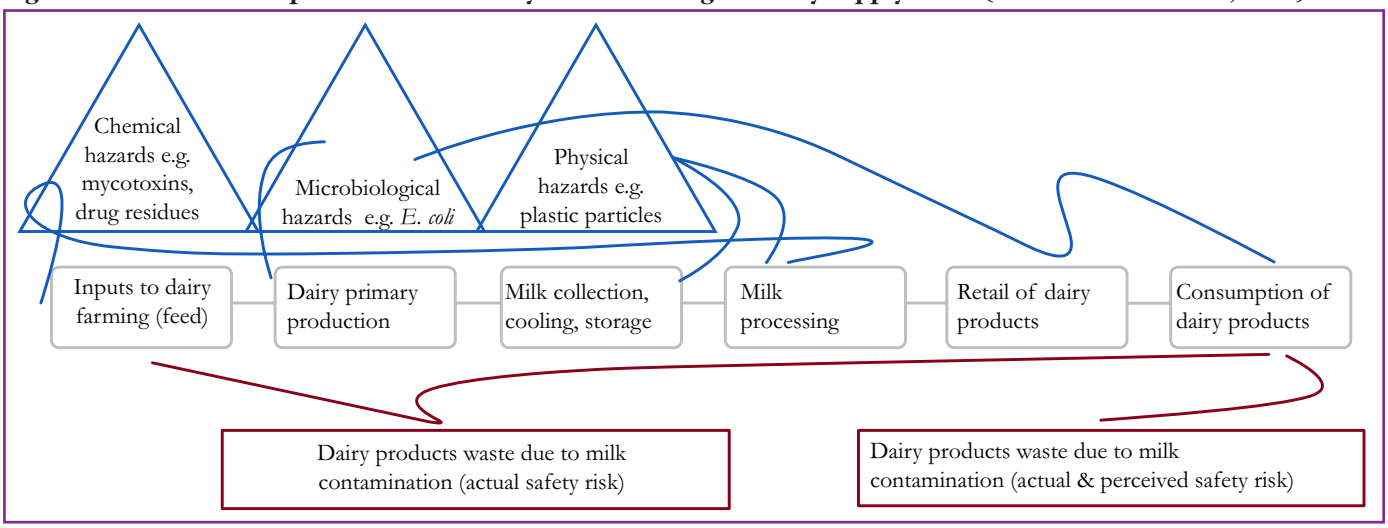
Food waste and safety at retail level

The current food waste regulatory agendas in the EU and the UK are pushing strongly towards improved food labelling with the aim of reducing food waste at retail and consumption levels. Current EU labelling requirements for food products (Regulation (EU) No. 1169/2011) specify the mandatory food information to be included in all food labels; including the date of minimum durability ('best before' date), and the 'use by' date. Most pre-packed food requires the 'best before' date. The 'use-by' date is required only for food products with potential microbiological hazards. Organisations such as WRAP (Waste & Resources Action Programme) have proposed new guidance on the application of date labels, including flexible implementation of the 'best before' date while maintaining strict food safety principles (WRAP, 2017).

The elimination of date labels such as 'sell-by' and 'display-until' that retailers may use for stock control purposes is under discussion. Increasing product shelf life without compromising food safety would offer retailers an opportunity to manage product flows more efficiently. Current food safety regulations at retail level have a direct impact on food waste: for instance, in redistributing surplus food that would otherwise have ended up as waste; while recycling food waste from caterers or supermarkets can raise difficult regulatory issues, particularly with regard to responsibility for the safety of foods of animal origins. There is scope for improving the balance between food safety regulatory control and waste mitigation.

Strict norms for acceptable levels of food contamination, such as maximum allowable limits for residue levels for pesticides and veterinary medicines, in addition to hygiene rules concerning the packaging and storage of food are seen as key drivers promoting the discarding of edible food in the retail and hospitality sectors. Priefer *et al.* (2016) propose a review of the current regime of food safety regulations in order to identify provisions that are not mandatory to protect human health, but lead to unnecessary food waste.

Figure 1: The relationship between food safety and FLW along the dairy supply chain (based on Asselt *et al.*, 2016)



Public discourse on food safety and food waste prevention can give rise to conflicting motivations at consumer level.

Technological or regulatory initiatives to reduce waste that target both food and food packaging, may have conflicting implications for food waste and safety unless properly synchronised. For example, *The Grocer* (Quinn, 2020) recently reported an increase in the level of food waste in the UK retail sector partly caused by efforts to reduce plastic packaging, which subsequently led to temporarily higher vegetable waste and additional operational costs for readjustment.

Similarly, asymmetrical efforts to mitigate waste in some parts of the supply chain may just shift the problem elsewhere. For instance, retail initiatives relaxing specifications on fresh produce to help reduce waste in primary production through e.g. misshapen fruit and vegetables led to an increase in waste in retailer depots and stores (Quinn, 2020); this was not immediately corrected through food redistribution to charities and/or differential retail price for these products.

The current food waste regulatory agendas in the EU and the UK are pushing strongly towards improved food labelling with the aim of reducing food waste at retail and consumption levels.

Food waste and safety at consumption level

While environmental concerns may tend to lead people to reduce food waste, food safety concerns may lead them to do just the opposite. Public discourse on food safety and food waste prevention can give rise to conflicting motivations at consumer level (Watson and Meah, 2013). This particularly relates to labelling and consumers' understanding and use of 'best before' date labels (referring to food quality issues rather than food safety ones) and 'use by' date labels (referring to food safety, i.e. the date a food product shall be deemed unsafe).

> "Es ist eine bessere Koordinierung zwischen den Maßnahmen im Bereich der Lebensmittelabfälle und der Lebensmittelsicherheit in Bezug auf die Kennzeichnungsvorschriften erforderlich, und zwar durch eine größere Ausgewogenheit zwischen wissenschaftlichen Erkenntnissen und dem Vorsorgeprinzip."

A number of authors argue that the current food date labelling system is a barrier to the management of both food waste and food safety issues (Prieferet *al.,* 2016). Simplifying and clarifying expiry date labelling could be one of the most cost-effective ways to reduce food waste. Consumers tend not to trust their ability to assess the edibility of food and may instead rely on date labelling. Moreover, even when their understanding of, for example, best-before dates is correct, consumers may still

perceive a safety risk after this date has passed (Thompson *et al.*, 2018). Other waste factors at consumption level relate to the understanding of storage-related labelling; when inadequately followed, food quality may reduce to unsafe levels and be thrown out.

> “Better coordination is needed between food waste and safety policies regarding labelling regulations, through greater balance between scientific evidence and the precautionary principle.”

Household food waste can also occur due to perceived, not actual, food safety issues. For example, food marketing and retailer communication on quality characteristics may have amplified safety concerns beyond the real needs of some relatively risk-averse consumers. Studies have identified consumers who waste edible foods because of exaggerated safety concerns (Watson and Meah, 2013). This indicates the need for improved access to knowledge and tailored education campaigns to reach different segments of the population (Toma *et al.,* 2017).

Direct associations between food waste and food safety at consumption level have been observed consistently at different stages of economic development (Figure 2). Both exhibit a direct positive relationship with income per capita up to a turning point characterised by optimal food safety and the most unacceptably high level of waste. In contrast, actual food safety would remain at the optimal level. Following higher trust in and access to better information and allowing scientific evidence to trump precautionary behaviour, perceived safety would gradually equal actual levels, and thus contribute to waste reduction. The ratio between perceived and actual safety will show a decreasing trend with the shape of the curve dependent on the strength of influencing factors and the specific food products (for illustration purposes, we assume a similar shape to the one taken by the waste curve).

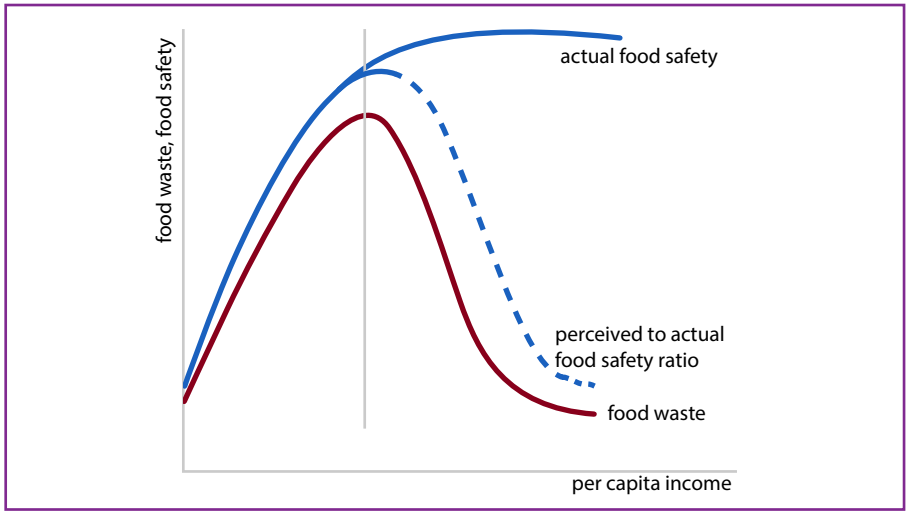
Simplifying and clarifying expiry date labelling could be one of the most cost-effective ways to reduce food waste.

Policy implications of food waste and safety linkages

This article highlights the need for a number of measures to ameliorate the impact of food safety on FLW through harmonisation of the various FLW and safety related aspects of food policies and food regulations.

1. Better coordination between food waste and safety policies regarding labelling regulations through greater balance between scientific evidence and the precautionary principle applied to safety. This would require changes in food labelling regulations and a review of current food safety regulations to identify areas potentially leading to avoidable waste.
2. Provision of clear tailored information to consumers to help them differentiate between different types of food safety hazards and increase awareness of the linkages between food safety and waste.
3. Better coordination between animal health and food safety

Figure 2: The relationship between food waste, food safety and consumption at different stages of economic development



Dairy farmers may dispose of milk deemed unfit for human consumption due to unacceptably high concentrations of antibiotic residues after treatment for animal diseases such as mastitis.

policies, potentially leading to further reductions in the use of antimicrobials in the rearing of food producing animals, with the corresponding safety and waste implications. This could be facilitated by provision of clear information on the effectiveness of alternative disease control options for farmers to help further improve animal health performance and reduce antibiotic use on farms.

4. Investment in technologies for accurate assessment of food edibility at retail and consumption level.
5. Synchronised monitoring of safety hazards and FLW along the agri-food chain.
6. Better provision of information on the safety of mechanisms in place for redistribution of food surpluses; and improved regulation of food redistribution processes to reduce actual and perceived safety risks.

Acknowledgments

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Further Reading

- Asselt, E.D. van, H.J.P. Marvin, P.E. Boon, M. Swanenburg, M. Zeilmaker, M.J.B. Mengelers and H.J. van der Fels-Klerx, (2016). *Chemical and physical hazards in the dairy chain*. Wageningen, RIKILT Wageningen UR report 2016.003 (University & Research centre).
- Beausang, C., Hall, C. and Toma, L. (2017). Food waste and losses in primary production: Qualitative insights from horticulture. *Resources, Conservation & Recycling*, **126**: 177–185.
- Brunton, L.A., Duncan, D., Coldham, N.G., Snow, L.C. and Jones, J.R. (2012). A survey of antimicrobial usage on dairy farms and waste milk feeding practices in England and Wales. *Veterinary Record*, **171**(12).
- Food and Agriculture Organization of the United Nations (2013). *Food wastage footprint: Impacts on natural resources*, FAO, Rome. Available online at: http://www.fao.org/3/i3347e/i3347e.pdf.
- Food and Agriculture Organization of the United Nations (2015). *Food wastage footprint andclimate change*. FAO, Rome. Available online at: www.fao.org/3/a-bb144e.pdf.
- Food and Agriculture Organization of the United Nations, (2019). *The state of food and agriculture 2019. Moving forward on food loss and waste reduction*. FAO, Rome.
- HLPE (2014). *Food losses and waste in the context of sustainable food systems*. A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014.
- Priefer, C., Jörissen, J. and Bräutigam, K-R. (2016). Review. Food waste prevention in Europe – A cause-driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling*, **109**: 155–165
- Quinn, I. (2020). UK retail food waste increases despite overall levels dropping. *The Grocer*, 24 January.
- Thompson, B., Toma, L., Barnes, A.P. and Revoredo-Giha, C. (2018). The effect of expiry dates on willingness to consume: Implications for food waste reduction. *Waste Management*,**78**: 124–134.
- Toma, L., Low, J.C., Ahmadi, B.V., Matthews, L. and Stott, A.W. (2015). An analysis of cattle farmers' perceptions of drivers and barriers to on-farm control of Escherichia coli O157. *Epidemiology and Infection*, **143**(11): 2355–2366.
- Toma, L., Costa Font, M. and Thompson, B. (2017). Impact of consumers' understanding of date labelling on food waste behaviour. *Operational Research*, online journal, available at: https://doi.org/10.1007/s12351-017-0352-3.
- Watson, M. and Meah, A. (2013). Food, waste and safety: Negotiating conflicting social anxieties into the practices of domestic provisioning. *The Sociological Review*, **60**:S2: 102–120.
- WRAP (2017). *Guidance on application of date labels and related advice*. Draft for consultation. Available online at: http://www.wrap.org.uk/sites/files/wrap/Draft_Guidance_on_application_of_date_marks_and_related_advice.pdf

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Summary

Food Waste and Food Safety Linkages along the Supply Chain

Food safety, whether actual or perceived, is one of the major reasons for food waste along the agri-food supply chain. Food safety hazards at farm level such as mycotoxin contamination of feed, overuse of antimicrobials in livestock disease control, and zoonotic disease incursion may lead to food unfit for human consumption and thus waste. Given the importance of safety as one of the most important attributes of food, the appropriate management of risks along the supply chain can contribute to reductions in food loss and waste. However, a better coordination between food waste and safety policies is also needed, which requires: balancing the scientific evidence and the precautionary principle; reviewing current food safety regulations to identify areas potentially leading to avoidable waste; combining the monitoring of safety hazards and waste along the agri-food chain; provision of tailored information on linkages between food safety and waste; and investment in technologies to accurately assess the edibility of food. Attention needs to be paid to policies and practices on food labelling and packaging to ensure that they do not lead to unintended or unnecessary impacts on food safety and waste, which are not justified by scientific evidence.

Liens entre le gaspillage alimentaire et la sécurité des aliments le long de la chaîne d'approvisionnement

La sécurité des aliments, qu'elle soit réelle ou perçue, est l'une des principales causes du gaspillage alimentaire le long de la chaîne d'approvisionnement agroalimentaire. Les dangers pour la sécurité sanitaire des aliments au niveau de l'exploitation, tels que la contamination des aliments pour animauxpar les mycotoxines, la surutilisation des antimicrobiens dans la lutte contre les maladies du bétail et l'apparition de zoonoses peuvent rendre les aliments impropres à la consommation humaine, et donc entraîner leur gaspillage. Étant donné l'importance de la sécurité sanitaire, qui représente l'un des attributs les plus importants des aliments, une gestion appropriée des risques tout au long de la chaîne d'approvisionnement peut contribuer à réduire les pertes et le gaspillage alimentaires. Cependant, une meilleure coordination entre les politiques visant le gaspillage alimentaire et les politiques de sécurité sanitaire est également nécessaire, ce qui nécessite: un équilibre entre les preuves scientifiques et le principe de précaution; revoir les réglementations actuelles en matière de sécurité sanitaire des aliments pour identifier les domaines permettant d'éviter le gaspillage; combiner la surveillance des risques pour la sécurité et des gaspillages tout au long de la chaîne agroalimentaire; la fourniture d'informations personnalisées sur les liens entre la sécurité sanitaire des aliments et le gaspillage; et l'investissement dans les technologies permettant d'évaluer avec précision la comestibilité des aliments. Il convient de prêter attention aux politiques et pratiques en matière d'étiquetage et d'emballage des aliments pour garantir qu'elles n'entraînent pas de conséquences involontaires ou inutiles sur la sécurité sanitaire des aliments et le gaspillage, qui ne sont pas justifiés par des preuves scientifiques.

Zusammenhänge zwischen Lebensmittelabfällen und Lebensmittelsicherheit entlang der Wertschöpfungskette

Die Lebensmittelsicherheit, ob tatsächlich oder nur empfunden, ist einer der Hauptgründe für Lebensmittelabfälle entlang der landwirtschaftlichen Wertschöpfungskette. Auf Betriebsebene können Gefahren wie die Kontamination von Futtermitteln mit Mykotoxinen, der übermäßige Einsatz von Antibiotika zur Bekämpfung von Tierkrankheiten und das Einschleppen von Zoonosen dazu führen, dass Lebensmittel für den menschlichen Verzehr nicht mehr geeignet sind und somit zu Abfällen werden. Angesichts der Bedeutung von Sicherheit als einer der wichtigsten Eigenschaften von Lebensmitteln könnte ein angemessenes Risikomanagement entlang der Wertschöpfungskette dazu beitragen, Lebensmittelverluste und -abfälle zu verringern. Es ist jedoch auch eine bessere Koordinierung zwischen den Maßnahmen im Bereich der Lebensmittelabfälle und jenen im Bereich der Lebensmittelsicherheit notwendig. Folgendes ist hierfür erforderlich: ein Abwägen zwischen wissenschaftlichen Erkenntnissen und dem Vorsorgeprinzip; eine Überprüfung der geltenden Vorschriften zur Lebensmittelsicherheit, um jene Bereiche zu identifizieren, die zu potenziell vermeidbaren Abfällen führen; eine Zusammenführung der Überwachung von Risiken für die Lebensmittelsicherheit mit der Überwachung von Abfällen entlang der landwirtschaftlichen Wertschöpfungskette; eine Bereitstellung von maßgeschneiderten Informationen über die Zusammenhänge zwischen Lebensmittelsicherheit und -abfällen sowie Investitionen in Technologien zur genauen Bewertung der Genießbarkeit von Lebensmitteln. Die Richtlinien und die Praxis in der Lebensmittelkennzeichnung und -verpackung müssen beachtet werden, um sicherzustellen, dass sie nicht unbeabsichtigte oder unnötige Auswirkungen auf die Lebensmittelsicherheit und Lebensmittelabfälle haben, welche nicht durch wissenschaftliche Erkenntnisse untermauert sind.