

Taking Stock

Waste in the food value chain: Issues and opportunities in sub-Saharan Africa

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Waste in the processed food sector has recently been brought to the fore as a critical factor as the world looks forward to the demands of a growing population and the threat of climate change. The fact that we only consume about a half of what we produce identifies an opportunity for saving and demands more attention. Waste is discussed in seven stages of a food value chain, with a focus on the differences between the losses in the developed and developing worlds. This reveals that first of all there is a growing blurring of the difference between the developed and developing world, as consumers grow richer and industrialization develops. This is less evident in sub-Saharan Africa than in, for example, the BRIC countries (Brazil, Russia, India, and China). In wealthier countries wastage tends to be concentrated in the consumption areas while in the poorer countries more wastage arises in the production end of the food chain. The paper argues that food processors and food scientists in sub-Saharan Africa have the advantage of being able to learn what has and is happening in the

developed world environment and therefore being able to address issues efficiently that will benefit both the community and their businesses.

An eye-opener by C-Tech Innovation (2004) reads: 'Few in society recognize that our developed economy is consuming in excess of 10 tonnes of raw material resources for every one tonne of output purchased at the point of sale by private individuals'.

The macro issues impacting on the food industry and food technology are changing quickly. The new President of the South African Association of Food Science and Technology (SAAFoST) identified food security, minimizing environmental impact while maximizing benefit of the food chain, and sustainability as the areas the South African food industry should be focusing on (Rolando, 2010). This is a significant change for the formal food industry in Africa and includes aspects that smaller enterprises will find

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it difficult to focus significant attention on, among their other pressing needs.

The International Union of Food Science and Technology (IUFoST) in its Cape Town declaration (IUFoST, 2010) has put a very strong emphasis on the right to food, food security, and food safety, directing a broad range of activities to this end:

- promotion of the safety and quality of all foods;
- reduction of physical and nutritional losses in the food value chain;
- adaptation and improvement of traditional foods and processes, while respecting the traditional, ethical, cultural, and religious aspects involved;
- beneficial application of science and technology;
- development and dissemination of improved knowledge of food composition;
- facilitation of domestic and international food trade;
- development of food materials with improved functionality;
- more efficient and environmentally sustainable food production, processing, and packaging;
- education in nutrition, food science, and technology at all levels.

These positions raise many issues which food processors and food scientists will have to incorporate into their strategies,

although some are very remote and developed world focused. Sometimes it is easy for developing country processors to ignore such issues as only being appropriate to large-scale producers or the consequence of wealthy, developed world consumers. However, these developments and changes at least require monitoring and evaluation. One issue that is common to these positions is that of food waste in the food value chain. While reducing loss has often been a developmental focus, it was originally aimed at ensuring that subsistence farmers could produce sufficient food to meet their needs and later to produce an excess to trade (although many smallholder farmers also trade, but incur high losses and poor cash returns; often due in part to a lack of post-harvest infrastructure and barriers to market entry). Reducing losses has now taken on an environmental flavour: reducing resource use and emissions has been seen to 'facilitate the achievement of multiple development objectives' (Lundqvist et al., 2008). It is food waste in the value chain that this paper examines in more detail, while trying to define appropriate action for developing country processors and food scientists to consider. Waste is an issue that small food-processing enterprises could and should be focusing on that can make a contribution to all these issues no matter how

small, while at the same time improving the financial profitability of the enterprise.

The following two examples of the wider impact of reducing waste, illustrate the broader implications before the paper focuses on information that is more appropriate to developing country processors and scientists. The International Water Management Institute (IWMI) argues that less than half of the food harvested on the farm (4,600 kcal per capita/day) is actually available (2,000 kcal per capita/day) for consumption (Lundqvist et al., 2008), although part of this apparent loss is the food energy required to feed cattle and produce meat. They note that losses vary from situation to situation but that a 50 per cent saving in food waste would

have a real impact on water availability worldwide.

A report in the *Journal of Environmental Science & Technology* (Webber and Cuéllar, 2010) calculates that the energy consumed in producing the 26 per cent of the food that the USDA believes is wasted is approximately 2 per cent of the US's total energy consumption, or the equivalent of 350 million barrels of oil a year. At that level they conclude that simply avoiding loss is an attractive way of saving energy.

A value chain view of food losses

Returning to the food-processing view, essentially the waste occurs throughout the food supply chain as discussed below (see Figure 1 for the IWMI model).

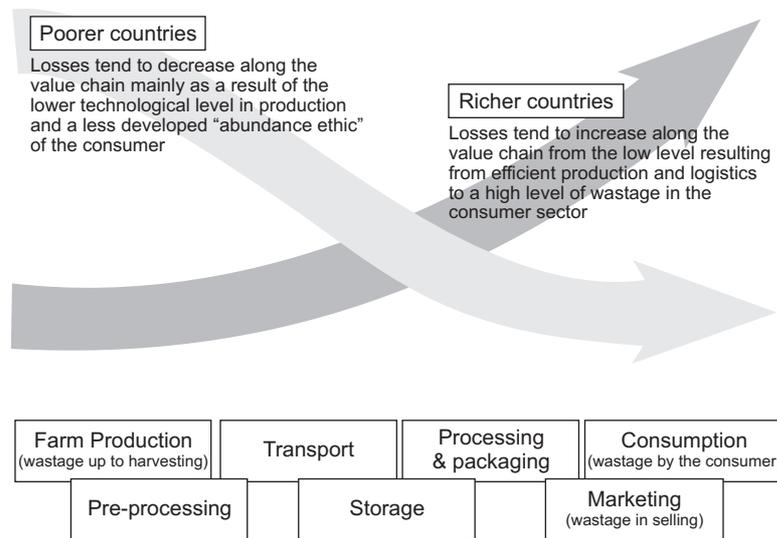


Figure 1. Trends in wastage over the food value chain

Without systematic evidence, arguments over the potential for reducing global food waste will remain largely rhetorical

With the increase in concern about carbon emissions and the environment, a lot of work has provided useful data on losses throughout the value chain (some of which is quoted in this report) for larger-scale processing in developed world environments. There is unfortunately much less data on value chains featuring smaller processors and especially those in non-industrial environments and no 'end to end' data exist on supply chain losses between non-industrial and developed world export markets.

There has recently been significant, detailed work by the African Postharvest Losses Information System (APLIS) on the post-harvest losses in East and Southern Africa, leading to a losses calculator. However, this work is only on cereals and does not cover losses from processing onwards.

A recent review in a Royal Society Special Issue on Food Security (Parfitt et al., 2010) concludes that:

A firm evidence base from which to assess food waste globally is lacking...with no specific information on the impact of food waste in BRIC countries a major concern, and with much of the loss estimates from developing countries collected over 30 years ago. There is a pressing need for quantitative evidence covering developing

countries and the rapidly evolving BRIC country food security centres (FSCs). Without systematic evidence, the arguments over the potential for reducing global food waste as a contribution to feeding nine billion people by 2050 will remain largely rhetorical, and measuring progress against any global reduction target impossible.

Because of this lack of data, this paper relies on qualitative data and personal experience in sub-Saharan Africa as a model for smaller-scale farmers and processors.

Farm production

On-farm waste comprises the loss of food in the field before harvest and is defined as the loss of crop to pests, diseases, pathogens, rodents, and other animals. This is high in developing country environments where the climate exacerbates losses and the expenditure on protective measures is lower. IWMI refers to a study (Kader, 2005) that presented some of the recorded losses, which were generally between 20 and 40 per cent in countries where pest and pathogen risk is high. Many of the solutions to these problems lie in high input agriculture (including seemingly simple solutions such as improved cultivars and fertilizer) but this

Significant losses in parts of the non-industrial world may be associated with poor choice of crops

is not widely used in many sub-Saharan African countries because of its cost. This creates a difference between the level of loss in developed and developing country environments. Significant losses in some parts of the non-industrial world may be associated with poor choice of crops or specific cultivars in relation to climatic or growing conditions (e.g. less disease-resistant varieties). Crop varieties may also be selected because they are perceived to have higher yields, but are less well adapted to storage and handling stages and so incur greater losses compared with more traditional, lower yielding, varieties.

Pre-processing

This covers harvesting and simpler and intermediate processes such as drying, threshing, and pre-processing of ingredients for manufacturing. There has also been a significant focus on this, both from the commercial and subsistence farmer viewpoints, especially on converting traditional labour-intensive techniques into mechanized ones. However, the loss in developing countries is recognized as being higher than in the developed world because of small scale, older equipment and a lack of industrial infrastructure.

Transport losses in the food chain are difficult to quantify

Transport and storage

Transport losses in developing country environment can be very high because of the poor road infrastructure, with transport even becoming impossible at certain times. This problem grows as urbanization continues to increase the amount of transport required to supply foods. Storage would include bulk storage in silos and warehouses in developed world environments and smaller structures and even huts in developing countries. It is affected by the lack of market viability (market prices are often too low to justify the investment), warm and humid weather, and the lack of finances in the developing world, making these losses higher than in the developed world environment. There have been many years of intensive work focused on the improvement of small-scale storage of cereals and legumes but less on the storage of fruit and vegetables. The losses in the food chain in these areas are difficult to quantify because there have been so many reports that have looked at a range of products in different areas, using different definitions of the part of the food chain being measured. For example, the IWMI (Lundqvist et al., 2008) reports a 10 to 15 per cent loss for pre-processing, transport, and storage but also

UK food
manufacturing
produced 1.9 MT
pa of waste from 59
MT of foods

acknowledges claims of 25 per cent loss for cereals and 50 per cent for fruit and vegetables in Africa.

This part of the food chain is mainly not in the ambit of the food processors in sub-Saharan Africa. It has also not been part of the focus of some of the more recent quantitative studies of losses in industrial, developed world food chains which are reported below.

Processing and packaging

This focuses on the production of final products that are consumed by the consumer. It involves a very diverse collection of processing plants carrying out a range of processing using many different ingredients. The lack of processing and packing infrastructure in non-industrialized countries means that, for example, lower grade, damaged fruits and vegetables are less likely to supply secondary markets (e.g. juice, pies, soup, animal feeds).

With the growing awareness of environmental and waste management issues in the UK, the government has funded a number of studies that have quantified waste in the food value chain. One of the earlier studies, that was interestingly funded from landfill taxes (C-Tech, 2004), calculated mass balances in the UK food industry. It showed that overall the UK food manufacturing

sector produced 1.9 million tonnes per year of biodegradable waste (essentially wasted food) during the manufacture of 59 million tonnes of food products.

This represents 3.39 per cent waste on input and should not be mistaken for a processing yield, which is normally much lower because part of the by-products are recycled or reused. For example presscake in sunflower oil production is used in the animal feed system and does not get counted as a waste. A further 3.9 million tonnes of packaging and other waste gave a total of 5.8 million tonnes of waste (10.4 per cent) leaving the factories.

Marketing

This is effectively the wastage in the wholesale and retail sectors that results from physical damage, breaks in the cold chain, and pilfering. The WRAP study (Lee and Willis, 2010) quantified this as 1.4 million tonnes a year in the UK or approximately 2 per cent of the total amount of food consumed. There does not appear to be any data on marketing losses in developing countries.

Consumption

Waste in this area consists of two distinct parts: the first being 'over-consumption', the excess food many in the wealthier developed world eat in relation to their actual dietary

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requirements. For example, a 'Cold Stone peanut butter and chocolate milkshake has 2,010 calories, sufficient to meet the daily energy need of an adult woman' (Roberts, 2010). This clearly shows how unconcerned many consumers are for the quantity of food they eat. Second, is the food that is not eaten but discarded by many of the same wealthy developed world consumers, either at home or within the hospitality and food service sectors.

On excess consumption, Michelle Obama has agreed a pact with the US food industry to cut one and a half trillion calories off food consumption in the USA. This could be conceptualized as equivalent to 10 million hungry people receiving an extra 400 calories a day for a year, which would likely improve their nutritional status vastly. This is an interesting step as it is surely an indication of the seriousness of the problem if food companies are prepared to give up sales or get consumers to trade-up to higher quality foods but consume less overall.

It is of course clear that this waste is limited in poorer, developing countries where people are generally focused on ensuring they remain properly nourished, and obesity, which is normally the consequence of this kind of overeating, is limited.

Vast quantities of food are also wasted in households, especially in the wealthier countries, when

consumers discard food which they are unable or unwilling to use. This is graphically illustrated by two recent stories which reported that half a billion dollars worth of wine a year is discarded in the UK and the weight of 74 Golden Gate Bridges of food a year is wasted in the USA (McLaren, 2010).

A recent study of the value chain by the Waste and Resources Action Programme (WRAP) (Lee and Willis, 2010) found that 11.9 million tonnes a year of food and drink waste was generated in UK households in 2008. This appears to be around a half of the total waste generated from manufacture to consumption in the UK food chain. The report also notes that a calculated 5.3 million tonnes of the food and drink that are discarded could have been avoided.

This very high relative loss in the household is basically a result of a lack of proper management of purchases, storage, and consumption by consumers.

The large quantities that are wasted have much to do with complicated dating of food products with statements such as 'best before', 'sell by', and 'eat by', all of which are confusing to consumers and encourage an often exaggerated fear of safety and hygiene that makes discarding food easy. It is worth noting that an eat-by date of a refrigerated product can have no real safety implication as it takes

no account of how well the cold chain has been maintained in the industry and particularly the household. The losses are also a result of a change in consumers' attention to avoiding waste that probably results from increased wealth, lower food prices, and general abundance – there is a recent thought that those who lived through wartime rationing should assist in reducing household waste.

Summary

There are high losses in all parts of the value chain and these vary according to circumstances for different products and in different geographical areas. It is also clear that the magnitude of losses in the production and consumption parts of the value chain is different in third- and developed-world environments. Poorer countries have higher losses in production, transport, and processing while the losses in richer countries are larger in the consumption part of the value chain. This seems to be mainly a consequence of the warmer and more humid climates, lack of technology, and financial constraints in developing countries and a lifestyle without constraints in the developed world. It is also clear that this is a generality and that the first developed/developing country divide used in the discussion is becoming less clear especially as wealth increases and industrialization

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While it is tempting to look at these figures and make simple arithmetic conclusions, such as 'if we are losing half our food we would be able to halve our costs by eliminating the loss', this is not simply proportional and a more detailed analysis is required.

Developing country response

The question is: where can third-world food processors and food scientists make inputs that will yield direct financial benefit from reducing these losses while also improving food security and reducing environmental impact and water usage?

Process optimization

The processor first of all has an advantage in that the minimization of waste is a primary objective of the enterprise because it reduces cost. But at the same time the business will be contributing to environmental or social benefits. Food waste in a small food-manufacturing enterprise is only one part of the process where savings can be made. Essentially the entrepreneur should be focused on making the product that the consumer expects, using a minimum of raw material and other inputs. Material losses happen throughout the business from underweight

Waste per unit of production is greater in small manufacturing operations than large ones

delivery by suppliers, losses in storage, pilfering, spillage, process efficiency and mass control. Waste per unit of production in a small manufacturing operation is greater than that in a large one because of the differences in batch size and the bigger losses that are associated with operations such as emptying, flushing, draining, and washing. Spillage and waste losses are also higher in a small business because of more manual operations and less 'closed' equipment. Damage and loss resulting from problems in manual storage are also higher in smaller operations that cannot spend as much on equipment, buildings, and management as a large, automated operation.

However, processors should still be weighing their production and relating it to the total weight of inputs to give a benchmark, to avoid unnoticed changes affecting the yield, and to act as a base for improvement.

Interaction with material suppliers

Although processors do not have a direct impact on field losses and post-harvest processing, they do influence the sector through their interaction with suppliers. In particular, specifying appropriate packaging and transport and guaranteeing off take will allow farmers and

suppliers to supply higher quality material and where necessary make appropriate improvements to their business.

The UK *Food 2030* study (Defra, 2010) specifically identifies developing country farmers as the producers of 55 per cent of the world's cereals who are overusing fertilizer in some places and operating with very low yields in others. It notes the country's responsibility as a consumer to avoid the degradation of the global agricultural resource and identifies actions that could improve the situation.

Processing of excesses in the food value chain

Perfectly nutritious food is often wasted because of mismatches between supply and demand in the food value chain. Examples are agricultural gluts due to poor crop selection, damaged food that cannot be sold, and wastage due to short-term local over supply. In all cases there is an opportunity for food processing to convert products on the verge of being wasted into products for which there is an alternative use or demand. However, it needs to be realized that all processing, especially if packaging and transport is required, adds much to the low cost of such excess crops and often makes the concept unviable. These excesses are therefore often better addressed by seeking to manage supply and demand.

Consumer wastage

As has been noted above, waste in the retail and consumer part of the value chain is small among really poor consumers because they cannot countenance discarding food and they often buy and eat on a day-to-day basis because of a lack of cash and appropriate storage systems. Processors can, however, make their contribution by manufacturing products that meet the particular needs of the poor and supplying food information that will support the consumer in making decisions around which products best suit their needs.

Food science information

In the modern, connected, information age, it is easy and in fact necessary for food scientists to keep up to date with trends and developments in the developed world industry. This will allow them both to anticipate and react to changes and to understand what demands the developed world's actions put on trade, which is always a goal of developing country farmers and manufacturers. They are also able to supply the benchmarks that will help people at all stages in the value chain, from storage conditions and soft handling for the material suppliers to manufacturing processes and their impact on losses for manufacturers. Food scientists

support food processors in their actions aimed at reducing waste and optimizing production. They do this by managing and supplying information and connections to manufacturers and by undertaking appropriate research aimed at supplying solutions within the developing country environment.

Food scientists have much of the knowledge, such as the effect of processing on nutritional value and the process needs for safe storage, to make inputs and suggestions in the related food security area. Besides becoming involved in addressing food security by addressing food loss, it is tempting for food scientists to become directly involved in funded projects in the food security sector. The scientist has to be careful not to focus on increasing output as a means of ensuring that more food is available, because the world already produces more food than required to feed the whole world's population. The other side of the issue is making the food accessible to the under-nourished poor, which generally does not suggest such interesting food science solutions.

In the area of consumer waste, it is up to food scientists to educate and inform consumers about the dangers of over-consumption and to assist consumers to understand food safety and hygiene and their effects on household storage.

It is easy and in fact necessary for food scientists to keep up-to-date with trends and developments

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Conclusion

Developing country processors would benefit their profitability if they took this renewed concern about food wastage as a goal for their companies, not only because of the developmental benefits that arise from an efficient operation but for the cost saving and growth potential it offers. The information supplied in this paper, along with the associated links to some of the organizations active in the areas, should supply processors and food scientists with the existing benchmarks and the ability to monitor developments so that they are able to lead the changes and opportunities that arise from this focus. As the Global South develops, it is inevitable that the distinction made between developed and developing countries with regard to technology, finances, and excess consumption will change. This will bring with it all the complexities of food processors/government/food scientists interactions arising from government's attempts to improve the health of its citizens and reduce the costs of its interventions. Knowing what others' experience indicates is most likely to happen, gives food processors and scientists the opportunity to monitor and understand developments. Being aware of changes that are very likely to face them in the future will allow them to support governments with information

and advice in the development of a country's strategy. On the technology level, it will allow them to develop products and information that could ameliorate the effects of issues such as rising obesity, the associated diseases, and unacceptable food waste that accompany these changes.

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