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The Crawford Fund

2016 Annual Conference

Canberra ACT, Australia

29–30 August 2016

Editor: A. Milligan

Food loss in supermarkets: what can supermarkets do to reduce food loss?

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ABSTRACT: Food loss occurs along the entire food chain, including losses at wholesale and retail markets. Among retail markets, supermarkets have important roles in food chains since they are located close to the end of the food chain. In developing countries, supermarkets are increasing, and are making a significant contribution to national retail food sales. Along with rapid development, food loss occurs in significant amounts in supermarkets since they sell large quantities of food. This paper aims to review and estimate food loss and food waste in Indonesian supermarkets focusing on fresh fruit and vegetables, fish and meat products. First we review food loss in supermarkets from the previous literature. Then we report on a case study conducted with a leading supermarket in Indonesia in order to estimate its food loss and its efforts to prevent the amount of food loss. Reducing food loss in supermarkets is an important issue in terms of the efforts to increase profit in supermarkets, to increase income for small farmers supplying to supermarkets, and to improve food security in urban areas, as well as avoid environmental problems caused by food waste.

Keywords: food losses, food waste, supermarkets, Indonesia

Food loss is an emerging issue in the food policy agenda because of its contribution to financial losses, food security issues, and waste of natural resources. According to some estimates, about one-third of food products intended for human consumption is lost or wasted globally, which amounts to about 1.3 billion tonnes per year (FAO 2011). When such a large amount of food goes to waste instead of being consumed by people, a lot of money will be lost (Ventour 2008). In addition, large amounts of limited natural resources dedicated to food production are wasted.

Food moves from farm to the table of consumers, and loss occurs along the entire food supply chain including (i) loss at farm level, (ii) loss at the wholesale and retail level, (iii) loss at the consumer level (Buzby *et al*. 2009). At the farm level, over-production, poor balancing of supply and demand, and inefficient supply chains contribute to food waste. Losses at the wholesale and retail level occur in both traditional and modern markets, and are caused by poor handling, poor transportation systems, and poor analysis of demand and supply. At the consumer level, losses include cooking loss and uneaten food such as plate waste which can be caused by insufficient purchase planning by the consumers.

This is the paper and some of the illustrations presented by Dr Daryanto at the conference.

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Loss at the retail stage is a relatively small share of the total food loss across all stages of food chains. Göbel *et al*. (2012) and Jensen *et al*. (2011) reported that the retail sector contributed about 3% to food loss in Germany and 3.8% in Sweden. Although the retail percentage loss is relatively low, the total loss (on a weight basis) is relatively high, about 95–115 kg/person/year in developed countries and 6–11 kg/person/year in developing countries (FAO 2011), or 39,000 tonnes per year in Sweden (Jensen *et al*. 2011) and 4.4 million tonnes per year in the European Union (EC 2010).

Among retail markets, supermarkets (a term which, in this study, means modern food retailers including supermarkets, hypermarkets and convenience stores) have important roles since they are located close to the end of the food chain. In developing countries, supermarkets are making increasingly significant contributions to national retail food sales. In Indonesia, the number of supermarket outlets increased significantly particularly in the period 2009–14. During this period, the number of hypermarket outlets grew about 12.7%; supermarkets by 15%; and convenience stores (mini-markets) by 34% (USDA GAIN Report 2015). In 2014, the number of hypermarkets, supermarkets, and convenience stores reached approximately 300, 1400, and 22,800, respectively. Supermarkets make a significant contribution to national retail food sales including of fresh fruit and vegetable products. Sahara *et al*. (2015) reported that in the three leading supermarkets in Indonesia, fresh fruit and vegetables contributed about 15% to supermarket sales in 2015. It is expected that supermarkets' share of retail food sales will continue to increase along with rapid growth of per capita income, urbanisation, and liberalisation in foreign direct investment.

Food loss in supermarkets can reduce profit, and the products most susceptible to loss are fresh products including fruit and vegetables. From a microeconomics perspective, examining the amount of fresh products that go unsold in supermarkets is timely, to understand where and how much food loss can be reduced to improve supermarket profitability (Buzby *et al*. 2015). In addition, as is the case in many developing countries, the majority of fresh products in supermarket chains in Indonesia are supplied by smallholder farmers (Sahara *et al*. 2015). Given this situation, a reduction in food losses might affect farmers' income. From the macro perspective, reducing food loss can contribute positively to food availability and food security particularly in urban areas, as well as saving natural resources. Unfortunately, studies on food loss at supermarkets are very limited, particularly in developing countries including Indonesia. This paper aims to review and estimate food loss in supermarkets, focusing on fresh products: meat, fruit, vegetables and fish.

Methods

The data in this study is based on a **literature review of studies** related to food loss at retail outlets, particularly supermarkets, and a **case study** performed in a leading supermarket chain (which we shall not name) in Indonesia. Fresh products are the main focus in the study, and for the case study we selected four fresh products including fruit, vegetables, fish and meat.

During the case study, we conducted a face to face interview with the director of the fresh product department in the leading supermarket chain regarding food loss of the fresh products that were the focus of the study. The leading supermarket is currently running two types of business stores: wholesale and retail (Table 1). The term 'wholesale store' refers to large stores mainly supplying hotels, restaurants, catering and other small retailers. With that kind of market segmentation, the wholesale stores sell large quantities of products at lower prices than in the retail market. The term 'retail store' refers to hypermarket and department stores mainly supplying households. The products sold by retail markets are more varied than those in wholesale stores, but relatively small in terms of quantity and value. The data for wholesale stores is available for a period of 27 months (January 2014 – March 2016). For retail stores, data is only available for the 24-month period January 2014 – December 2015.

Table 1. Types of stores run by the leading supermarket chain in this study 2014–16

Type of store	**2014**	**2015**	**2016**
Wholesale store	24	24	25
Retail store			
– Hypermarket	13	13	14
– Department Store	1	3	2

Fruit, vegetable and seawater fish are sourced from farmers or middle men and sent to the distribution centre owned by the leading supermarket chain. For meat and poultry products, the products are sourced from farmers or the slaughterhouse before they are delivered to the distribution centre.

All the fresh products need to meet the quality and quantity standards required by the leading supermarket chain. Checking for the quality standards of all the fresh products is conducted at the distribution centre. Products that do not fulfil the requirements are rejected and sent back to the farmers or middle men. Products that have met the quality standards are distributed to the stores run by the leading supermarket.

This study examines food loss occurring from the distribution centre to stores run by the leading supermarket, on a value basis. Following Lipinski *et al*. (2013), we define food loss and waste as edible parts of plants and animals that are produced or harvested for human consumption but that are not ultimately consumed by people. In this study, the food waste calculation is based on the ratio between the value of food losses (unsold products) and total value of sales in each store run by the leading supermarket chain (Figure 1). Due to

$$\text{Percentage of food loss} = \frac{\text{Value of food losses}}{\text{Total sale value}} \times 100\%$$

Figure 1. Formula used in this study for calculating the value of food waste.

confidentiality issues with respect to the data, particularly the values of food loss and sales, we can only display the final results of the calculation as percentages.

Results and discussion

Review of food loss studies at the supermarket and retail levels

Despite increasing attention to the food loss issue among researchers and policy makers, empirical studies examining the amounts of food loss for fresh products in supermarkets are still limited, particularly in Indonesia. A few studies have examined causes and amount of food loss (and waste) in supermarkets and how to reduce the number (FAO 2011; Eriksson 2012; Bond *et al*. 2013; Lipinski *et al*. 2013; Buzby *et al*. 2015). The definitions of food loss vary among the studies and are sometimes interchangeable with food waste. As such, the estimates from previous studies are not directly comparable, making it difficult to perform precise comparisons across the studies.

Eriksson (2012) examined food loss at six supermarkets in the Uppsala-Stockholm region of Sweden. The study defined food loss as food waste: the products discarded in the supermarkets, irrespective of whether they belonged to the supplier or the supermarket. In the study, Eriksson (2012) focused on pre-store waste and recorded in-store waste. Pre-store waste refers to items rejected by the supermarket at delivery because of non-compliance with quality requirements. Recorded in-store waste refers to products discarded by supermarkets when there is little or no possibility of selling the products. The estimate was based on weight. The study found that loss in the fresh food and vegetables department was dominated by pre-store waste compared to in-store waste, 3% versus 1.3% respectively. The main cause of pre-store waste was rejection because the supplier could not meet the quality standards needed by the supermarkets. Tomato was the most wasted product followed by banana and lettuce. Among fresh products sold in the supermarkets the organic products contributed the highest percentage of waste.

Buzby *et al*. (2015) assumed that 'shrink' for fresh fruits and vegetables was food loss, when they estimated fresh produce and food loss of US supermarkets. In the study, 'shrink' is defined as the produce that is delivered into supermarkets for sale but is not sold for any reason. The estimate was based on weight. They found that in the period 2011–12 the shrink rate for individual fresh vegetable products ranged from 2.2% for sweet corn to 62.9% for turnip greens. During the same period, the shrink rate for individual fresh fruit products ranged from 4.1% for bananas to 43.1% for papayas. On average, the annual food losses for fresh vegetable and fruit products were about 6.1 billion pounds and 5.9 billion pounds, respectively.

Other studies on food loss highlight food losses occurring along the entire food chain including losses at the supermarket level. FAO (2011) examined food losses in the entire food chain by utilising the definition of food losses as the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. In the study, food losses taking place at the end of the food chain (retail including supermarkets, and final consumption) are called food waste. In some countries, the researchers calculated food loss at the supermarket level, but in most cases they calculated

the loss for all retail including loss in supermarkets (Table 2). On average, the loss rate for fruit and vegetables was the highest, and was above 10% in all countries, followed by waste of fish and seafood products and meat.

Table 2. Fresh products waste at the retail level (%)

Countries	Fruits and vegetables	Meat	Fish and seafood
Europe including Russia (supermarket retail)	10	4	9
North America and Oceania (supermarket retail)	12	4	9
Industrialised Asia (all retail including supermarket)	8	6	11
SubSaharan Africa (all retail including supermarket)	17	7	15
North Africa, West and Central Asia (all retail including supermarket)	15	5	10
South and South East Asia (all retail including supermarket)	10	7	15
Latin America (all retail including supermarket)	12	5	10

Source: FAO (2011)

Similarly, Bond *et al*. (2013) examined food loss along the entire food chain in the UK. In their study, food loss refers to all food and drinks discarded throughout the entire food chain, from production through to post consumption. The research focused on the whole food products, not differentiated between staple foods, fruit and vegetables, meat and fish. The estimate was based on weight. For all food products focused on in the study, losses within distribution and retail reached about 3% of total losses, equivalent to 366,000 tonnes/year.

While most previous literature has estimated food loss on a weight basis, Lipinski *et al*. (2013) estimated food loss based on weight and then converted the weights into calories. They argued that measuring food losses by weight does not consistently reflect the energy in food products that could have been consumed by people. They defined food loss as the edible parts of plants and animals produced or harvested for human consumption but not ultimately consumed by people. Similar to Bond *et al*. (2013) and FAO (2011), this study also estimated loss at any stage of the food value chain including waste at the supermarket level. They also examined food loss for different food commodities including loss for cereals, roots and tubers, fruits and vegetables, oilseeds and pulses, meat, milk, fish and seafood. In all stages of the food chain, fruit and vegetable products were the largest source of loss on a weight basis – about 44% (where 100% = 1.3 billion tonnes). If the calculation is instead based on loss by kcal (kilocalories), fruit and vegetables contributed about 13% (where 100% = 1.5 quadrillion kcal). For meat products, loss rates based on weight and kcal were about 4% and 7%, respectively. For fish and seafood commodities,

loss rates based on weight and kcal were about 2% and 1%, respectively. For all food commodities, loss rates (on the basis of kcal) at the distribution level varied among countries, ranging from 7% (in North America and Oceania) to 18% (in North Africa, West and Central Asia).

A wide range of approaches for reducing food loss particularly at the retail level (or distribution level) have been highlighted by previous studies. They include: improved packaging, facilitating increased donation of unsold food, changing food date labelling practices, changing in-store promotions, and providing guidance on food storage and preparation to consumers (Lipinski *et al*., 2013). Eriksson (2012) suggested making a clear definition with respect to quantity requirements, in terms of quality and quantity; using more advanced packaging, sticking with the 'first-in first-out' principle, maintaining storage temperature, and establishing good ordering systems. Buzby *et al*. (2015) introduced three strategies for reducing food loss: reduce, recover and recycle. Reducing food loss can be achieved by improving product development, storage, shopping/ordering, marketing, labelling and cooking methods. A 'recover' strategy can be established by connecting potential food donors to hunger relief organisations, e.g. food banks. A 'recycle' strategy can be managed by giving food to feed animals or by creating compost, bioenergy and natural fertilisers. FAO (2011) suggested reducing package size, and for supermarkets to conduct consumer surveys to identify consumers' specific requirements.

Case study results

The flow of fresh products in the store

The flow of products in all stores run by the leading supermarket has four stages before they can be sold to consumers: receiving (Figure 2), transiting (Figure 3), storing and displaying.

Figure 2. Quality checking and distribution in progress at the distribution centre.

Figure 3. A typical transit area at a supermarket.

Receiving stage. Fresh food products are received from various suppliers at the distribution centre owned by the leading supermarket chain in Jakarta. The distribution centre can accommodate 35–40 tonnes of fresh food products per day which consist of 60% vegetables, 30% fruit and 10% seawater products. The products received in the distribution centre are checked and distributed (Figure 2) to stores located in Jakarta, Bogor, Depok, Bekasi and Serang (the most populated cities in Indonesia). The receiving process is conducted from 1 am to 3 am. After quality checking, the products are distributed to all stores in the distribution centre's coverage area at 6 am. At that time, the temperature is good enough to maintain the quality of the products since the leading supermarket does not operate a chiller truck.

Transit area. Each store has a transit area (Figure 3). At this stage, the quality and quantity of the products are re-checked before the goods are placed into the storage room.

Storage activity is applied at each store before the products are displayed on the shelves. Fresh food products are perishable, and they are stored in the chiller room. Some activities take place before the goods are put into the chiller room. For example, meat and poultry products are cut to various sizes at this stage.

Products are **displayed** on the shelves in each store. Consumers can choose items they would like to buy by selecting the best quality in terms of appearance, size and colour. Therefore, frequent physical contact between products and consumers may occur during this selection process, increasing the probability of products' damage. During the display stage, the staff in each store check the quantity and quality of fresh products twice a day, in the morning and evening. Quality checking is conducted to prevent rotten products from infecting others.

The causes of waste

At every stage as outlined above, there are some factors causing waste of fresh products (Figure 4), including over-ordering, lack of quality checks, temperature problems, bad handling, and failure to apply the 'first-in first-out' principle.

Over-ordering of fresh products occurs when there is a lack of coordination between supply and demand in each store. The shelf life of products, the stores' selling capabilities and the stock of fresh food products are crucial factors when the stores send their orders to the suppliers. Order decisions should

Figure 4. Causes of food loss and waste.

also consider the number of buyers visiting the stores from time to time. For example, the amount of fresh products ordered for the weekend will be higher than the amount ordered for weekdays. Similarly, for special occasions, e.g. Eid celebration and Christmas, the amounts of fresh products will be higher than in normal situations. If staff who are responsible for ordering fresh products do not have enough experience to decide the right amount to order, there is greater probability of over-ordering.

If **staff lack the ability to perform correct quality checks**, this can also increase the amount of food waste. By performing quality checks based on the standard quality, the leading supermarket chain can prevent product rejection at the consumer level. Consumers prefer to buy high-quality fresh products and they will reject products that cannot meet their standards.

Since fresh food products are perishable, maintaining **temperature** is important for each store to ensure the quality of fresh products prior to selling to their buyers. Failure to maintain temperature, particularly at the storage stage, increases food waste. **Bad handling** can also increase the amount of food waste. For example, if the staff is late in moving products from the receiving area to the storage room, that will reduce product quality. Crushing and bruising, particularly of soft fruit, increases when the handling process is not performed correctly.

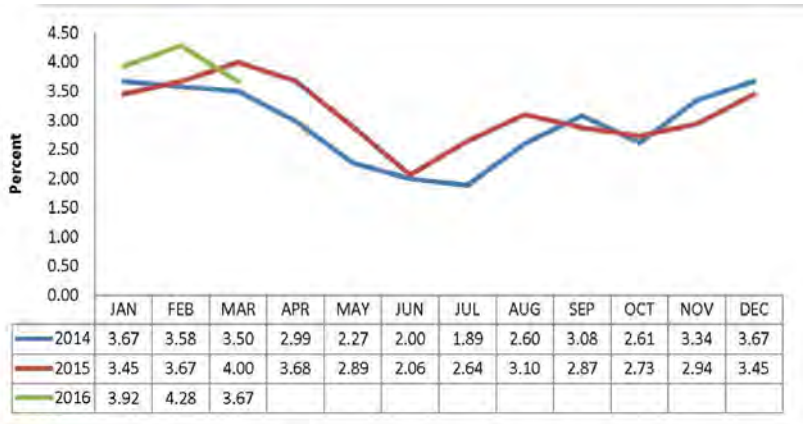
Each store has established the 'first-in first-out' (FIFO) principle. In FIFO, fresh products are sold in the same chronological order in which they arrived. This is related to the perishable nature of fresh food products, so sales of goods must be prioritised to the earlier-arriving products. Staff sometimes make mistakes in applying the FIFO principle.

Quantification of loss values

As outlined previously, we quantified food loss in the two types of stores run by the leading supermarket, on a value basis. The average loss rates for four fresh products in the wholesale stores were estimated for the period January 2014 – March 2016. In the retail store, the loss rates were estimated for the period January 2014 – December 2015.

In the wholesale stores, the average loss rates during the 27 months (January 2014 – March 2016) for four fresh products (fruit, vegetable, fish and meat) ranged from 1.89% to 4.28% of their total sales (Figure 5). For the retail stores, the average loss rates were higher than in the wholesale stores, ranging from 6.05% to 8.24% of their total sales (Figure 5).

Store policies that require retail stores to sell a range of products including fresh products might explain higher rates in the retail stores than the wholesale stores. Also, as discussed previously, the wholesale stores focus on sales to hotels, restaurants and catering; therefore, they are more concerned with selling products in packs or bundled in large numbers. In this situation, the sale values will be higher compared to the retail stores that focus on direct sales to consumers. As we know, the numbers of products bought by final consumers tends to be lower than the numbers of products bought by hotels and restaurants.



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	3.67	3.58	3.50	2.99	2.27	2.00	1.89	2.60	3.08	2.61	3.34	3.67
2015	3.45	3.67	4.00	3.68	2.89	2.06	2.64	3.10	2.87	2.73	2.94	3.45
2016	3.92	4.28	3.67									

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	6.87	6.75	6.69	6.90	7.02	6.30	7.32	8.00	7.63	7.13	7.25	7.71
2015	8.24	8.30	6.51	7.00	6.05	6.45	7.49	7.60	7.26	7.27	7.23	8.40

Figure 5. Estimated losses in four fresh products: wholesale stores (*top*); retail stores (*bottom*).

In both stores, there was a month to month fluctuation with respect to the loss rates (Figure 5). Month to month fluctuations in demand and supply of individual products contributed to the differentiation of loss rates in each month. For example, the highest rates of loss in the wholesale and retail stores tend to occur from December to March. This is because of the seasonality of fruit. In these periods, the stores are selling fruit and that increases the amount of loss. According to the director of the fresh food department, fruit makes the highest contribution to food waste in the leading supermarket chain.

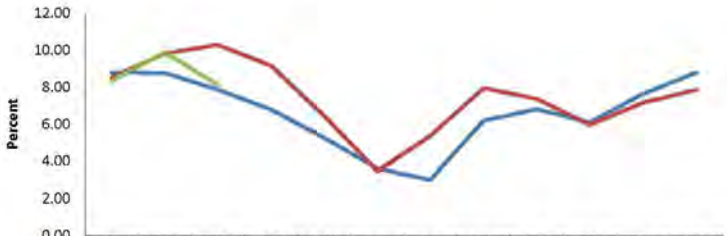
The loss rates for fruit products were 3.01–10.29% in the wholesale stores and 7.28–10.56% in the retail stores (Figures 6a, 6b). These findings are similar to those of FAO (2011) and Lipinski *et al*. (2013), in which fruit products contribute to the highest level of supermarket loss. Both wholesale and retail stores sell local and imported fruits. Peak season for local fruits (e.g. durian, mango) is from December to March, and that contributes significantly to fruit waste in that period. In the same period, the number of imported fruits (e.g. mandarin, orange, grape) was also higher than in other months because that is the peak season for these fruits in their countries of origin. Buzby *et al*. (2009) reported that the majority of fruits are soft. When consumers select fruits displayed in the stores, the probability of crushing and bruising of the fruit will increase. In addition, poor handling can also contribute to crushing and bruising of fruit products, increasing the number of fruit losses.

For vegetable products the estimated loss rates varied from 1.81% to 4.01% in the wholesale stores and from 6.85% to 11.10% in the retail stores (Figures 6c, 6d). Vegetable products, particularly leafy greens such as spinach, water spinach and lettuce, are relatively more prone to loss than many other types of products and this likely contributes to higher shrink. Products such as tomatoes, chillies and green beans are usually sold in bunches and are not protected by packaging. All vegetable products need to be refrigerated promptly in order to maintain their quality and freshness. Failure to maintain temperature at the vegetable space leads to higher waste.

Fish contributes a relatively small share of food losses both in wholesale and retail stores. This is because the fish products sold in both stores are mainly in the form of chilled fish (in retail stores) or frozen fish (in wholesale stores). Such types of products have longer shelf life than fresh or live fish. The stores sell only a small amount of live or fresh fish. The fish loss rates at the wholesale stores and the retail stores varied as shown in Figures 7a, 7b.

In agreement with FAO (2011), this study finds that meat products made the smallest contribution to the loss rates in both stores. The percentage loss rates on the value basis were about 0.24–1.06% in the wholesale stores and 2.43–5.77% in the retail stores. Compared to the wholesale stores, loss rates of meat products in retail stores were higher (Figures 7c, 7d). The wholesale stores focus on selling meat in frozen form, while the retail stores sell meat mainly in chilled form. The frozen meat has longer shelf life than the chilled meat. Longer shelf life leads to lower loss rates of meat products.

(6a)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	8.79	8.77	7.86	6.79	5.25	3.61	3.01	6.19	6.81	6.10	7.63	8.79
2015	8.54	9.82	10.29	9.16	6.44	3.46	5.37	7.95	7.37	5.97	7.16	7.85
2016	8.34	9.9	8.11									

(6b)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	9.17	9.20	8.49	9.23	9.05	7.98	9.31	9.33	10.16	8.18	8.42	10.26
2015	10.37	12.19	8.42	9.26	7.49	8.17	8.93	9.82	8.96	7.28	8.37	10.56

(6c)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	2.74	3.12	3.45	2.88	2.08	2.22	2.39	2.29	2.72	2.35	2.64	2.74
2015	2.92	3.05	3.50	2.86	2.89	2.89	2.77	1.90	1.63	2.31	1.81	2.63
2016	4.01	3.98	3.60									

(6d)

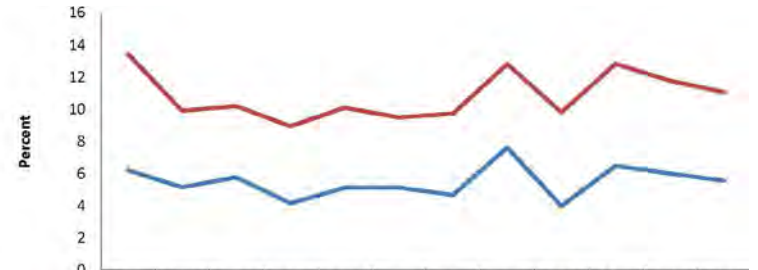
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	7.18	7.58	7.65	9.02	8.90	7.99	9.41	9.16	8.17	8.43	9.35	9.68
2015	9.43	9.24	7.75	8.11	6.85	7.98	9.30	7.85	7.58	9.69	9.34	11.06

Figure 6. Estimated losses of fruit products in wholesale stores (6a) and retail stores (6b) and vegetable products in wholesale stores (6c) and retail stores (6d).

(7a)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	2.59	1.96	2.07	1.68	1.45	1.91	1.65	1.52	2.22	1.96	2.04	2.59
2015	1.83	1.33	1.73	2.02	1.78	1.58	1.9	1.98	2.01	2.07	2.42	2.37
2016	2.73	2.71	2.48									

(7b)

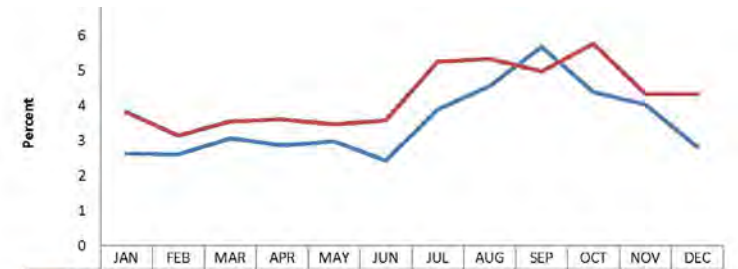


	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2015	7.23	4.75	4.42	4.79	4.97	4.36	5.06	5.19	5.83	6.34	5.76	5.51
2014	6.22	5.16	5.78	4.16	5.13	5.14	4.68	7.62	3.99	6.49	6.02	5.56

(7c)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	0.56	0.45	0.62	0.6	0.3	0.24	0.49	0.4	0.57	0.04	1.06	0.56
2015	0.51	0.46	0.46	0.67	0.45	0.32	0.53	0.56	0.48	0.57	0.36	0.94
2016	0.61	0.54	0.48									

(7d)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	2.63	2.61	3.06	2.87	2.98	2.43	3.89	4.56	5.68	4.39	4.03	2.82
2015	3.81	3.14	3.55	3.61	3.46	3.58	5.26	5.34	4.98	5.77	4.34	4.34

Figure 7. Estimated losses of fish products in wholesale stores (7a) and retail stores (7b) and meat products in wholesale stores (7c) and retail stores (7d).

Conclusions and implications

This study has reviewed food losses at the retail (supermarket) level in several countries and estimated the level of loss rates for four fresh products (fruit, vegetable, fish and meat) in a leading supermarket chain in Indonesia. The review indicates that the definitions of food loss varied considerably across the studies, making it difficult to conduct precise comparisons across the studies. In general, the studies found fruit and vegetable products contributed the highest share of food loss at the retail (supermarket level).

In agreement with those previous studies, this study also demonstrates the highest loss rates for fruit and vegetable products in the wholesale and retail stores. Our estimates are based the proportion of losses for each product in relation to the total sale values in each store. Higher loss rates at the retail stores, compared to the wholesale stores, related to the supermarket chain's policy that requires retail stores to sell a wider range of products. This study also identified factors contributing to the losses of fresh products in the leading supermarket chain. They include: over-ordering, lack of quality checks, temperature problems, bad handling, and failure to apply the 'first-in first-out' principle.

As we know, fruit, vegetables, fish and meat are considered high value agriculture products. It is expected that demand for high value agriculture products will tend to increase in the future along with increases in consumer income and consumers' greater concern about their diet.

For supermarkets, reducing food waste is very important to improve their profitability. In such situations, actions that could be performed to prevent and reduce food losses in the supermarket chain include:

- Managing and establishing good ordering systems based on historical sales for each store
- Improving space management at the display area
- Improving quality control at the receiving area
- Improving handling at the receiving, storage and display areas
- Maintaining temperature at the receiving, storage and display areas
- Conducting training in the handling process
- Sticking with the 'first-in first-out' principle
- Improving in-store promotion strategies.

The estimation of food losses in this study relies on the case study data in one leading supermarket chain in Indonesia, though we have covered all stores run by the leading supermarket chain (e.g. 40 stores in 2015). Future studies need to include other supermarket chains in Indonesia. Currently, there are at least three leading supermarket chains in Indonesia and each of them operates several stores.

References and further reading

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