FOOD WASTE IN SOUTH AFRICA

Understanding the Magnitude: Water Footprint and Cost.

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Food is treated as a disposable commodity throughout the developed world (Oelofse and Nahman, 2013). It is estimated that between 30% and 50% (or 1.2-2 billion tonnes) of all food produced for human consumption is lost or wasted before consumption (Institution of Mechanical Engineers, 2013). It is further reported that food wastage in developing countries (including sub-Saharan Africa) tend to occur mostly in the production and distribution stages as compared to developed countries where the bulk of the wastage occur at the retail and consumer end of the supply chain (Institution of Mechanical Engineers, 2013). Dutch households are reported to waste 13.6% of edible food (Ministry of Economic Affairs, 2014) while UK households waste nearly 20% of the food they buy (Bond et al., 2013).

Globally agriculture accounts for the largest human use of water (Lundqvist et al., 2008). This is of significance when considering that about 90 percent of local South African fruit, vegetables and wine are produced under irrigation (DAFF, 2012) and mostly for the export market (ITC, 2010). There is thus the potential of high levels of food wastage at the production side in South Africa and again at the consumptions stages if the final point of sale is Europe or other developed countries. In 2009, 46% of South African agricultural production was exported (GCIS, 2011) of which 40% was destined for European countries (ITC, 2010).

It is therefore important to understand the magnitude and causes of food waste and its impacts in both developing and developed countries in order to manage the food supply chain and resources used to produce food better.

The magnitude of food waste in South Africa

Research on food wastage in South Africa suggests that between 9 and 10 million tonnes of food waste is generated annually, this is equal to about 30% of the local agricultural production in South Africa (Oelofse and Nahman, 2013; Nahman and de Lange, 2013). The bulk of this food waste is generated in the pre-consumer stages of the supply chain as illustrated in Figure 1. It is estimated that only about 5% of the food

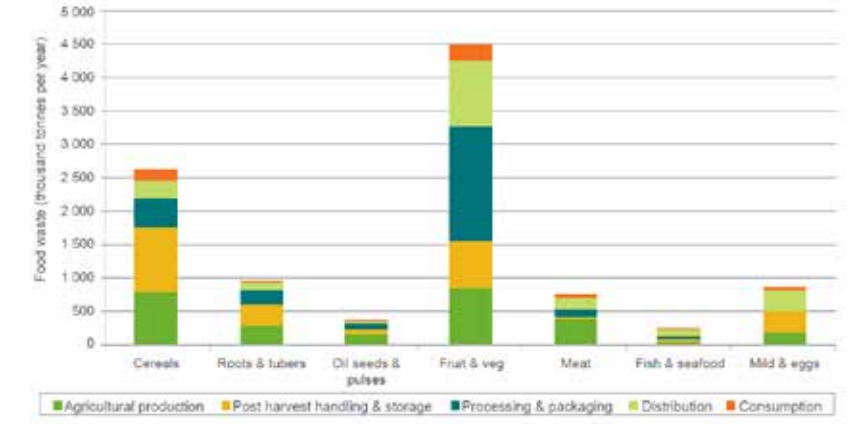

Figure 1: Estimated food waste in South Africa per commodity group at the different staged in the food supply chain (Oelofse and Nahman, 2013).

waste is generated during consumption (Figure 1) (Oelofse and Nahman, 2013). This is in line with international assumptions.

International trends suggest that food wastage moves up the food supply chain as the level of development in a country increases (Institution of Mechanical Engineers, 2013). It is therefore likely that South Africa, as a developing economy may see similar trends in food waste over time. Changes in the South African food consumption patterns supported by a growing middle class, is already reported. The shift is most evident in the decrease in the consumption of staple maize and bread to a more diverse diet (WWF-SA, 2010).

Understanding where in the supply chain the wastages occur, the value of food going to waste and the associated water losses will provide a clear picture of where in the supply chain intervention is required and on which commodity groups interventions should focus to reap the best results.

Impacts

The Food and Agriculture Organisation of the United Nations (FAO) published the first study analysing the environmental impacts of food waste in 2013 (FAO, 2013). The environmental footprint of global food wastage is assessed through carbon footprint; water footprint; land occupation/ degradation impact; and potential biodiversity impact (FAO, 2013). The general approach to the assessment is based on multiplications of activity data (i.e. food wastage volumes) and specific factors (i.e. carbon, water and land impact factor) (FAO, 2013). Since the environmental impacts relate to the entire product and not only the edible portion, the general approach is to use the food wastage volumes of edible and non-edible parts in the footprint calculations (FAO, 2013). For the purposes of this paper, the focus will be on determining the water footprint of food waste in South Africa.

Water footprint

The water footprint concept was introduced by Hoekstra in 2002 as an indicator of consumption-based water use (Chapagain and Hoekstra, 2004). The water footprint of an individual, business or nation is defined as the total volume of fresh water that is used to produce the goods and services consumed by the individual, business or nation (Chapagain and Hoekstra, 2004). The Water Footprint Network (WFN) has developed a global standard on water footprint assessments (Hoekstra et al., 2011). Under the WFN definition, a water footprint consists of three sub-components namely blue water, green water and grey water. Blue water in agriculture refers to the consumptive use of irrigation water abstracted from surface or ground water. Green water is the rainwater used in dry-land agriculture. Grey water does not reflect actual water consumption, but it measures a theoretical volume of water that is required to dilute pollutants (FAO, 2013).

The global water footprint in the period 1996-2005 was 9087 Gm3/year (74% green, 11% blue and 15% grey) (Mekonnen and Hoekstra, 2011). The South African water footprint in the same period was 58853 Mm3 /year with agriculture contributing 76% of the total footprint (Mekonnen and Hoekstra, 2011). Water loss as a result of food waste can therefore be based on published water footprints of food products and the calculated food waste values for South Africa (including imports and exports).

Calculating the water footprint of food waste in South Africa

The published water footprints as discussed above, is focused on water use during

agricultural production only since this is where the bulk of consumptive use takes place (FAO, 2013) The water footprint data is sometimes provided in more detail than commodity groups reported for food waste. In such instances, South African production was used to calculate the water use of the food waste as presented in Table 1 and 2 below. The total food waste estimates as determined by Nahman and De Lange (2013) was split based on the percentage production, between the different commodities to calculate the water use per commodity. The water use (m3/ton) for total meat (Table 1) was determined by dividing the total water use of all meat types by the total meat waste (i.e. 3333531000 m3/753000 ton = 4477 m3/ton). A similar approach was followed to calculate the water use (m3/ton) for fruit and vegetables and oil seed and pulses (Table 2) Since no fresh water consumption can be associated with fish and seafood (Zimmer and Renault, 2003) the water footprint of fish and seafood was not included in this study. In order not to skew the numbers, the waste as a result of fish and seafood was not included in the overall calculations as indicated in Table 3.

The calculated water loss as a result of food waste (excluding fish and seafood) in South Africa is estimated at 12 854 million m3 (Table 3). The overall water footprint of food waste in South Africa is therefore in the order of 1288 m3/t (Table 3). It is evident

Meat type	% production 2009 (Nahman and De Lange, 2013)	Water use m3/ton (Mekonnen 2010, Wenhold et al, 2012)	Food waste (t)	Water use (m3)
Poultry	52	3 800	391 560	1 487 928 000
Beef	29	5 200	5 200	1 135 524 000
Pork	12	5 000	90 360	451 800 000
Mutton	7	4 900	52 710	258 279 000
Total Meat	100	4 477	753 000	753 000

Table 1: Contribution of meat by type to water loss as a result of food waste

Commodities	Global water use m3/t	% produced 2011	Food waste (t)	Water use (m3)
Vegetables	300	45	2 020 950	606 285 000
Fruits	1 000	55	2 470 050	2 470 050
Total fruit and vegetables	**685**	**100**	**4 491 000**	**3 076 335 000**
Oil seed	2 400	61	211 060	506 544 000
Pulses	4 000	39	134 940	539 760 000
Total oil seed and pulses	**3 024**	**100**	**346 000**	**1 046 304 000**

Table 2: Contribution of food commodities to water loss as a result of food waste

	Food waste (1000 t) (Nahman and De Lange, 2013)	Water use (m3/t) (after Mekonnen, 2010)	Water loss (million m3)	% contribution to water loss
Cereals	2 605	1 600	4 168	32
Roots and Tubers	955	400	382	3
Oil seeds and pulses	346	3 024	1 046	8
Fruits and vegetables	4 491	685	3 076	24
Meat	753	4 427	3 334	26
Milk	831	1 020	848	7
Total	**9 981**	**1 288**	**12 854**	**100**

Table 3: Calculated water loss as a result of food waste in South Africa

that cereals (32%), meat (26%) and fruit and vegetables (24%), combined are responsible for 82% of the water losses associated with food wastage in South Africa (Figure 2).

Discussion and conclusions

South Africa is a water scarce country and therefore should ensure efficient and effective use of its water resources. The overall water footprint for agricultural production in South Africa is estimated at 588 853 Mm3 (Mekonnen and Hoekstra, 2011). The total water loss as a result of food waste is in the order of 12 854 Mm3 or the equivalent of nearly 22% of the total water footprint of agricultural production in the country. Reducing food wastage could therefore result in a significant saving of water. When considering actions to reduce food wastage of certain commodity groups, one have to consider the volumes of waste, the cost and the environmental impacts. The cost of food wastage to society is in the order of R61.5 billion per annum; equivalent to 2.1% of South Africa's gross domestic product (Nahman and de Lange, 2013). Although the cost impact of fruit and vegetables are the highest (42%) followed by meat (32%)(Nahman and de Lange, 2013), cereals are contributing the most to water loss (32%) followed by meat (26%) (Figure 3). It is therefore evident that actions to reduce cost vs water savings as a result of food waste should be targeting different commodities. Another significant resource used in the production and processing of food is energy. Adding energy wasted as a result of food waste to this equation, will provide further guidance as to where interventions are most urgently required.

It should further be noted that although South Africa is a developing country, a shift in diet is already evident and changed consumer patterns will ultimately result in changes in the volumes and composition of household food waste. Continued research aimed at understanding the drivers of household food waste in developed countries is therefore required to avoid South Africa from following the same trends as developed countries with levels of post-consumer food waste reaching 20% or more.

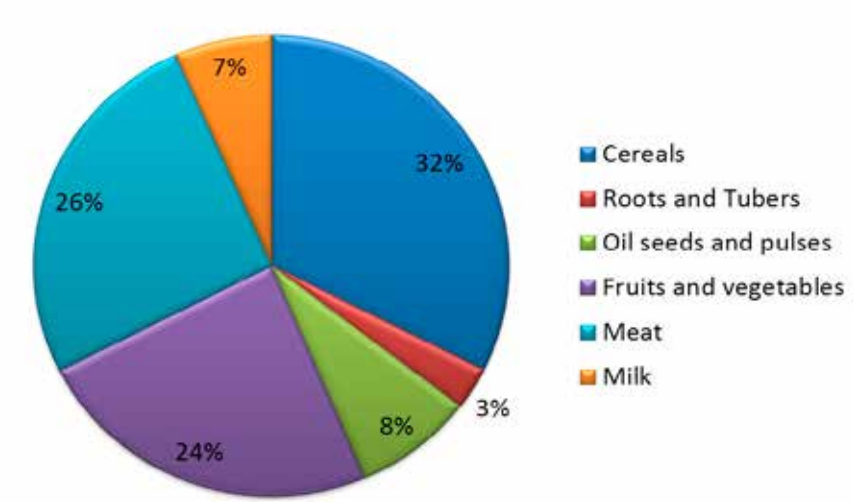

Figure 2: Percentage water loss as a result of food waste per commodity group in South Africa

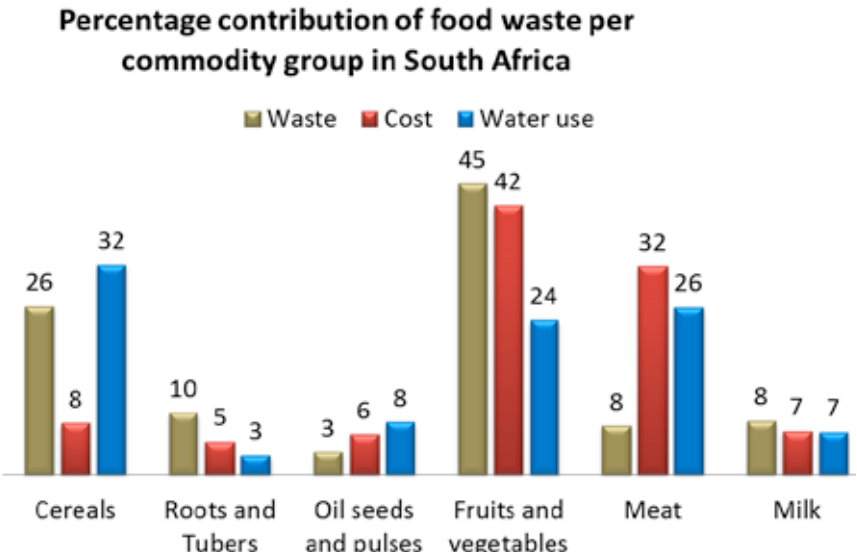

Figure 3: Percentage contribution of food waste per commodity group to wastage, cost and water use (Adapted from Nahman and de Lange, 2013).

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