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Every nutrient is sacred: developing a nutrient retention paradigm to aid global food security

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ABSTRACT: It is estimated that the world currently loses close to 90% of its nutrients between the farm and the fork. Future global food security will consequently not only be reliant on reducing the third of food produced that is currently lost or wasted, it will also require the development of a nutrient retention paradigm as part of the circular economy. This talk discusses a logical approach to nutrient retention, including transformation technologies, to ensure that the greatest amount of nutrient is retained in the human food chain. It details how high value and nutritionally enhanced functional foods can be created from such an approach, for the economic benefit of innovators in the field. Notwithstanding, it also discusses the importance of reinvigorating the lost art of utilising food leftovers to retain nutrients, because over half of food waste occurs in households in the developed world. The development of a new paradigm of nutrient retention within the circular economy will be essential for global food security – with nutritional security for all, not just food security, being the ultimate aim.

Keywords: food loss and waste, source retention, food recovery, targeted fertilisers, sewage, leftovers

I have an important and simple message to give here: that is, if we are going to talk about food security, we also need to be talking about nutrient security.

Globally, we are losing up to 90% of the nutrients gathered by our food production systems. About 50% of the fertilisers we put into the ground do not reach their target. About 20% of the food that is produced in primary production and processing is lost, with nutrients also being lost during processing. Then we waste about 20% of the food that enters our homes. We also lose nutrients in the cooking process as many of you will be aware. What is worse is that we also send many of those nutrients out to landfill in wasted food, and via sewerage into the sea, which creates dead zones.

This is a worrying trend, because food is becoming less nutritious and chronic diseases are on the rise (Figure 1). These topics have been the subject of a number of publications recently in *Scientific American*, and they are quite well understood. Yet we continue to lose or waste 30–40% of the food that we produce in Australia.

The bar chart (Figure 2) is from the work of Carlos Beteta, a Masters student working with me in 2015, who critically analysed where we are in terms of

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This is an edited transcript of the presentation, with some of the powerpoint slides shown.

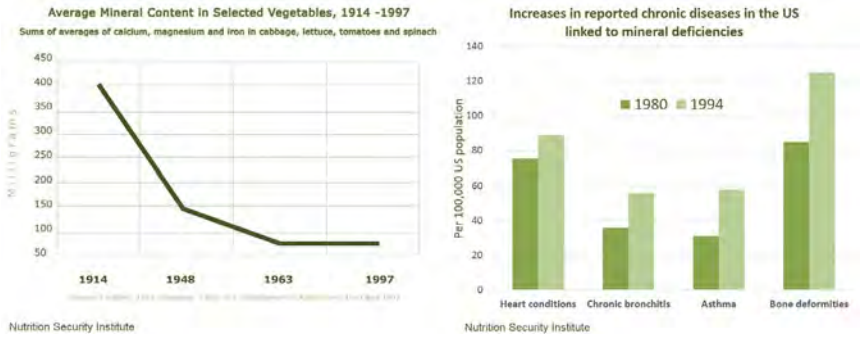

Figure 1. Decline in mineral nutients in vegetables (*left*); and increase in chronic heart, breathing and bone disease in USA, 1980–1994 (dark–pale) (*right*).
Source: Nutrition Security Institute.

food loss and waste in Australia, and these are the latest figures. This is a work in progress, and the production losses are still yet to be completely mapped out. We talk to a lot of the major commodity groups, so as the production bar potentially rises as a percentage, the bars for household and food service will come down a bit, but overall our findings are similar to the figures used by the Food & Agriculture Organization of the United Nations (FAO) for North America and for Oceania including Australia. Figure 2 shows that household consumption and food service are real culprits in food loss in Australia. However, we can also do more about the food loss from farms.

There is a food recovery hierarchy in use around the world at the moment that is actively used in Australia (Figure 3). We have a good food recovery system via groups like Foodbank and Second Bite, to name just two. Also we send food that is lost in primary production and processing to animals, and so it does re-enter the food chain. Other food waste goes to biodigesters, such as the one used in Perth, Western Australia, run by RichGro; and some excellent composting companies around Australia are doing great work with the materials they are receiving.

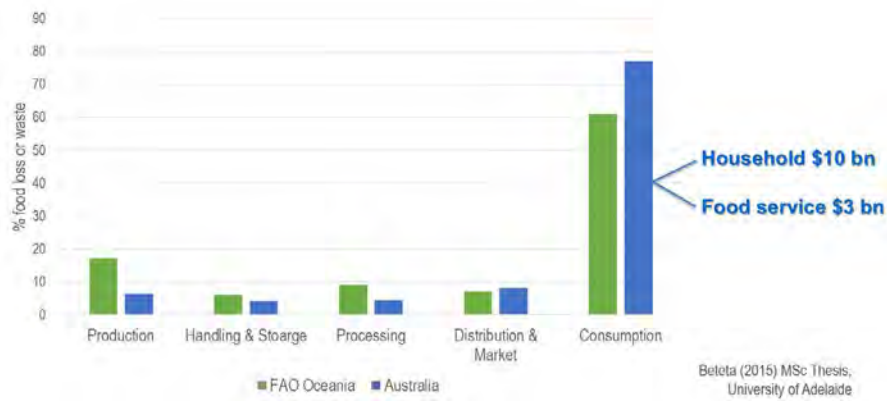

Figure 2. Percentage food loss or waste in Australia (blue) and Oceania (green, FAO data), in production, handling/storage, processing, distribution/market and consumption.
Source: Beteta (2015).

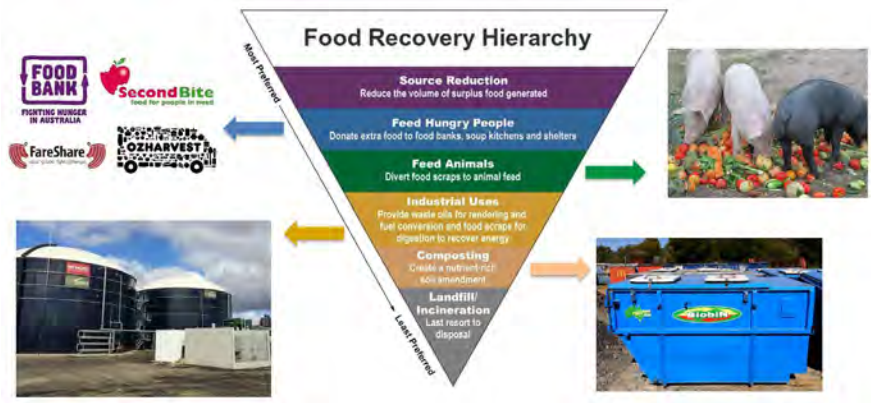

Figure 3. Source reduction is most preferred (top) and composting slightly better than landfill or incineration (tip) in the food recovery hierarchy.

However, the fact remains that we are losing a lot of nutrients in that process and it is a very linear system. We need to be talking about a *circular* economy system. To me, this means we must include new innovative solutions that direct, retain and recover nutrients. We need better targeted fertilisers – as used in some of the new production systems coming on-line now, such as at Sundrop Farms near Port Augusta, which are quite amazing. Every nutrient in that closed system is either taken up by a plant or it is recycled. There are no wasted nutrients from that production system. The system will not suit every crop but it will certainly work for many.

It is also possible to reduce processing losses. For example, we worked with groups like Clean Seas Ltd in South Australia, on Yellowtail Kingfish. The aim is to make sure that all the meat is extracted off that kingfish frame, because normally it contains about 50% more meat than is taken off in the two single fillets.

Valuable nutrients in lost food

At the moment I spend a fair bit of time on the recovery of nutrients from lost food. There's a plethora of techniques out there. They are coming down in cost and they are increasing in availability, and that is something that we need to be taking a serious look at before we send our food off to landfill or to animals or to compost (e.g. Figure 4).

It may be controversial, but we need to extract nutrients from sewage before we send it out to sea. Sewage contains phosphorus – prime fertiliser – which will be a limited commodity when the mineral phosphate mines run out (see also Cordell, this Proceedings). Phosphorus has been extracted from sewage in America and then fed back into farms, and there are plenty of other nutrients that can be extracted from sewage. The reason we need to do this is to develop the nutritionally enhanced foods of the future.

Whether you agree or not, we are taking food in a different way. We are taking in nutrients in a different way (e.g. Figure 5). We are choosing functional foods,

Figure 4. The nutrient retention paradigm must include new innovative solutions to direct, retain or recover nutrients.

Figure 5. Nutritionally enhanced foods available now – e.g. functional foods and nutraceuticals – and in the future, e.g. printed food with tailored nutrition.

such as enhanced yoghurts, omega-3-enriched eggs, fermented milk drinks, and others. We are choosing nutraceuticals. You only need to look at the share prices of vitamin and supplement manufacturers such as Blackmores or Swisse to see that we are choosing them in a very big way. In the future, we will be choosing 'printed food' which will include tailored nutrition. You will wake up and have your 'printed' eggs or breakfast cereal, and that will carry in it the nutrition that you need for the day. Obviously we need the feed stocks for that nutrition.

What we can all do

We all can work to preserve nutrients (Figure 6). Everyone has a really simple role to play, and it starts in the home. There are the 'ugly fruit and vegetables' initiatives of Walmart in USA and Woolworths with 'the Odd Bunch' in Australia. However, we just need to be less choosy when we're buying fruit and veg at the supermarket. Rather than going in search of packaged 'ugly' products, just grab the produce in front of you, so the farmer can get a premium price for it as well.

We need to make ourselves more educated in how to reduce food waste. In fact, we need to revive the kitchen practices of the Depression era and the post-war years, in many ways, because certainly there was no food waste then.

As other speakers have mentioned, as incomes increase, food waste increases, and that is why we need to return to habits such as eating leftovers. Using up

Figure 6. Everyone has a role to play: whether buying ugly fruit and vegetables, not buying excess fresh food, and composting scraps, or using up leftovers in tasty meals.

leftovers tastily used to be an art, but it is now a lost art in many homes, though it is starting to make a comeback, with Jamie Oliver recently publishing a book on it: *Save with Jamie.* It is a key way we can keep nutrients in the home, not only in our food systems. We also need to compost and use that compost to grow more vegetables. For people living in high-rise apartments, there are community composting areas popping up in Adelaide and in Sydney and Melbourne, so no-one really has an excuse not to compost – except of course that we are all time-poor.

In summary, nutritional security for all, not just food security, must be the aim. Some excellent papers have come out in the last few months on this topic. It seems to me that developing the circular food economy will be integral to success in this, where everything is recycled until it no longer has a value.

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Oliver J. (2013). *Save with Jamie: Shop smart, cook clever, waste less* (various publishers).

Steve Lapidge is the Director of Science Partnerships at the South Australian Research & Development Institute (SARDI), a division of Primary Industries & Regions SA. He is responsible for developing new industry-focused R&D opportunities and managing existing large-scale strategic multi-partner research collaborations. His current research interests include reducing food loss and waste through developing the circular food economy, as well as the development of functional foods. Steve's qualifications include a BSc Hons from Flinders University, a PhD from Sydney University and an MBA from University of SA. He is a graduate of the Australian Institute of Company Directors and European Summer School for Advanced Management, and was the 2010 Fulbright Professional Business/Industry (Coral Sea) Scholar.