THE CRAWFORD FUND

*For a Food Secure World*

# WASTE NOT, WANT NOT

## The circular economy to food security

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# Waste not, warm not: poverty, hunger and climate change in a circular food system

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**ABSTRACT:** Reduction of food loss and waste has received increased attention in recent years. Several spikes in food prices since 2008 have highlighted the hardship that poor people, and especially poor children, face when food is priced out of their reach. With as many as 800 million people still undernourished, of whom about 160 million are stunted young children, the fact that as much as 30% of food is lost or wasted appears unconscionable. Surely the loss could be recovered and channelled towards the hungry! Much of the discussion of food loss and waste has been predicated on this assumption, with the related conclusion that better management and distribution of existing supplies could substitute for investment in increased productive capacity. The assumption is in part borne out by empirical evidence but, as is often the case, the full picture is more complex. Moreover, discussion of food loss and waste in terms of feeding the hungry misses the environmental benefits associated with better management of existing production. Food systems that lose and waste less will generate fewer greenhouse gases and contribute less to global warming. The economics of reduced loss and waste creates both winners and losers, but the environmental calculus has only winners. The policy and institutional arrangements of food systems that generate less loss and waste would look quite different from our present systems.

*Keywords*: food loss and waste, feed the hungry, waste and gas emissions

Thank you to the Crawford Fund for defining this year's conference topic as food loss and waste, and for giving me a chance to talk with you about it.

One of my main messages is that addressing food loss and waste should be an integral part of any strategy for green growth. It is very important for food security: it increases the amount of food available for consumptive use. It is very important for consumer welfare: having less loss and waste reduces consumer prices, makes food more affordable and improves consumer incomes. It is also very important for reducing the environmental footprint of agriculture – a key factor in tackling climate change and promoting sustainable use of resources. For all those reasons, it is very important to address the very large levels of food loss and waste.

We often think about these issues in the context of global hunger, either with regard to Sustainable Development Goals or with regard to the question of how we feed the population that we expect to have in 2050. Often it is argued that if

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

we could reduce loss and waste we would not need to produce all this extra food. We would be able to solve global hunger and we would be able to feed the growing population.

Instead, I would argue that while reducing loss and waste is definitely part of the solution, it is not the *whole* solution because, whether the hunger is local or global, there need to be companion measures to ensure that hungry people have access to food. It is not just a question of the quantity and the availability of food, but also a question of access.

There may be too much food in this refrigerator for a small household to eat before some must be thrown out.

A separate factor is individuals' management of food waste. The photo here of my own refrigerator shows that my household is definitely part of the problem, not yet part of the solution. Other people I know, however, regularly eat all the food in their refrigerators rather than leaving it there too long and then carrying it out as trash. Clearly we have differing levels of optimal food waste – and that is part of the issue we are addressing here.

In fact, the generation of food loss and waste is the result of millions of optimisation decisions that economic agents take. Our challenge is to figure out how we can shift their incentives. How do we shift that decision calculus so that people will make different choices?

## Food prices

Attention to food loss and waste tends to track closely the movement of global food prices. Professor Louise Fresco in her Sir John Crawford Memorial Address last evening* told us that Sir John was interested in this topic in the 1940s. Those years were not a period of high food prices, so he was ahead of his time.

As an example, look at the price of rice in Thailand through the years 1900–2012 (Figure 1). We know that there was a spike in food prices and interest in loss and waste at the time when the prices went up in the early 1970s. After that, there was a period where people did not really pay much attention to loss and waste. Concern rose again in the 2008–09 price spikes and then again in 2011 and 2012.

During periods when prices are relatively low we should be very concerned about food loss and waste, because it is then that waste actually goes up. In fact, we should be concerned at all times – whether prices are high or whether prices are low. It is an important topic.

## Measuring food waste

We should know how much food is being wasted. We can expect to hear a range of numbers in the course of this conference – and that is correct. We cannot know exactly what the amounts are, and in fact there are no exact

*not included in these Proceedings.

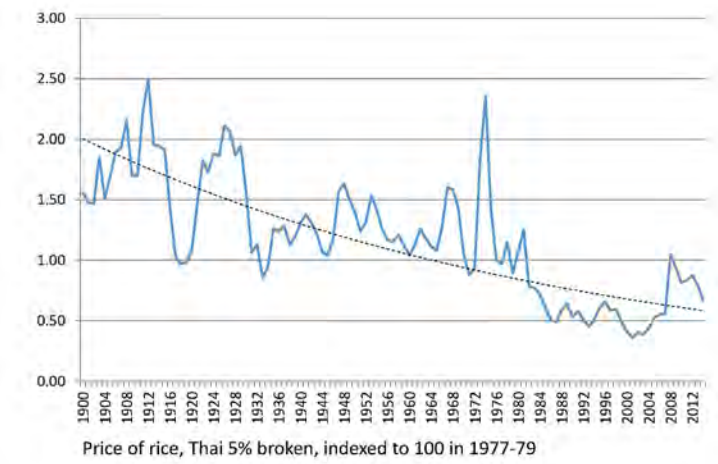



Figure 1. Attention to food loss and waste tracks spikes in prices.

amounts. Food waste depends on context and on measurement approaches and methodologies. It depends on the type of food and the commodity that is being looked at.

Through a very comprehensive literature search, a colleague of mine, Mark Rosegrant, found a wide range of measurements across the many references to food loss and waste, as shown in Figure 2. Amounts tended to be relatively large and narrowly ranging for animal products. For grains and for fruit and vegetables the measurements were also high but ranged much more widely.

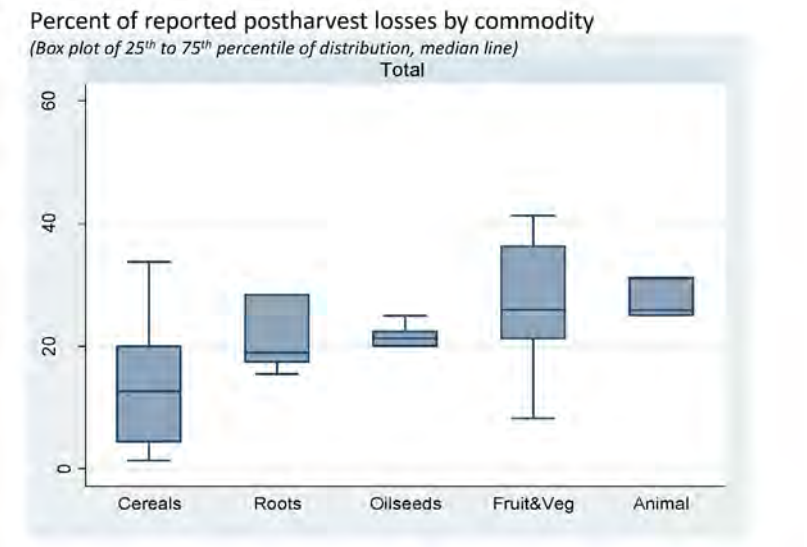



Figure 2. Measures of postharvest losses vary widely. *Source*: Rosegrant *et al.* (2015).

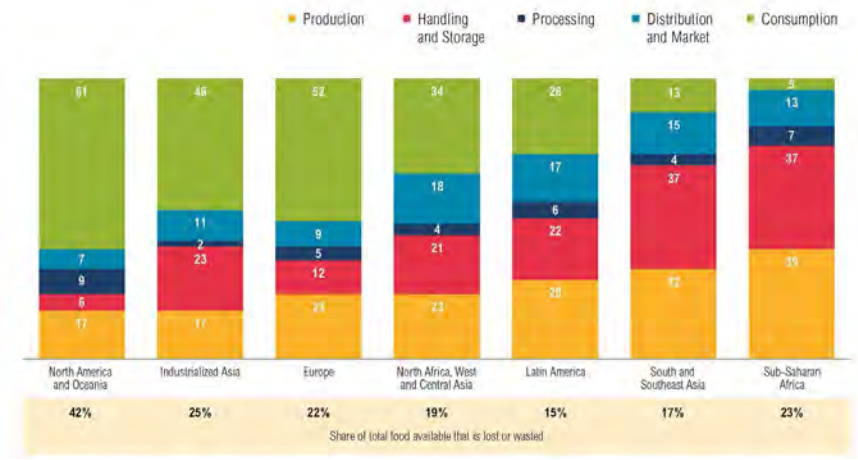



Figure 3. Food loss and waste occurs more 'near the fork' in developed regions and more 'near the farm' in developing regions (as a percentage of kcal lost and wasted). *Source*: World Resources Institute (based on FAO 2011). Numbers may not sum to 100 because of rounding.

We could think about the measurements in another way: by region. The bar chart (Figure 3) shows that North America and Oceania – where I and many of you live – are big losers and wasters, and that much of that loss and waste takes place at the consumer level, close to the fork. By comparison, in South Asia and Latin America, percentage loss and waste is relatively smaller but still significant (values in the pink horizontal bar). Percentage loss and waste in Africa south of the Sahara is intermediate and occurs mostly close to the farm. This gives us an understanding of the global distribution of loss and waste, and a little bit of understanding of the distribution along the value chain.

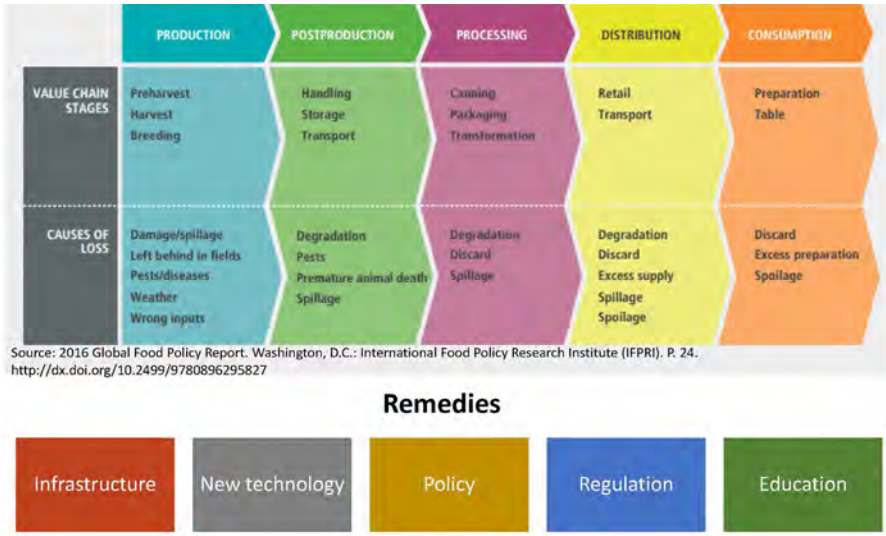



Figure 4. Diagnosing why loss and waste happen, and where along the value chain, can help in choosing appropriate remedies. *Source*: IFPRI (2016) page 24.

When we look at food loss and waste across the value chain itself (Figure 4), we see that at different stages of the value chain there are different mechanisms causing loss. Once we understand those, we can see that there are different remedies for addressing loss and waste. We need to know the quantities, and where the loss and waste are happening, before we can calibrate interventions and remedies appropriately to address the issues.

## Can reducing loss and waste address global hunger?

The global map (Figure 5) shows the Global Hunger Index that IFPRI and other colleagues produce on an annual basis. It shows areas where many people experience severe hunger (the pale and deep orange on the map). Yet in the places where loss and waste are high, that is North America and Oceania, few people have deep hunger. In areas where loss and waste are moderate or relatively low, there are low-income populations and high levels of hunger. It is clear, from this very simple geographic distribution, that there is not a good correlation between where loss and waste of food are greatest and the hunger is greatest. That is something to consider as we ponder how to reduce loss and waste to address hunger.

## Productivity shock. Who benefits?

Productivity shock is a sudden boost in food production. My very esteemed agricultural economist colleague from Australia, Will Martin, now at IFPRI, has been considering what would happen if we suddenly had more food for a given bundle of inputs. Focusing particularly on the implications for poverty, he asked 'What would be the distributional impact of that? Who would gain and who would lose and by how much?' (Figure 6).

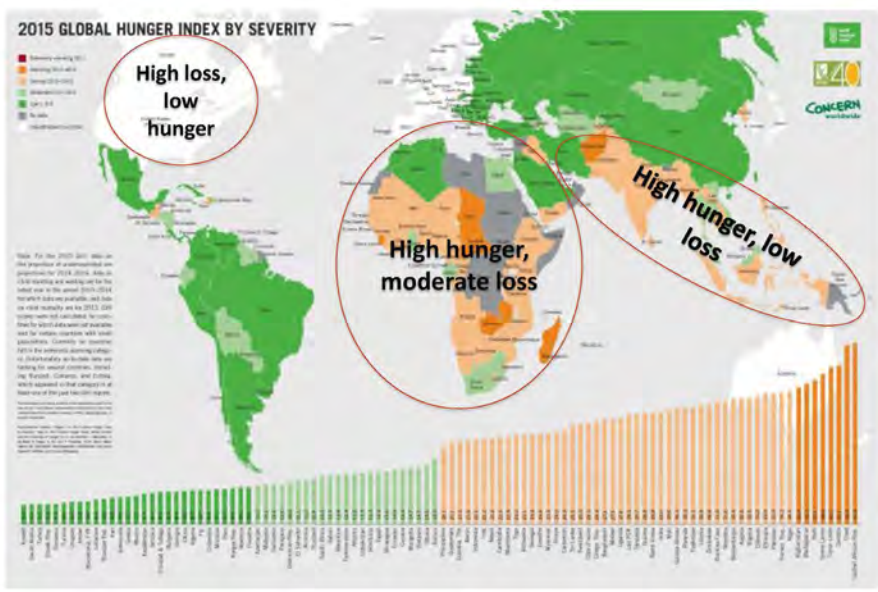
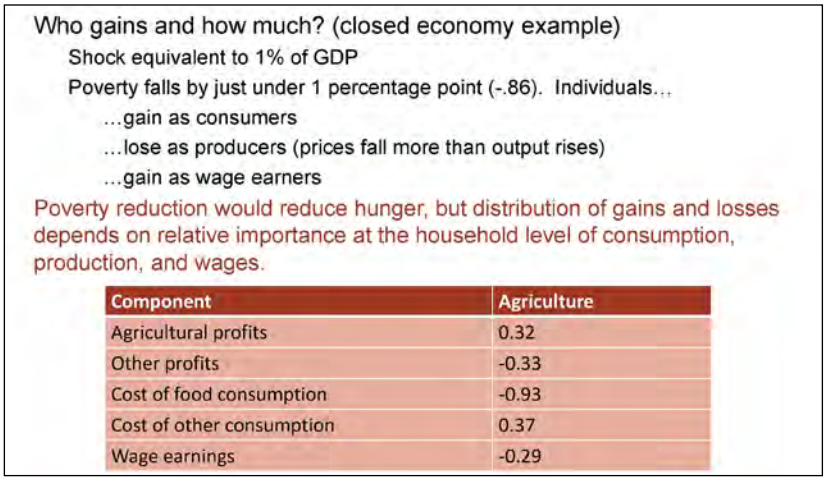



Figure 5. Global hunger mapped against areas of the world where food losses are large.




| Component | Agriculture |
|---|---|
| Agricultural profits | 0.32 |
| Other profits | -0.33 |
| Cost of food consumption | -0.93 |
| Cost of other consumption | 0.37 |
| Wage earnings | -0.29 |

Figure 6. Considering reduction of loss and waste as equivalent to productivity shock, a one-time boost to agricultural productivity. *Source*: Ivanic & Martin (2014).

If we were able to substantially reduce loss and waste, the effect would be the same as a productivity shock. We would get an additional amount of food for the same agricultural input. If we then go through a global general-equilibrium assessment of who gains, who loses and by how much, we can see that there are very substantial gains. On balance, the gains are positive.

The main people who gain are consumers and wage earners, because when the food available is more affordable these people are able to buy other things in addition to food. Jobs are created. Demand for waged work goes up and so they benefit. The ones who have a more ambiguous benefit are the actual agricultural producers, the farmers. More food means that prices are going to go down, all things being equal, so farmers will not necessarily benefit from a reduction of loss and waste. This depends a bit on where the reduction takes place in the food chain.

In any case, we see that there are net gains and they are very significant and we should keep that in mind. It is a reason to aim for reductions in food loss and waste, but there are distributional issues there and some people gain more than others.

Mark Rosegrant has worked through a different exercise. Thinking about the Sustainable Development Goals and feeding the world in 2050, he asked: 'If we reduce loss and waste, *how much* does that reduce hunger?'. He recognised that of course it is not free to reduce loss and waste. We have to make investments in order to do that, mainly in infrastructure – in roads, in power and in storage capacity within the developing world. In this exercise he examined the costs of those and how much loss and waste might be reduced by making those investments in infrastructure. Is that a good investment? Does it help reduce hunger? Does it yield a good return, and how does that compare to an alternative investment in agricultural research where the amount of food is increased by enhancing agricultural productivity?

Population at Risk of Hunger in 2050

| Region | Million People | | | | % Change from baseline | | |
|---|---|---|---|---|---|---|---|
| | Baseline | Reduced losses, developing world (6% by 2025) | Reduced losses, global (10% by 2030) | Faster productivity growth, no change in losses (.4% crops, .2% livestock) | Reduced losses, developing world | Reduced losses, global | Faster productivity growth, no change in losses |
| East Asia and Pacific | 126 | 118 | 116 | 115 | -6.3 | -7.5 | -8.6 |
| Europe and Central Asia | 38 | 37 | 37 | 37 | -2.9 | -3.7 | -4.1 |
| LAC | 48 | 45 | 44 | 44 | -6.0 | -7.7 | -8.6 |
| MENA | 38 | 37 | 36 | 36 | -3.9 | -4.9 | -5.8 |
| South Asia | 162 | 138 | 134 | 131 | -15.3 | -17.6 | -19.2 |
| SS Africa | 137 | 116 | 112 | 108 | -15.8 | -18.6 | -21.2 |
| Developing | 509 | 452 | 442 | 434 | -11.2 | -13.1 | -14.7 |
| Developed | 59 | 56 | 55 | 55 | -4.7 | -6.1 | -6.9 |
| World | 568 | 508 | 497 | 489 | -10.5 | -12.4 | -13.9 |

Figure 7. Can we feed the hungry in 2015 by reducing loss and waste? Calculations from IFPRI IMPACT Model version 3. *Source*: Rosegrant *et al.* (2015).

The results of his estimates (Figure 7) are very interesting because they show that if we simply continue doing what we are doing now – with reasonable economic growth – we will have growth in agricultural productivity. By 2050 there will be fewer people at risk of hunger in the world: about 568 million will remain at risk. That is fewer than today, but still a very large number. If we invest in infrastructure to reduce loss and waste, or invest in agricultural growth to increase the rate of productivity growth, by how much do those alternatives reduce the population at risk of hunger? For both approaches, the answer is something significant, but not actually all that big. On the bottom line of the table, the numbers go down from 568 million to a little bit over or under 500 million – roughly comparable. These approaches yield good rates of return and they tell us that it is important to do each of these things ... but that those are not enough.

To really reduce global hunger, we will have to do something more than simply reduce loss and waste, simply invest in infrastructure or simply invest in agricultural research. We have to do all those, and some other things as well.

Reducing food loss and waste also costs money. It is not free. It is not achieved simply by me opening my refrigerator and deciding I will not let all that food go to waste, and changing my consumer behaviour. Most of the investments that are required to reduce food loss and waste are rather expensive, and we have to recognise that this approach is going to cost money. Even if food prices are lower, many poorer people will still be hungry and so there need to be additional companion measures to specifically address the needs of the hungry.

## What can the first world do?

Now, let us consider North America and Oceania, places where there are relatively high incomes but still there is hunger. In my own country, the United

States, we understand that approximately one in five children is at risk of hunger. It is a very high number for a very rich country. If we reduce food loss and waste in an area where we know hunger is very high in the US, what does that do for this specific population which is hungry?

The answer is: it helps. Reducing loss and waste makes a modest contribution by reducing prices and making the food stamps go further, making food more affordable. However, that approach does not solve the issue – which is, fundamentally, one of access to food supply by these hungry people. We need additional measures that take that avoided loss or waste and make it available to the populations at risk. Examples might include school feeding programs, soup kitchens, pantries. It takes special instruments and special measures to address the needs of special groups.

## Summarising so far

- Although it is not part of the agenda addressed in this conference, we know now that an increase in the supply of food definitely helps consumers but does not necessarily reach hungry people. Solving the issue of hunger involves solving access to food and not just overall adequacy of food supply.
- Producers also do not necessarily gain if prices fall when food loss and waste are reduced. Producers may gain as consumers, but they do not necessarily gain as producers. This means we need to look at the distributional impact of addressing loss and waste.
- Ownership matters. The economic agent who owns the food that is not lost or wasted, the food that is saved, is the person (along with consumers) who reaps significant benefit. Therefore it is very important to understand where losses occur and where the savings can take place along the value chain.
- Investment in agricultural research remains important. Together with increased trade it should complement reduction of loss. Innovative technologies can reduce food loss and improve the storage of commodities.
- Special measures – such as safety nets, special stores or distribution centres, and food distribution channels – may be necessary for specific populations in hunger. General market measures will not be sufficient.

## Warm not

This conference is not just looking at the want-not side. The conference title also mentions the circular economy – and that brings in sustainability and environmental aspects.

If we think of reducing food loss and waste as part of a strategy of green growth, then we should think of the environmental dimensions as well. These include resources that are used in agricultural production but are underpriced and not necessarily accounted for as they should be, especially water.

In a green growth strategy, we are thinking of the environmental footprint. That includes the footprint of the disposal of spoiled food, and also the greenhouse gas emissions generated both in the production of food that ultimately no-one is able to eat, and in the transportation and the marketing of those items. These are very important other dimensions of food loss and waste, quite apart from

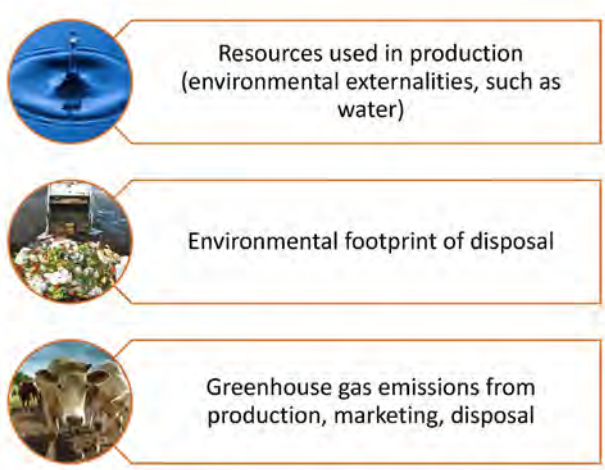



Figure 8. The circular economy focuses attention on environmental aspects of waste and loss.

hunger. I want to spend just a few minutes talking about one of those: namely, the greenhouse gas emissions.

Generation of greenhouse gases from lost and wasted foods takes place across the value chain (Figure 8). Most of the greenhouse gases associated with loss and waste result from the fact that we are not able to use all the food we produce, although there is supplementary generation of gases from landfills and from transportation.

All those resources used in the production side are generating greenhouse gases. Looking at the commodity composition where these losses are generated, we see that a lot of the generation is in the livestock sector, producing meat and dairy products. Quite a substantial proportion also comes from the fruit and vegetables sector, but, although we know that spoilage in that sector is very high, the greenhouse gases generated in the livestock sector are still greater.

We know that these amounts add up to very large quantities in the United States. One particular study (Figure 9) assessed the quantity at approximately 2% of the total generation of greenhouse gases within the United States. If we think about the overall contribution of agriculture to greenhouse gas production and then we think about the – even imperfectly – measured amounts of food that are lost and wasted, those numbers are roughly consistent. Therefore, we could say that about 2% or 3% of greenhouse gas emissions globally are associated with lost and wasted food. It is not 100% but it is a significant amount, and in considering overall strategies for green growth and for climate management we should keep this in mind. It is a relevant element in the agenda.

## Summary

To be effective in our thinking about managing agricultural loss and waste, we have to think of both sides – the hunger and food security side, and the environmental side.

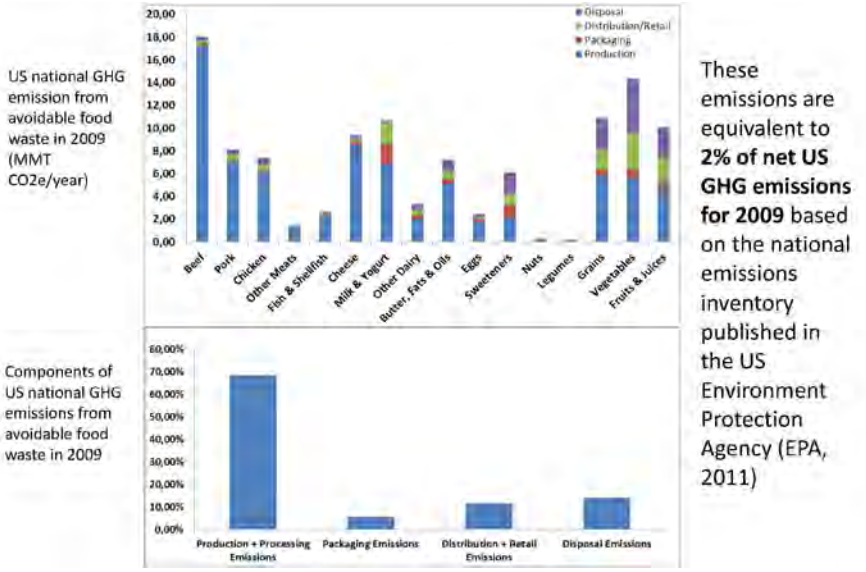



Figure 9. Greenhouse gas production in the United States. *Source*: Venkat (2011).

We need to pay sustained attention to food loss and waste, both when prices are high and when they are low. I am very pleased this conference is taking place now, when there is no price spike. We are paying attention to the issue, and that is very important.

Accepting that the want-not and the warm-not agendas really complement each other, these are the kinds of actions we should keep in mind (see also Figure 10):

- We need good measures of how much is lost, in what context, and where. That allows us to calibrate our remedial measures.
- We need to recognise that remedial measures take money. There is going to be a requirement for investment in infrastructure, and we should think of multi-purpose infrastructure – not only to reduce loss and waste, but also to add it into the calculations of where we build roads and where power goes.
- We also need increased investment in agricultural research. That is not a substitute for infrastructure investment. Managing food loss and waste and managing food productivity, particularly in climate-smart technologies, are complementary to each other.
- We need targeted assistance for the hungry, and we need recognition that not only the overall quantity of food is important for managing hunger, but also providing access to food for those who need it.
- Finally, we need innovation in the hospitality and retail sectors, as well as in consumer behaviour, so that each of us becomes part of the solution, not part of the problem. Some changes are already under way, and we will hear about them throughout the day. Much more can be done.

I look forward to our discussions today.

Figure 10. Attention to hunger and environment warrants sustained attention to loss and waste, not episodic preoccupation and then neglect.

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Dr Karen Brooks joined IFPRI in 2012 as Director, CGIAR Research Program on Policies, Institutions and Markets. Prior to that she worked for the World Bank for more than twenty years in various capacities, including ten years as Sector Manager, Agricultural Operations, Africa Region, and during the 1990s as Lead Economist on agricultural issues of the transition from central planning in Eastern Europe and Central Asia. Prior to joining the World Bank, she was Associate Professor in the Department of Applied Economics at the University of Minnesota. Karen holds an undergraduate degree in Political Science from Stanford University, and a PhD in economics from The University of Chicago. She has published on issues related to agricultural policy in centrally planned economies, price and land policy in countries transitioning from planned to market economies, and the challenges of youth employment in Africa south of the Sahara.

# Session 1 Q&A

with Dr Karen Brooks

Chair: Andrew Campbell

**Q – Tony Fischer**, *Crawford Fund and CSIRO*
You mentioned insects, pests and weather as factors in food loss. A very simple question: where do we draw the line with this discussion?

**A – Karen Brooks**
Most of our calculations would be at the harvest or the post-harvest stage. Prior to that, we would be looking probably at issues of productivity and yield, rather than at loss after the harvest. Clearly, if we can avoid pests in the process of harvesting, if we can harvest more, then that's a positive and it gives us more food, so we're reducing loss, but I think that's one of the issues of measurement that people are grappling with and we need clear definitions. Whether you call the calculations as starting at the point of harvest or starting before harvest, you can think of remedies, and if you diagnose your problem you can think of different solutions, according to what the problem is that you're trying to solve.

**Q – Peter Wynn**, *Charles Sturt University*
Thanks for the talk. Look, in many parts of the world, farmers do not receive appropriate prices for their commodities, for reasons that may include manipulation and corruption along marketing chains. I could instance examples from smallholder dairy farmers in Pakistan and dairy farmers in Australia. How much does this situation of inappropriate payment help limit the amount of food produced throughout the world?

**A – Karen Brooks**
The how-much issue is one that I really can't answer, but I think there's a lot of interest in investigating and learning more about that. In relation to the qualitative problem that you've highlighted, my colleague Maximo Torero at IFPRI, who does a lot of our value chain work, has been looking specifically at the milk marketing issue. It's a question of how you manage quality. Quality is related to loss, because if producers are able to deliver higher quality milk and know they're going to be paid for it, then that milk is more likely to get constructively embedded in the processing chain and result in something that a consumer can drink or eat. The problem that was being addressed there was that producers would take their milk to the processor and the processor would say, "Oh, this doesn't look like very good quality. We'll give you this much for it so we'll only pay you for low quality", no matter what the quality was. They didn't really trust the testing that the processor was undertaking, in order to calibrate the payment, so they turned to a third party tester who was trusted by both the processor and the producers to go through that testing process and to

This is an edited transcript of this Q&A session at the conference.

provide a verdict to the quality that both sides were willing to accept and that resulted in processors being forced to pay for higher quality and for producers being willing to deliver higher quality. In other words, institutional solutions can sometimes address some of these issues of quality. Not all of course. There can be other instances of lack of competition along the value chain which impede payment for quality. This is just one example.

**Q – Addisalem Benyam**, *Central Queensland University*
You cited the problem that increased supply helps some consumers but does not necessarily reach the hungry in developing countries. Increase in food production requires commitments of resources. We're talking about reducing greenhouse gas emissions, but vegetable production and transportation all contribute to greenhouse gas emissions, and there is no guarantee that the food that has been produced will reach the consumers or the target hungry people. How is it possible to narrow the divide between the problems and solutions in terms of greenhouse gas?

**A – Karen Brooks**
Thank you for raising that, because it gives us a chance to go over one other very important message. Let's say we start with a situation of food production where there's a certain amount of loss, a relatively high level of loss, relatively early in the value chain. That food is going along the value chain and it doesn't necessarily reach the consumer. If we can address the loss, close to the production stage, through building a better road or helping with investment in storage, or perhaps through providing water supply or power for a local market, those interventions will reduce the loss and make more food available in that market to reach consumers. More food available makes that food more affordable because the price comes down. That's all positive and it helps all consumers buying that food.

The point I wanted to make is that many consumers buying that food will benefit, but people who are very poor and hungry need more than a modest reduction in the price of food. They need something designed specially for them. Programs often used in developing countries to address this situation are 'safety net' programs, 'targeted food assistance', 'school feeding' programs – which are specifically targeted for the population that is at highest risk of hunger. They aim to supplement the reduction in food loss and waste, and can take place anywhere along the value chain, and bring down prices for everybody.

**Q – Heather Smillie**, *the University of Melbourne*
You discussed that when there's an abundance of food, there's an abundance of waste. Clearly when prices rise, people tend to value food a lot more and there's more concern about waste. Other than hiking up the price of food in the developed world, how else can we make people value food and therefore want to waste it less?

**A – Karen Brooks**
In high-income environments where we have a lot of media, a lot of communication, there's quite a lot that can be done through consumer awareness and behaviour change, and I think that's happening. I think people now feel less comfortable buying things and just letting them sit in the refrigerator. I think we shouldn't underestimate the willingness of consumers to take voluntary actions that they understand to be important. In addition, we can have innovations in the retail system. In car-based cultures such as North America and Australia, it is possible to shop less frequently and buy more. That can lead to increased waste and loss. In a retail system that has fewer smaller outlets as opposed to a few large ones, it's easier for people to shop more regularly and to manage their inventory at home. In the US, we're seeing the big grocery stores opening smaller stores with what they call 'a curated collection' of products, a selection of things you ordinarily need. People can stop in there and shop more frequently. This is an example of changes in the retail system. If we really want to, we can put fines on people. We can say you can only have one garbage bin, and if you have more garbage bins we're going to tax you via your property taxes. There are a lot of things that could be done. We've not quite achieved them yet in municipal management, but instruments are available.

**Q – Shiwangni Rao**, *Charles Sturt University*
I'm originally from Fiji, and coming from a small country into Australia and seeing the consumer market in these big countries, I noticed that there is a push towards plus sizes, bigger sizes. People get food in bigger quantities, often opting for a bigger size instead of a smaller one. They buy more and they may not end up using it. I believe that may be one of the bigger contributors to creating so much waste. What is your perspective on this issue? Can we effectively reduce food waste if we reduce the sizes of our products?

**A – Karen Brooks**
I think that is a very important part of the solution. I think it comes into the general category of changes in consumer behaviour. I think consumers are sending the message to the hospitality industry, to restaurants, saying "We want a choice". There may be a few of us who really want that half pound steak on the plate and we should be able to order it, but many of us, particularly as the population ages, want smaller portions. The restaurants are finding it helps their business to make that available, to offer that greater choice. I think the same is happening, perhaps not as rapidly as it should, in the packaging within the grocery business where one has a choice of either getting the enormous amount if you have a huge family or getting a very small amount if that is what you need.

I think this way of empowering consumers to understand the issue, to recognise that they can do something and to feed that information back into the retail and the hospitality industry, can be rather powerful. It doesn't work instantaneously, but I think we already see it at work.