Food waste and related climate impacts in the Finnish food chain

WASTE ALONG THE SUPPLY CHAIN OECD FOOD CHAIN ANALYSIS NETWORK – 4TH MEETING, 20-21 June 2013 OECD Conference Centre, Paris, France

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High-quality food, clean environment - better well-being

Our research promotes consumer well-being, the competitiveness of agriculture and the food industry, the sustainable use of natural resources, the quality of the production and living environment, and the vitality of the countryside

MTT Agrifood Research Finland
Objectives of the “Responsible Food chain - Better Consumer Well-being” Research Area

1. Developing responsibility and sustainability in the food chain
2. Decreasing the footprints of food products and food chain
3. Enabling consumers to make more responsible choices
4. Improving public health
Importance and significance of food and food waste: Unnecessary environmental impacts!

- Housing
- Nutrition (24%)
- Leisure time
- Well-being
- Clothing
- Education and work
- Others

• Agriculture
• Food industry
• Retail
• Food services
• Grocery shopping
• Food preparation and storage

Toxicity footprint
Nutrient footprint
Water footprint
Biodiversity
Use of resources...

Food waste unnecessary environmental burden!!

- Greenhouse gas emissions, i.e. carbon footprint
- Other environmental impacts


OECD meeting, Katajajuuri 20062013
Waste entering totally wrong places - attitudes
Carbon footprint of bread system
- current situation with energy recovery


kg CO2-ekv/t bread consumed
Climate impact of bread packaging system: product loss, packaging and WM (product excluded) - current situation (with energy recovery)

Most important is to eliminate food waste

kg CO2-eqv/ t bread consum.

- Packaging production
- Household product loss
- Waste management


OECD meeting, Katajajuuri 20062013
### Foodspill (2010-2012) food waste study

Food Waste Volume and Composition in Finnish Food Chain

<table>
<thead>
<tr>
<th>Food Industry</th>
<th>Retail</th>
<th>Restaurants/Hotels/ Catering/Canteens</th>
<th>Households</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partners:</strong></td>
<td><strong>Partners:</strong></td>
<td><strong>Partners:</strong></td>
<td><strong>Participants:</strong></td>
</tr>
<tr>
<td>Meat/ convenience</td>
<td>• SOK</td>
<td>• 17 Restaurants and hotels</td>
<td>• 380 Finnish households</td>
</tr>
<tr>
<td>• HK Scan</td>
<td>• Kesko</td>
<td>• 30 Schools</td>
<td><strong>Used methods:</strong></td>
</tr>
<tr>
<td>• Atria</td>
<td>• Finland’s Local</td>
<td>• 14 Daycare</td>
<td>Food waste diary study, background questionnaire &amp; food weighting (+ collecting shopping receipts from 3-week period)</td>
</tr>
<tr>
<td>• Saarioinen</td>
<td>Store</td>
<td>• 6 Communal public caterings</td>
<td></td>
</tr>
<tr>
<td>• Kokkikartano</td>
<td>Lidl</td>
<td>• 5 Work - and university canteens</td>
<td></td>
</tr>
<tr>
<td><strong>Dairy production</strong></td>
<td>Helsinki Region Environmental Services</td>
<td><strong>= 72 places!</strong></td>
<td></td>
</tr>
<tr>
<td>• Arla Ingman</td>
<td>• Finnish Grocery Trade Association</td>
<td><strong>Used methods:</strong></td>
<td></td>
</tr>
<tr>
<td>• Ingman Ice Cream</td>
<td>• Finnish Glasshouse Growers' Association</td>
<td>Interviews</td>
<td>Food waste weightings, Workshops</td>
</tr>
<tr>
<td>• Valio</td>
<td><strong>Used methods:</strong></td>
<td><strong>Interviews</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Greenhouse prod.:</strong></td>
<td>Interviews, statistics, reports</td>
<td><strong>Workshops</strong></td>
<td></td>
</tr>
<tr>
<td>Finnish Glasshouse Growers' Association</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Used methods:**
- Interviews
- Food waste weightings
- Workshops
- Food waste diary study
- Background questionnaire
- Food weighting
- Collecting shopping receipts

**OECD meeting, Katajajuuri 20062013**
Households

380 households (1054 persons) participated in the study, September 2010

1. Background information
   - Socio-demographic factors (size and type of household, age, education, incomes, city/town/countryside, current life stage, etc.)
   - Shopping and consumer behaviour and attitudes in food waste

2. Shopping receipts
   - Households collected receipts from a three week period

3. Food waste weighing
   - The household weighed their avoidable edible food waste daily every time they disposed food and results were recorded in a diary from a two week period

Vegetable peels and bones etc not included → food that had the potential to be eaten included only
### Household characteristics and sample size

<table>
<thead>
<tr>
<th>Household type character</th>
<th>Sample size</th>
<th>Sample size percentage</th>
<th>Share of all households % 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of family members</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>58</td>
<td>15</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>135</td>
<td>36</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>79</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>≥4</td>
<td>44</td>
<td>28</td>
<td>15</td>
</tr>
<tr>
<td>Gender of respondent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woman</td>
<td>278</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Man</td>
<td>102</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Household type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>58</td>
<td>15</td>
<td>41</td>
</tr>
<tr>
<td>Woman</td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Man</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Couple</td>
<td>122</td>
<td>32</td>
<td>28</td>
</tr>
<tr>
<td>Family with children</td>
<td>185</td>
<td>49</td>
<td>24</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

| Total No. of households  | 380         |                        |                                |
| Total No. people in households | 1054       | 5 272 000              |                                |
Household results

- Avoidable food waste average 23 kg per person
- Food waste totals 120 - 160 million kg per year and around 5 % of purchased food
- More than 30 % waste leftovers every day
- Influence of socio-demographical, behavioural and attitudinal factors (shopping habits, waste sorting habits, influence of package size); following were statistically significant (per capita):
  - The size of the household (*per household*)
  - The gender of the person mainly responsible grocery shopping
  - The appreciation of low food prices
  - Respondent’s own view of the potential to reduce food waste
  - Respondent’s own view of the effect of purchasing right packaging sizes on the amount of food waste

Ref: Koivupuro et al. 2012, *Consumer Studies*
Proportion of avoidable food waste by food type

<table>
<thead>
<tr>
<th>Food Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables inc potato</td>
<td>19</td>
</tr>
<tr>
<td>Home cooked food</td>
<td>18</td>
</tr>
<tr>
<td>Dairy</td>
<td>17</td>
</tr>
<tr>
<td>Fruit and berries</td>
<td>13</td>
</tr>
<tr>
<td>Bread and grains</td>
<td>13</td>
</tr>
<tr>
<td>Meat, fish and egg</td>
<td>7</td>
</tr>
<tr>
<td>Convenience meal and take away food</td>
<td>6</td>
</tr>
<tr>
<td>Rice and pasta</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
</tr>
</tbody>
</table>

Ref: Silvennoinen et al. 2012

OECD meeting, Katajajuuri 2006-2013
Proportion of avoidable food waste by reason to throw away

Proportion of waste by reason

- Spoiled, moulded: 29%
- Expires date: 19%
- Plate leftovers: 14%
- Over prepared: 13%
- Food was not wanted to eat anymore: 10%
- Food looks fine but no risk wanted to take: 9%
- Other: 7%

Ref: Silvennoinen et al. 2012

OECD meeting, Katajajuuri 2006-2013
Reducing food waste in households

When asked about the best ways of reducing waste, the respondents selected following:

1. Opening a new package only when the old has been finished
2. Storing foodstuff correctly
3. Serving smaller portions
4. Consuming perishable products first
5. Using of freezer
6. Better position of foodstuff in fridge
7. Using more leftovers
8. Using shopping lists
Results on household food waste from different studies

- Food waste research globally still in its beginnings
- Research method has an effect on the results: waste bag sorting and composition analysis, literature studies and statistical data, food waste diary studies
- Samples in some studies too small or unrepresentative for reliable extrapolation

→ The results are non comparable with each other

OECD meeting, Katajajuuri 20062013
Food waste analysis KURU-project (to be published 27th June 2013)

✓ Collecting food (avoidable) waste samples using a waste bag analysis
✓ Samples were collected from an area of 10,000 residents

→ Comparison of results of these two research methods/approaches (diary vs waste bag)
Project Kuru (2011-2013): detailed information on avoidable households food waste, its reasons and prevention methods
Kuru sorting study Ämmassuo landfill
September 2012

• Mixed waste
• Kitchen waste
  • Avoidable food waste
  • Unavoidable food waste
• Loose, open packages, unopen packages

Results of KURU available in 27th June 2013!
Mixed landfill waste

Kitchen waste

- Inedible organic waste, peels, bones etc.
- Edible food waste (that has been avoidable)

Other mixed waste, carton, glass, metal

1. Leftovers, over production
2. Unopened packaging
3. Opened packaging
Do you think that smaller packaging sizes would decrease avoidable food waste in your household?

• We asked the impacts of packaging size to food waste, and according to the results
  ➔ More food waste was produced in those households where the inhabitants believed they could reduce the amount of food waste by using smaller packaging sizes

• The smaller the size of the household, the preferable method smaller packaging sizes are in reducing food waste

• In all household sizes more food waste was produced if the household perceived smaller packaging sizes a good way in reducing food waste in their household

Ref: Katajajuuri et al. 2012

The number of answers

Food waste kg/cap/a

The size of the household: 1, 2, 3, 4 and 5 (/or more) inhabitants

Reducing the packaging size:
blue= Significant method, N=113
green/red= Not significant method, N=267
ECOPAF-project (2011-2013, published 17.5.2013)

- Main focus is to view the shopping receipts (from the 3-week period) collected from the 380 households.
  - In order to study the shopping behavior in relation to households’ food waste amounts.
    - For instance, to solve the amount of money spent on food in relation to food waste.
- Special focus on food packaging, esp. packaging sizes.
- Participants: MTT, PTR, Meat/convenience producers Atria and HK Scan, Retail chain Kesko Food, packaging manufacturers M-real and StoraEnso, PYR, Tekes.
**Product**: Milk, fat 1,5%
**Origin**: 
**Packaging**: LPB
**Weight**: 1,5 l (estimate)
**Price**: 1,29 €
**Category**: Milk

**Product**: cucumber
**Origin**: Suomi
**Packaging**: plastic bag etc.
**Weight**: 0,295 kg
**Price**: 0,87 €
**Category**: vegetables, cucumber
**Storing**: fresh
Due to the food waste we lose euros in trash per year...

Altogether households waste food in 500 million euros per year in Finland.

- Single household: 103 euros per year
- Couple: 73 euros per capita, 145 euros per household
- Households with children*: 74 euros per capita, 283 euros per household

*Average 3.8 persons

Ref: Hartikainen et al. 2013

OECD meeting, Katajajuuri 20062013
What type of food is wasted in relation to amount of food we buy?

- Potato: 8.5%
- Bread: 8.4%
- Fruits: 8.4%
- Berries: 7.5%
- Vegetables: 6.9%
- Rice/pasta: 5.9%
- Grain prod. (not bread): 5.4%
- ...: 5.3%
- ...: 4.2%
- Milk: 3.5%
- Oil, butter: 3.1%
- Snacks: 1.9%
- Alltogether ~ 6% of bought food is wasted

Ref: Hartikainen et al. 2013

OECD meeting, Katajajuuri 20062013
More the households buy food (per capita) in kilos and euros, the more food is wasted!
What sizes of packaging household buy?
- animal based products

Packaging size = Food (g)/package

Singles buy almost same packaging sizes but they buy more food per capita (esp. Vegetables)
Restaurant sector

• The food waste was divided into two categories
  1. **Avoidable food waste**
     • e.g. spoiled products, overproduction
  2. Unavoidable food waste
     • e.g. vegetable peels and bones
• For weighing and sorting the avoidable food waste was divided into three categories:
  • kitchen waste
  • service waste
  • leftovers
Public Catering in Finland

• In Finland public food service sector serve about 440 million meals every year
• There are around 5000 restaurants
• Public food services are an integral part of Finnish food culture, as they provide up to half of the meals consumed outside home
• One third of the population uses communal food services daily, and all Finnish schools serve free lunch.
• Most of the food is served in buffets (eg schools, lunch restaurants)
Public Catering: Foodspill Study outlets and days

<table>
<thead>
<tr>
<th>Outlet</th>
<th>Quantity</th>
<th>Study time days per outlet</th>
<th>Outlet total days</th>
<th>Days with leftover contests analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Primary Schools</td>
<td>30</td>
<td>5</td>
<td>150</td>
<td>8</td>
</tr>
<tr>
<td>• High Schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ‘Trade’ Schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day care centers</td>
<td>14</td>
<td>5</td>
<td>70</td>
<td>2</td>
</tr>
<tr>
<td>Hospitals, elderly service centres</td>
<td>6</td>
<td>5</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td></td>
<td>250</td>
<td>14</td>
</tr>
</tbody>
</table>

All restaurants

<table>
<thead>
<tr>
<th>Other Foodspill Outlets</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workplace restaurants and canteens</td>
<td>5</td>
</tr>
<tr>
<td>Restaurants, diners, hotels</td>
<td>9</td>
</tr>
<tr>
<td>Cafes, petrol stations, fast food restaurants</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
</tr>
</tbody>
</table>
The amount of food waste in the restaurants covered by the study, extrapolated to describe annual food waste for the whole restaurant sector.

<table>
<thead>
<tr>
<th>Category</th>
<th>Food Waste % (Food Produced)</th>
<th>Million Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pizza, kebab, hamburger</td>
<td>3-4</td>
<td>8</td>
</tr>
<tr>
<td>Schools</td>
<td>18-20</td>
<td>18</td>
</tr>
<tr>
<td>Cafes, petrol stations</td>
<td>5-6</td>
<td>19</td>
</tr>
<tr>
<td>Restaurants, diners, hotels</td>
<td>18-20</td>
<td>19</td>
</tr>
<tr>
<td>Workplace and students canteens</td>
<td>14-16</td>
<td>24</td>
</tr>
<tr>
<td>Hospitals, elderly service centres</td>
<td>17-19</td>
<td>26</td>
</tr>
<tr>
<td>Day care centers</td>
<td>1-2</td>
<td>27</td>
</tr>
</tbody>
</table>

OECD meeting, Katajajuuri 2006-2013
Estimate of food waste in restaurants and food services and its sources. Food waste of the research period has been extrapolated to reflect the whole restaurant sector (% from food produced)

<table>
<thead>
<tr>
<th>Category</th>
<th>Kitchen waste</th>
<th>Service waste</th>
<th>Leftovers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-care centres</td>
<td>6</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Hospitals, elderly service centres</td>
<td>5</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Workplace restaurants and canteens</td>
<td>4</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>Cafes, petrol stations</td>
<td>5</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Restaurants, diners, hotels</td>
<td>6</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Schools</td>
<td>2</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Fast food restaurants</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Food waste in retail sector

- The study was carried out by interviewing various parties in retail chains, waste management and other associated actors.
- Food waste in Finnish wholesale and retail sector is 65–75 million kg; 12–14 kg per citizen per year.
- The research did not include any weighings to determine the actual amount of waste.
- The main product groups causing food waste in stores were fruits and vegetables, and bread. Other products resulting in waste as dairy products, fresh meat and fish, and convenience food. The least food waste was found in tinned goods, dried or frozen food, and other non-perishable.
Food waste in Finnish food industry

- Food waste in Finnish food industry 75 – 140 million kg/year
- 14 – 26 kg per capita per annum
- Food waste is approximately 3% of the production volume in sectors included in the study
- Now part of side streams that could be seen as edible in principle were excluded from the calculation
  - If all of these side streams would be included in the calculation, the total amount of food waste could be considerably higher than that stated
- Large share of edible food that gets wasted in the food industry is exploited e.g. as animal feed or raw material in the production of biogas or bioethanol
## The amount of food waste in different sectors and the whole food industry

<table>
<thead>
<tr>
<th>Sector</th>
<th>Volume of food waste (million kg)</th>
<th>Average percentage of wastage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of meat products and prepared meals</td>
<td>11 – 14</td>
<td>2 – 2.5 %</td>
</tr>
<tr>
<td>Manufacture of dairy products</td>
<td>33 – 43*</td>
<td>about 3 %</td>
</tr>
<tr>
<td>Manufacture of bakery products</td>
<td>21 - 25</td>
<td>6.5 – 8 %</td>
</tr>
<tr>
<td>Other sectors altogether**</td>
<td>10 - 55</td>
<td>1 – 4.5 %</td>
</tr>
<tr>
<td>Altogether</td>
<td>about 75 – 140</td>
<td>about 3 %</td>
</tr>
</tbody>
</table>

*The volume of food waste in the dairy industry is high because also the production volume is high, the percentage of wastage is equivalent to the average of the food industry

**grain milling, processing of vegetables and fruit, processing of fish, manufacture of oils and fats, and manufacture of other food products

OECD meeting, Katajajuuri 20062013
Calculated avoidable food waste in Finnish food chain (exl. primary production): 335 – 460 million kg per year = ca 10 - 15 % of the consumed food

- Food industry: 75-140 million kg
- Households: 120-160 million kg
- Retail: 65-75 million kg
- Restaurants and catering: 75-85 million kg
Challenges of estimation of carbon footprint

• Food waste data resolution between different product categories not good enough in the household level
  • Especially ‘food types’ such as ‘home made food’ and leftover, or ‘meat’ (is it beef of pork...?) or ‘vegetables’
  • (same challenge, even bigger in other parts of food chain...)

• And respective carbon footprint ranges/variation (between studies, methods, countries....)
  • between different beef studies, from 8 to 25 kg CO2-eqv/kg...
  • between Finnish or imported cucumbers/tomatoes from 0,2 to 6 kg/kg...

• Need of harmonisation between different carbon footprint guidelines, practices and data (in Finland and globally)
  • e.g. by using IDF carbon footprint guide or using past Finnish/Swedish CFP results of hard cheese: range around from 6 to 12 kg/kg cheese...
  • Finnish Foodprint protocol published November 7th, 2012

• Impossible to assess meaningful exact (enough) emission estimates → only magnitude of results presented...
On the climate impacts of...

- Household food waste - annual carbon dioxide emissions of around 100,000 cars
  - even though pork and beef products amounted to only 4% of all discarded food, their carbon footprints were among the highest compared with other food categories
  - the amount of discarded cheese was less than 2% of total household food waste, but its carbon footprint was almost equal to that of discarded vegetables
- At the entire Finnish food chain level, including households, retailers, restaurants and the food industry, the total carbon footprint of food waste was around 1000 million kilograms of CO₂-equivalent per year, more than 1% of Finnish total annual greenhouse gas emissions.
  - The share of households was 36% of the total climate impacts.

------------------------------------------------------------------------------------------------------------------

- “Food waste generates about 170 Mt of CO₂ eq. in the EU each year”
  - The overall impact of food waste of the entire food chain corresponds about 3% of total EU27 climate impacts
- ”The climate impacts of household food waste in the UK are equivalent to about 20 million tonnes of CO₂ a year”
  - Household food waste is responsible for up to approximately 3% of the UK’s domestic greenhouse gas emissions
Food waste in the entire food chain

• Estimates on the amounts of food waste presented in different studies vary greatly, most estimates fall between 25 and 50 % of food produced for human consumption

• FAO (2011; desk study by SIK): roughly one-third of edible food parts get wasted in the food chain, altogether even 300 kg/capita/year

• According to the study ordered by the European commission (2010) food waste in the entire chain is about 180 kg/capita/year

• The results are not reliably comparable

⇒ Need to harmonize research methods on food waste and to get
⇒ More reliable food waste measurements in Europe
⇒ EU-level Fusions (food waste) research project launched 2012!!

<table>
<thead>
<tr>
<th>Sector</th>
<th>Households</th>
<th>Food Services</th>
<th>Retail Sector</th>
<th>Food industry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total m kg/year</td>
<td>120–160</td>
<td>75–85</td>
<td>65–75</td>
<td>75 -140</td>
<td>335–460</td>
</tr>
<tr>
<td>Sector</td>
<td>Households</td>
<td>Food Services</td>
<td>Retail Sector</td>
<td>Food industry</td>
<td>Total</td>
</tr>
<tr>
<td>Per capita kg/year</td>
<td>22–30</td>
<td>14–16</td>
<td>12–14</td>
<td>14-26</td>
<td>62–86</td>
</tr>
</tbody>
</table>

OECD meeting, Katajajuuri 20062013
License to eat! -website motivates to reduce the amount of food waste in households.

Website includes:

- **Recipe search**, which finds you recipes combining ingredients that you already have in your fridge.
- **Portion planner**
- **Tips and ideas** how to minimise food waste and save money
- **Facts about food waste**
Experiment on sharing food

- It was tested in a housing company located in Helsinki, whether it is possible to reduce the amount of household food waste by sharing food in the neighbourhood.

- In the apartment house cold storage cellar, a food sharing point (Herkkupesä – ‘Treat Nest’) has been set up, which the inhabitants can bring fresh vegetables and fruits or unopened food packages that have not reached their ‘best by’

- Information about the food left in the food sharing point is communicated through Facebook and a blog.
Some of the main references / links


- www.mtt.fi/english/foodspill

- Almost 400 million kilos wasted in the Finnish food production chain. 2012. Press release by MTT.

Expert in responsible food production and consumption and in food nutrition

MTT Agrifood Research Finland