Food waste prevention and packaging re-use: experiences, environmental assessment and challenges

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AGENDA

✓ Municipal waste generation and prevention in Italy
✓ Assessment of selected waste prevention activities, mainly targeting the packaging
✓ Packaging re-use and its role
✓ Food waste estimates based on composition analysis and its environmental impact
✓ Conclusions and recommendations
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INTRODUCTION

Waste prevention and re-use are on top of the EU hierarchy (2008/98/EC, Art. 4)

Prevention
If you can’t prevent, then....

Prepare for reuse
If you can’t prepare for reuse, then....

Recycle
If you can’t recycle, then....

Recover other value (e.g. energy)
If you can’t recover value, then....

Disposal
Landfill if no alternative available.

Source: http://www.sepa.org.uk
INTRODUCTION

Quantitative targets of waste prevention are now in place in some Member States (e.g. for Italy -5% of MSW per GDP unit in 2020 vs. 2010)

But also waste prevention should be critically assessed in order to properly address such efforts, keeping in mind that:

“When applying the waste hierarchy, Member States shall take measures to encourage the options that deliver the best overall environmental outcome. This may require specific waste streams departing from the hierarchy where this is justified by life-cycle thinking on the overall impacts of the generation and management of such waste” (2008/98/EC, Art. 4)

MUNICIPAL WASTE GENERATION AND PREVENTION IN ITALY

Trend observed in recent years (kg/inhabitant*year)

MUNICIPAL WASTE GENERATION AND PREVENTION IN ITALY

1. Following the peaks of the late 2000’s, MSW generation has decreased and stabilised at about 490 kg/in./y
2. First signs of decoupling from economic indicators are observed

Target set by the national prevention programme


MUNICIPAL WASTE GENERATION AND PREVENTION IN ITALY

1. National target for Source Separation (65% @2012) far from being reached, but stable linear progression
2. A wide gap still exists between Northern and Southern regions

Organic fraction (mainly food waste) is driving the SS increase

<table>
<thead>
<tr>
<th>Organic fraction</th>
<th>Paper</th>
<th>Glass</th>
<th>Plastic</th>
<th>Metals</th>
<th>Wood</th>
<th>WEEE</th>
<th>Bulky waste</th>
<th>Textile</th>
<th>Selective</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>4.813</td>
<td>3.037</td>
<td>1.598</td>
<td>0.889</td>
<td>248.9</td>
<td>614.1</td>
<td>219.7</td>
<td>377.3</td>
<td>101.1</td>
<td>39.6</td>
</tr>
<tr>
<td>2013</td>
<td>5.216</td>
<td>3.051</td>
<td>1.600</td>
<td>0.945</td>
<td>241.0</td>
<td>635.2</td>
<td>209.2</td>
<td>398.5</td>
<td>110.9</td>
<td>39.9</td>
</tr>
<tr>
<td>2014</td>
<td>5.720</td>
<td>3.153</td>
<td>1.691</td>
<td>1.012</td>
<td>249.6</td>
<td>676.0</td>
<td>213.7</td>
<td>447.3</td>
<td>124.4</td>
<td>40.6</td>
</tr>
<tr>
<td>2015</td>
<td>6.071</td>
<td>3.149</td>
<td>1.747</td>
<td>1.178</td>
<td>261.1</td>
<td>695.3</td>
<td>222.9</td>
<td>484.3</td>
<td>129.0</td>
<td>42.4</td>
</tr>
</tbody>
</table>

Italy as a whole is on the right track towards the **EU targets on preparation for re-use and recycling** set for 2020.
AIM OF THE RESEARCH

- To evaluate the environmental convenience of some waste prevention activities included in the National Waste Prevention Programme
- To evaluate whether such waste prevention activities can actually improve the overall environmental performance of municipal waste management at the regional level

TWO STEPS:
1. Life Cycle Assessment (LCA) of the selected waste prevention activities, at the product level
2. LCA of the integrated waste management system of Lombardia Region when the selected waste prevention activities are implemented

AIM OF THE RESEARCH

By applying the LCA methodology it is possible:

- To check if a reduction in waste generation implies also a reduction in the overall environmental impacts

- To verify and quantify the possible improvement of the environmental performance of the integrated waste management system when prevention activities are implemented
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WASTE PREVENTION ACTIVITIES EVALUATED SO FAR

1. Use of tap water or water from public fountains
2. Loose distribution of liquid detergents
3. Loose distribution of pasta, rice and cereals
4. Farm delivery (apples and carrots)
5. Use of rechargeable household batteries instead of disposable ones

- The comparison was based on waste generation, on 13 impact categories on the environment and on human health (according to the PEF Guide by EC DG Environment & JRC) and on the Cumulative Energy Demand indicator
BREAKFAST CEREALS: SCENARIOS AND FUNCTIONAL UNIT

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Primary packaging</th>
<th>Size of primary packaging</th>
<th>Transport packaging</th>
<th>Bag for purchase of loose product</th>
<th>Amount of cereal withdrawn from dispensers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>300-g bag-in-box</td>
<td>300 g</td>
<td>Corrugated cardboard box</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>375-g bag-in-box</td>
<td>375 g</td>
<td>Wooden pallet</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>500-g bag-in-box</td>
<td>500 g</td>
<td>LLDPE stretch film</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>960-g bag-in-box</td>
<td>960 g</td>
<td>LLDPE stretch film</td>
<td>300 g</td>
<td></td>
</tr>
<tr>
<td>Prevention</td>
<td>10-kg sack</td>
<td>10 kg</td>
<td>Wooden pallet</td>
<td>375 g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper sack</td>
<td></td>
<td>LLDPE bag</td>
<td>500 g</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>960 g</td>
<td></td>
</tr>
</tbody>
</table>

Functional unit: “distribution of 1 kg of food product (pasta, breakfast cereals, or rice)”

Dolci et al., 2016

BREAKFAST CEREALS: RESULTS

Waste generation across the life cycle is significantly decreased!

Dolci et al., 2016
LOOSE DRY FOOD DISTRIBUTION: RESULTS

Environmental indicators for breakfast cereals are also improving, from -40% up to -83% compared to one-way packaging scenarios.

The picture is less straightforward for pasta, where an impact increase is observed for some indicators, due to the fact that primary and transport packages are similar in type and mass per functional unit in both scenarios.

Loose distribution of rice also shows encouraging results vs. baseline, but concerns on hygienic problems due to possible insect infestation are actually limiting such practice.

Dolci et al., 2016

FARM DELIVERY: SCENARIOS AND FUNCTIONAL UNIT

Apples and carrots were selected as typical products delivered via farm delivery (box) schemes vs. conventional ones (supermarkets).

Real-life experiences of Regione Lombardia were considered.

Functional unit: “distribution of 1 kg of food product (apples or carrots)”

Tua et al., 2017
FARM DELIVERY: WASTE GENERATION (carrots)

Tua et al., 2017

FARM DELIVERY: WASTE GENERATION (apples)

Tua et al., 2017
FARM DELIVERY: RESULTS

Farm delivery schemes can hardly compete with the highly optimised logistics of retail chains.

This applies to the used packaging but also to the transportation, where inefficient travel habits by the customers to the central distribution points might affect the overall environmental impacts.

A true local supply of the distributed products is also essential to reduce the environmental impacts.

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PACKAGING RE-USE: OVERVIEW
Survey on the current situation of packaging re-use in Italy

Intermediate Bulk Containers
Collapsible crates & mini-bins for fruit and vegetables
Barrels for chemical and petrochemical products
Pallets
Gas cylinders for CO₂
Bottles for beer

PACKAGING RE-USE: A FOCUS ON INTERMEDIATE BULK CONTAINERS (IBCs)

Use: transport and storage of bulk liquid and granulated substances, such as chemicals, food ingredients, solvents, pharmaceuticals

Structure: HDPE bottle + steel cage + pallet (wood, plastics or steel)

After use, IBCs can be reconditioned or sent to recycling

AIM OF THE STUDY: to evaluate the environmental impacts associated with the life cycle of IBCs as a function of the number of "rotations", by using an LCA approach
The analyzed system includes:

- the IBCs production
- the reconditioning process:
  - first selection (24% of IBCs are discarded because too damaged)
  - cleaning
  - second selection (25.5% of HDPE bottles are discarded because cannot be properly cleaned and are substituted with new ones)
  - recycling/disposal of the discarded IBCs and bottles
  - wastewater treatment
- recycling/disposal of the IBCs at their end of life
FUNCTIONAL UNIT: 100 IBCs ready to be used n times, with n included between 1 and 5

RESULTS: amount of waste prevented across the life cycle as a function of the number of re-uses (tonnes per FU)
PACKAGING RE-USE: A FOCUS ON IBCs

RESULTS: percentage contribution of the life stages “production”, “reconditioning”, and “end of life” for 100 IBCs with wood pallet

PACKAGING RE-USE: A FOCUS ON IBCs

Decrease of the impacts according to the number of re-uses (2 to 5 times) vs. the same number of single uses
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RESEARCH ON FOOD WASTE

A PROJECT OF RESEARCH, EDUCATION AND COMMUNICATION

- Biennial PROJECT (December 2015 - December 2017) supported by the ITALIAN MINISTRY OF THE ENVIRONMENT with the objective to concur to REDUCE FOOD WASTE AT THE NATIONAL LEVEL according to the NATIONAL WASTE PREVENTION PROGRAMME

- RESEARCH TEAM

  COORDINATOR DISTAL - Università di Bologna
  PARTNERS
  DEIM - Università della Tuscia
  DICA - Politecnico di Milano
  DIES - Università degli Studi di Udine
  SIAN - Azienda ULSS 20 di Verona

http://www.sprecozero.it/cose-il-progetto-reduce/
RESEARCH ON FOOD WASTE

A PROJECT OF RESEARCH, EDUCATION AND COMMUNICATION

Our role in the project:

✓ To carry out waste composition analysis on the Residual Waste (RW) and on the organic fraction separated at the source, in order to quantify the avoidable food waste

✓ To estimate the environmental impacts of food waste, based on LCA

http://www.sprecozero.it/cose-il-progetto-reduce/

RESEARCH ON FOOD WASTE

Classification of food waste based on its *edibility* (EU FUSIONS Project guidelines)

**AVOIDABLE**
edible food, at some point prior to disposal, discarded regardless of the reason

**POSSIBLY AVOIDABLE**
edible parts of food which some people eat and others not or that can be eaten when prepared in one way but not in another

**NOT AVOIDABLE**
parts of food which are inedible under normal circumstances
RESEARCH ON FOOD WASTE

ESTIMATES for NORTHERN ITALY (kg/in./year)

MUNICIPAL WASTE 494
TOTAL FOOD WASTE 89 - 112
AVERAGE: 98

AVOIDABLE FOOD WASTE 13 - 39
AVERAGE: 27

AVERAGE COMPOSITION (weight %)

- Vegetables 35%
- Bread 25%
- Fruit 17%
- Meat 10%
- Dairies 3%
- Pasta 7%
- Beverages 3%

SELECTED IMPACT INDICATORS

• IMPACTS ON CLIMATE (total GHGs emissions)

• IMPACTS ON WATER RESOURCES (overall consumption of ‘blue water’)

• IMPACTS ON THE SOIL (total occupied agricultural land)
RESEARCH ON FOOD WASTE

System boundaries

Agricultural/animal production
Industrial processing
Transport
Distribution / Sale
Consumption
End-of-life

27 kg/in./y (Northern Italy)
1.64 Mt/y (Italy)
0.13% food waste worldwide

AVOIDABLE FOOD WASTE

CLIMATE (CO₂-eq - IPPC, 2013)
64 kg CO₂-eq/in/y
3.9 Mt CO₂/y
0.9% GHG national emissions (2015)

WATER RESOURCES
3.2 m³/in/y
197 Mm³/y
1.8% national water volume for irrigation (2009/2010)

AGRICULTURAL LAND
78 m²/in/y
4719 km²/y
3.8% useful agricultural land (2013)
RESEARCH ON FOOD WASTE

AVOIDABLE WASTE COMPOSITION

- Vegetables: 35%
- Bread: 25%
- Fruit: 17%
- Meat: 10%
- Pasta: 7%
- Dairies: 3%
- Beverages: 3%

GHG IMPACT

- Meat: 59%
- Fruit: 7%
- Vegetables: 14%
- Dairies: 9%
- Pasta: 6%
- Beverages: 1%

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CONCLUSIONS

- First sign of decoupling waste generation from economic indicators are observed in Italy
- Preventing the production of waste does not automatically imply a better overall environmental performance, since burden shifting may play a role
- Compared to traditional waste treatment, the effectiveness of waste prevention activities is strongly dependent on the behaviour of citizens/consumers
- Some waste prevention practices have to compete with highly optimised conventional systems/processes
- For waste re-use, only preliminary evaluations have been carried out, but they show encouraging results
- Waste of food has a high environmental impact, especially for animal-based products

A robust LCA-based guidance is needed to support local authorities wishing to implement waste prevention and re-use practices, as well as for citizens to make such practices really effective.
FOR MORE INFORMATION


Assessment on WAste and REsources
1 associate professor: M. Grosso
1 senior researcher (and lecturer): L. Rigamonti
3 post-doc researchers: L. Biganzoli, S. Nessi, S. Pantini
4 research collaborators: G. Dolci, C. Tua, F. Villa, G. Borghi

www.aware.polimi.it
THANK YOU FOR YOUR ATTENTION!

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