An overview of primary production side flows in the Nordic region

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 PRIMARY PRODUCTION

FOOD PRODUCTION

PRODUCED FOR FOOD
- Crops, vegetables, fruit and berries that are mature for harvest
- Wild fruit and berries at the time of harvest
- Domesticated animals from birth
- Wild animals when they are caught or killed
- Milk that is drawn from animals
- Eggs when laid
- Wild fish/shellfish when caught
- Farmed fish/shellfish from hatching

NON-FOOD PARTS
- E.G. STRAW, PEELS, BONES

SIDE FLOW (SF)

FOOD-CHAIN- SUITABLE SIDE FLOW
- Food/Primary product that is still expected to be consumed by humans

INEDIBLE SIDE FLOW
- E.g. Contaminated food/primary product e.g. due to diseases/pests

VALORISATION AND CONVERSION
- E.g. Used as feed, bio based material or biobased processing

LEFT IN FIELD, COMPOSTED, SENT TO WASTE TREATMENT

Safety dimension of edibility

What happens with the side flow
“The flows of primary products that were meant to be eaten by humans, but never entered the next step in the food supply chain (e.g. slaughter, retail, processing), and instead were used for other purposes or sent to waste treatment. Non-edible parts of wasted food, e.g. peels and bones, are not included as part of side flow.“
Methodological framework

Edible parts

- Pre-harvest of plants
- Rearing of animals/
  Fish cultivation

Inedible parts

- Pre-harvest of plants
- Rearing of animals/
  Fish cultivation

“Pre-harvest”
- Harvest/Wild fish caught/Milk drawn/Eggs laid
- Storing/Pre-processing at farm site (e.g. sorting, washing)
- Transport to the next step in the food chain
- Side flow/Waste used for feed/Other valuable non-food subject

This study
FUSIONS Definititional Framework for Food Waste
FLW Standard
Methodological framework

Total yield = \( p \times \frac{1}{1 - SF} \)

Side flow (SF) = \( p \times \frac{1}{1 - SF} \times SF \times CF \)

FUSIONS food waste (FFW) = \( p \times \frac{1}{1 - SF} \times FW \)

Where
\( p = \text{food production amount (sold product)} \)
\( CF = \text{conversion factor} \)
\( SF = \text{side flow percentage} \)
\( FW = \text{FUSIONS food waste percentage} \)

Conversion factor

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Wheat, rye, barley, oats</td>
<td>0.78</td>
</tr>
<tr>
<td>Starchy roots</td>
<td>0.82</td>
</tr>
<tr>
<td>Sugar crops</td>
<td>0.20</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.77</td>
</tr>
<tr>
<td>Fruits</td>
<td>0.77</td>
</tr>
<tr>
<td>Meat: bovine, pig, poultry</td>
<td>0.70, 0.80, 0.60</td>
</tr>
<tr>
<td>Fish, seafood</td>
<td>0.50</td>
</tr>
</tbody>
</table>
## Waste percentages

<table>
<thead>
<tr>
<th></th>
<th>Food waste (%)</th>
<th>Side flow (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FAO report (Gustavsson et al. 2011)</td>
<td>Our study</td>
</tr>
<tr>
<td>Agriculture, aquaculture, fisheries</td>
<td>2%</td>
<td>4-14%</td>
</tr>
<tr>
<td>Postharvest handling and storage</td>
<td>4%</td>
<td>10% potatoes, 26% carrots and turnips</td>
</tr>
<tr>
<td>Primary production (including postharvest handling and storage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cereals</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Roots and tubers</td>
<td>20%</td>
<td>9%</td>
</tr>
<tr>
<td>Oilseeds and pulses</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>20%</td>
<td>5%</td>
</tr>
<tr>
<td>Meats</td>
<td>3.1%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Fish and seafood</td>
<td>9.4% wild fish</td>
<td>0.5%</td>
</tr>
<tr>
<td>Milk</td>
<td>3.5%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
# Case-studies in project

<table>
<thead>
<tr>
<th>Products</th>
<th>Methods applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>Questionnaires (D, F, N, S), Field studies (F, N), Interviews (F, N)</td>
</tr>
<tr>
<td>Onions</td>
<td>Questionnaires (D, F, N, S), Field studies (S), Interviews (S, F)</td>
</tr>
<tr>
<td>Green peas</td>
<td>Questionnaires (D, F, N, S), Interviews (S, F)</td>
</tr>
<tr>
<td>Field peas</td>
<td>Questionnaires (D, F, S), Field study (F), Interviews (F)</td>
</tr>
<tr>
<td>Wheat, Rye</td>
<td>Questionnaires (Wheat) (D, N, S), Questionnaires (Rye) (F), Field study (Wheat) (F), Interviews (Rye) (F)</td>
</tr>
<tr>
<td>Rainbow trout,</td>
<td>Questionnaires (Rainbow trout) (D, F, S), Questionnaires (Char) (S), Interviews (F)</td>
</tr>
</tbody>
</table>
Case-studies in project – Example: carrot, Finland

The uses of carrot yield (weighted average), 27 producers answered:

- Food (primary use) %
- Food (secondary use) %
- Sideflow: Left in field/sorted out during harvest %
- Sideflow: Animal feed %
- Sideflow: composted/biowaste %
- Side flow: other use %
- Sideflow: no use %
Case-studies in project – Example: carrot questionnaire, Finland

Reasons for the side flow (weighted averages), 26% of the carrot production was side flow:
## Case-studies in project – Example: carrot questionnaires

<table>
<thead>
<tr>
<th>Country</th>
<th>Response rate (of all who received the questionnaire)</th>
<th>Side flow amount (standard deviation)</th>
<th>Side flow treatment (of total side flow)</th>
<th>Reasons for side flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>32%</td>
<td>20.8%</td>
<td>10% left in the field, 61% used for animal feed, 25% composted, 4% other.</td>
<td>Quality issues, pests, plant diseases, harvesting methods.</td>
</tr>
<tr>
<td>Finland</td>
<td>10%</td>
<td>25.8% (15%)</td>
<td>Three major usages: Composted, animal feed, left in field.</td>
<td>Most important: After harvest: Quality (appearance, size), plant diseases and damage. During harvest: Weather conditions, plant diseases and harvesting procedures.</td>
</tr>
<tr>
<td>Norway</td>
<td>23%</td>
<td>17.6% (4.6%)</td>
<td>25.5% left in the field, 66% used for animal feed, 8.5% other.</td>
<td>Quality issues, pests, and plant diseases and are the main reasons.</td>
</tr>
<tr>
<td>Sweden</td>
<td>35%</td>
<td>13-31% (different storage time and storage practice)</td>
<td>51% animal feed, 16% bioenergy or deposited, 15% brought back to the field, 9% not harvested, 9% other use.</td>
<td>Unacceptable size and shape, damage during harvest and handling, insect or animal damage. Main post-harvest side flow reasons: Unacceptable size and shape, unacceptable appearance, damage during handling.</td>
</tr>
</tbody>
</table>
Yearly side flow and food waste amounts in primary production

1000 tonnes

- Yearly food waste amounts (FUSIONS), 1000 tonnes
- Yearly side flow amounts: rearing phase, 1000 tonnes
- Yearly side flow amounts: excl. rearing phase, 1000 tonnes
Yearly side flow and food waste amounts in primary production
- Side flow, Side flow (- rearing), Food waste (Fusions)

1000 tonnes

- Finland
- Sweden
- Norway
- Denmark

- Fish, Seafood
- Milk
- Eggs
- Animal fats
- Offal
- Meat
- Fruits
- Vegetables
- Oil crops
- Pulses
- Sugar Crops
- Starchy Roots
- Oats
- Barley
- Rye
- Wheat
Conclusion

- Side flow: amount of food that does not end up for human consumption
- The total amount of side flow in Denmark, Finland, Norway and Sweden is 922,000 tonnes: approximately 3-4%,
  - of which 119,000 tonnes occurs during the rearing phase of fish and meat
- The side flow estimates of this study are still fairly uncertain
  - Need to get better data
- Food waste in primary production needs special focus
  - Side flows are largely caused by factors outside the farmers’ control such as weather conditions and consumers’ demand for ‘cosmetically perfect’ products.
  - Side flows are often put to very good use, such as animal feed.
- There is need for more open discussion on the reasoning and motives behind different approaches and outcomes
Publications


• Hartikainen et al. 2017 Food losses and waste in primary production: Case studies on carrots, onions, peas, cereals and farmed fish http://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-4762

• Hartikainen et al. Food waste quantification in primary production – the Nordic countries as a case study, Submitted in 2017
