Enabling the Exploitation of Insects as a Sustainable Source of Protein for Animal Feed and Human Nutrition

2. Life Cycle Inventory (LCI)
- Gathering Inputs and outputs
- Classification of all interventions for each unit process
Mandatory features of LCA studies:

- **Objective and unprejudiced approach**
- **Consistency** between reference systems and systems under research
- **Transparent** research setup (comprehensive method descriptions)
- **Cautious conclusion** drawing (Accentuate applicability limitations)
- Study results need to be reviewed by respective experts (prior publishing)

Challenges and limitations for PROteINSECT

- Different trophic levels
- Different economic, societal and biophysical environments
- Various conceivable Life Cycle Scenarios
- Site specificity of research results

STUDY SUBJECT - Trophic pathways of insect-derived PAPs

<table>
<thead>
<tr>
<th>Primary producer</th>
<th>Primary consumer</th>
<th>Secondary consumer</th>
<th>Tertiary consumer</th>
<th>Conversion process</th>
<th>Consumer</th>
<th>Apex consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photoautotroph</td>
<td>Chemoheterotroph</td>
<td>Chemoheterotroph</td>
<td></td>
<td></td>
<td></td>
<td>Chemoheterotroph</td>
</tr>
</tbody>
</table>

Architectural diagram:

- Meat production
- Insect rearing
- Protein extraction
- Meat production / aquaculture
- Humans
2.1. Ecoefficiency and trophic levels

**REFERENCE SYSTEM - Trophic pathways of mammal-derived PAPs (offal)**

- **Primary producer**: Photoautotroph
- **Primary consumer**: Chemoheterotroph
- **Secondary consumer**: Chemoheterotroph
- **Tertiary consumer**: Chemoheterotroph
- **Conversion process**: "Rendering"
- **Consumer**: Chemoheterotroph
- **Apex consumer**: Chemoheterotroph

Meat production to Humans

**REFERENCE SYSTEM - Trophic pathways of fish-derived PAPs (fish industry)**

- **Primary producer**: Algae
- **Primary consumer**: Zooplankton
- **Secondary consumer**: Forage fish
- **Tertiary consumer**: Target fish from fish industry
- **Conversion process**: "Fish meal production"
- **Consumer**: Chemoheterotroph
- **Apex consumer**: Chemoheterotroph

Algae to Humans
2.1. Ecoefficiency and trophic levels

Primary producer: Photoautotroph
Primary consumer: Chemoheterotroph
Secondary consumer: Chemoheterotroph
Tertiary consumer: Chemoheterotroph
Conversion process
Consumer: Chemoheterotroph
Apex consumer: Chemoheterotroph

REFERENCE SYSTEM - Trophic pathways of fish-derived PAPs (wild caught fish)

Primary producer: Photoautotroph
Primary consumer: Chemoheterotroph
Secondary consumer: Chemoheterotroph
Tertiary consumer: Chemoheterotroph
Conversion process
Consumer: Chemoheterotroph
Apex consumer: Chemoheterotroph

OPTIONAL REFERENCE SYSTEM - Trophic pathways of soy protein

Primary producer: Photoautotroph
Primary consumer: Chemoheterotroph
Secondary consumer: Chemoheterotroph
Tertiary consumer: Chemoheterotroph
Conversion process
Primary consumer: Chemoheterotroph
Apex consumer: Chemoheterotroph

Soy
→ lacking comparability

Soy meal production
Meat production
Humans
Societal conditions:
- Present regulations, odour nuisance, employment, income contribution, safety and health protection standards, tax revenues, risk of worker exploitation, child labor etc.

Cost characteristics:
- Resources, transportation, means of production, machine costs, labor costs, energy, insurance, claimed land, opportunity costs, substrate costs, present demand etc.

Biophysical conditions:
- Energy consumption, heating and cooling efforts, humidity, seasonal variations, water availability, substrate availability, emissions, effects on adjacent ecosystems etc.

- High site specificity of study results (China, UK, Mali, Ghana)!!!