Sustainability of the chicken supply chain in Lebanon: An evaluation system

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• **Status of Lebanese chicken industry**

  - Enough production to satisfy private consumption and export frozen product around the Middle East

  - 200 farms for table eggs and 1000 farms for broilers, producing seven million eggs and 180 million broilers per year respectively (Freiji, 2008)

• **Difficulties**

  - High production cost

  - Volatile feed cost

  - High solid waste, water depletion, GHG production (IFC, 2007)
• **Proposed approach**

  - A multifaceted problem requires a multidisciplinary approach
  - Horizontally (environmental, economic and social), **sustainability**
  - Vertically to include the supply chain actors (farmers, processors and distributors) **supply chain**

• **Objectives**

  - Setting up an evaluation system of the **sustainability** of the chicken production **supply chain**
  - Validation through testing
Building the evaluation system:
a Life Cycle Analysis Approach

- **Step 1**: Defining the study objective and borders
- **Step 2**: Performing input and output inventory
- **Step 3**: Identifying and calculating sustainability indicators
- **Step 4**: Validating the system through sample testing
- **Step 5**: Transforming indicators results into scores
Building the evaluation system: a Life Cycle Analysis Approach

1. Step 1: Defining the study objective and borders
2. Step 2: Performing input and output inventory
3. Step 3: Identifying and calculating sustainability indicators
4. Step 4: Validating the system through sample testing
5. Step 5: Transforming indicators results into scores
1. Introduction

2. Materials and Method

3. Results

4. Discussion

5. Conclusion

Step 1 • Defining the study objective and borders

Supply chain actors:
• Producers
• Processors
• Distributors

Functional Unit
(Kg of edible meat)
Building the evaluation system: a Life Cycle Analysis Approach

1. Defining the study objective and borders
2. Performing input and output inventory
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5. Transforming indicators results into scores
## 2. Materials and Method

### Step 2
- Performing input and output inventory

<table>
<thead>
<tr>
<th>Level</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
</table>
| **Production** | • Feed  
• Water  
• Energy  
• Medicine  
• Bedding  
• Equipment | • Air emissions  
• Wastewater  
• Manure  
• fallen stock  
• Waste  
• Birds |
| **Processing** | • Water  
• Energy  
• Chemicals  
• Raw material (birds)  
• Equipment | • Air emissions  
• Wastewater  
• Animal products  
• Solid waste |
| **Distribution** | • Water  
• Energy  
• Chemicals  
• Equipment | • Air emissions  
• Wastewater  
• Solid waste |
Building the evaluation system: a Life Cycle Analysis Approach

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### Identifying and calculating sustainability indicators

<table>
<thead>
<tr>
<th>Variables</th>
<th>Measuring Unit</th>
<th>Supply Chain level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Energy</td>
<td>MJ/kg</td>
<td>Production: Electricity, Transportation; Processing: Electricity, Transportation; Distribution: Electricity</td>
</tr>
<tr>
<td>2) GHG emission</td>
<td>g CO₂/kg</td>
<td>Production: Electricity, Transportation; Animal activity, Transportation; Processing: Electricity, Transportation; Boilers; Distribution: Electricity</td>
</tr>
<tr>
<td>3) Nitrogenous effluents</td>
<td>L/kg</td>
<td>Production: Animal drinking, Cleaning, Cooling; Processing: Cleaning, Cooling, Cooking; Distribution: NA</td>
</tr>
<tr>
<td>4) Water consumption</td>
<td>g/kg</td>
<td>Production: Manure, Dead birds; Processing: Wastewater treatment, Offal and viscera; Distribution: NA</td>
</tr>
<tr>
<td>5) Packaging material</td>
<td>g/kg</td>
<td>Production: Feed packs; Processing: Cartons and nylon; Distribution: Nylon bags</td>
</tr>
<tr>
<td><strong>Social</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Equity</td>
<td>% of women</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td>7) Salary</td>
<td>LBP/year</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td>8) Employees turn-over or rotation rate</td>
<td>Average of working years</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td>9) Training</td>
<td>Number of trainings per year</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td>10) Age</td>
<td>Mean age of workers</td>
<td></td>
</tr>
<tr>
<td>11) Working environment security</td>
<td>% of injuries</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td><strong>Economic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12) Productivity</td>
<td>Kg/HWU</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td>13) Profit growth</td>
<td>%</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td>14) Yearly investment</td>
<td>%</td>
<td>Applied at all levels</td>
</tr>
<tr>
<td>15) Added value</td>
<td>%</td>
<td>Applied at all levels</td>
</tr>
</tbody>
</table>
Building the evaluation system: a Life Cycle Analysis Approach

Step 1 • Defining the study objective and borders
Step 2 • Performing input and output inventory
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Step 4 • Validating the system through sample testing
Step 5 • Transforming indicators results into scores
Questionnaire (40 questions), four sections:

1. **General information** (name, the date of opening, the number of employees, etc.)
2. **Environmental issues** (energy consumption for production and transportation, water consumption, chemical detergents, organic effluents etc.
3. **Social conditions** (salary for blue and white collars, rotation rate, average age of workers, etc.
4. **Economical data** (productivity, added value, profit growth, internal investment, etc.)

**Sample interviewees**
- Two major producers with large market segments
- two processors
- five distributors.
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**Step 5**

- Transforming indicators results into scores

#### Score ranging between 0 and 10

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Acronyms</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (MJ/Kg)</td>
<td>ENV-ENG</td>
<td>x≥250</td>
<td>250&gt;x≥220</td>
<td>220&gt;x≥200</td>
<td>200&gt;x≥150</td>
<td>150&gt;x≥100</td>
<td>100&gt;x≥80</td>
<td>80&gt;x≥60</td>
<td>60&gt;x≥20</td>
<td>20&gt;x≥10</td>
<td>10&gt;x≥5</td>
<td>5&gt;x</td>
</tr>
<tr>
<td>Green House Gases (g/kg)</td>
<td>ENV-GHG</td>
<td>x≥290</td>
<td>290&gt;x≥260</td>
<td>260&gt;x≥200</td>
<td>200&gt;x≥100</td>
<td>100&gt;x≥50</td>
<td>50&gt;x≥25</td>
<td>25&gt;x≥20</td>
<td>20&gt;x≥15</td>
<td>15&gt;x≥10</td>
<td>10&gt;x≥5</td>
<td>5&gt;x</td>
</tr>
<tr>
<td>Effluents (g/Kg)</td>
<td>ENV-N</td>
<td>x≥30</td>
<td>30&gt;x≥25</td>
<td>25&gt;x≥20</td>
<td>20&gt;x≥15</td>
<td>10&gt;x≥5</td>
<td>5&gt;x≥2.5</td>
<td>2.5&gt;x≥2</td>
<td>2&gt;x≥1.5</td>
<td>1.5&gt;x≥1</td>
<td>1&gt;x≥0.5</td>
<td>0.5&gt;x</td>
</tr>
<tr>
<td>Water (L/Kg)</td>
<td>ENV-WAT</td>
<td>x≥20</td>
<td>20&gt;x≥15</td>
<td>15&gt;x≥10</td>
<td>10&gt;x≥8</td>
<td>8&gt;x≥6</td>
<td>6&gt;x≥4</td>
<td>4&gt;x≥2</td>
<td>2&gt;x≥1.5</td>
<td>1.5&gt;x≥1</td>
<td>1&gt;x≥0.5</td>
<td>0.5&gt;x</td>
</tr>
<tr>
<td>Packaging (kg/kg)</td>
<td>ENV-PACK</td>
<td>x≥5</td>
<td>5&gt;x≥4.5</td>
<td>4.5&gt;x≥4</td>
<td>4&gt;x≥3.5</td>
<td>3.5&gt;x≥3</td>
<td>3&gt;x≥2.5</td>
<td>2.5&gt;x≥2</td>
<td>2&gt;x≥1.5</td>
<td>1.5&gt;x≥1</td>
<td>1&gt;x≥0.5</td>
<td>0.5&gt;x</td>
</tr>
<tr>
<td>Equity (%)</td>
<td>SOC-EQU</td>
<td>0 ≤ x ≤ 10</td>
<td>10 ≤ x ≤ 15</td>
<td>15 ≤ x ≤ 20</td>
<td>20 ≤ x ≤ 25</td>
<td>25 ≤ x ≤ 30</td>
<td>30 ≤ x ≤ 32.5</td>
<td>32.5 ≤ x ≤ 37.5</td>
<td>37.5 ≤ x ≤ 40</td>
<td>40 ≤ x ≤ 45</td>
<td>45 ≤ x ≤ 50</td>
<td>50 ≤ x &gt; 50</td>
</tr>
<tr>
<td>Salary (000 LBP/year)</td>
<td>SOC-SAL</td>
<td>x&lt;750</td>
<td>750≤x&lt;950</td>
<td>950≤x&lt;1050</td>
<td>1050≤x&lt;1100</td>
<td>1100≤x&lt;1150</td>
<td>1150≤x&lt;1200</td>
<td>1200≤x&lt;1500</td>
<td>1500≤x&lt;1700</td>
<td>1700≤x&lt;1750</td>
<td>1700≤x&lt;1750</td>
<td>1700≤x&lt;1750</td>
</tr>
<tr>
<td>Rotation Rate (%) ≥25</td>
<td>SOC-SAL</td>
<td>x&lt;950</td>
<td>950≤x&lt;1050</td>
<td>1050≤x&lt;1150</td>
<td>1150≤x&lt;1200</td>
<td>1200≤x&lt;1500</td>
<td>1500≤x&lt;1700</td>
<td>1700≤x&lt;1750</td>
<td>1700≤x&lt;1750</td>
<td>1900≤x&lt;2000</td>
<td>x≥2000</td>
<td></td>
</tr>
<tr>
<td>Age % 30&lt;40</td>
<td>SOC-AGE</td>
<td>&lt;5%</td>
<td>5 ≤ x &lt; 10</td>
<td>10 ≤ x &lt; 20</td>
<td>20 ≤ x &lt; 30</td>
<td>30 ≤ x &lt; 40</td>
<td>40 ≤ x &lt; 50</td>
<td>50 ≤ x &lt; 60</td>
<td>60 ≤ x ≤ 70</td>
<td>70 ≤ x &lt; 80</td>
<td>80 ≤ x &lt; 90</td>
<td>x ≥ 90</td>
</tr>
<tr>
<td>Training (days/year)</td>
<td>SOC-TRAIN</td>
<td>x&lt;1</td>
<td>1≤x&lt;3</td>
<td>3≤x&lt;5</td>
<td>5≤x&lt;8</td>
<td>8≤x&lt;10</td>
<td>10≤x&lt;12</td>
<td>12≤x&lt;15</td>
<td>15≤x&lt;18</td>
<td>18≤x&lt;20</td>
<td>20≤x&lt;25</td>
<td>x≥25</td>
</tr>
<tr>
<td>Injuries</td>
<td>SOC-INJ</td>
<td>x≥100</td>
<td>100≤x&lt;200</td>
<td>200≤x&lt;260</td>
<td>260≤x&lt;400</td>
<td>400≤x&lt;1000</td>
<td>1000≤x&lt;1500</td>
<td>1500≤x&lt;2000</td>
<td>2000≤x&lt;2500</td>
<td>2500≤x&lt;3000</td>
<td>3000≤x&lt;3500</td>
<td>x≥3500</td>
</tr>
<tr>
<td>Productivity (T/WFU)</td>
<td>SOC-PROD</td>
<td>x&lt;1</td>
<td>1≤x&lt;10</td>
<td>10≤x&lt;15</td>
<td>15≤x&lt;20</td>
<td>20≤x&lt;50</td>
<td>50≤x&lt;750</td>
<td>750≤x&lt;2500</td>
<td>2500≤x&lt;5000</td>
<td>5000≤x&lt;10000</td>
<td>x≥10000</td>
<td></td>
</tr>
<tr>
<td>Profit Growth (%)</td>
<td>SOC-PG</td>
<td>x&lt;0.25</td>
<td>0.25≤x&lt;0.5</td>
<td>0.5≤x&lt;1</td>
<td>1≤x&lt;3</td>
<td>3≤x&lt;4.5</td>
<td>4.5≤x&lt;6</td>
<td>6≤x&lt;7.5</td>
<td>7.5≤x&lt;9</td>
<td>9≤x&lt;10.5</td>
<td>10.5≤x&lt;15</td>
<td>x≥15</td>
</tr>
<tr>
<td>Investment (%)</td>
<td>SOC-INV</td>
<td>x&lt;0.25</td>
<td>0.25≤x&lt;1</td>
<td>1≤x&lt;1.5</td>
<td>1.5≤x&lt;2</td>
<td>2.5≤x&lt;3</td>
<td>3≤x&lt;3.5</td>
<td>3.5≤x&lt;4</td>
<td>4≤x&lt;4.5</td>
<td>4.5≤x&lt;5</td>
<td>x≥5</td>
<td></td>
</tr>
<tr>
<td>Added Value</td>
<td>SOC-AV</td>
<td>x&lt;200</td>
<td>200≤x&lt;400</td>
<td>400≤x&lt;600</td>
<td>600≤x&lt;800</td>
<td>800≤x&lt;1000</td>
<td>1000≤x&lt;1500</td>
<td>1500≤x&lt;2000</td>
<td>2000≤x&lt;2500</td>
<td>2500≤x&lt;3000</td>
<td>3000≤x&lt;3500</td>
<td>x≥3500</td>
</tr>
</tbody>
</table>

**Acceptability Benchmark**
1. Unit sustainability performance scoring

Sustainability performance evaluation of processor 2
2. Supply chain level group performance
3. Typology according to sustainability performances

- High economic performance
- High water and nitrogenous effluent performances
- High profit growth
- High \( N \) effluents score
The system was able to:

1. Group supply chain actors into categories solely based on their sustainability performance

2. Quantify sustainability levels and provide scores

3. Offer a static description and a dynamic follow up of the supply chain’s sustainability level

4. Offer a holistic approach and reveals the interaction between the different supply chain actors

5. Track sustainability weak sustainability scores to their origin
Use of the evaluation system

- Gathering and quantifying sustainability scores to help take agricultural policy decisions
- Transfer of results by specialised agricultural technicians to stakeholders in a simplified manner
- A fine balance between the accuracy of the information and the simplicity of its presentation

Perspectives

- Test the system on a broader scale to allow fine tuning the scores calculations
- Test the adaptability of the system by testing it in different countries with different production systems and weather conditions
- Automating the calculation system through adapted computer programs
Questions ?