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CASE STUDY: SOYBEAN OIL PRODUCTION

STEP 1. System boundaries (goal and scope)

The first step in an LCA is the definition of the goal and scope. In this case, the goal of this work is to analyse the environmental impacts of soya oil production. Within the scope and taking into account the flow diagram showed in Figure 1 and the life cycle inventory (see excel file) you have to determine the system boundaries and the cut off rules.

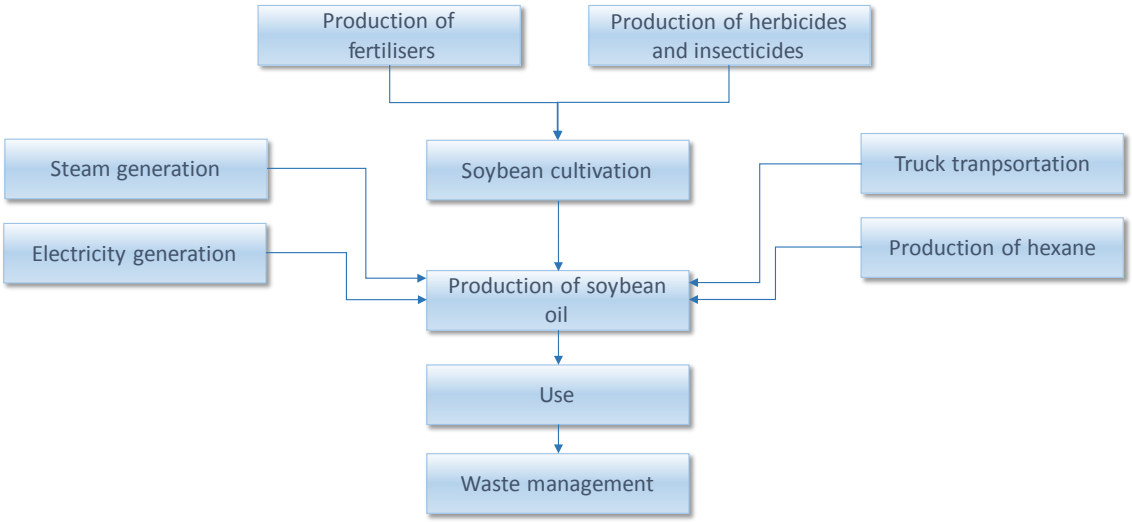

Fig. 1 Soybean oil production.

STEP 2. Function of the system and functional unit (goal and scope)

Based on theoretical classes and previous exercises you have to determine the functional unit (FU) to which all the input and output data will be referred.

STEP 3. Life cycle inventory

The result of the life cycle inventory (LCI) stage is an inventory of environmental exchanges based on the allocation rules and assumption defined in the previous step related to the FU. With the different sheets of the Excel you have to compile the LCI, including all the inputs and output data.

STEP 4. Classification and characterization (life cycle impact assessment)

The life cycle impact assessment (LCIA) step quantifies the potential for resources consumption and environmental impact over all of the stages involved in the supply chain. LCIA comprises four steps, two of the mandatory:

- Classification: it includes the selection of the impact categories and characterisation models.
- Characterisation: the impact of each emission or resource consumption is modelled quantitatively using a characterisation factor (Eq. 1). This factor expresses how much that flow contributes to the specific impact category under assessment.

$$EB_j = CF_{i,j} * M_i \qquad \text{Eq.1}$$

Where EB_j is the environmental Burden j; M_j is the mass of elementary flow I and $CF_{i,j}$ is the characterisation factor of elementary flow i for EB_j .

This case study analyses the impact categories provided in Table 1. You will find the characterisation factor in the last sheet of the excel file.

Table 1. Impact categories selected for the case study.

Environmental impacts	**Units**
Abiotic resources depletion (ARD)	kg de Sb eq.
Global Warming Potential (GWP)	kg de CO_2 eq.
Acidification Potential (AP)	kg de SO_2 eq.
Eutrophication Potential (EP)	kg de PO_4^{3-} eq.

STEP 5. Normalisation and weighting (life cycle impact assessment)

Additionally, the life cycle impact assessment includes two optional steps:

- Normalisation (optional): it relates the magnitude of impacts in different impact categories to references values, facilitating the comparison among indicators (Eq. 2).

$$NEB_j = \frac{EB_j}{N_j} \qquad \text{Eq. 2}$$

Where EB_j represents the value of the different environmental impact indicators; NEB_j is the normalised value of EB_j and N_j is the reference value for each indicator that in this case, is represented by global world value.

- Weighting (optional): the different environmental impact categories are ranked according to their relative importance (Eq. 3). Weighting may be necessary when trade-off situations occur in LCAs, which are being used for comparing alternative process/products.

$$TNEB\ [-] = \sum_{j=1}^{j=M} W_j * NEB_j \qquad \text{Eq. 3}$$

Where, NEB is the total normalised EB; NEB_j is the normalised value of EB_j and W_j is the weighting factor for the normalisation.
You will find the normalisation and weighting factors in the last sheet of the excel file.

STEP 6. Interpretation

1. Based on the results, which are the stages with higher environmental impact?
2. If allocation rules were based on mass, would the results change? Which impact would be allocated to the oil and which to the flour?
3. The commercial price of the oil is three times the flour price. Based on an economic allocation, ¿which impact would be allocated to each product?